HARDWARE MANUAL

AC500 PLC

System Assembly and Device Specifications for AC500 V2 Products

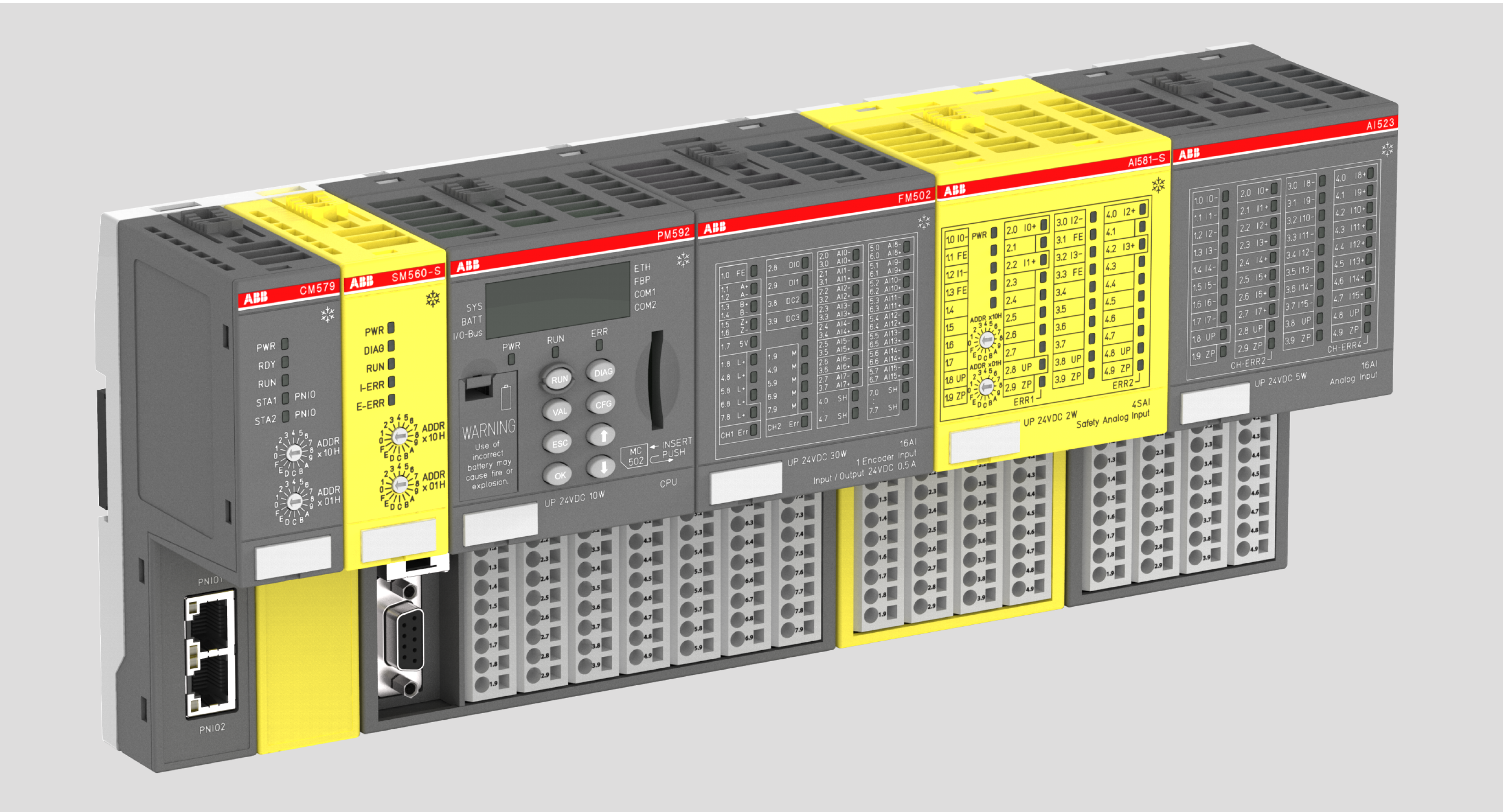


Table of contents

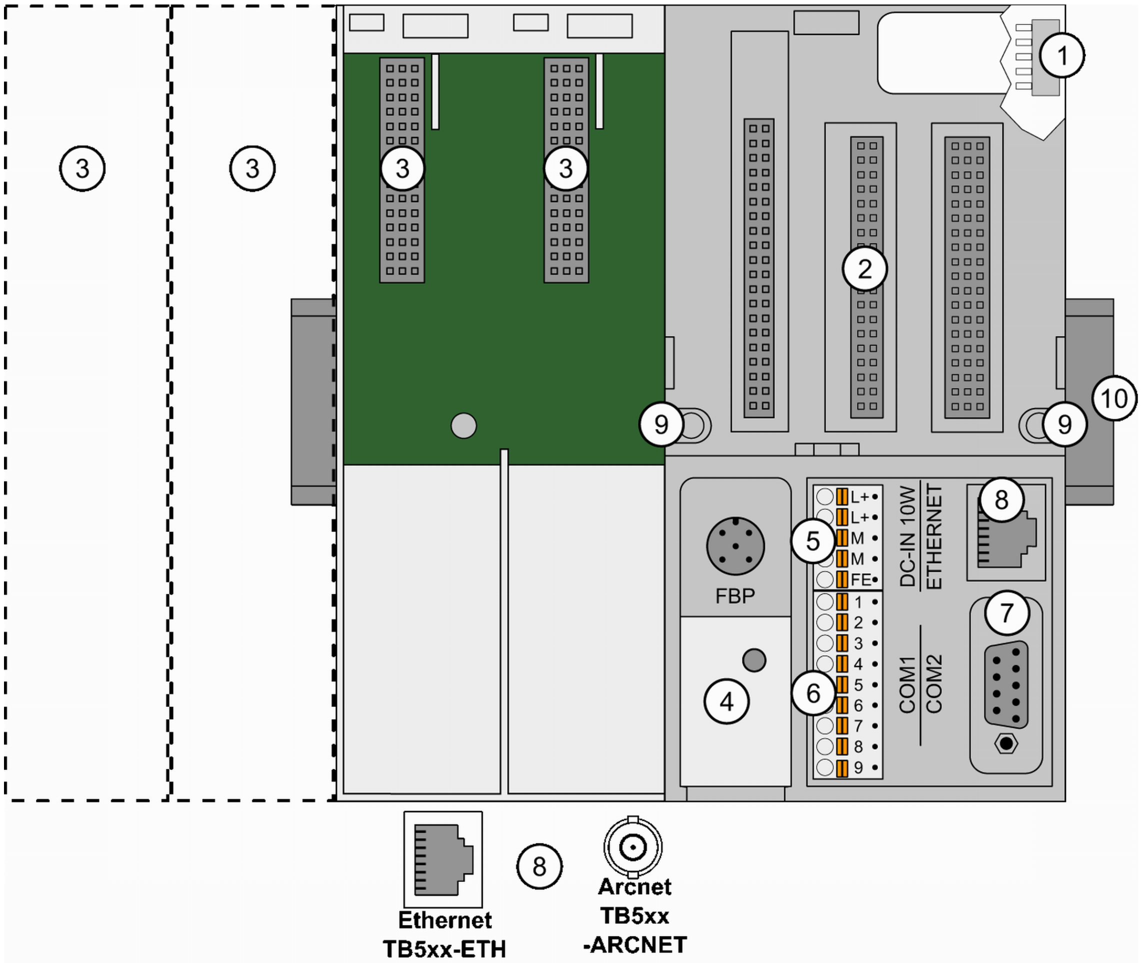
1 Device Specifications

1.1 Terminal Bases (AC500 Standard)

For AC500-eCo processor modules and special AC500 (Standard) processor modules the terminal base cannot be removed.

1.1.1 TB51x-TB54x

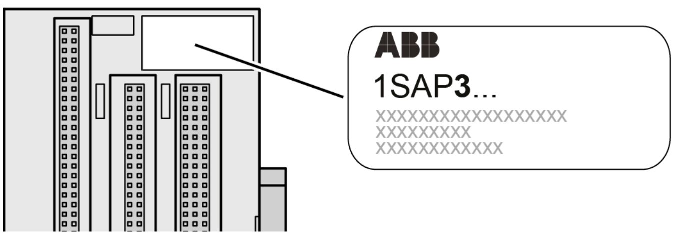
- TB511-ARCNET: 1 processor module, 1 communication module, with network interface ARCNET BNC
- TB511-ETH: 1 processor module, 1 communication module, with network interface Ethernet RJ45
- TB521-ARCNET: 1 processor module, 2 communication modules, with network interface ARCNET BNC
- TB521-ETH: 1 processor module, 2 communication modules, with network interface Ethernet RJ45
- TB523-2ETH: 1 processor module, 2 communication modules, with 2x network interface Ethernet RJ45
- TB541-ETH: 1 processor module, 4 communication modules, with network interface Ethernet RJ45
- XC version for use in extreme ambient conditions available (-ETH versions only)



1 I/O bus (10-pin, female) to electrically connect the I/O terminal units
2 Slot for processor module
3 Slots for communication modules (TB511-xxx: 1 slot, TB521-xxx: 2 slots, TB541-xx: 4 slots)
4 Interface for FieldBusPlug, not for terminal base TB523-2ETH
5 Power supply (5-pin terminal block, removable)
6 Serial interface COM1 (9-pin terminal block, removable)
7 TB5x1: Serial interface COM2 (D-sub 9, female), TB523-2ETH: second Ethernet network interface
8 Network interfaces: TB5xx-ETH: Ethernet, TB5xx-ARCNET: ARCNET
9 Holes for screw mounting
10 DIN rail

XC Version

XC = e**X**treme **C**onditions



Extreme conditions

Terminal bases for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **3** in the Part no. 1SAP**3**... (label) identifies the XC version.*

1.1.1.1 Short Description

Terminal bases are used as sockets for processor modules and communication modules. Up to 10 I/O terminal units for I/O expansion modules can be added to these terminal bases.

The terminal bases have slots for one processor module and for communication modules as well as terminals and interfaces for power supply, expansion and networking.

Terminal Base	TB51x	TB52x	TB54x
Slots for processor modules	1	1	1
Slots for communication modules	1	2	4

NOTICE!
Risk of malfunctions!
Unused slots for communication modules are not protected against accidental physical contact.

– Unused slots for communication modules must be covered with dummy communication modules (TA524 *Chapter 1.8.2.3 “TA524 - Dummy Communication Module” on page 1153* to achieve IP20 rating.
– I/O bus connectors must not be touched during operation.

Terminal Base		TB511-		TB521-		TB523-	TB541-
		ETH	ARCNET	ETH	ARCNET	2ETH	ETH
I/O bus	I/O interface for direct connection of up to 10 I/O terminal units	x	x	x	x	x	x
Power supply	removable 5-pin terminal block	x	x	x	x	x	x
COM1	Serial interface, removable 9-pin terminal block	x	x	x	x	x	x
COM2	Serial interface, 9-pin D-sub connector (female)	x	x	x	x	-	x
Network interface [1])	Ethernet RJ45	x	-	x	-	-	x
	ARCNET BNC	-	x	-	x	-	-
	2x Ethernet RJ45	-	-	-	-	x	-

Terminal Base		**TB511-**		**TB521-**		**TB523-**	**TB541-**
		ETH	**ARCNET**	**ETH**	**ARCNET**	**2ETH**	**ETH**
FBP interface	Fieldbus-neutral slave interface (M12, 5-pin, male, fastening with screw)	x	x	x	x	-	x
CAN interface	CAN 2 A/B	-	-	-	-	-	-
[1]) Type must be equal to the type of the used processor module.							

PM57x-ETH, PM58x-ETH and PM59x-ETH with part No. 1SAPxxxxxxR0271 can only be used with terminal bases with part No. 1SAPxxxxxxR0270.

PM5xx-2ETH can only be used with TB5x3-2ETH terminal bases.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.1.1.2 Connections

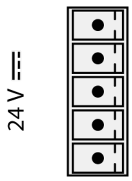
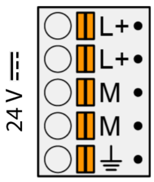
1.1.1.2.1 I/O Bus

The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added (see description for I/O bus in the system assembly chapter *Chapter 2.4.1 "Serial I/O Bus" on page 1180*).

1.1.1.2.2 Power Supply

The supply voltage of 24 VDC is connected to a removable 5-pin terminal block. L+/M exist twice. It is therefore possible to feed e.g. external sensors (up to 8 A max. with 1.5 mm^2 conductor) via these terminals.

Pin Assignment

Pin Assignment		**Label**	**Function**	**Description**
 Terminal block removed	 Terminal block inserted	L+	+24 VDC	Positive pin of the power supply voltage
		L+	+24 VDC	Positive pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		⏚	FE	Functional earth

Faulty Wiring on Power Supply Terminals

NOTICE!
Risk of damaging the processor module and terminal base!
Exceeding the maximum voltage could lead to unrecoverable damage to the system.

The system could be destroyed.

NOTICE!
Risk of malfunction!
To ensure reliability and proper functionality, the supply voltage must ramp-up from 0 V to 24 V within max. 2.5 s

NOTICE!
Risk of damaging the terminal base and power supply!
Short circuits might damage the terminal base and power supply.

Make sure that the four clamps L+ and M (two of each) are not wrongly connected (e. g. +/- of power supply is connected to both L+/L+ or both M/M)

NOTICE!
Risk of damaging the terminal base!
Terminal base can be damaged by connecting the power supply terminal block (L+/M) to COM1.

Make sure that the COM1 terminal block is always connected to the terminal base even if you do not use COM1 to prevent this.

NOTICE!
Risk of damaging the terminal base!
Excessive current might damage the clamp and terminal base.

Make sure that the current flowing through the removable clamps never exceeds 8 A (with 1.5 mm^2 conductor).

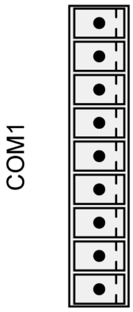
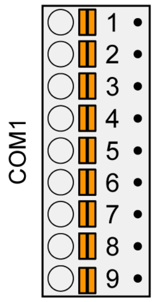
1.1.1.2.3 Serial Interfaces COM1/COM2

Serial Interface COM1

The serial interface COM1 is connected to a removable 9-pin terminal block. It is configurable for RS-232 and RS-485 and can be used (depending on the processor module) for:

- Online access (RS-232 programming interface for Automation Builder)
- A free protocol
- Modbus RTU, client and server
- CS31 system bus (RS-485), as master only *Chapter 2.6.4.8.2 “Wiring” on page 1287*

Pin Assignment

		Pin	Signal	Interface	Description
 Terminal block removed	 Terminal block inserted	1	Terminator P	RS-485	Terminator P
		2	RxD/TxD-P	RS-485	Receive/Transmit, positive
		3	RxD/TxD-N	RS-485	Receive/Transmit, negative
		4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	Signal Ground
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

NOTICE!
Unused connector!
Make sure that the terminal block is always connected to the terminal base, even if you do not use the interface.

Serial Interface COM2

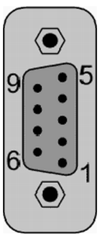
The serial interface COM2 is connected to a 9-pin D-sub connector. It is configurable for RS-232 and RS-485 and can be used (depending on the processor module) for:

- Online access (RS-232 programming interface for Automation Builder)
- A free protocol
- Modbus RTU, client and server

COM2 is not intended to establish a CS31 system bus.

TB5x3-2ETH terminal bases have no COM2 D-sub connector.

Pin Assignment

Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative

Serial Interface	Pin	Signal	Interface	Description	
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

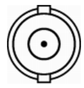
NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices *TA535 ⇘ Chapter 1.8.4.6 "TA535 - Protective Caps for XC Devices" on page 1174*.

1.1.1.2.4 ARCNET Network Interface



ARCNET connection of the processor modules PM5xx-ARC.

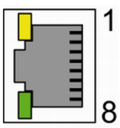
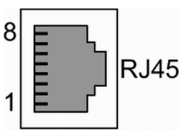
1.1.1.2.5 Ethernet Networking Interfaces

This interface is used for the connection of processor modules with onboard Ethernet e.g. PM5xx-ETH.

Terminal bases TB5x3-2ETH for processor modules PM5xx-2ETH provide 2 independent Ethernet interfaces.

For structured Ethernet cabling only use cables in accordance with TIA/EIA-568-A, ISO/IEC 11801 or EN 50173.

Pin Assignment

Interface	Pin	Signal	Description
 or 	1	TxD+	Transmit Data +
	2	TxD-	Transmit Data -
	3	RxD+	Receive Data +
	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive Data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

See supported protocols and used Ethernet ports for AC500 V2 products:*Ethernet Protocols and Ports*.

See communication via Modbus for AC500 V2 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V2 products: *Modbus RTU*.

See supported protocols and used Ethernet ports for AC500 V3 products:*Ethernet Protocols and Ports*.

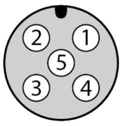
See communication via Modbus for AC500 V3 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V3 products: *Modbus RTU*.

1.1.1.2.6 Neutral FieldBusPlug Interface

Via a 5-pin neutral FBP interface, a processor module can be connected as a slave to a fieldbus master. The FieldBusPlug is fastened using a screw.

Pin Assignment in Serial Mode

FieldBusPlug	Pin	Signal	Description
	1	+24 V	Standard power supply
	2	Diagnosis pin	
	3	0 V	Standard power supply
	4	Serial data	
	5	Serial data	

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *TA535* *Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

> *Terminal bases TB5x3-2ETH for processor modules PM5xx-2ETH do not provide an FBP interface.*

1.1.1.3 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Connection of the supply voltage 24 VDC at the terminal base of the processor module	removable 5-pin terminal block spring type
Slots	TB511: 1 processor module, 1 communication module
	TB521 / TB523: 1 processor module, 2 communi-cation modules
	TB541: 1 processor module, 4 communication modules
Processor module interfaces at TB5x1	I/O bus, COM1, COM2, FBP
Processor module interfaces at TB5x3	I/O bus, COM1
Processor module network interfaces	TB5x1-ETH / PM5xx-ETH: Ethernet
	TB523-2ETH / PM523-2ETH: 2x Ethernet
	TB5x1-ARCNET / PM5xx-ARCNET: ARCNET
Net weight (terminal base without pro-cessor module)	TB511: 175 g
	TB521: 200 g
	TB541: 250 g
Mounting position	Horizontal or vertical

1.1.1.4 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 111 100 R0260	TB511-ARCNET, terminal base AC500, slots: 1 processor module, 1 communication module, ARCNET COAX connector	Active
1SAP 111 100 R0270	TB511-ETH, terminal base AC500, slots: 1 processor module, 1 communication module, Ethernet RJ45 connector	Active
1SAP 311 100 R0270	TB511-ETH-XC, terminal base AC500, slots: 1 processor module, 1 communication module, Ethernet RJ45 connector, XC version	Active
1SAP 112 100 R0260	TB521-ARCNET, terminal base AC500, slots: 1 processor module, 2 communication modules, ARCNET COAX connector	Active
1SAP 112 100 R0270	TB521-ETH, terminal base AC500, slots: 1 processor module, 2 communication modules, with network interface Ethernet RJ45	Active
1SAP 312 100 R0270	TB521-ETH-XC, terminal base AC500, slots: 1 processor module, 2 communication modules, with network interface Ethernet RJ45, XC version	Active

Part no.	Description	Product Life Cycle Phase *)
1SAP 112 300 R0277	TB523-2ETH, teminal base AC500, slots: 1 processor module, 2 communication modules, with 2 network interfaces Ethernet RJ45	Active
1SAP 114 100 R0270	TB541-ETH, slots: 1 processor module, 4 communication modules, with network interface Ethernet RJ45	Active
1SAP 314 100 R0270	TB541-ETH-XC, slots: 1 processor module, 4 communication modules, with network interface Ethernet RJ45, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

Processor module PM591-2ETH can only be used with TB523-2ETH.

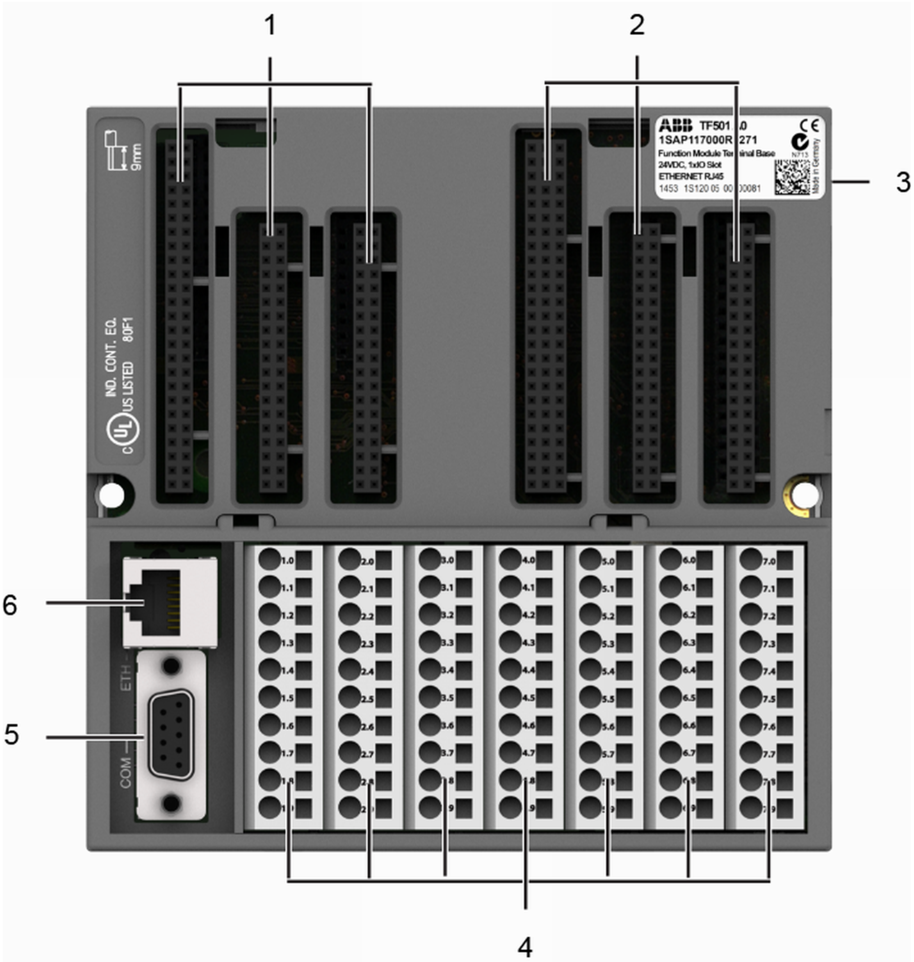
Processor modules PM57x-ETH(-XC), PM58x-ETH(-XC) and PM59x-ETH(-XC) with ordering No. 1SAPxxxxxxR0271 can only be used with terminal bases TB5x1-ETH(-XC) with ordering No. 1SAPxxxxxxR0270.

Table 1: Accessories

Part no.	Description
1SAP 180 200 R0001	TK501, programming cable D-sub / D-sub, length: 5 m
1SAP 180 200 R0101	TK502, programming cable terminal block / D-sub, length: 5 m
1TNE 968 901 R1100	TK503, programming cable USB / D-sub (RS-485), length 3 m
1SAP 180 800 R0001	TA526, wall mounting accessory

1.1.2 TF501-CMS and TF521-CMS - Function Module Terminal Bases

- For function module FM502-CMS
- TF501-CMS: 1 processor module, 1 FM502-CMS, with network interface Ethernet RJ45
- TF521-CMS: 1 processor module, 1 FM502-CMS, 2 communication modules, with network interfaces Ethernet RJ45
- XC version for use in extreme ambient conditions available



1 Slots for PM592-ETH
2 Slots for FM502-CMS
3 I/O bus to electrically connect the terminal units
4 Terminal blocks for analog/digital inputs/outputs
5 Serial interface COM1
6 Network interface

The TF5x1-CMS are used as terminal bases for FM502-CMS, PM592-ETH and communication modules *Chapter 1.6.2.2 “FM502-CMS - Analog Measurements” on page 676* *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64*.

1.1.2.1 Description

The function module terminal bases have slots for one FM502-CMS, one processor module and for communication modules as well as terminals and interfaces for power supply, expansion, networking and IO. The number of slots differs depending on the type of terminal base.

Table 2: Number of slots

Slot	TF501-CMS	TF521-CMS
Slots for processor modules	1	1
Slots for function modules	1	1
Slots for communication modules	0	2

NOTICE!
Risk of malfunctions!

Unused slots for communication modules are not protected against accidental physical contact.

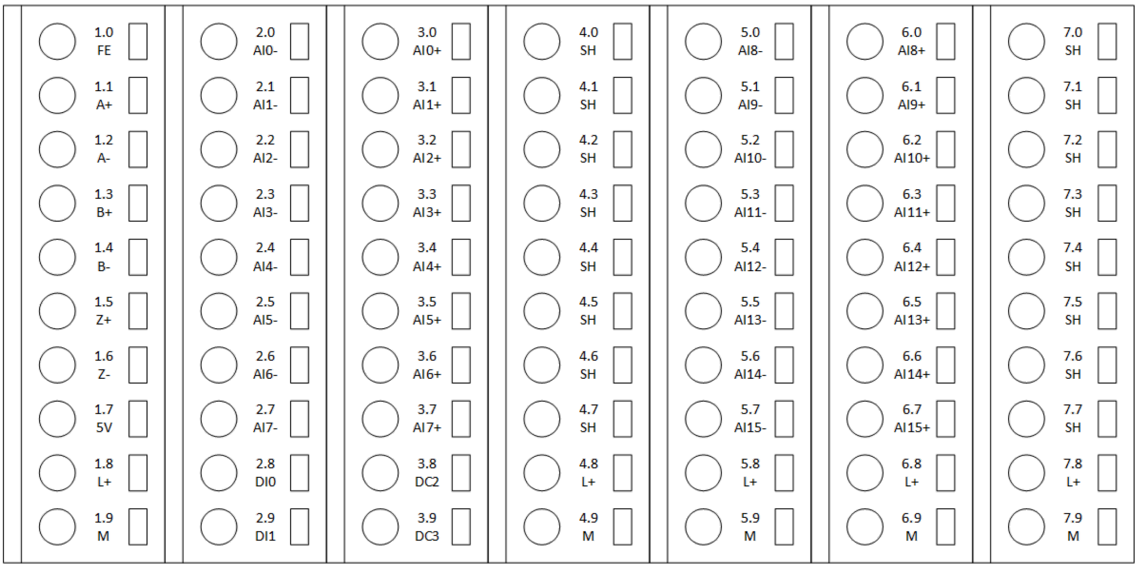
– Unused slots for communication modules must be covered with dummy communication modules (TA524 *Chapter 1.8.2.3 “TA524 - Dummy Communication Module” on page 1153* to achieve IP20 rating.
– I/O bus connectors must not be touched during operation.

1.1.2.2 Electrical Connection

The electrical connection is set up using the terminals of the TF5x1-CMS.

Mounting, disassembling and electrical connection for the terminal function block and the I/O modules are described in the system assembly chapter, as well as the serial I/O bus Chapter 2.4 “Overall Information (valid for complete AC500 Product Family)” on page 1180.

Terminal assignment of the TF5x1-CMS



Terminal	Signal	Description
1.0	FE	Functional earth for encoder shield connection
1.1	A+	Input signal A of encoder 0
1.2	A-	Inverted input signal A of encoder 0
1.3	B+	Input signal B of encoder 0
1.4	B-	Inverted input signal B of encoder 0
1.5	Z+	Input signal Z of encoder 0
1.6	Z-	Inverted input signal Z of encoder 0
1.7	5 V	+5 VDC power supply output for encoder
1.8	L+	Process voltage L+ (24 VDC)

Terminal	Signal	Description
1.9	M	Process voltage M (0 VDC)
2.0...2.7	AI0-...AI7-	Negative input signal AI0...AI7 for analog channel 0...7
2.8/2.9	DI0/DI1	Input signal I0/I1 (standard digital input)
3.0...3.7	AI0+...AI7+	Positive input signal AI0...AI7 for analog channel 0...7
3.8/3.9	DC2/DC3	Signal of configurable digital input/output C2/C3
4.0...4.7	SH	Shield connection
4.8	L+	Process voltage L+ (24 VDC)
4.9	M	Process voltage M (0 VDC)
5.0...5.7	AI8-...AI15-	Negative input signal AI0AI7 for analog channel 8...15
5.8	L+	Process voltage L+ (24 VDC)
5.9	M	Process voltage M (0 VDC)
6.0...6.7	AI8+...AI15+	Positive input signal AI0...AI7 for analog channel 8...15
6.8	L+	Process voltage L+ (24 VDC)
6.9	M	Process voltage M (0 VDC)
7.0...7.7	SH	Shield connection
7.8	L+	Process voltage L+ (24 VDC)
7.9	M	Process voltage M (0 VDC)

CAUTION!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you remove or replace a module.

Analog signals must be transmitted through shielded cables. The analog cable shield must only be connected to the side of the module (SH terminals) to avoid relaxation currents influencing the measuring results and for optimal robustness against external noise. The shield connection must be as short as possible (< 3 cm). The analog shield is capacitive and internally coupled with the functional earth (FE). To avoid unacceptable potential differences between different parts of the installation, low-resistance equipotential bonding conductors must be laid.

CAUTION!
Risk of damaging the processor module and terminal base!
Voltages surpassing the permitted range might damage the processor module and terminal base.

Never connect supply and process voltages > 30 VDC to the terminal base.

NOTICE!

Risk of damaging the terminal base and power supply!

Short circuits might damage the terminal base and power supply.

Make sure that the four clamps L+ and M (two of each) are not wrongly connected (e. g. +/- of power supply is connected to both L+/L+ or both M/M)

NOTICE!

Risk of damaging terminal base!

Excessive current might damage the clamp and terminal base.

Make sure that the current flowing through the spring terminals never exceeds 10 A.

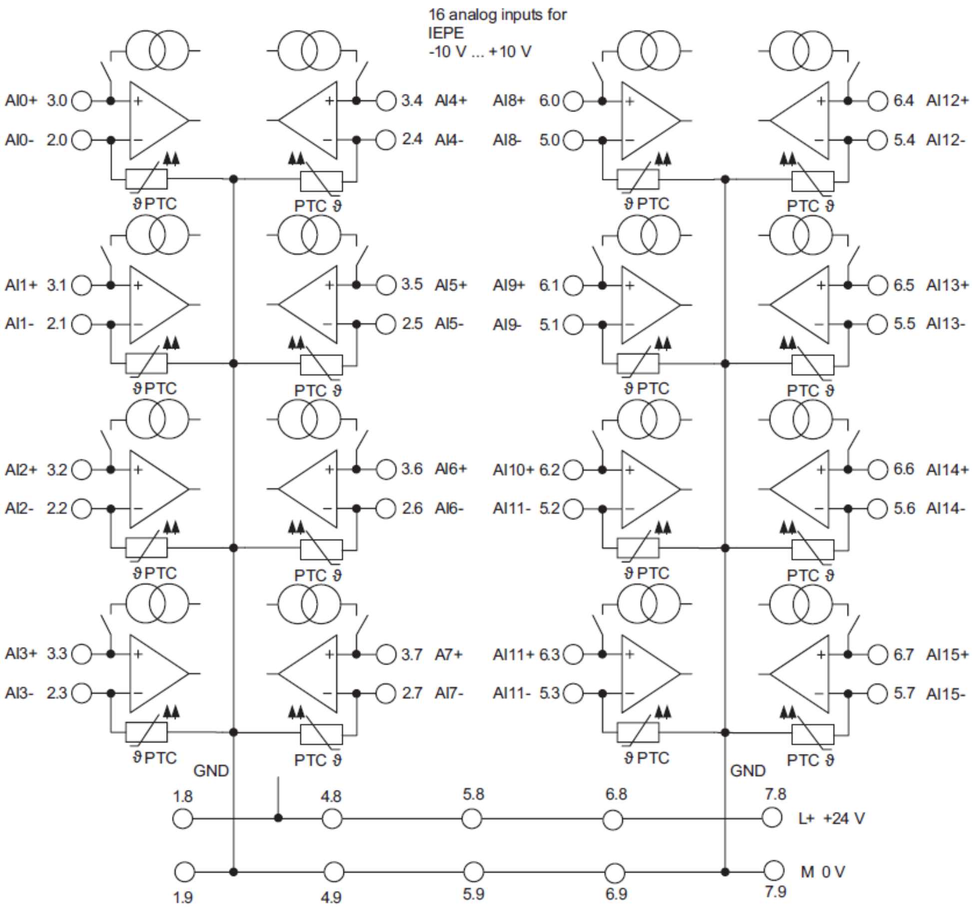


Fig. 1: Terminal assignment and electrical connection

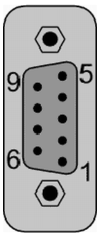
1.1.2.2.1 Serial Interface COM1

The serial interface COM1 can be used for:

- Online access (RS-232 programming interface for Automation Builder software)
- Free protocol
- Modbus RTU, client and server
- CS31 system bus (RS-485), as master only

↳ *Chapter 2.6.4.6 “Serial Interface COM1 of the Terminal Bases” on page 1282.*

Pin Assignment

Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *TA535 ⇨ Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

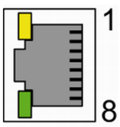
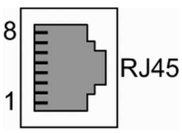
1.1.2.2.2 Ethernet Networking Interface

This interface is the connection to the internal Ethernet communication module of the processor modules.

Applications:

- TCP/IP for PC/Automation Builder (programming)
- UDP: communication via function blocks
- Modbus on TCP/IP, master and slave

Pin Assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit Data +
	2	TxD-	Transmit Data -
	3	RxD+	Receive Data +
or	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive Data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

See supported protocols and used Ethernet ports for AC500 V2 products:*Ethernet Protocols and Ports*.

See communication via Modbus for AC500 V2 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V2 products: *Modbus RTU*.

See supported protocols and used Ethernet ports for AC500 V3 products:*Ethernet Protocols and Ports*.

See communication via Modbus for AC500 V3 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V3 products: *Modbus RTU*.

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *TA535* *Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

1.1.2.3 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Connection of the supply voltage 24 VDC at the TF5x1-CMS		The terminals 1.8, 4.8...7.8, 1.9, 4.9...7.9, 4.0...4.7, 7.0...7.7 are electrically interconnected within the TF5x1-CMS. Terminals 1.8, 4.8...7.8: process voltage L+ = +24 VDC Terminals 1.9, 4.9...7.9: process voltage M = 0 V Terminals 4.0...4.7, 7.0...7.7: analog shield clamps SH Terminal 1.0: FE shield clamp of encoder
Rated voltage		24 VDC
Max. permitted total current		10 A (between terminals 1.8, 4.8...7.8 and 1.9, 4.9...7.9)
Slots		
	TF501-CMS	1 function module FM502-CMS, 1 processor module PM592-ETH, 0 communication modules
	TF521-CMS	1 function module FM502-CMS, 1 processor module PM592-ETH, 2 communication modules
Processor module interfaces		I/O bus, COM1
Weight		TF501-CMS: 350 g
		TF521-CMS: 400 g
Mounting position		Horizontal or vertical

Table 3: Connection of the TF5x1-CMS

Parameter	Value
I/O bus	I/O interface for directly adding up to 10 terminal units
Terminal block	70 clamps for I/O, shield and power supply connection
COM1	Serial interface, 9-pin D-sub connector, female
Network interface (type must be equal to the type of the used processor module)	Ethernet RJ45

1.1.2.4 Ordering Data

Part No.	Scope of delivery	Product life cycle status
1SAP 117 000 R0271	TF501-CMS, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 1 communication module, Ethernet RJ45 connector	Active
1SAP 317 000 R0271	TF501-CMS-XC, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 1 communication module, Ethernet RJ45 connector, XC version	Active
1SAP 117 200 R0271	TF521-CMS, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 2 communication modules, Ethernet RJ45 connector	Active
1SAP 317 200 R0271	TF521-CMS-XC, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 2 communication modules, Ethernet RJ45 connector, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.2 Processor Modules

The AC500 product family consists of the product groups:

- AC500 (standard):
  AC500 standard PLCs offer a wide range of performance levels and scalability. The PLCs are highly capable of communication and extension for flexible application.
- AC500-eCo:
  AC500-eCo PLCs are cost-effective, high-performance compact PLCs that offer total interoperability with the core AC500 range and provide battery-free uninterrupted output. All I/O modules can be freely connected in a simple, stable and reliable manner.

- AC500-S:
  AC500-S PLCs are designed for safety applications involved in factory or machinery automation area.
- AC500-XC:
  AC500 (standard) and AC500-S provide devices with -XC extension as a product variant. These variants operate according to their product group and can, in addition, be operated under extreme conditions. AC500-XC PLCs can be used at high altitudes, extended operating temperature and in humid condition. Further, the PLCs provide immunity to vibration and hazardous gases. The AC500-XC Series is consistent with ordinary PLC in the overall dimensions, control function and software compatibility. System data: *AC500-XC*.

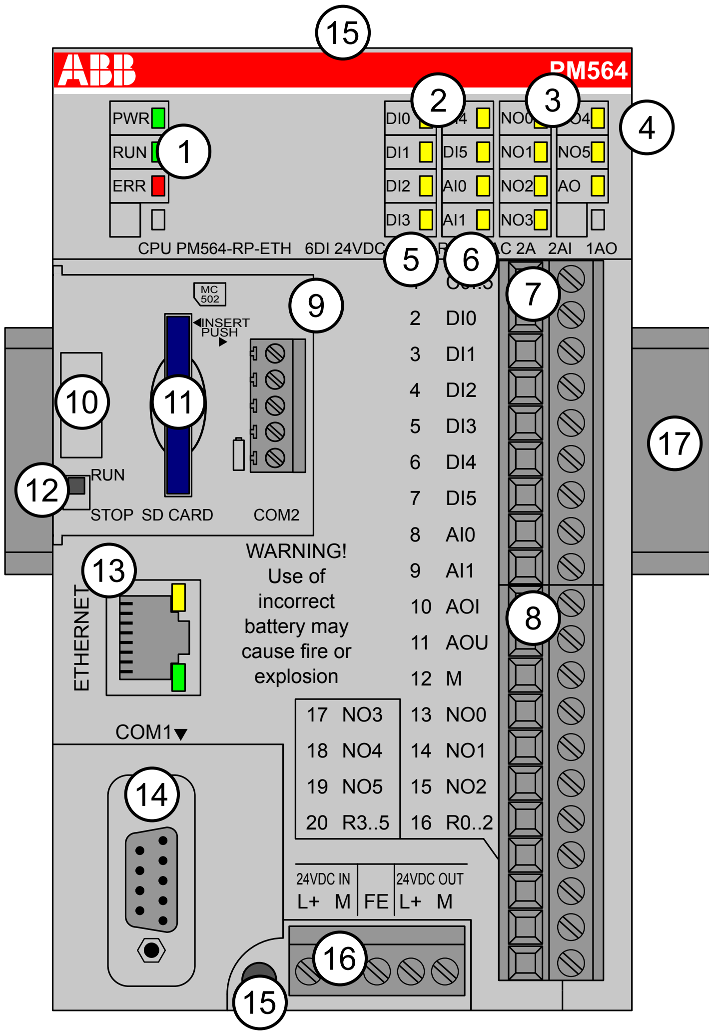
The AC500 product family is characterized by functional modularity. As the complete AC500 product family shares the same hardware platform and programming software tool, the devices of the AC500 product groups can be flexibly combined.

S500 devices represent the I/O modules of the product group AC500 (standard), whereas S500-eCo devices represent the I/O Modules of the product group AC500-eCo. Both S500 and S500-eCo devices can be combined with devices of the AC500 product family in a flexible way.

1.2.1 AC500-eCo

1.2.1.1 PM55x-xP and PM56x-xP

- PM55x-xP: Processor module with integrated digital inputs and outputs
- PM56x-xP: Processor module with integrated digital and analog inputs and outputs



1 3 LEDs to display the states of the processor module
2 **PM55x-xP**: 8 yellow LEDs to display the states of the digital input signals.
PM56x-xP: 6 yellow LEDs to display the states of the digital input signals, 2 yellow LEDs to display the states of the analog input signals.
3 **PM55x-xP**: 6 yellow LEDs to display the states of the digital output signals.
PM56x-xP: 6 yellow LEDs to display the states of the digital output signals, 1 yellow LED to display the state of the analog output signal
4 I/O bus for connecting additional I/O modules
5 Terminal number
6 Signal name according to terminal number
7 Terminal block for input/output signals (9-pin)
8 Terminal block for input/output signals (11-pin)
9 Removable 5-pin connector for COM2 (optional)
10 Recess for opening the option cover
11 Memory card slot (optional)
12 RUN/STOP switch
13 Ethernet interface (depending on model)
14 9-pin D-sub jack (COM1) for RS-485 connection
15 2 holes for wall-mounting with screws
16 Removable 5-pin connector for power supply (24 VDC or 100-240 VAC - depending on model)
17 DIN rail

> *The processor module is shown with pluggable terminal blocks mounted. These terminal blocks must be ordered separately.*

1.2.1.1.1 Short Description

The processor modules PM55x-xP and PM56x-xP are the central units of AC500-eCo. Their main characteristics are:

- 128 kB (PM554-xP and PM564-xP types) program memory, 512 kB (PM556-xP and PM566-xP types) program memory
- I/O bus (for expansion with max. 10 I/O devices)
- COM1 (serial RS-485 interface)
- 8 digital inputs (PM55x-xP), 6 digital inputs (PM56x-xP)
- 6 digital outputs
- 2 analog inputs (PM56x-xP only; the 2 analog inputs can be configured as digital inputs)
- 1 analog output (PM56x-xP only)

The various processor module variants differ in the following characteristics:

- Power supply (24 VDC or 100-240 VAC)
- Type of the digital outputs (transistor or relays)
- Ethernet interface (only models with suffix -ETH) - Analog inputs/outputs (only type PM56x-xP)

All processor module variants can be expanded to include an memory card slot, a second serial RS-485 interface (COM2) and an RTC (real time clock).

Details and technical data are provided in the technical data section *Chapter 1.2.1.1.8 “Technical Data” on page 31*.

1.2.1.1.2 Assortment

Processor Module	Program memory	Cycle time [1])	Ethernet interface	Other interfaces	Type of digital outputs	Power supply
PM554-TP	128 kB	Binary: min 0.08 ms Word: min. 0.1 ms Floating point: min. 1.2 ms	-	Serial RS-485 interface (COM1) Serial RS-485 interface (COM2, optional) I/O bus Memory card slot (optional)	Transistor	24 VDC
PM554-TP-ETH			x		Transistor	24 VDC
PM554-RP			-		Relays	24 VDC
PM554-RP-AC			-		Relays	100-240 VAC
PM556-TP-ETH	512 kB		x		Transistor	24 VDC
PM564-TP	128 kB		-		Transistor	24 VDC
PM564-TP-ETH			x		Transistor	24 VDC
PM564-RP			-		Relays	24 VDC
PM564-RP-AC			-		Relays	100-240 VAC
PM564-RP-ETH			x		Relays	24 VDC
PM564-RP-ETH-AC			x		Relays	100-240 VAC
PM566-TP-ETH	512 kB		x		Transistor	24 VDC

[1]) for 1000 instructions

1.2.1.1.3 Connections

I/O Bus

The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added (see description for I/O bus in the system assembly chapter ⇘ *Chapter 2.4.1 “Serial I/O Bus” on page 1180*).

Serial interface COM1

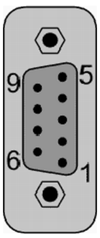
The serial non-isolated COM1 interface provides communication via RS-485 and is carried out as a 9-pin D-sub jack. The COM1 interface can be used

- for online connection with Automation Builder software (via a RS-485 programming cable. e. g. TK503 ⇘ *Chapter 1.8.2.9 “TK503 - Programming Cable” on page 1163*)
- as Modbus RTU (master and slave)
- for ASCII serial protocols
- as CS31 system bus (master only).

> *COM1 does not support communication via RS-232. The programming cable TK501 cannot be used.*

Serial interface COM1

Table 4: Pin assignment

Serial Interface	Pin	Signal	Description
Serial Interface 	1	FE	Functional earth
	2	SGND	0 V power supply, internally connected to M terminal
	3	RxD/TxD-P	Receive/Transmit positive
	4	Reserved	Reserved, not connected
	5	SGND	0 V power supply, internally connected to M terminal
	6	+3.3 V	3.3 V power supply
	7	Reserved	Reserved, not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	Reserved	Reserved, not connected
	Shield	Cable shield	Functional earth

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

> **NOTICE!**
> The internal power supply voltage, which is connected to pin 6 of the D-sub connector, must not be short-circuited or connected to any other voltages.

Serial interface COM2 (optional)

The optional serial COM2 interface provides communication via RS-485 and is carried out as a removable 5-pin terminal with screw connection. The COM2 interface can be used

- for online connection with Automation Builder software (via a RS-485 programming cable. e. g. TK504 *Chapter 1.8.1.9 “TK504 - Programming Cable” on page 1130*
- as Modbus RTU (master and slave)
- for ASCII serial protocols

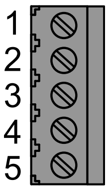
> *The serial RS-485 interface is not electrically isolated using TA562-RS or TA562-RS-RTC.*
>
> *Using TA569-RS-ISO the RS-485 serial interface has galvanic isolation.*

> *Communication via CS31 bus is not possible.*

Additional information for installing the accessory modules can be found in *Chapter 1.8.1.4 “TA562-RS - Serial RS-485 Adaptor” on page 1115*, *Chapter 1.8.1.5 “TA569-RS-ISO - Serial RS-485 Isolated Adaptor” on page 1116* and *Chapter 1.8.1.6 “TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock ” on page 1117*.

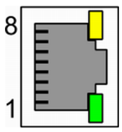
Additional information for wiring the COM2 interface can be found in serial interface COM2 (PM55x, PM56x) *Chapter 2.5.4.3 “Serial Interface COM2” on page 1214*.

Table 5: Pin assignment

Serial Interface	Pin	Description
	1	Terminator P
	2	TxD/RxD-P
	3	TxD/RxD-N
	4	Terminator N
	5	Functional earth

Ethernet Interface

The Ethernet interface is carried out via a RJ45 jack. The pin assignment of the Ethernet interface:

Interface	Pin	Description	
	1	Tx+	Transmit Data +
	2	Tx-	Transmit Data -
	3	Rx+	Receive Data +
	4	NC	Not connected

Interface	Pin	Description	
	5	NC	Not connected
	6	Rx-	Receive Data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

The supported protocols and used Ethernet ports can be found in a separate *chapter*.

Communication via Modbus TCP/IP is described in detail in a separate *chapter*.

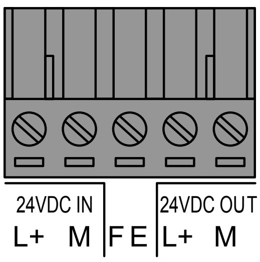
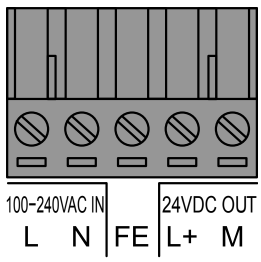
Electrical Connection

> **WARNING!**
> **Risk of death by electric shock!**
> Hazardous voltages can be present at the terminals of the module.
>
> Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

1.2.1.1.4 Power Supply

Power Supply Depending on the variant, the processor modules can be connected to the following supply voltages:

<table>
<tr><td>
</td><td>
</td></tr>
<tr><td>24 VDC</td><td>100 - 240 VAC</td></tr>
</table>

The electrical connection is established via a removable 5-pin terminal block. As the terminal block is also available as a spare part (inside TA570 Spare Part Set for AC500-eCo processor modules), further information on the terminal block for power supply and the terminal block for serial RS-485 adaptor is provided under *Chapter 1.8.1.7 “TA570 - Spare Part Set” on page 1124*.

The 24 VDC variant contains 2 L+ and M terminals. The L+ terminal on the left side is the input and the right side is the output. The M terminals are internally interconnected. The supply can be easily looped through to the onboard digital inputs.

CAUTION!
Risk of damaging the processor module and the connected modules!
Voltages > 35 VDC (DC variants only) or > 288 VAC (AC variants only) might damage the processor module and the connected modules.

Make sure that the supply voltage never exceeds 35 VDC / 288 VAC.

CAUTION!
Risk of damaging the processor module!
Excess currents at 24 VDC output (24 VDC processor module variant) will damage the processor module.

Use an appropriate fuse *Chapter 1.2.1.1.8 “Technical Data” on page 31*within 24 VDC input connection.

The 100-240 VAC variant contains an internal power supply with a wide-range input. It provides a 24 VDC output at the terminals L+ and M which can be used to supply the onboard digital inputs.

The voltage output at 100-240 VAC variants can provide 180 mA max. The output is protected against overload by a self-resetting fuse (PTC).

According to IEC 60204-1:2016, where control circuits are supplied from an AC source, transformers having separate windings shall be used to separate the power supply from the control supply.

1.2.1.1.5 Onboard I/Os

For connection of the onboard inputs and outputs, both a 9-pin and an 11-pin terminal block are needed and must be ordered separately. Compatible terminal blocks can be found in TA563-TA565 terminal blocks *Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166.*

Processor Module PM55x

The processor module PM55x provides 8 onboard digital inputs (24 VDC) and 6 onboard digital outputs (depending on variant 24 VDC transistor outputs or relay outputs).

Numbers and types of the onboard I/Os are listed in the table below:

Processor module	Power supply	No. and type of digital inputs	No. and type of digital outputs	No. and type of analog inputs	No. and type of analog outputs
PM55x-T(P), PM55x-T(P)-ETH	24 VDC	8 x 24 VDC	6 x 24 VDC, 0.5 A max. (transistor)	none	none
PM55x-R(P)	24 VDC	8 x 24 VDC	6 x relay output, 2 A max.	none	none
PM55x-R(P)-AC	120 to 240 V AC	8 x 24 VDC	6 x relay output, 2 A max.	none	none

All inputs (DI0...DI7) belong to 1 group. All outputs (DO0...DO5 / NO0...NO5) belong to 1 group. The inputs and outputs are group-wise electrically isolated.

Processor Module PM56x

The processor module PM56x provides 6 onboard digital inputs (24 VDC), 6 onboard digital outputs (depending on variant 24 VDC transistor outputs or relay outputs), 2 onboard analog inputs (voltage 0 V...10 V) and 1 onboard analog output (voltage 0 V...10 V or current 0 mA...20 mA / 4 mA...20 mA). The onboard analog inputs can be configured as digital inputs, so 8 onboard digital inputs may be available if no analog inputs are needed.

Numbers and types of the onboard I/Os are listed in the table below:

Processor module	Power supply	No. and type of digital inputs	No. and type of digital outputs	No. and type of analog inputs	No. and type of analog outputs
PM56x-T(P), PM56x-T(P)-ETH	24 VDC	6 x 24 VDC *)	6 x 24 VDC, 0.5 A max. (transistor)	2 x voltage *)	1 x voltage or current
PM56x-R(P), PM56x-R(P)-ETH	24 VDC	6 x 24 VDC *)	6 x relay output, 2 A max.	2 x voltage *)	1 x voltage or current
PM56x-R(P)-AC, PM56x-R(P)-ETH-AC	100-240 VAC	6 x 24 VDC *)	6 x relay output, 2 A max.	2 x voltage *)	1 x voltage or current

*) PM56x has 2 analog inputs which can be configured as digital inputs. If the analog inputs are configured as digital inputs, 8 digital inputs are available overall.

All digital inputs (DI0...DI5) belong to 1 group. All digital outputs (DO0...DO5 / NO0...NO5) belong to 1 group. These inputs and outputs are group-wise galvanically isolated.

The 2 analog inputs are not galvanically isolated from the 24 V power supply of the processor module.

For more information on the onboard I/Os, refer to onboard I/Os in processor module PM55x *Chapter 1.2.1.2 "Onboard I/Os in Processor Module PM55x" on page 36* and onboard I/Os in processor module PM56x *Chapter 1.2.1.3 "Onboard I/Os in Processor Module PM56x" on page 48*.

1.2.1.1.6 Diagnosis

The AC500 processor module can display various errors according to the error classes. The following error classes are possible. The reaction of the processor module is different for each type of error.

Error class	Type	Description	Example
E1 ERR-LED is ON	Fatal error	A safe function of the operating system is no longer guaranteed.	Checksum error in the system Flash or RAM error
E2 ERR-LED is ON	Severe error	The operating system is functioning without problems, but the error-free processing of the user program is no longer guaranteed.	Checksum error in the user Flash, independent of the task duration
E3 ERR-LED is ON/OFF *)	Light error	It depends on the application if the user program should be stopped by the operating system or not. The user should determine which reaction is necessary.	Flash could not be programmed, I/O module has failed
E4 ERR-LED is ON/OFF *)	Warning	Error in the periphery (e.g. I/O) which may show an impact in the future. The user should determine which reaction is necessary.	Short-circuit at an I/O module, the battery is run down or not inserted
*) The behaviour if the ERR-LED lights up at error classes E3 or E4 is configurable.			

Occurred errors can be displayed with the commands diagshow all in the PLC-Browser of Automation Builder software.

1.2.1.1.7 State LEDs and Operating Elements

RUN/STOP switch

The processor modules PM55x-xP and PM56x-xP contain a RUN/STOP switch which can be set with a small screwdriver. In the RUN position, the program loaded in the processor module will be executed and in the STOP position it will be stopped.

When COM1 and COM2 are not in online access mode, the user program can only be changed, uploaded and downloaded if the RUN/STOP switch is in STOP position.

State LEDs

The processor modules PM55x-xP and PM56x-xP indicate their states of operation via 3 LEDs located on the upper left edge of the processor module.

LED	State	Color	LED = ON	LED = OFF	LED flashing
PWR	Power supply	Green	Power supply present	Power supply missing	--
RUN	RUN/STOP state	Green	Processor module is in state RUN	Processor module is in state STOP	Fast flashing (4 Hz): The processor module is reading/ writing data from/to the memory card. If the ERR-LED is also flashing, data is being written to the Flash-EEPROM. Slow flashing (1 Hz): The firmware update from the memory card has been completed successfully.
ERR	Error indica-tion	Red	An error occurred	No errors or only warnings encountered (E4-errors). The LED behavior for the error classes 2 to 4 is configu-rable.	With 4 Hz (fast): dis-plays together with the RUN LED a cur-rently running a firmware-upgrade or writing data to the Flash-EPROM.

I/O LEDs

Each processor module contains up to 15 LEDs (depending on type) to display the states of the inputs and outputs.

Processor module	LED	State	Color	LED = ON	LED = OFF
PM55x-xP PM56x-xP	I0...I7 (PM55x-xP) I0...I5 (PM56x-xP)	Digital input	Yellow	Input is ON	Input is OFF
	O0...O5	Digital output	Yellow	Output is ON	Output is OFF
PM56x-xP	AI0, AI1 *)	Analog input	Yellow	Input is ON	Input is OFF
	AO	Analog output	Yellow	Output is ON	Output is OFF
*) The analog inputs AI0 and AI1 can be configured as digital input or analog input.					

State LEDs

Table 6: State LEDs at Ethernet Connector (-ETH models only)

LED	Color	OFF	ON	Flashing
Activity	Yellow	No activity	---	Activity
Link	Green	No link	Link	---

1.2.1.1.8 Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

General Data

Power supply	24 VDC	100 - 240 VAC
Connection of power supply	Via removable 5-pin screw terminal	
Current consumption from power supply (max.)	PM554-TP: 180 mA PM554-TP-ETH: 190 mA PM554-RP: 220 mA PM556-TP-ETH: 190 mA PM564-TP: 210 mA PM564-TP-ETH: 220 mA PM564-RP: 240 mA PM564-RP-ETH: 250 mA PM566-TP-ETH: 220 mA	PM554-RP-AC: 200 mA at 100 VAC, 110 mA at 240 VAC *) PM564-RP-AC: 210 mA at 100 VAC, 125 mA at 240 VAC *) PM564-RP-ETH-AC: 220 mA at 100 VAC, 130 mA at 240 VAC *)
Current consumption from power supply (typ.)	PM554-TP: 60 mA PM554-TP-ETH: 70 mA PM554-RP: 80 mA PM556-TP-ETH: 70 mA PM564-TP: 95 mA PM564-TP-ETH: 100 mA PM564-RP: 110 mA PM564-RP-ETH: 120 mA PM566-TP-ETH: 100 mA	PM554-RP-AC: 20 mA at 100 VAC, 12 mA at 240 VAC *) PM564-RP-AC: 20 mA at 100 VAC, 11 mA at 240 VAC *) PM564-RP-ETH-AC: 23 mA at 100 VAC, 14 mA at 240 VAC *)
Inrush current at nominal voltage	Typ. 3.9 A^2s	Typ. 0.3 A^2s
Required fuse	3 A fast	Max. 10 A

Power supply	24 VDC	100 - 240 VAC
Max. power dissipation within the processor module	PM554-TP: 3.0 W PM554-TP-ETH: 3.3 W PM554-RP: 3.5 W PM556-TP-ETH: 3.3 W PM564-TP: 3.9 W PM564-TP-ETH: 4.4 W PM564-RP: 4.5 W PM564-RP-ETH: 4.9 W PM566-TP-ETH: 4.4 W	PM554-RP-AC: 4.8 W PM564-RP-AC: 4.8 W PM564-RP-ETH-AC: 5.3 W
Processor module interfaces	I/O bus, COM1, COM2 (optional), Ethernet (depending on model)	
Connection system	see System Assembly, Construction and Connection *Chapter 2.5 "AC500-eCo" on page 1194*	
Weight	PM554-TP: 300 g PM554-TP-ETH: 300 g PM554-RP: 350 g PM556-TP-ETH: 300 g PM564-TP: 300 g PM564-TP-ETH: 300 g PM564-RP: 350 g PM564-RP-ETH: 350 g PM566-TP-ETH: 300 g	PM554-RP-AC: 400 g PM564-RP-AC: 400 g PM564-RP-ETH-AC: 400 g
Mounting position	horizontal or vertical	

*) These values show the value of the apparent current (sum of active and reactive current)

Detailed Data

Program memory	128 kB Flash EPROM (PM554-xP and PM564-xP types) 512 kB Flash EPROM (PM556-xP and PM566-xP types)
Data memory	
- VAR data	10 kB
- VAR_RETAIN data	1 kB, always buffered in flash
- %RB data (persistent)	1 kB, can be buffered in flash (depending on configuration)
- %MB data	2 kB (PM554 and PM564 types) 64 kB (PM556 and PM566 types)
Data buffering	In flash memory
Real time clock (RTC)	Optional
Battery low indication	Warning

Programming languages	- Instruction List (IL) - Function Block Diagram (FBD) - Ladder Diagram (LD) - Sequential Function Chart (SFC) - Structured Text (ST) - Continuous Function Chart (CFC)
Cycle time for 1000 instructions	
Binary	0.08 ms
Word	0.1 ms
Floating point	1.2 ms
Program execution	
Cyclic	Yes
Time-controlled	Yes
Multitasking	Yes
Interruption	1 interrupted with up or down edge detection
LEDs	Power, Run, Error, Status of I/Os
RUN/STOP switch	Yes
Protection of the user program by password	Possible
Usable accessories	MC503: Memory card TA561-RTC: Real time clock TA562-RS: Serial RS485 TA569-RS-ISO: Serial RS485 isolated TA562-RS-RTC: Real time clock and serial RS485

Detailed data of the interfaces

Serial interface COM1	
Physical link	RS-485
Electrical isolation	none
Baudrate	Configurable from 1.2 to 187.5 kBit/s
Connection	9-pin D-sub female connector
Common mode range	Typ. -8 V / +12 V (CAUTION: The interface can be damaged if the signal exceeds the common mode range.)
Usage	- Programming port - Modbus (master and slave) - Serial ASCII communication - CS31 (master only)

Serial interface COM2 (optional)	
Physical link	RS-485
Electrical isolation	none (TA562-RS or TA562-RS-RTC) 500 VDC (TA569-RS-ISO)
Baudrate	Configurable from 1.2 to 115.2 kBit/s
Connection	Removable 5-pin terminal block
Common mode range	Typ. -8 V / +12 V (CAUTION: The interface can be damaged if the signal exceeds the common mode range.)
Usage	- Programming port - Modbus (master and slave) - Serial ASCII communication

Data of I/Os

	PM55x-xP	PM56x-xP
Max. number of I/O modules	10	10
Digital inputs	320 + 8	320 + 8
Digital outputs	240 + 6	240 + 6
Type of digital outputs	PM554-TP PM554-TP-ETH PM554-RP PM554-RP-AC PM556-TP-ETH PM564-TP PM564-TP-ETH PM564-RP PM564-RP-AC PM564-RP-ETH PM564-RP-ETH-AC PM566-TP-ETH	Transistor Transistor Relays Relays Transistor Transistor Transistor Relays Relays Relays Relays Transistor
Analog inputs	160	160 + 2
Analog outputs	160	160 + 1
Number of decentralized inputs and outputs	On CS31 Bus: up to 31 stations with up to 120 digital inputs / 120 digital outputs each	
Detailed data of the onboard I/O	Onboard I/Os in PM55x and Onboard I/Os in PM56x *Chapter 1.2.1.2 “Onboard I/Os in Processor Module PM55x” on page 36* *Chapter 1.2.1.3 “Onboard I/Os in Processor Module PM56x” on page 48*	

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

1.2.1.1.9 Ordering Data

Table 7: Processor Modules for AC500-eCo

Part no.	Description	Product Life Cycle Phase *)
1SAP 120 600 R0001	PM554-TP, processor module, 128 kB memory, 8 DI, 6 DO-T, 24 VDC, with pluggable I/O terminal blocks	Active
1SAP 120 600 R0071	PM554-TP-ETH, processor module, 128 kB memory, 8 DI, 6 DO-T, 24 VDC, onboard Ethernet, with pluggable I/O terminal blocks	Active
1SAP 120 700 R0001	PM554-RP, processor module, 128 kB memory, 8 DI, 6 DO-R, 24 VDC, with pluggable I/O terminal blocks	Active
1SAP 120 800 R0001	PM554-RP-AC, processor module, 128 kB memory, 8 DI, 6 DO-R, 100 VAC...240 VAC, with pluggable I/O terminal blocks	Active
1SAP 121 200 R0071	PM556-TP-ETH, processor module, 512 kB memory, 8 DI, 6 DO-T, 24 VDC, onboard Ethernet, with pluggable I/O terminal blocks	Active
1SAP 120 900 R0001	PM564-TP, processor module, 128 kB memory, 6 DI, 6 DO-T, 2 AI and 1 AO, 24 VDC	Active
1SAP 120 900 R0071	PM564-TP-ETH, processor module, 128 kB memory, 6 DI, 6 DO-T 2 AI and 1 AO, 24 VDC, Ethernet interface	Active
1SAP 121 000 R0001	PM564-RP, processor module, 128 kB memory, 6 DI, 6 DO-R, 2 AI and 1 AO, 24 VDC	Active
1SAP 121 100 R0001	PM564-RP-AC, processor module, 128 kB memory, 6 DI, 6 DO-R, 2 AI and 1 AO, 100 VAC...240 VAC	Active
1SAP 121 000 R0071	PM564-RP-ETH, processor module, 128 kB memory, 6 DI, 6 DO-R, 2 AI and 1 AO, 24 VDC, Ethernet interface	Active
1SAP 121 100 R0071	PM564-RP-ETH-AC, processor module, 128 kB memory, 6 DI, 6 DO-R, 2 AI and 1 AO, 100 VAC...240 VAC, Ethernet interface	Active
1SAP 121 500 R0071	PM566-TP-ETH, processor module, 512 kB memory, 6 DI, 6 DO-T, 2 AI and 1 AO, 24 VDC, Ethernet interface	Active

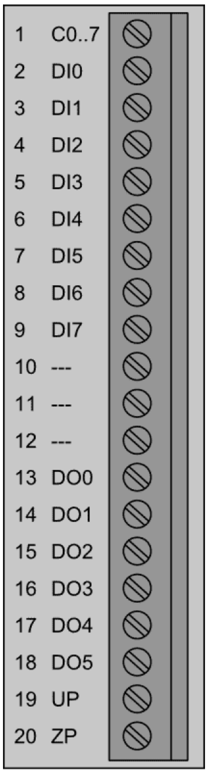
**) For planning and commissioning of new installations use modules in Active status only.*

Table 8: Accessories

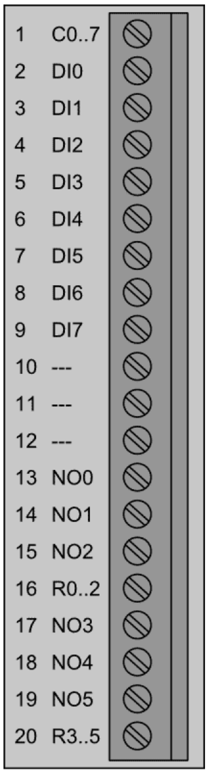
Part no.	Description
1TNE 968 901 R3101	Terminal Block TA563-9, 9-pin, screw front, cable side, 6 pieces per unit
1TNE 968 901 R3102	Terminal Block TA563-11, 11-pin, screw front, cable side, 6 pieces per unit
1TNE 968 901 R3103	Terminal Block TA564-9, 9-pin, screw front, cable front, 6 pieces per unit
1TNE 968 901 R3104	Terminal Block TA564-11, 11-pin, screw front, cable front, 6 pieces per unit
1TNE 968 901 R3105	Terminal Block TA565-9, 9-pin, spring front, cable front, 6 pieces per unit
1TNE 968 901 R3106	Terminal Block TA565-11, 11-pin, spring front, cable front, 6 pieces per unit
1SAP 180 100 R0001	MC502: Memory card
1TNE 968 901 R0100	MC503: Memory card adaptor for PM55x-xP and PM56x-xP
1TNE 968 901 R1100	TK503: programming cable USB to RS485 SUB-D
1TNE 968 901 R2100	TK504: programming cable USB to RS485 terminal block
1TNE 968 901 R3200	TA561-RTC: real-time clock adaptor for PM55x-xP and PM56x-xP
1TNE 968 901 R4300	TA562-RS: RS-485 adaptor for PM55x-xP and PM56x-xP
1SAP 186 400 R0001	TA569-RS-ISO: RS-485 adaptor with galvanic isolation for PM55x-XP and PM56x-xP
1TNE 968 901 R5210	TA562-RS-RTC: real-time clock and RS-485 adaptor for PM55x-xP and PM56x-xP
1TNE 968 901 R3107	TA566: wall mounting accessory, 100 pieces
1TNE 968 901 R3203	TA570: spare part set for AC500-eCo processor modules

1.2.1.2 Onboard I/Os in Processor Module PM55x

- 8 DI 24 VDC
- PM55x-T(P): 6 DO (24 VDC, 0.5 A max. transistor outputs)
- PM55x-R(P) and PM55x-R(P)-AC: 6 DO (24 VDC or 120/240 VAC, 2 A max. relay outputs)



Terminals of Onboard I/Os for PM55x-T



Terminals of Onboard I/Os for PM55x-R and PM55x-R-AC

AC500-eCo processor modules are equipped with non-removable terminals.

AC500-eCo processor modules are equipped with removable terminal blocks which must be ordered separately.

The electrical functionality of both processor module types is identical.

1.2.1.2.1 Intended Purpose

Processor Module PM55x

The processor module PM55x provides 8 onboard digital inputs (24 VDC) and 6 onboard digital outputs (depending on variant 24 VDC transistor outputs or relay outputs).

Numbers and types of the onboard I/Os are listed in the table below:

Processor module	Power supply	No. and type of digital inputs	No. and type of digital outputs	No. and type of analog inputs	No. and type of analog outputs
PM55x-T(P), PM55x-T(P)-ETH	24 VDC	8 x 24 VDC	6 x 24 VDC, 0.5 A max. (transistor)	none	none
PM55x-R(P)	24 VDC	8 x 24 VDC	6 x relay output, 2 A max.	none	none
PM55x-R(P)-AC	120 to 240 V AC	8 x 24 VDC	6 x relay output, 2 A max.	none	none

All inputs (DI0...DI7) belong to 1 group. All outputs (DO0...DO5 / NO0...NO5) belong to 1 group. The inputs and outputs are group-wise electrically isolated.

1.2.1.2.2 Functionality

Parameter	Value
Digital inputs	8 (24 VDC), can be used as source inputs or as sink inputs
Interrupt inputs	4 (DI0...DI3), configurable
Interrupt response time	Max. 0.8 ms when input delay is set to 0.1 ms
Fast counter	2 (DI0 and DI1), configurable
Digital outputs	6 transistor outputs (24 VDC, 0.5 A max.) or relay outputs (2 A max.), (depending on processor module)
PWM outputs	2 (DO2 and DO3), configurable
LED displays	For signal states
Internal power supply	Via processor module
External power supply	Via UP and ZP terminal

1.2.1.2.3 Electrical Connection

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

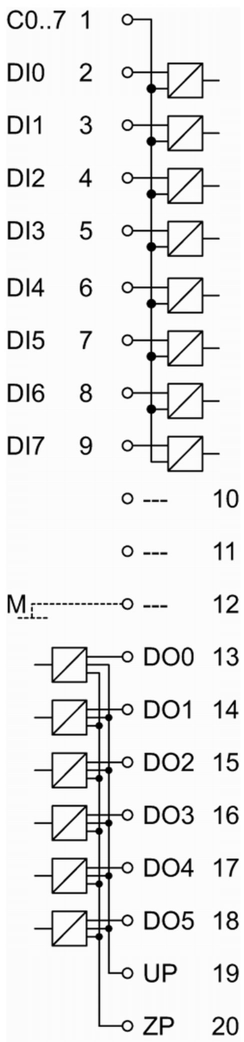
NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

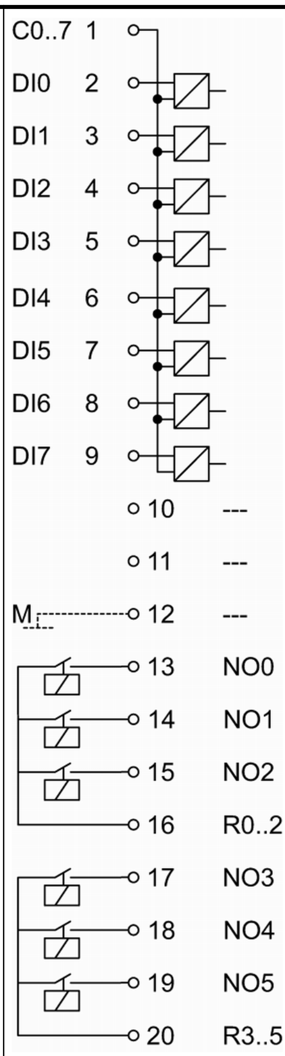
When replacing a processor module, it is recommended to mark each wire connected to the onboard I/O terminal block before disconnecting it. This should make sure that the wires can be reconnected in the same order.

The electrical connection is carried out by using a non-removable 20-pin terminal block.

The following block diagram shows the internal structure of the onboard I/Os:



PM55x-T(P)



PM55x-R(P)

The assignment of the terminals for PM55x-T(P):

Terminal	Signal	Description
1	C0...7	Input common for digital input signals DI0 to DI7
2	DI0	Digital input signal DI0
3	DI1	Digital input signal DI1
4	DI2	Digital input signal DI2
5	DI3	Digital input signal DI3
6	DI4	Digital input signal DI4
7	DI5	Digital input signal DI5
8	DI6	Digital input signal DI6
9	DI7	Digital input signal DI7
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	DO0	Digital output signal O0

Terminal	Signal	Description
14	DO1	Digital output signal O1
15	DO2	Digital output signal O2
16	DO3	Digital output signal O3
17	DO4	Digital output signal O4
18	DO5	Digital output signal O5
19	UP	Process supply voltage UP +24 VDC
20	ZP	Process supply voltage ZP 0 VDC

The assignment of the terminals for PM55x-R(P):

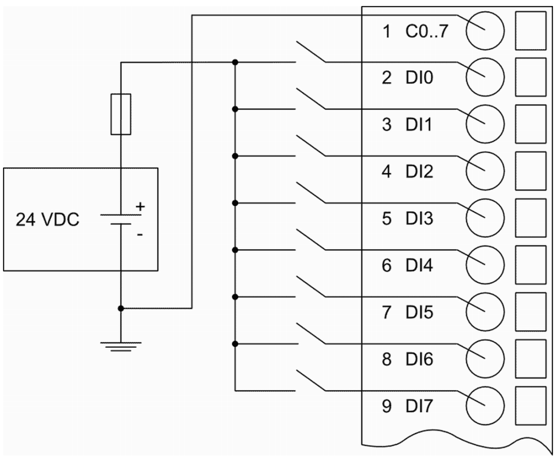
Terminal	Signal	Description
1	C0...7	Input common for digital input signals DI0 to DI7
2	DI0	Digital input signal DI0
3	DI1	Digital input signal DI1
4	DI2	Digital input signal DI2
5	DI3	Digital input signal DI3
6	DI4	Digital input signal DI4
7	DI5	Digital input signal DI5
8	DI6	Digital input signal DI6
9	DI7	Digital input signal DI7
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	NO0	Normally-open relay contact of the output NO0
14	NO1	Normally-open relay contact of the output NO1
15	NO2	Normally-open relay contact of the output NO2
16	R0..2	Output common for signals NO0 to NO2
17	NO3	Normally-open relay contact of the output NO3
18	NO4	Normally-open relay contact of the output NO4
19	NO5	Normally-open relay contact of the output NO5
20	R3...5	Output common for signals NO3 to NO5

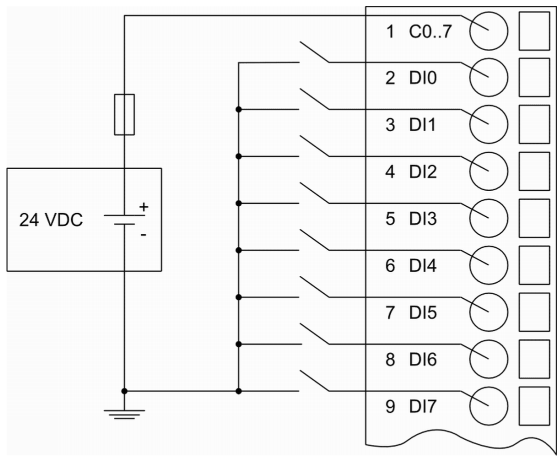
Connection of the Digital Inputs

The digital inputs can be used as source inputs or as sink inputs.

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> A ground closure, e. g. caused by a damaged cable insulation, can bridge switches accidentally.
>
> Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

The following figure shows the electrical connection of the digital inputs to the PM55x processor modules:





Electrical connection of digital inputs (sink inputs)	Electrical connection digital inputs (source inputs)

Connection of the Digital Transistor Outputs (PM55x-T(P) only)

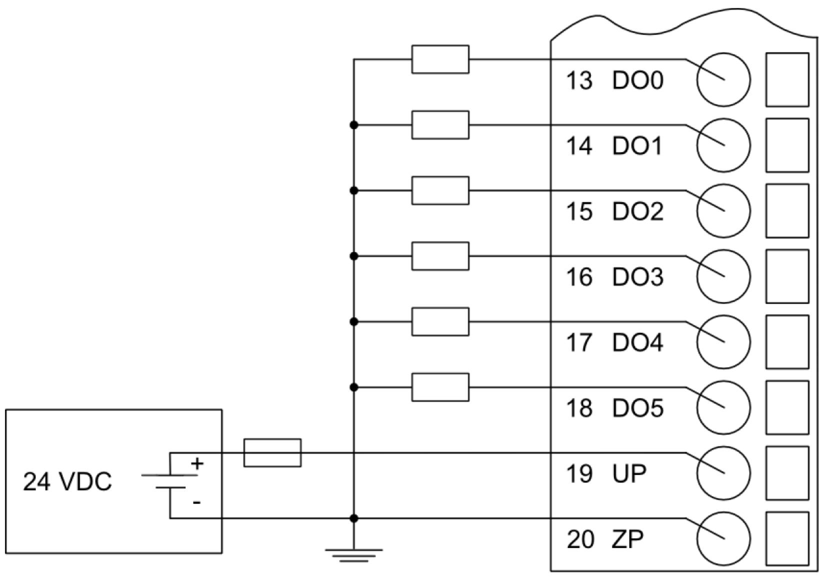


Fig. 2: Electrical connection of digital transistor outputs

NOTICE!
Risk of malfunctions in the plant!
The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.

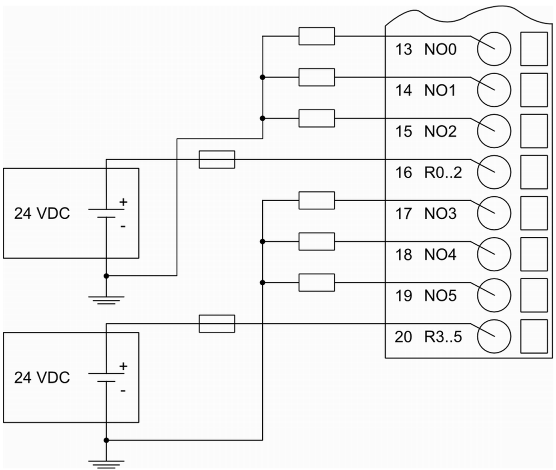
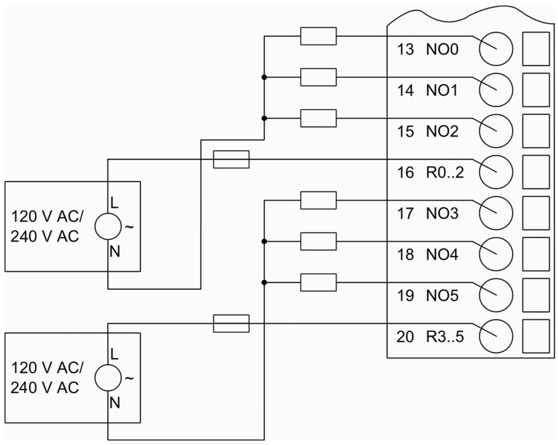
This must be considered in the planning of the application.

CAUTION!
Risk of damaging the processor module!
The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect the outputs to other voltages.
– Use an external 3 A fast protection fuse for the outputs.

Connection of the Digital Relay Outputs (PM55x-R(P) only)

The following figures show the electrical connection of the digital relay outputs to the processor modules:

	
Connection of digital relay outputs (24 VDC)	Connection of digital relay outputs (100-240 VAC)

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

CAUTION!
Risk of damaging the processor module!
– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be fed from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

1.2.1.2.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1

1.2.1.2.5 I/O Configuration

The configuration data of the onboard I/Os is stored in the processor module PM55x.

1.2.1.2.6 Parameterization

For information about parameterization, refer to the description for onboard I/Os for processor module PM55x *AC500-eCo Onboard I/Os*.

1.2.1.2.7 Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
Errors for Onboard I/O							
Light errors							
3	8	255	2	0	3	MaxWaitRun for onboard I/O module has expired, when PLC is put into RUN state	Reboot and try it again. If the error still exists, replace processor module for testing
3	8	255	3	0	26	Invalid configuration of onboard I/O module, e. g. 2 input channels are configured as fast counter and interrupt input at the same time.	Correct PLC configuration
Warnings							

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
4	8	1	2	1	2	Invalid configuration value for PWM channel. Frequency / cycletime for the PWM channel of the 8DI+6DO and 8DI+6DO +2AI+1AO module are common and if both channels are configured for PWM, the frequency of the second channel must be set to 0.	Correct frequency
4	8	1	2	0..1	4	PWM channel frequency or cycle time too high	Correct frequency or cycle time
4	8	1	2	0..1	7	PWM channel frequency or cycle time too low	Correct frequency or cycle time
4	8	1	2	0	52	Frequency on interrupt input pin too high and interrupt events are missed	Correct frequency
4	8	255	2	0	26	PLC was put into RUN state, although a configuration error is present, because parameter Run on config fault is set to YES	Correct PLC configuration
4	8	255	0	0	43	Unspecified or internal error occured	Replace processor module

1.2.1.2.8 Displays

LED	Status	Color	LED = ON	LED = OFF
DI0...DI7	Digital input	yellow	Input is ON	Input is OFF
DO0...DO5	Digital output	yellow	Output is ON	Output is OFF

1.2.1.2.9 Technical Data

Technical Data of the Digital Inputs

Parameter	Value	
Number of channels per module	8 transistor inputs (24 VDC)	
Distribution of the channels into groups	1 group for 8 channels	
Galvanic isolation	Yes, per group	
Connections of the channels I0 to I7	Terminals 2 to 9	
Reference potential for the channels I0 to I7	Terminal 1	
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1) and the module's logic is in operation	
Input type according to EN 61131-2	Type 1 source	Type 1 sink

Parameter	Value	
Input signal range	-24 VDC	+24 VDC
Signal 0	-5 V...+3 V	-3 V...+5 V
Undefined signal	-15 V...- 5 V	+5 V...+15 V
Signal 1	-30 V...-15 V	+15 V...+30 V
Ripple with signal 0	Within -5 V...+3 V	Within -3 V...+5 V
Ripple with signal 1	Within -30 V...-15 V	Within +15 V...+30 V
Input current per channel		
Input voltage +24 V	Typ. 5 mA	
Input voltage +5 V	Typ. 1 mA	
Input voltage +15 V	> 2.5 mA	
Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)	1 mA	
Input delay (0->1 or 1->0)	Typ. 0.1 to 32 ms (configurable via software), default: 8 ms	
Max. cable length		
Shielded	500 m	
Unshielded	300 m	

Technical Data of the Fast Counter

Parameter	Value
Used inputs for the traces A and B	DI0 / DI1
Used output	DO0 / NO0
Counting frequency	On Request
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

Technical Data of the Digital Transistor Outputs

Parameter	Value
Number of channels per module	6 transistor outputs (24 VDC, 0.5 A max.)
Distribution of the channels into groups	1 group of 6 channels
Galvanic isolation	Yes, per group
Connection of the channels DO0 to DO5	Terminals 13 to 18
Common power supply voltage	Terminals 19 (+24 VDC, signal name UP) and 20 (0 VDC, signal name ZP)
Reference potential for the channels DO0 to DO5	Terminal 20 (minus pole of the process voltage, name ZP)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1)

Parameter		Value
Way of operation		Non-latching type
Min. output voltage at signal 1		20 VDC at max. current consumption
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Rated protection fuse (per group)		3 A fast
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 VDC
	Rated current per group (max.)	3 A
	Rated current (all channels together, max.)	3 A
Lamp load (max.)		5 W
Max. leakage current with signal 0		0.5 mA
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 1 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
Overload message		No
Output current limitation		No
Resistance to feedback against 24 VDC		No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Technical Data of the Digital Relay Outputs

Parameter		Value
Number of channels per module		6 normally-open relay outputs
Distribution of the channels into groups		2 groups for 3 channels
Galvanic isolation		Yes, per group
Connection of the channels NO0 to NO2		Terminals 13 to 15
Connection of the channels NO3 to NO5		Terminals 17 to 19
Reference potential for the channels NO0 to NO2		Terminal 16
Reference potential for the channels NO3 to NO5		Terminal 20
Relay output voltage		
	Rated value	24 VDC or 120/240 VAC
	Range	5 to 30 VDC or 5 to 250 VAC

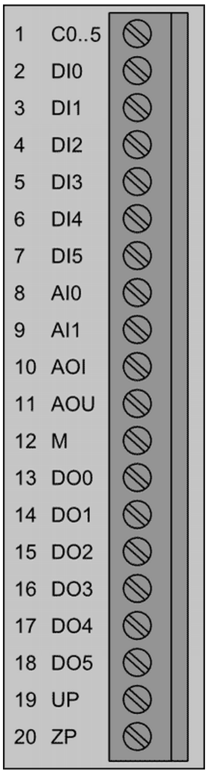
Parameter		Value
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered through the I/O bus
Way of operation		Non-latching type
Output delay		
	0 to 1	Typ. 10 ms
	1 to 0	Typ. 10 ms
Rated protection fuse		On request
Output current		
	Rated current per channel (max.)	2.0 A (24 VDC / 24 VAC / 48 VAC / 120 VAC / 240 VAC, only resistive loads) 2.0 A (24 VAC / 48 VAC / 120 VAC, only pilot duty) 1.5 A (240 VAC, only pilot duty)
	Rated current per group (max.)	6 A
	Rated current (all channels together, max.)	12 A
Lamp load (max.)		200 W (230 VAC), 30 W (24 VDC)
Demagnetization when inductive loads are switched off		A free-wheeling diode must be circuited in parallel to the inductive load
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	Not possible
	With lamp loads	Max. 1 Hz
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
Rated protection fuse (for each channel)		5 A fast
Overload message		No
Output current limitation		No
Resistance to feedback against 24 VDC		No
Connection of 2 outputs in parallel		Not possible
Life time of relay contacts (cycles)		100.000 at rated load
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Technical Data of the PWM Outputs

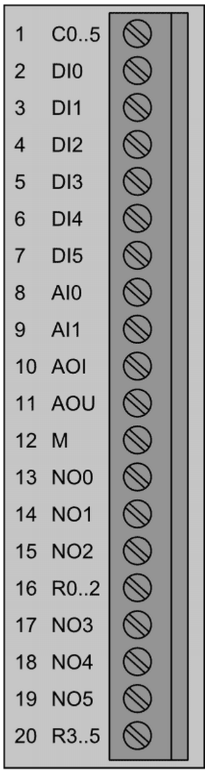
Parameter	Value
Used outputs for PWM	DO2 and DO3
Output frequency	125 Hz 20 kHz

1.2.1.3 Onboard I/Os in Processor Module PM56x

- 6 DI 24 VDC
- PM56x-T(P): 6 DO (24 VDC, 0.5 A max. transistor outputs)
- PM56x-R(P) and PM56x-R(P)-AC: 6 DO (24 VDC or 120/240 VAC, 2 A max. relay outputs)
- 2 AI (voltage 0 V...10 V)
- 1 AO (voltage 0 V...10 V or current 0 mA...20 mA / 4 mA...20 mA)



Terminals of onboard I/Os for PM56x-T(P)



Terminals of onboard I/Os for PM56x-R(P) and PM56x-R(P)-AC

AC500-eCo processor modules are equipped with non-removable terminals.

AC500-eCo processor modules are equipped with removable terminal blocks which must be ordered separately.

The electrical functionality of both processor modules is identical.

1.2.1.3.1 Intended Purpose

Processor Module PM56x

The processor module PM56x provides 6 onboard digital inputs (24 VDC), 6 onboard digital outputs (depending on variant 24 VDC transistor outputs or relay outputs), 2 onboard analog inputs (voltage 0 V...10 V) and 1 onboard analog output (voltage 0 V...10 V or current 0 mA...20 mA / 4 mA...20 mA). The onboard analog inputs can be configured as digital inputs, so 8 onboard digital inputs may be available if no analog inputs are needed.

Numbers and types of the onboard I/Os are listed in the table below:

Processor module	Power supply	No. and type of digital inputs	No. and type of digital outputs	No. and type of analog inputs	No. and type of analog outputs
PM56x-T(P), PM56x-T(P)-ETH	24 VDC	6 x 24 VDC *)	6 x 24 VDC, 0.5 A max. (transistor)	2 x voltage *)	1 x voltage or current
PM56x-R(P), PM56x-R(P)-ETH	24 VDC	6 x 24 VDC *)	6 x relay output, 2 A max.	2 x voltage *)	1 x voltage or current
PM56x-R(P)-AC, PM56x-R(P)-ETH-AC	100-240 VAC	6 x 24 VDC *)	6 x relay output, 2 A max.	2 x voltage *)	1 x voltage or current

*) PM56x has 2 analog inputs which can be configured as digital inputs. If the analog inputs are configured as digital inputs, 8 digital inputs are available overall.

All digital inputs (DI0...DI5) belong to 1 group. All digital outputs (DO0...DO5 / NO0...NO5) belong to 1 group. These inputs and outputs are group-wise galvanically isolated.

The 2 analog inputs are not galvanically isolated from the 24 V power supply of the processor module.

1.2.1.3.2 Functionality

Parameter	Value
Digital inputs	6 (24 VDC), can be used as source inputs or as sink inputs
Interrupt inputs	4 (DI0...DI3), configurable
Interrupt response time	Max. 0.8 ms when input delay is set to 0.1 ms
Fast Counter	2 (DI0 and DI1), configurable
Digital outputs	6 transistor outputs (24 VDC, 0.5 A max) or relay outputs (2 A max), (depending on processor module)
PWM outputs	2 (DO2 and DO3), configurable
Analog inputs	2, voltage input 0 VDC...10 VDC, can be configured as digital inputs
Analog outputs	1, voltage output 0 VDC...10 VDC or current output 0 mA...20 mA / 4 mA...20 mA
LED displays	For signal states
Internal power supply	Via processor module
External power supply	Via processor module

1.2.1.3.3 Electrical Connection

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

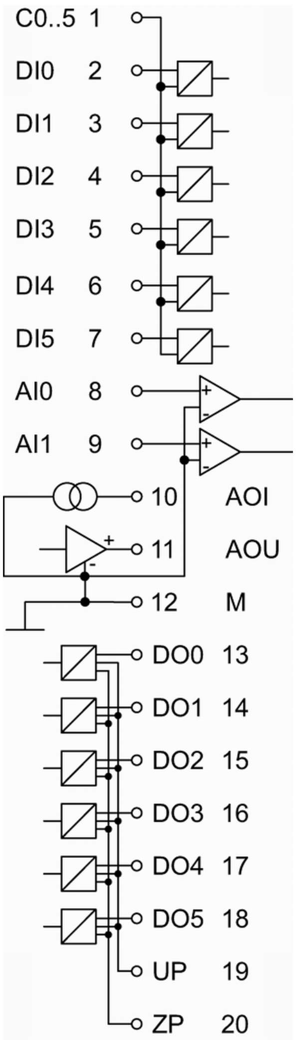
NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

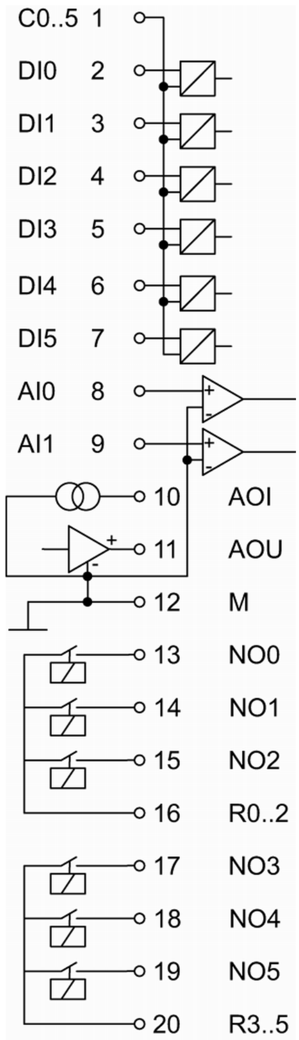
When replacing a processor module, it is recommended to mark each wire connected to the onboard I/O terminal block before disconnecting it. This should make sure that the wires can be reconnected in the same order.

The electrical connection is carried out by using a non-removable 20-pin terminal block.

The following block diagram shows the internal structure of the onboard I/Os:



PM56x-T(P)



PM56x-R(P)

Assignment of the Terminals for PM56x-T(P)

Terminal	Signal	Description
1	C0...5	Input common for digital input signals DI0 to DI5
2	DI0	Digital input signal DI0
3	DI1	Digital input signal DI1
4	DI2	Digital input signal DI2
5	DI3	Digital input signal DI3
6	DI4	Digital input signal DI4
7	DI5	Digital input signal DI5
8	AI0	Analog voltage input signal AI0
9	AI1	Analog voltage input signal AI1
10	AOU	Analog voltage output
11	AOI	Analog current output
12	M	Input/output common for analog signals
13	DO0	Digital output signal O0
14	DO1	Digital output signal O1
15	DO2	Digital output signal O2

Terminal	Signal	Description
16	DO3	Digital output signal O3
17	DO4	Digital output signal O4
18	DO5	Digital output signal O5
19	UP	Process supply voltage UP +24 VDC
20	ZP	Process supply voltage ZP 0 VDC

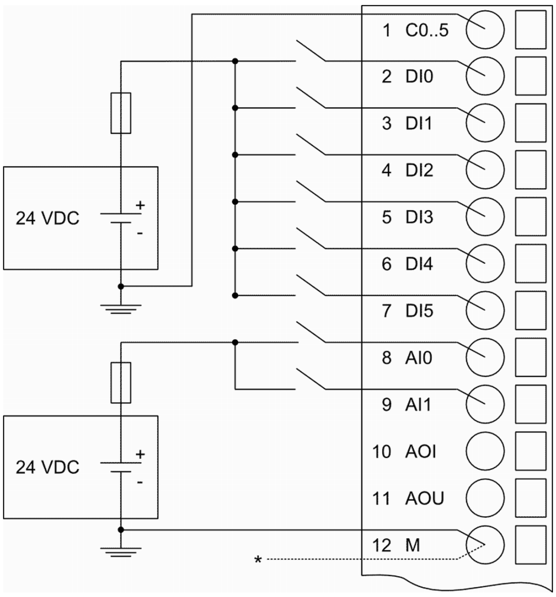
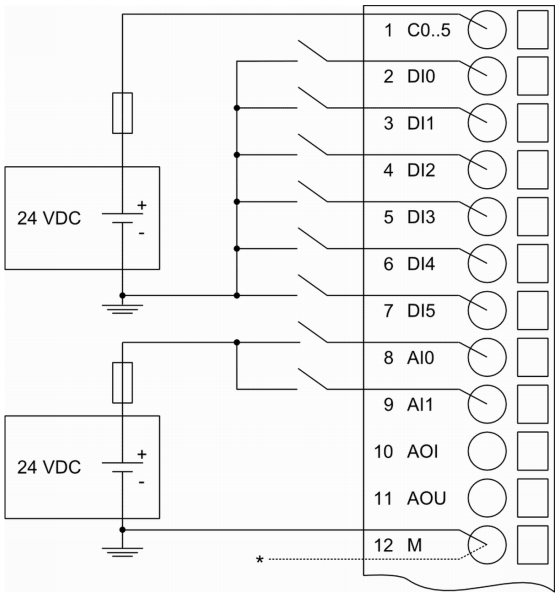
Assignment of the Terminals for PM56x-R(P)

Terminal	Signal	Description
1	C0...5	Input common for digital input signals DI0 to DI5
2	DI0	Digital input signal DI0
3	DI1	Digital input signal DI1
4	DI2	Digital input signal DI2
5	DI3	Digital input signal DI3
6	DI4	Digital input signal DI4
7	DI5	Digital input signal DI5
8	AI0	Analog voltage input signal AI0
9	AI1	Analog voltage input signal AI1
10	AOU	Analog voltage output
11	AOI	Analog current output
12	M	Input/output common for analog signals
13	NO0	Normally-open relay contact of the output NO0
14	NO1	Normally-open relay contact of the output NO1
15	NO2	Normally-open relay contact of the output NO2
16	R0..2	Output common for signals NO0 to NO2
17	NO3	Normally-open relay contact of the output NO3
18	NO4	Normally-open relay contact of the output NO4
19	NO5	Normally-open relay contact of the output NO5
20	R3...5	Output common for signals NO3 to NO5

Connection of the Digital Inputs

The digital inputs can be used as source inputs or as sink inputs.

> **!**
> **NOTICE!**
> **Risk of malfunctions in the plant!**
> A ground closure, e. g. caused by a damaged cable insulation, can bridge switches accidentally.
>
> Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

	
*) The M-terminal of the onboard I/Os is internally connected to the M-terminal of the processor-module supply voltage	*) The M-terminal of the Onboard I/Os is internally connected to the M-terminal of the processor-module supply voltage
Electrical connection of digital inputs (sink inputs)	Electrical connection digital inputs (source inputs)

If the inputs AI0 and AI1 are to be used as digital inputs, they must be configured as digital inputs.

The inputs AI0 and AI1 can only be used as sink inputs.

Connection of the Digital Transistor Outputs (PM56x-T(P) only)

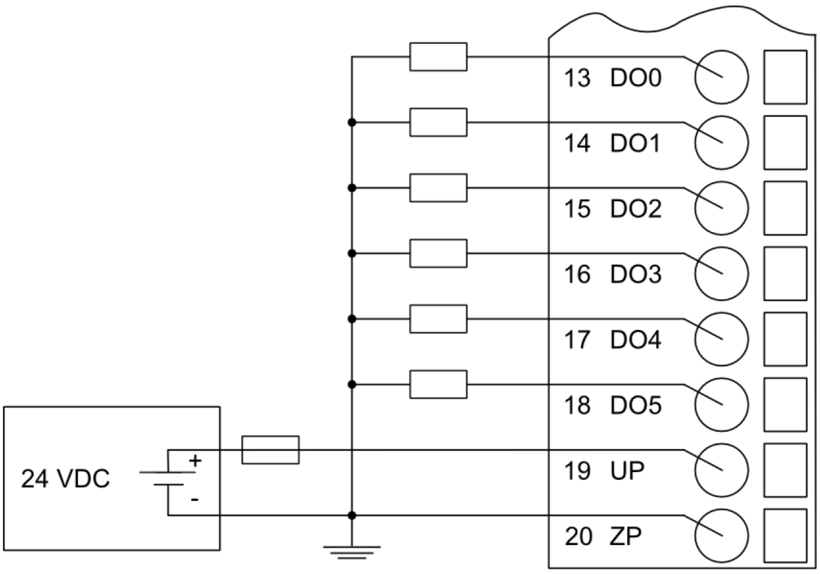


Fig. 3: Electrical connection of digital transistor outputs

NOTICE!
Risk of malfunctions in the plant!
The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.

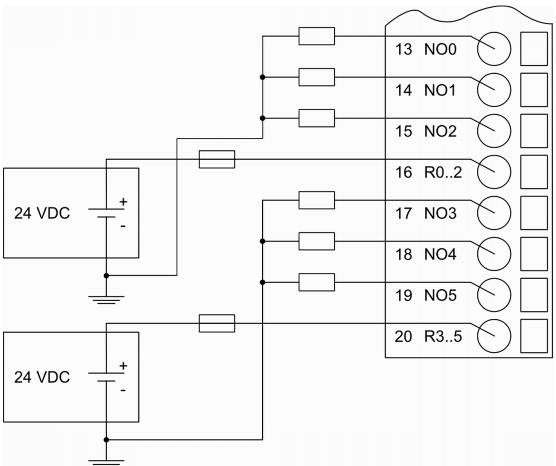
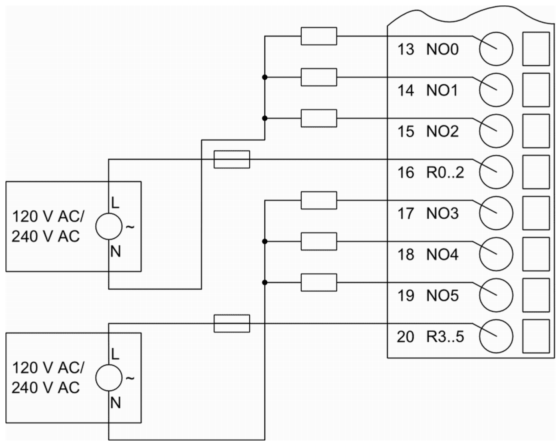
This must be considered in the planning of the application.

CAUTION!
Risk of damaging the processor module!
The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect the outputs to other voltages.
– Use an external 3 A fast protection fuse for the outputs.

Connection of the Digital Relay Outputs (PM56x-R(P) only)

The following figures show the electrical connection of the digital relay outputs to the processor modules:

<table>
<tr>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Connection of digital relay outputs (24 VDC)</td>
<td>Connection of digital relay outputs (100-240 VAC)</td>
</tr>
</table>

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

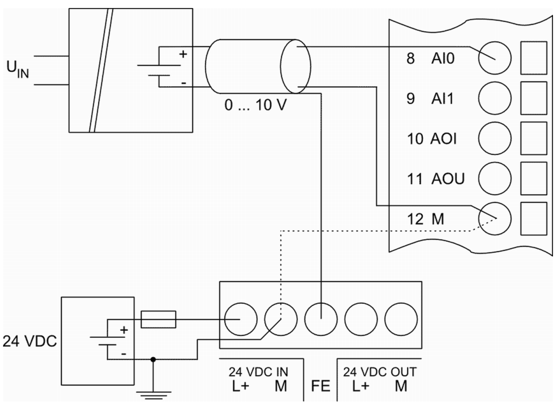
WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

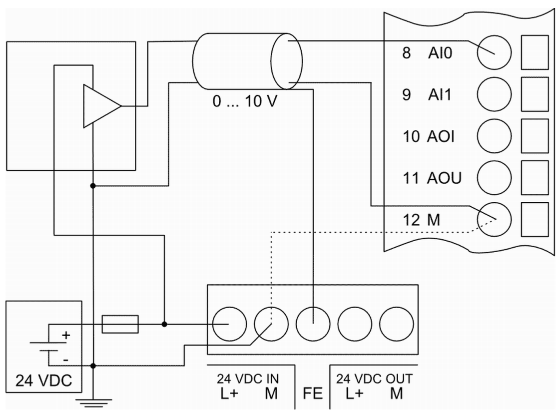
CAUTION!
Risk of damaging the processor module!
– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be fed from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

Connection of the Analog Inputs

The following figures show an example of the electrical connection of analog sensors (voltage) to the input AI0 of PM56x processor modules. Proceed with the input AI1 in the same way:



Connection of active-type analog sensors (voltage)

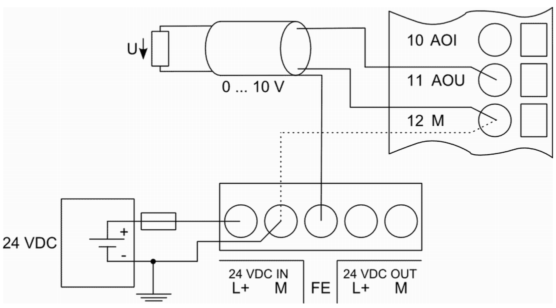


Connection of passive-type analog sensors (voltage)

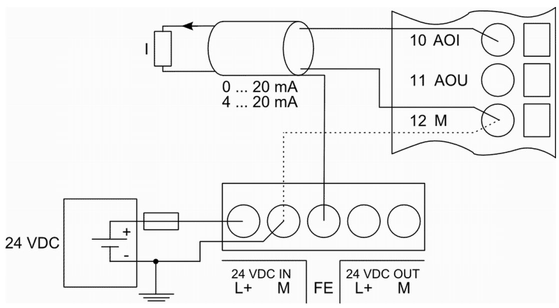
The inputs AI0 and AI1 must be configured as analog inputs.

Connection of the Analog Output

The following figures show the electrical connection of analog actuators (voltage and current) to the output AO of PM56x processor modules:



Connection of analog actuator (voltage)



Connection of analog actuator (current)

1.2.1.3.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Analog inputs (bytes)	4
Analog outputs (bytes)	2

1.2.1.3.5 I/O Configuration

The configuration data of the onboard I/Os is stored in the processor module PM56x.

1.2.1.3.6 Parameterization

For information about parameterization, refer to the description for onboard I/Os for processor module PM56x *AC500-eCo Onboard I/Os*.

1.2.1.3.7 Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
Errors for Onboard I/O							
Light errors							
3	8	255	2	0	3	MaxWaitRun for onboard I/O module has expired, when PLC is put into RUN state	Reboot and try it again. If the error still exists, replace processor module for testing

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
3	8	255	3	0	26	Invalid configuration of onboard I/O module, e. g. 2 input channels are configured as fast counter and interrupt input at the same time.	Correct PLC con-figuration
Warnings							
4	8	1	2	1	2	Invalid configuration value for PWM channel. Frequency / cycletime for the PWM channel of the 8DI+6DO and 8DI +6DO+2AI+1AO module are common and if both channel are configured for PWM, the frequency of the second channel must be set to 0.	Correct frequency
4	8	1	2	0..1	4	PWM channel fre-quency or cycle time too high	Correct frequency or cycle time
4	8	1	2	0..1	7	PWM channel fre-quency or cycle time too low	Correct frequency or cycle time
4	8	1	2	0	52	Frequency on interrupt input pin too high and interrupt events are missed	Correct frequency
4	8	4	2	0..1	48	Analog input value too high	Correct value
4	8	5	2	0	48	Analog output value too high	Correct value
4	8	255	2	0	26	PLC was put into RUN state, although a config-uration error is present, because parameter Run on config fault is set to YES	Correct PLC con-figuration
4	8	255	0	0	43	Unspecified or internal error occured	Replace processor module

1.2.1.3.8 Displays

LED	Status	Color	LED = ON	LED = OFF
DI0...DI5	Digital input	yellow	Input is ON	Input is OFF
DO0...DO5	Digital output	yellow	Output is ON	Output is OFF
AI0, AI1*)	Analog input	yellow	Input is ON	Input is OFF
AO	Analog output	yellow	Output is ON	Output is OFF
*) The analog inputs can be configured as digital inputs				

1.2.1.3.9 Measuring Ranges

> ***Risk of invalid analog input values!***
> *The analog input values may be invalid if they exceed the measuring range of the inputs.*
>
> *Make sure that the analog signal at the connection terminals is always within the signal range.*

Range	0 V...10 V	Digital value	
		Decimal	**Hex.**
Overflow	> 11.7589	32767	7FFF
Measured value too high	11.7589 : 10.0004	32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	27648 : 1	6C00 : 0001
	0.0000	0	0000

The represented resolution corresponds to 10 bits.

1.2.1.3.10 Output Ranges

Range	0 V...+10 V	0 mA...20 mA	Digital value	
			Decimal	**Hex.**
Overflow	11.75 11.75	23.50 23.50	32767 : 32512	7FFF : 7F03
Output value too high	11.75 : 10.01	23.50 : 20.02	32480 : 27680	7EE0 : 6C20
Normal range	10.00 : 0.01	20.00 : 0.02	27648 : 32	6C00 : 20

Range	0 V...+10 V	0 mA...20 mA	Digital value	
			Decimal	Hex.
	0.00	0.00	0	0000
Output value too low or underflow		0.00	-32 : -6912 : -32768	FFE0 : E500 : 8000

Range	4 mA...20 mA	Digital value	
		Decimal	Hex.
Overflow	22.80 : 22.80	32767 : 32520	7FFF : 7F08
Output value too high	22.80 : 20.02	32480 : 27668	7EE0 : 6C28
Normal range	20.00 : 4.02	27648 : 40	6C00 : 28
	4	0	0
Output value too low or underflow	3.98 : 0.00 : 0.00	-40 : -6920 : -32768	FFD8 : E4F8 : 8000

The represented resolution corresponds to 10 bits.

1.2.1.3.11 Technical Data

Technical Data of the Digital Inputs

Parameter	Value	
Number of channels per module	8 transistor inputs (24 VDC)	
Distribution of the channels into groups	1 group for 8 channels	
Electrical isolation	Yes, per group	
Connections of the channels I0 to I7	Terminals 2 to 9	
Reference potential for the channels I0 to I7	Terminal 1	
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)	
Input type according to EN 61131-2	Type 1 source	Type 1 sink
Input signal range	-24 VDC	+24 VDC

Parameter	Value	
Signal 0	-5 V...+3 V	-3 V...+5 V
Undefined signal	-15 V...- 5 V	+5 V...+15 V
Signal 1	-30 V...-15 V	+15 V...+30 V
Ripple with signal 0	Within -5 V...+3 V	Within -3 V...+5 V
Ripple with signal 1	Within -30 V...-15 V	Within +15 V...+30 V
Input current per channel		
Input voltage +24 V	Typ. 5 mA	
Input voltage +5 V	Typ. 1 mA	
Input voltage +15 V	> 2.5 mA	
Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)	1 mA	
Input delay (0->1 or 1->0)	Typ. 0.1 to 32 ms (configurable via software), default: 8 ms	
Max. cable length		
Shielded	500 m	
Unshielded	300 m	

Technical Data of the Fast Counter

Parameter	Value
Used inputs for the traces A and B	DI0 / DI1
Used output	DO0 / NO0
Counting frequency	On Request
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

Technical Data of the Digital Transistor Outputs

Parameter	Value
Number of channels per module	6 transistor outputs (24 VDC, 0.5 A max.)
Distribution of the channels into groups	1 group of 6 channels
Galvanic isolation	Yes, per group
Connection of the channels DO0 to DO5	Terminals 13 to 18
Common power supply voltage	Terminals 19 (+24 VDC, signal name UP) and 20 (0 VDC, signal name ZP)
Reference potential for the channels DO0 to DO5	Terminal 20 (minus pole of the process voltage, name ZP)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1)
Way of operation	Non-latching type

Parameter		Value
Min. output voltage at signal 1		20 VDC at max. current consumption
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Rated protection fuse (per group)		3 A fast
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 VDC
	Rated current per group (max.)	3 A
	Rated current (all channels together, max.)	3 A
Lamp load (max.)		5 W
Max. leakage current with signal 0		0.5 mA
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 1 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
Overload message		No
Output current limitation		No
Resistance to feedback against 24 VDC		No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Technical Data of the Digital Relay Outputs

Parameter		Value
Number of channels per module		6 normally-open relay outputs
Distribution of the channels into groups		2 groups for 3 channels
Galvanic isolation		Yes, per group
Connection of the channels NO0 to NO2		Terminals 13 to 15
Connection of the channels NO3 to NO5		Terminals 17 to 19
Reference potential for the channels NO0 to NO2		Terminal 16
Reference potential for the channels NO3 to NO5		Terminal 20
Relay output voltage		
	Rated value	24 VDC or 120/240 VAC
	Range	5 to 30 VDC or 5 to 250 VAC

Parameter		Value
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered through the I/O bus
Way of operation		Non-latching type
Output delay		
	0 to 1	Typ. 10 ms
	1 to 0	Typ. 10 ms
Rated protection fuse		On request
Output current		
	Rated current per channel (max.)	2.0 A (24 VDC / 24 VAC / 48 VAC / 120 VAC / 240 VAC, only resistive loads) 2.0 A (24 VAC / 48 VAC / 120 VAC, only pilot duty) 1.5 A (240 VAC, only pilot duty)
	Rated current per group (max.)	6 A
	Rated current (all channels together, max.)	12 A
Lamp load (max.)		200 W (230 VAC), 30 W (24 VDC)
Demagnetization when inductive loads are switched off		A free-wheeling diode must be circuited in parallel to the inductive load
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	Not possible
	With lamp loads	Max. 1 Hz
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
Rated protection fuse (for each channel)		5 A fast
Overload message		No
Output current limitation		No
Resistance to feedback against 24 VDC		No
Connection of 2 outputs in parallel		Not possible
Life time of relay contacts (cycles)		100.000 at rated load
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Technical Data of the PWM Outputs

Parameter	Value
Used outputs for PWM	DO2 and DO3
Output frequency	125 Hz 20 kHz

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		2 voltage inputs
Distribution of channels into groups		1 group for 2 channels
Galvanic isolation		None
Power Supply Voltage		Via the L+ and the M terminal of the processor-module power supply
Resolution		Voltage 0 VDC...10 VDC: 10 bits
Connection of the signals AI0 and AI1		Terminals 8 and 9
Input type		Unipolar
Data word format		
	Unipolar, full-scale range	0 to 27648
	Indication of the input signals	No
Channel input resistance		Voltage: > 100 kΩ
Accuracy		
	Typical (25 °C)	±1 %
	Worst case (at 0 °C...60 °C or EMC disturbances)	±2.5 % of full-scale
Time constant of the input filter		Typ. 1 ms
Relationship between input signal and hex code		*Chapter 1.2.1.3.9 “Measuring Ranges” on page 58*
Analog to digital conversion time		Typ. 6.2 ms
Unused inputs		Can be left open and should be configured as "unused"
Overvoltage protection		Yes, up to 30 VDC
Max. cable length		Conductor cross section > 0.14 mm²
	Unshielded wire	On request
	Shielded wire	100 m

Technical Data of the Analog Output

Parameter	Value
Number of channels per module	1 configurable voltage or current outputs
Distribution of channels into groups	1 group for 1 channel
Electrical isolation	None
Connection of the signal AOU	Terminal 11
Connection of the signal AOI	Terminal 10
Power supply voltage	Via the L+ and the M terminal of the processor module power supply
Output type	Unipolar (voltage and current)
Resolution	10 bits
Indication of the output signals	Yes, one LED per channel
Output Resistance (load) as current output	0 Ω...500 Ω

Parameter		Value
Output load ability as voltage output		+2 mA max.
Accuracy for current and voltage output		
	Typical (25 °C)	±1 % of full-scale
	Worst case (at 0 °C...60 °C or EMC disturbances)	±2.5 % of full-scale
Relationship between input signal and hex code		*Chapter 1.2.1.3.10 “Output Ranges” on page 58*
Unused inputs		Can be left open and should be configured as "unused"
Overvoltage protection		Yes, up to 30 VDC
Max. cable length		Conductor cross section > 0.14 mm²
	Unshielded wire	On request
	Shielded wire	100 m

1.2.2 AC500 (Standard)

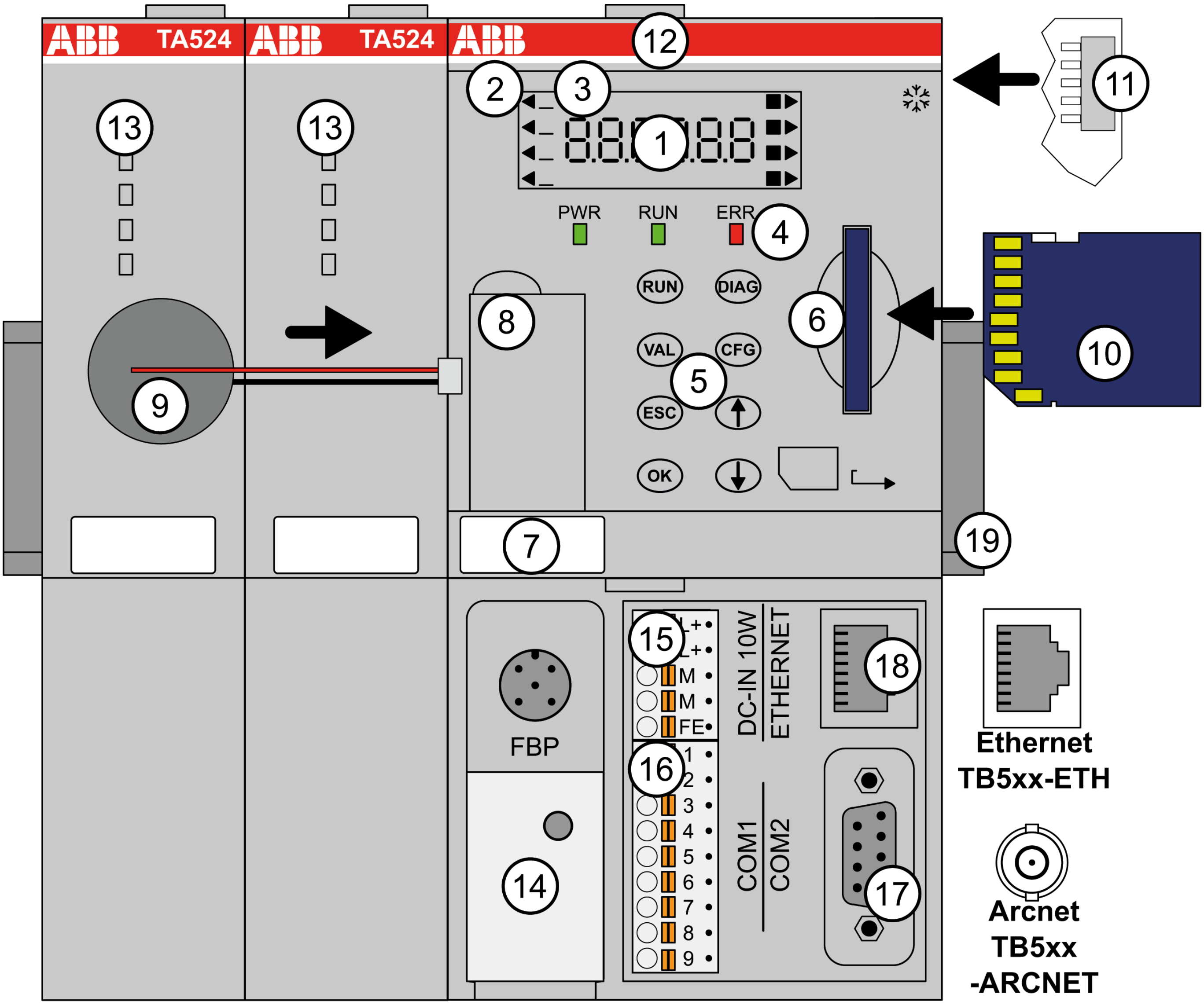
1.2.2.1 PM57x (-y), PM58x (-y) and PM59x (-y)

Processor modules without onboard interfaces:

- PM57x, PM58x, PM59x: processor module without Ethernet support
- The processor module PM595 is described in a seperate device description *Chapter 1.2.2.2 “PM595” on page 79*
- XC version for usage in extreme ambient conditions available (some models versions only)

Processor modules with onboard interfaces:

- PM5xy-ETH: processor module with Ethernet support (onboard Ethernet) - 1 network interface RJ45 on the terminal base
- PM5xy-2ETH: processor module with Ethernet support (onboard Ethernet) - 2 network interfaces RJ45 on the terminal base
- PM5xy-ARC: processor module with ARCNET support (onboard ARCNET) - 1 network interface ARCNET BNC on the terminal base



1 6x 7-segment state displays with background lighting
2 "Triangle" displays for "item"
3 "Square" displays for "state"
4 3 state LEDs
5 8 function keys
6 Slot for memory card
7 Label
8 Compartment for lithium battery TA521
9 Lithium battery TA521
10 Memory card (MC502)
11 I/O bus for connection of I/O modules
12 Slot for processor module (processor module mounted on terminal base)
13 Slots for communication modules (multiple, depending on terminal base; unused slots must be covered with TA524)
14 Interface for FieldBusPlug
15 Power supply (5-pin terminal block, removable)
16 Serial interface COM1 (9-pin terminal block, removable)
17 PM5xy-ETH and PM5xy-ARCNET: D-sub 9 for serial interface COM2. PM5xy-2ETH: RJ45 female connector for 2nd Ethernet connection
18 RJ45 female connector for Ethernet connection / BNC female connector for ARCNET connection (depending on terminal base)
19 DIN rail
❄ Sign for XC version

1.2.2.1.1 Short Description

The processor modules are the central units of the control system AC500. The types differ in their performance (memory size, speed etc.). Each processor module must be mounted on a suitable terminal base.

The terminal base type depends on the number of communication modules which are used together with the processor module and on the processor module's network interface type (1x Ethernet, 2x Ethernet or ARCNET).

Each processor module can operate multiple communication modules through its communication module interface (defined by the terminal base).

The communication modules are mounted on the left side of the processor module on the same terminal base.

On the right side of the processor module, up to 10 digital or analog I/O expansion modules can be connected to the I/O bus. Each I/O module requires a suitable terminal unit depending on the module type.

Terminal bases, terminal units, I/O modules, communication modules and accessories have their own technical descriptions.

Each processor module can be used as:

- Stand-alone processor module
- Stand-alone processor module with local IOs
- Remote IO Server
- Remote IO Client

The processor modules (except PM591-2ETH) can be used as a slave with

- *PROFIBUS*
- *DeviceNet*
- *CANopen*

The processor modules are powered with 24 VDC.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

- connect or disconnect any signal or terminal block
- remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

The processor module PM595 is described in a separate device description *Chapter 1.2.2.2 “PM595” on page 79.*

1.2.2.1.2 Assortment

Module	Program and Data Memory	Cycle Time for 1 Instruction	Network Interface		Other Interfaces	Suitable Terminal Base
			Ethernet	ARCNET		
PM572	128 kB	Binary: min. 0.06 µs Word: min. 0.09 µs Floating point: min. 0.70 µs	-	-	[3])	TB5x1-ETH
PM573-ETH	512 kB		Onboard Ethernet	-	[3])	TB5x1-ETH (1SAP11x100R0 270 only)
PM582	512 kB	Binary: min. 0.05 µs Word: min. 0.06 µs Floating point: min. 0.50 µs	-	-	[3])	TB5x1-ETH
PM583-ETH	1 MB		Onboard Ethernet	-	[3])	TB5x1-ETH (1SAP11x100R0 270 only)
PM585-ETH	1 MB				[3])	
PM590-ETH ([1])	2 MB	Binary: min. 0.002 µs Word: min. 0.004 µs Floating point: min. 0.004 µs	Integrated communication module	-	[3])	TB5x1-ETH
PM590-ARCNET (R0261)	2 MB	-	-	Integrated communication module	[3])	TB5x1-ARCNET
PM591-ETH	4 MB	-	Integrated communication module	-	[3])	TB5x1-ETH
PM591-ETH	4 MB	-	Onboard Ethernet	-	[3])	TB5x1-ETH (1SAP11x100R0 270 only)
PM591-2ETH	4 MB	-	2x Onboard Ethernet	-	[2])	TB5x3-2ETH
PM592-ETH	4 MB		Onboard Ethernet	-	[3])	TB5x1-ETH (1SAP11x100R0 270 only)

Remarks:

[1]): The processor modules PM59x-ETH can only be used with terminal bases with product index C6 or higher. Otherwise, they should be updated to that index. *Chapter 1.1.1 "TB51x-TB54x" on page 4*

[2]): Serial interface COM1, Communication Interface Module, I/O bus

[3]): Serial interface COM1, Serial interface COM1, Communication Interface Module, FieldBus-Plug (FBP), I/O bus

Processor modules PM57x-ETH, PM58x-ETH and PM59x-ETH with ordering No. 1SAPxxxxxxR0271 can only be used with terminal bases with ordering No. 1SAPxxxxxxR0270.

Processor modules PM5xx-2ETH can only be used with TB5x3-2ETH terminal bases.

1.2.2.1.3 Connections

All terminals for electrical connection are available on the terminal base. For information on connection and available interfaces see the descriptions for

- TB511
- TB521
- TB523
- TB541 *Chapter 1.1.1 “TB51x-TB54x” on page 4*.

1.2.2.1.4 Storage Elements

Lithium Battery

The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

See *AC500 Battery*.

The CPU monitors the discharge degree of the battery. A warning is issued before the battery condition becomes critical (about 2 weeks before). Once the warning message appears, the battery should be replaced as soon as possible.

The technical data, handling instructions and the insertion/replacement of the battery is described in detail in chapter *TA521 Lithium Battery*.

Memory Card

AC500 processor modules are supplied without memory card. It must be ordered separately.

The memory card can be used

- to read and write user files
- for firmware updates

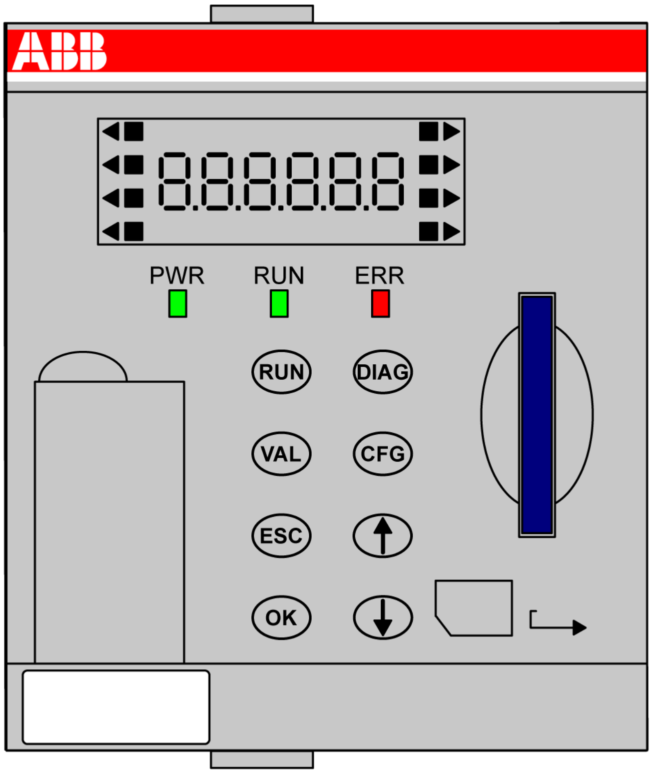
Detailed information can be found in the *System Technology chapter*.

AC500 processor modules can be operated with and without memory cards. The processor module uses a standard file system (FAT; filenames stored in 8.3 format, on memory card). This allows standard card readers to read and write the memory cards (MC502).

> *Only genuine MC502 memory cards are supported.*

For more information on the technical data, handling instructions and the insertion/replacement of the memory card, please refer to the chapter Memory Card *MC502*.

1.2.2.1.5 LEDs, Display and Function Keys on the Front Panel



Detailed information on using the LEDs, display and the function keys such as startup procedure and error coding is described in the System Technology section Display.

1.2.2.1.6 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Processor Module and Terminal Base

Parameter	Value
Connection of the supply voltage 24 VDC at the terminal base of the processor module	Removable 5-pin terminal block with spring connection
Current consumption from 24 VDC	PM57x: 50 mA PM57x-ETH: 110 mA
	PM58x: 50 mA PM58x-ETH: 110 mA PM58x-ARCNET: 110 mA

Parameter	Value
	PM59x: 90 mA PM59x-ETH: 150 mA PM59x-2ETH: 150 mA PM59x-ARCNET: 150 mA
Fuse melting integral at 24 VDC	Min. 1 A²s [1]) see *Chapter 2.4.5.2 “Dimensioning of the Fuses” on page 1193*
Max. input power from 24 VDC	10 W [2])
Slots on the terminal bases	TB511: 1 processor module, 1 communication module
	TB521 / TB523: 1 processor module, 2 communication modules
	TB541: 1 processor module, 4 communication modules
Processor module interfaces at the terminal bases TB5x1	I/O bus, COM1, COM2, FBP
Processor module interfaces at the terminal bases TB5x3	I/O bus, COM1
Processor module network interfaces at the terminal bases	TB5x1-ETH *Chapter 1.1.1 “TB51x-TB54x” on page 4* / PM5xx-ETH: Ethernet
	TB5x3-ETH *Chapter 1.1.1 “TB51x-TB54x” on page 4*/ PM5xx-ETH: 2x Ethernet
	TB5x1-ARCNET *Chapter 1.1.1 “TB51x-TB54x” on page 4*/ PM5xx-ARCNET: ARCNET
Connection system	see System Assembly, Construction and Connection *Chapter 2.6.4 “Connection and Wiring” on page 1276*
Weight (processor module without terminal base)	PM582: 135 g PM58x-ETH: 150 g
	PM59x: 135 g PM59x-ETH: 150 g PM59x-2ETH: 150 g PM59x-ARCNET: 160 g
Mounting position	Horizontal or vertical

Table 9: Remarks:

[1])	The inrush current and the melting integral of the processor module depends on the processor module's integrated power supply, and the number and type of communication modules and I/O modules connected to the I/O bus. The values are valid for all processor modules.
[2])	Including communication modules and I/O bus modules

Detailed Data

Table 10: PM57x

Processor Module		PM572	PM573-ETH
Program memory flash EPROM and RAM		128 kB	512 kB
Data memory, integrated		128 kB, incl. 12 kB buffered	512 kB, incl. 288 kB buffered
Expandable memory		None	None
Integrated mass storage memory		None	None
Pluggable memory card for:			
	User data storage	x	x
	Program storage	x	x
	Firmware update	x	x
Cycle time for 1 instruction:			
	Binary	Min. 0.06 µs	Min. 0.06 µs
	Word	Min. 0.09 µs	Min. 0.09 µs
	Floating point	Min. 0.70 µs	Min. 0.70 µs
Max. number of central inputs and outputs (up to 7 exp. modules): ([1])			
	Digital inputs	224	224
	Digital outputs	224	224
	Analog inputs	112	112
	Analog outputs	112	112
Max. number of central inputs and outputs (10 exp. modules):			
	Digital inputs	320	320
	Digital outputs	320	320
	Analog inputs	160	160
	Analog outputs	160	160
Number of decentralized inputs and outputs		Depends on the fieldbus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)	
Data backup		Battery	
Data buffering time at 25 °C		Typ. 3 years without power supply	
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical	
Real-time clock:			
	With battery back-up	x	x
	Accuracy	Typ. ± 2 s / day at 25 °C	
Program execution:			
	Cyclic	x	x
	Time-controlled	x	x
	Multitasking	x	x
Protection of the user program by a password		x	x
Serial interface COM1:			

Processor Module		PM572	PM573-ETH
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) pluggable terminal block, spring connection for programming, as Modbus (master/slave), as serial ASCI communication, as CS31 Master	
	Connection		
	Usage		
Serial interface COM2 (not for PM5xy-2ETH models):			
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) D-sub for programming, as Modbus (master/slave), as serial ASCII communication	
	Connection		
	Usage		
Integrated communication module:			
	ETH = Ethernet	-	ETH onboard with web server, SNTP and IEC60870-5-104 protocol
	RJ45	-	
	ARCNET = ARCNET BNC	-	
Number of external communication modules		Up to 4 communication modules like PROFIBUS DP, Ethernet, CANopen. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 4 PROFIBUS DP communication modules are possible)	
Ethernet		-	10/100 base-TX, 1x RJ45 socket, provided on TB5x1-ETH
LEDs, LCD display, 8 function keys		For RUN/STOP switchover, status displays and diagnosis	
Number of timers		Unlimited	
Number of counters		Unlimited	
Programming languages:			
	Structured Text ST	x	x
	Instruction List IL	x	x
	Function Block Diagram FBD	x	x
	Ladder Diagram LD	x	x
	Sequential Function Chart SFC	x	x
	Continuous Function Chart CFC	x	x
[1]): up to 7 I/O terminal units before PS501 V1.2 and processor module firmware before V1.2.0.			

Table 11: PM58x

Processor Module		PM582	PM583-ETH	PM585-ETH
Program memory flash EPROM and RAM		512 kB	1024 kB	1024 kB
Data memory, integrated		416 kB, incl. 288 kB buffered	1024 kB, incl. 288 kB buffered	1536 kB, incl. 512 kB buffered
Expandable memory		None	None	None
Integrated mass storage memory		None	None	None
Pluggable memory card for:				
	User data storage	x	x	x

Processor Module		PM582	PM583-ETH	PM585-ETH
	Program storage	x	x	x
	Firmware update	x	x	x
Cycle time for 1 instruction:				
	Binary	Min. 0.05 µs		Min. 0.004 µs
	Word	Min. 0.06 µs		Min. 0.008 µs
	Floating point	Min. 0.50 µs		Min. 0.008 µs
Max. number of central inputs and outputs (up to 7 exp. modules): [1])				
	Digital inputs	224		
	Digital outputs	224		
	Analog inputs	112		
	Analog outputs	112		
Max. number of central inputs and outputs (10 exp. modules):				
	Digital inputs	320		
	Digital outputs	320		
	Analog inputs	160		
	Analog outputs	160		
Number of decentralized inputs and outputs		Depends on the fieldbus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)		
Data backup		Battery		
Data buffering time at 25 °C		Typ. 3 years without power supply		
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical		
Real-time clock:				
	With battery back-up	x		
	Accuracy	Typ. ±2 s / day at 25 °C		
Program execution:				
	Cyclic	x		
	Time-controlled	x		
	Multitasking	x		
Protection of the user program by a pass-word		x		
Serial interface COM1:				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) pluggable terminal block, spring connection for programming, as Modbus (master/slave), as serial ASCI communication, as CS31 master		
	Connection			
	Usage			
Serial interface COM2 (not for PM5xy-2ETH models):				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) D-sub for programming, as Modbus (master/slave), as serial ASCII communication		
	Connection			
	Usage			
Integrated communication module:				

Processor Module		PM582	PM583-ETH	PM585-ETH
	ETH = Ethernet	-	ETH onboard with web server, SNTP and IEC60870-5-104 protocol	
	RJ45	-		
	ARCNET = ARCNET BNC	-		
Number of external communication modules		Up to 4 communication modules like PROFIBUS DP, Ethernet, CANopen. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 4 PROFIBUS DP communication modules are possible)		
Ethernet		-	10/100 base-TX, 1x RJ45 socket, provided on TB5x1-ETH	
LEDs, LCD display, 8 Function Keys		For RUN/STOP switchover, status displays and diagnosis		
Number of timers		Unlimited		
Number of counters		Unlimited		
Programming languages:				
	Structured Text ST	x		
	Instruction List IL	x		
	Function Block Diagram FBD	x		
	Ladder Diagram LD	x		
	Sequential Function Chart SFC	x		
	Continuous Function Chart (CFC)	x		
[1]): up to 7 I/O terminal units before PS501 V1.2 and processor module firmware before V1.2.0.				

Table 12: PM59x [2])

Processor Module		PM59x-ETH	PM59x-ARCNET	PM59x-ETH PM59x-2ETH
Program memory flash EPROM and RAM		PM590: 2048 kB PM591/PM592: 4096 kB		
Data memory, integrated		PM590: 2560 kB, PM591: 3584 kB, incl. 1536 kB buffered		PM590: 3072 kB, PM591/592: 5632 kB, incl. 1536 kB buffered
Expandable memory		None	None	None
Integrated mass storage memory		None	None	PM592-ETH: 4 GB flash disk
Pluggable memory card for:				
	User data storage	x	x	x
	Program storage	x	x	x
	Firmware update	x	x	x
Cycle time for 1 instruction:				

Processor Module		**PM59x-ETH**	**PM59x-ARCNET**	**PM59x-ETH** **PM59x-2ETH**
	Binary	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Word	Min. 0.004 µs	Min. 0.004 µs	Min. 0.004 µs
	Floating point	Min. 0.004 µs	Min. 0.004 µs	Min. 0.004 µs
Max. number of central inputs and outputs (up to 7 exp. modules): [1])				
	Digital inputs	224	224	224
	Digital outputs	224	224	224
	Analog inputs	112	112	112
	Analog outputs	112	112	112
Max. number of central inputs and outputs (10 exp. modules):				
	Digital inputs	320	320	320
	Digital outputs	320	320	320
	Analog inputs	160	160	160
	Analog outputs	160	160	160
Number of decentralized inputs and outputs		Depends on the fieldbus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)		
Data backup		Battery		
Data buffering time at 25 °C		Typ. 3 years without power supply		
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical		
Real-time clock:				
	With battery back-up	x	x	x
	Accuracy	Typ. ±2 s / day at 25 °C	Typ. ±2 s / day at 25 °C	Typ. ±2 s / day at 25 °C
Program execution:				
	Cyclic	x	x	x
	Time-controlled	x	x	x
	Multitasking	x	x	x
Password protection of user program		x	x	x
Serial interface COM1:				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) pluggable terminal block, spring connection for programming, as Modbus (master/slave), as serial ASCII communication, as CS31 master		
	Connection			
	Usage			
Serial interface COM2 (not for PM5xy-2ETH models):				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) D-sub for programming, as Modbus (master/slave), as serial ASCII communication		
	Connection			
	Usage			
Integrated communication module:				

Processor Module		**PM59x-ETH**	**PM59x-ARCNET**	**PM59x-ETH** **PM59x-2ETH**
	ETH = Ethernet	ETH	ARCNET	ETH onboard with Web-server, SNTP and IEC60870-5-104 protocol
	RJ45	ETH	ARCNET	
	ARCNET = ARCNET BNC	ETH	ARCNET	
Number of external communication modules		Up to 4 communication modules like PROFIBUS DP, Ethernet, CANopen. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 4 PROFIBUS DP communication modules are possible)		
Ethernet		10/100 base-TX, 1x RJ45 socket	-	PM59x-ETH: 10/100 base-TX, 1x RJ45 socket, provided on TB5x1-ETH PM591-2ETH: 10/100 base-TX, independent interfaces, 2x RJ45 socket, provided on TB521-2ETH
LEDs, LCD display, 8 Function Keys		For RUN/STOP switchover, status displays and diagnosis		
Number of timers		Unlimited	Unlimited	Unlimited
Number of counters		Unlimited	Unlimited	Unlimited
Programming languages:				
	Structured Text ST	x	x	x
	Instruction List IL	x	x	x
	Function Block Diagram FBD	x	x	x
	Ladder Diagram LD	x	x	x
	Sequential Function Chart SFC	x	x	x
	Continuous Function Chart (CFC)	x	x	x

Table 13: Remarks:

1)	Up to 7 I/O terminal units before PS501 V1.2 and processor module firmware before V1.2.0.
2)	For PM595 see device description for PM595 *Chapter 1.2.2.2 “PM595” on page 79*.

1.2.2.1.7 Ordering Data

Processor Modules for AC500 (Standard) V2 Products

Part no.	Description	Product Life Cycle Phase *)
1SAP 130 200 R0200	PM572, processor module, memory 128 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display	Active
1SAP 130 300 R0271	PM573-ETH, processor module, memory 512 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 330 300 R0271	PM573-ETH-XC, processor module, memory 512 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active
1SAP 140 200 R0201	PM582, processor module, memory 512 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display	Active
1SAP 340 200 R0201	PM582-XC, processor module, memory 512 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, XC version	Active
1SAP 140 300 R0271	PM583-ETH, processor module, memory 1024 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 340 300 R0271	PM583-ETH-XC, processor module, memory 1024 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active
1SAP 140 500 R0271	PM585-ETH, processor module, memory 1024 kB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 150 000 R0261	PM590-ARCNET, processor module, memory 2 MB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, integrated communication module ARCNET	Active

Part no.	Description	Product Life Cycle Phase *)
1SAP 150 000 R0271	PM590-ETH, processor module, memory 2 MB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 150 100 R0271	PM591-ETH, processor module, memory 4 MB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 150 100 R0277	PM591-2ETH, processor module, memory 4 MB, 24 VDC, memory card slot, interfaces 1x RS-232/485 (programming, Modbus/CS31), display, 2x onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 350 100 R0271	PM591-ETH-XC, processor module, memory 4 MB, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active
1SAP 150 200 R0271	PM592-ETH, processor module, memory 4 MB / 4 GB flash disk, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 350 200 R0271	PM592-ETH-XC, processor module, memory 4 MB / 4 GB flash disk, 24 VDC, memory card slot, interfaces 2x RS-232/485 (programming, Modbus/CS31), 1x FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

Table 14: Accessories

Part no.	Description
1SAP 180 300 R0001	TA521, lithium battery
1SAP 180 100 R0001	MC502, memory card

Processor module PM591-2ETH can only be used with TB523-2ETH.

Processor modules PM57x-ETH(-XC), PM58x-ETH(-XC) and PM59x-ETH(-XC) with ordering No. 1SAPxxxxxxR0271 can only be used with terminal bases TB5x1-ETH(-XC) with ordering No. 1SAPxxxxxxR0270.

1.2.2.2 PM595

- High-performance processor module with 1.3 GHz
- XC version with 1 GHz for use in extreme ambient conditions available (maintenance free)

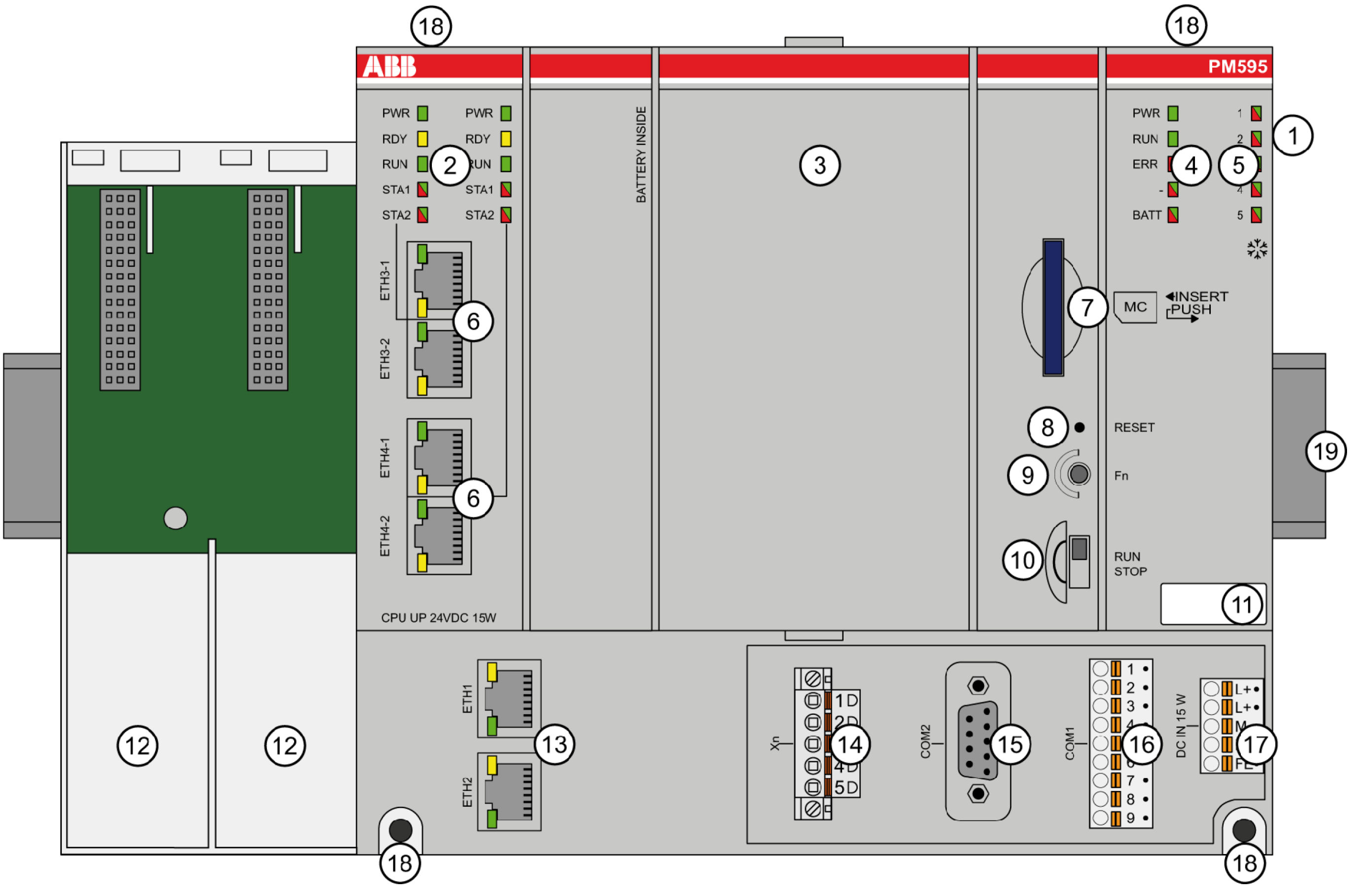


Fig. 4: Processor Module PM595

1 I/O bus for connection of I/O modules
2 2x 5 LEDs to display the states of the fieldbuses
3 Cover for battery and display
4 5 LEDs to display the states of the processor module
5 5 LEDs (reserved)
6 2x 2 RJ45 interfaces for fieldbuses
7 Slot for memory card
8 Reset button (reserved)
9 Button (reserved)
10 RUN/STOP switch
11 Label
12 Slots for communication modules (max. 2; unused slots must be covered with TA524)
13 2 RJ45 interfaces for Ethernet connection
14 5-pin terminal block (reserved)
15 Serial interface COM2 (D-sub 9)
16 Serial interface COM1 (9-pin terminal block, removable)
17 Power supply (5-pin terminal block, removable)
18 4 holes for wall mounting
19 DIN rail
❄ Sign for XC version

1.2.2.2.1 Short Description

The processor module is a central unit for AC500 with high performance.

Each processor module can operate up to 2 communication modules via its communication module interface. The communication modules are mounted on the left side of the processor module. On the right side of the processor module, up to 10 digital or analog I/O modules can be attached. Each of these I/O modules requires its own I/O terminal unit, whose type depends on the module type.

> *For a description of the mounting, disassembling and the electrical connection of the I/O modules, please refer to the System Assembly, Construction and Connection chapter* *Chapter 2.6.3.3 “Mounting and Demounting the Processor Module PM595” on page 1270.*

> **WARNING!**
>
> **Removal/Insertion under power**
>
> The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.
>
> Make sure that all voltage sources (supply and process voltage) are switched off before you
>
> – connect or disconnect any signal or terminal block
> – remove, mount or replace a module.
>
> Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.
>
> Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.
>
> The devices must not be opened when in operation. The same applies to the network interfaces.

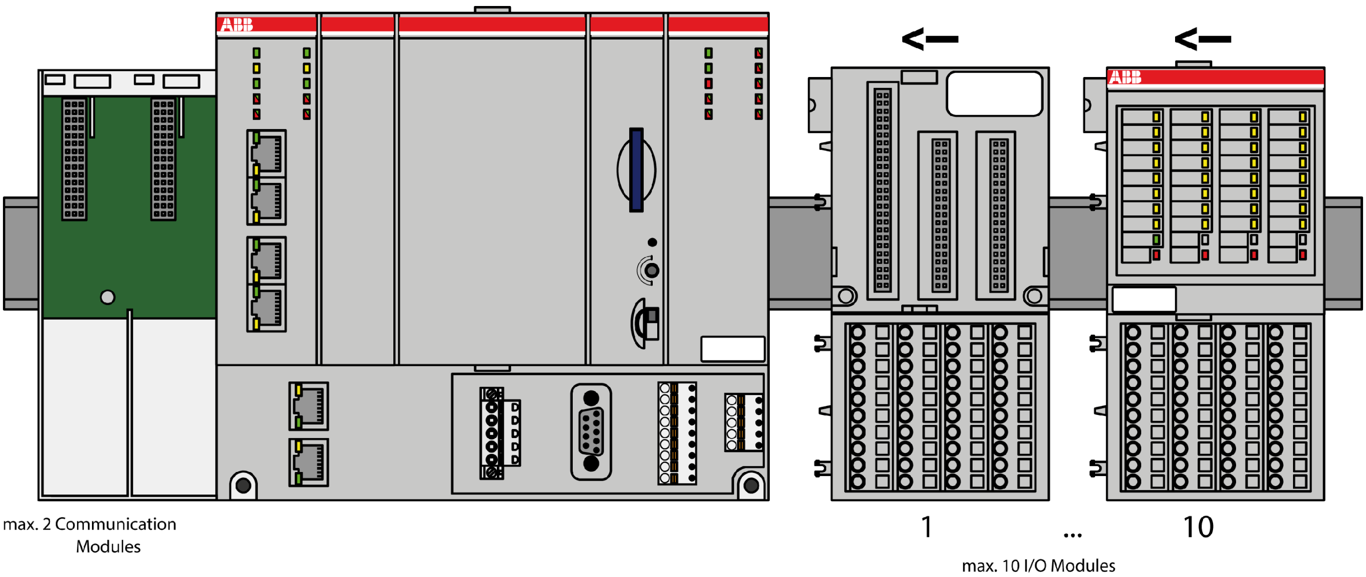


Fig. 5: Processor module, communication modules and I/O modules

For PM595 only:

For EtherCAT and PROFINET support make sure the following firmware is installed:

- *PROFINET: V 2.8.1.2 or newer*
- *EtherCAT: V 4.2.23 (2) or newer*

To update the Firmware of PM595, please follow the instructions in the chapter Firmware update.

1.2.2.2.2 Assortment

Table 15: Processor Modules:

Processor Module	Program Memory	Cycle Time for 1 Instruction	Ethernet Interfaces	Other Interfaces
PM595-4ETH-F PM595-4ETH-M-XC	16384 kB SDRAM user program memory 16384 kB SDRAM user data memory 32768 kB flash for boot projects, symbols, web pages	Binary: min. 0.0006 µs Word: min. 0.001 µs Floating point: min. 0.001 µs	ETH1 and ETH2 for Ethernet-based system communication ETH3.1 and ETH3.2 for Ethernet-based fieldbuses with switch functionality ETH4.1 and ETH4.2 for Ethernet-based fieldbuses with switch functionality	Serial interface COM1 Serial interface COM2 Communication module interface I/O bus

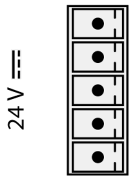
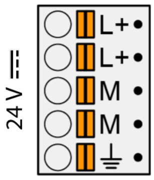
1.2.2.2.3 Connections

I/O Bus

The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added (see description for I/O bus in the system assembly chapter *Chapter 2.4.1 “Serial I/O Bus” on page 1180*).

Power Supply

Pin Assignment The supply voltage of 24 VDC is connected to a removable 5-pin terminal block. L+/M exist twice. It is therefore possible to feed e.g. external sensors (up to 8 A max. with 1.5 mm² conductor) via these terminals.

Pin assignment		Label	Function	Description
 Terminal block removed	 Terminal block inserted	L+	+24 VDC	Positive pin of the power supply voltage
		L+	+24 VDC	Positive pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		⏚	FE	Functional earth

> **NOTICE!**
> **Risk of damaging the processor module and terminal base!**
> Exceeding the maximum voltage could lead to unrecoverable damage to the system.
>
> The system could be destroyed.

> **NOTICE!**
> **Risk of malfunction!**
> To ensure reliability and proper functionality, the supply voltage must ramp-up from 0 V to 24 V within max. 2.5 s

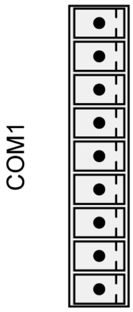
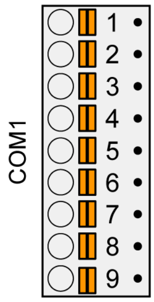
> **NOTICE!**
> **Risk of damaging the terminal base and power supply!**
> Short circuits might damage the terminal base and power supply.
>
> Make sure that the four clamps L+ and M (two of each) are not wrongly connected (e. g. +/- of power supply is connected to both L+/L+ or both M/M)

> **NOTICE!**
> **Risk of damaging the terminal base!**
> Terminal base can be damaged by connecting the power supply terminal block (L+/M) to COM1.
>
> Make sure that the COM1 terminal block is always connected to the terminal base even if you do not use COM1 to prevent this.

> **NOTICE!**
> **Risk of damaging the terminal base!**
> Excessive current might damage the clamp and terminal base.
>
> Make sure that the current flowing through the removable clamps never exceeds 8 A (with 1.5 mm² conductor).

Serial Interface COM1

Pin Assignment

Serial Interface		Pin	Signal	Interface	Description
 Terminal block removed	 Terminal block inserted	1	Terminator P	RS-485	Terminator P
		2	RxD/TxD-P	RS-485	Receive/Transmit, positive
		3	RxD/TxD-N	RS-485	Receive/Transmit, negative
		4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

The serial interface COM1 is connected to a removable 9-pin terminal block. It is configurable for RS-232 and RS-485.

> **NOTICE!**
> **Unused connector!**
> Make sure that the terminal block is always connected to the terminal base, even if you do not use the interface.

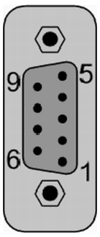
For a detailed description of COM1, please refer to Serial interface COM1 ↬ *Chapter 2.6.4.6 “Serial Interface COM1 of the Terminal Bases” on page 1282*.

Serial Interface COM2

The serial interface COM2 is connected to a D-sub 9. It is configurable for RS-232 and RS-485.

> *COM2 cannot be used for communication via CS31 System Bus. For a detailed description of COM2, please refer to Serial interface COM2.* ↬ *Chapter 2.6.4.7 “Serial Interface COM2 of the Terminal Bases ” on page 1284*

Pin Assignment

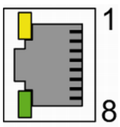
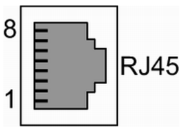
Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

NOTICE!
Risk of corrosion!
Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices *TA535* *Chapter 1.8.4.6 "TA535 - Protective Caps for XC Devices" on page 1174*.

Network Interfaces Ethernet (ETHx)

Pin Assignment

Interface	Pin	Signal	Description
 or 	1	TxD+	Transmit Data +
	2	TxD-	Transmit Data -
	3	RxD+	Receive Data +
	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive Data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

See supported protocols and used Ethernet ports for AC500 V2 products:*Ethernet Protocols and Ports*.

See communication via Modbus for AC500 V2 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V2 products: *Modbus RTU*.

See supported protocols and used Ethernet ports for AC500 V3 products:*Ethernet Protocols and Ports*.

See communication via Modbus for AC500 V3 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V3 products: *Modbus RTU*.

MAC Addresses The MAC addresses of the network interfaces of the PM595-4ETH are printed on the label in the following way:

MAC ETH1

MAC ETH2

MAC ETH3

MAC ETH4

The figure below shows the assignment of the MAC addresses to the corresponding interface.

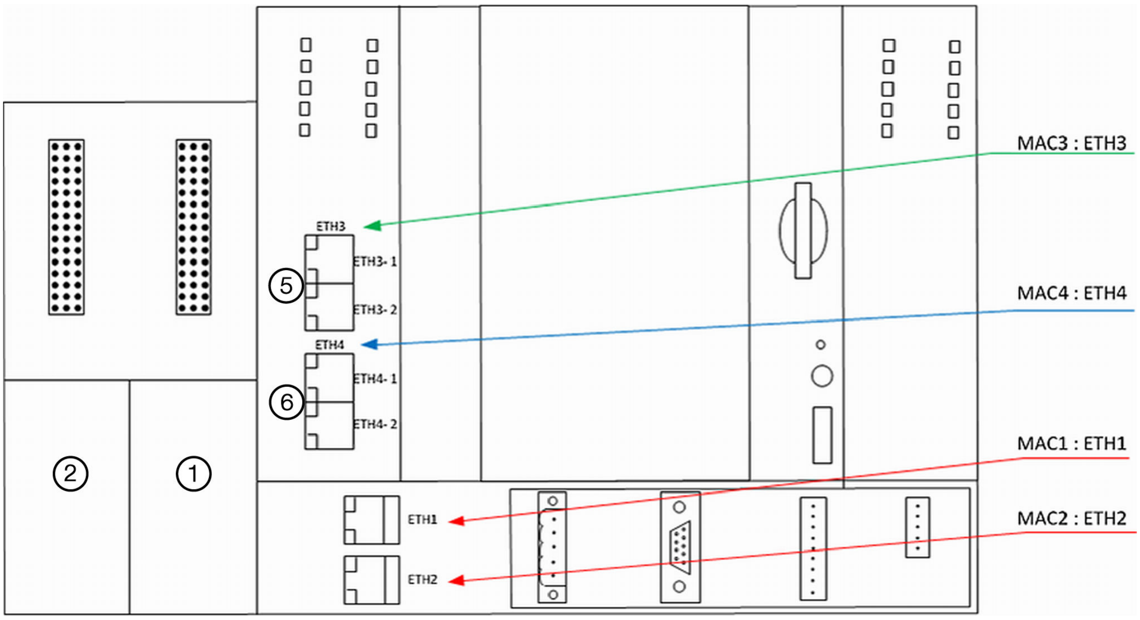


Fig. 6: Assignment of the MAC addresses to the corresponding interface

The figure above also shows the assigned SLOT-Numbers 1, 2, 5 and 6.

1.2.2.2.4 Storage Elements

Lithium Battery AC500 processor modules are supplied without a lithium battery. It must therefore be ordered separately. The TA541 lithium battery is used to save SRAM contents of processor modules (PM595-4ETH-F only) and back up the real-time clock in case of power failures. Even if the processor modules can work without a battery, its use is still recommended in order to prevent process data being lost in case of power failures (PM595-4ETH-F only).

The processor module monitors the battery's state of charge. If the processor module signals a low state of charge (via the diagnostic system and LED), the battery has to be replaced immediately.

For technical data, handling instructions and a description of the insertion/replacement of the battery, please refer to the chapter TA541 Lithium Battery *Chapter 1.8.2.5 “TA541 - Lithium Battery” on page 1155*.

> *The processor module PM595-4ETH-M-XC is maintenance-free. The lithium battery TA541 in this processor module type is used only for back-up of the real-time clock (RTC) in case of no power supply. If the RTC is not used, there is no need to install a TA541 lithium battery.*

Memory Card AC500 processor modules are supplied without memory card. It must be ordered separately.

The memory card can be used

- to read and write user files
- for firmware updates

Detailed information can be found in the *System Technology chapter*.

AC500 processor modules can be operated with and without memory cards. The processor module uses a standard file system (FAT; filenames stored in 8.3 format, on memory card). This allows standard card readers to read and write the memory cards (MC502).

Only genuine MC502 memory cards are supported.

For more information on the technical data, handling instructions and the insertion/replacement of the memory card, please refer to the chapter Memory Card *MC502*.

1.2.2.2.5 Operating Elements on the Front Panel

Status LEDs

Table 16: Meaning of the status LEDs (left part)

LED	Color	Status	Description
PWR *)	Green	On	Power supply available
		Blinking	---
		Off	Power supply not available or defective hardware
RDY *)	Yellow	On	Boot procedure
		Blinking	Boot failure
		Off	---
RUN *)	Green	On	Communication module is operational
		Blinking	---
		Off	Communication module is not operational
STA1 *)	Red	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus
	Green	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus
STA2 *)	Red	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus
	Green	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus

*) These LEDs exist twice.

LED	Color	Status	Description
PWR	Green	On	Power supply available
		Blinking	---
		Off	Power supply not available or defective hardware
RUN	Green	On	Processor module is in RUN mode
		Blinking	---
		Off	Processor module is in STOP mode
ERR	Red/green	On	An error has occurred
		Blinking	Flashing fast (4 Hz): Indicates together with RUN a firmware update process and a flash EEPROM write.
		Off	No errors are encountered or only warnings (E4 errors). This is configurable (for errors 2 - 4, the LED behaviour is configurable.
-	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
Batt	Red/green	On	TA541 lithium battery is not installed or is weak
		Blinking	---
		Off	TA541 lithium battery is installed and has sufficient capacity
1	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
2	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
3	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
4	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
5	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved

Buttons and Switches

The processor module can be operated manually using the buttons and switches at the front panel. Meaning of the buttons and switches:

Button	Description
RESET	If pressed during power-on: Enter serial download of firmware. This is signalized by blinking of the RUN LED with a frequency of 1 Hz. If pressed during normal operation: reserved for future implementation.
Fn	If pressed during power-on: Bootproject will not be loaded. This is signalized by blinking of the RUN LED with a frequency of 1 Hz. If pressed during normal operation: reserved for future implementation.
RUN/STOP	Switches the processor module from RUN to STOP mode.

The AC500 processor module can display various errors according to the error classes. The reaction of the Processor Module is different for each type of error. See System Technology *LED display*.

1.2.2.2.6 Technical Data

The System Data of AC500 and S500 ➪ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ➪ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

General Data of the Processor Modules

Parameter		Value
Connection of the supply voltage 24 VDC at the removable terminal block of the processor module		at a removable 5-pin terminal block with spring connection
	Current consumption from 24 VDC	0.4 A
	Inrush current at 24 VDC	1 A^2s ∗)
	Max. power dissipation within the module	15 W
	Slots for communication modules	2
	Processing module's interfaces	I/O bus, COM1, COM2
	Processing module's network interfaces	ETH1 and ETH2 for Ethernet-based system communication ETH3.1 and ETH3.2 for Ethernet-based fieldbuses with switch functionality ETH4.1 and ETH4.2 for Ethernet-based fieldbuses with switch functionality
Connection system		see System Assembly chapter ➪ *Chapter 2.6.4 “Connection and Wiring” on page 1276*
Weight		1070 g
Mounting position		horizontal or vertical with derating (50 % output load, reduction of temperature to 40 °C)

∗1) The melting integral of the processor module depends on the processor module's integrated power supply, and the number and type of communication modules and I/O modules connected to the I/O bus.

Detailed Data

Parameter		Value
Flash memory for boot projects, symbols and web pages		32768 kB
SDRAM for user program		16384 kB
SDRAM for user data		16384 kB
Expandable memory		None
Integrated mass storage memory		4 GB non rotating flashdisk
Pluggable memory card for:		x
	User data storage	
	Program source code storage	
	Firmware update	
Cycle time for 1 instruction		
	Binary	Min. 0.0006 µs
	Word	Min. 0.001 µs
	Floating point	Min. 0.001 µs
Max. number of central inputs and outputs (10 exp. modules):		
	Digital inputs	320
	Digital outputs	240
	Analog inputs	160
	Analog outputs	160
Number of decentralized inputs and outputs		Depends on the field bus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)
Data backup		Battery for PM595-4ETH-F, MRAM for PM595-4ETH-M-XC without battery
Data buffering time at 25 °C		About 3 years
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical
Real-time clock		
	With battery back-up	x
	Accuracy	Typ. ± 2 s / day at 25 °C
Integrated Communication Module, ETH = Ethernet RJ45		2x Ethernet, 2x Ethernet interfaces with downloadable protocol e.g. PROFINET IO, EtherCAT (in preparation)
Number of external communication modules		Up to 2 communication modules like PROFIBUS DP, Ethernet, CANopen or safety module SM560-S. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 2 PROFIBUS DP communication modules are possible)
LEDs		5 to display states, rest of LEDs reserved

Parameter	Value
LCD display	Optional
Buttons and switches	1 button for Reset (Reserved) 1 Button (Reserved) 1 Switch for RUN/STOP

1.2.2.2.7 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 155 500 R0279	PM595-4ETH-F, processor module, user progr./data memory 16 MB / 16 MB, 1.3 GHz, 24 VDC, memory card slot, interfaces 2x RS232-485, 2x independent Ethernet interfaces (progr., web server, IEC60870-5-104 protocols), 2x independent Ethernet based interfaces with 2-port switch (between fieldbus protocols PROFINET IO, EtherCAT and Ethernet)	Active
1SAP 351 500 R0279	PM595-4ETH-M-XC, processor module, user progr./data memory 16 MB / 16 MB, 1.0 GHz, 24 VDC, memory card slot, interfaces 2x RS232-485, 2x independent Ethernet interfaces (progr., web server, IEC60870-5-104 protocols), 2x independent Ethernet based interfaces with 2-port switch (between fieldbus protocols PROFINET IO, EtherCAT and Ethernet), XC version	Active

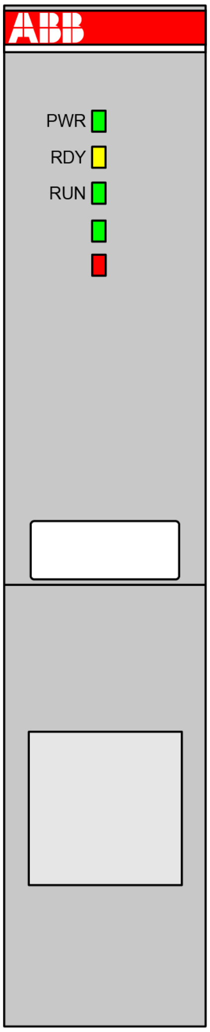
**) For planning and commissioning of new installations use modules in Active status only.*

Table 17: Accessories

Part no.	Description
1SAP 182 700 R0001	TA541, lithium battery
1SAP 180 100 R0001	MC502, memory card
1SAP 180 200 R0001	TK501, programming cable D-sub / D-sub, length: 5 m
1SAP 180 200 R0101	TK502, programming cable terminal block / D-sub, length: 5 m
1TNE 968 901 R1100	TK503, programming cable USB / D-sub (RS-485), length 3 m
1SAP 182 300 R0001	TA535, protective caps for XC devices
1SAP 182 600 R0001	TA540, front cover as spare part (3 pieces)
1SAP 182 800 R0001	TA543, screw mounting accessory (20 pieces)

1.3 Communication Modules (AC500 Standard)

1.3.1 Overview



AC500 communication modules are required for

- a connection to standard field bus systems and
- for integration into existing networks.

AC500 communication modules

- enable communication on different field buses.
- are mounted on the left side of the processor module on the same terminal base.
- are directly powered via the internal communication module bus of the terminal base. A separate voltage source is not required.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

For information on mounting, disassembling and electrical connection, please refer to System Assembly

The communication between the processor module and the communication modules takes place via the communication module bus, which is integrated in the terminal base. Depending on the used *Terminal Base*, 1, 2 or 4 communication modules can be connected.

There are no restrictions concerning which communication modules can be arranged for a processor module.

The communication modules can be used as

- bus master or
- slave

within the AC500 control system.

It depends on the

- selected protocol,
- the functionality of the communication module and
- the several field buses and networks.

The following name extensions of the device names describe the supported field bus/protocol:

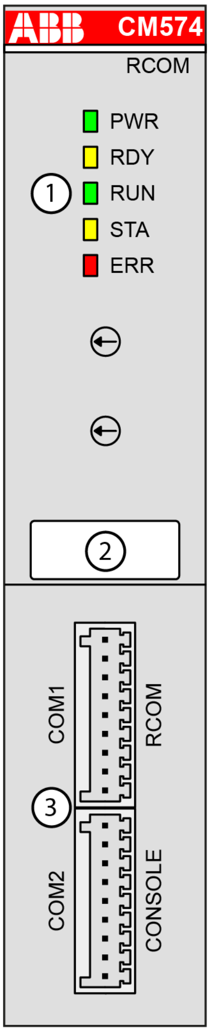
- CMxyz-ETH: Ethernet
- CMxyz-DP: PROFIBUS
- CMxyz-PNIO: PROFINET
- CMxyz-ETHCAT: EtherCAT
- CMxyz-CN: CANopen
- CMxyz-RCOM: RCOM/RCOM+ protocol (and 2 serial interfaces)
- CMxyz-RS: 2 serial interfaces (COM1/COM2)

If a XC version of the device is available, for use in extreme ambient conditions (e.g. wider temperature and humidity range), this is indicated with a snowflake sign.

1.3.1.1 Technical Data (Overview)

	CM574-RCOM	**CM574-RS**	**CM579-ETHCAT**	**CM582-DP** **CM592-DP**	**CM598-CN** **CM588-CN**	**CM589-PNIO(-4)** **CM579-PNIO**	**CM597-ETH**
Field bus	RCOM/ RCOM+	Serial (ASCII/ Modbus)	EtherCAT	PROFIBUS DP	CANopen	PROFINET	2 x Ethernet
Transmission rate	2.4 kBit/s to 19.2 kBit/s	9.6 kBit/s to 187.5 kBit/s	10 MBit/s or 100 MBit/s	9.6 kBit/s to 12 MBit/s	10 kBit/s to 1 MBit/s	100 MBit/s	10 MBit/s or 100 MBit/s
Field bus connector	MC 0.5/9-G-2.5, 9-pin, male		2 x RJ45	D-sub, 9-pin, female, bended	COMBICON 2x 5-pin, bended	2 x RJ45	
Processor	PowerPC		Hilscher netX100				
Ambient temperature	0 °C...60 °C (standard version) -30 °C ... +70 °C (XC version only)						
Communication Module interface	Dual-port memory, 8 kByte		Dual-port memory, 16 kByte				
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 80 mA		Typ. 85 mA	Typ. 65 mA		Typ. 85 mA	
Internal RAM memory	256 kByte		128 kByte				
External RAM memory	-		8 MByte				
External flash memory	-	512 kByte (firmware) + 2 x 64 kByte (user data)	4 MByte or 8 MByte	8 MByte		4 MByte or 8 MByte	8 MByte
Status display	PWR RDY RUN STA ERR		PWR RDY RUN STA1 STA2 2x LINK 2x ACT	PWR RDY RUN STA ERR	PWR RDY RUN CAN-RUN CAN-ERR	PWR RDY RUN STA1 STA2 2x LINK 2x ACT	PWR RDY RUN STA ERR 2x LINK 2x ACT
Weight	150 g		170 g	150 g		170 g	

1.3.2 CM574-RCOM for RCOM/RCOM+



1 5 LEDs for state display
2 Label
3 2 interfaces: 1x RCOM protocol interface, 1x CONSOLE

1.3.2.1 Purpose

Communication module CM574-RCOM is equipped with 2 serial interfaces (RCOM protocol communication and Console) which provide the remote protocol RCOM/RCOM+.

Depending on the electrical connection, the physical interface of the RCOM protocol interface and of the debugging terminal interface is either RS-232 or RS-485.

1.3.2.2 Electrical Connection

1.3.2.2.1 Serial Interfaces

The serial interface connectors (COM1/COM2) have the following pin assignment:

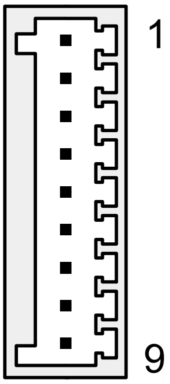
Pin		Signal	Interface	Description
	1	Term. P	RS-485	Terminator P
	2	RxD/TxD-P	RS-485	Receive/Transmit, positive
	3	RxD/TxD-N	RS-485	Receive/Transmit, negative
	4	Term. N	RS-485	Terminator N
	5	RTS	RS-232	Request to send (output)
	6	TxD	RS-232	Transmit data (output)
	7	SGND	Signal Ground	Signal Ground
	8	RxD	RS-232	Receive data (input)
	9	CTS	RS-232	Clear to send (input)

Table 18: Protocols:

No.	Protocol	Description
COM1		
1	Online access	Online access for IEC 61131-3 programming via serial driver
2	Modbus	Modbus RTU, master or slave
3	ASCII	Any protocol with FB COM_SEND, COM_REC
4	SysLibCom	Support for blocks contained in the SysLibCom.lib library
5	Multi	Switch between two protocols (Online access, Modbus, ASCII, SysLibCom) using the block COM_SET_PROT
6	CS31 bus	CS31 bus master
7	RCOM/RCOM+	ABB remote protocol RCOM or RCOM+ (only available as separate communication module CM574-RCOM)
COM2		
1	Online access	Online access for IEC 61131-3 programming with serial driver
2	Modbus	Modbus RTU, master or slave
3	ASCII	Any protocol with FB COM_SEND, COM_REC
4	SysLibCom	Support for SysLibCom.lib library blocks
5	Multi	Switch between two protocols (Online access, Modbus, ASCII, SysLibCom) using the block COM_SET_PROT

Bus Cable for RS-485

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm² (24 AWG)
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω...150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends

Bus line	
Remarks	Commonly used telephone cables with PE insulation and a core diameter of > 0.8 mm are usually sufficient.
	Cables with PVC core insulation and core diameter of 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Cable Lengths

The maximum possible cable length of a serial connection subnet within a segment depends on the baud rate (transmission rate).

COM1 - RCOM:

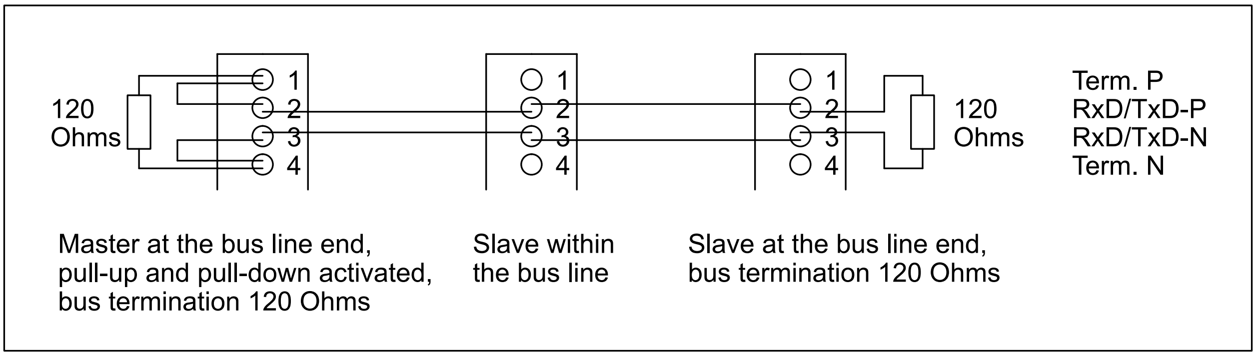
Baud rate	Maximum cable length
2.4 kBaud to 19.2 kBaud	On request

COM2 - CONSOLE:

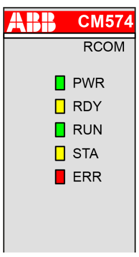
Baud rate	Maximum cable length
19.2 kBaud	On request

Bus Termination (RS-485 only)

The line ends of the bus segment must be equipped with bus termination resistors. Normally, these resistors are integrated in the interface connectors.



1.3.2.3 State LEDs

LED		**Color**	**State**	**Description**
	PWR	Green	ON	Voltage is present
			OFF	Voltage is missing
	RDY	Yellow	ON	Communication module is ready
			Flashes cyclically	Event queue blocked (slave devices only)
			OFF	Hardware defective
	RUN	Green	ON	Normal operation

LED		Color	State	Description
			Flashes cyclically	Protocol error occurred
			OFF	No communication
	STA	Yellow	Flashes	Traffic detected
	ERR	Red	ON	Error
			OFF	No error

1.3.2.4 Technical Data

The System Data of AC500 and S500 ➪ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ➪ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Interface	Serial interface
Transmission rate	2.4 kbit/s to 19.2 kbit/s
Protocol	RCOM/RCOM+
Interface connector	MC 0.5/9-G-2.5, 9-pin, male
Processor	PowerPC
Usable CPUs	PM57x, PM58x, PM59x ➪ *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64*
Usable terminal bases	All TB5xx ➪ *Chapter 1.1.1 “TB51x-TB54x” on page 4*
Ambient temperature	see: System data AC500 ➪ *Chapter 2.6.1 “System Data AC500” on page 1252* System Data AC500 XC ➪ *Chapter 2.7.1 “System Data AC500-XC” on page 1313*
Communication module bus	Dual-port memory, 8 kByte
Internal power supply	Through the communication module bus of the terminal base
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 80 mA
Internal RAM memory	256 kByte
External RAM memory	-
External flash memory	512 kByte (firmware)
State display	PWR, RDY, RUN, STA, ERR
Weight	Ca. 150 g

Table 19: Technical Data of the Interfaces

Parameter	Value
Serial interface standard	EIA RS-232 or EIA RS-485
Interface connector	Pluggable 9-pin terminal block
Potential separation	Yes, from the CPU, 500 VDC
Serial interface parameters	Protocol interface configurable via PLC configuration. Preset configuration for debugging the terminal interface.
Modes of operation	Data exchange
Protocols supported	RCOM/RCOM+

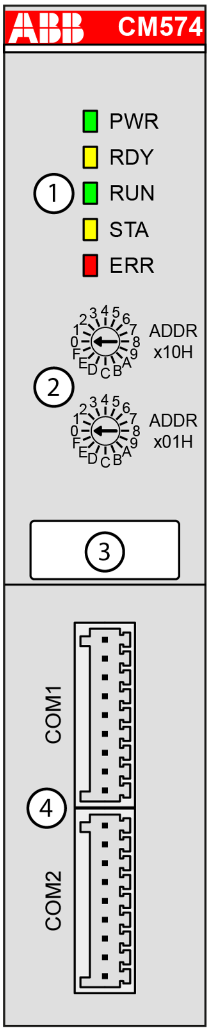
The pin assignment of the serial interfaces RCOM and OPERATOR is identical to the serial interface COM1 of the processor modules PM57x, PM58x and PM59x.

1.3.2.5 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 170 401 R0201	CM574-RCOM, communication module, 2x serial RS-232/485, RCOM/RCOM+ protocol	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.3 CM574-RS with 2 Serial Interfaces



1 5 LEDs for state display
2 2 rotary switches for address setting
3 Label
4 2 serial communication interfaces

1.3.3.1 Purpose

Communication module CM574-RS is equipped with 2 serial interfaces (COM1 and COM2) which can be used as programming interface or for communication e.g. for communication via Modbus or ASCII.

The CM574-RS can be a CS31 Master at COM1 and COM2.

Depending on the electrical connection, the physical interface of COM1 and COM2 is either RS-232 or RS-485.

1.3.3.2 Electrical Connection

1.3.3.2.1 Serial Interfaces

The serial interface connectors (COM1/COM2) have the following pin assignment:

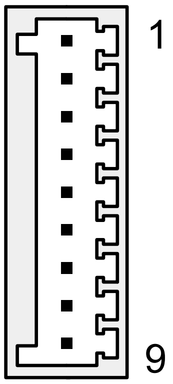
Pin		Signal	Interface	Description
	1	Term. P	RS-485	Terminator P
	2	RxD/TxD-P	RS-485	Receive/Transmit, positive
	3	RxD/TxD-N	RS-485	Receive/Transmit, negative
	4	Term. N	RS-485	Terminator N
	5	RTS	RS-232	Request to send (output)
	6	TxD	RS-232	Transmit data (output)
	7	SGND	Signal Ground	Signal Ground
	8	RxD	RS-232	Receive data (input)
	9	CTS	RS-232	Clear to send (input)

Table 20: Protocols:

No.	Protocol	Description
COM1		
1	Online access	Online access for IEC 61131-3 programming via serial driver
2	Modbus	Modbus RTU, master or slave
3	ASCII	Any protocol with FB COM_SEND, COM_REC
4	SysLibCom	Support for blocks contained in the SysLibCom.lib library
5	Multi	Switch between two protocols (Online access, Modbus, ASCII, SysLibCom) using the block COM_SET_PROT
6	CS31 bus	CS31 bus master
7	RCOM/RCOM+	ABB remote protocol RCOM or RCOM+ (only available as separate communication module CM574-RCOM)
COM2		
1	Online access	Online access for IEC 61131-3 programming with serial driver
2	Modbus	Modbus RTU, master or slave
3	ASCII	Any protocol with FB COM_SEND, COM_REC
4	SysLibCom	Support for SysLibCom.lib library blocks
5	Multi	Switch between two protocols (Online access, Modbus, ASCII, SysLibCom) using the block COM_SET_PROT

Bus Cable for RS-485

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm^2 (24 AWG)
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω...150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends

Bus line	
Remarks	Commonly used telephone cables with PE insulation and a core diameter of > 0.8 mm are usually sufficient.
	Cables with PVC core insulation and core diameter of 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Cable Lengths

The maximum possible cable length of a serial connection subnet within a segment depends on the baud rate (transmission rate).

RS-232 (for point-to-point connection):

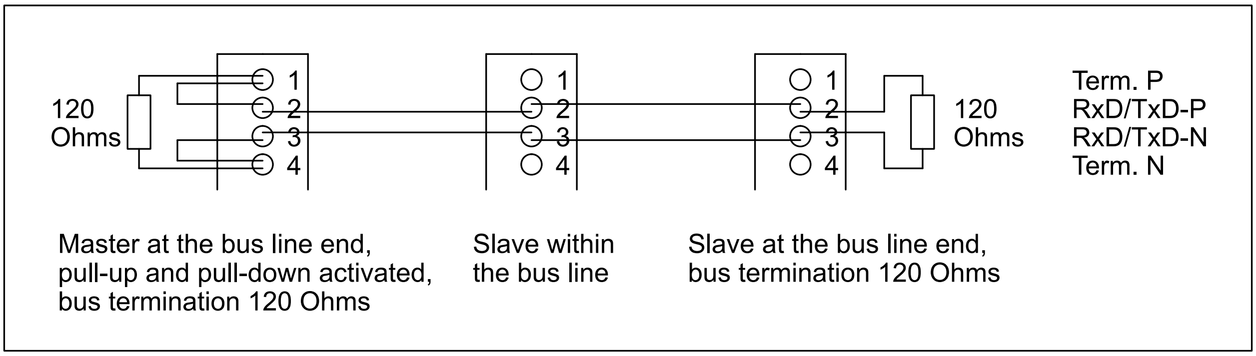
Baud rate	Maximum cable length
9.6 kBaud to 187.5 kBaud	On request

RS-485 (for point-to-point or bus connection):

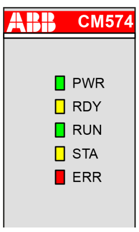
Baud rate	Maximum cable length
9.6 kBaud to 187.5 kBaud	On request

Bus Termination (RS-485 only)

The line ends of the bus segment must be equipped with bus termination resistors. Normally, these resistors are integrated in the interface connectors.



1.3.3.3 State LEDs

LED		**Color**	**State**	**Description**
	PWR	Green	ON (light)	Voltage is present
			OFF (dark)	Voltage is missing
	RDY	Yellow	Programmable	Depends on user program
	RUN	Green	Programmable	Depends on user program
	STA	Yellow	Programmable	Depends on user program
	ERR	Red	Programmable	Depends on user program

1.3.3.4 Technical Data

The System Data of AC500 and S500 ↳ *Chapter 2.6.1 "System Data AC500" on page 1252* are valid for standard version.

The System Data of AC500-XC ↳ *Chapter 2.7.1 "System Data AC500-XC" on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Protocol	Programmable with Automation Builder e.g. Modbus / ASCII via serial interfaces
Interface	Serial interface
Serial interface standard	EIA RS-232 or EIA RS-485
Potential separation	Yes, from the CPU, 500 VDC
Serial interface parameters	Configurable via software
Modes of operation	Programming or data exchange
Transmission rate	9.6 kbit/s to 187.5 kbit/s
Protocol	Programmable
Interface connector	MC 0.5/9-G-2.5, 9-pin, male
Processor	PowerPC
Usable CPUs	PM57x, PM58x, PM59x ↳ *Chapter 1.2.2.1 "PM57x (-y), PM58x (-y) and PM59x (-y)" on page 64*
Usable terminal bases	All TB5xx ↳ *Chapter 1.1.1 "TB51x-TB54x" on page 4*
Ambient temperature	see: System data AC500 ↳ *Chapter 2.6.1 "System Data AC500" on page 1252* System Data AC500 XC ↳ *Chapter 2.7.1 "System Data AC500-XC" on page 1313*
Communication module bus	Dual-port memory, 8 kByte
Internal power supply	Through the communication module bus of the terminal base
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 80 mA
Internal RAM memory	256 kByte
External RAM memory	-
External Flash memory	512 kByte (firmware) + 2 x 64 kByte (user data)
Status display	PWR, RDY, RUN, STA, ERR
Weight	Ca. 150 g

1.3.3.5 Ordering Data

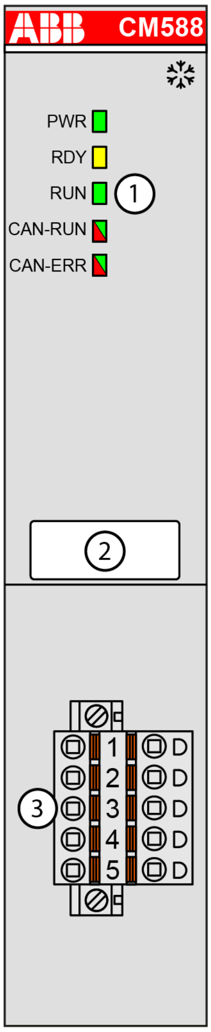
Part no.	Description	Product Life Cycle Phase *)
1SAP 170 400 R0201	CM574-RS, communication module, 2x serial RS232/485, free configurable serial interface module	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.4 CANopen

1.3.4.1 CM588-CN - CANopen Slave

- CANopen slave 1 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface, 5-pin, Combicon, male, removable plug with spring terminals
Sign for XC version

1.3.4.1.1 Purpose

Communication module CM588-CN enables communication via the CANopen field bus. CM588-CN *Chapter 1.3.4.1 “CM588-CN - CANopen Slave” on page 103* is a slave in a CANopen network. It is connected to the processor module via an internal communication bus. CM588-CN allows communicating of multiple CPUs in a CANopen network.

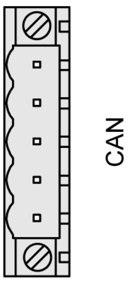
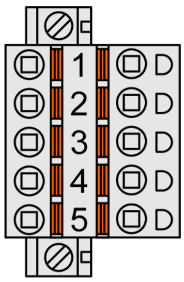
1.3.4.1.2 Electrical Connection

Field Bus Interface

Interface socket	5-pin COMBICON
Transmission standard	ISO 11898, potential-free
Transmission protocol	CANopen (CAN), 1 Mbaud max.
Transfer rate (baud rate)	10 kbit/s, 20 kbit/s, 50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s and 1 Mbit/s,

The CANopen connector has the following pin assignment:

Pin Assignment

<table>
<tr><th colspan="2">Interface</th><th>Pin</th><th>Signal</th><th>Description</th></tr>
<tr><td rowspan="5">
Terminal block removed</td><td rowspan="5">
Terminal block inserted</td><td>1</td><td>CAN_GND</td><td>CAN reference potential</td></tr>
<tr><td>2</td><td>CAN_L</td><td>Bus line, receive/transmit line, LOW</td></tr>
<tr><td>3</td><td>CAN_SHLD</td><td>Shield of the bus line</td></tr>
<tr><td>4</td><td>CAN_H</td><td>Bus line, receive/transmit line, HIGH</td></tr>
<tr><td>5</td><td>NC</td><td>Not connected</td></tr>
</table>

NOTICE!
Unused connector!
Make sure that the terminal block is always connected to the terminal base, even if you do not use the interface.

Bus Length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Types of Bus Cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	Bus cable (shielded, twisted pair)			Max. baud rate [kbit/s]
	Conductor cross section [mm²]	Line resistance [Ω/km]	Wave impedance [Ω]	
0...40	0.25...0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34...0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50...0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75...0.80 / AWG18	< 26	120	< 50 at 1000 m

Bus Terminating Resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

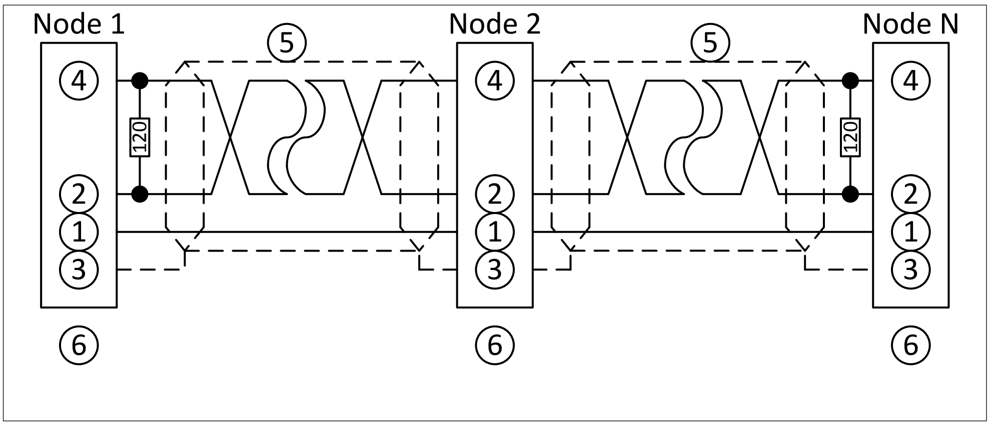


Fig. 7: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

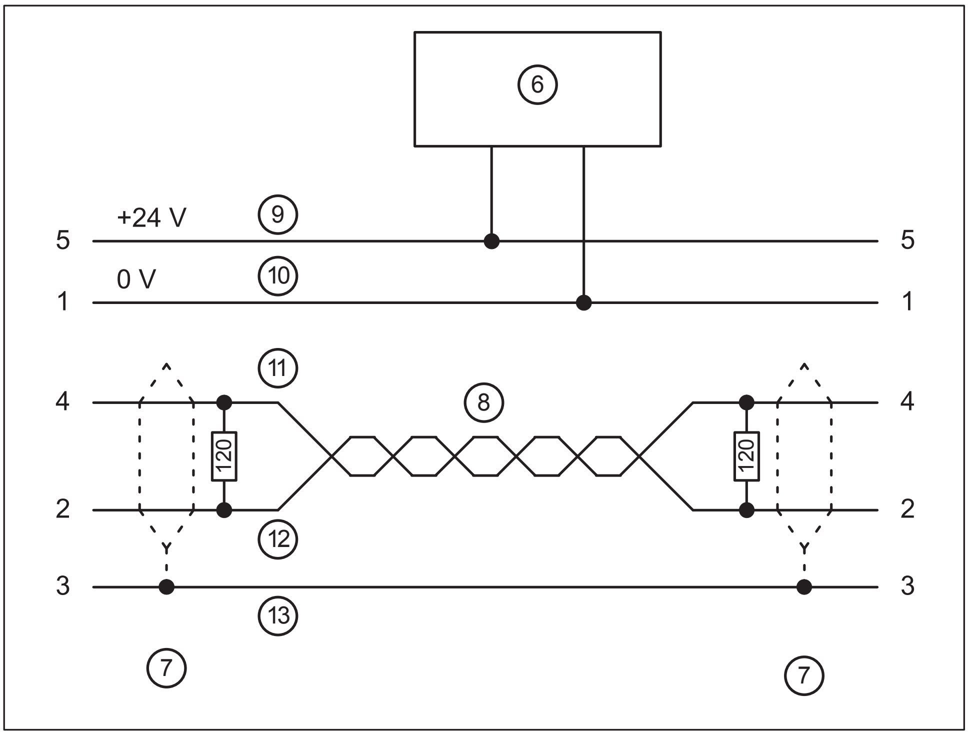


Fig. 8: DeviceNet interface, bus terminating resistors connected to the line ends

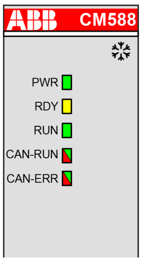
6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The earthing of the shield should take place at the switch-gear. Please refer to *↻ Chapter 2.6.1 "System Data AC500" on page 1252.*

1.3.4.1.3 State LEDs

The state of the CANopen communication module is displayed by means of 5 state LEDs.

Table 21: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
	RUN	Green	ON	Communication module is operational
			OFF	Communication module is not operational
	CAN-RUN	Green	ON	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running
			Blinking	CANopen bus in PRE-OPERATIONAL state and slave are being configured
	CAN-ERR	Red	ON	CANopen bus is off
			Blinking	Configuration error
			Single flash	Error counter overflow due to too many error frames
			Double flash	A node-guard or a heartbeat event occurred
			OFF	No error
	CAN-RUN	Yellow	Blinking	No production data available,
	CAN-ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	CAN-RUN	Green	Blinking	Firmware file transfers during communication module firmware update.
	CAN-ERR	Red	(synchronously)	
	CAN-RUN	Green	Blinking	Communication module writes the firmware file to the internal flash.
	CAN-ERR	Red	(alternately)	Do not power off the PLC!

1.3.4.1.4 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Protocol	CANopen slave
Technology	Hilscher netX100

Parameter	Value
Usable CPUs	PM57x, PM58x, PM59x ➮ *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64*
Usable terminal bases	All TB5xx ➮ *Chapter 1.1.1 “TB51x-TB54x” on page 4*
Bus connection	Pluggable connector COMBICON, 2x5-pin
Internal power supply	Via the communication module Interface of the terminal base
Transfer rate	10 kbit/s to 1 Mbit/s
Transfer method	According to CAN standard
Bus length (segment length max.)	According to table: Maximum cable length within a CANopen field bus
Indicators	5 LEDs
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 65 mA
Weight	Ca. 150 g
Ambient temperature	see: System data AC500 ➮ *Chapter 2.6.1 “System Data AC500” on page 1252* System Data AC500-XC ➮ *Chapter 2.7.1 “System Data AC500-XC” on page 1313*
Adjusting elements	None
Quantity of input and output data per I/O device	Max. 512 byte (respectively for input and output)
Supported protocol services	NMT slave PDO SDO server Heartbeat Nodeguard
Min. bus cycle	1 ms

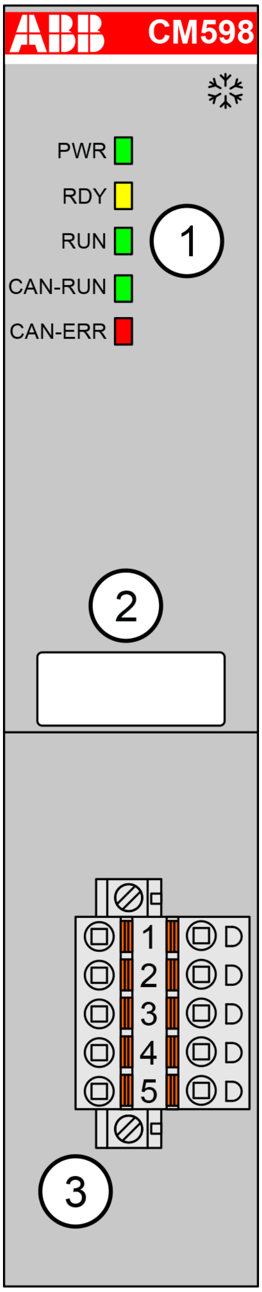
1.3.4.1.5 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 172 800 R0001	CM588-CN, communication module CANopen slave	Active
1SAP 372 800 R0001	CM588-CN-XC, communication module CANopen slave, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.4.2 CM598-CN - CANopen Master

- CANopen master 1 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface, 5-pin, Combicon, male, removable plug with spring terminals
Sign for XC version

1.3.4.2.1 Purpose

Communication Module CM598-CN enables communication over the CANopen field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

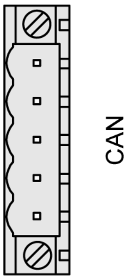
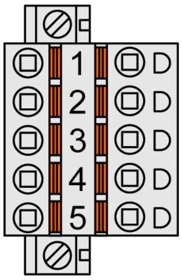
1.3.4.2.2 Electrical Connection

Field Bus Interface

Interface socket	5-pin COMBICON
Transmission standard	ISO 11898, potential-free
Transmission protocol	CANopen (CAN), 1 Mbaud max.
Transfer rate (baud rate)	10 kbit/s, 20 kbit/s, 50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s and 1 Mbit/s,

The CANopen connector has the following pin assignment:

Pin Assignment

Interface		Pin	Signal	Description
 Terminal block removed	 Terminal block inserted	1	CAN_GND	CAN reference potential
		2	CAN_L	Bus line, receive/transmit line, LOW
		3	CAN_SHLD	Shield of the bus line
		4	CAN_H	Bus line, receive/transmit line, HIGH
		5	NC	Not connected

NOTICE!
Unused connector!
Make sure that the terminal block is always connected to the terminal base, even if you do not use the interface.

Bus Length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Types of Bus Cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	Bus cable (shielded, twisted pair)			Max. baud rate [kbit/s]
	Conductor cross section [mm²]	Line resistance [Ω/km]	Wave impedance [Ω]	
0...40	0.25...0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34...0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50...0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75...0.80 / AWG18	< 26	120	< 50 at 1000 m

Bus Terminating Resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

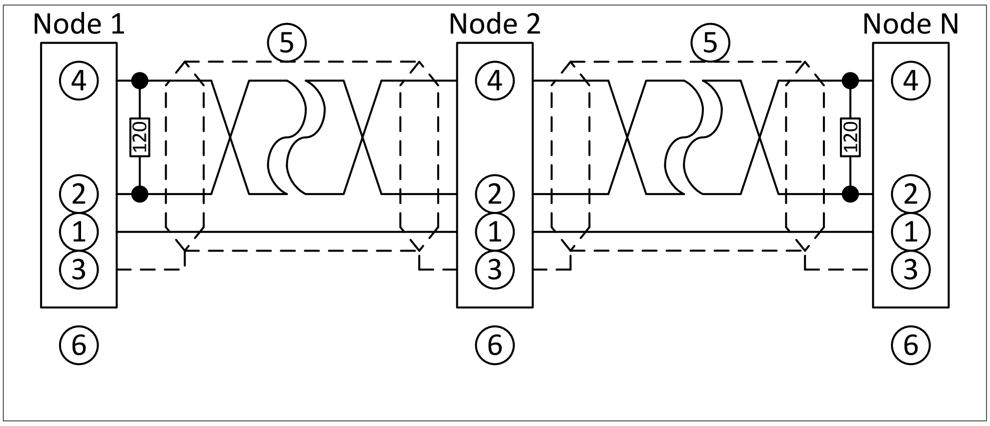


Fig. 9: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

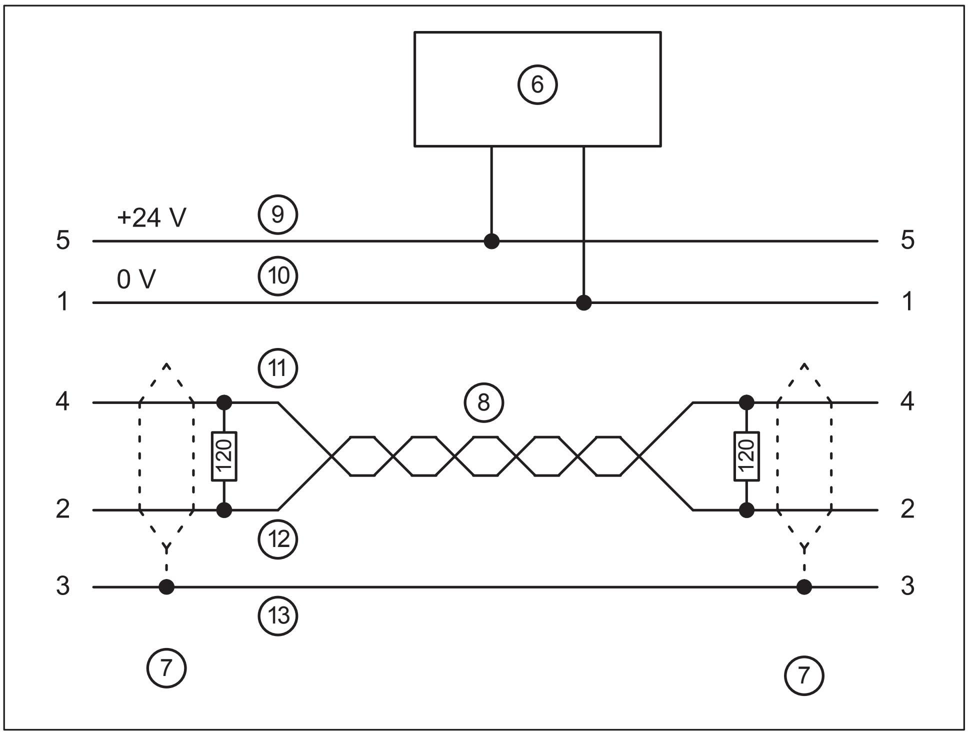


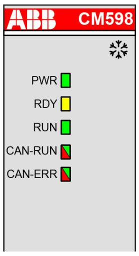
Fig. 10: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The earthing of the shield should take place at the switch-gear. Please refer to *↯ Chapter 2.6.1 “System Data AC500” on page 1252.*

1.3.4.2.3 State LEDs

Table 22: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	CAN-RUN	Green	ON	Operational: Device is in the OPERATIONAL state
			Single Flash	Stopped: Device is in STOPPED state
			Blinking	Pre-operational: Device is in the PREOPERATIONAL state
			OFF	No communication or no power supply
	CAN-ERR	Red	ON	CANopen bus is off
			Single flash	Warning limit reached: At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
			Double flash	Error control event: A guard event (NMT Slave or NMTmaster) or a heartbeat event (Heartbeat consumer) has occurred
			OFF	No Error: Device is in working condition
	CAN-RUN	Yellow	Blinking	No production data available,
	CAN-ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	CAN-RUN	Green	Blinking	Firmware file transfers during communication module firmware update.
	CAN-ERR	Red	(synchronously)	
	CAN-RUN	Green	Blinking	Communication module writes the firmware file to the internal flash.
	CAN-ERR	Red	(alternately)	Do not power off the PLC!

1.3.4.2.4 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 "System Data AC500" on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 "System Data AC500-XC" on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Protocol	CANopen Master, CAN2A, CAN2B
Transmission rate	10 kbit/s to 1 Mbit/s
Ambient temperature	see: System data AC500 *Chapter 2.6.1 “System Data AC500” on page 1252* System Data AC500 XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313*
Usable terminal bases	All TB5xx *Chapter 1.1.1 “TB51x-TB54x” on page 4*
Field bus connector	Pluggable connector COMBICON, 5-pin
Technology	Hilscher netX100
Indicators	5 LEDs
Internal power supply	Via the communication module interface of the terminal base
Current consumption from 24 VDC power supply at the Terminal Base of the CPU	Typ. 65 mA
Number of Slaves	Max. 126
Number of receive/transmit PDOs	Max. 512 (respectively for receive and transmit)
Total quantity of input and output data	Max. 3584 byte (respectively for input and output)
Weight	Ca. 150 g

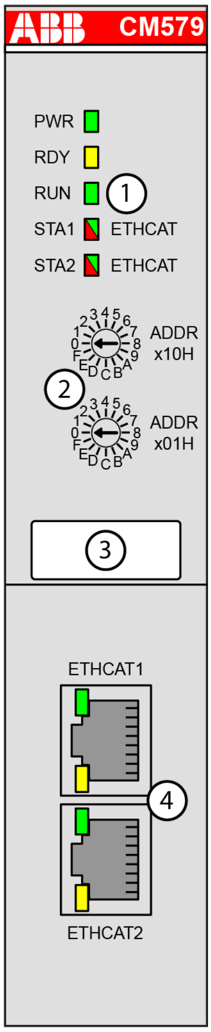
1.3.4.2.5 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 173 800 R0001	CM598-CN, communication module CANopen master	Active
1SAP 373 800 R0001	CM598-CN, communication module CANopen master, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.5 EtherCAT

1.3.5.1 CM579-ETHCAT - EtherCAT Master



1 5 LEDs for state display
2 2 rotary switches for address setting (not used)
3 Label
4 2 communication interfaces RJ45 (ETHCAT1 and ETHCAT2)

1.3.5.1.1 Intended Purpose

Communication module CM579-ETHCAT is for EtherCAT communication.

The comunication module is configured via the dual-port memory by means of a system configurator. The configuration is saved in a non-volatile way on a flash EPROM.

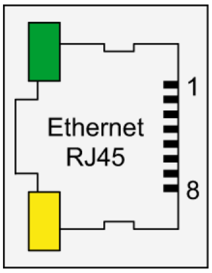
Error codes

1.3.5.1.2 Electrical Connection

Field Bus Interfaces

The EtherCAT communication module provides 2 RJ45 interfaces with the following pin assignment. The pin assignment is used for the EtherCAT slaves (communication interface modules CI5xy-ETHCAT) as well.

Table 23: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet *Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.*

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

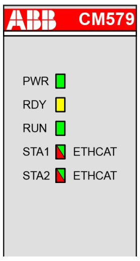
At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

1.3.5.1.3 State LEDs

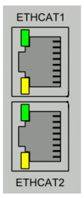
The EtherCAT state is shown by the EtherCAT communication module's LEDs. Some LEDs are two-colored.

Table 24: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Green	On	No bus error, communication running
			Blinking	Establishing communication
			Off	System error
	STA2	Red	On	Configuration error
			Blinking	---
			Off	No error
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash.
	STA2	Red	(alternately)	Do not power off the PLC!

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 25: Meaning of the diagnosis LEDs

LED		Color	State	Description
	ETHCAT1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETHCAT1 LED "RX/TX"	Yellow	On	Device sends/receives frames
			Off	No Ethernet connection
	ETHCAT2 LED "Link"	Green		Connector ETHCAT2 is not used
	ETHCAT2 LED "RX/TX"	Yellow		

1.3.5.1.4 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Internal Supply	Via the communication module interface of the terminal base
Protocol	EtherCAT
Field bus connector	2 x RJ45 (ETHCAT1 and ETHCAT2)
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m at 100 Mbit/s
Indicators	5 LEDs
Usable CPUs	PM57x, PM58x, PM59x *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64* *PM56xx*
Usable terminal bases	All TB5xx *Chapter 1.1.1 “TB51x-TB54x” on page 4* All *TB56xx* (not TB5600)
Ambient temperature	System data AC500 *Chapter 2.6.1 “System Data AC500” on page 1252* System Data AC500 XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313*
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Number of slaves	Limited to 200
Quantity of input and output data for a single slave	Max. 5760 byte (respectively for input and output)
Total quantity of input and output data	Max. 5760 byte (respectively for input and output)
Supported protocols	RTC - Real-time cyclic protocol, class 1 RTA - Real-time acyclic protocol
Acyclic services	● CoE upload ● CoE download (1500 bytes max.) ● Emergency
Min. bus cycle	1 ms

Parameter	Value
Max. size of the bus configuration file	2 MB
Weight	Ca. 170 g

1.3.5.1.5 Ordering Data

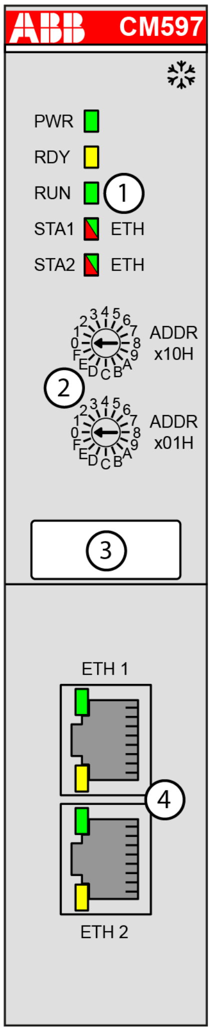
Part no.	Description	Product Life Cycle Phase *)
1SAP 170 902 R0101	CM579-ETHCAT, EtherCAT communication module	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.6 Ethernet

1.3.6.1 CM597-ETH

- TCP/IP with integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for address setting
3 Label
4 2 communication interfaces Ethernet RJ45
Sign for XC version

1.3.6.1.1 Purpose

The communication module provides communication via the Ethernet bus. Ethernet connection can be established directly to the communication module, an additional switch is not necessary.

The Ethernet communication module is an intelligent 100-base-T-Ethernet communication interface based on the highly integrated netX100 micro-controller. The complete TCP/IP protocol and the application layers are supported.

The user interface is based on a dual-port memory. The Ethernet communication runs via RJ45 interfaces.

The communication module is configured via the dual-port memory, the diagnosis interface or a TCP/IP connection by means of a system configurator.

> *It is not possible to close a RSTP ring by using the two ports of the communication module.*

Applications:

- TCP/IP for PC/ Automation Builder (programming)
- UDP (communication via the Function Blocks *ETH_UDP_SEND* and *ETH_UDP_REC*
- Modbus on TCP/IP (Modbus on TCP/IP, client and server)

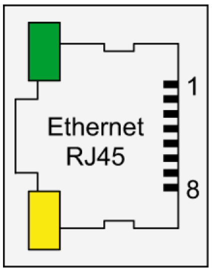
For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.3.6.1.2 Electrical Connection

Field Bus Interfaces

The Ethernet communication module has 2 RJ45 interfaces:

Table 26: Pin assignment RJ45 jack:

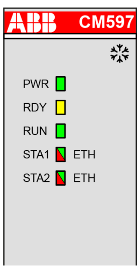
Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet *⇘ Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.*

1.3.6.1.3 State LEDs

The Ethernet state is shown by the Ethernet communication module's LEDs.

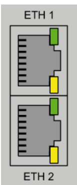
Table 27: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
	RUN	Green	On	Communication module is operational
			Off	Communication module is not operational
	STA1	Green	Blinking (1 Hz)	Device ready

LED		Color	State	Description
			Blinking (5 Hz)	Device configured / UDP traffic
			On	Modbus communication established
	STA2	Red	On	Modbus communication error
			Off	No error
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	STA2	Red	(alternately)	

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 28: Meaning of the diagnosis LEDs

LED		Color	State	Description
	ETH1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETH1 LED "RX/TX"	Yellow	On	---
			Blinking	Device sends/receives frames
			Off	---
	ETH2 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETH2 LED "RX/TX"	Yellow	On	---
			Blinking	Device sends/receives frames
			Off	---

1.3.6.1.4 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Field bus	2 x Ethernet
Transmission rate	10 Mbit/s or 100 Mbit/s
Protocol	Ethernet TCP/IP, UDP/IP, Modbus TCP, ICMP (Ping), DNS, SMTP (email)
Field bus connectors	2 x RJ45, with integrated 2-port switch

Parameter	Value
Processor	Hilscher netX100
Usable CPUs	PM57x, PM58x, PM59x ⇨ *Chapter 1.2.2.1 "PM57x (-y), PM58x (-y) and PM59x (-y)" on page 64*
Usable terminal bases	All TB5xx ⇨ *Chapter 1.1.1 "TB51x-TB54x" on page 4*
Communication module interface	Dual-port memory, 16 kByte
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 85 mA
Internal power supply	Via the communication module interface of the terminal base
External RAM memory	8 MByte
External flash memory	8 MByte
State display	PWR, RDY, RUN, STA, ERR, 2 x LINK, 2 x ACT
Ethernet	10/100 Base-TX, internal switch, 2 x RJ45 socket
LED indication	State indication via 5 LEDs
Station identification	Rotary switch, 0...255 (00...FFhex)
Transmission mode	Half or full-duplex operation, adjustable
Transmission rate	10 or 100 Mbit/s, adjustable
Auto negotiation	Optionally adjustable
MAC address	Optionally configurable
Ethernet frame types	Ethernet II (RFC 894), IEEE 802.3 receive only (RFC 1042)
Weight	Ca. 170 g

1.3.6.1.5 Ordering Data

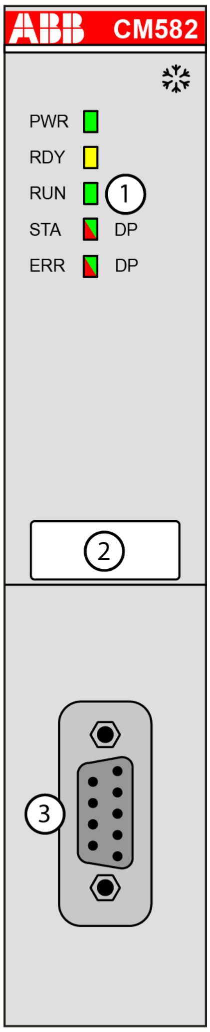
Part no.	Description	Product Life Cycle Phase *)
1SAP 173 700 R0001	CM597-ETH, communication module Ethernet TCP/IP with integrated 2-port switch	Active
1SAP 373 700 R0001	CM597-ETH-XC, communication module Ethernet TCP/IP with integrated 2-port switch, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.7 PROFIBUS

1.3.7.1 CM582-DP - PROFIBUS DP Slave

- PROFIBUS DP Slave 12 Mbit/s
- Compatible with Automation Builder version starting from V2.0.2, and with CPU firmware version starting from V2.6
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface PROFIBUS DP D-sub, 9-pin, female
Sign for XC version

1.3.7.1.1 Purpose

Communication module CM582-DP enables communication over the PROFIBUS DP field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.3.7.1.2 Electrical Connection

Field Bus Interface

The PROFIBUS DP connector (9-pin, female) has the following pin assignment:

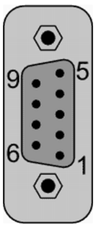
Pin		Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 VI
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

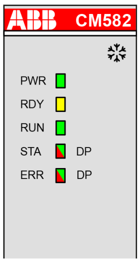
Table 29: Correlation of baudrate, bit time and cable length:

Baudrate in [kbit/s]	Bit time [tBit]	Max. cable length in [m]
9.6	104.2 µs	1200
19.2	52.1 µs	1200
31.25	32 µs	1200
45.45	22 µs	1200
93.75	10.7 µs	1200
187.5	5.3 µs	1000
500	2 µs	400
1500	666.7 ns	200
3000	333.3 ns	100
6000	166.7 ns	100
12000	83.3 ns	100

1.3.7.1.3 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 30: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available.
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	STA	Green	ON	Communication to all slaves is established
			Flashes cyclic	---
			Flashes non-cyclic	No configuration or stack error
			OFF	No communication
	ERR	Red	Blinking	No data exchange to the master module or the cable is disconnected
			OFF	No error
	STA	Yellow	Blinking	No production data available,
	ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA	Green	Blinking	Firmware file transfers during communication module firmware update.
	ERR	Red	(synchronously)	
	STA	Green	Blinking	Communication module writes the firmware file to the internal flash.
	ERR	Red	(alternately)	Do not power off the PLC!

1.3.7.1.4 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 "System Data AC500" on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 "System Data AC500-XC" on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
State indication	By 5 LEDs PWR, RDY, RUN, STA, ERR
Usable CPUs	PM57x, PM58x, PM59x *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64*
Usable terminal bases	All TB5xx *Chapter 1.1.1 “TB51x-TB54x” on page 4*
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 65 mA
Internal power supply	Through the communication module interface of the terminal base
Maximum number of cyclic input data	244 bytes
Maximum number of cyclic output data	244 bytes
Maximum number of acyclic read/write	240 bytes
Configuration data	max. 244 bytes
Parameter data	237 bytes application specific parameters
Processor	Hilscher netX100
Internal RAM memory	8 MB
External Flash memory	8 MB
Weight	Ca. 150 g

Technical Data of the Interface

Parameter	Value
Interface socket	9-pin, D-sub socket
Transmission standard	EIA RS-485 acc. to IEC 61158/61784, potential-free
Transmission protocol	PROFIBUS DP
Transmission rate	9.6 kbit/s up to 12 Mbit/s

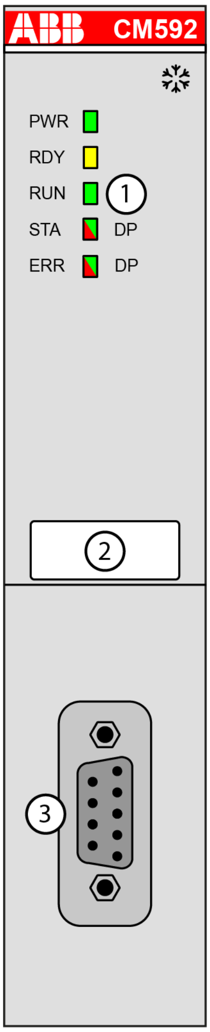
1.3.7.1.5 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 172 200 R0001	CM582-DP, communication module PROFIBUS DP slave, 12 MBit/s	Active
1SAP 372 200 R0001	CM582-DP, communication module PROFIBUS DP slave, 12 MBit/s, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.7.2 CM592-DP - PROFIBUS DP Master

- Master 12 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface PROFIBUS DP D-sub, 9-pin, female
Sign for XC version

1.3.7.2.1 Purpose

Communication module CM592-DP enables communication over the PROFIBUS DP field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.3.7.2.2 Electrical Connection

Field Bus Interface

The PROFIBUS DP connector (9-pin, female) has the following pin assignment:

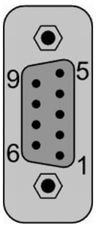
Pin		Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 VI
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

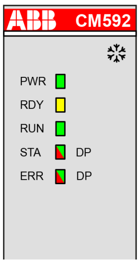
Table 31: Correlation of baudrate, bit time and cable length:

Baudrate in [kbit/s]	Bit time [tBit]	Max. cable length in [m]
9.6	104.2 µs	1200
19.2	52.1 µs	1200
31.25	32 µs	1200
45.45	22 µs	1200
93.75	10.7 µs	1200
187.5	5.3 µs	1000
500	2 µs	400
1500	666.7 ns	200
3000	333.3 ns	100
6000	166.7 ns	100
12000	83.3 ns	100

1.3.7.2.3 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 32: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	STA	Green	ON	Communication to all slaves is established
			Flashes cyclic	---
			Flashes non-cyclic	No configuration or stack error
			OFF	No communication
	ERR	Red	ON	Communication to one/all slaves is dis-connected
			Flashes cyclic	Communication to at least one slave is disconnected
			OFF	No error
	STA	Yellow	Blinking	No production data available,
	ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA	Green	Blinking	Firmware file transfers during communication module firmware update.
	ERR	Red	(synchronously)	
	STA	Green	Blinking	Communication module writes the firmware file to the internal flash.
	ERR	Red	(alternately)	Do not power off the PLC!

1.3.7.2.4 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
State indication	By 5 LEDs PWR, RDY, RUN, STA, ERR
Usable CPUs	PM57x, PM58x, PM59x *Chapter 1.2.2.1 "PM57x (-y), PM58x (-y) and PM59x (-y)" on page 64*
Usable terminal bases	All TB5xx *Chapter 1.1.1 "TB51x-TB54x" on page 4*
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 65 mA
Internal power supply	Through the communication module interface of the terminal base
Maximum number of supported slaves	125 (DPV0/DPV1)
Maximum number of total cyclic input data	5712 bytes (Status information is separately managed)
Maximum number of total cyclic output data	5760 bytes
Maximum number of cyclic intput data	244 bytes/slave
Maximum number of cyclic output data	244 bytes/slave
Configuration data	max. 244 bytes per slave
Parametrization data per slave	7 bytes/slave standard parameters 237 bytes/slave application specific parameters
Maximum number of acyclic read/write	240 bytes per slave and telegram
Processor	Hilscher netX100
Internal RAM memory	8 MB
External Flash memory	8 MB
Weight	Ca. 150 g

Technical Data of the Interface

Parameter	Value
Interface socket	9-pin, D-sub socket
Transmission standard	EIA RS-485 acc. to IEC 61158/61784, potential-free
Transmission protocol	PROFIBUS DP
Transmission rate	9.6 kbit/s up to 12 Mbit/s

1.3.7.2.5 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 173 200 R0001	CM592-DP, communication module PROFIBUS DP master, 12 MBit/s	Active
1SAP 373 200 R0001	CM592-DP, communication module PROFIBUS DP master, 12 MBit/s, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.7.3 PROFIBUS Connection Details

Attachment Plug for the Bus Cable

9-pin D-sub connector, male

Parameter	Value
Fastening torque	0.4 Nm

Assignment

Pin	Signal	Description
1	Shield	Shielding, protective earth
2	not used	-
3	RxD/TxD-P	Reception / transmission line, positive
4	CBTR-P	Control signal for repeater, positive (optional)
5	DGND	Reference potential for data lines and +5 V
6	VP	+5 V, supply voltage for bus terminating resistors
7	not used	-
8	RxD/TxD-N	Reception / transmission line, negative
9	CNTR-N	Control signal for repeater, negative (optional)

Bus Cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω...165 Ω
Cable capacity	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable Lengths

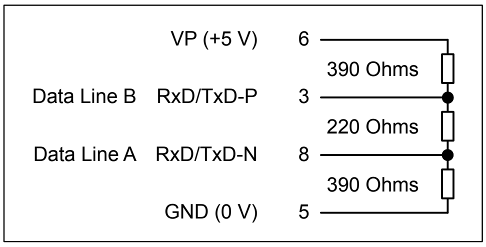
The maximum possible cable length of a PROFIBUS subnet within a segment depends on the baud rate (transmission rate).

Baud Rate	Maximum Cable Length
9.6 / 19.2 / 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

Branch lines are generally permissible for baud rates of up to 1500 kbit/s. But in fact they should be avoided for transmission rates higher than 500 kbit/s.

Bus Terminating Resistors

The line ends (of the bus segments) have to be terminated using bus terminating resistors according to the drawing below. The bus terminating resistors are usually placed inside the bus connector.



Repeaters

One bus segment can have up to 32 subscribers. Using repeaters a system can be expanded to up to 126 subscribers. Repeaters are also required for longer transfer lines. Please note that a repeater's load to the bus segment is the same as the load of a normal bus subscriber. The sum of normal bus subscribers and repeaters in one bus segment must not exceed 32.

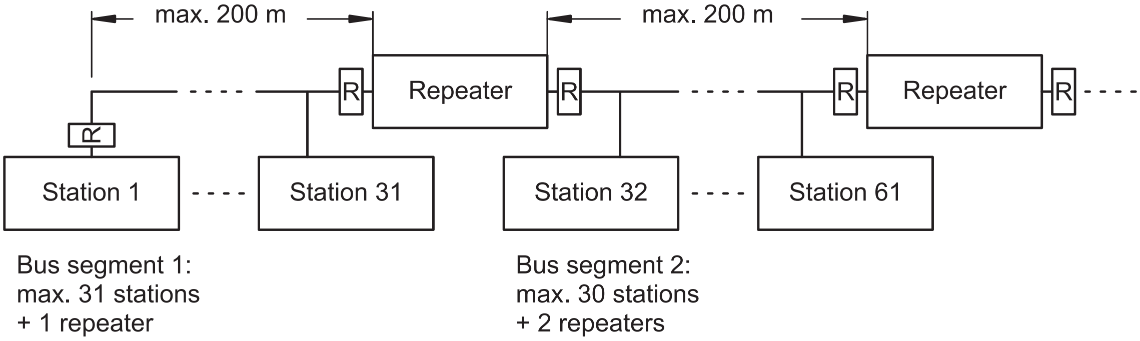
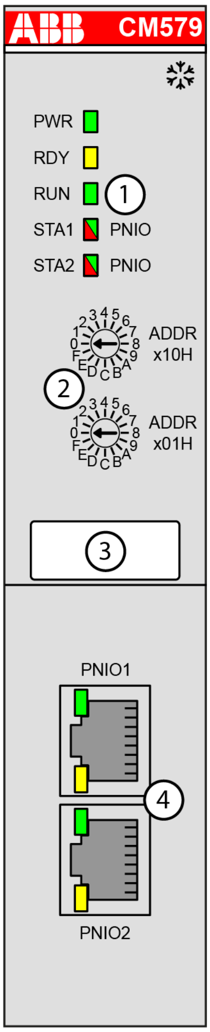


Fig. 11: Principle example for a PROFIBUS-DP system with repeaters (1500 kbit/s baud rate)

1.3.8 PROFINET

1.3.8.1 CM579-PNIO

- PROFINET I/O controller
- Integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for address setting (not used)
3 Label
4 2 communication interfaces RJ45 (PNIO1 and PNIO2)
Sign for XC version

1.3.8.1.1 Intended Purpose

The communication module is for PROFINET RT communication.

The PROFINET communication module includes an internal Ethernet switch. The connection to the Ethernet can be established directly to the communication module. An additional switch is not necessary.

The communication module is configured via the dual-port memory by means of a system configurator. The configuration is saved in a non-volatile way on a flash EPROM.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.3.8.1.2 Functionality

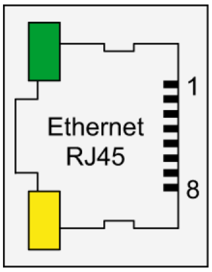
Parameter	Value
Protocol	PROFINET I/O RT
Usable CPUs	PM57x, PM58x, PM59x ➮ *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64* *PM56xx*
Usable terminal bases	All TB5xx ➮ *Chapter 1.1.1 “TB51x-TB54x” on page 4* All *TB56xx* (not TB5600)
Field bus connector	2 x RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

1.3.8.1.3 Electrical Connection

Field Bus Interfaces

The communication module provides 2 RJ45 interfaces.

Table 33: Pin assignment RJ45 jack:

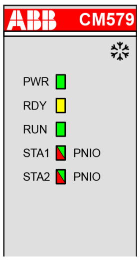
Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet ➮ Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.

1.3.8.1.4 State LEDs

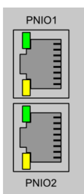
The PROFINET state is shown by the state LEDs.

Table 34: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Red	On	In incorporation with STA2 PNIO: License fault
			Blinking	System error
			Off	No system error
	STA2	Red	On	No connection; in incorporation with STA1 PNIO: license fault
			Blinking	Configuration fault: some configured IO devices are not connected
			Off	No bus error, communication is running
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash.
	STA2	Red	(alternately)	Do not power off the PLC!

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 35: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PNIO1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO1 LED "RX/TX"	Yellow	On	---
			Blinking	Device sends/receives frames
			Off	---
	PNIO2 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO2 LED "RX/TX"	Yellow	On	---

LED		Color	State	Description
			Blinking	Device sends/receives frames
			Off	---

1.3.8.1.5 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Protocol	PROFINET I/O RT
Bus connection	2 x RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Switch	Integrated
Technology	Hilscher netX100
Transfer rate	100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m
Indicators	5 LEDs
Usable terminal bases	All TB5xx *Chapter 1.1.1 “TB51x-TB54x” on page 4* All *TB56xx* (not TB5600)
Supported alarm types	Process alarm, diagnostic alarm, return of SubModule, plug alarm, pull alarm
Alarm processing	Requires handling in application program
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Weight	Ca. 170 g
Supported protocols	RTC - real-time cyclic protocol, class 1 RTA - real-time acyclic protocol DCP - discovery and configuration protocol *) CL-RPC - connectionless remote procedure call Since revision FW 2.4.8.0 additionally LLDP - link layer discovery protocol SNMP - simply network management protocol (SNMP v1)

Parameter	Value
Acyclic services	PNIO read / write (max. 1392 bytes per telegram, max. 4096 bytes per service request)
Total quantity of input and output data	CM579-PNIO < FW 2.4.8.0 1024 bytes input and output data per IO device but in total 3072 bytes input output data CM579-PNIO = FW 2.4.8.0 1024 bytes input and output data per IO device but in total 4096 bytes input output data CM579-PNIO > FW 2.4.8.0 1440 bytes input and output data per IO device but in total 4096 bytes input output data
Min. bus cycle	1 ms
Conformance class	CC A

*) CM579-PNIO does not allow setting "Station name" by using PROFINET service "DCP SET NameOfStation".

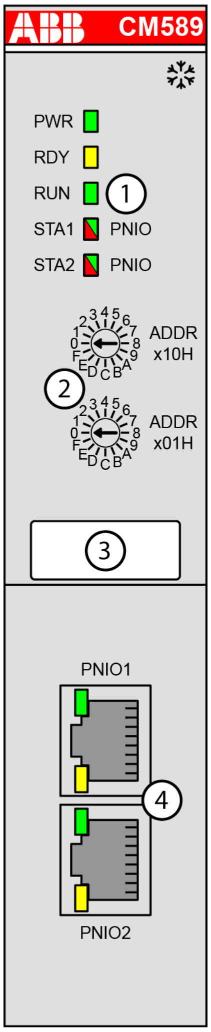
1.3.8.1.6 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 170 901 R0101	CM579-PNIO, PROFINET communication module	Active
1SAP 370 901 R0101	CM579-PNIO-XC, PROFINET communication module, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.3.8.2 CM589-PNIO(-4)

- PROFINET I/O device
- Integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for setting the I/O device identifier
3 Label
4 2 communication interfaces RJ45 (PNIO1 and PNIO2)
Sign for XC version

The communication module is for PROFINET RT communication.

The PROFINET communication module includes an internal Ethernet switch. The connection to the Ethernet can be established directly to the communication module. An additional switch is not necessary.

The communication module is configured via the dual-port memory by means of a system configurator. The configuration is saved in a non-volatile way on a flash EPROM.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

CM589-PNIO(-4)

CM589-PNIO supports one application relation to communicate to one single PROFINET I/O controller.

CM589-PNIO-4 supports 4 application relations to communicate to up to 4 PROFINET I/O controllers in parallel using PROFINET Shared Device technology.

1.3.8.2.1 Functionality

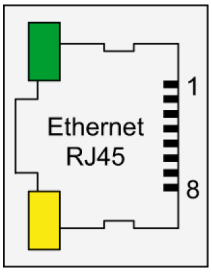
Parameter	Value
Protocol	PROFINET I/O RT
Usable CPUs	PM57x, PM58x, PM59x ➡ *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64* *PM56xx*
Usable terminal bases	All TB5xx ➡ *Chapter 1.1.1 “TB51x-TB54x” on page 4* All *TB56xx* (not TB5600)
Field bus connector	2 x RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

1.3.8.2.2 Electrical Connection

Field Bus Interfaces

The PROFINET communication module provides 2 RJ45 interfaces:

Table 36: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet ➡ Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.

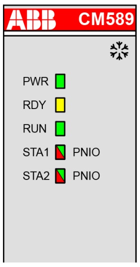
1.3.8.2.3 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

1.3.8.2.4 State LEDs

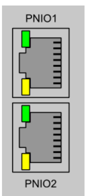
The PROFINET state is shown by the state LEDs.

Table 37: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Red	On	System error; watchdog timeout
			Blinking	
			Off	No system error
	STA2	Red	On	No connection; no configuration
			Blinking	No data exchange
			Off	No bus error, communication is running
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash.
	STA2	Red	(alternately)	Do not power off the PLC!

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 38: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PNIO1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO1 LED "RX/TX"	Yellow	On	Device sends/receives frames
			Blinking	Device sends/receives frames
			Off	---
	PNIO2 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO2 LED "RX/TX"	Yellow	On	Device sends/receives frames

LED		Color	State	Description
			Blinking	Device sends/receives frames
			Off	---

1.3.8.2.5 Technical Data

The System Data of AC500 and S500 ⇨ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ⇨ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Protocol	PROFINET I/O RT
Bus connection	2 x RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Switch	Integrated
Technology	Hilscher netX100
Transfer rate	100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m
Indicators	5 LEDs
Usable terminal bases	All TB5xx ⇨ *Chapter 1.1.1 “TB51x-TB54x” on page 4*
Supported alarm types	Process alarm, diagnostic alarm, return of SubModule, plug alarm, pull alarm
Current consumption from 24 VDC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Setting of the I/O device identifier	With 2 rotary switches at the front side of the module
Weight	Ca. 170 g
Supported protocols	RTC - real-time cyclic protocol, class 1 RTA - real-time acyclic protocol DCP - discovery and configuration protocol *) CL-RPC - connectionless remote procedure call LLDP - link layer discovery protocol SNMP - simply network management protocol MRP - MRP Client

Parameter	Value
Acyclic services	PNIO read / write CM589-PNIO < FW 1.4.0: max. 1024 bytes CM589-PNIO ≥ FW 1.4.0: max. 8096 bytes CM589-PNIO-4: max. 8096 bytes
Total quantity of input and output data	CM589-PNIO < FW 1.4.0 (respectively for input and output): max. 1024 byte CM589-PNIO ≥ FW 1.4.0 (respectively for input and output): max. 1440 byte CM589-PNIO-4 (respectively for input and output): max. 1440 byte
Min. bus cycle	1 ms
Conformance class	CC B

*) Setting NameOfStation via service "DCP SET NameOfStation" is enabled only if rotary switches are adjusted to position "00".

1.3.8.2.6 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 172 900 R0011	CM589-PNIO, PROFINET communication module	Active
1SAP 372 900 R0011	CM589-PNIO-XC, PROFINET communication module, XC version	Active
1SAP 172 900 R0111	CM589-PNIO-4, PROFINET communication module	Active
1SAP 372 900 R0111	CM589-PNIO-4-XC, PROFINET communication module, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.4 Terminal Units (AC500 Standard)

Hot swap

System requirements for hot swapping of I/O modules:

– *Hot-swappable terminal units have the appendix TU5xx**-H**.*
– *I/O modules as of index F0.*
– *Communication interface modules CI5xx as of index F0.*

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for Hot Swapping

– *Digital outputs are not under load.*
– *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
– *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

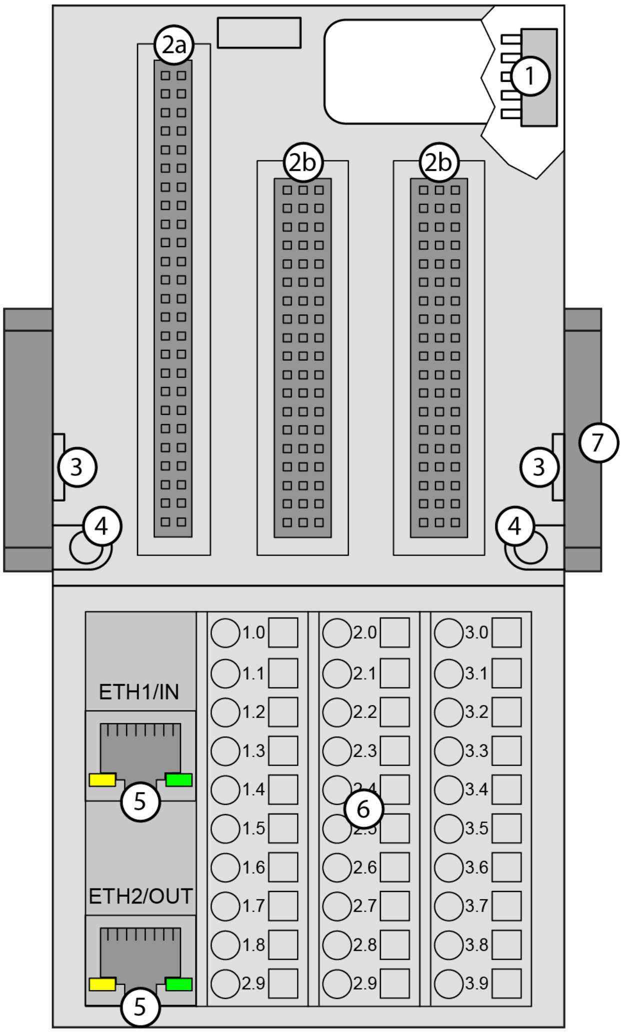
Hot Swap

Further Information about Hot Swap for V2 Products see System Technology.

Further Information about Hot Swap for V3 Products see System Technology.

1.4.1 TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules

- TU507-ETH, Ethernet terminal unit, 24 VDC, screw terminals
- TU508-ETH, Ethernet terminal unit, 24 VDC, spring terminals
- TU508-ETH-XC, Ethernet terminal unit, 24 VDC, spring terminals, XC version



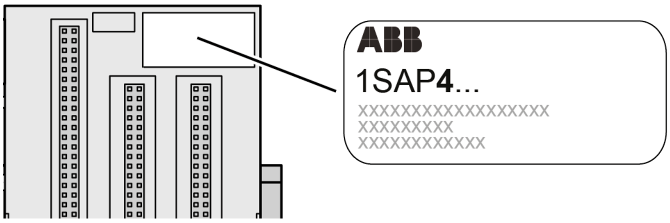
1 I/O bus (10 pins, female) to electrically connect the first terminal unit
2a Plug (2x 25 pins) to electrically connect the inserted Ethernet communication interface module
2b Plug (3x 19 pins) to electrically connect the inserted Ethernet communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 2 RJ45 interfaces with indication LEDs for connection with the Ethernet network
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

The Ethernet communication interface modules plug into the Ethernet terminal unit. When properly seated, they are secured with two mechanical locks. All the electrical connections are made through the Ethernet terminal unit, which allows removal and replacement of the Ethernet communication interface modules without disturbing the wiring at the Ethernet terminal unit.

The Ethernet terminal units TU507-ETH and TU508-ETH are specifically designed for use with AC500/S500 Ethernet communication interface modules (e. g. CI501-PNIO).

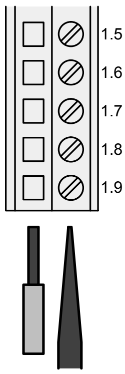
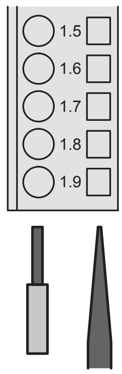
XC Version

XC = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			Spring terminals		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> *For information about wiring specifications see the description of the Terminal Units* *Chapter 2.6.4.3 "Terminals at the Terminal Unit" on page 1278.*

> *For a detailed description of the mounting, disassembly and electrical connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter* *Chapter 2.6.3 "Mounting and Demounting" on page 1265.*

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 VDC

Terminal 3.8: Process supply voltage UP3 = +24 VDC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

The assignment of the other terminals is dependent on the inserted communication interface module.

NOTICE!
Risk of corrosion!
Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices TA535 ➪ *Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

1.4.1.1 Technical Data

The System Data of AC500 and S500 ➪ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ➪ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted bus module)
Distribution of the channels into groups	3 groups of max. 8 channels each (1.0...1.7, 2.0...2.7, 3.0...3.7), the allocation of the channels is given by the inserted Ethernet bus module
Network interface connector	2 RJ45, 8-pole
Rated voltage	24 VDC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Ethernet	10/100 base-TX or 100 base-TX (depending on CI5xx module plugged in), 2x RJ45 socket
Earthing	Direct connection to the earthed DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring-type terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

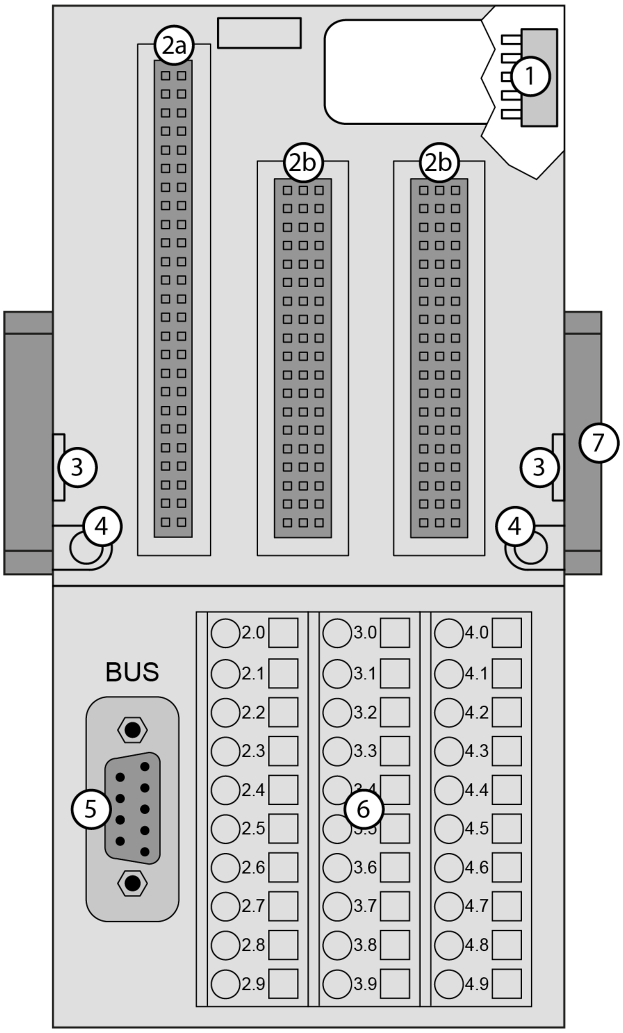
1.4.1.2 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 214 200 R0001	TU507-ETH, Ethernet terminal unit, 24 VDC, screw terminals	Active
1SAP 214 000 R0001	TU508-ETH, Ethernet terminal unit, 24 VDC, spring terminals	Active
1SAP 414 000 R0001	TU508-ETH-XC, Ethernet terminal unit, 24 VDC, spring terminals, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.4.2 TU509 and TU510 for Communication Interface Modules

- TU509, terminal unit, 24 VDC, screw terminals
- TU510, terminal unit, 24 VDC, spring terminals
- TU510-XC, terminal unit, 24 VDC, spring terminals, XC version



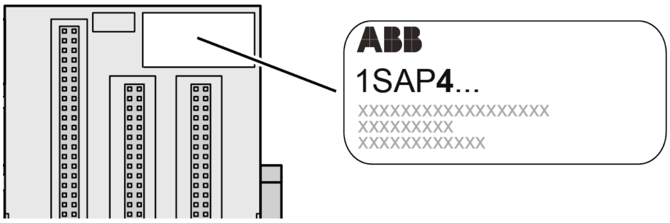
1 I/O bus (10 pins, female) to electrically connect the first terminal unit
2a Plug (2x 25 pins) to electrically connect the inserted communication interface module
2b Plug (3x 19 pins) to electrically connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 D-sub 9 (female) for connection with the PROFIBUS network
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

The communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the electrical connections are established via the terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU509 and TU510 are specifically designed for use with AC500/S500 communication interface modules (e. g. CI451-DP).

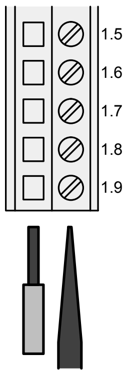
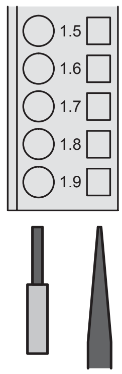
XC Version

XC = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> *For information about wiring specifications see the description of the Terminal Units Chapter 2.6.4.3 “Terminals at the Terminal Unit” on page 1278.*

> *For a detailed description of the mounting, disassembly and electrical connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter Chapter 2.6.3 “Mounting and Demounting” on page 1265.*

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 VDC

Terminal 4.8: process supply voltage UP3 = +24 VDC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see communication interface modules for CANopen and PROFIBUS).

NOTICE!
Risk of corrosion!
Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices *TA535* ⇨ *Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

1.4.2.1 Technical Data

The System Data of AC500 and S500 ⇨ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ⇨ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted bus module)
Distribution of the channels into groups	3 groups of max. 8 channels each (2.0...2.7, 3.0...3.7, 4.0...4.7), the allocation of the channels is given by the inserted bus module
Network interface connector	9-pin D-sub connector, female
Rated voltage	24 VDC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Earthing	Direct connection to the earthed DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.4.2.2 Ordering Data

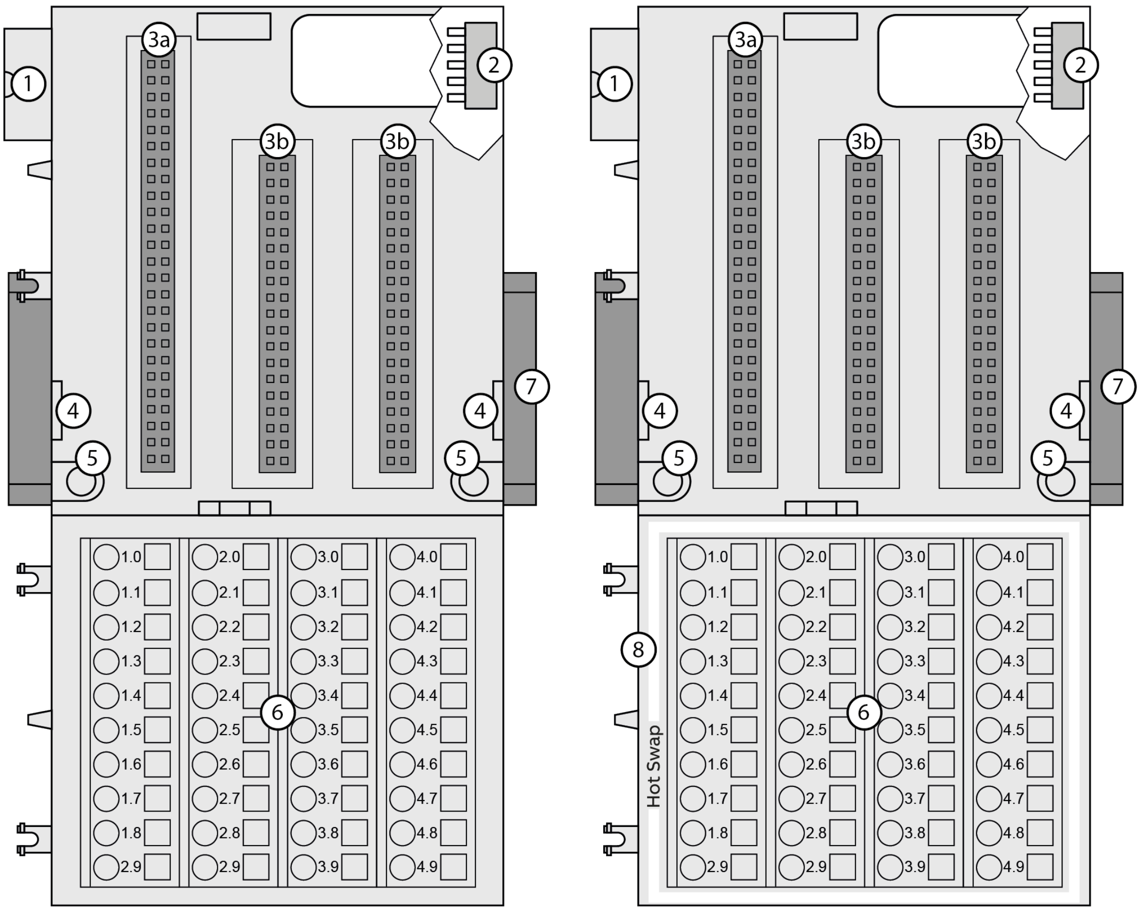
Part no.	Description	Product Life Cycle Phase *)
1SAP 211 000 R0001	TU509, terminal unit, 24 VDC, screw terminals	Active
1SAP 210 800 R0001	TU510, terminal unit, 24 VDC, spring terminals	Active
1SAP 410 800 R0001	TU510-XC, terminal unit, 24 VDC, spring terminals, XC version	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

1.4.3 TU515, TU516, TU541 and TU542 for I/O Modules

- TU515, I/O terminal unit, 24 VDC, screw terminals
- TU516, I/O terminal unit, 24 VDC, spring terminals
- TU516-XC, I/O terminal unit, 24 VDC, spring terminals, XC version
- TU516-H, I/O terminal unit, hot swap, 24 VDC, spring terminals
- TU516-H-XC, I/O terminal unit, hot swap, 24 VDC, spring terminals, XC version
- TU541, I/O terminal unit, 24 VDC, screw terminals
- TU542, I/O terminal unit, 24 VDC, spring terminals
- TU542-XC, I/O terminal unit, 24 VDC, spring terminals, XC version
- TU542-H, I/O terminal unit, hot swap, 24 VDC, spring terminals
- TU542-H-XC, I/O terminal unit, hot swap, 24 VDC, spring terminals, XC version

The input/output modules plug into the I/O terminal unit. When properly seated, they are secured with two mechanical locks. All the electrical connections are established via the terminal unit, which allows removal and replacement of the I/O modules without disturbing the wiring at the terminal unit.



1 I/O bus (10 pins, male) to electrically connect the previous terminal unit, the CPU terminal base or the communication interface module to the terminal unit
2 I/O bus (10 pins, female) to electrically connect other terminal units
3a Plug (2x 25 pins) to electrically connect the inserted I/O modules

3b Plug (2x 19 pins) to electrically connect the inserted I/O modules
4 With a screwdriver inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
5 Holes for wall mounting
6 40 terminals for signals and process supply voltage
7 DIN rail
8 White boarder signifies hot swap capability of the terminal unit

Hot Swap

H = **H**ot swap

> ***Hot swap***
>
> *System requirements for hot swapping of I/O modules:*
>
> – *Hot-swappable terminal units have the appendix TU5xx**-H**.*
> – *I/O modules as of index F0.*
> – *Communication interface modules CI5xx as of index F0.*

> *The index of the module is in the right corner of the label.*

> **NOTICE!**
> **Risk of damage to I/O modules!**
> Modules with index below F0 can be damaged when inserted or removed from the terminal unit in a powered system.

> **NOTICE!**
> **Risk of damage to I/O modules!**
> Do not perform hot swapping if any I/O module with firmware version lower than 3.0.14 is part of the I/O configuration.
>
> For min. required device index see table below.

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for Hot Swapping

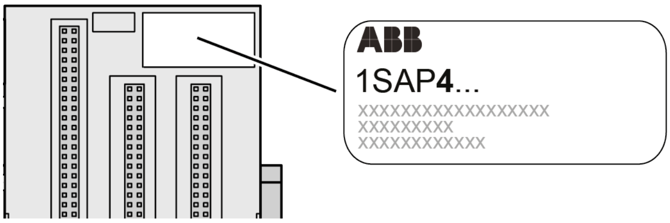
- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

Device	Min. required device index for I/O module as of FW Version 3.0.14
AI523 (-XC)	D2
AI531	D4
AI531-XC	D2
AI561	B2
AI562	B2
AI563	B3
AO523 (-XC)	D2
AO561	B2
AX521 (-XC)	D2
AX522 (-XC)	D2
AX561	B2
CD522 (-XC)	D1
DA501 (-XC)	D2
DC522 (-XC)	D2
DC523 (-XC)	D2
DC532 (-XC)	D2
DC561	B2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2
DI572	A1
DO524 (-XC)	A3
DO526	A2
DO526-XC	A0
DO561	B2
DO562	A2

Device	Min. required device index for I/O module as of FW Version 3.0.14
DO571	B3
DO572	B2
DO573	A1
DX522 (-XC)	D2
DX531	D2
DX561	B2
DX571	B3
FM562	A1

XC Version

XC = e**X**treme **C**onditions

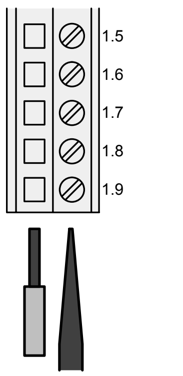
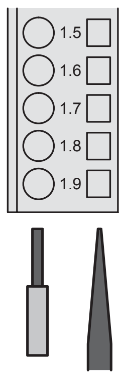


Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (lable) identifies the XC version.*

Terminals

Screw terminals			Spring terminals		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

For information about wiring specifications see the description of the Terminal Units *➪ Chapter 2.6.4.3 “Terminals at the Terminal Unit” on page 1278.*

For a detailed description of the mounting, disassembly and electrical connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter *➪ Chapter 2.6.3 “Mounting and Demounting” on page 1265.*

The following terminals are used for connection of the process supply voltage.

	Terminals							
Type	1.8	2.8	3.8	4.8	1.9	2.9	3.9	4.9
TU515, TU516 and TU516-H	These terminals are internally connected with assignment: process supply voltage UP = +24 VDC				These terminals are internally connected with assignment: process supply voltage ZP = 0 V			
TU541, TU542 and TU542-H	These terminals are internally connected with assignment: process voltage UP = +24 VDC		Separate process supply voltage UP3 = +24 VDC	Separate process supply voltage UP4 = +24 VDC	These terminals are internally connected with assignment: process supply voltage ZP = 0 V		Separate process supply voltage ZP = 0 V	Separate process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted decentralized communication interface module (see the description of the respective module used).

1.4.3.1 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Number of channels per module	Max. 32
Distribution of the channels into groups	4 groups of 8 channels each (1.0...1.7, 2.0...2.7, 3.0...3.7, 4.0...4.7), the allocation of the channels is given by the inserted I/O module
Rated voltage	24 VDC
Max. permitted total current	10 A, per separated process voltage terminal or for internal connection of process voltages
Earthing	Direct connection to the earthed DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

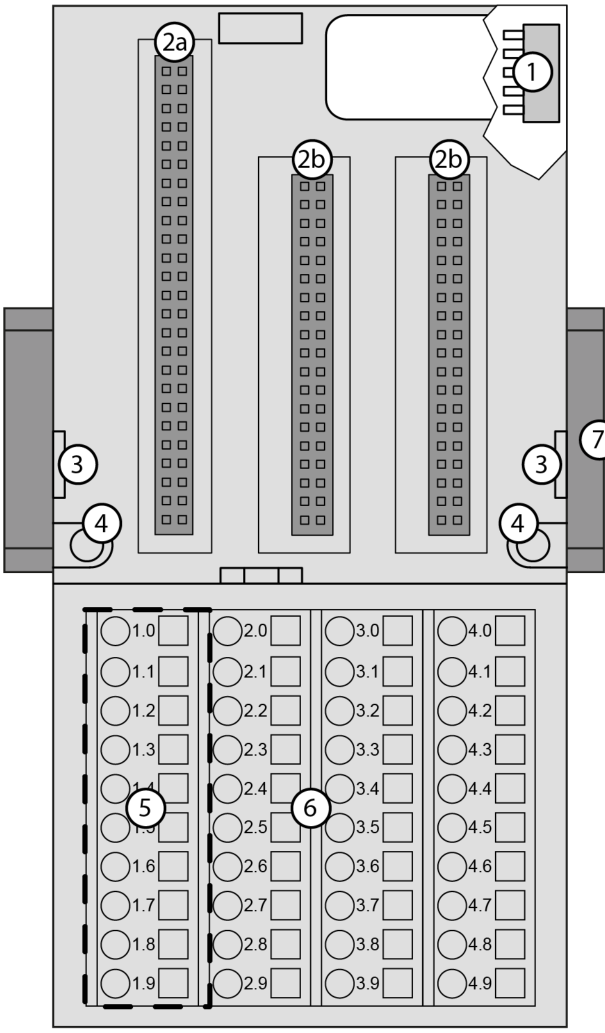
1.4.3.2 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 212 200 R0001	TU515, I/O terminal unit, 24 VDC, screw terminals	Active
1SAP 212 000 R0001	TU516, I/O terminal unit, 24 VDC, spring terminals	Active
1SAP 412 000 R0001	TU516-XC, I/O terminal unit, 24 VDC, spring terminals, XC version	Active
1SAP 215 000 R0001	TU516-H, I/O terminal unit, hot swap, 24 VDC, spring terminals, XC version	Active
1SAP 415 000 R0001	TU516-H-XC, I/O terminal unit, hot swap, 24 VDC, spring terminals	Active
1SAP 213 000 R0001	TU541, I/O terminal unit, 24 VDC, screw terminals	Active
1SAP 213 200 R0001	TU542, I/O terminal unit, 24 VDC, spring terminals	Active
1SAP 413 200 R0001	TU542-XC, I/O terminal unit, 24 VDC, spring terminals, XC version	Active
1SAP 215 200 R0001	TU542-H, I/O terminal unit, hot swap, 24 VDC, spring terminals	Active
1SAP 415 200 R0001	TU542-H-XC, I/O terminal unit, hot swap, 24 VDC, spring terminals, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.4.4 TU517 and TU518 for Communication Interface Modules

- TU517, terminal unit, 24 VDC, screw terminals
- TU518, terminal unit, 24 VDC, spring terminals
- TU518-XC, terminal unit, 24 VDC, spring terminals, XC version



1 I/O bus (10 pins, female) to electrically connect the first terminal unit
2a Plug (2x 25 pins) to electrically connect the inserted communication interface module
2b Plug (2x 19 pins) to electrically connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent I/O terminal unit can be shoved from each other
4 2 holes for wall mounting
5 10 terminals for connection with the bus system
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

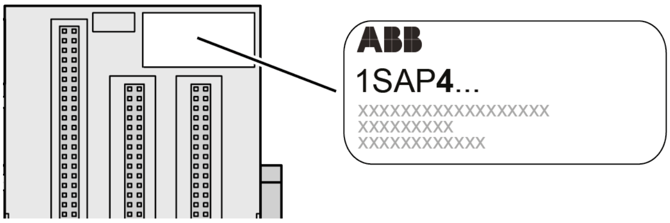
The communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the electrical connections are established via the terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU517 and TU518 are specifically designed for use with AC500/S500 communication interface modules (e. g. CI581-CN, CI541-DP):

- CANopen communication interface modules
- DeviceNet modules
- PROFIBUS DP communication interface modules

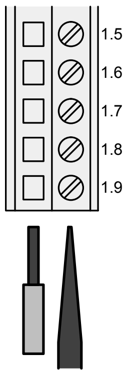
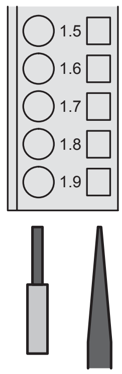
XC Version

XC = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> *For information about wiring specifications see the description of the Terminal Units ⇘ Chapter 2.6.4.3 “Terminals at the Terminal Unit” on page 1278.*

> *For a detailed description of the mounting, disassembly and electrical connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter ⇘ Chapter 2.6.3 “Mounting and Demounting” on page 1265.*

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted communication interface module:

- Terminals 2.8 and 3.8: process supply voltage UP = +24 VDC
- Terminal 4.8: process supply voltage UP3 = +24 VDC
- Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see communication interface modules for CANopen and PROFIBUS).

1.4.4.1 Technical Data

The System Data of AC500 and S500 ↳ *Chapter 2.6.1 "System Data AC500" on page 1252* are valid for standard version.

The System Data of AC500-XC ↳ *Chapter 2.7.1 "System Data AC500-XC" on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted bus module)
Distribution of the channels into groups	3 groups of max. 8 channels each (2.0...2.7, 3.0...3.7, 4.0...4.7), the allocation of the channels is given by the inserted bus module
Network interface connector	10 screw or spring terminals (1.0...1.9)
Rated voltage	24 VDC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Earthing	Direct connection to the earthed DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

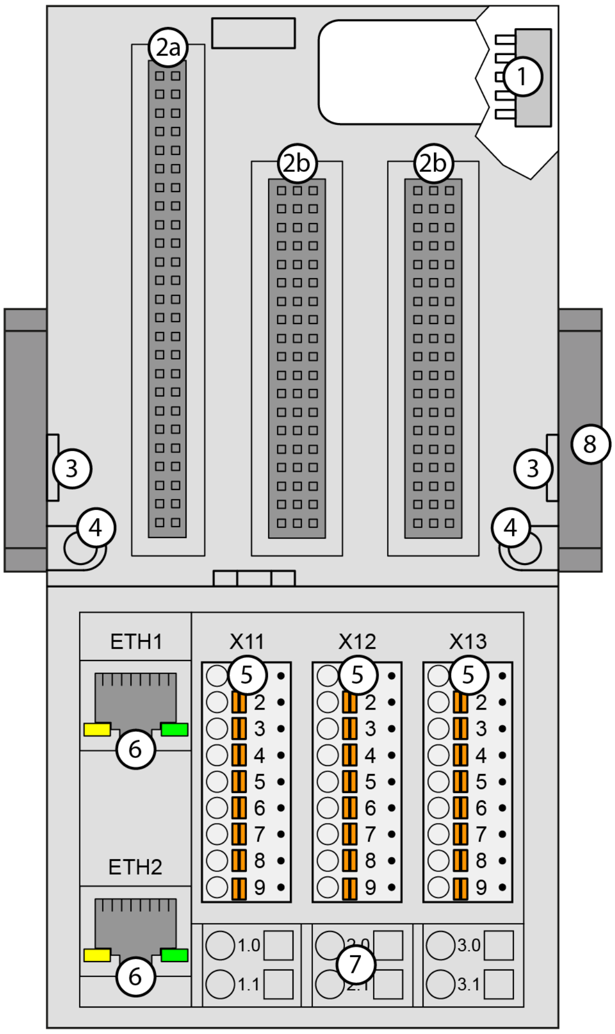
1.4.4.2 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 211 400 R0001	TU517, terminal unit, 24 VDC, screw terminals	Active
1SAP 211 200 R0001	TU518, terminal unit, 24 VDC, spring terminals	Active
1SAP 411 200 R0001	TU518-XC, terminal unit, 24 VDC, spring terminals, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.4.5 TU520-ETH for PROFINET Communication Interface Modules

- TU520-ETH, 2 RJ45 interfaces for connection to PROFIBUS network, 3 removable connectors for bus systems
- TU520-ETH-XC, 2 RJ45 interfaces for connection to PROFIBUS network, 3 removable connectors for bus systems, XC version



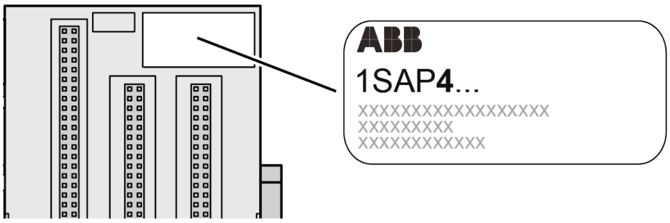
1 I/O bus (10 pins, female) to electrically connect the first terminal unit
2a Plug (2x 25 pins) to electrically connect the inserted PROFINET communication interface module
2b Plug (3x 19 pins) to electrically connect the inserted PROFINET communication interface module
3 With a screwdriver, inserted in this place, the PROFINET I/O terminal unit and the adjacent I/O terminal unit can be shoved from each other
4 2 holes for wall mounting
5 3 removable connectors to connect the subordinated bus systems
6 2 RJ45 interfaces with indication LEDs for connection with the PROFINET network
7 6 spring terminals for process supply voltage (UP)
8 DIN rail

The PROFINET communication interface modules plug into the PROFINET I/O terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the electrical connections are established via the PROFINET I/O terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the PROFINET I/O terminal unit.

The PROFINET I/O terminal unit TU520-ETH are specifically designed for use with AC500/S500 PROFINET communication interface modules (e. g. CI504-PNIO, CI506-PNIO).

XC Version

XC = e**X**treme **C**onditions



Extreme conditions

Terminal units for use in extreme ambient conditions have no sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

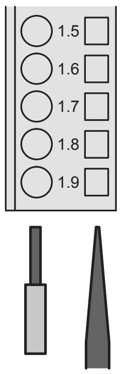
NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices *TA535 Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

Spring Terminals

Conductor		Screwdriver (opens terminal)

For information about wiring specifications see the description for the terminal unit Chapter 2.6.4.3 “Terminals at the Terminal Unit” on page 1278.

For a detailed description of the mounting, disassembly and electrical connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter Chapter 2.6.3 “Mounting and Demounting” on page 1265.

The terminals 1.0, 2.0, 3.0, 1.1, 2.1 and 3.1 are electrically interconnected within the PROFINET I/O terminal unit and always have the same assignment, irrespective of the inserted PROFINET communication interface module:

- Terminals 1.0, 2.0 and 3.0: process supply voltage UP = +24 VDC
- Terminals 1.0, 2.1 and 3.1: process supply voltage ZP = 0 V

The assignment of the bus system terminals depends on the inserted PROFINET communication interface module (see Ethernet communication interface modules overview).

1.4.5.1 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Ethernet	10/100 base-TX or 100 base-TX (depending on the plugged CI5xx module), 2x RJ45 socket
Number of bus system connectors	3 (the type of bus system depends on the PROFINET I/O bus module)
Rated voltage	24 VDC
Max. permitted total current	10 A via the supply terminals (UP and ZP)
Earthing	Direct connection to the earthed DIN rail or via the screws with wall mounting
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.4.5.2 Ordering Data

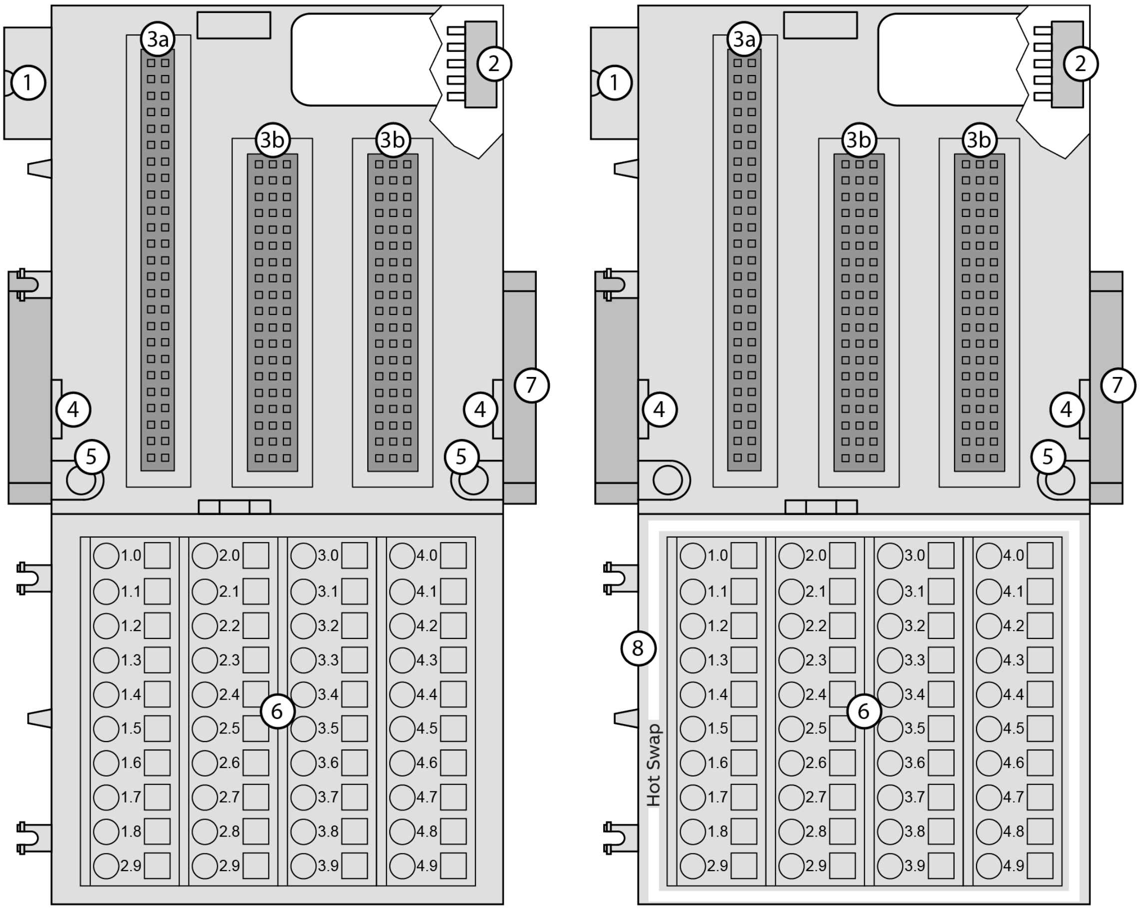
Part no.	Description	Product Life Cycle Phase *)
1SAP 214 400 R0001	TU520-ETH, PROFINET I/O terminal unit, 24 VDC, spring terminals	Active
1SAP 414 400 R0001	TU520-ETH-XC, PROFINET I/O terminal unit, 24 VDC, spring terminals, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.4.6 TU531 and TU532 for I/O Modules

- TU531, I/O terminal unit, 230 VAC, screw terminals
- TU532, I/O terminal unit, 230 VAC, spring terminals

- TU532-XC, I/O terminal unit, 230 VAC, spring terminals, XC version
- TU532-H, I/O terminal unit, hot swap, 230 VAC, spring terminals
- TU532-H-XC, I/O terminal unit, hot swap, 230 VAC, spring terminals, XC version



1 I/O bus (10 pins, male) to electrically connect the previous terminal unit, the CPU terminal base or the FBP terminal unit
2 I/O bus (10 pins, female) to electrically connect other terminal units
3a Plug (2x 25 pins) to electrically connect the inserted I/O modules
3b Plug (3x 19 pins) to electrically connect the inserted I/O modules
4 With a screwdriver inserted in this place, the terminal unit and the adjacent I/O terminal unit can be shoved from each other
5 2 holes for wall mounting
6 40 terminals for signals and process supply voltage
7 DIN rail
8 White boarder signifies hot swap capability of the terminal unit

The input/output modules (I/O modules) plug into the I/O terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the electrical connections are established via the terminal unit, which allows removal and replacement of the I/O modules without disturbing the wiring at the terminal unit.

The terminal units TU531 and TU532 are specifically designed for use with AC500/S500 I/O modules that incorporate 115-230 VAC inputs and/or 230 VAC relay outputs.

Hot Swap **H** = **H**ot swap

Hot swap

System requirements for hot swapping of I/O modules:

- *Hot-swappable terminal units have the appendix TU5xx-**H**.*
- *I/O modules as of index F0.*
- *Communication interface modules CI5xx as of index F0.*

The index of the module is in the right corner of the label.

NOTICE!
Risk of damage to I/O modules!
Modules with index below F0 can be damaged when inserted or removed from the terminal unit in a powered system.

NOTICE!
Risk of damage to I/O modules!
Do not perform hot swapping if any I/O module with firmware version lower than 3.0.14 is part of the I/O configuration.

For min. required device index see table below.

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

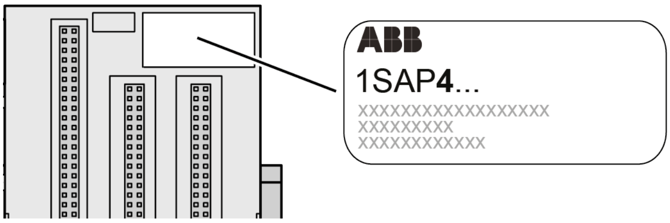
Conditions for Hot Swapping

- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

Device	Min. required device index for I/O module as of FW Version 3.0.14
AI523 (-XC)	D2
AI531	D4
AI531-XC	D2
AI561	B2
AI562	B2
AI563	B3
AO523 (-XC)	D2
AO561	B2
AX521 (-XC)	D2
AX522 (-XC)	D2
AX561	B2
CD522 (-XC)	D1
DA501 (-XC)	D2
DC522 (-XC)	D2
DC523 (-XC)	D2
DC532 (-XC)	D2
DC561	B2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2
DI572	A1
DO524 (-XC)	A3
DO526	A2
DO526-XC	A0
DO561	B2
DO562	A2
DO571	B3
DO572	B2
DO573	A1
DX522 (-XC)	D2
DX531	D2
DX561	B2
DX571	B3
FM562	A1

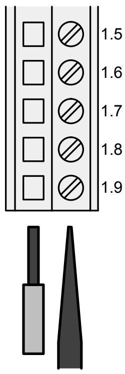
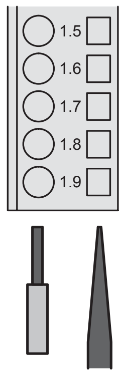
XC Version

XC = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			Spring terminals		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> *For information about wiring specifications see the description of the Terminal Units ➡ Chapter 2.6.4.3 “Terminals at the Terminal Unit” on page 1278.*

> *For a detailed description of the mounting, disassembly and electrical connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter ➡ Chapter 2.6.3 “Mounting and Demounting” on page 1265.*

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the terminal unit and always have the same assignment, independent of the inserted module:

- Terminals 1.8 to 4.8: process supply voltage UP = +24 VDC
- Terminals 1.9 to 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted decentralized communication interface module (see the description of the respective module used).

The supply voltage of 24 VDC for the module's circuitry comes from the I/O expansion bus (I/O bus).

1.4.6.1 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Number of channels per module		32
Distribution of the channels into groups		4 groups of 8 channels each (1.0...1.7, 2.0...2.7, 3.0...3.7, 4.0...4.7), the allocation of the channels is given by the inserted I/O module
Terminals 1.8...4.8 and 1.9...4.9		
	Max. voltage	30 VDC
	Max. permitted total current	10 A
Terminals 1.0...1.7, 2.0...2.7, 3.0...3.7, 4.0...4.7		
	Max. voltage	300 VAC [1])
	Max. permitted current	3 A [2])
Earthing		Direct connection to the earthed DIN rail or via the screws with wall mounting
Screw terminals		Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals		Front terminal, conductor connection vertically with respect to the printed circuit board
Weight		200 g
Mounting position		Horizontal or vertical

[1]) Only when the voltage is not limited by the specification of the I/O channel or the supply input which is internally connected to the terminal.

[2]) The terminals are connected to the electronic module via internal connectors (X22 (or 3b), X23 (or 3b), X32, X33 and X34). The current per terminal is limited by the permitted current of these connectors.

1.4.6.2 Ordering Data

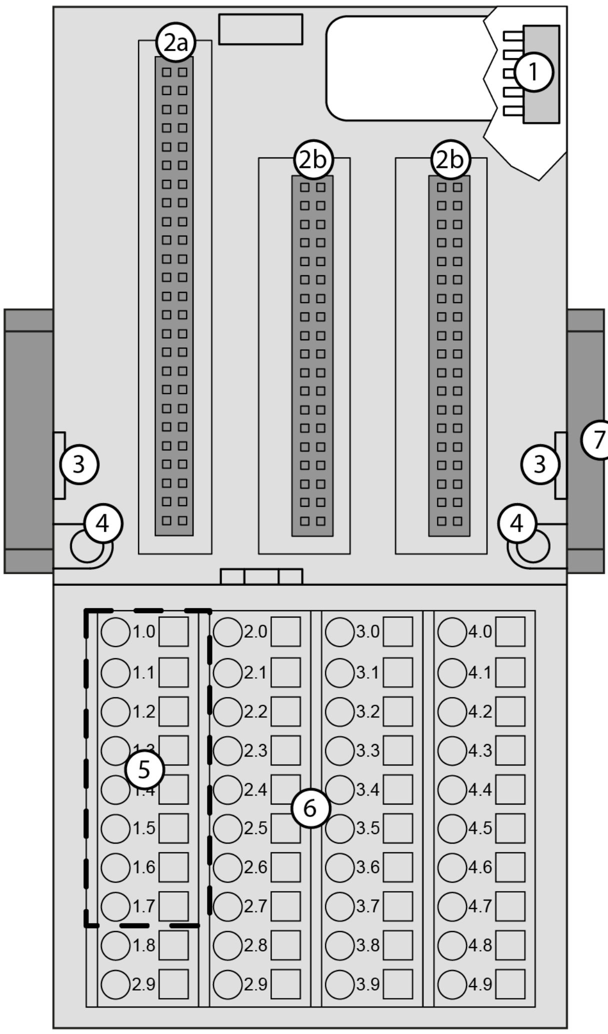
Part no.	Description	Product Life Cycle Phase *)
1SAP 217 200 R0001	TU531, terminal unit, 230 VAC, relays, screw terminals	Active
1SAP 217 000 R0001	TU532, terminal unit, 230 VAC, relays, spring terminals	Active
1SAP 417 000 R0001	TU532-XC, terminal unit, 230 VAC, relays, spring terminals, XC version	Active

Part no.	Description	Product Life Cycle Phase *)
1SAP 215 100 R0001	TU532-H, terminal unit, hot swap, 230 VAC, relays, spring terminals	Active
1SAP 415 100 R0001	TU532-H-XC, terminal unit, hot swap, 230 VAC, relays, spring terminals, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.4.7 TU551-CS31 and TU552-CS31 for CS31 Communication Interface Modules

- TU551-CS31, CS31 bus terminal unit, 24 VDC, screw terminals
- TU552-CS31, CS31 bus terminal unit, 24 VDC, spring terminals
- TU552-CS31-XC, CS31 bus terminal unit, 24 VDC, spring terminals, XC version



1 I/O bus (10 pins, female) to electrically connect other terminal units
2a Plug (2x 25 pins) to electrically connect the inserted I/O modules
2b Plug (2x 19 pins) to electrically connect the inserted I/O modules
3 With a screwdriver inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other

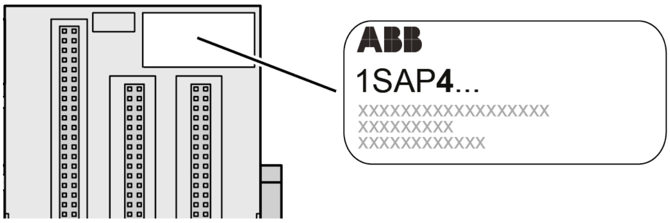
4 2 holes for wall mounting
5 CS31 bus interface
6 30 terminals for signals and process supply voltage
7 DIN rail

The CS31 communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the electrical connections are established via the terminal unit, which allows removal and replacement of the CS31 communication interface modules without disturbing the wiring at the terminal unit.

The Terminal Units TU551-CS31 and TU552-CS31 are specifically designed for use with S500 CS31 communication interface modules that incorporate only 24 VDC inputs/outputs or interface signals.

XC Version

XC = e**X**treme **C**onditions

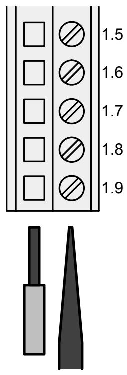
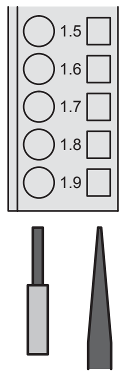


Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

For information about wiring specifications see the description of the Terminal Units *Chapter 2.6.4.3 “Terminals at the Terminal Unit” on page 1278.*

For a detailed description of the mounting, disassembly and electrical connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter *Chapter 2.6.3 “Mounting and Demounting” on page 1265.*

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 to 4.8: process voltage UP = +24 VDC
- Terminals 1.9 to 4.9: process voltage ZP = 0 V

The assignment of the other terminals depends on the inserted CS31 bus module.

The supply voltage of 24 VDC for the module's circuitry comes from ZP and UP.

1.4.7.1 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Number of channels per module	24
Distribution of the channels into groups	3 groups of 8 channels each (2.0...2.7, 3.0...3.7, 4.0...4.7), the allocation of the channels is given by the inserted CS31 bus module
CS31 field bus connector	Terminals 1.0 to 1.7
Rated voltage	24 VDC
Max. permitted total current	10 A (between the terminals 1.8...4.8 and 1.9...4.9)
Earthing	Direct connection to the earthed DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.4.7.2 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 210 600 R0001	TU551-CS31, CS31 bus terminal unit, 24 VDC, screw terminals	Active
1SAP 210 400 R0001	TU552-CS31, CS31 bus terminal unit, 24 VDC, spring terminals	Active
1SAP 410 400 R0001	TU552-CS31-XC, CS31 bus terminal unit, 24 VDC, spring terminals, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5 I/O Modules

Hot swap

System requirements for hot swapping of I/O modules:

– *Hot-swappable terminal units have the appendix TU5xx**-H**.*
– *I/O modules as of index F0.*
– *Communication interface modules CI5xx as of index F0.*

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for Hot Swapping

– *Digital outputs are not under load.*
– *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
– *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

Hot Swap

Further Information about Hot Swap for V2 Products see System Technology.

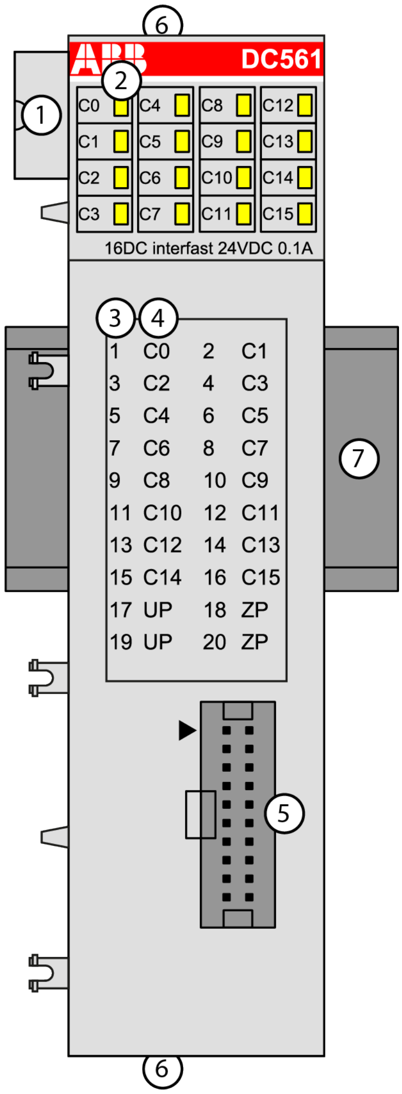
Further Information about Hot Swap for V3 Products see System Technology.

1.5.1 Digital I/O Modules

1.5.1.1 S500-eCo

1.5.1.1.1 DC561 - Digital Input/Output Module

- 16 configurable digital inputs/outputs 24 VDC,
- Connection via Interfast
- Module-wise electrically isolated



1 I/O bus
2 16 yellow LEDs to display the states of the inputs/outputs C0 to C15
3 Terminal number
4 Allocation of signal name
5 Interfast connector (20-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended Purpose

The digital input/output module DC561 can be connected to the following devices via the I/O bus connector:

- S500 bus modules (e. g. CI501-PNIO, CI541-DP, CI581-CN)
- AC500 CPUs (PM5xx)
- other AC500 I/O modules

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

The module contains 16 digital channels in 1 group, each channel can be used as a digital 24 VDC input or 24 VDC output.

The inputs/outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs/outputs.

Functionality

Parameter	Value
Digital inputs	Max. 16 (24 VDC), can be used as sink inputs
Digital outputs	Max. 16 (transistor outputs 24 VDC, max. 0.1 A)
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *↬ Chapter 2.5 "AC500-eCo" on page 1194.*

The electrical connection is established out by using the 20-pin Interfast connector. For further information, refer to the Interfast documentation.

The assignment of the terminals:

Terminal	Signal	Description
1	C0	Input/output signal C0
2	C1	Input/output signal C1
3	C2	Input/output signal C2
4	C3	Input/output signal C3
5	C4	Input/output signal C4
6	C5	Input/output signal C5
7	C6	Input/output signal C6
8	C7	Input/output signal C7
9	C8	Input/output signal C8
10	C9	Input/output signal C9
11	C10	Input/output signal C10
12	C11	Input/output signal C11
13	C12	Input/output signal C12
14	C13	Input/output signal C13
15	C14	Input/output signal C14
16	C15	Input/output signal C15
17	UP	Process voltage UP +24 VDC
18	ZP	Process voltage ZP 0 VDC

Terminal	Signal	Description
19	UP	Process voltage UP +24 VDC
20	ZP	Process voltage ZP 0 VDC

The arrow located next to the Interfast connector marks terminal 1.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DC561.

The external power supply connection is carried out via the UP (+24 VDC) and ZP (0 VDC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Process supply voltage must be connected to UP/ZP of the module. The inputs and UP/ZP must use the same power supply.

If DC561 with index A0 is used, the process supply voltage must stem from the same source as the power supply voltage of the CPU. The index consists of 1 letter, followed by 1 digit, and can be found on the type plate of the module next to the type designator "DC561".

The module provides several diagnosis functions ↪ *Chapter 1.5.1.1.1.6 “Diagnosis” on page 177*.

The meaning of the LEDs is described in the section State LEDs ↪ *Chapter 1.5.1.1.1.7 “State LEDs” on page 177*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configu-ration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6100 [1])	WORD	6100 0x17D4	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

Remarks:

[1])	With CS31 and addresses smaller than 70, the value is increased by 1
[2])	The module has no additional user-configurable parameters
[3])	Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0x25, 0x17, 0x00;

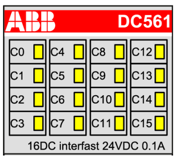
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error DI571							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs/outputs C0...C15	Digital input or digital output	Yellow	Input/output is OFF	Input/output is ON (the LEDs are only operating if the module's circuitry is supplied via the I/O bus)

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process voltage UP		
	Connections	Terminals 17 and 19 for UP (+24 VDC); terminals 18 and 20 for ZP (0 V)
	Rated value	24 VDC
	Current consumption via UP terminal	10 mA + 0.1 A per output (max.)
	Max. ripple	5 %
	Inrush current	0.000001 A^2s
	Protection against reversed voltage	Yes
	Protection fuse on UP	Recommended; the outputs must be protected by an 1 A fast fuse
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 10 mA
Galvanic isolation		Yes, between the input/output group and the rest of the module
Isolated groups		1 group for 16 channels
Surge voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		On request
Input data length		2 bytes
Output data length		2 bytes
Weight		Ca. 115 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Inputs/Outputs if Used as Inputs

Parameter	Value
Number of channels per module	16 configurable inputs (24 VDC)
Distribution of the channels into groups	1 (16 channels per group)
Connections of the channels C0 to C15	Terminals 1 to 16
Reference potential for the channels C0 to C15	Terminals 18 and 20 (negative pole of the process voltage, name ZP)

Parameter		Value
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered via the I/O bus.
Input type according to EN 61131-2		Type 1 sink
Input signal range		+24 VDC
	Signal 0	-3 V...+5 V
	Undefined signal	+5 V...+15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		-3 V...+5 V
Ripple with signal 1		+15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	> 2.5 mA
	Input voltage +30 V	< 8 mA
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Input delay (0->1 or 1->0)		Typ. 8 ms
Max. cable length		
	Shielded	500 m
	Unshielded	300 m

Technical Data of the Digital Inputs/Outputs if Used as Outputs

Parameter		Value
Number of channels per module		16 configurable transistor outputs
Distribution of the channels into groups		1 (16 channels per group)
Connections of the channels C0 to C15		Terminals 1 to 16
Reference potential for the channels C0 to C15		Terminals 18 and 20 (negative pole of the process voltage, signal name ZP)
Common power supply voltage		Terminals 17 and 19 (positive pole of the process voltage, signal name UP)
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered via the I/O bus.
Way of operation		Non-latching type
Output voltage at signal 1		UP -0.3 V at max. current
Output delay (max. at rated load)		
	0 to 1	50 μs
	1 to 0	200 μs
Output current		
	Rated current per channel (max.)	0.1 A at UP 24 VDC
	Rated current per group (max.)	1.6 A

Parameter		Value
	Rated current (all channels together, max.)	1.6 A
	Lamp load (max.)	Not applicable
	Max. leakage current with signal 0	< 0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		1 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to load specification
Switching frequency		
	With inductive loads	Max. 0.5 Hz
Short-circuit-proof / overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 VDC signals	Yes
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

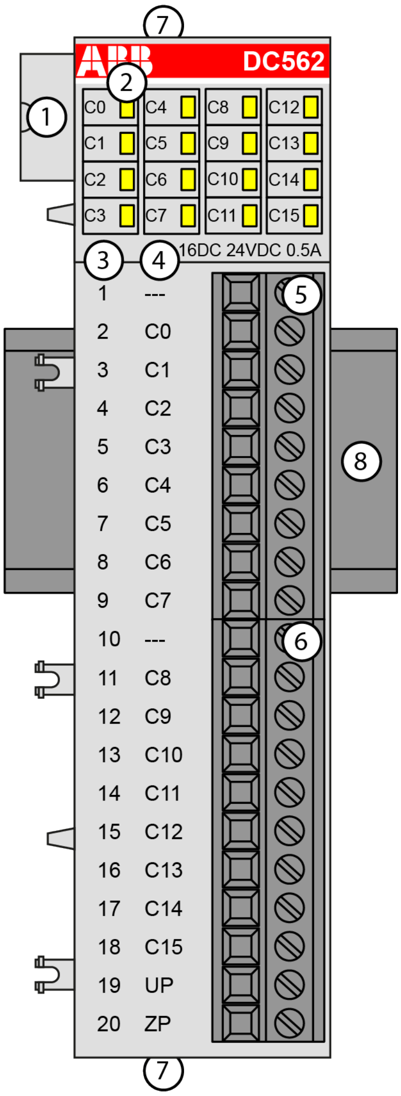
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2001	DC561, digital input/output module, 16 configurable inputs/outputs, transistor output, interfast connector	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.2 DC562 - Digital Input/Output Module

- 16 configurable digital inputs/outputs in 1 group, 24 VDC
- Module-wise electrically isolated



1 I/O bus
2 16 yellow LEDs to display the states of the inputs/outputs C0 to C15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input and output signals (9-pin)
6 Terminal block for input and output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs/outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs/outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *➪ Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system *➪ Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166* (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital inputs and outputs:

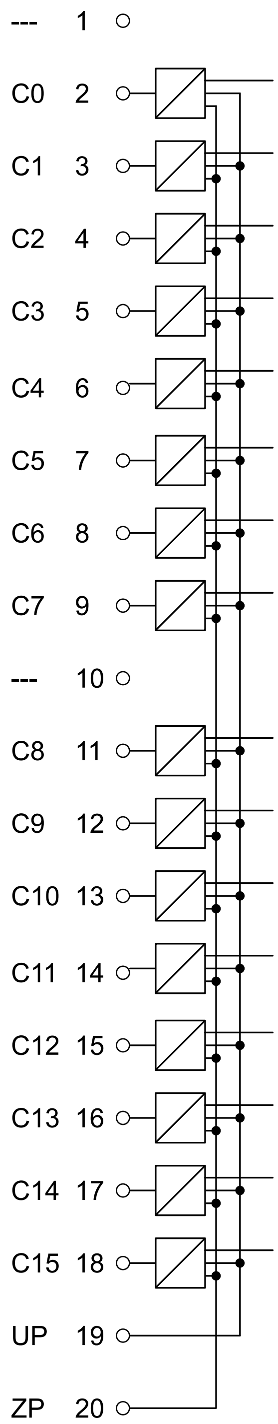


Table 39: Assignment of the Terminals:

Terminal	Signal	Description
1	---	Reserved
2	C0	Input/output signal C0
3	C1	Input/output signal C1
4	C2	Input/output signal C2
5	C3	Input/output signal C3
6	C4	Input/output signal C4
7	C5	Input/output signal C5

Terminal	Signal	Description
8	C6	Input/output signal C6
9	C7	Input/output signal C7
10	---	Reserved
11	C8	Input/output signal C8
12	C9	Input/output signal C9
13	C10	Input/output signal C10
14	C11	Input/output signal C11
15	C12	Input/output signal C12
16	C13	Input/output signal C13
17	C14	Input/output signal C14
18	C15	Input/output signal C15
19	UP	Process voltage UP +24 VDC
20	ZP	Process voltage ZP 0 VDC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DC562.

The external power supply connection is carried out via the UP (+24 VDC) and ZP (0 VDC) terminals.

WARNING!
Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

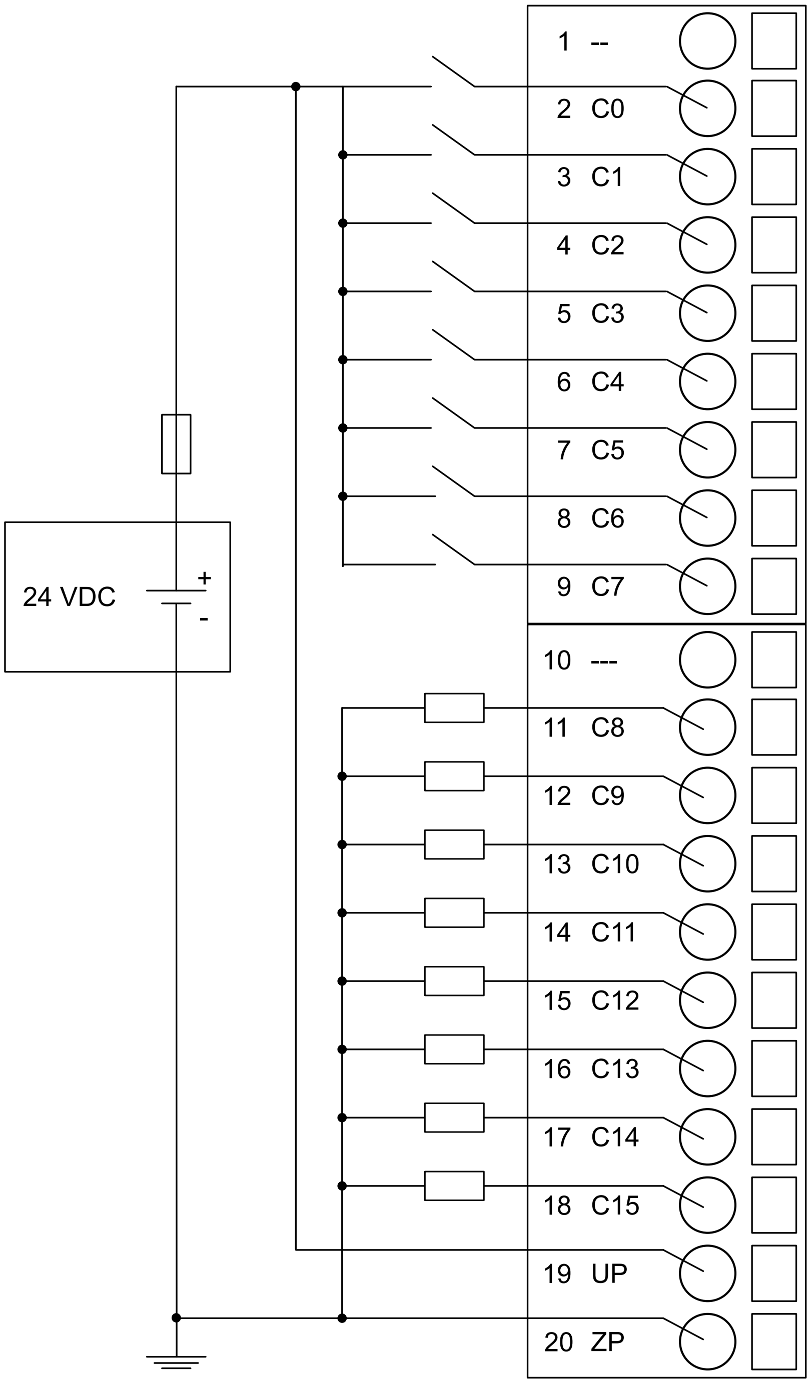
NOTICE!
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Process supply voltage must be connected to UP/ZP of the module. The inputs and UP/ZP must use the same power supply.

The following figure shows the electrical connection of the digital input/output module DC562:



In this connection example, the inputs/outputs C0...C7 are connected as inputs and the inputs/outputs C8...C15 are connected as outputs.

The module provides several diagnosis functions *Chapter 1.5.1.1.2 “DC562 - Digital Input/Output Module” on page 180*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.5.1.1.2.7 “State LEDs” on page 187*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6155 [1])	WORD	6155 0x180B	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x06
Ext_User_Prm_Data_Const(0) =	0x18, 0x0C, 0x00, 0x02, 0x00, 0x00;

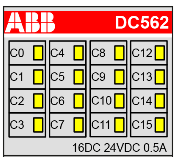
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	PNIO diagnosis block	
Class	Inter-face	Device	Module	Channel	Error-Identifier	Error message	Remedy
	1)	2)	3)	4)			
Module error DC562							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1...10 = expansion module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (4 = DC); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs/outputs C0...C15	Digital input or digital output	Yellow	Input/output is OFF	Input/output is ON (the LEDs are only operating if the module's circuitry is supplied via the I/O bus)

Technical Data

The System Data of AC500-eCo apply ↬ *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process voltage UP		
	Connections	Terminal 19 for UP (+24 VDC) and terminal 20 for ZP (0 V)
	Rated value	24 VDC
	Current consumption via UP terminal	90 mA + 0.5 A per output (max.)
	Max. ripple	5 %
	Inrush current	0.000001 A^2s
	Protection against reversed voltage	Yes
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 10 mA
Galvanic isolation		Yes, between the input/output group and the rest of the module
	Isolated groups	1 group for 16 channels
Surge voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		4.8 W
Input data length		2 bytes
Output data length		2 bytes
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Inputs/Outputs if Used as Inputs

Parameter	Value
Number of channels per module	16 configurable inputs (24 VDC)
Distribution of the channels into groups	1 (16 channels per group)
Connections of the channels C0 to C15	Terminals 1 to 16
Reference potential for the channels C0 to C15	Terminal 20 (minus pole of the process voltage, name ZP)
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O-Bus.
Input type according to EN 61131-2	Type 1 sink

Parameter		Value
Input signal range		+24 VDC
	Signal 0	-3 V...+5 V
	Undefined signal	+5 V...+15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		-3 V...+5 V
Ripple with signal 1		+15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	> 2.5 mA
	Input voltage +30 V	< 8 mA
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Input delay (0->1 or 1->0)		Typ. 8 ms
Max. cable length		
	Shielded	500 m
	Unshielded	300 m

Technical Data of the Digital Inputs/Outputs if Used as Outputs

Parameter		Value
Number of channels per module		16 configurable transistor outputs
Distribution of the channels into groups		1 (16 channels per group)
Connections of the channels C0 to C15		Terminals 1 to 16
Reference potential for the channels C0 to C15		Terminal 20 (negative pole of the process voltage, signal name ZP)
Common power supply voltage		Terminal 19 (positive pole of the process voltage, signal name UP)
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.
Way of operation		Non-latching type
Output voltage at signal 1		UP -0.3 V at max. current
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 VDC
	Rated current per group (max.)	8 A
	Rated current (all channels together, max.)	8 A
	Lamp load (max.)	5 W

Parameter		Value
	Max. leakage current with signal 0	< 0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching frequency		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 VDC signals	Yes
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

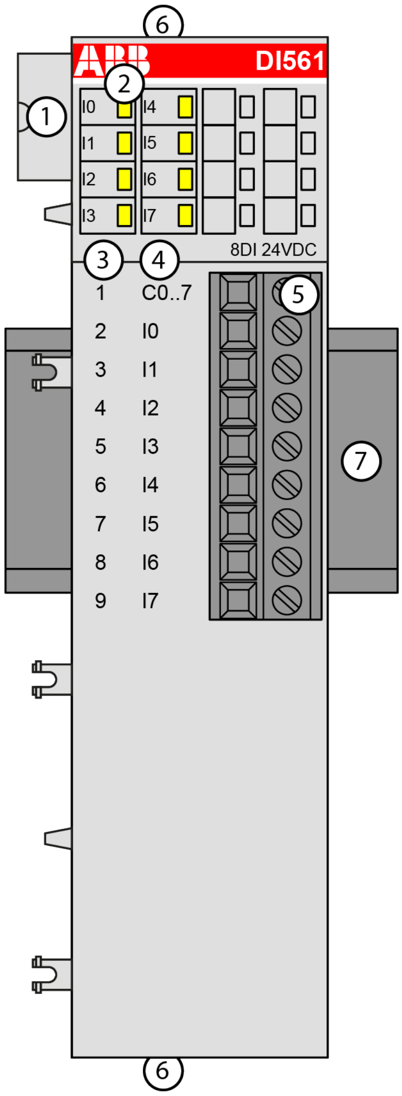
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 231 900 R0000	DC562, digital input/output module, 16 configurable inputs/outputs, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.3 DI561 - Digital Input Module

- 8 digital inputs 24 VDC / 24 VAC (I0 to I7) in 1 group
- Module-wise electrically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 to I7
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *⇘ Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using a removable 9-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter terminal blocks for S500-eCo I/O modules *⇘ Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital inputs:

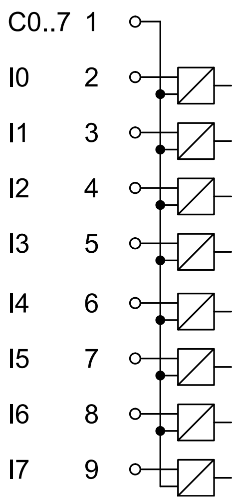


Table 40: Assignment of the Terminals:

Terminal	Signal	Description
1	C0...7	Input common for signals I0 to I7
2	I0	Input signal I0

Terminal	Signal	Description
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DI561.

An external power supply connection is not needed.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

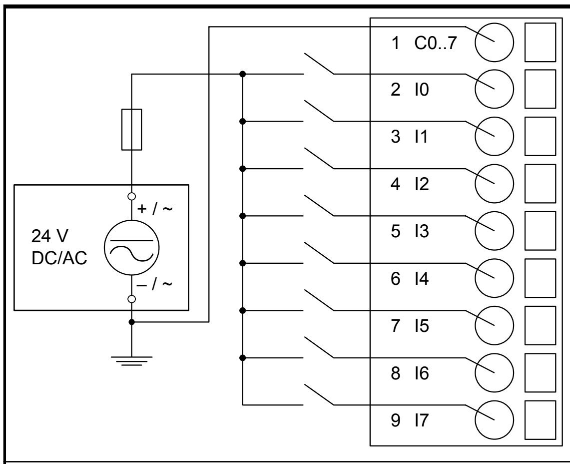
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The digital inputs can be used as source inputs or as sink inputs.

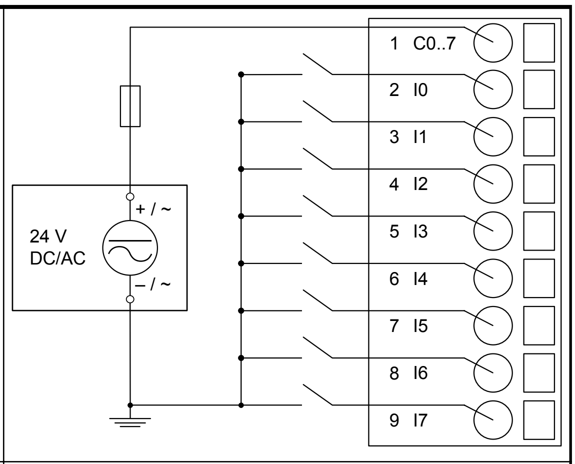
NOTICE!
Risk of malfunctions in the plant!
A ground closure, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

The following figure shows the electrical connection of the digital input module DI561:



Electrical connection of DI561 - sink inputs



Electrical connection of DI561 - source inputs

The module provides several diagnosis functions *Chapter 1.5.1.1.3.6 “Diagnosis” on page 195*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.5.1.1.3.7 “State LEDs” on page 196*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6105 [1])	WORD	6105 0x17D9	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

3) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDA, 0x17, 0x00;

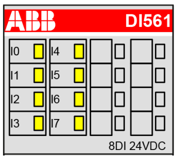
Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0...I7	Digital input	Yellow	Input is OFF	Input is ON

In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Galvanic isolation		Yes, between the input group and the rest of the module
	Isolated groups	1 (8 channels per group)
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 10 mA
Max. power dissipation within the module		1.6 W
Weight		Ca. 110 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

Technical Data of the Digital Inputs

Parameter	Value		
Number of channels per module	8 inputs (24 VDC / 24 VAC)		
Distribution of the channels into groups	1 (8 channels per group)		
Connections of the channels I0 to I7	Terminals 2 to 9		
Reference potential for the channels I0 to I7	Terminal 1 (plus or negative pole of the process supply voltage, signal name C0..7)		
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.		
Monitoring point of input indicator	LED is part of the input circuitry		
Input type according to EN 61131-2	Type 1 source	Type 1 sink	Type 1 AC

Parameter	Value		
Input signal range	-24 VDC	+24 VDC	24 VAC 50/60 Hz
Signal 0	-5 V...+3 V	-3 V...+5 V	0 VAC...5 VAC
Undefined signal	-15 V...-5 V	+5 V...+15 V	5 VAC...14 VAC
Signal 1	-30 V...-15 V	+15 V...+30 V	14 VAC...27 VAC
Input current per channel			
Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
Input voltage 14 V			Typ. 2.7 mA r.m.s.
Input voltage 15 V	> 2.5 mA		
Input voltage 27 V			Typ. 5.5 mA r.m.s.
Input voltage 30 V	< 8 mA		
Max. permissible leakage current (at 2-wire proximity switches)	1 mA		Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)	Typ. 8 ms		
Input data length	1 byte		
Max. cable length			
Shielded	500 m		
Unshielded	300 m		

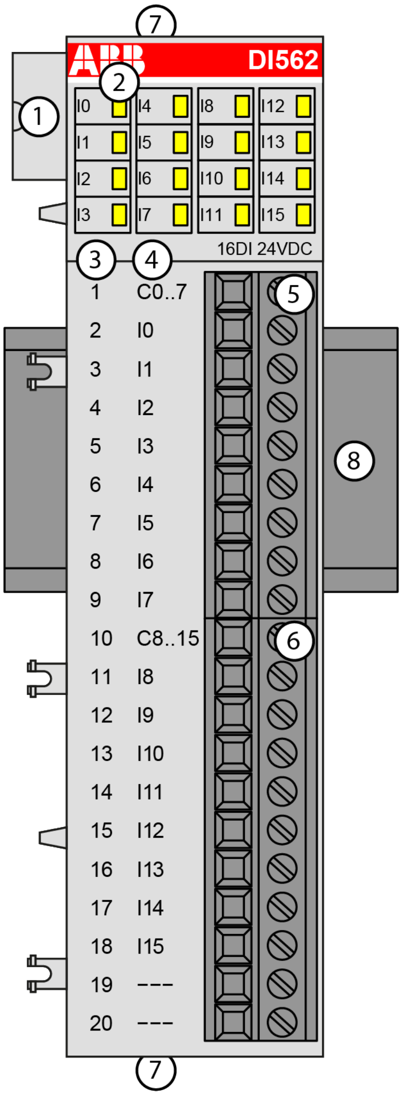
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2101	DI561, digital input module, 8 DI, 24 VDC / 24 VAC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.4 DI562 - Digital Input Module

- 16 digital inputs 24 VDC / 24 VAC (I0 to I15) in 2 groups
- Group-wise electrically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the inputs I0 to I15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are group-wise electrically isolated from each other.

The other electronic circuitry of the module is electrically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

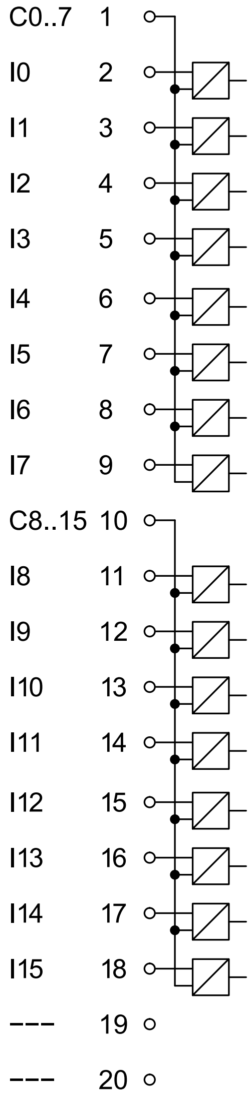
Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw-type terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules *Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital inputs:



The assignment of the terminals:

Terminal	Signal	Description
1	C0...7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	C8...15	Input common for signals I8 to I15
11	I8	Input signal I8
12	I9	Input signal I9
13	I10	Input signal I10
14	I11	Input signal I11
15	I12	Input signal I12
16	I13	Input signal I13
17	I14	Input signal I14
18	I15	Input signal I15
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DI562.

An external power supply connection is not needed.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

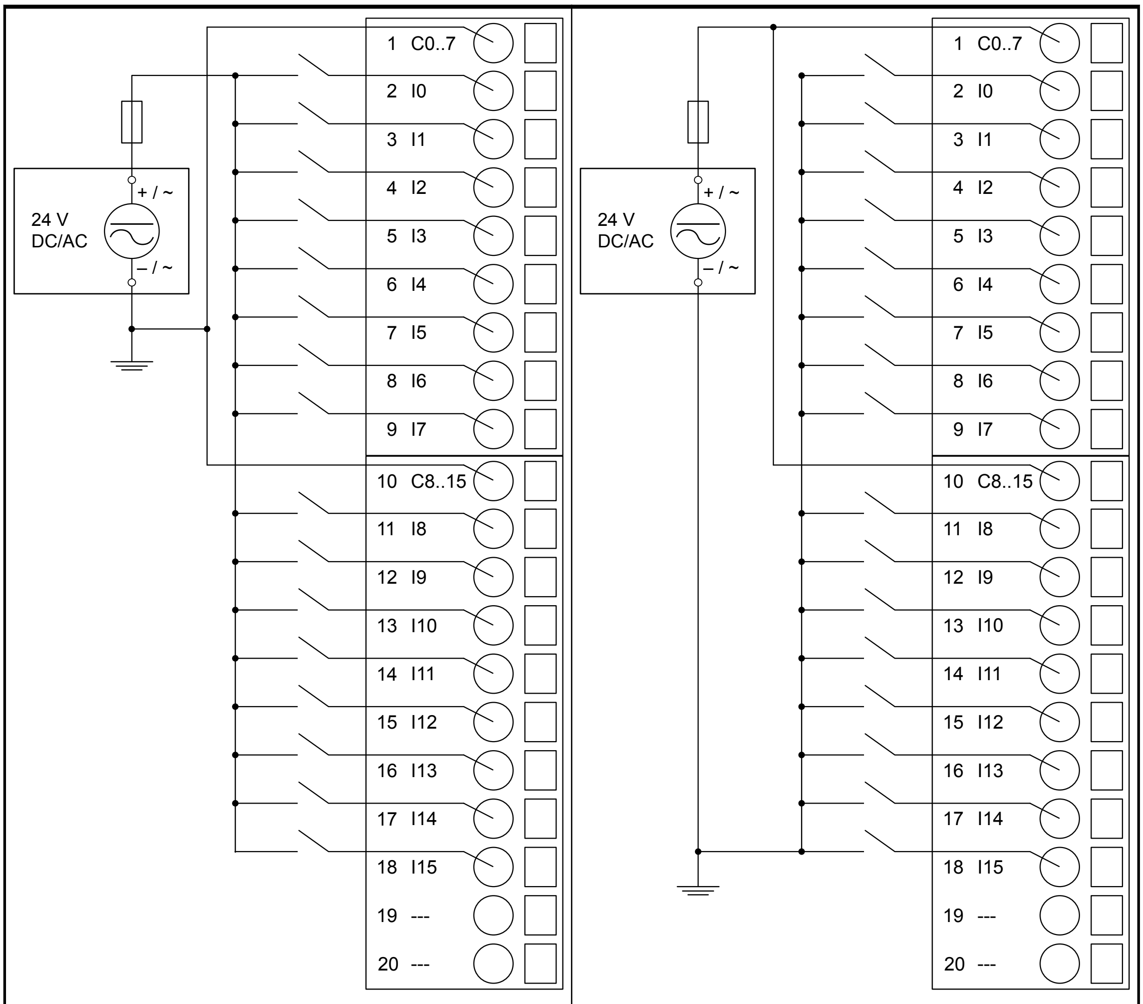
> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions ↳ *Chapter 1.5.1.1.4.6 “Diagnosis” on page 203*.

The digital inputs can be used as source inputs or as sink inputs.

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> A ground closure, e. g. caused by a damaged cable insulation, can bridge switches accidentally.
>
> Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

The following figure shows the electrical connection of the digital input module DI562:



Electrical connection of DI562 - sink inputs	Electrical connection of DI562 - source inputs

The meaning of the LEDs is described in section State LEDs ✎ *Chapter 1.5.1.1.4.7 “State LEDs” on page 203*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6110 1)	WORD	6110 0x17DE	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length 2)	Internal	1 - CPU	BYTE	0	0	255	xx02 3)

Remarks:

1)	With CS31 and addresses less than 70, the value is increased by 1
2)	The module has no additional user-configurable parameters
3)	Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDF, 0x17, 0x00;

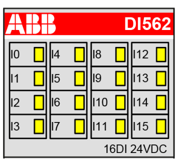
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	PNIO diagnosis block	
Class	Interface	Device	Module	Channel	Error Identifier	Error message	Remedy
	1)	2)	3)	4)			
Module error DI562							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0...I15	Digital input	Yellow	Input is OFF	Input is ON

> *In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.*

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module	Ca. 10 mA
Max. power dissipation within the module	3.2 W
Weight	Ca. 115 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

Technical Data of the Digital Inputs

Parameter	Value		
Number of channels per module	16 inputs (24 VDC / 24 VAC)		
Distribution of the channels into groups	2 (8 channels per group)		
Connections of the channels I0 to I7	Terminals 2 to 9		
Connections of the channels I8 to I15	Terminals 11 to 18		
Reference potential for the channels I0 to I7	Terminal 1 (positive or negative pole of the process supply voltage, signal name C0..7)		
Reference potential for the channels I8 to I15	Terminal 10 (positive or negative pole of the process supply voltage, signal name C8..15)		
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.		
Monitoring point of input indicator	LED is part of the input circuitry		
Input type according to EN 61131-2	Type 1 source	Type 1 sink	Type 1 AC
Input signal range	-24 VDC	+24 VDC	24 VAC 50/60 Hz
Signal 0	-5 V...+3 V	-3 V...+5 V	0 VAC...5 VAC
Undefined signal	-15 V...-5 V	+5 V...+15 V	5 VAC...14 VAC
Signal 1	-30 V...-15 V	+15 V...+30 V	14 VAC...27 VAC

Parameter	Value	
Input current per channel		
Input voltage 24 V	Typ. 5 mA	Typ. 5 mA r.m.s.
Input voltage 5 V	Typ. 1 mA	Typ. 1 mA r.m.s.
Input voltage 14 V		Typ. 2.7 mA r.m.s.
Input voltage 15 V	> 2.5 mA	
Input voltage 27 V		Typ. 5.5 mA r.m.s.
Input voltage 30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)	1 mA	Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)	Typ. 8 ms	
Input data length	2 bytes	
Max. cable length		
Shielded	500 m	
Unshielded	300 m	

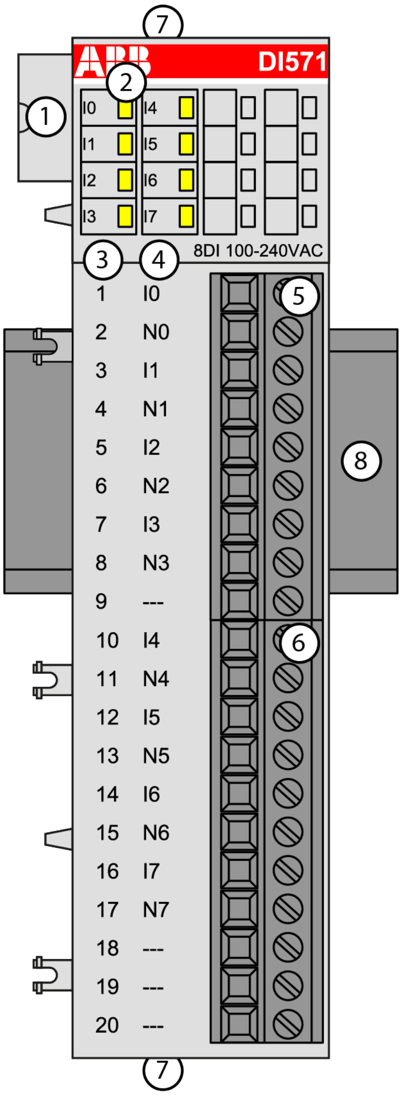
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2102	DI562, digital input module, 16 DI, 24 VDC / 24 VAC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.5 DI571 - Digital Input Module

- 8 digital inputs 100-240 VAC (I0 to I7) in 8 groups
- Module-wise electrically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 to I7
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *⇘ Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw-type terminals, cable mounting from the front or from the side). For more information, refer to Terminal Blocks for S500-eCo I/O Modules.. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital inputs:

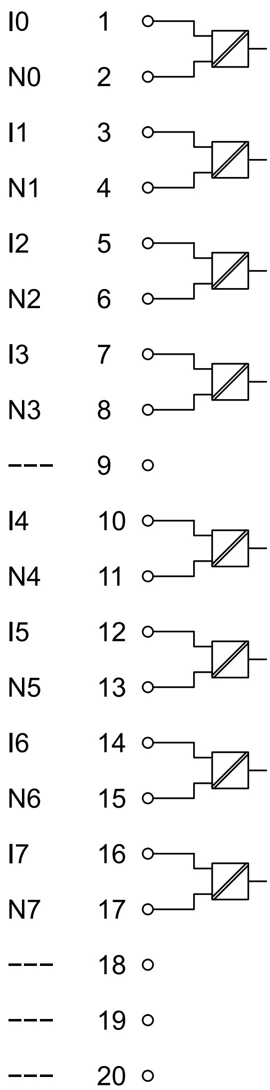


Table 41: Assignment of the Terminals:

Terminal	Signal	Description
1	I0	Input signal I0
2	N0	Neutral conductor for the input signal I0
3	I1	Input signal I1
4	N1	Neutral conductor for the input signal I1
5	I2	Input signal I2
6	N2	Neutral conductor for the input signal I2
7	I3	Input signal I3
8	N3	Neutral conductor for the input signal I3
9	---	Reserved
10	I4	Input signal I4
11	N4	Neutral conductor for the input signal I4
12	I5	Input signal I5
13	N5	Neutral conductor for the input signal I5
14	I6	Input signal I6
15	N6	Neutral conductor for the input signal I6
16	I7	Input signal I7
17	N7	Neutral conductor for the input signal I7
18	---	Reserved
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DI571.

An external power supply connection is not needed.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

WARNING!
Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

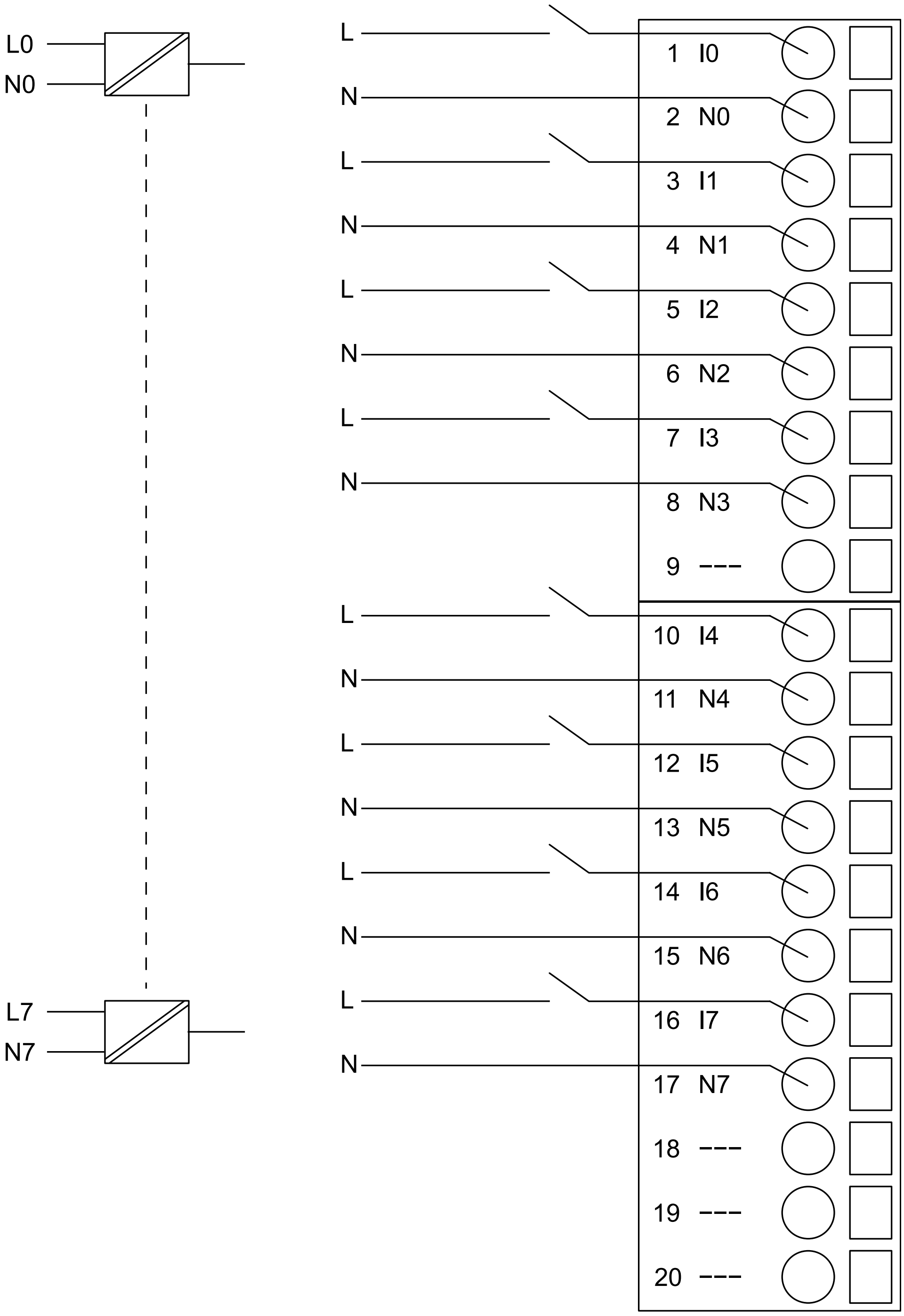
The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the digital input module DI571:



NOTICE!

Risk of damaging the PLC modules!

The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions ↻ *Chapter 1.5.1.1.5.7 “Diagnosis” on page 212*.

The meaning of the LEDs is described in the section State LEDs ↻ *Chapter 1.5.1.1.5.8 “State LEDs” on page 212*.

Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	0

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of the modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6115 [1])	WORD	6115 0x17E3	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDF, 0x17, 0x00;

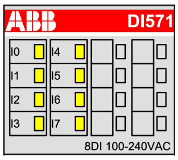
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<– Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	1)	2)	3)	4)				
Module error								
3	14	1...10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1...10					
3	14	1...10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1...10					
3	14	1...10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1...10					
3	14	1...10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1...10					

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0...I7	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is only displayed if the supply voltage of the module is ON)

Technical Data

The System Data of AC500-eCo apply ↯ *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Galvanic isolation		Yes, between the channels and the rest of the module
	Isolated groups	8 (1 channel per group)
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 10 mA
Max. power dissipation within the module		On request
Weight		Ca. 135 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		8 AC inputs (100-240 VAC)
Distribution of the channels into groups		8 (1 channel per group)
Input voltage range		0 VAC..264 VAC (47 Hz...63 Hz)
Input current per channel (typically at 25 °C)		<5 mA (at 40 VAC) >6 mA (at 159 VAC, 50 Hz) >7 mA (at 159 VAC, 60 Hz)
Connections of the channels I0 to I7		Terminals 1, 3, 5, 7, 10, 12, 14, 16
Reference potential for the channels I0 to I7		Terminals 2, 4, 6, 8, 11, 13, 15, 17
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)
Input type according to EN 61131-2		Type 1
Input signal range		
	Signal 0 (max.)	20 VAC
	Undefined signal	20 VAC < U < 79 VAC
	Signal 1 (min.)	79 VAC
Input delay		
	Signal 0 -> 1	Typ. 15 ms
	Signal 1 -> 0	Typ. 30 ms
Input data length		1 byte
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Max. cable length		

Parameter		Value
	Shielded	500 m
	Unshielded	300 m

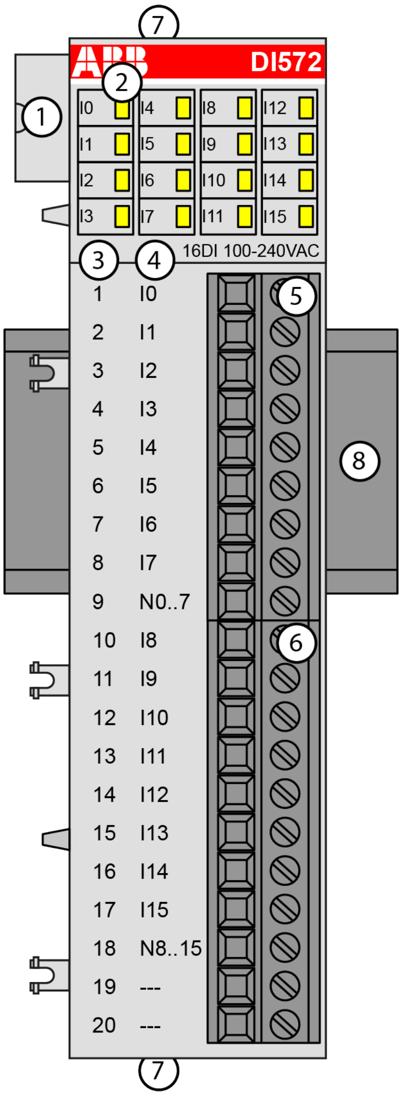
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2103	DI571, digital input module, 8 DI, 100 VAC...240 VAC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.6 DI572 - Digital Input Module

- 16 digital inputs 100-240 VAC (I0 to I15) in 2 groups
- Module-wise electrically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the inputs I0 to I15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *➥ Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules *➥ Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

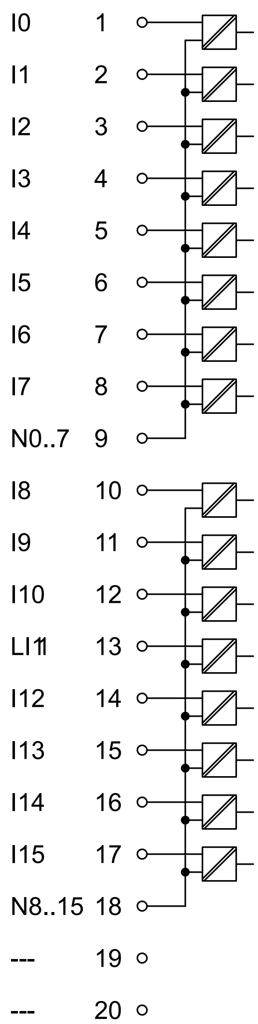


Fig. 12: Block diagram for the internal construction of the digital inputs.

Table 42: Assignment of the terminals

Terminal	Signal	Description
1	I0	Input signal I0
2	I1	Input signal I1
3	I2	Input signal I2
4	I3	Input signal I3
5	I4	Input signal I4
6	I5	Input signal I5
7	I6	Input signal I6
8	I7	Input signal I7
9	N0...7	Neutral conductor for the input signals I0...I7
10	I8	Input signal I8
11	I9	Input signal I9
12	I10	Input signal I10
13	I11	Input signal I11
14	I12	Input signal I12
15	I13	Input signal I13
16	I14	Input signal I14
17	I15	Input signal I15
18	N8...15	Neutral conductor for the input signals I8...I15
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DI572.

An external power supply connection is not needed.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

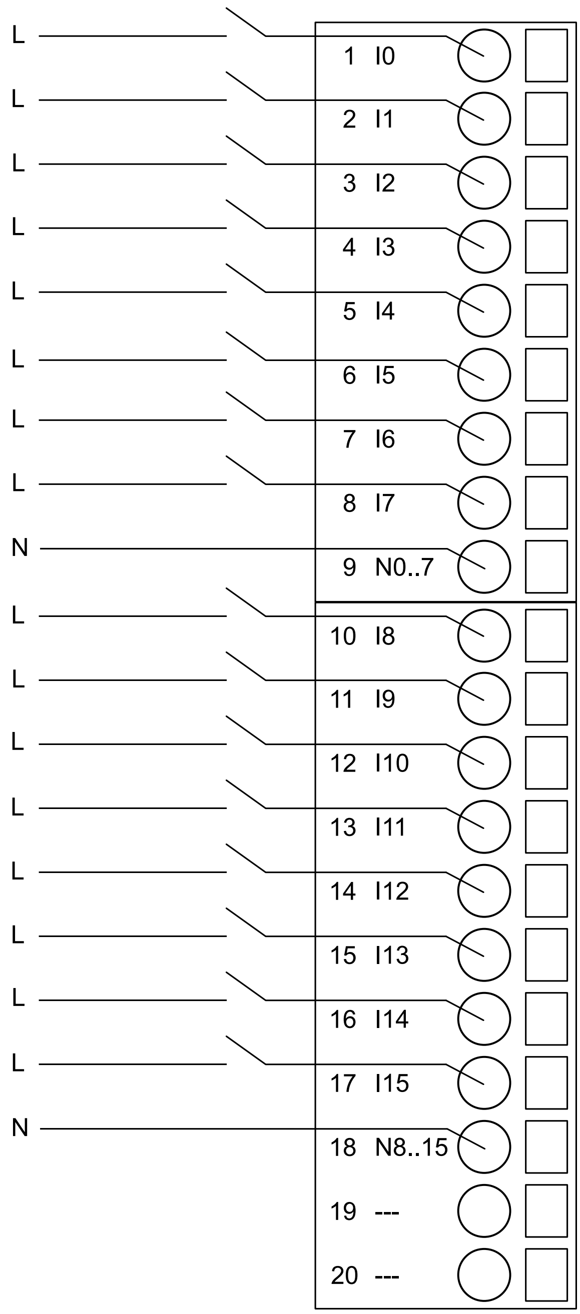
The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.



NOTICE!

Risk of damaging the PLC modules!

The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions *Chapter 1.5.1.1.6.6 “Diagnosis” on page 221*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Parameter name	Value	Internal value	Data type of internal value	Default value	Min.	Max.	EDS Slot Index
Module ID	Internal	6160 [1])	WORD	6160 0x1810	0	65535	xx01 [2])
Ignore module	No	0	BYTE	No 0x00	-	-	-
	Yes	1					
Parameter length	Internal	3	BYTE	3	0	255	xx02 [2])
Input delay	20 ms	0	BYTE	20 ms 0x00	0	1	-
	100 ms	1					

[1]) With CS31 and addresses less than 70, the value is increased by 1.

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n).

GSD file:

Ext_Module_Prm_Data_Len =	7
Ext_User_Prm_Data_Const(0) =	0x18, 0x11, 0x00, 0x03, 0x00, 0x00, 0x00;

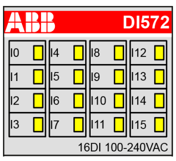
Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

Parameter	**Remark**
1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		**State**	**Color**	**LED = OFF**	**LED = ON**
	Inputs I0...I15	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is only displayed if the supply voltage of the module is ON)

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/bus module	Ca. 10 mA
Max. power dissipation within the module	6 W
Weight	Ca. 222 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		16 AC inputs (100-240 VAC)
Distribution of the channels into groups		2 (8 channels per group)
Input voltage range		0 VAC...264 VAC (47 Hz...63 Hz)
Input current per channel (typically at 25 °C)		< 3 mA (at 40 VAC) > 6 mA (at 164 VAC) > 8 mA (at 240 VAC)
Connections of the channels I0..I7		Terminals 1...8
Connections of the channels I8...I15		Terminals 10...17
Reference potential for the channels I0...I7		Terminal 9
Reference potential for the channels I8...I15		Terminal 18
Indication of the input signals		1 yellow LED per channel. The LED is on when the input signal is high (signal 1).
Input type according to EN 61131-2		Type 1
Input signal range		
	Signal 0 (max.)	40 VAC
	Undefined signal	40 VAC < U < 79 VAC
	Signal 1 (min.)	79 VAC
Input delay		
	Signal 0 -> 1	Typ. 24 ms
	Signal 1 -> 0	Typ. 24 ms
Input data length		2 bytes

Parameter	Value
Max. permissible leakage current (at 2-wire proximity switches)	1 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

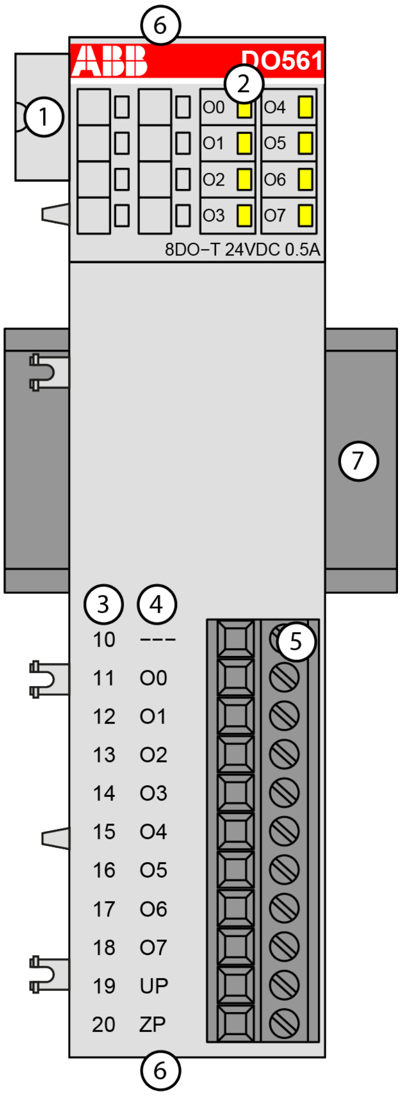
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 230 500 R0000	DI572, digital input module, 16 DI, 100 VAC...240 VAC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.7 DO561 - Digital Output Module

- 8 digital outputs 24 VDC (O0 to O7) in 1 group
- Module-wise electrically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 to O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process supply voltage 24 VDC)

Electrical Connection

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter ➭ Chapter 2.5 "AC500-eCo" on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules ➭ *Chapter 1.8.3.2 "TA563-TA565 - Terminal Blocks" on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital outputs:

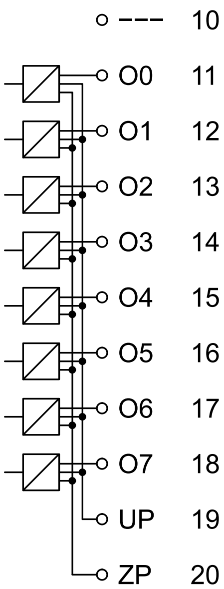


Table 43: Assignment of the Terminals:

Terminals	Signal	Description
10	---	Reserved
11	O0	Output signal O0
12	O1	Output signal O1
13	O2	Output signal O2
14	O3	Output signal O3

Terminals	Signal	Description
15	O4	Output signal O4
16	O5	Output signal O5
17	O6	Output signal O6
18	O7	Output signal O7
19	UP	Process supply voltage UP +24 VDC
20	ZP	Process supply voltage ZP 0 V

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DO561.

The external power supply connection is carried out via the UP (+24 VDC) and ZP (0 VDC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

- connect or disconnect any signal or terminal block
- remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

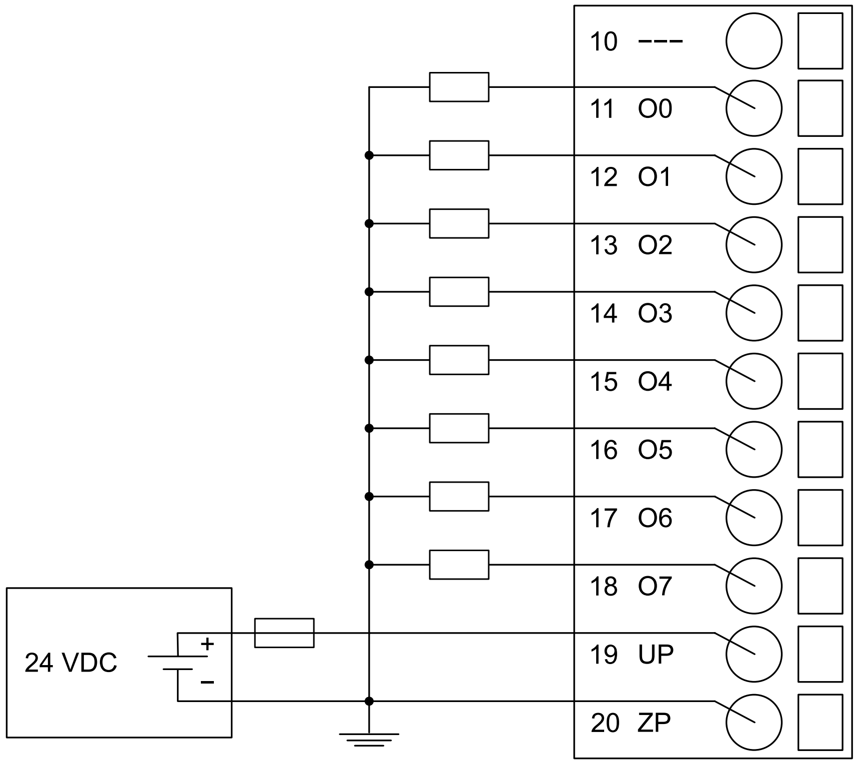
NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

- Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
- Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the digital output module DO561:



NOTICE!

Risk of malfunctions in the plant!

The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.

This must be considered in the planning of the application.

NOTICE!

Risk of damaging the I/O Module!

The outputs are not protected against short circuits and overload.

– Never short-circuit or overload the outputs.
– Never connect the outputs to other voltages.
– Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions (see Diagnosis *Chapter 1.5.1.1.7.6 “Diagnosis” on page 228*).

The meaning of the LEDs is described in the section State LEDs *Chapter 1.5.1.1.7.7 “State LEDs” on page 229*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6120 [1])	WORD	6120 0x17E8	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xE9, 0x17, 0x00;

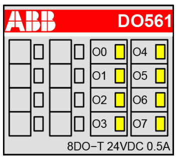
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
				Module error DO561			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0...O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical Data

The System Data of AC500-eCo apply ⇘ *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 VDC) and terminal 20 for ZP (0 VDC)
	Rated value	24 VDC
	Current consumption via UP terminal	5 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast fuse
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 10 mA

Parameter	Value
Galvanic isolation	Yes, between the output group and the rest of the module
Isolated groups	1 (8 channels per group)
Surge-voltage (max.)	35 VDC for 0.5 s
Power dissipation within the module (max.)	1.6 W
Weight	Ca. 115 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8 transistor outputs (24 VDC, 0.5 A max.)
Distribution of the channels into groups		1 (8 channels per group)
Connection of the channels O0 to O7		Terminals 11 to 18
Common power supply voltage		Terminal 19 (plus pole of the process voltage, signal name UP)
Reference potential for the channels O0 to O7		Terminal 20 (minus pole of the process voltage, signal name ZP)
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Min. output voltage at signal 1		20 VDC at max. current consumption
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 VDC
	Rated current per group (max.)	4 A
	Lamp load (max.)	5 W
Max. leakage current with signal 0		0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification

Parameter		Value
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 VDC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

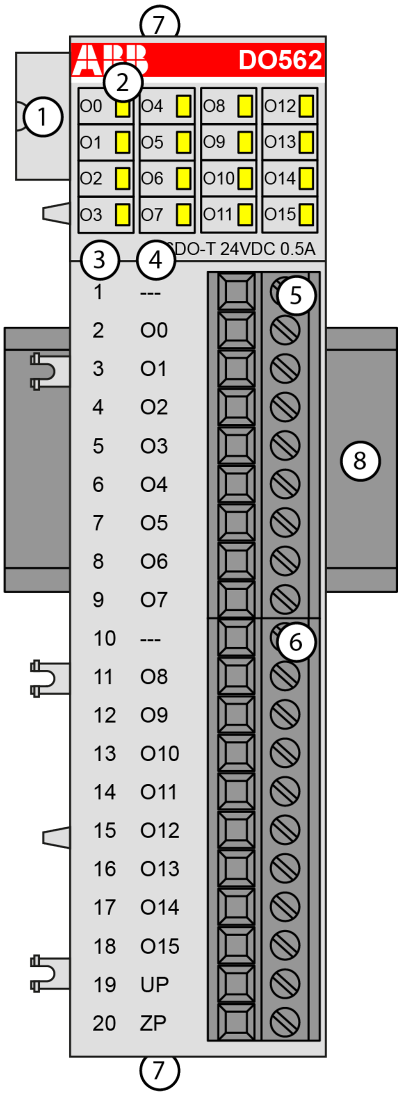
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2201	DO561, digital output module, 8 DO, transistor output	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.8 DO562 - Digital Output Module

- 16 digital outputs 24 VDC (O0 to O15) in 1 group
- Module-wise electrically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the outputs O0 to O15
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process supply voltage 24 VDC)

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *⇘ Chapter 2.5 "AC500-eCo" on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules *⇘ Chapter 1.8.3.2 "TA563-TA565 - Terminal Blocks" on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital outputs:

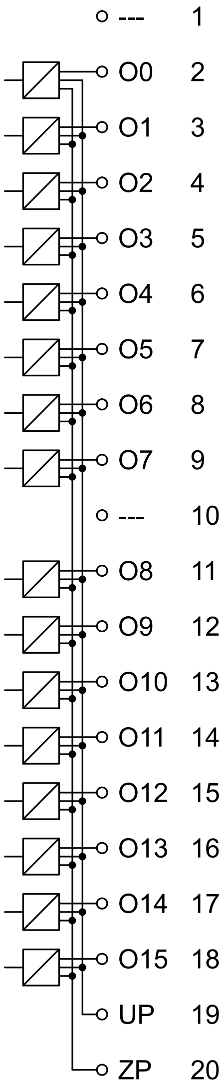


Table 44: Assignment of the Terminals:

Terminal	Signal	Description
1	---	Reserved
2	O0	Output signal O0
3	O1	Output signal O1
4	O2	Output signal O2
5	O3	Output signal O3
6	O4	Output signal O4
7	O5	Output signal O5
8	O6	Output signal O6
9	O7	Output signal O7
10	---	Reserved
11	O8	Output signal O8
12	O9	Output signal O9
13	O10	Output signal O10
14	O11	Output signal O11

Terminal	Signal	Description
15	O12	Output signal O12
16	O13	Output signal O13
17	O14	Output signal O14
18	O15	Output signal O15
19	UP	Process voltage UP (24 VDC)
20	ZP	Process voltage ZP (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DO562.

The external power supply connection is carried out via the UP (+24 VDC) and ZP (0 VDC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

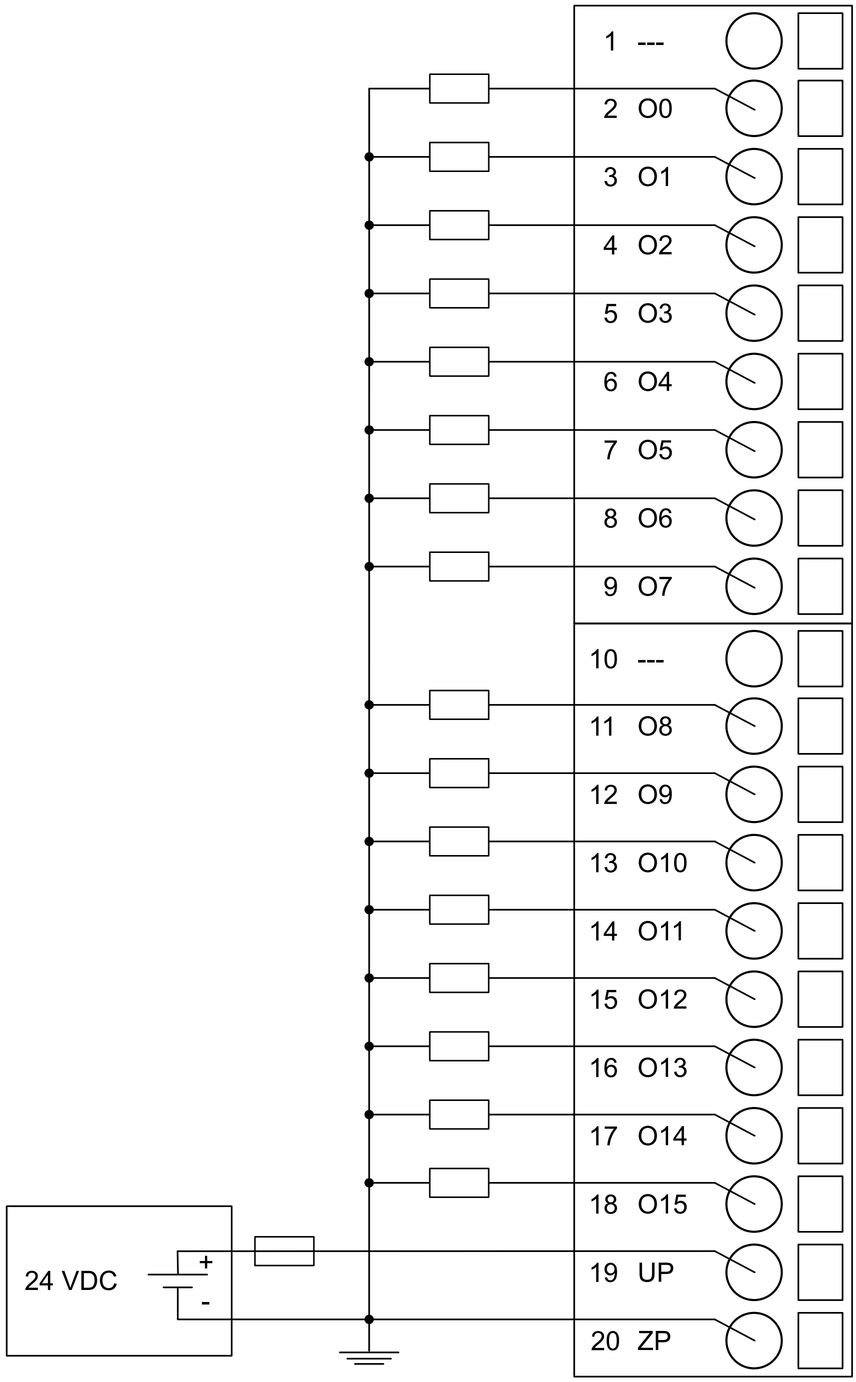
NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the digital output module DO562:



NOTICE!

Risk of malfunctions in the plant!

The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.

This must be considered in the planning of the application.

NOTICE!
Risk of damaging the I/O Module!
The outputs are not protected against short circuits and overload.

– Never short-circuit or overload the outputs.
– Never connect the outputs to other voltages.
– Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions (see Diagnosis *Chapter 1.5.1.1.8.6 "Diagnosis" on page 238*).

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.5.1.1.8.7 "State LEDs" on page 238*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6145 [1])	WORD	6145 0x1801	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x06
Ext_User_Prm_Data_Const(0) =	0x18, 0x02, 0x00, 0x02, 0x00, 0x00;

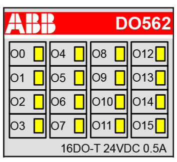
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	PNIO diagnosis block	
Class	**Inter- face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
				Module error			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = Module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0...O15	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 VDC) and terminal 20 for ZP (0 VDC)
	Rated value	24 VDC
	Current consumption via UP terminal	20 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast fuse
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 10 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		1 (16 channels per group)
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		1.4 W
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	16 transistor outputs (24 VDC, 0.5 A max.)
Distribution of the channels into groups	1 (16 channels per group)
Connection of the channels O0 to O7	Terminals 1 to 9
Connection of the channels O8 to O15	Terminals 11 to 18
Common power supply voltage	Terminal 19 (positive pole of the process voltage, signal name UP)
Reference potential for the channels O0 to O15	Terminal 20 (negative pole of the process voltage, signal name ZP)

Parameter		Value
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Min. output voltage at signal 1		UP -0.3 V at max. current consumption
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		2 bytes
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 VDC
	Rated current per group (max.)	8 A
	Lamp load (max.)	5 W
Max. leakage current with signal 0		0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 VDC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Ordering Data

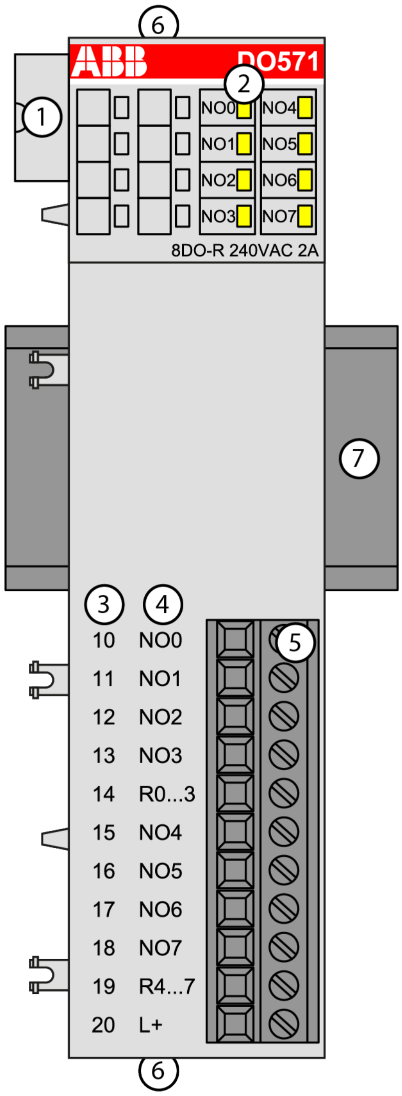
Part no.	Description	Product Life Cycle Phase *)
1SAP 230 900 R0000	DO562, digital output module, 16 DO, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.9 DO571 - Digital Output Module

- 8 digital normally open relay outputs 24 VDC / 24 VAC or 100-240 VAC, 2 A max. (NO0 to NO7) in 2 groups
- Group-wise electrically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 to O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminal L+ (process voltage 24 VDC). The negative pole is provided by the I/O bus.

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter ✎ Chapter 2.5 "AC500-eCo" on page 1194.

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules ✎ *Chapter 1.8.3.2 "TA563-TA565 - Terminal Blocks" on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital outputs:

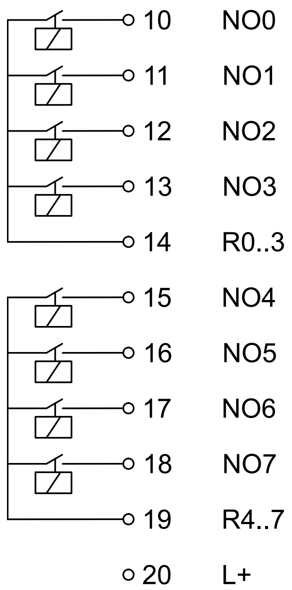


Table 45: Assignment of the Terminals:

Terminal	Signal	Description
10	NO0	Normally-open contact of the output NO0
11	NO1	Normally-open contact of the output NO1
12	NO2	Normally-open contact of the output NO2
13	NO3	Normally-open contact of the output NO3
14	R0..3	Output common for signals NO0 to NO3

Terminal	Signal	Description
15	NO4	Normally-open contact of the output NO4
16	NO5	Normally-open contact of the output NO5
17	NO6	Normally-open contact of the output NO6
18	NO7	Normally-open contact of the output NO7
19	R4..7	Output common for signals NO4 to NO7
20	L+	Process voltage L+ +24 VDC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 5 mA per DO571.

The external power supply connection is carried out via the L+ (+24 VDC) terminal. The negative pole of the external power supply is realized via the I/O bus. Therefore, the CPU/bus module and the DO571 must have a common power supply.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

For screw-type terminals only:

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the module:

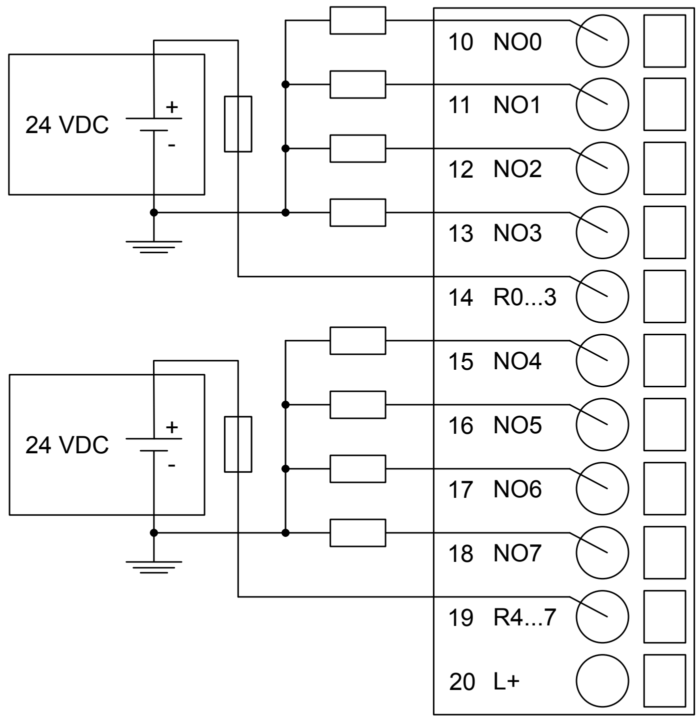


Fig. 13: Connection of 24 VDC actuators

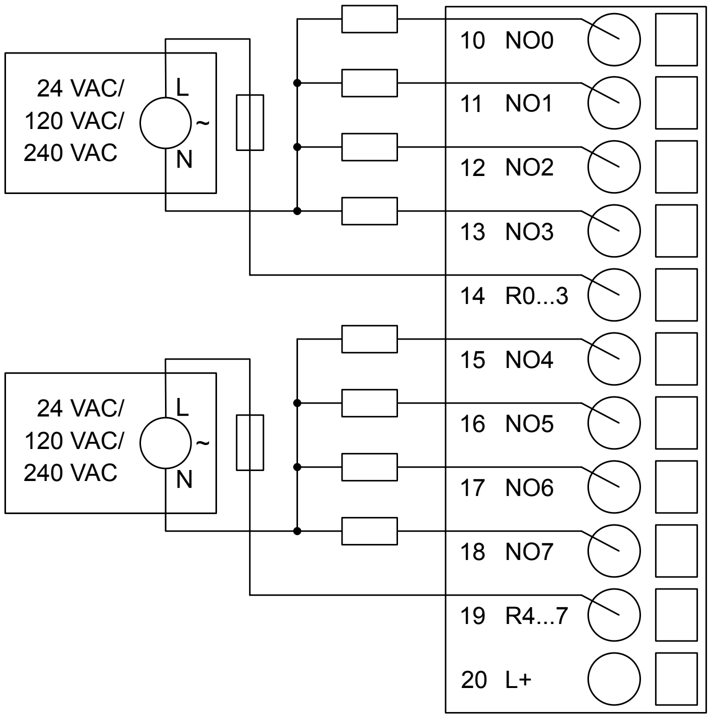


Fig. 14: Connection of 24 VAC or 100-240 VAC actuators

NOTICE!

Risk of damaging the I/O Module!

The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be supplied from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

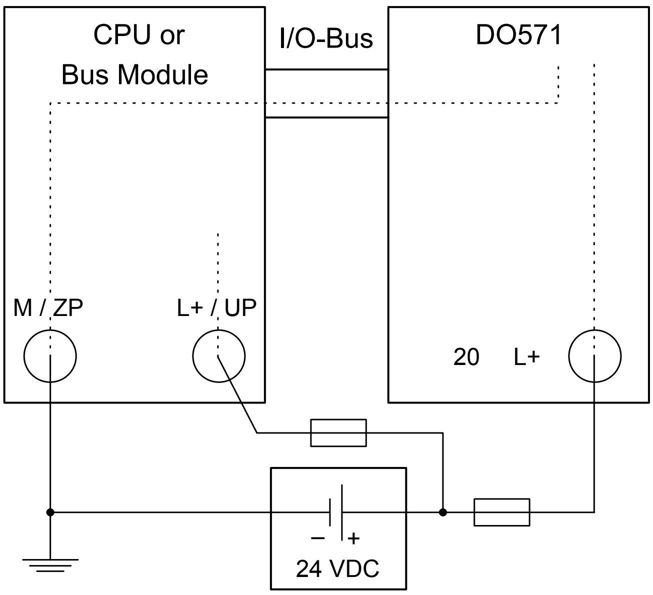


Fig. 15: Power supply - the negative connection is realized via the I/O bus

> *The L+ connection of the DO571 and the 24 V supply of the CPU/bus module must be connected to the same 24 V power supply.*

The module provides several diagnosis functions (see Diagnosis *Chapter 1.5.1.1.9.6 "Diagnosis" on page 248*).

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.5.1.1.9.7 "State LEDs" on page 249*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6125 [1])	WORD	6125 0x17ED	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x04
Ext_User_Prm_Data_Const(0) =	0xEF, 0x17, 0x00,\ 0x01;

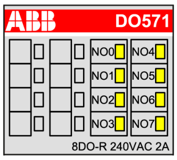
Diagnosis

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500-Display	<- Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	PNIO diag-nosis block	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
			Module error				
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
4	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = Hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1..10 = expansion 1..10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0...O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical Data

The System Data of AC500-eCo apply ➡ *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 VDC). The negative pole is provided by the I/O bus.
	Rated value	24 VDC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by a 3 A fast fuse
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 5 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		2 (4 channels per group)
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		2.0 W
Weight		Ca. 150 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8 normally-open relay outputs
Distribution of the channels into groups		2 (4 channels per group)
Connection of the channels O0 to O3		Terminals 10 to 13
Connection of the channels O4 to O7		Terminals 15 to 18
Reference potential for the channels O0 to O3		Terminal 14 (signal name R0..3)
Reference potential for the channels O4 to O7		Terminal 19 (signal name R4..7)
Relay coil power supply		Terminal 20 (plus pole of the process supply voltage, signal name L+). The minus pole is provided by the I/O bus.
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 VDC / 24 VAC or 120/240 VAC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		1 byte
Output current		
	Rated current per channel (max.)	2.0 A (24 VDC / 24 VAC / 48 VAC / 120 VAC / 240 VAC, only resistive loads) 2.0 A (24 VAC / 48 VAC / 120 VAC, only pilot duty) 1.5 A (240 VAC, only pilot duty)
	Rated current per group (max.)	8 A
	Lamp load (max.)	200 W (230 VAC), 30 W (24 VDC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Life time of relay contacts (cycles)		100.000 at rated load

Parameter		Value
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

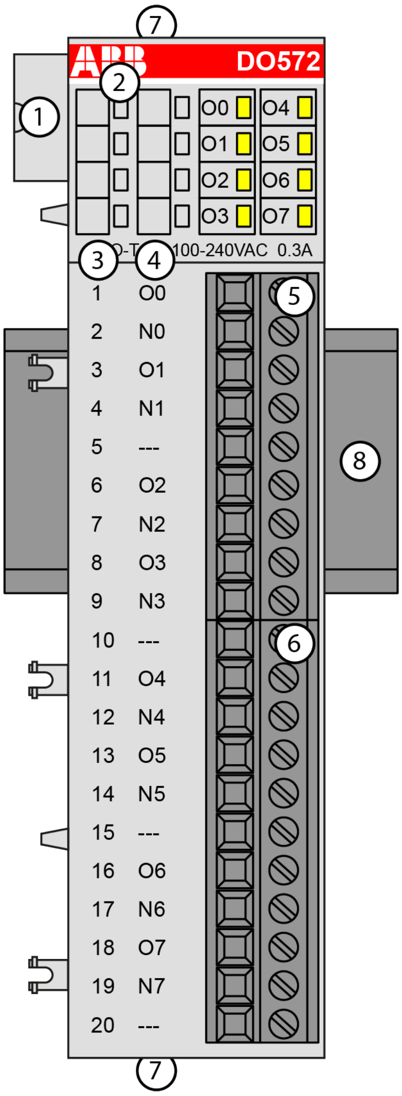
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2202	DO571, digital output module, 8 DO, relay output	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.10 DO572 - Digital Output Module

- 8 digital triac outputs (O0 to O7) in 8 groups
- 240 VAC
- Module-wise electrically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 to O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *⇘ Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules ⇘ *Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital outputs:

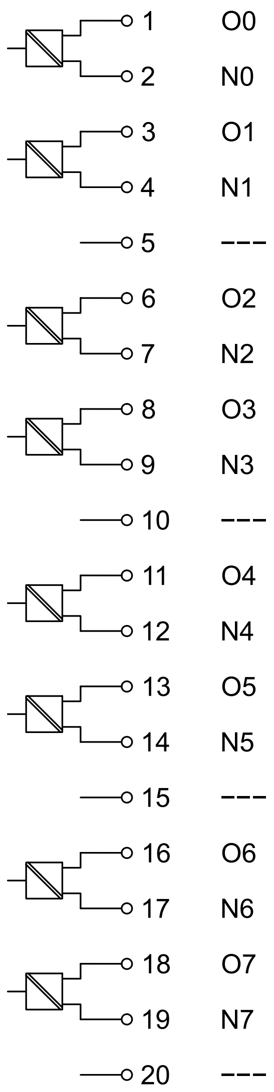


Table 46: Assignment of the Terminals:

Terminal	Signal	Description
1	O0	Output signal O0
2	N0	Neutral conductor for the output signal O0
3	O1	Output signal O1
4	N1	Neutral conductor for the output signal O1
5	---	Reserved
6	O2	Output signal O2
7	N2	Neutral conductor for the output signal O2
8	O3	Output signal O3
9	N3	Neutral conductor for the output signal O3
10	---	Reserved
11	O4	Output signal O4

Terminal	Signal	Description
12	N4	Neutral conductor for the output signal O4
13	O5	Output signal O5
14	N5	Neutral conductor for the output signal O5
15	---	Reserved
16	O6	Output signal O6
17	N6	Neutral conductor for the output signal O6
18	O7	Output signal O7
19	N7	Neutral conductor for the output signal O7
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DO572.

An external power supply connection is not needed.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

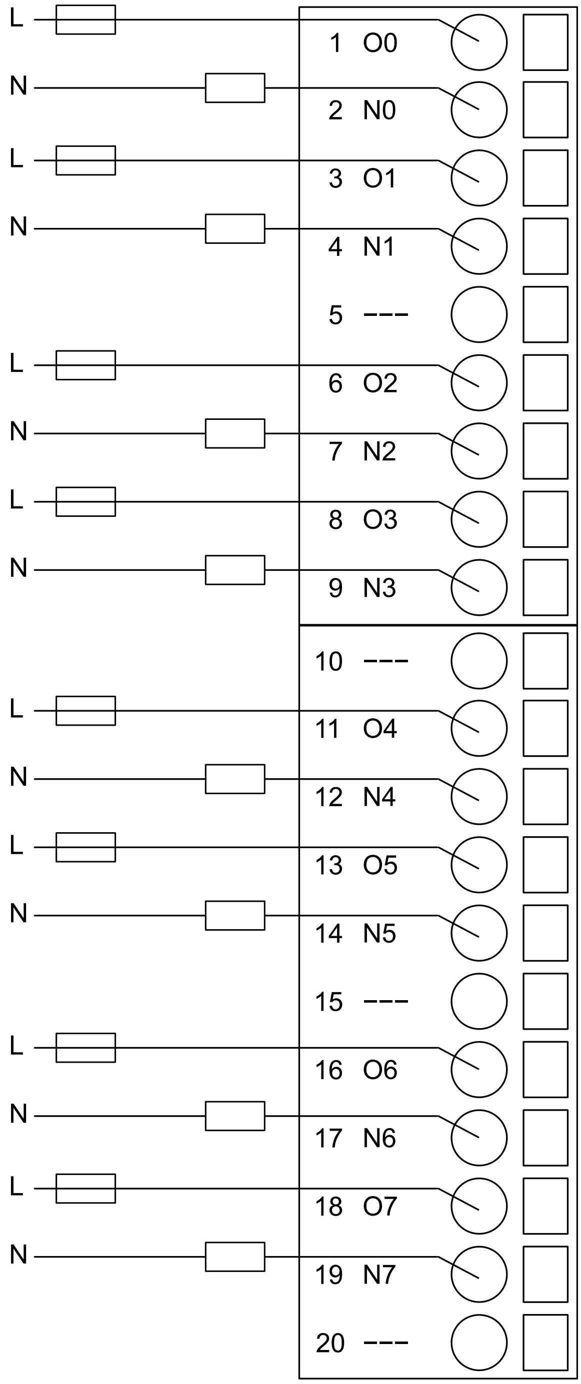
Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the module:



NOTICE!
Risk of damaging the PLC modules!
The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions (see chapter Diagnosis *Chapter 1.5.1.1.10.6 “Diagnosis” on page 258*).

The meaning of the LEDs is described in the section State LEDs *Chapter 1.5.1.1.10.7 “State LEDs” on page 259*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6130 1)	WORD	6130 0x17F2	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length 2)	Internal	1 - CPU	BYTE	0	0	255	xx02 3)

1)	With CS31 and addresses smaller than 70, the value is increased by 1
2)	The module has no additional user-configurable parameters
3)	Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xF3, 0x17, 0x00;

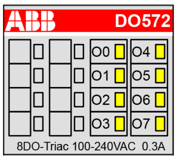
Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
				Module error			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
4	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0...O7	Digital output	Yellow	Output is OFF	Output is ON

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 "System Data AC500-eCo" on page 1194*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the channels and the rest of the module
Isolated groups	8 (1 channel per group)
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/Bus Module	Ca. 10 mA
Max. power dissipation within the module	On Request
Weight	ca. 120 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8 triac outputs
Distribution of the channels into groups		8 groups (1 channel per group)
Connection of the channels O0 to O7		Terminals 1, 3, 5, 7, 10, 12, 14, 16
Reference potential for the channels O0 to O7		Terminals 2, 4, 6, 8, 11, 13, 15, 17
Output voltage for signal 1		On Request
Max. leakage current with signal 0		1.1 mA root mean square at 132 VAC and 1.8 mA root mean square at 264 VAC
Output voltage		
	Rated value	120 VAC or 240 VAC
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus

Parameter		Value
Way of operation		Non-latching type
Output delay		On Request
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.3 A
	Rated current per group (max.)	0.3 A
Surge current (max.)		On request
Lamp load (max.)		On request
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 10 Hz
	With inductive loads	Not applicable
	With lamp loads	Max. 10 Hz
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse		2 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Resistance to feedback against 230 VAC		No
Connection of 2 outputs in parallel		Not applicable
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Ordering Data

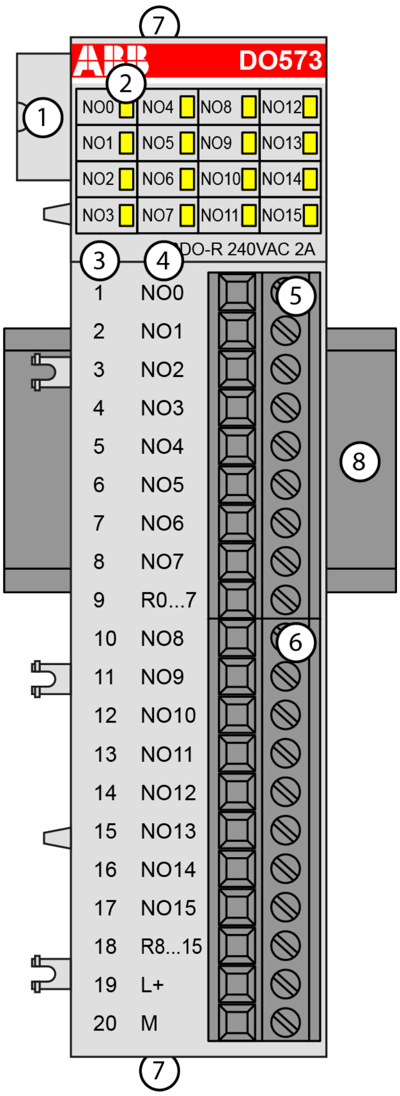
Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2203	DO572, digital output module, 8 DO, triac output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.11 DO573 - Digital Output Module

- 16 digital normally open relay outputs 24 VDC or 100-240 VAC (NO0 to NO15) in 2 groups, 2 A max.
- Group-wise electrically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the outputs O0 to O15
3 Terminal number

4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals L+ (process voltage 24 VDC) and M (0 VDC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Electrical Connection

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter* *Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules *Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital outputs:

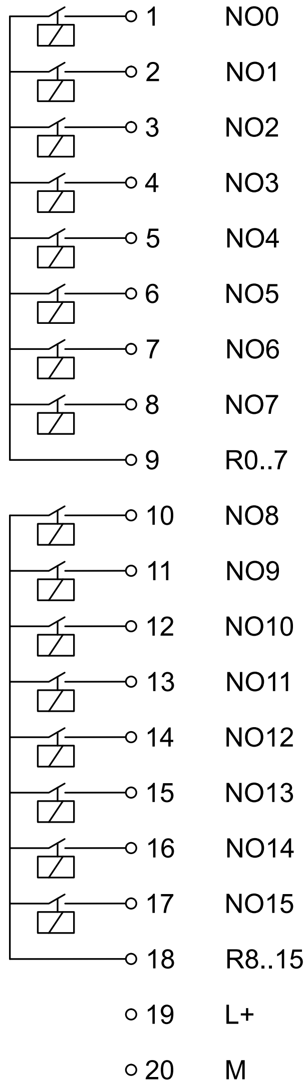


Table 47: Assignment of the Terminals:

Terminal	Signal	Description
1	NO0	Normally-open contact of the output NO0
2	NO1	Normally-open contact of the output NO1
3	NO2	Normally-open contact of the output NO2
4	NO3	Normally-open contact of the output NO3
5	NO4	Normally-open contact of the output NO4
6	NO5	Normally-open contact of the output NO5
7	NO6	Normally-open contact of the output NO6
8	NO7	Normally-open contact of the output NO7
9	R0..7	Output common for signals NO0 to NO7
10	NO8	Normally-open contact of the output NO8
11	NO9	Normally-open contact of the output NO9
12	NO10	Normally-open contact of the output NO10
13	NO11	Normally-open contact of the output NO11
14	NO12	Normally-open contact of the output NO12

Terminal	Signal	Description
15	NO13	Normally-open contact of the output NO13
16	NO14	Normally-open contact of the output NO14
17	NO15	Normally-open contact of the output NO15
18	R8..15	Output common for signals NO8 to NO15
19	L+	Process voltage L+ (24 VDC)
20	M	Process voltage M (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 5 mA per DO573.

The external power supply connection is carried out via the L+ (+24 VDC) and the M (0 VDC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/bus module.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

For screw-type terminals only:

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the I/O Module!
The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be supplied from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules can be damaged by overload.

Make sure that the total current of each output common terminal (R0..7 and R8..15) does not exceed 10 A.

Never connect total currents > 10 A per group.

The following figure shows the electrical connection of the module:

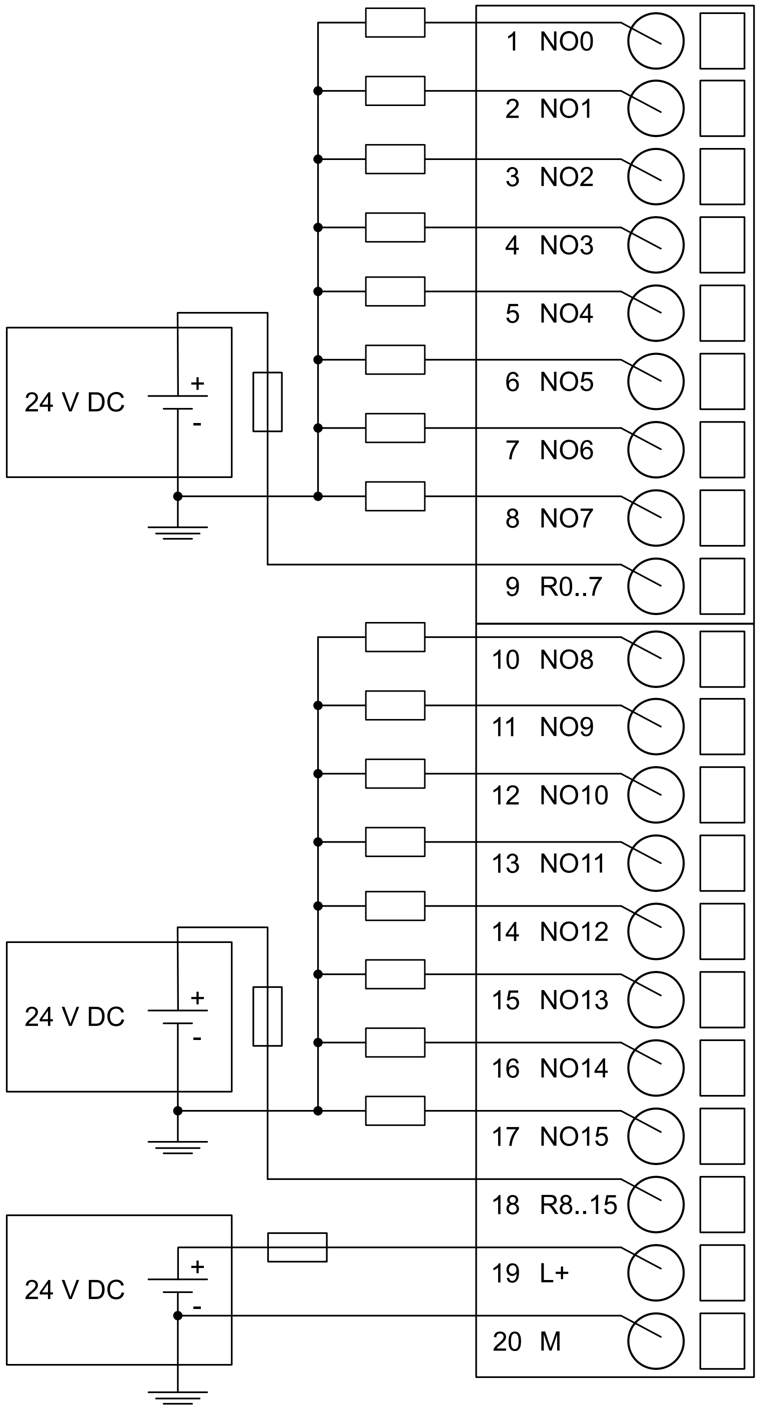


Fig. 16: Connection of 24 VDC actuators

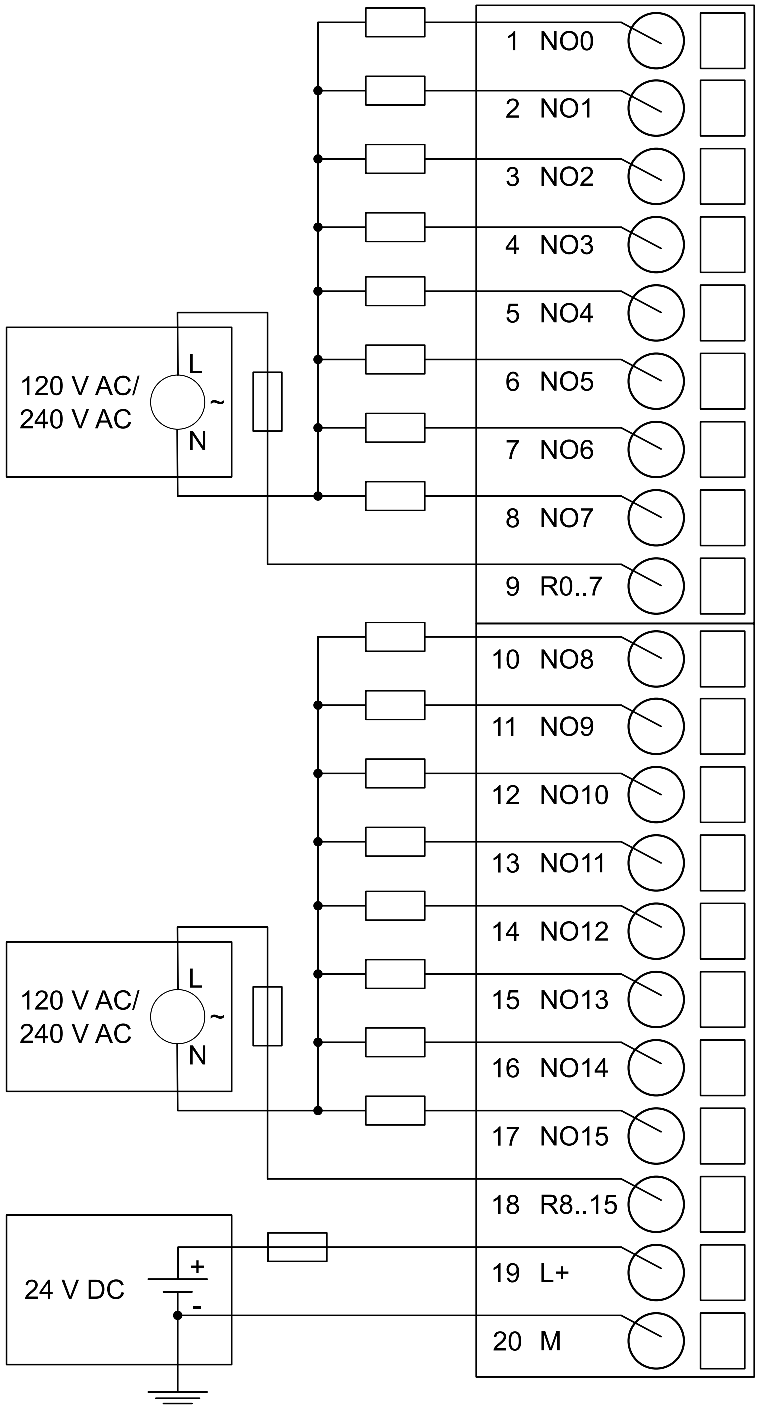


Fig. 17: Connection of 100-240 VAC actuators

The module provides several diagnosis functions (see section Diagnosis ➪ *Chapter 1.5.1.1.11.6 "Diagnosis" on page 269*).

The meaning of the LEDs is described in the section State LEDs ➪ *Chapter 1.5.1.1.10.7 "State LEDs" on page 259*.

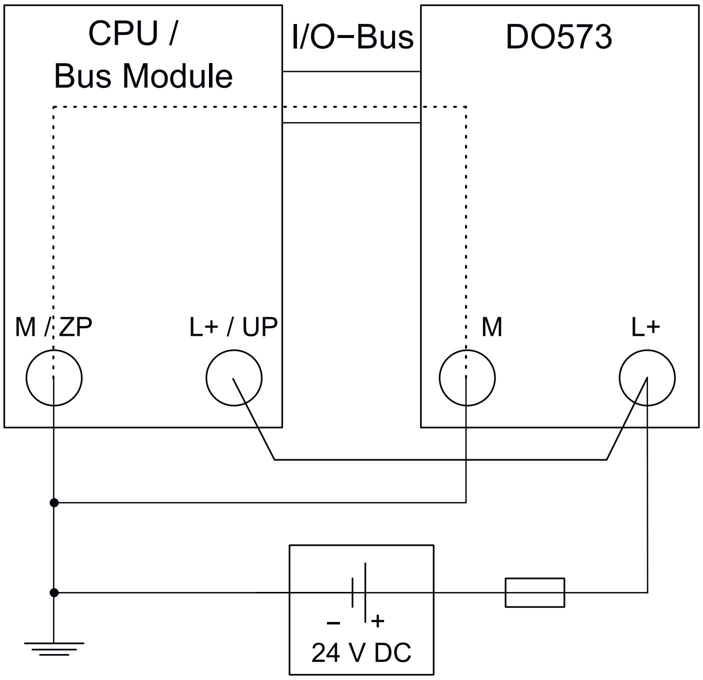


Fig. 18: Power supply - the negative connection is realized via the I/O bus

> *The L+ connection of the DO573 and the 24 V supply of the CPU/bus module must be connected to the same 24 V power supply .*

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6150 [1])	WORD	6150 0x1806	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x07 0x18, 0x07, 0x00, 0x03, 0x01, 0x00, 0x00;

Diagnosis

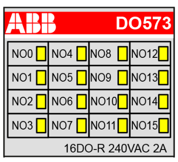
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
				Module error			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
4	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1...10 = decentralized communication interface module 1...10, ADR = Hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs NO0...NO15	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminals 19 for L+ (+24 VDC) and 20 for M (0 VDC)
	Rated value	24 VDC
	Current consumption via L+	50 mA
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by an 5 A fast fuse
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 5 mA
Galvanic isolation		Yes, between the output groups and the rest of the module
Isolated groups		2 (8 channels per group)
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		2.0 W
Weight		Ca. 160 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	16 normally-open relay outputs
Distribution of the channels into groups	2 (8 channels per group)
Connection of the channels NO0 to NO7	Terminals 1 to 8
Connection of the channels NO8 to NO15	Terminals 10 to 17
Reference potential for the channels NO0 to NO7	Terminal 9 (signal name R0..7)
Reference potential for the channels NO8 to NO15	Terminal 18 (signal name R8..15)
Relay coil power supply	Terminals 19 and 20 (signal names L+ and M)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation	Non-latching type

Parameter		Value
Relay output voltage		
	Rated value	24 VDC or 120/240 VAC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		2 bytes
Output current		
	Rated current per channel (max.)	2.0 A (24 VDC / 24 VAC / 48 VAC / 120 VAC / 240 VAC, only resistive loads) 2.0 A (24 VAC / 48 VAC / 120 VAC, only pilot duty) 1.5 A (240 VAC, only pilot duty)
	Rated current per group (max.)	10 A
Lamp load (max.)		200 W (230 VAC), 30 W (24 VDC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Life time of relay contacts (cycles)		100.000 at rated load
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Ordering Data

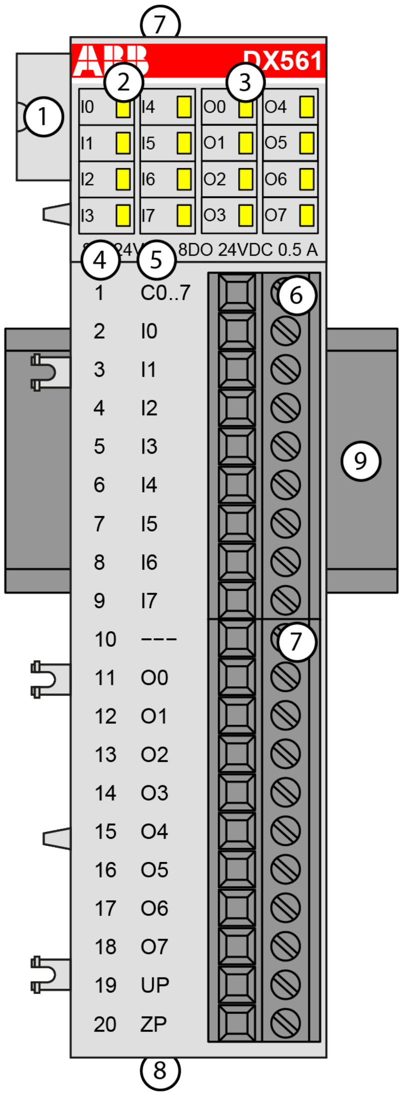
Part no.	Description	Product Life Cycle Phase *)
1SAP 231 300 R0000	DO573, digital output module, 16 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.12 DX561 - Digital Input/Output Module

- 8 digital inputs 24 VDC (I0 to I7) in 1 group
- 8 digital transistor outputs 24 VDC (O0 to O7) in 1 group
- Group-wise electrically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 to I7
3 8 yellow LEDs to display the signal states of the outputs O0 to O7
4 Terminal number
5 Allocation of signal name
6 Terminal block for input signals (9-pin)
7 Terminal block for output signals (11-pin)
8 2 holes for wall-mounting with screws
9 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs and outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules *Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital inputs and outputs:

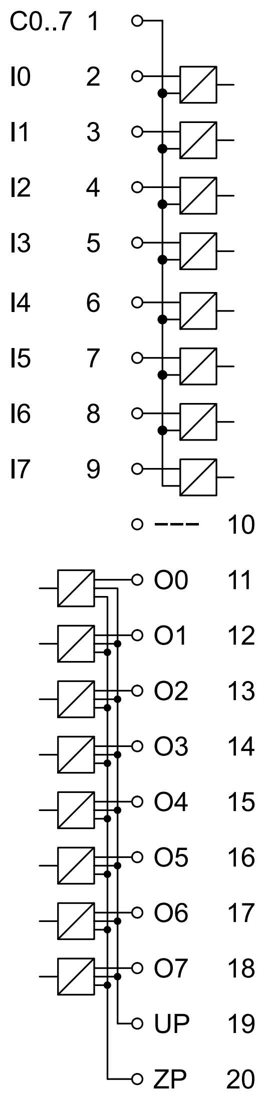


Table 48: Assignment of the Terminals:

Terminal	Signal	Description
1	C0...7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	---	Reserved
11	O0	Output signal O0
12	O1	Output signal O1
13	O2	Output signal O2

Terminal	Signal	Description
14	O3	Output signal O3
15	O4	Output signal O4
16	O5	Output signal O5
17	O6	Output signal O6
18	O7	Output signal O7
19	UP	Process voltage UP +24 VDC
20	ZP	Process voltage ZP 0 VDC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per DX561.

The external power supply connection is carried out via the UP (+24 VDC) and ZP (0 VDC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The digital inputs can be used as source inputs or as sink inputs.

NOTICE!
Risk of malfunctions in the plant!
A ground closure, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

The following figure shows the electrical connection of the inputs to the digital input/output module DX561:

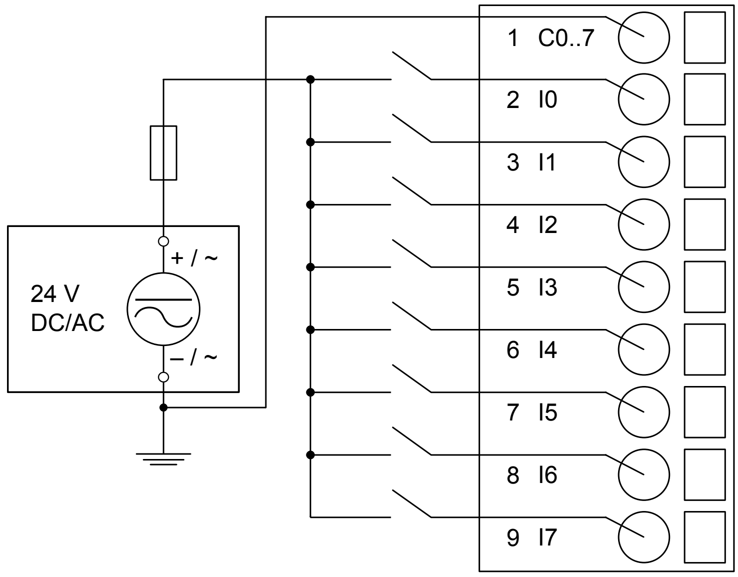


Fig. 19: Electrical connection of inputs - sink inputs

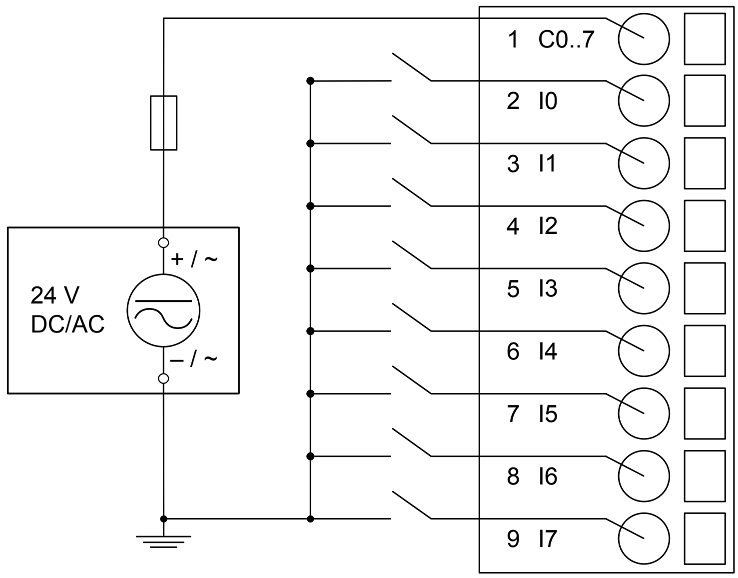


Fig. 20: Electrical connection of inputs - source inputs

The following figure shows the electrical connection of the outputs to the module:

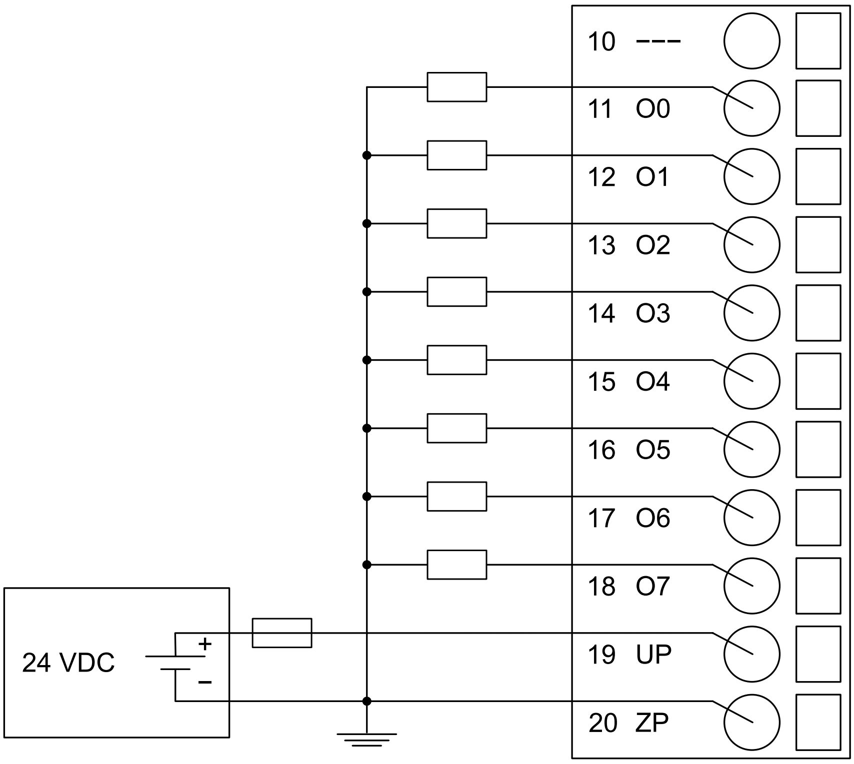


Fig. 21

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.
>
> This must be considered in the planning of the application.

> **NOTICE!**
> **Risk of damaging the I/O Module!**
> The outputs are not protected against short circuits and overload.
>
> – Never short-circuit or overload the outputs.
> – Never connect the outputs to other voltages.
> – Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions (see chapter Diagnosis *Chapter 1.5.1.1.12.6 “Diagnosis” on page 281*).

The meaning of the LEDs is described in the Displays section *Chapter 1.5.1.1.12.7 “State LEDs” on page 282* chapter.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configu-ration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6135 [1])	WORD	6135 0x17F7	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xF8, 0x17, 0x00,\
(0) =	0x01;

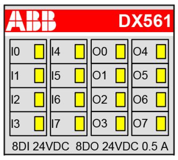
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
			Module error				
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
4	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0...I7	Digital input	Yellow	Input is OFF	Input is ON
	Outputs O0...O7	Digital output	Yellow	Output is OFF	Output is ON

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 VDC) and terminal 20 for ZP (0 VDC)
	Rated value	24 VDC
	Current consumption via UP terminal	5 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast fuse
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 10 mA
Galvanic isolation		Yes, between the input group and the output group and the rest of the module
Isolated groups		2 groups (1 group for 8 input channels, 1 group for 8 output channels)
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		2.3 W
Weight		ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Inputs

Parameter		Value	
Number of channels per module		8	
Distribution of the channels into groups		1 group for 8 channels	
Connections of the channels I0 to I7		Terminals 2 to 9	
Reference potential for the channels I0 to I7		Terminal 1	
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)	
Monitoring point of input indicator		LED is part of the input circuitry	
Input type according to EN 61131-2		Type 1 source	Type 1 sink
Input signal range		-24 VDC	+24 VDC
Signal 0		-5 V...+3 V	-3 V...+5 V
Undefined signal		-15 V...+ 5 V	+5 V...+15 V
Signal 1		-30 V...-15 V	+15 V...+30 V
Ripple with signal 0		-5 V...+3 V	-3 V...+5 V
Ripple with signal 1		-30 V...-15 V	+15 V...+30 V
Input current per channel			
	Input voltage +24 V	Typ. 5 mA	
	Input voltage +5 V	Typ. 1 mA	
	Input voltage +15 V	> 2.5 mA	
	Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	
Input delay (0->1 or 1->0)		Typ. 8 ms	
Input data length		1 byte	
Max. cable length			
	Shielded	500 m	
	Unshielded	300 m	

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	8 transistor outputs (24 VDC, 0.5 A max.)
Distribution of the channels into groups	1 group of 8 channels
Connection of the channels O0 to O7	Terminals 11 to 18
Reference potential for the channels O0 to O7	Terminal 20 (negative pole of the process voltage, name ZP)
Common power supply voltage	Terminal 19 (positive pole of the process voltage, name UP)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Monitoring point of output indicator	Controlled together with transistor

Parameter		Value
Way of operation		Non-latching type
Max. output voltage at signal 1		20 VDC at max. current consumption
Output delay		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 VDC
	Rated current per group (max.)	4 A
	Rated current (all channels together, max.)	4 A
	Lamp load (max.)	5 W
	Max. leakage current with signal 0	0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 VDC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Ordering Data

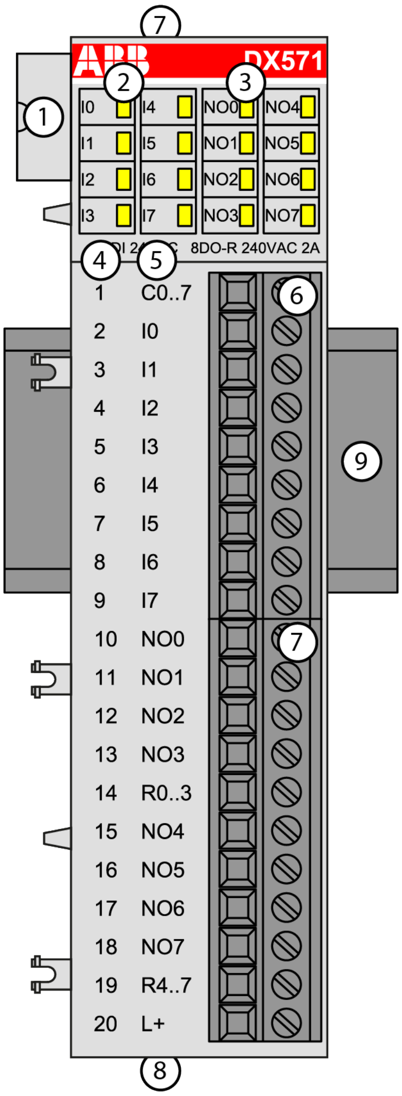
Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2301	DX561, digital input/output module, 8 DI 24 VDC, 8 DO 24 VDC, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.1.13 DX571 - Digital Input/Output Module

- 8 digital inputs 24 VDC / 24 VAC (I0 to I7) in 1 group
- 8 digital normally open relay outputs 24 VDC / 24 VAC or 100-240 VAC, 2 A max. (NO0 to NO7) in 2 groups
- Group-wise electrically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 to I7
3 8 yellow LEDs to display the signal states of the outputs NO0 to NO7
4 Terminal number
5 Allocation of signal name
6 Terminal block for input signals (9-pin)
7 Terminal block for output signals (11-pin)
8 2 holes for wall-mounting with screws
9 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs and outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminal L+ (process voltage 24 VDC). The negative pole is provided by the I/O bus.

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *➪ Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter Terminal Blocks for S500-eCo I/O Modules ➪ *Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital inputs and outputs:

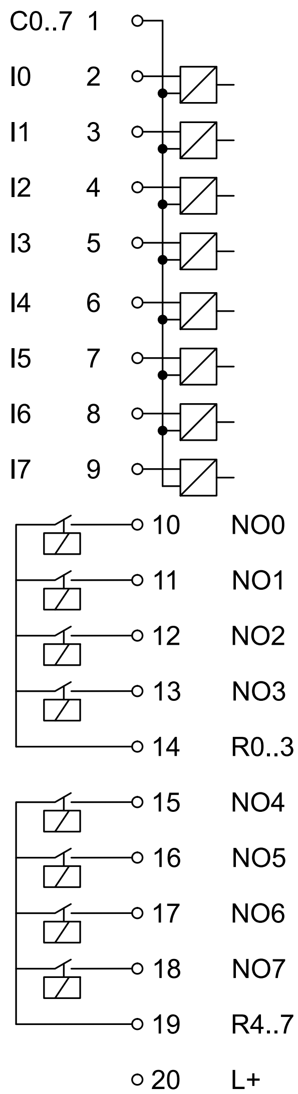


Table 49: Assignment of the Terminals:

Terminal	Signal	Description
1	C0...7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	NO0	Normally-open contact of the output 0
11	NO1	Normally-open contact of the output 1
12	NO2	Normally-open contact of the output 2

Terminal	Signal	Description
13	NO3	Normally-open contact of the output 3
14	R0...3	Output common for signals O0 to O3
15	NO4	Normally-open contact of the output 4
16	NO5	Normally-open contact of the output 5
17	NO6	Normally-open contact of the output 6
18	NO7	Normally-open contact of the output 7
19	R4...7	Output common for signals O4 to O7
20	L+	Process voltage +24 VDC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 5 mA per DX571.

The external power supply connection is carried out via the L+ (+24 VDC) terminal. The negative pole of the external power supply is realized via the I/O bus. Therefore, the CPU/bus module and the DX571 must have a common power supply.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions (see Diagnosis *Chapter 1.5.1.1.13.6 “Diagnosis” on page 294*).

The digital inputs can be used as source inputs or as sink inputs.

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> A ground closure, e. g. caused by a damaged cable insulation, can bridge switches accidentally.
>
> Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

The following figures show the electrical connection of the inputs to the digital input/output module DX571:

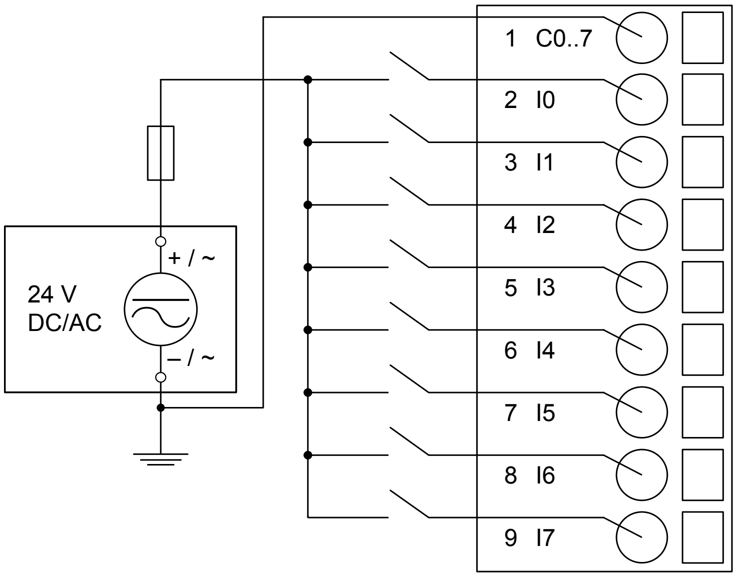


Fig. 22: Electrical connection of inputs - sink inputs

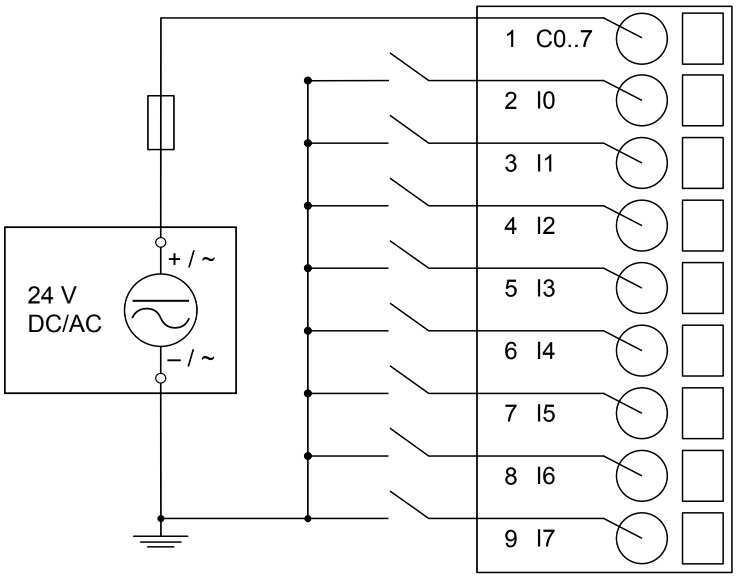


Fig. 23: Electrical connection of inputs - source inputs

The following figures show the electrical connection of the outputs to the module:

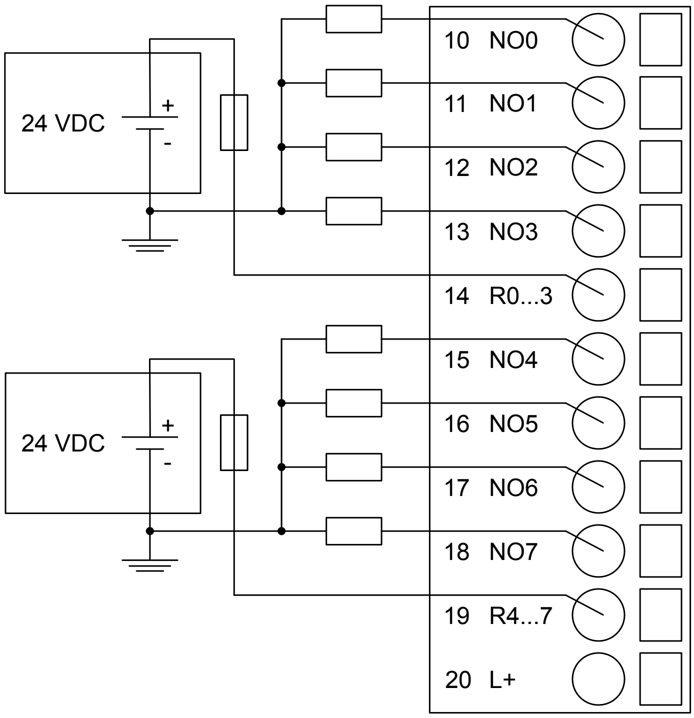


Fig. 24: Connection of 24 VDC actuators

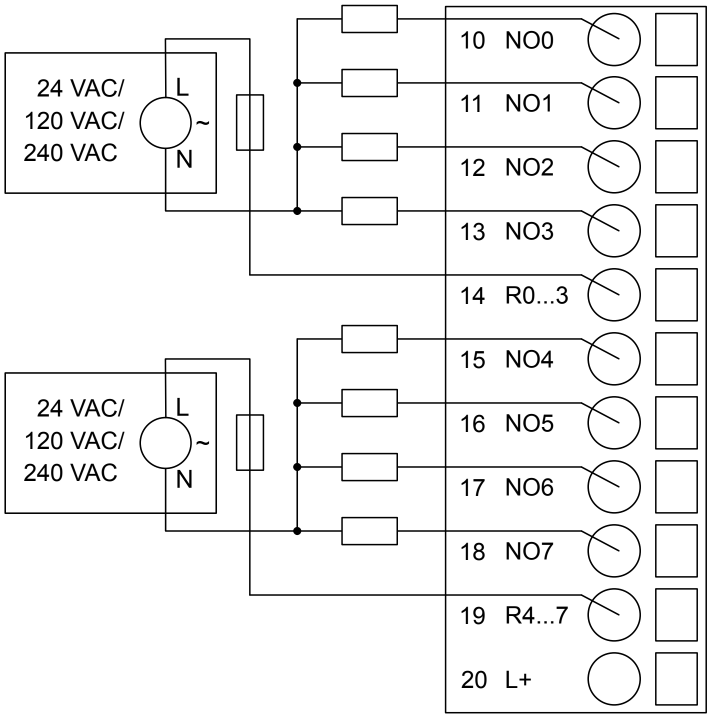


Fig. 25: Connection of 24 VAC or 100-240 VAC actuators

The L+ connection of the DX571 and the 24 V supply of the CPU/bus module must be connected to the same 24 V power supply.

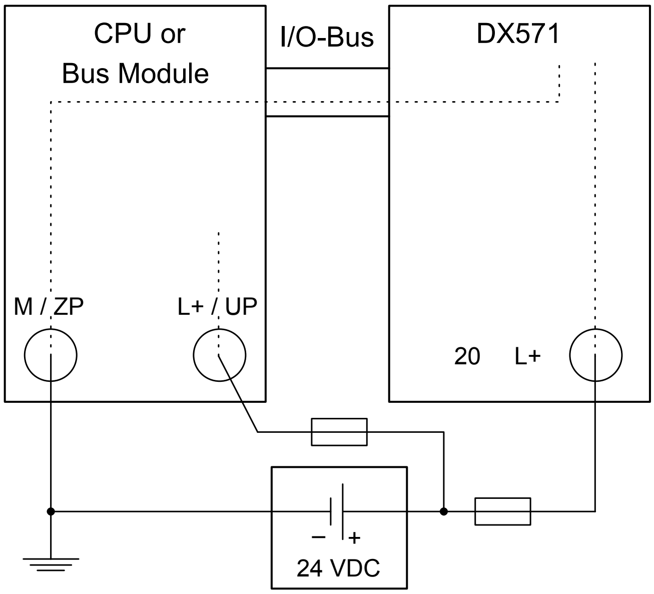


Fig. 26: Power supply - the minus connection is realized via the I/O bus

> **WARNING!**
> **Risk of death by electric shock!**
> Hazardous voltages can be present at the terminals of the module.
>
> Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

For screw-type terminals only:

> **WARNING!**
> **For screw terminals only: Danger of death by electric shock!**
> The IP 20 protection degree is only provided if all terminal screws are tightened.
>
> Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

> **NOTICE!**
> **Risk of damaging the I/O Module!**
> The outputs are not protected against short circuit and overload.
>
> – Never short-circuit or overload the outputs.
> – Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
> – Never connect voltages > 240 V. All outputs must be supplied from the same phase.
> – Use an external 5 A fast protection fuse for the outputs.

The meaning of the LEDs is described in the Displays section *Chapter 1.5.1.1.13.7 “State LEDs” on page 295*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configu-ration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6140 [1])	WORD	6140 0x17FC	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			
[1]) with CS31 and addresses smaller than 70, the value is increased by 1							
[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)							

GSD file:

Ext_User_Prm_Data_Len =	0x04
Ext_User_Prm_Data_Const(0) =	0xFD, 0x17, 0x00,\
(0) =	0x01;

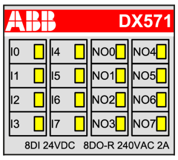
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<- Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	PNIO diagnosis block	
Class	Inter face	Device	Module	Channel	Error Identifier	Error message	Remedy
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
4	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1...10 = communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = Module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = Module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0...I7	Digital input	Yellow	Input is OFF	Input is ON
	Outputs NO0...NO7	Digital output	Yellow	Output is OFF	Output is ON

In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 VDC). The minus pole is provided by the I/O-Bus.
	Rated value	24 VDC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by a 3 A fast fuse
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the output group and the rest of the module
Isolated groups		3 groups (1 group for 8 input channels, 2 groups for 8 output channels)
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		2.3 W
Weight		Ca. 150 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Inputs

Parameter	Value		
Number of channels per module	8		
Distribution of the channels into groups	1 group for 8 channels		
Connections of the channels I0 to I7	Terminals 2 to 9		
Reference potential for the channels I0 to I7	Terminal 1		
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)		
Monitoring point of input indicator	LED is part of the input circuitry		
Input type according to EN 61131-2	Type 1 source	Type 1 sink	Type 1 AC
Input signal range	-24 VDC	+24 VDC	24 VAC 50/60 Hz
Signal 0	-5 V...+3 V	-3 V...+5 V	0 VAC...5 VAC
Undefined signal	-15 V...+ 5 V	+5 V...+15 V	5 VAC...14 VAC
Signal 1	-30 V...-15 V	+15 V...+30 V	14 VAC...27 VAC
Input current per channel			
Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
Input voltage 14 V			Typ. 2.7 mA r.m.s.
Input voltage 15 V	> 2.5 mA		
Input voltage 27 V			Typ. 5.5 mA r.m.s.
Input voltage 30 V	< 8 mA		
Max. permissible leakage current (at 2-wire proximity switches)	1 mA		Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)	Typ. 8 ms		
Input data length	1 byte		
Max. cable length			
Shielded	500 m		
Unshielded	300 m		

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	8 normally-open relay outputs
Distribution of the channels into groups	2 (4 channels per group)
Connection of the channels O0 to O3	Terminals 10 to 13
Connection of the channels O4 to O7	Terminals 15 to 18

Parameter		Value
Reference potential for the channels O0 to O3		Terminal 14 (signal name R0..3)
Reference potential for the channels O4 to O7		Terminal 19 (signal name R4..7)
Relay coil power supply		Terminal 20 (positive pole of the process supply voltage, signal name L+). The negative pole is provided by the I/O bus.
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered through the I/O bus
Monitoring point of output indicator		Controlled together with relay
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 VDC / 24 VAC or 120/240 VAC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		1 byte
Output current		
	Rated current per channel (max.)	2.0 A (24 VDC / 24 VAC / 48 VAC / 120 VAC / 240 VAC, only resistive loads) 2.0 A (24 VAC / 48 VAC / 120 VAC, only pilot duty) 1.5 A (240 VAC, only pilot duty)
	Rated current per group (max.)	8 A
Lamp load (max.)		200 W (230 VAC), 30 W (24 VDC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Life time of relay contacts (cycles)		100.000 at rated load
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Ordering Data

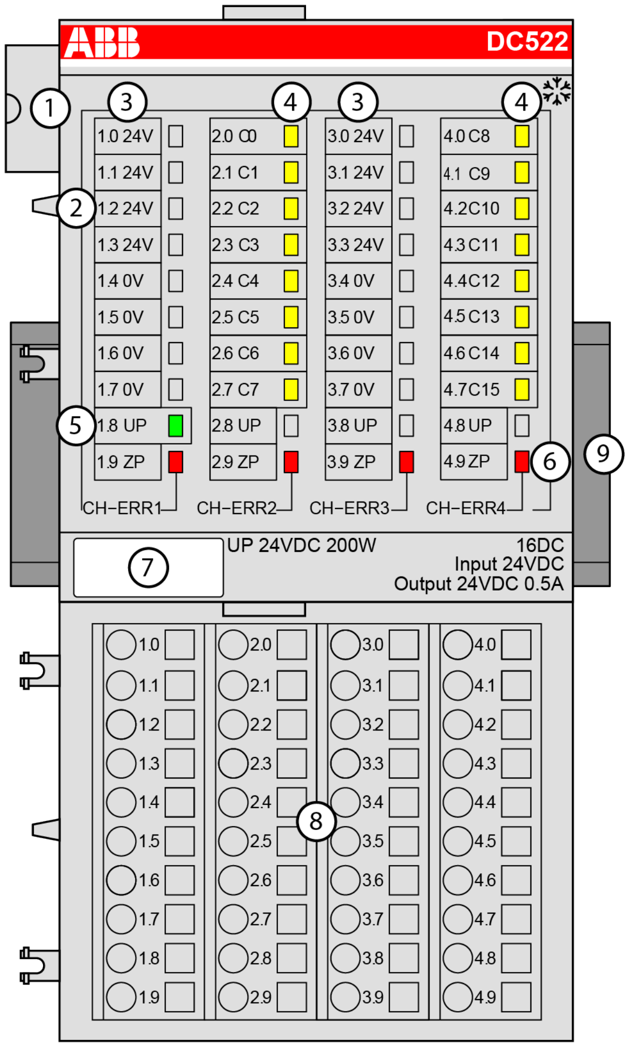
Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R2302	DX571, digital input/output module, 8 DI 24 VDC / 24 VAC, 8 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2 S500

1.5.1.2.1 DC522 - Digital Input/Output Module

- 16 configurable digital inputs/outputs
- Module-wise electrically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 Sensor power supply 24 VDC / 0.5 A
4 16 yellow LEDs to display the signal states at the digital inputs/outputs (C0 - C15)
5 1 green LED to display the state of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Digital configurable input/output unit.

- 2 sensor supply voltages 24 VDC, 0.5 A, with short-circuit and overload protection
- 16 digital configurable inputs/outputs 24 VDC (C0 to C15) in 1 group (2.0...2.7 and 4.0...4.7), each of which can be used
  - as an input,
  - as a transistor output with short-circuit and overload protection, 0.5 A rated current or
  - as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 VDC.

All available inputs/outputs are electrically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit	TU515 or TU516 ➡ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit ➡ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting (TA526 ➡ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

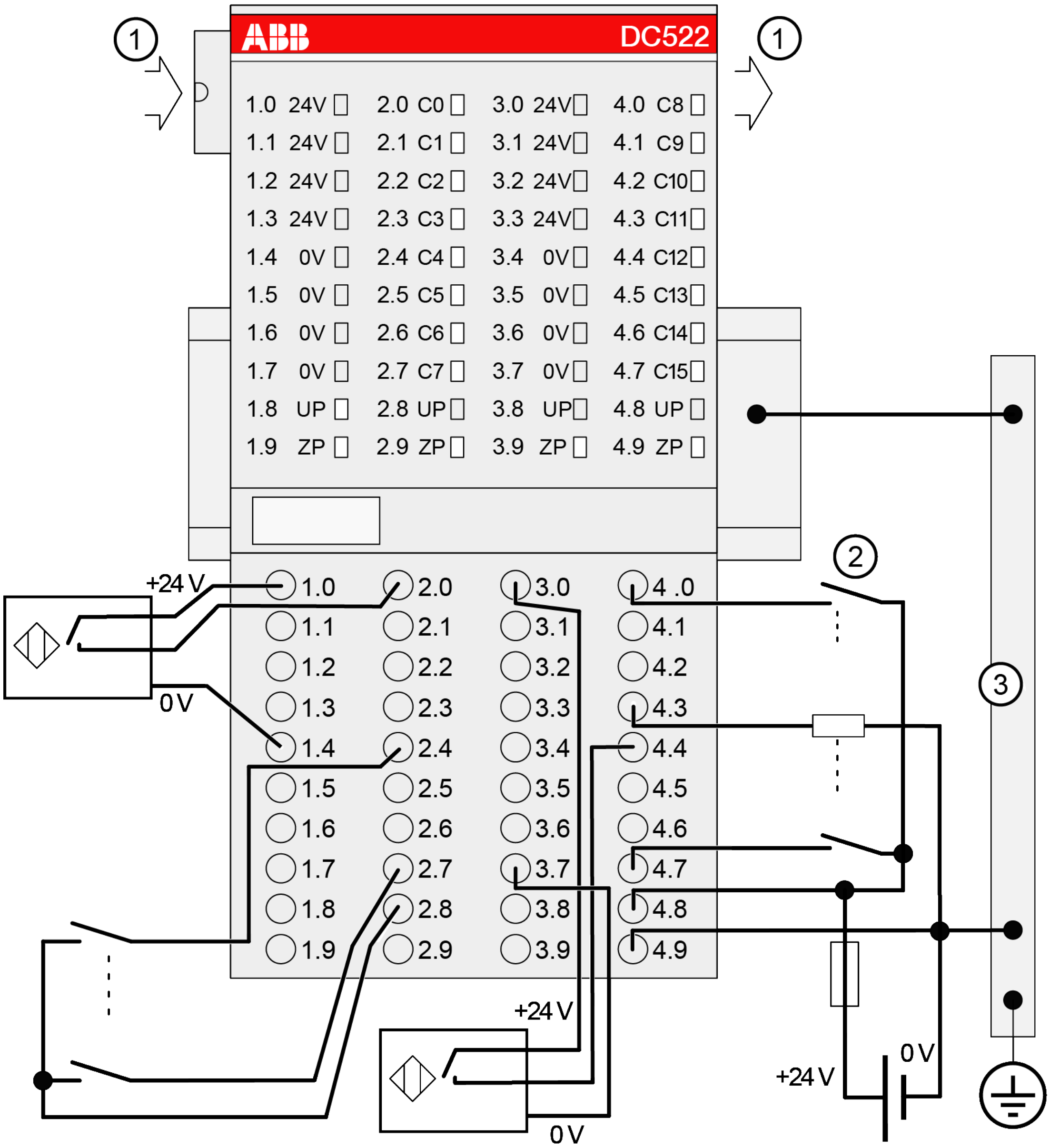
Electrical Connection

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 to 4.8: process voltage UP = +24 VDC

Terminals 1.9 to 4.9: process voltage ZP = 0 VDC



1 I/O bus
2 4.0 - 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Switch-gear cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 to 1.7	0 V	0 V (reference potential)
2.0 to 2.7	C0 to C7	8 digital inputs/outputs
3.0 to 3.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
3.4 to 3.7	0 V	0 V (reference potential)
4.0 to 4.7	C8 to C15	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DC522.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC522.

Connect a 470 Ω / 1 W resistor in series to inputs C8/C9 if they are used as fast counter inputs to avoid any influences.

The modules provide several diagnosis functions *Chapter 1.5.1.2.1.7 “Diagnosis” on page 304*.

Internal Data Exchange

	Without the Fast Counter	With the Fast Counter (only with AC500)
Digital inputs (bytes)	2	4
Digital outputs (bytes)	2	4
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1220 [1])	Word	1220 0x04C4	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	7	Byte	7-CPU 6-FBP	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter 4)	0 : 10 3)	0 : 10	Byte	Mode 0 0x00			Not for FBP
Short-circuit detection of output or sensor supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs Bit 15 = Output 15 Bit 0 = Output 0	0... 65535	0... 0xffff	Word	0 0x0000	0	65535	0x0Y07

Remarks:

1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the Fast Counter section ↯ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*
4)	With FBP or CS31 without the parameter Fast counter

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	9 0x04, 0xc5, 0x06, \ 0x01, 0x02, 0x01, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short-circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	2	0...15	47	Short-circuit at an output	Check connection
	11 / 12	ADR	1...10				

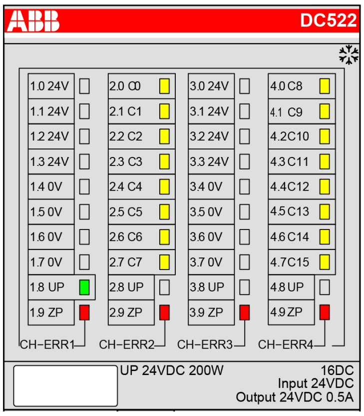
Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O-Bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = communication interface module 1...10, ADR = hardware address (e.g. of the DC551)

3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (4 = DC); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.



LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs C0...C15	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON 1)	--
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR 2)	Module error	Red	--	Internal error	--
	1) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	2) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)

Parameter		Value
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.005 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Sensor power supply		
	Connections	Terminals 1.0...1.3 = +24 V, 1.4...1.7 = 0 V Terminals 3.0...3.3 = +24 V, 3.4...3.7 = 0 V
	Voltage	24 VDC with short-circuit and overload protection
	Loadability	Terminals 1.0...1.3, in total max. 0.5 A Terminals 3.0...3.3, in total max. 0.5 A
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	16 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 16 channels
If the channels are used as inputs	
Channels C0...C7	Terminals 2.0...2.7
Channels C8...C15	Terminals 4.0...4.7
If the channels are used as outputs	
Channels C0...C7	Terminals 2.0...2.7
Channels C8 C15	Terminals 4.0...4.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Galvanic isolation	From the rest of the module

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter	Value
Number of channels per module	Max. 16 digital inputs
Reference potential for all inputs	Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation	From the rest of the module
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Input type acc. to EN 61131-2	Type 1
Input delay (0->1 or 1->0)	Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V *)
Undefined signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V *)
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 5 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

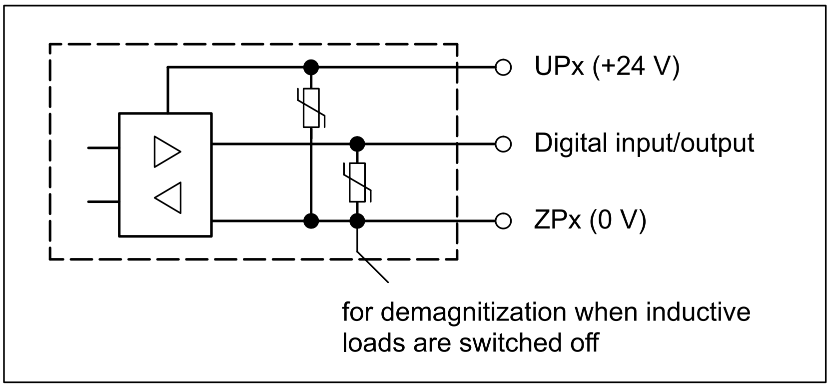


Fig. 27: Digital input/output (circuit diagram)

Technical Data of the Fast Counter

The fast counter of the module does not work if the module is connected to a

- *FBP interface module*
- *CS31 bus module*
- *CANopen bus module*

Parameter	Value
Used inputs	C8 / C9
Used outputs	C10
Counting frequency	Max. 50 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

Ordering Data

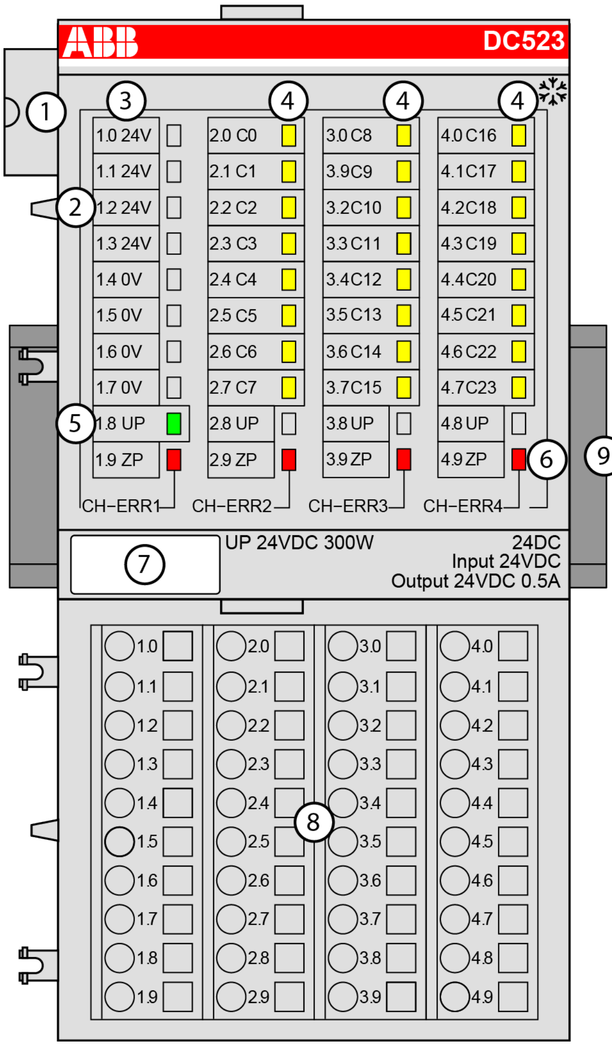
Part no.	Description	Product Life Cycle Phase *)
1SAP 240 600 R0001	DC522, digital input/output module, 16 DC, 24 VDC / 0.5 A, 2-wires	Active
1SAP 440 600 R0001	DC522-XC, digital input/output module, 16 DC, 24 VDC / 0.5 A, 2-wires, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.2 DC523 - Digital Input/Output Module

- 24 configurable digital inputs/outputs
- Module-wise electrically isolated

- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 Sensor power supply 24 VDC / 0.5 A
4 24 yellow LEDs to display the signal states at the digital inputs/outputs (C0 - C23)
5 1 green LED to display the status of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Digital configurable input/output unit.

- 1 sensor supply voltage 24 VDC, 0.5 A, with short circuit and overload protection
- 24 digital configurable inputs/outputs 24 VDC (C0 to C23) in 1 group (2.0...2.7, 3.0...3.7 and 4.0...4.7), of which each can be used
  – as an input,
  – as a transistor output with short circuit and overload protection, 0.5 A rated current or
  – as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 VDC.

All available inputs/outputs are electrically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit	TU515 or TU516 *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

> **!** **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

The device is plugged on a terminal unit *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

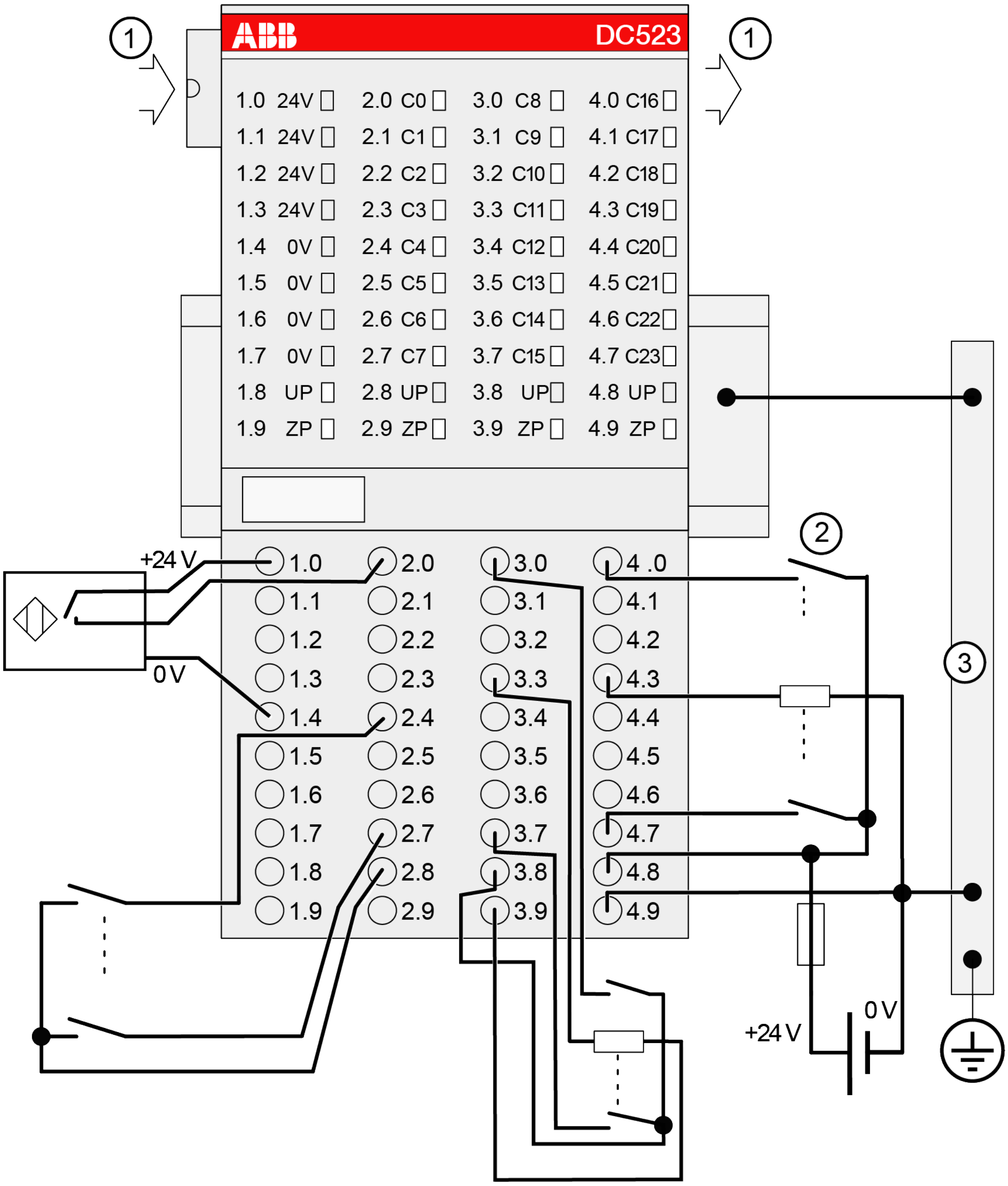
Electrical Connection

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 to 4.8: process voltage UP = +24 VDC

Terminals 1.9 to 4.9: process voltage ZP = 0 VDC



1 I/O bus
2 4.0 - 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Switch-gear cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 to 1.7	0 V	0 V (reference potential)
2.0 to 2.7	C0 to C7	8 digital inputs/outputs

Terminals	Signal	Description
3.0 to 3.7	C8 to C15	8 digital inputs/outputs
4.0 to 4.7	C16 to C23	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DC523.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC523.

Connect a 470 Ω / 1 W resistor in series to inputs C16/C17 if they are used as fast counter inputs to avoid any influences.

The modules provide several diagnosis functions *Chapter 1.5.1.2.2.7 “Diagnosis” on page 317*.

Internal Data Exchange

	Without the Fast Counter	With the Fast Counter (only with AC500)
Digital inputs (bytes)	3	5
Digital outputs (bytes)	3	5
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1215 [1])	Word	1215 0x04BF	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	9	Byte	9-CPU 8-FBP	0	255	0x0Y02
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x=Y03

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP
Short circuit detection of output or sensor supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs B23 = Output 23 Bit 0 = Output 0	0... 16777215	0... 0x00ff-ffff	DWord	0 0x0000 -0000	0	224−1	0x0Y07

Remarks:

[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the Fast Counter section *Chapter 1.5.1.2.10 “Fast Counter” on page 396*
[4])	With FBP or CS31 without the parameter fast counter

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	11 0x04, 0xc0, 0x08, \ 0x01, 0x02, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

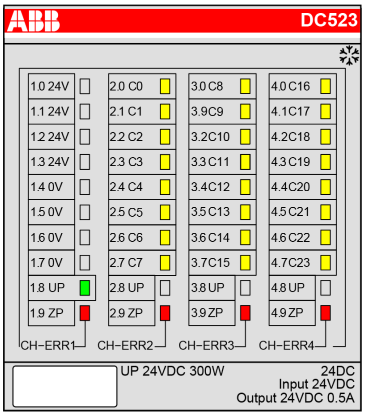
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	2	0...23	47	Short circuit at an output	Check connection
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = Hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = Module type (4 = DC); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs C0...C23	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON [1])	--
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical Data

The System Data of AC500 and S500 ↪ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ↪ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/Bus Module	Ca. 2 mA
	From UP at normal operation / with outputs	0.1 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.008 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Sensor power supply		
	Connections	Terminals 1.0...1.3 = +24 V, 1.4...1.7 = 0 V
	Voltage	24 VDC with short circuit and overload protection
	Loadability	Terminals 1.0...1.3, in total max. 0.5 A
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	24 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 24 channels
If the channels are used as inputs	
Channels C0...C7	Terminals 2.0...2.7
Channels C8...C15	Terminals 3.0...3.7
Channels C16...C23	Terminals 4.0...4.7
If the channels are used as outputs	
Channels C0...C7	Terminals 2.0...2.7
Channels C8 C15	Terminals 3.0...3.7
Channels C16...C23	Terminals 4.0...4.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Galvanic isolation	From the rest of the module

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter	Value
Number of channels per module	Max. 24 digital inputs
Reference potential for all inputs	Terminals 1.9, 2.9, 3.9 and 4.9 (minus pole of the process supply voltage, signal name ZP)
Galvanic isolation	From the rest of the module
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Input type acc. to EN 61131-2	Type 1
Input delay (0->1 or 1->0)	Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V *)
Undefined signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V *)
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 5 mA

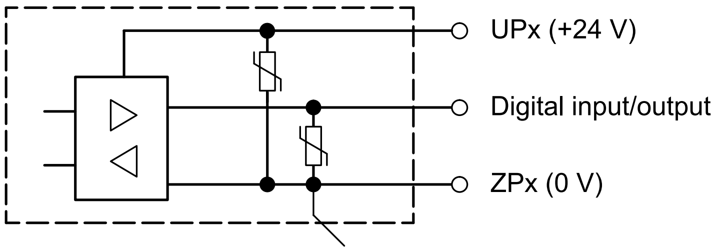
Parameter		Value
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter		Value
Number of channels per module		Max. 24 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



Technical Data of the Fast Counter

The fast counter of the module does not work if the module is connected to a
- *FBP interface module*
- *CS31 bus module*
- *CANopen bus module*

Parameter	Value
Used inputs	C16 / C17
Used outputs	C18
Counting frequency	Max. 50 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

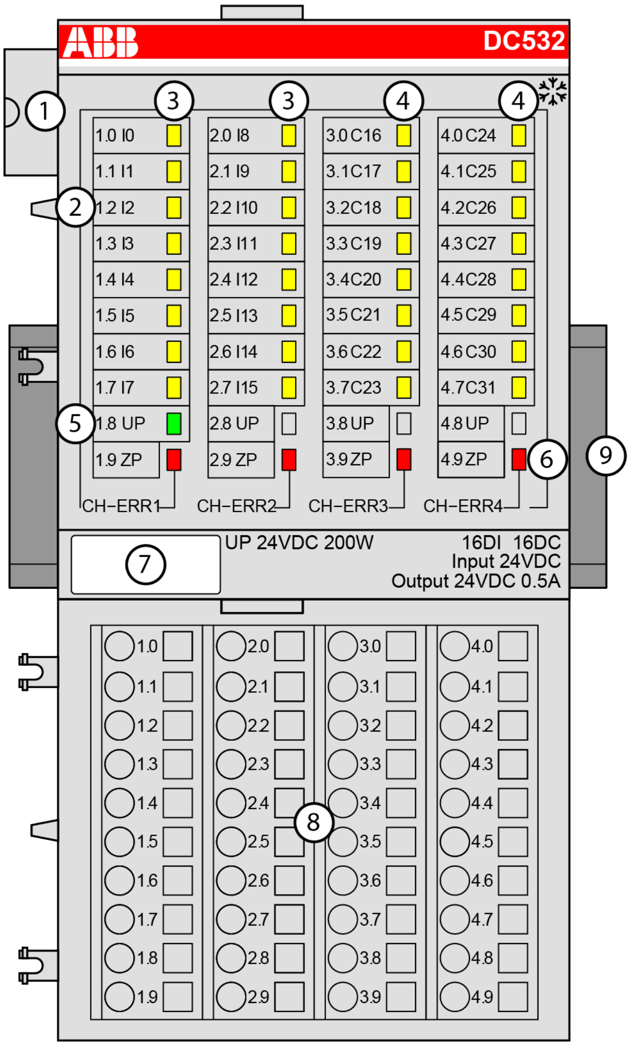
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 240 500 R0001	DC523, digital input/output module, 24 DC, 24 VDC / 0.5 A, 1-wire	Active
1SAP 440 500 R0001	DC523-XC, digital input/output module, 24 DC, 24 VDC / 0.5 A, 1-wire, XC Version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.3 DC532 - Digital Input/Output Module

- 16 digital inputs 24 VDC, 16 configurable digital inputs/outputs
- Module-wise electrically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the digital inputs (I0 - I15)
4 16 yellow LEDs to display the signal states at the digital inputs/outputs (C16 - C31)
5 1 green LED to display the state of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Digital configurable input / output unit.

- 16 digital inputs 24 VDC in 2 groups (1.0...1.7 and 2.0...2.7)
- 16 digital configurable inputs/outputs 24 VDC (C16 to C31) in 1 group (3.0...3.7 and 4.0...4.7), of which each can be used
  - as an input,
  - as a transistor output with short circuit and overload protection, 0.5 A rated current or
  - as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 VDC.

All available inputs/outputs are electrically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Digital inputs	16 (24 VDC)
Digital inputs/outputs	16 (24 VDC)
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit	TU515 or TU516 *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter Chapter 2.6 “AC500 (Standard)” on page 1252.

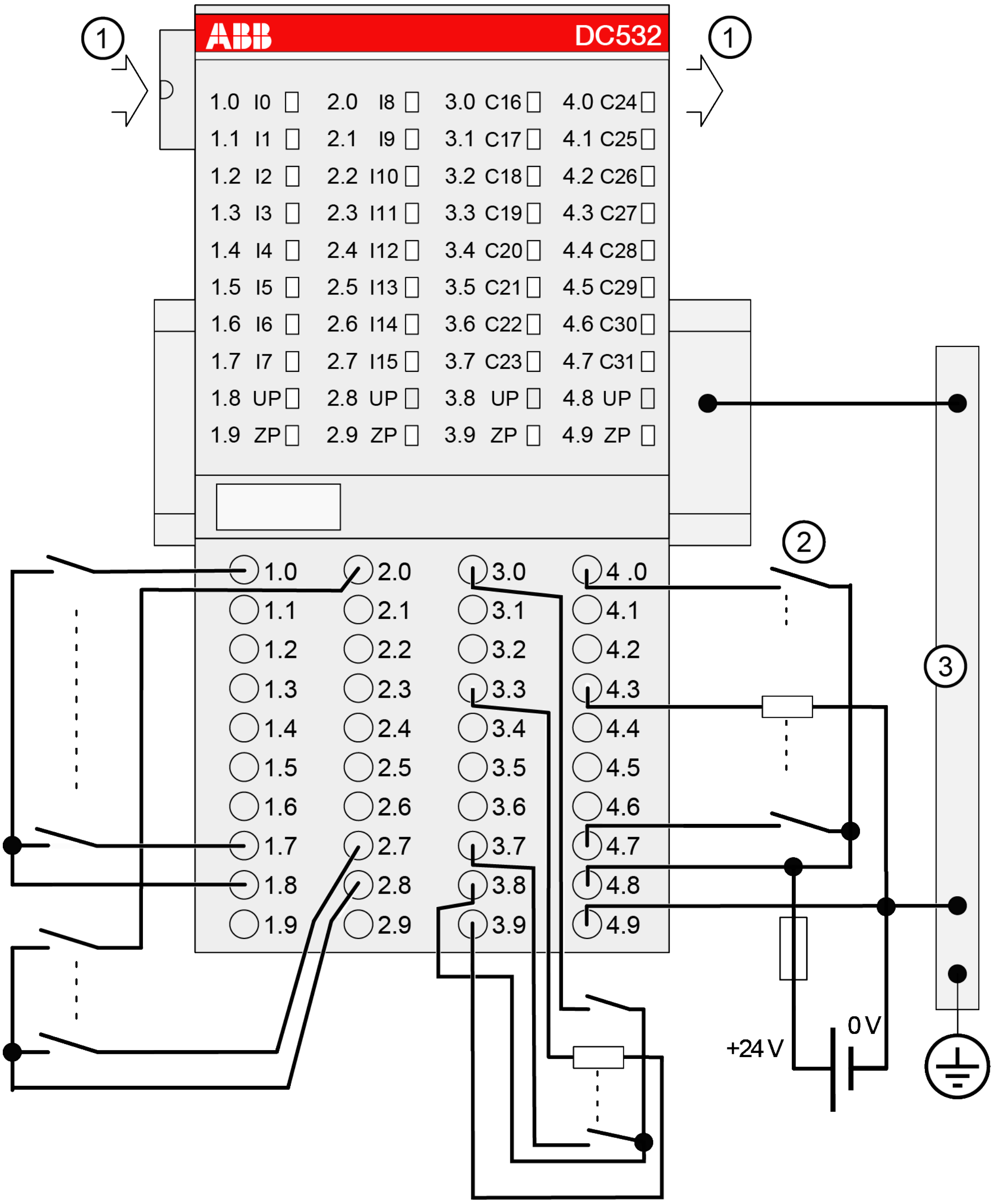
Electrical Connection

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 to 4.8: process voltage UP = +24 VDC

Terminals 1.9 to 4.9: process voltage ZP = 0 VDC



1 I/O bus
2 4.0 - 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Switch-gear cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0 to I7	8 digital inputs
2.0 to 2.7	I8 to I15	8 digital inputs
3.0 to 3.7	C16 to C23	8 digital inputs/outputs
4.0 to 4.7	C24 to C31	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DC532.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC532.

Connect a 470 Ω / 1 W resistor in series to inputs C24/C25 if using them as fast counter inputs to avoid any influences.

The module provides several diagnosis functions *Chapter 1.5.1.2.3.7 “Diagnosis” on page 329*.

Internal Data Exchange

	Without the Fast Counter	**With the Fast Counter (only with AC500)**
Digital inputs (bytes)	4	6
Digital outputs (bytes)	2	4
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	**Configuration**
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	**Value**	**Internal value**	**Internal value, type**	**Default**	**Min.**	**Max.**	
Module ID	Internal	1200 [1])	Word	1200 0x04B0	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	7	Byte	7-CPU 6-FBP	0	255	0x0Y02

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter 4)	0 : 10 3)	0 : 10	Byte	Mode 0 0x00			Not for FBP
Output short circuit detection	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs Bit 15 = Output 15 Bit 0 = Output 0	0... 65535	0... 0xffff	Word	0 0x0000	0	65535	0x0Y07

Remarks:

1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the Fast Counter section *Chapter 1.5.1.2.10 “Fast Counter” on page 396*
4)	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	9
Ext_User_Prm_Data_Const(0) =	0x04, 0xb1, 0x06, \
	0x01, 0x02, 0x01, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore, an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

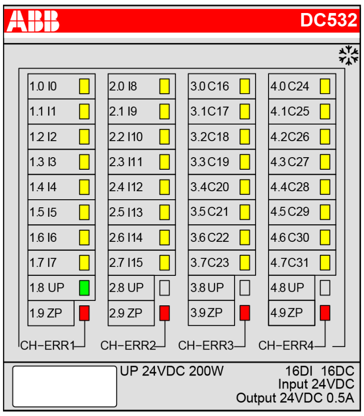
E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500 display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error Identi-fier	Error message	Remedy
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firm-ware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON –> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error DC532							
4	14	1...10	2	16...31	47	Short circuit at a digital output	Check connec-tion
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (4 = DC); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.



LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I15	Digital input	Yellow	Input = OFF	Input = ON 1)	--
	Inputs/ outputs C16...C31	Digital input/ output	Yellow	Input/output = OFF	Input/output = ON 1)	--
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR 2)	Module Error	Red	--	Internal error	--
	1) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	2) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical Data

The System Data of AC500 and S500 ➪ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ➪ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.007 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		16
Distribution of the channels into groups		1 group of 16 channels
Terminals of the channels I0 to I7		1.0 to 1.7
Terminals of the channels I8 to I15		2.0 to 2.7
Reference potential for all inputs		Terminals 1.9, 2.8, 3.8 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module (I/O bus)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V
	Undefined signal	> +5 V...< +15 V Parameter
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		16 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
If the channels are used as inputs		
	Channels I16...I23	Terminals 3.0...3.7
	Channels I24...I31	Terminals 4.0...4.7
If the channels are used as outputs		

Parameter		Value
	Channels Q16...Q23	Terminals 3.0...3.7
	Channels Q24...Q31	Terminals 4.0...4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		From the rest of the module

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter		Value
Number of channels per module		Max. 16 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Input current, per channel		See Technical Data of the Digital Inputs ➡ *Chapter 1.5.1.2.3.9.1 “Technical Data of the Digital Inputs” on page 332*
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 VDC
Signal 0		-3 V...+5 V *)
undefined signal		> +5 V...< +15 V
Signal 1		+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V *)
Ripple with signal 1		Within +15 V...+30 V
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

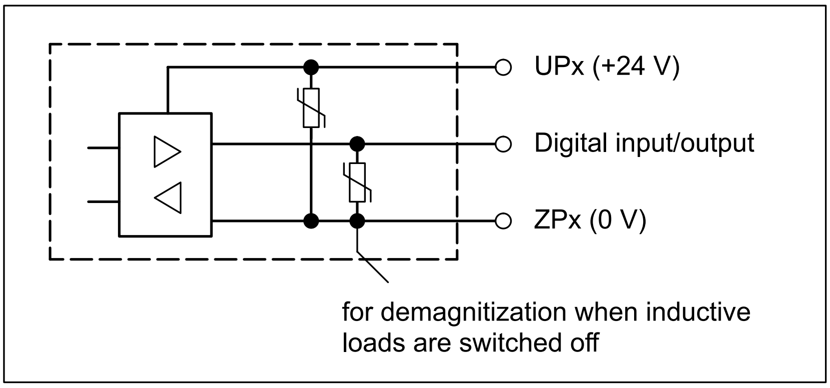
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	Max. 16 transistor outputs
Reference potential for all outputs	Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)
Output delay (0->1 or 1->0)	On request

Parameter		Value
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



Technical Data of the Fast Counter

> *The fast counter of the module does not work if the module is connected to a*
> – *FBP interface module*
> – *CS31 bus module*
> – *CANopen bus module*

Parameter	Value
Used inputs	C24/C25
Used outputs	C26
Counting frequency	Max. 50 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

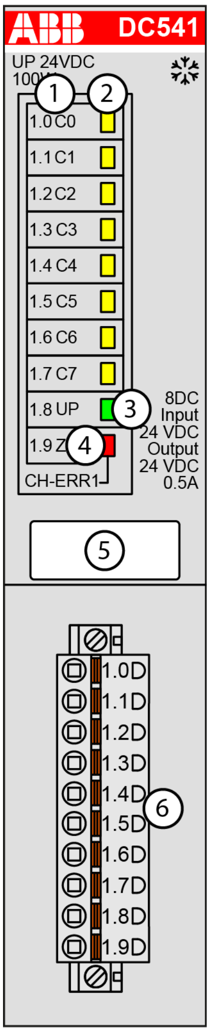
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 240 100 R0001	DC532, digital input/output module, 16 DI, 16 DC, 24 VDC / 0.5 A, 1-wire	Active
1SAP 440 100 R0001	DC532-XC, digital input/output module, 16 DI, 16 DC, 24 VDC / 0.5 A, 1-wire, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.4 DC541-CM - Digital Input/Output Module

- 8 configurable digital inputs/outputs 24 VDC, in a communication module housing
- Fast counter
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 Allocation between terminal number and signal name
2 8 yellow LEDs to display the signal states at the inputs/outputs C0 to C7
3 1 green LED to display the state of the process supply voltage UP
4 1 red LED to display errors (CH-ERR1)
5 Label
6 Terminal block with 10 terminals for 8 inputs/outputs and process power supply (ZP/UP)
Sign for XC version

Intended Purpose

In contrast to other I/O modules, the digital I/O module (multi-function module) DC541-CM is connected to a communication module slot to the left of the AC500 CPU. It contacts the internal communication module bus. This way, the full functionality of the communication module bus is available for the module DC541-CM. Depending on the terminal base TB5x1 used, up to 4 DC541-CM modules can be connected.

The multi-function module DC541-CM can optionally (not at the same time) be configured as an interrupt module or as a fast counter module for 24 V signals (e.g. 24 V incremental encoder).Automation Builder is used for the configuration.

The module contains 8 fast channels (C0...C7) with the following features:

- 8 digital inputs/outputs in one group (1.0...1.7), of which each can be used
  - as an input,
  - as a transistor output with short-circuit and overload protection, 0.5 A rated current or
  - as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.

The states of the inputs/outputs are indicated by yellow LEDs (one per channel). There is no potential separation between the channels.

Functionality

Parameter	Value
Digital inputs/outputs	8 (24 VDC)
Fast counter	Integrated, many configurable operating modes
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the communication module bus
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

In the operating mode Interrupt I/O device, the channels can be configured as follows:

- Input
- Output
- Interrupt input

In this way, important input information can be evaluated independently of the program cycle and outputs can be set.

In the operating mode Counter, the channels can be configured as follows:

- Input
- Output
- 32-bit up/down counter (uses C0...C3) as a 32-bit-counter without limit
- 32-bit periodic counter as a 32-bit counter with a limit
- Limiter for a 32-bit counter (limit channel 0)
- 32-bit up counter (forward counter) with the frequencies 50 kHz, 5 kHz and 2.5 kHz
- Pulse-width modulation (PWM) with a resolution of 10 kHz
- Time and frequency measurement
- Frequency output

Used as a fast counter module, the 8 channels of the multi-function module DC541-CM can be configured and combined individually, easily and versatilely in the PLC configuration. The module is therefore also excellent for universal high-frequency counting tasks up to 50 kHz. In addition, it has measuring functions for rotational speed, time and frequency.

These different channel configurations can now be combined flexibly on-board.

Example 1: 32-bit up/down counter incl. zero trace and touch-trigger for max. 50 kHz plus 4 accompanying limiting values (comparison values). When the counter reaches one of the comparison values, the corresponding output can be set in order to trigger control functions at the machine or installation directly.

Example 2: 2 counters for 50 kHz plus frequency measurement with a resolution of 200 µs plus 4 digital I/Os.

Further examples and a detailed description of the fields of application are contained in the chapter "System Technology of *DC541*.

Commissioning is carried out via the user program by using the appropriate function blocks.

Electrical Connection

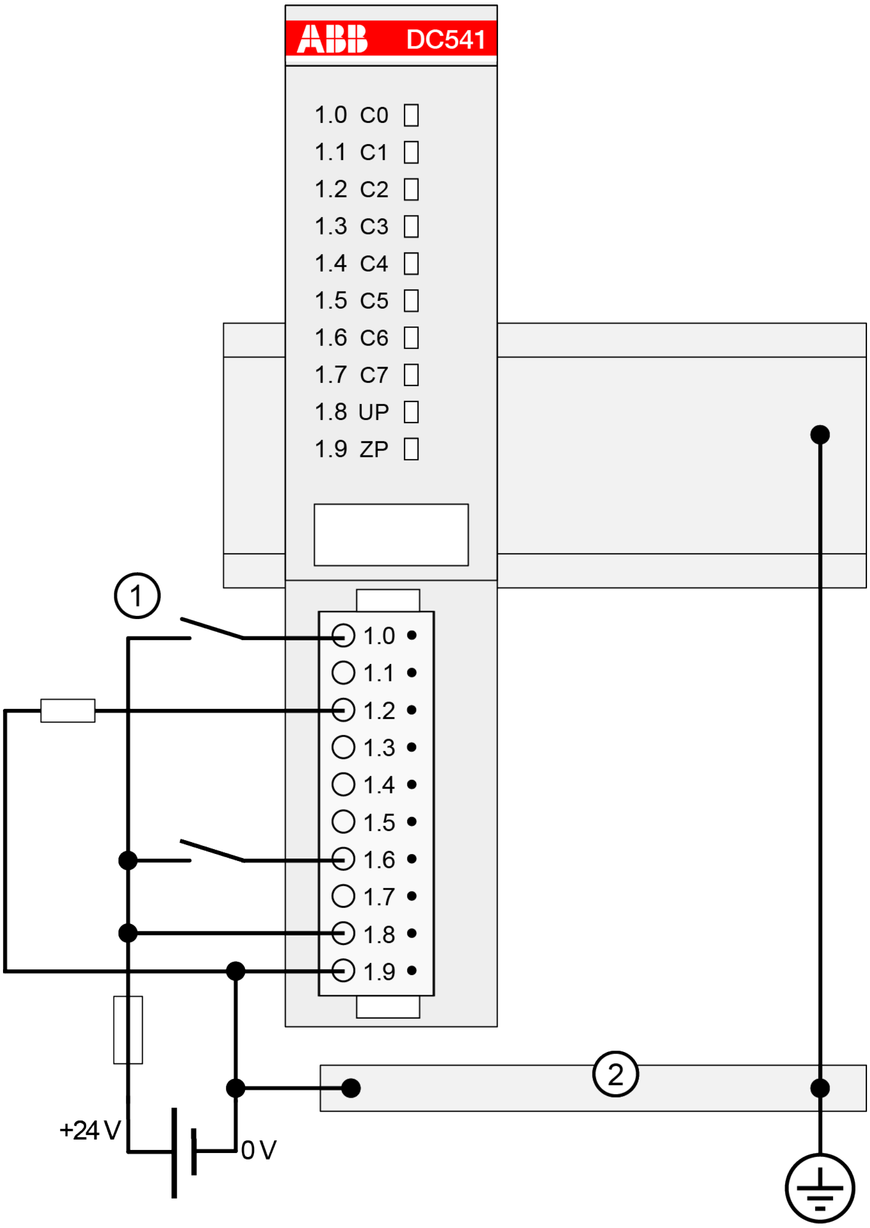
The I/O module DC541-CM is mounted to the left of an AC500 CPU on the same terminal base. The connection to the communication module bus is automatically established while mounting.

The electrical connection of the I/O channels is carried out using the 10 terminals of the removable terminal block. I/O modules can be replaced without re-wiring.

The process voltage is connected in the following way:

Terminal 1.8: process voltage UP = +24 VDC

Terminal 1.9: process voltage ZP = 0 VDC



1 1.0 - 1.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output

2 Switch-gear cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	C0 to C7	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

The internal supply voltage for the module's circuitry comes from the communication module bus. The process voltage for the inputs/outputs is provided via ZP and UP.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC522.

Connect a 470 Ω / 1 W resistor in series to inputs C8/C9 if they are used as fast counter inputs to avoid any influences.

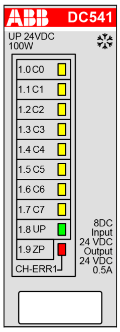
The module provides several diagnostic functions *Chapter 1.5.1.2.4.5 “State LEDs” on page 340*).

I/O Configuration and Parameterization

The DC541-CM module does not store configuration data itself. Configuration and parameterization are performed with Automation Builder software *DC541-CM*.

State LEDs

In case of overload or short-circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore, an acknowledgement of the outputs is not necessary.

LED		State	Color	LED = OFF	LED = ON
	Inputs/ out-puts C0...C7	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK and initialization terminated
	CH-ERR1	Module Error	Red	No error	Error

Technical Data

The System Data of AC500 and S500 ⇘ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ⇘ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8 for +24 V (UP) and 1.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Absolute limits at XC version	Above 60 °C: 20 VDC...30 VDC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
Galvanic isolation		Yes, per module
Current consumption		
	From 24 VDC power supply at the Ter-minal Base of the CPU	10 mA
	Current consumption from UP at normal operation / with outputs	10 mA + 5 mA per input
	Inrush current from UP (at power up)	0.002 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Max. power dissipation within the module		On request
Weight (without terminal block)		Ca. 125 g

Parameter	Value
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.
Altitude	> 2000 m: On request

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 8 channels
If the channels are used as inputs	
Channels C0...C7	Terminals 1.0...1.7
If the channels are used as outputs	
Channels C0...C7	Terminals 1.0...1.7
Reference potential for all inputs/outputs	Terminal 1.9 (ZP = Minus pole of the process supply voltage)
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Galvanic isolation	From the rest of the module

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter	Value
Number of channels per module	Max. 8 digital inputs
Reference potential for all inputs	Terminal 1.9 (negative pole of the process supply voltage, signal name ZP)
Input current per channel	

Parameter	Value
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 5 mA
Input voltage +30 V	< 8 mA
Input type acc. to EN 61131-2	Type 1
Input delay (0 -> 1 or 1 -> 0)	Typ. 2 µs
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V *)
Undefined signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V *)
Ripple with signal 1	Within +15 V...+30 V
Max. cable length	
Shielded	1000 m
Unshielded	600 m

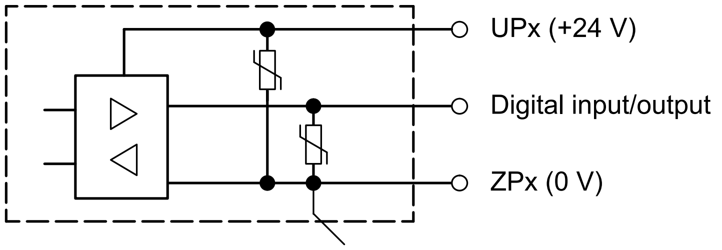
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	Max. 8 transistor outputs
Common power supply voltage	For all outputs: terminal 1.8 (plus pole of the process supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)
Output delay (0 -> 1 or 1 -> 0)	Typ. 10 µs
Output current	
Rated value, per channel	500 mA at UP = 24 V
Maximum value (all channels together)	8 A
Leakage current with signal 0	< 0.5 mA
Rated protection fuse for UP	10 A fast
De-magnitization when inductive loads are switched off	With varistors integrated in the module (see figure below)
Switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms

Parameter	Value
Output current limitation	Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals	Yes
Max. cable length	
Shielded	1000 m
Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



Technical Data of the Fast Counters

Parameter	Value
Used inputs for the traces A and B	C0 / C1
Used input for the zero trace, touch trigger	C2 / C3
Used outputs	C4 to C7, if needed
Operating modes	*Chapter 1.5.1.2.4.2 “Functionality” on page 337*

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 270 000 R0001	DC541-CM, digital input/output module, 8 DC, 24 VDC / 0.5 A, 1-wire	Active
1SAP 470 000 R0001	DC541-CM-XC, digital input/output module, 8 DC, 24 VDC / 0.5 A, 1-wire, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.5 DI524 - Digital Input Module

- 32 digital inputs 24 VDC in 4 groups (1.0...1.7, 2.0...2.7, 3.0...3.7 and 4.0...4.7)
- Fast counter
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available

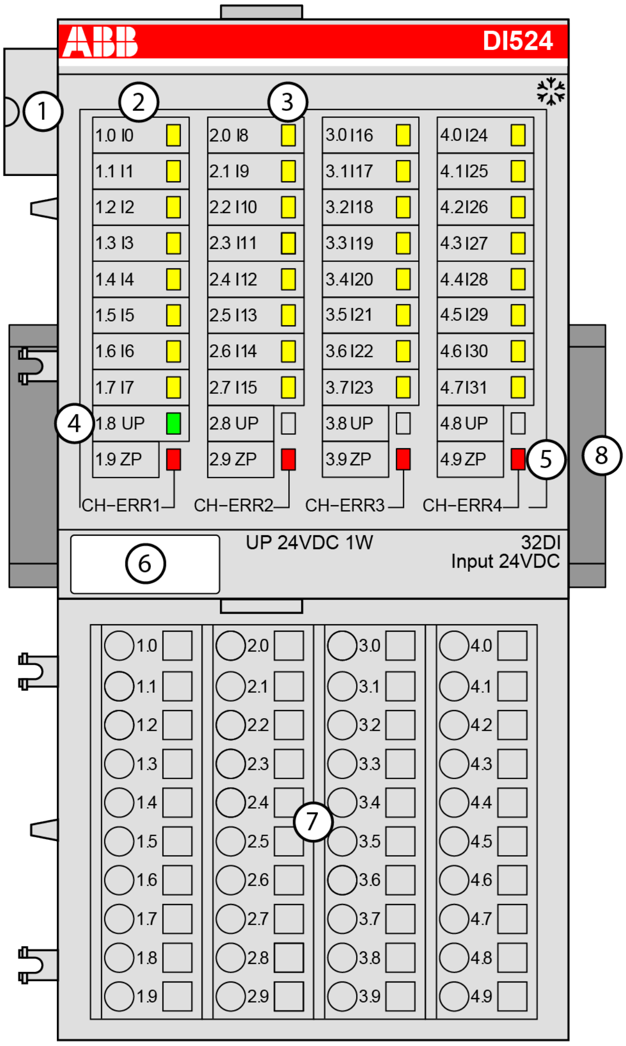


Fig. 28: Digital input module DI524, plugged on a terminal unit TU516

1 I/O bus
2 Allocation between terminal number and signal name
3 32 yellow LEDs to display the signal states at the digital inputs (I0 - I31)
4 1 green LED to display the state of the process supply voltage UP
5 4 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 VDC.

All available inputs/outputs are electrically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Via the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal units	TU515 or TU516 ➡ *Chapter 1.4.3 "TU515, TU516, TU541 and TU542 for I/O Modules" on page 152*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit ➡ *Chapter 1.4.3 "TU515, TU516, TU541 and TU542 for I/O Modules" on page 152*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting (TA526 ➡ *Chapter 1.8.2.4 "TA526 - Wall Mounting Accessory" on page 1154*).

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ➡ Chapter 2.6 "AC500 (Standard)" on page 1252.

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, irrespective of the inserted module:

Terminals 1.8 to 4.8: process voltage UP = +24 VDC

Terminals 1.9 to 4.9: process voltage ZP = 0 VDC

Table 50: Assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0 to I7	8 digital inputs
2.0 to 2.7	I8 to I15	8 digital inputs
3.0 to 3.7	I16 to I23	8 digital inputs
4.0 to 4.7	I24 to I31	8 digital inputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DI524.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

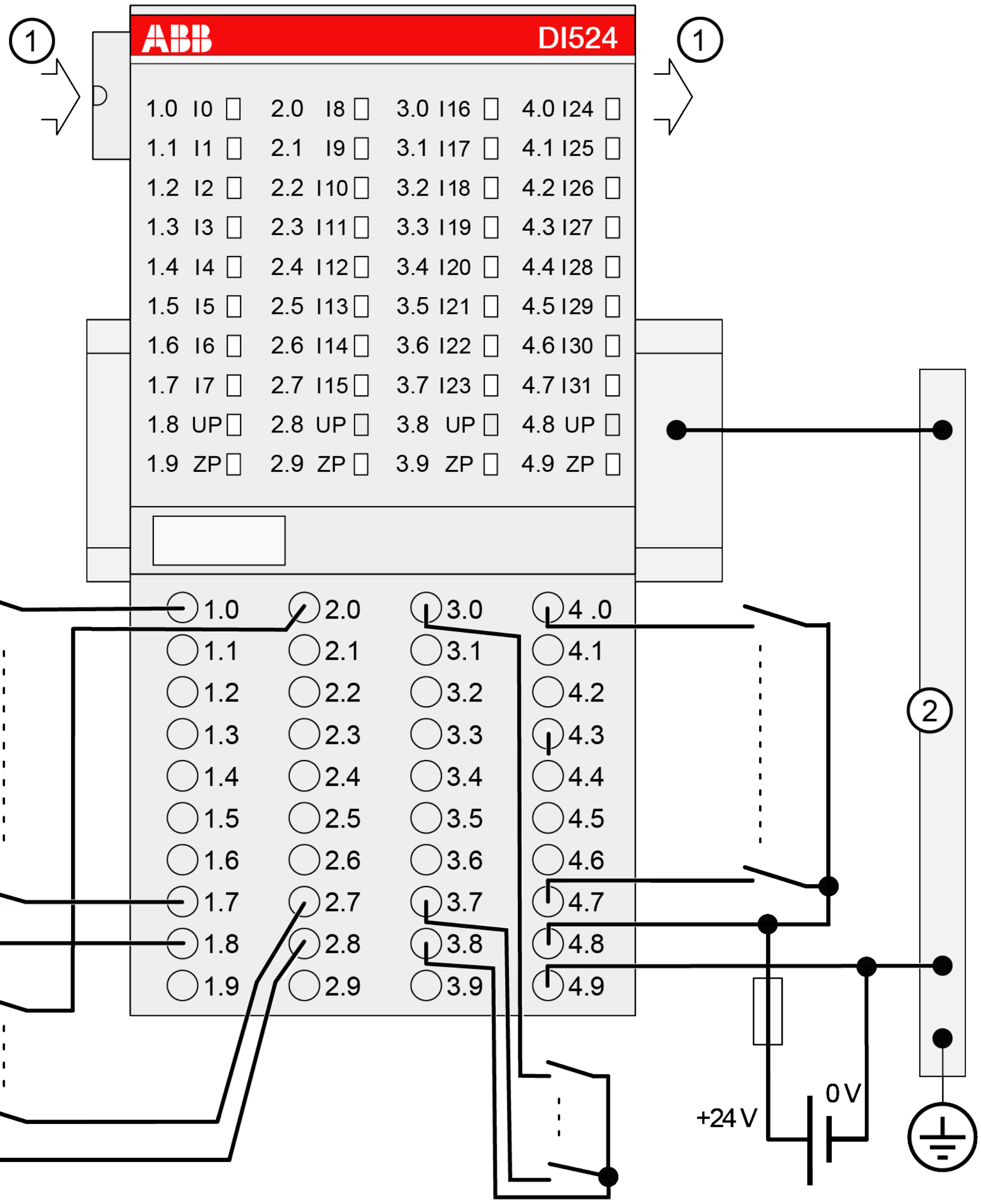
The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.



1 I/O bus
2 Switch-gear cabinet earth

CAUTION!
The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

The module provides several diagnosis functions ↳ *Chapter 1.5.1.2.5.7 “Diagnosis” on page 349*.

Internal Data Exchange

	Without the Fast Counter	With the Fast Counter (only with AC500)
Digital inputs (bytes)	4	6
Digital outputs (bytes)	0	2

	Without the Fast Counter	With the Fast Counter (only with AC500)
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1000 [1])	Word	1000 0x03E8	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length	Internal	3-CPU 2-FBP	Byte	3 2	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
5	Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
6	Fast counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP

Remarks:

[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the Fast Counter section *Chapter 1.5.1.2.10 “Fast Counter” on page 396*
[4])	With FBP or CS31 without the parameter Fast counter

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	5 0x03, 0xe9, 0x02, \ 0x01, 0x02;

Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				

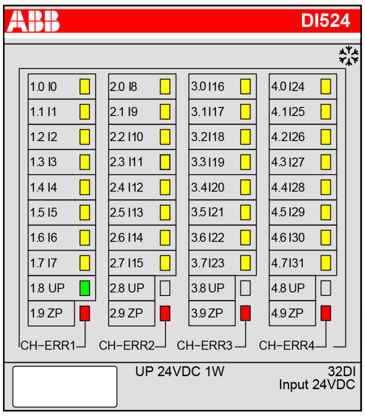
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I31	Digital input	Yellow	Input = OFF	Input = ON [1])	--
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	ca. 2 mA
	From UP at normal operation	0.15 A
	Inrush current from UP (at power up)	0.008 A²s
Weight (without terminal unit)		ca. 105 g

Parameter	Value
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		32
Distribution of the channels into groups		1 group of 32 channels
Terminals of the channels I0 to I7		1.0 to 1.7
Terminals of the channels I8 to I15		2.0 to 2.7
Terminals of the channels I16 to I23		3.0 to 3.7
Terminals of the channels I24 to I31		4.0 to 4.7
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module (I/O bus)
Indication of the input signals		One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0 -> 1 or 1 -> 0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V
	Undefined signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Fast Counter

The fast counter of the module does not work if the module is connected to a
- *FBP interface module*
- *CS31 bus module*
- *CANopen bus module*

Parameter	Value
Used inputs	I24 / I25
Used outputs	None
Counting frequency	Max. 50 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

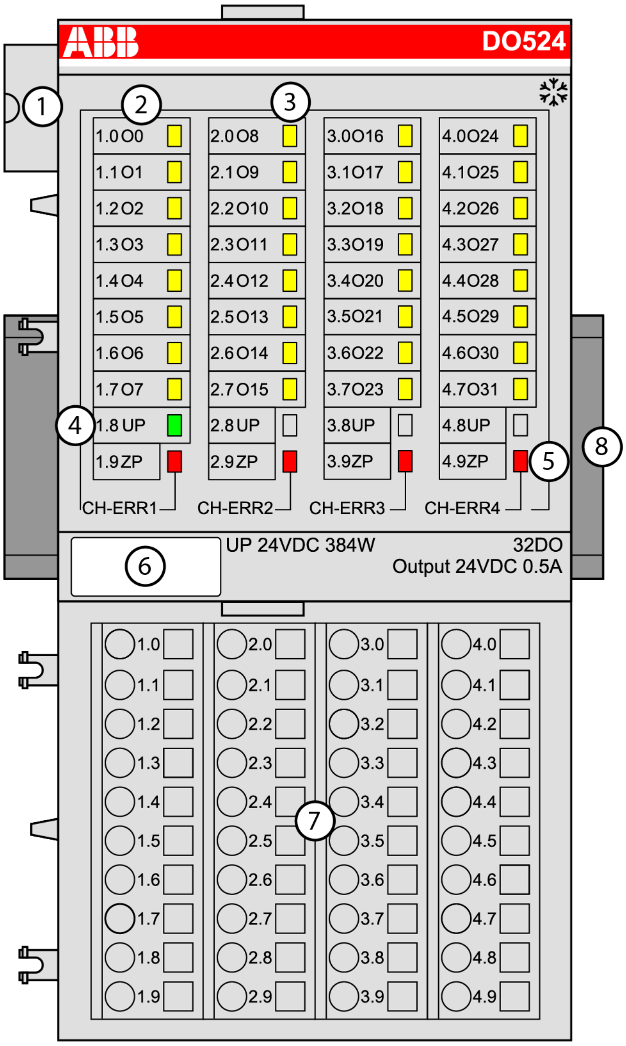
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 240 000 R0001	DI524, digital input module, 32 DI, 24 VDC, 1-wire	Active
1SAP 440 000 R0001	DI524-XC, digital input module, 32 DI, 24 VDC, 1-wire, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.6 DO524 - Digital Output Module

- 32 digital outputs 24 VDC / 0.5 A in 4 groups (1.0...4.7) with short circuit and overload protection
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 32 yellow LEDs to display the signal states at the digital outputs (O0 - O31)
4 1 green LED to display the state of the process supply voltage UP
5 4 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are electrically isolated from all other circuitry of the module. There is no potential separation between the channels.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltage
Internal power supply	Via the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit	TU515 or TU516 ♘ *Chapter 1.4.3 "TU515, TU516, TU541 and TU542 for I/O Modules" on page 152*

The device is plugged on a terminal unit ♘ *Chapter 1.4.3 "TU515, TU516, TU541 and TU542 for I/O Modules" on page 152*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting (TA526 ♘ *Chapter 1.8.2.4 "TA526 - Wall Mounting Accessory" on page 1154*).

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Electrical Connection

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ♘ Chapter 2.6 "AC500 (Standard)" on page 1252.*

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 to 4.8: process voltage UP = +24 VDC

Terminals 1.9 to 4.9: process voltage ZP = 0 VDC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	O0 to O7	8 digital outputs
2.0 to 2.7	O8 to O15	8 digital outputs
3.0 to 3.7	O16 to O23	8 digital outputs
4.0 to 4.7	O24 to O31	8 digital outputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DO524.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

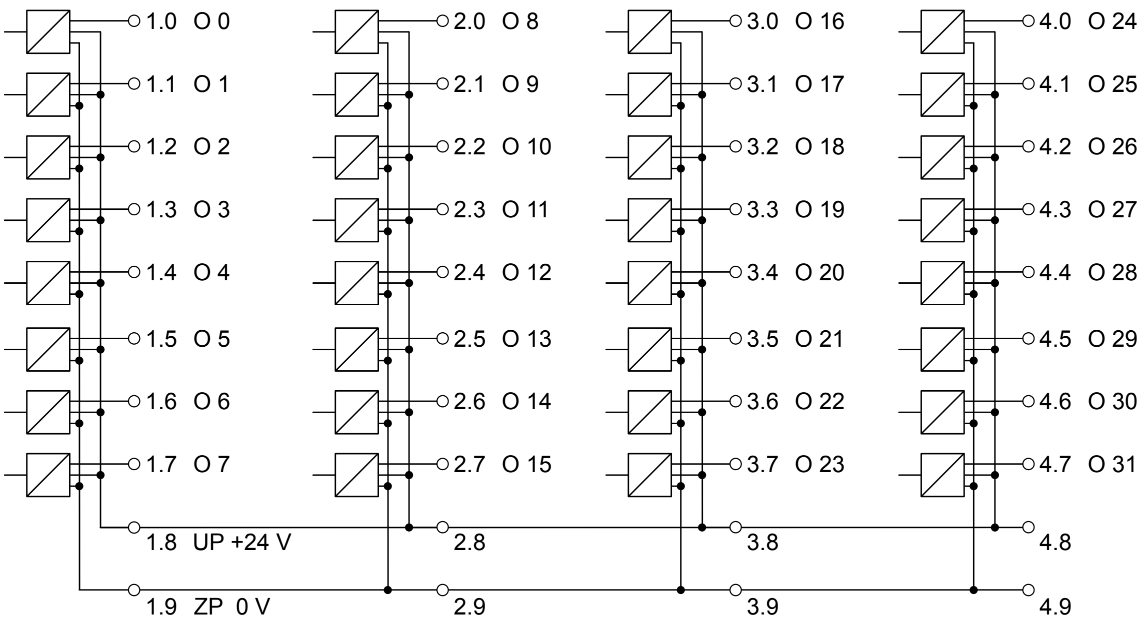
NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following block diagram shows the internal construction of the digital outputs:



The module provides several diagnosis functions *Chapter 1.5.1.2.6.7 “Diagnosis” on page 358*.

Internal Data Exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	4

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Module ID	Internal	1101 1)	WORD	1101 0x044D	0	65535	0x0Y01
Ignore module 2)	No Yes	0 1	BYTE	No 0x00			not for FBP
Parameter length	Internal	7	BYTE	7-CPU 7-FBP	0	255	0x0Y02
Check supply	Off on	0 1	BYTE	On 0x01	0	1	0x0Y03
Output short circuit detection	Off On	0 1	BYTE	On 0x01	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	BYTE	Off 0x00	0	2	0x0Y05
Substitute value at outputs Bit 31 = Output 31 Bit 0 = Output 0	0... 4294967295	0... 0xffffffff	DWORD	0 0x00000000	0	4294967295	0x0Y06

1) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

2) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	10
Ext_User_Prm_Data_Const(0) =	0x04, 0x4d, 0x07, \\ 0x01, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore, an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

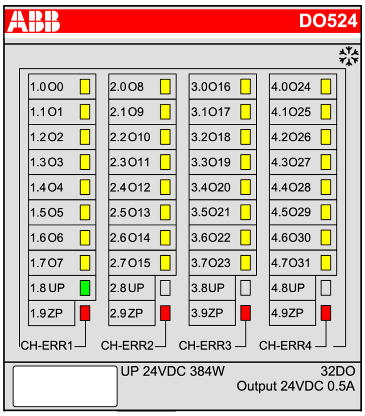
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	2	0...31	47	Short circuit at a digital output	Check connection
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = Hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (4 = DC); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.



LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0...O31	Digital output	Yellow	Output = OFF	Output = ON	--
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 "System Data AC500" on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 "System Data AC500-XC" on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation / with outputs	0.10 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.005 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		Ca. 100 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

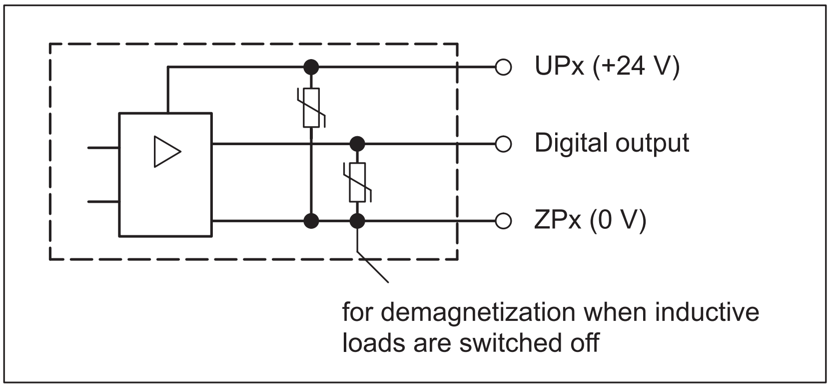
Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		32 outputs (with transistors)
Distribution of the channels into groups		1 group of 32 channels
Connection of the channels		
	O0 to O7	Terminals 1.0 to 1.7
	O8 to O15	Terminals 2.0 to 2.7
	O16 to O23	Terminals 3.0 to 3.7

Parameter		Value
	O24 to O31	Terminals 4.0 to 4.7
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0 -> 1 or 1 -> 0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (channels O0 to O15)	4 A
	Maximum value (channels O16 to O31)	4 A
	Maximum value (all channels together)	8 A
Max. leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit proof / overload proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short-circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital output with the varistors for demagnetization when inductive loads are switched off.



Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 240 700 R0001	DO524, digital output module, 32 DO, 24 VDC / 0.5 A, 1-wire	Active
1SAP 440 700 R0001	DO524-XC, digital output module, 32 DO, 24 VDC / 0.5 A, 1-wire, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.7 DO526 - Digital Output Module

- 8 digital outputs 24 VDC (O0 to O7) in 2 groups without short circuit and without overload protection.
- Module and group-wise electrically isolated
- XC version for use in extreme ambient conditions available

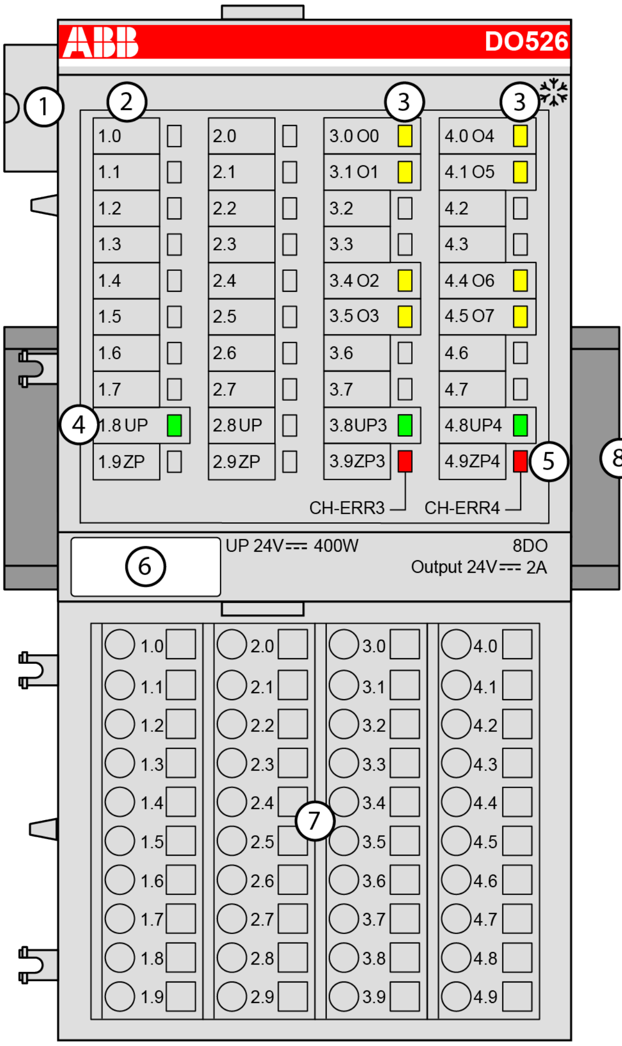


Fig. 29: DO526-XC, plugged on a terminal unit TU542-XC

1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the outputs O0 to O7
4 3 green LEDs to display the states of the process supply voltage UP, UP3 and UP4
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN-rail
❄ Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are group-wise electrically isolated from each other.

All other circuitry of the module is electrically isolated from the outputs.

Potential separation between the channel groups.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltages
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP, ZP3, ZP4, UP, UP3 and UP4 (process voltage 24 VDC)
Required terminal unit	TU542 ➫ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

The output module is plugged on the terminal unit TU542. Properly position the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ➫ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ➫ Chapter 2.6 “AC500 (Standard)” on page 1252.

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 2.8 and 1.9 to 2.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 to 2.8:	Process voltage UP = +24 VDC
Terminals 1.9 to 2.9:	Process voltage ZP = 0 V
Terminal 3.8:	Process voltage UP3 = +24 VDC
Terminal 3.9:	Process voltage ZP3 = 0 V
Terminal 4.8:	Process voltage UP4 = +24 VDC
Terminal 4.9:	Process voltage ZP4 = 0 V

Terminals	Signal	Description
3.0, 3.1, 3.4, 3.5	O0 to O3	4 digital outputs
4.0, 4.1, 4.4, 4.5	O4 to O7	4 digital outputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus Module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DO526.

The external power supply connection is carried out via the UP, UP3, UP4 (+24 VDC) and the ZP, ZP3, ZP4 (0 VDC) terminals.

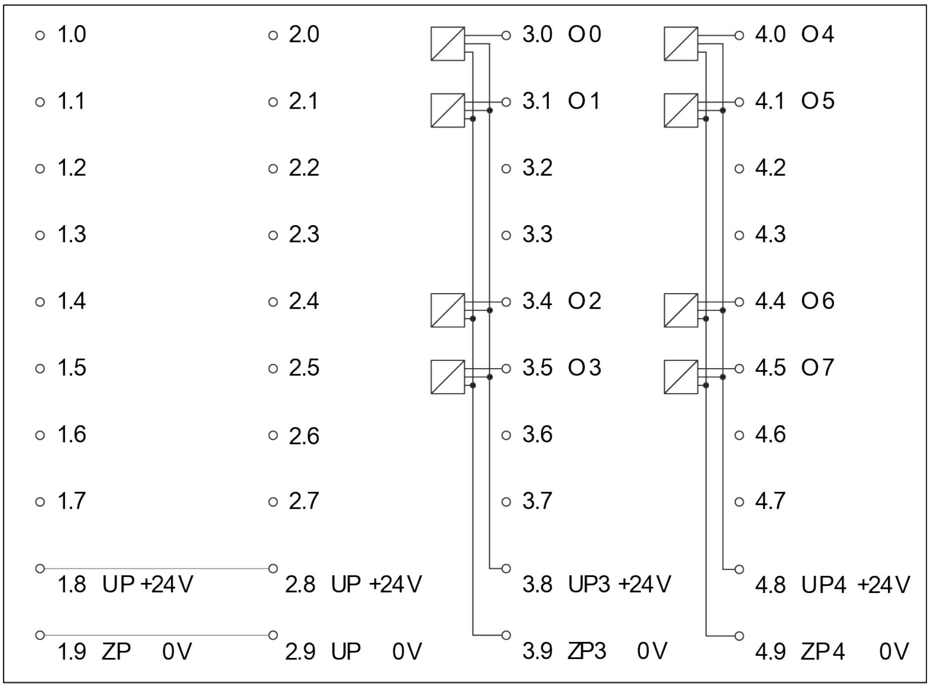
NOTICE!

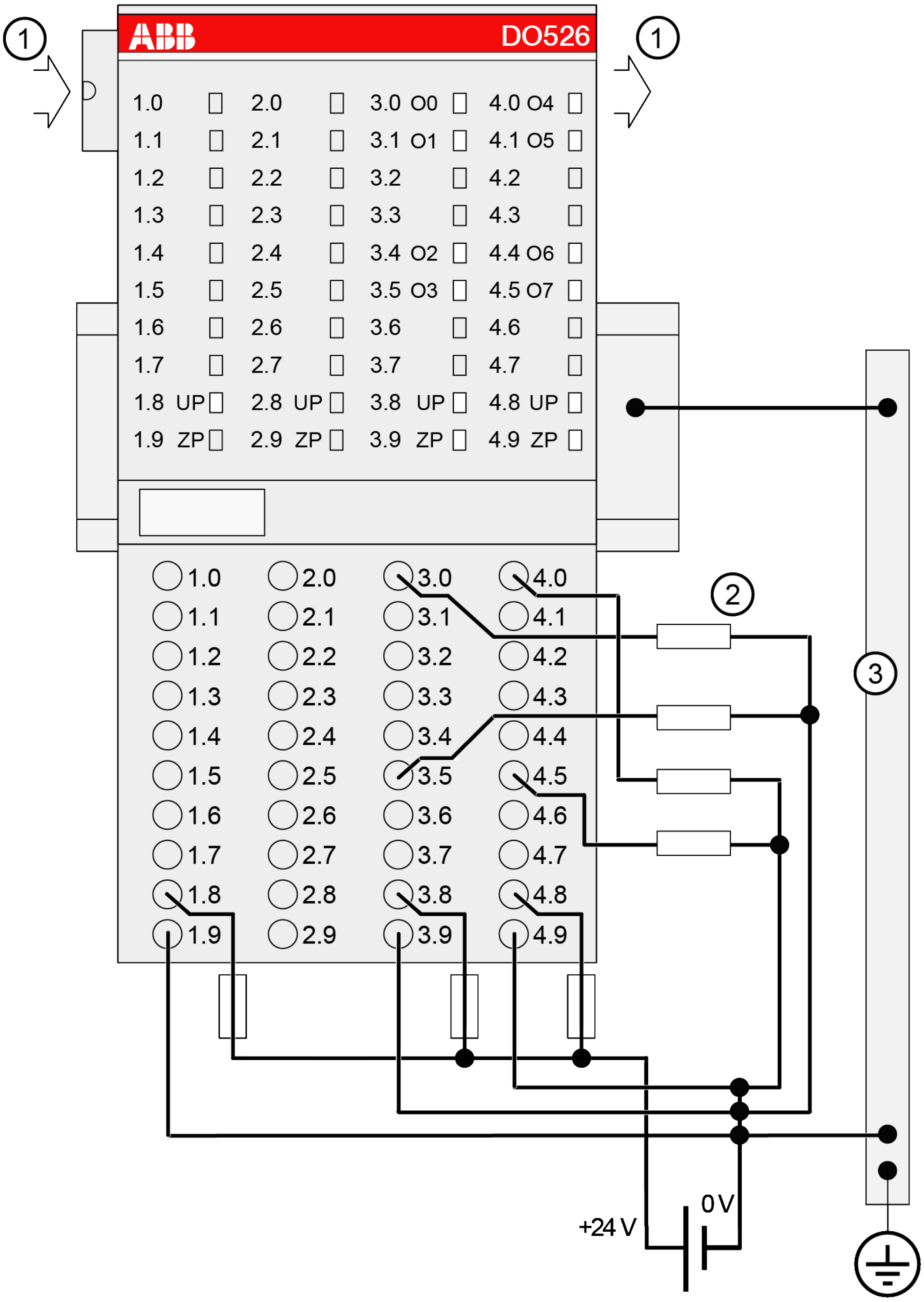
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following block diagram shows the internal construction of the digital outputs:





1 I/O bus
2 4.0 - 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Switch-gear cabinet earth

> **CAUTION!**
> The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

The module provides several diagnosis functions *Chapter 1.5.1.2.7.7 "Diagnosis" on page 368*.

Internal Data Exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	1

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software, versions ≥ 1.2.3.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...7

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Module ID	Internal	1105 [1])	WORD	1105 0x0451	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	BYTE	No 0x00			not for FBP
Parameter length	Internal	6	BYTE	6-CPU 6-FBP	0	6	0x0Y02
Check supply	Off on	0 1	BYTE	On 0x01	0	1	0x0Y03
Reserve	0...255	0...0xff	BYTE	On 0x01	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	BYTE	Off 0x00	0	2	0x0Y05

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Substitute value at outputs Bit 7 = Output 7 Bit 0 = Output 0	0...255	0...0xff	BYTE	0x00	0	255	0x0Y06
Reserve	0...255	0...0xff	BYTE	0x00	0	255	0x0Y07
Reserve	0...255	0...0xff	BYTE	0x00	0	255	0x0Y08
1) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 2) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len =	10
Ext_User_Prm_Data_Const(0) =	0x04, 0x51, 0x00, 0x06, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00

Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				

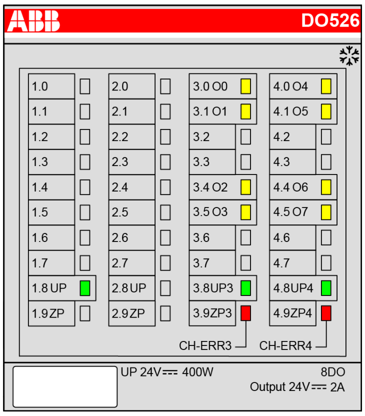
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diag-nosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	1)	**2)**	**3)**	**4)**				
3	14	1...10	31	31	9	Overflow diagnosis buffer		New start
	11 / 12	ADR	1...10					
3	14	1...10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1...10					
3	14	1...10	31	31	11	Process voltage UP3 and/or UP4 too low		Check process voltage
	11 / 12	ADR	1...10					
4	14	1...10	31	31	45	Process voltage UP is switched off (ON −> OFF)		Process voltage ON
	11 / 12	ADR	1...10					
Channel error								
4	14	1...10	31	0(UP3)	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1...10	4(UP4)				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.



LED	State	Color	LED = OFF	LED = ON	LED flashes
Outputs O0...O7	Digital output	Yellow	Output = OFF	Output = ON [2]	--
UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
UP3	Process supply voltage outputs 0...3 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
UP4	Process supply voltage outputs 4...7 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
CH-ERR3	Channel Error, error messages in groups (digital outputs combined into the groups 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on in the corresponding group
CH-ERR4		Red			
CH-ERR [1]	Module Error	Red	--	Internal error	--

[1]) All of the LEDs CH-ERR3 to CH-ERR4 light up together

[2]) The state of the LEDs corresponds to the logic state of the output. In case of missing or low process supply voltage UP3 or UP4, the signal on the output terminal is off even though the LED is on.

Technical Data

The System Data of AC500 and S500 ✎ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ✎ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP, UP3 and UP4		
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) as well as 1.9 and 2.9 0 V (ZP) Terminals 3.8 for +24 V (UP3) as well as 3.9 for 0 V (ZP3) Terminals 4.8 for +24 V (UP4) as well as 4.9 for 0 V (ZP4)

Parameter		Value
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP, UP3 and UP4	10 A fast (for each process supply voltage)
	Galvanic isolation	Yes, per module and per output channel groups
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation / with outputs	Ca. 20 mA + 1.5 mA per output
	From UP3 or UP4 at normal operation / with outputs	Ca. 0.01 A + max. 2 A per output
	Inrush current from UP (at power up)	0.015 A^2s
	Inrush current from UP3 or UP4 (at power up)	0.005 A^2s (without output load)
Max. power dissipation within the module		6 W
Weight (without terminal unit)		Ca. 135 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply and continuous overvoltage up to 30 VDC.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8 outputs (with transistors, non-latching type)
Distribution of the channels into groups		2 groups of 4 channels
Connection of the channels		
	O0 to O3	Terminals 3.0, 3.1, 3.4, 3.5
	O4 to O7	Terminals 4.0, 4.1, 4.4, 4.5
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)

Parameter		Value
Power supply voltage for the module		Terminals 1.8 and 2.8 (positive pole of the process supply voltage, signal name UP)
Reference potential for module power supply		Terminals 1.9 and 2.9 (negative pole of the process supply voltage, signal name ZP)
Power supply voltage for the outputs O0 to O3		Terminal 3.8 (positive pole of the process supply voltage, signal name UP3)
Reference potential for the outputs O0 to O3		Terminal 3.9 (negative pole of the process supply voltage, signal name ZP3)
Power supply voltage for the outputs O4 to O7		Terminal 4.8 (positive pole of the process supply voltage, signal name UP4)
Reference potential for the outputs O4 to O7		Terminal 4.9 (negative pole of the process supply voltage, signal name ZP4)
Output voltage for signal 1		UP (-0.4 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	2 A at UP3 or UP4 = 24 V
	Maximum value (channels O0 to O3)	8 A
	Maximum value (channels O4 to O7)	8 A
Leakage current with signal 0		< 0.1 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With clamp diode in output high side driver
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 2 Hz
	With lamp loads	Max. 11 Hz with max. 48 W
Short-circuit proof / overload proof		No (should be done externally)
Overload message		No
Output current limitation		No (should be done externally)
Resistance to feedback against 24 V signals		Yes to UP3 or UP4. No to outputs in same group.
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

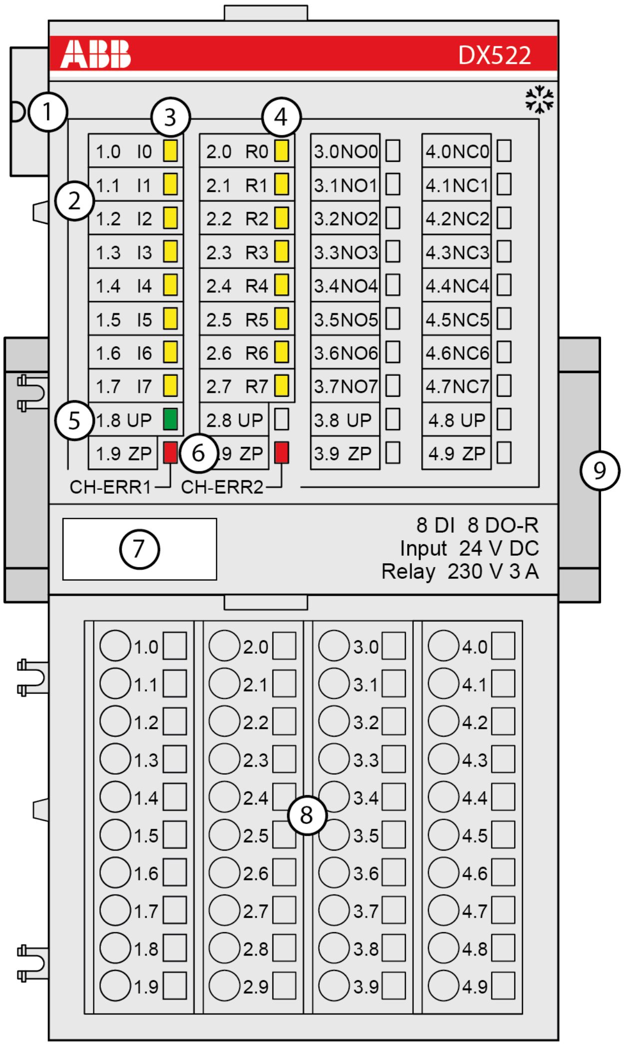
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 240 800 R0001	DO526, digital output module, 8 DO, 24 VDC / 2 A, 1-wire	Active
1SAP 440 800 R0001	DO526-XC, digital output module, 8 DO, 24 VDC / 2 A, 1-wire, XC version	Active

Part no.	Description	Product Life Cycle Phase *)
1SAP 213 200 R0001	TU542, I/O terminal unit, 24 VDC, spring terminals	Active
1SAP 413 200 R0001	TU542-XC, I/O terminal unit, 24 VDC, spring terminals, XC version	Active

1.5.1.2.8 DX522 - Digital Input/Output Module

- 8 digital inputs 24 VDC, module-wise electrically isolated
- 8 relay outputs
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the digital inputs (I0 - I7)
4 8 yellow LEDs to display the signal states at the digital relay outputs (R0 - R7)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Digital configurable input/output unit.

- 8 digital inputs 24 VDC in 1 group (1.0...1.7)
- 8 digital relay outputs with one switch-over contact each (R0...R7). All output channels are electrically isolated from each other.
- Fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 VDC.

All available inputs/outputs are electrically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process supply voltage 24 VDC)
Required terminal units	TU531 or TU532 ➪ *Chapter 1.4.6 “TU531 and TU532 for I/O Modules” on page 163*

The device is plugged on a terminal unit ➪ *Chapter 1.4.6 “TU531 and TU532 for I/O Modules” on page 163*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting (TA526 ➪ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

Electrical Connection

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ↯ Chapter 2.6 “AC500 (Standard)” on page 1252.*

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, irrespective of the inserted module:

- Terminals 1.8 to 4.8: process supply voltage UP = +24 VDC
- Terminals 1.9 to 4.9: process supply voltage ZP = 0 VDC

Table 51: Assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0 to I7	Input signals of the 8 digital inputs
1.8 to 4.8	UP	Process supply voltage +24 VDC
1.9 to 4.9	ZP	Reference potential for the 8 digital inputs and the process supply voltage
2.0	R0	Common contact of the first relay output
3.0	NO 0	Normally-open contact of the first relay output
4.0	NC 0	Normally-closed contact of the first relay output
2.1	R1	Common contact of the second relay output
3.1	NO 1	Normally-open contact of the second relay output
4.1	NC 1	Normally-closed contact of the second relay output
:	:	:
2.7	R7	Common contact of the eighth relay output
3.7	NO 7	Normally-open contact of the eighth relay output
4.7	NC 7	Normally-closed contact of the eighth relay output

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DX522.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions (see Diagnosis and State LEDs *Chapter 1.5.1.2.8.7 “Diagnosis” on page 379*).

The following figure shows the electrical connection of the digital input/output module DX522.

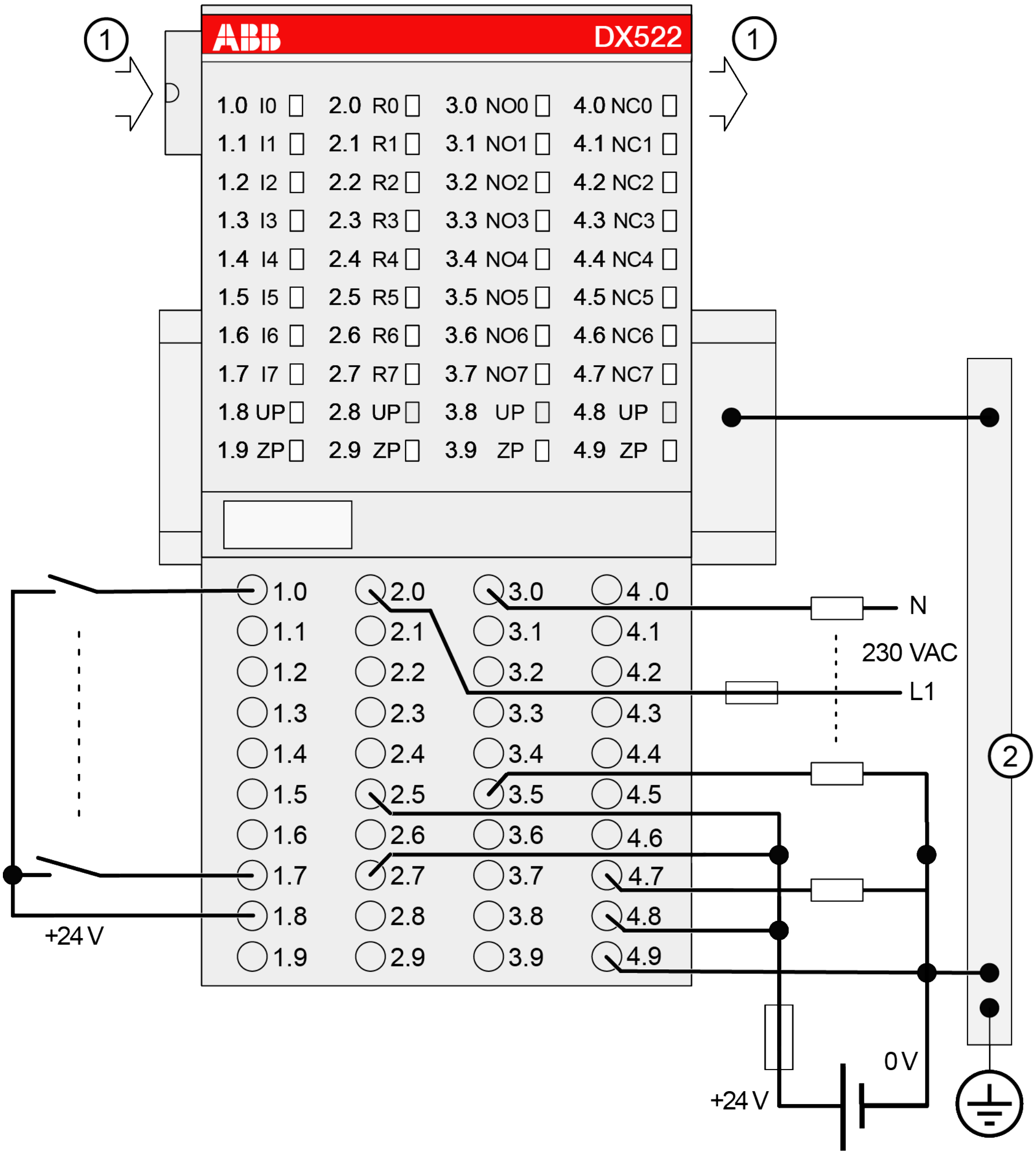


Fig. 30: Electrical connection of the module

1 I/O bus
2 Switch-gear cabinet earth

NOTICE!

– If the relay outputs have to switch inductive **DC loads**, free-wheeling diodes must be circuited in parallel to these loads.
– If the relay outputs have to switch inductive **AC loads**, spark suppressors are required.

CAUTION!

The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

NOTICE!

Risk of damaging the PLC module!

The following things have to be considered when connecting input and output voltages to the module:

– All 230 VAC feeds must be single-phase from the same supply system.
– Connection of 2 or more relay contacts in series is possible; however, voltages above 230 VAC and 3-phase loads are not allowed.
– The 8 switch-over contacts of the relays are electrically isolated from channel to channel. This allows to connect loads of 24 VDC and 230 VAC to relay outputs of the same module. In such cases it is necessary that both supply voltages are grounded to prevent unsafe floating grounds.

NOTICE!

Risk of damaging the PLC module!

There is no internal short-circuit or overload protection for the relay outputs.

Protect the relay contacts by back-up fuses of 6 A max. (characteristic gG/gL). Depending on the application, fuses can be used for single channels or module-wise.

Internal Data Exchange

	Without the Fast Counter	With the Fast Counter (only with AC500)
Digital inputs (bytes)	1	3
Digital outputs (bytes)	1	3
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1210 [1])	Word	1210 0x04BA	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	5	Byte	5-CPU 4-FBP	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast Counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
Substitute value at outputs) Bit 7 = Output 7 Bit 0 = Output 0	0... 255	0... 0xff	Byte	0 0x00	0	255	0x0Y06

Remarks:

1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the Fast Counter section ⇘ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*
4)	With FBP and without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	7
Ext_User_Prm_Data_Const	0x04, 0xbb, 0x04, \
(0) =	0x01, 0x02, 0x00, 0x00;

Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000...063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				

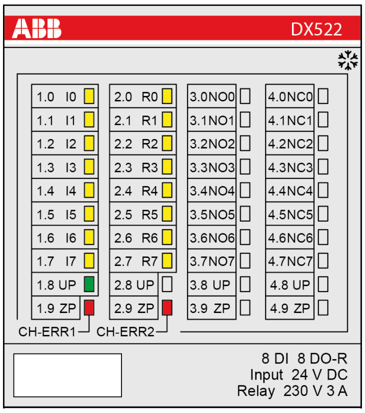
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process supply voltage too low	Check process supply voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process supply voltage is switched off (ON −> OFF)	Process supply voltage ON
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I7	Digital input	Yellow	Input = OFF	Input = ON [1])	--
	Outputs R0...R7 (relays)	Digital output	Yellow	Relay output = OFF	Relay output = ON	--
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1 and 2)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR2		Red			
	CH-ERR [2])	Module Error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR2 light up together					

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module

Parameter		Value
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/Bus Module	ca. 2 mA
	From UP at normal operation / with outputs	0.05 A + output loads
	Inrush current from UP (at power up)	0.010 A^2s
Max. power dissipation within the module		6 W (outputs OFF)
Weight (without terminal unit)		ca. 300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels I0 to I7	1.0 to 1.7
Reference potential for all inputs	Terminals 1.9, 2.9, 3.9 and 4.9 (minus pole of the process supply voltage, signal name ZP)
Galvanic isolation	From the rest of the module (I/O bus)
Indication of the input signals	One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator	LED is part of the input circuitry
Input type acc. to EN 61131-2	Type 1
Input delay (0->1 or 1->0)	Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V
Undefined signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V
Ripple with signal 1	Within +15 V...+30 V

Parameter		Value
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Relay Outputs

Parameter		Value
Number of channels per module		8 relay outputs
Distribution of channels into groups		8 groups of 1 channel each
Connection of the channel R0		Terminal 2.0 (common), 3.0 (NO) and 4.0 (NC)
Connection of the channel R1		Terminal 2.1 (common), 3.1 (NO) and 4.1 (NC)
Connection of the channel R6		Terminal 2.6 (common), 3.6 (NO) and 4.6 (NC)
Connection of the channel R7		Terminal 2.7 (common), 3.7 (NO) and 4.7 (NC)
Galvanic isolation		Between the channels and from the rest of the module
Indication of the output signals		One yellow LED per channel, the LED is ON when the relay coil is energized
Monitoring point of output indicator		LED is controlled by process CPU
Way of operation		Non-latching type
Output delay (0->1 or 1->0)		On request
Relay power supply		By UP process supply voltage
Relay outputs		
	Output short circuit protection	Should be provided externally with a fuse or circuit breaker
Rated protection fuse		6 A gL/gG per channel
Min. switching current		10 mA
Output switching capacity		
	Resistive load, max.	3 A; 3 A (230 VAC), 2 A (24 VDC)
	Inductive load, max.	1.5 A; 1.5 A (230 VAC), 1.5 A (24 VDC)
	Lamp load	60 W (230 VAC), 10 W (24 VDC)
Output switching capacity (XC version above 60 °C)		On request
Life time (cycles)		Mechanical: 300 000; Under load: 300 000 (24 VDC at 2 A), 200 000 (120 VAC at 2 A), 100 000 (230 VAC at 3 A)
Spark suppression with inductive AC load		Must be performed externally according to driven load specifications

Parameter		Value
Demagnetization with inductive DC load		A free-wheeling diode must be circuited in parallel to the inductive load
Switching frequency		
	With resistive load	Max. 10 Hz
	With inductive load	Max. 2 Hz
	With lamp load	On request
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Fast Counter

The fast counter of the module does not work if the module is connected to a

– *FBP interface module*
– *CS31 bus module*
– *CANopen bus module*

Parameter	Value
Used inputs	I0 / I1
Used outputs	None
Counting frequency	50 kHz max.
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

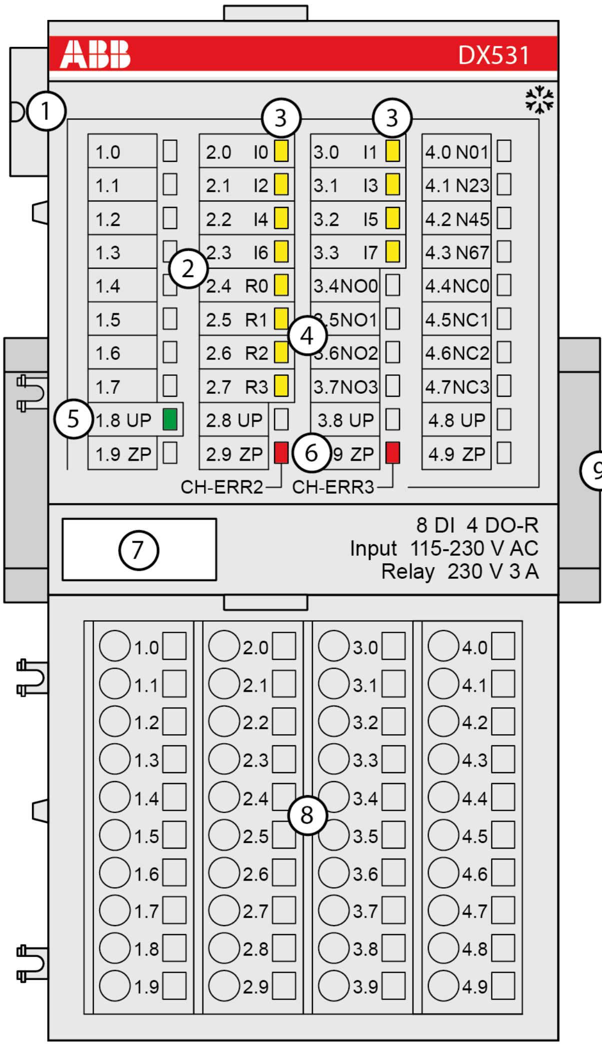
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 245 200 R0001	DX522, digital input/output module, 8 DI, 24 VDC, 8 DO relays	Active
1SAP 445 200 R0001	DX522-XC, digital input/output module, 8 DI, 24 VDC, 8 DO relays, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.9 DX531 - Digital Input/Output Module

- 8 digital inputs 120/230 VAC
- 4 relay outputs with one switch-over contact each
- Module-wise electrically isolated



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the digital inputs (I0 - I7)
4 4 yellow LEDs to display the signal states at the digital relay outputs (R0 - R3)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Digital configurable input / output unit.

- 8 digital inputs 120/230 VAC in 1 group (2.0...2.3 and 3.0...3.3)
- 4 digital relay outputs with one switch-over contact each (R0...R3). All output channels are electrically isolated from each other.

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 VDC.

All available inputs/outputs are electrically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	**Value**
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process supply voltage 24 VDC)
Required terminal units	TU531 or TU532 *Chapter 1.4.6 “TU531 and TU532 for I/O Modules” on page 163*

The device is plugged on a terminal unit *Chapter 1.4.6 “TU531 and TU532 for I/O Modules” on page 163*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

Electrical Connection

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 to 4.8: process supply voltage UP = +24 VDC
- Terminals 1.9 to 4.9: process supply voltage ZP = 0 VDC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	unused	
2.0 and 3.0	I0 and I1	Input signals for the digital inputs I0 and I1
4.0	N01	Neutral conductor for the digital inputs I0 and I1
2.1 and 3.1	I2 and I3	Input signals for the digital inputs I2 and I3
4.1	N23	Neutral conductor for the digital inputs I2 and I3
2.2 and 3.2	I4 and I5	Input signals for the digital inputs I4 and I5
4.2	N45	Neutral conductor for the digital inputs I4 and I5
2.3 and 3.3	I6 and I7	Input signals for the digital inputs I6 and I7
4.3	N67	Neutral conductor for the digital inputs I6 and I7
2.4	R0	Common contact of the first relay output
3.4 and 4.4	NO0 and NC0	NO and NC contacts of the first relay output
2.5	R1	Common contact of the second relay output
3.5 and 4.5	NO1 and NC1	NO and NC contacts of the second relay output
2.6	R2	Common contact of the third relay output
3.6 and 4.6	NO2 and NC2	NO and NC contacts of the third relay output
2.7	R3	Common contact of the fourth relay output
3.7 and 4.7	NO3 and NC3	NO and NC contacts of the fourth relay output

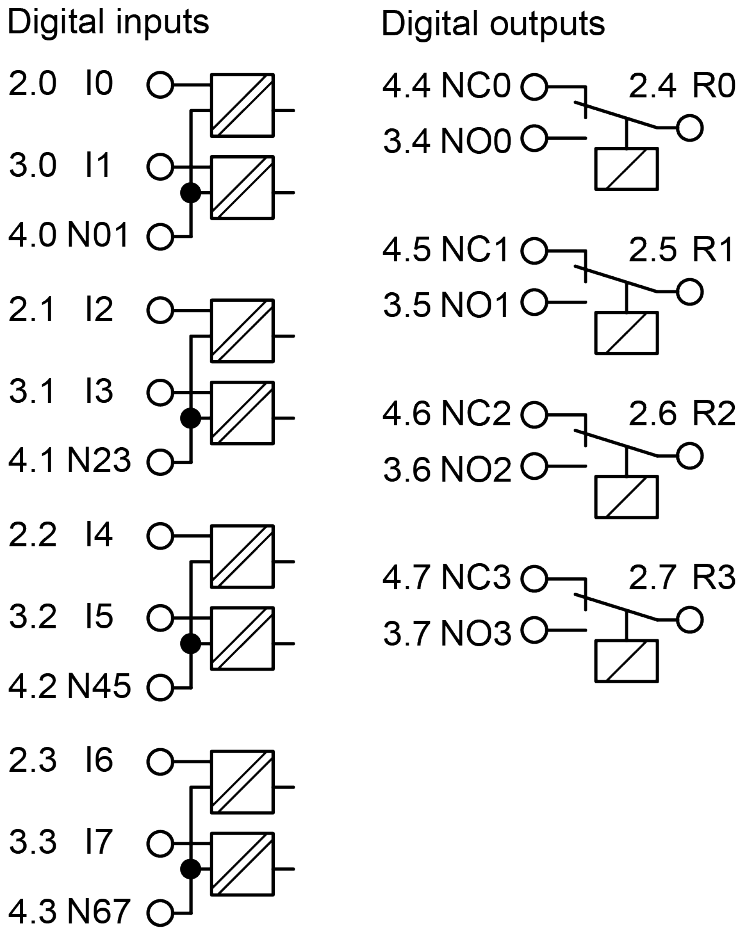
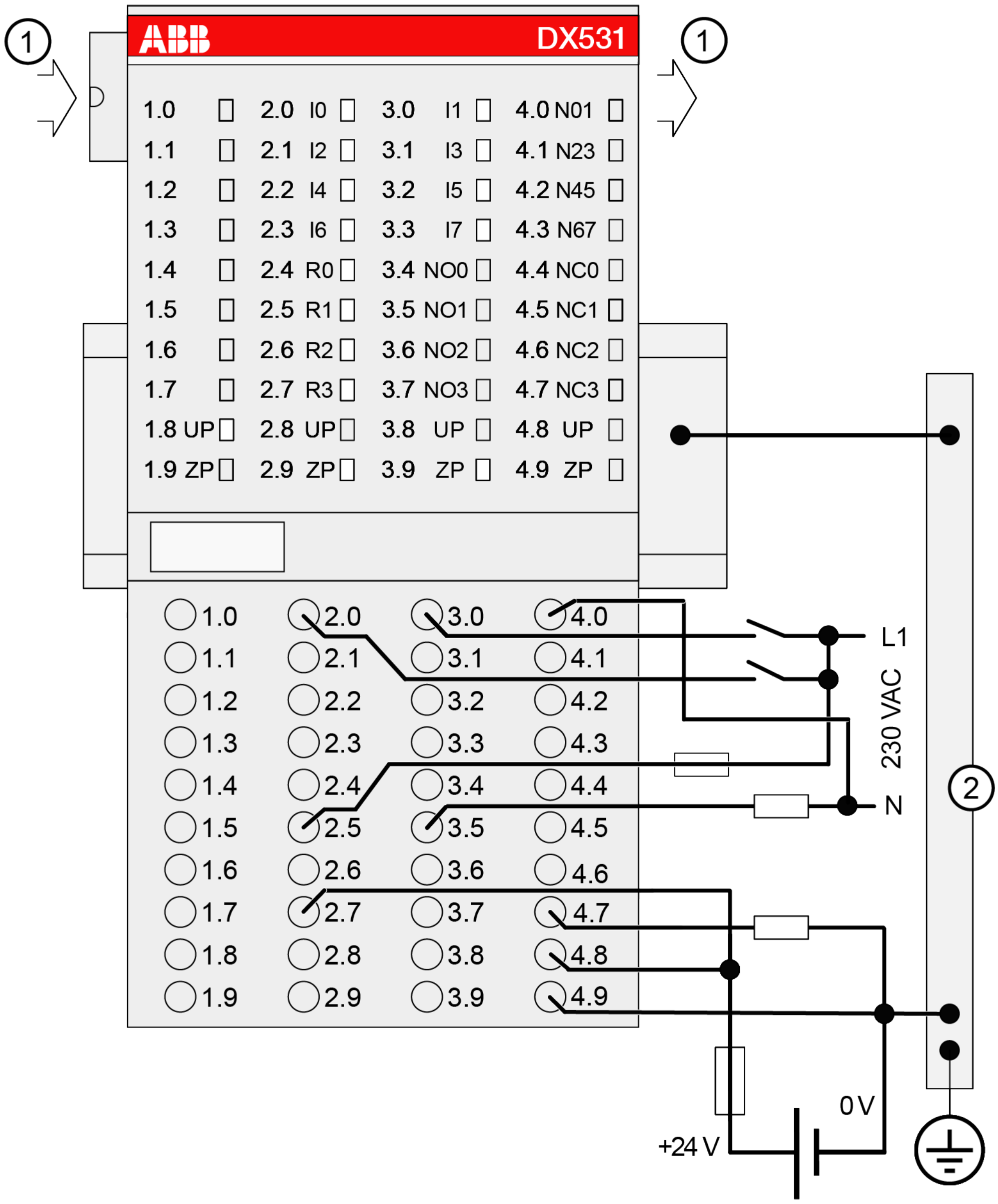


Fig. 31: Internal construction

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DX531. The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

> **!**
>
> **NOTICE!**
>
> **Risk of damaging the PLC modules!**
>
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
>
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the module:



1 I/O bus
2 Switch-gear cabinet earth

NOTICE!

– If the relay outputs have to switch inductive **DC loads**, free-wheeling diodes must be circuited in parallel to these loads.
– If the relay outputs have to switch inductive **AC loads**, spark suppressors are required.

CAUTION!

The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

NOTICE!

Risk of damaging the PLC module!

The following things have to be considered when connecting input and output voltages to the module:

– All 230 VAC feeds must be single phase from the same supply system.
– Connection of 2 or more relay contacts in series is possible; however, voltages above 230 VAC and 3-phase loads are not allowed.
– The 4 switch-over contacts of the relays are electrically isolated from channel to channel. This allows to connect loads of 24 VDC and 230 VAC to relay outputs of the same module. In such cases it is necessary that both supply voltages are grounded to prevent unsafe floating grounds.
– All input signals must come from the same phase of the same supply system (together with the used neutral conductor). The module is designed for 120/230 VAC max., not for 400 VAC, not even between two input terminals.
– All neutral conductor connections must be common to the same supply system, since the terminals 4.0 to 4.3 are interconnected within the module. Otherwise, accidental energization could occur.

NOTICE!

Risk of damaging the PLC module!

There is no internal short-circuit or overload protection for the relay outputs.

Protect the relay contacts by back-up fuses of 6 A max. (characteristic gG/gL). Depending on the application, fuses can be used for single channels or module-wise.

The module provides several diagnosis functions (see chapter Diagnosis and State LEDs *Chapter 1.5.1.2.9.7 “Diagnosis” on page 392*).

Internal Data Exchange

Digital inputs (bytes)	1
Digital outputs (bytes)	1
Counter input data (words)	0
Counter output data (words)	0

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1205 [1])	Word	1205 0x04B5	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
Parameter length	Internal	4	Byte	4-CPU 4-FBP	0	255	0x0Y02
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	20 ms 100 ms	0 1	Byte	20 ms 0x00	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
Substitute value at outputs Bit 3 = Output 3 Bit 0 = Output 0	0...15	0... 0x0f	Byte	0 0x00	0	15	0x0Y06
[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 [2]) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const (0) =	7 0x04, 0xb6, 0x04, \ 0x01, 0x00, 0x00, 0x00;

Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diag- nosis block	
Class	Interface	Device	Module	Channel	Error Identifier	Error message	Remedy
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process supply voltage too low	Check process supply voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process supply voltage is switched off (ON –> OFF)	Process supply voltage ON
	11 / 12	ADR	1...10				

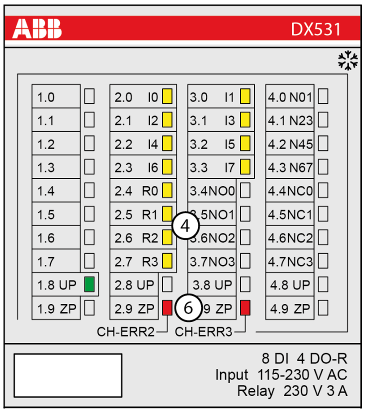
Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I7	Digital input	Yellow	Input = OFF	Input = ON	--
	Outputs R0...R3 (relays)	Digital output	Yellow	Relay output = OFF	Relay output = ON	--
	UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR2 CH-ERR3	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 2 and 3)	Red Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR *)	Module Error	Red	--	Internal error	--
	*) All of the LEDs CH-ERR2 to CH-ERR3 light up together					

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 VDC (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 VDC (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L + and ZP/M of the CPU/bus module	ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + output loads
Inrush current from UP (at power up)		0.004 A^2s
Max. power dissipation within the module		6 W (outputs OFF)
Weight (without terminal unit)		Ca. 300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

No effects of multiple over-loads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	4 groups of 2 channels each
Terminals of the channels I0 to I7	*Chapter 1.5.1.2.9.3 “Electrical Connection” on page 386*
Galvanic isolation	2500 VAC from the rest of the module (I/O bus)
Indication of the input signals	1 yellow LED per channel The LEDs are only operating if the module is initialized
Monitoring point of input indicator	LED is controlled by process CPU

Parameter		Value
Input type acc. to EN 61131-2		Type 2
Input delay (0->1 or 1->0)		Typ. 20 ms
Input signal voltage		230 VAC or 120 VAC
Input signal range		0 VAC...265 VAC
Input signal frequency		47 Hz...63 Hz
Input characteristic		According EN 61132-2 Type 2
Signal 0		0 VAC...40 VAC
Undefined signal		> 40 VAC...< 74 VAC
Signal 1		74 VAC...265 VAC
Input current per channel		
	Input voltage = 159 V AC	> 7 mA
	Input voltage = 40 V AC	< 5 mA
Overvoltage protection		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Relay Outputs

Parameter		Value
Number of channels per module		4 relay outputs
Distribution of channels into groups		4 groups of 1 channel each
Connection of the four relays		*Chapter 1.5.1.2.9.3 "Electrical Connection" on page 386*
Galvanic isolation		Between the channels and from the rest of the module
Indication of the output signals		1 yellow LED per channel, the LED is ON when the relay coil is energized
Monitoring point of output indicator		LED is controlled by process CPU
Way of operation		Non-latching type
Output delay (0->1 or 1->0)		On request
Relay power supply		By UP process supply voltage
Relay outputs		
	Output short circuit protection	Must be provided externally with a fuse or circuit breaker
	Rated protection fuse	6 A gL/gG per channel
Output switching capacity		
	Resistive load, max.	3 A; 3 A (230 VAC), 2 A (24 VDC)
	Inductive load, max.	1.5 A; 1.5 A (230 VAC), 1.5 A (24 VDC)
	Lamp load	60 W (230 VAC), 10 W (24 VDC)

Parameter		Value
Life time (cycles)		Mechanical: 300 000; Under load: 300 000 (24 VDC at 2 A), 200 000 (120 VAC at 2 A), 100 000 (230 VAC at 3 A)
Spark suppression with inductive AC load		Must be performed externally according to driven load specifications
Demagnetization with inductive DC load		A free-wheeling diode must be circuited in parallel to the inductive load
Switching frequency		
	With resistive load	Max. 10 Hz
	With inductive load	Max. 2 Hz
	With lamp load	On request
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 245 000 R0001	DX531, digital input/output module, 8 DI, 230 VAC, 4 DO relays, 2-wires	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.1.2.10 Fast Counter

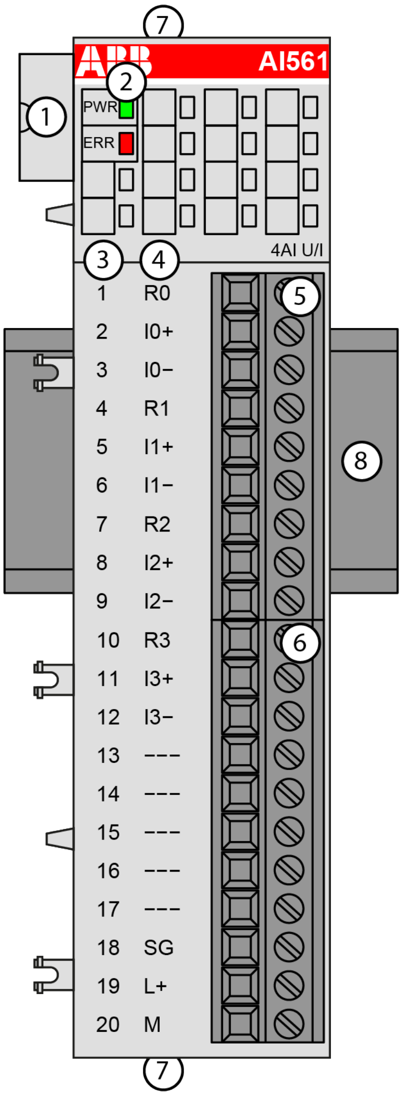
Details on fast counters:*System Technology*

1.5.2 Analog I/O Modules

1.5.2.1 S500-eCo

1.5.2.1.1 AI561 - Analog Input Module

- 4 configurable analog inputs (I0 to I3) in 1 group
- Resolution: 11 bits plus sign or 12 bits



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are not electrically isolated from each other.

All other circuitry of the module is not electrically isolated from the inputs or from the I/O bus.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.

Functionality

4 analog inputs, individually configurable for

- Not used (default setting)
- -2.5 V...+2.5 V
- -5 V...+5 V
- 0 V...+5 V
- 0 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA

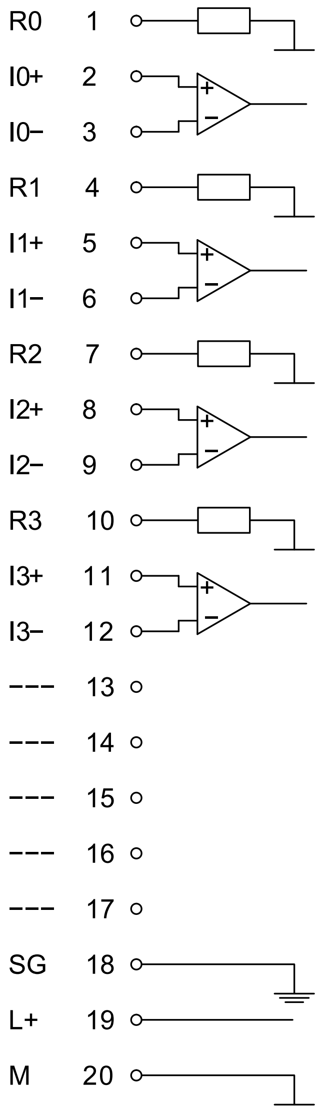
Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V...+2.5 V; -5 V...+5 V)	11 bits plus sign
	Voltage unipolar (0 V...5 V; 0 V...10 V)	12 bits
	Current (0 mA...20 mA; 4 mA...20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 VDC) and M (0 VDC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *➫ Chapter 2.5 "AC500-eCo" on page 1194.*

The electrical connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side) *➫ Chapter 1.8.3.2 "TA563-TA565 - Terminal Blocks" on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the analog inputs:



The assignment of the terminals:

Terminal	Signal	Description
1	R0	Burden resistor for input signal 0 for current sensing
2	I0+	Positive pole of input signal 0
3	I0-	Negative pole of input signal 0
4	R1	Burden resistor for input signal 1 for current sensing
5	I1+	Positive pole of input signal 1
6	I1-	Negative pole of input signal 1
7	R2	Burden resistor for input signal 2 for current sensing
8	I2+	Positive pole of input signal 2
9	I2-	Negative pole of input signal 2
10	R3	Burden resistor for input signal 3 for current sensing
11	I3+	Positive pole of input signal 3

Terminal	Signal	Description
12	I3-	Negative pole of input signal 3
13	---	Reserved
14	---	Reserved
15	---	Reserved
16	---	Reserved
17	---	Reserved
18	SG	Shield grounding
19	L+	Process voltage L+ (24 VDC)
20	M	Process voltage M (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 10 mA per AI561.

The external power supply connection is carried out via the L+ (+24 VDC) and the M (0 VDC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/bus module.

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

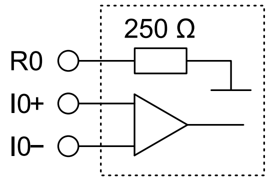
– connect or disconnect any signal or terminal block
– remove or replace a module.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 1.5.2.1.1.6 “Diagnosis” on page 403*.

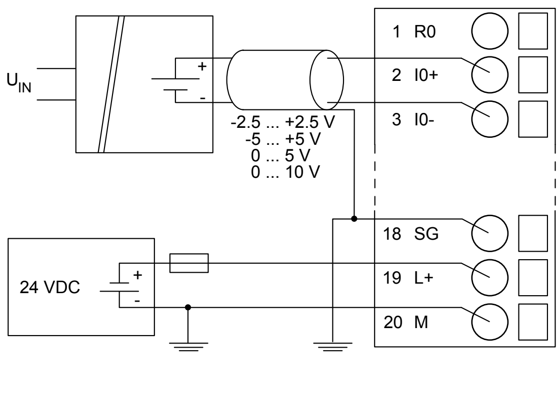
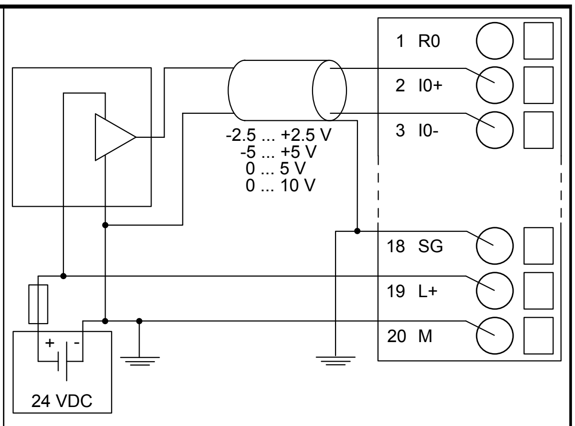
The following figure is an example of the internal construction of the analog input AI0. The analog inputs AI1...AI3 are designed in the same way.



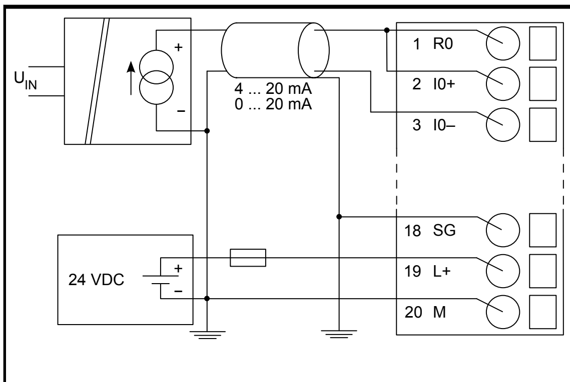
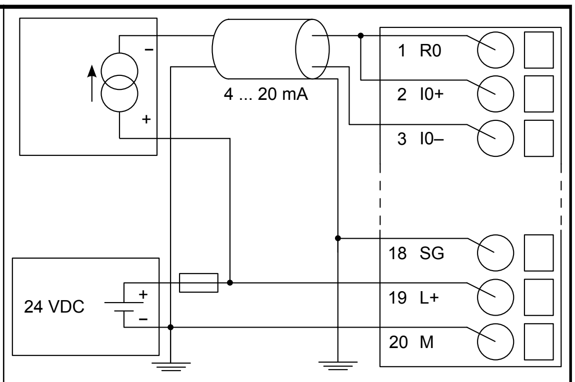
CAUTION!
Risk of damaging the analog input!
The 250 Ω input resistor can be damaged by overcurrent.

Make sure that the current through the resistor never exceeds 30 mA.

The following figures are an example of the electrical connection of analog sensors (voltage) to the input I0 of the analog input module AI561. Proceed with the inputs I1 to I3 in the same way.

	
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)

The following figures are an example of the electrical connection of analog sensors (current) to the input I0 of the analog input module AI561. Proceed with the inputs I1 to I3 in the same way.

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

The meaning of the LEDs is described in the Displays section *Chapter 1.5.2.1.1.7 “State LEDs” on page 404*.

I/O Configuration

The analog input module AI561 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6500 [1])	WORD	0x1964	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Internal	6	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1...n)

GSD file:	Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x09 0x65, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input Channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00	0	65535

Table 52: Channel Configuration [2])

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
1	0 V...10 V
3	0 mA...20 mA
4	4 mA...20 mA
6	0 V...5 V

Internal value	Operating modes for the analog inputs, individually configurable
7	-5 V...+5 V
20	-2,5 V...+2,5 V

Diagnosis

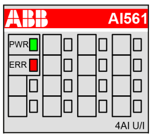
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...3	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1...0				
4	14	1...10	1	0...3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...0				

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1...10 = expansion 1..10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 VDC via terminal	Green	CPU module voltage or external 24 VDC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 VDC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Measuring Ranges

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Range	-2.5 ... +2.5 V	-5 ... +5 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
							Decimal	Hex.
Overflow	>2.9397	>5.8795	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397 : 2.5014	5.8795 : 5.0029	5.8795 : : : 5.0015	11.7589 : : : 10.0029	23.5178 : : : 20.0058	22.8142 : : 20.0058	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range	2.5000 : 0.0014	5.0000 : 0.0029	5.0000 : : : 0.0015	10.0000 : : : 0.0029	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008

Range	-2.5 ... +2.5 V	-5 ... +5 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
							Decimal	**Hex.**
Normal range or meas-ured value too low	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	: -0.0014 : : : -2.5000	: -0.0029 : : : -5.0000				3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Meas-ured value too low	-2.5014 : -2.9398	-5.0029 : -5.8795					-27664 : -32512	93F0 : 8100
Under-flow	<-2.9398	<-5.8795	<-0.0300	<-0.0600	<-0.1200	<-0.1200	-32768	8000

The represented resolution corresponds to 12 bits respectively 11 bits plus sign.

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 VDC) and terminal 20 for M (0 V)
	Rated value	24 VDC
	Current consumption via L+ terminal	0.1 A
	Inrush current (at power up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Recommended
Current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module		Ca. 10 mA
Galvanic isolation		No
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		2.7 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

> **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter	Value
Number of channels per module	4 individually configurable voltage or current inputs
Distribution of channels into groups	1 (4 channels per group)
Resolution	
Unipolar	Voltage: 0 V...+5 V; 0 V...+10 V: 12 bits Current 0 mA...20 mA; 4 mA...20 mA: 12 bits
Bipolar	Voltage -2.5 V...+2.5 V; -5 V...+5 V: 11 bits plus sign
Connection of the signals I0- to I3-	Terminals 3, 6, 9, 12
Connection of the signals I0+ to I3+	Terminals 2, 5, 8, 11
Input type	Differential
Galvanic isolation	No galvanic isolation between the inputs and the I/O bus
Common mode input range	Signal voltage plus common mode voltage must be within ±12 V
Indication of the input signals	No
Channel input resistance	Voltage: > 1 MΩ Current: ca. 250 Ω
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.: ±0.5 % of full scale (voltage) ±0.5 % of full scale (current 0 mA...20 mA) ±0.7 % of full scale (current 4 mA...20 mA) at 25 °C Max.: ±2 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Time constant of the input filter	Voltage: 300 µs Current: 300 µs
Relationship between input signal and hex code	*Chapter 1.5.2.1.1.8 “Measuring Ranges” on page 404*
Analog to digital conversion time	Typ. 500 µs per channel
Unused inputs	Can be left open and should be configured as "unused"
Input data length	8 bytes
Overvoltage protection	Yes, up to 30 VDC only for voltage input

Parameter		Value
Max. cable length (conductor cross section > 0,14 mm²)		
	Unshielded wire	10 m
	Shielded wire	100 m

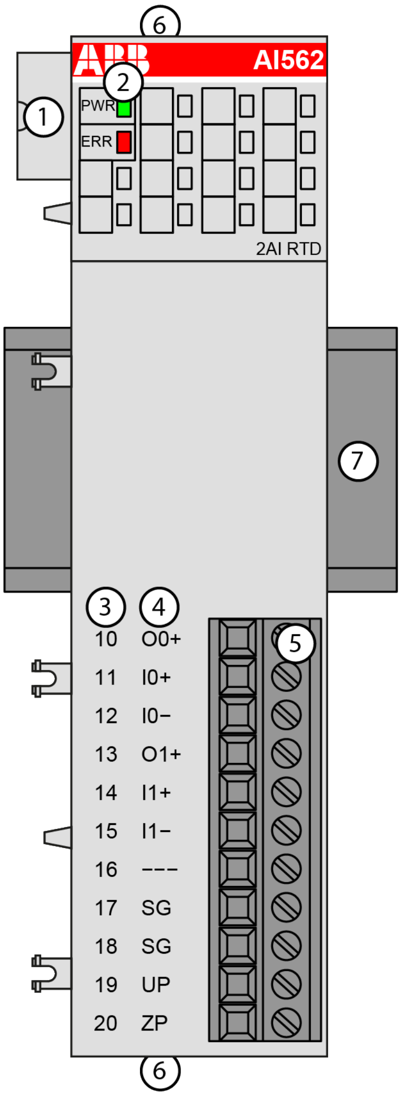
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R1101	AI561, analog input module, 4 AI, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.1.2 AI562 - Analog Input Module

- 2 configurable analog resistance temperature detector (RTD) inputs (I0 and I1) in 1 group
- Resolution: 15 bits plus sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are not electrically isolated from each other.

All other circuitry of the module is electrically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

2 analog RTD-inputs, individually configurable for

- Not used (default)
- Pt100, -50 °C...+400 °C, 2-wire
- Pt100, -50 °C...+400 °C, 3-wire
- Pt1000, -50 °C...+400 °C, 2-wire
- Pt1000, -50 °C...+400 °C, 3-wire
- Ni1000, -50 °C...+150 °C, 2-wire
- Ni1000, -50 °C...+150 °C, 3-wire
- Ni100, -50 °C...+150 °C, 2-wire
- Ni100, -50 °C...+150 °C, 3-wire
- Analog input resistance 0 Ω...150 Ω
- Analog input resistance 0 Ω...300 Ω

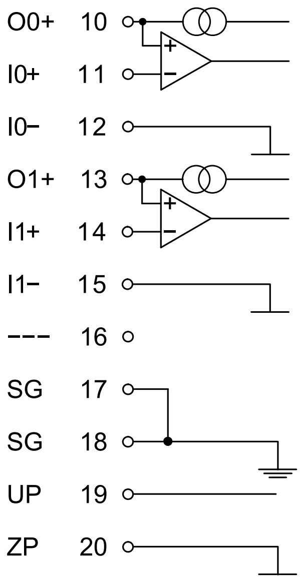
Parameter	Value
Resolution of the analog channels	
Temperature	0.1 °C
LED displays	2 LEDs for process voltage and error messages
Internal supply	Via I/O bus
External supply	Via the terminals UP (process voltage 24 VDC) and ZP (0 VDC)

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *➪ Chapter 2.5 “AC500-eCo” on page 1194.*

The electrical connection is carried out by using a removable 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). *➪ Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the analog inputs:



The assignment of the terminals:

Terminal	Signal	Description
10	O0+	Current source of channel 0
11	I0+	Sense input of channel 0
12	I0-	Return input of channel 0
13	O1+	Current source of channel 1
14	I1+	Sense input of channel 1
15	I1-	Return input of channel 1
16	---	Reserved
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 VDC)
20	ZP	Process voltage ZP (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 5 mA per AI562.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

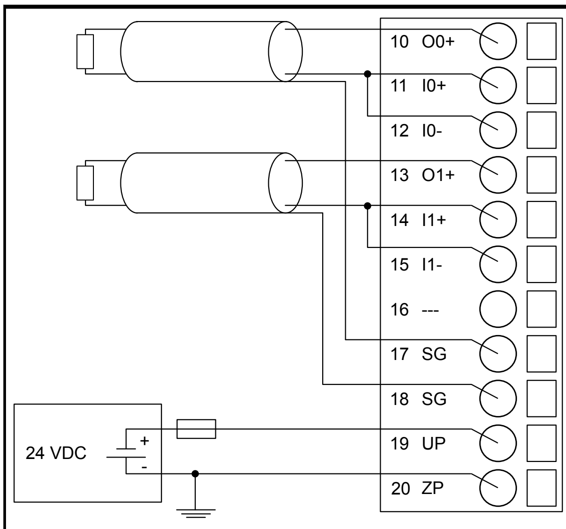
– connect or disconnect any signal or terminal block
– remove or replace a module.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

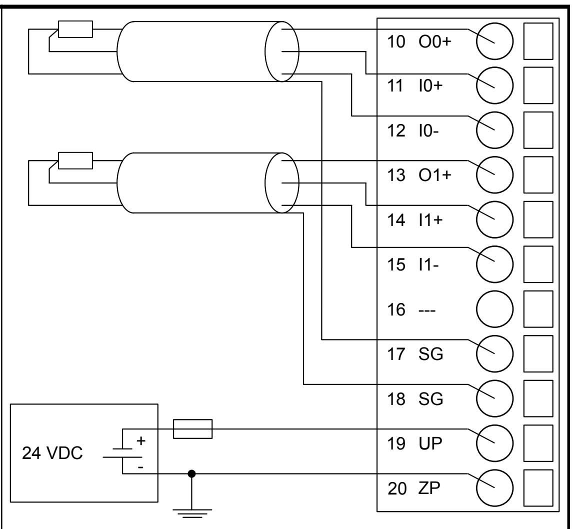
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 1.5.2.1.2.6 “Diagnosis” on page 413*.

The following figures show the electrical connection of RTDs to the inputs of the analog input module AI562.



2-wires input



3-wires input

With 2-wires connection, the resistance of the connection wires influences the accuracy of the measured value. Use 3-wires connection to achieve the guaranteed measuring accuracy.

The meaning of the LEDs is described in the Displays section *Chapter 1.5.2.1.2.7 “State LEDs” on page 414*.

I/O Configuration

The analog input module AI562 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6505 [1])	WORD	0x1969	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x07
Ext_User_Prm_Data_Const(0) =	0x6A, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00;

Input Channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [3])	0	65535

Table 53: Channel Configuration [2])

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default) [3])
8	2-wire Pt100 -50 °C...+400 °C
9	3-wire Pt100 -50 °C...+400 °C
16	2-wire Pt1000, -50 °C...+400 °C

Internal value	Operating modes for the analog inputs, individually configurable
17	3-wire Pt1000, -50 °C...+400 °C
18	2-wire Ni1000 -50 °C...+150 °C
19	3-wire Ni1000 -50 °C...+150 °C
22	2-wire Ni100, -50 °C...+150 °C
23	3-wire Ni100, -50 °C...+150 °C
32	Analog input resistor 0 Ω...150 Ω
33	Analog input resistor 0 Ω...300 Ω

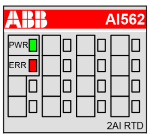
Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000...063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...1	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...1	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 VDC via terminal	Green	CPU module voltage or external 24 VDC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 VDC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring Ranges

Risk of invalid analog input values!
The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Resistance Temperature Detectors

Range	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 / Ni100 -50 ... +150 °C	Digital value	
			Decimal	**Hex.**
Overflow	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high	450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 / Ni100 -50 ... +150 °C	Digital value	
			Decimal	**Hex.**
		160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
Normal range	400.0 °C : : : : 0.1 °C	 150.0 °C : : 0.1 °C	4000 2000 1500 700 : 1	0FA0 07D0 05DC 02BC : 1
	0,0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500 -2000	FFFF : FE0C F830
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Resistances

Range	Resistance 0 ... 150 Ω	Resistance 0 ... 300 Ω	Digital value	
			Decimal	**Hex.**
Overflow	>176.383	>352.767	32767	7FFF
Measured value too high	176.383 150.005	352.767 300.011	32511 27649	7EFF 6C01
Normal range	150.000 : 0.005	300.000 : 0.011	27648 : 1	6C00 : 0001
	0	0	0	0000

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 VDC) and terminal 20 for ZP (0 V)
	Rated value	24 VDC
	Current consumption	0.04 A
	Inrush current (at power-up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Recommended
Current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/Bus Module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the rest of the module
	Isolated groups	1 (2 channels per group)
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		1.1 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		2 configurable RTD (resistance temperature detector) inputs
Distribution of channels into groups		1 (2 channels per group)
Resolution		
	RTD	0.1 °C / 0.1 °F
	Resistance	15 bits + sign
Connection of the signals O0+ and O1+		Terminals 10 and 13
Connection of the signals I0- and I1-		Terminals 11 and 14
Connection of the signals I0+ and I1+		Terminals 12 and 15
Input type		Module ground referenced RTD for 2-wire and 3-wire resistance temperature detectors

Parameter	Value	
Galvanic isolation	Against internal power supply and other modules	
Input ranges	Pt100, Pt1000, Ni100, Ni1000	
	150 Ω, 300 Ω	
Indication of the input signals	No	
Module update time	All channels: < 1 s	
Channel input resistance	> 100 kΩ	
Input filter attenuation	-3 dB at 3.6 kHz	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	Depending on RTD max. ±0.6 % of full scale (guaranteed for 3-wires connection only) at 25 °C
	Max.	±2 % of full scale (guaranteed for 3-wires connection only) at 0 °C...60 °C or EMC disturbances
Measuring range	*Chapter 1.5.2.1.2.8 “Measuring Ranges” on page 414*	
Analog to digital conversion time	Typ. 140 ms per channel	
Unused inputs	Can be left open and should be configured as "unused"	
Input data length	4 bytes	
Power dissipation inside the sensor (max.)	1 mW	
Suppression of interference	On request	
Maximum input voltage	30 VDC (sense), 5 VDC (source)	
Basic error (resistance)	0.1 % of full-scale	
Repeatability	0.05 % of full-scale	
Overvoltage protection	Yes, up to 30 VDC	
Wire loop resistance	< 20 Ω	
Max. cable length (conductor cross section > 0.14 mm²)		
Unshielded wire	10 m	
Shielded wire	100 m	

Ordering Data

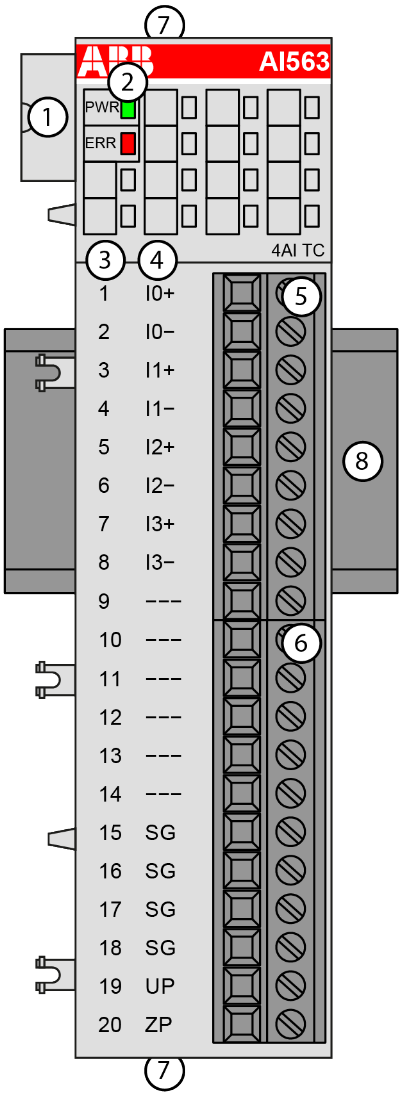
Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R1102	AI562, analog input module, 2 AI, RTD	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.1.3 AI563 - Analog Input Module

- 4 configurable thermocouple (TC) / -80 mV...+80 mV inputs (I0 to I3) in 1 group
- Resolution: 15 bits plus sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number

4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are group-wise electrically isolated from each other.

The other electronic circuitry of the module is electrically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.*

Functionality

4 analog TC inputs, individually configurable for

- Not used (default)
- Voltage -80 mV ... + 80 mV
- Thermocouple J-type -210 °C...+1200 °C
- Thermocouple K-type -270 °C...+1372 °C
- Thermocouple R-type -50 °C...+1768 °C
- Thermocouple S-type -50 °C...+1768 °C
- Thermocouple T-type -270 °C...+400 °C
- Thermocouple E-type -270 °C...+1000 °C
- Thermocouple N-type -270 °C...+1300 °C

Parameter	Value
Resolution of the analog channels	
Temperature	0.1 °C
LED displays	2 LEDs for process voltage and error messages
Internal supply	Via I/O bus
External supply	Via the terminals UP (process voltage 24 VDC) and ZP (0 VDC)

Electrical Connection

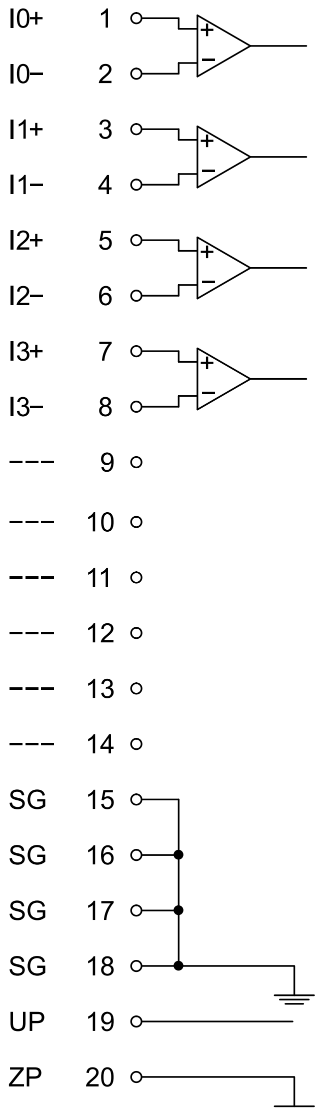
> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter* *Chapter 2.5 “AC500-eCo” on page 1194.*

After powering up the system, input channels, which are configured will have undefined values /diagnosis message for typically 45 seconds, if the wires of all configured channels are broken.

If the AI563 is connected to a PROFINET Bus Module, the firmware version of PROFINET Bus Modules must be 1.2 or above.

The electrical connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw-type terminals, cable mounting from the front or from the side). *Chapter 1.8.3.2 "TA563-TA565 - Terminal Blocks" on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the analog inputs:



The assignment of the terminals:

Terminal	Signal	Description
1	I0+	Plus pole of channel 0
2	I0-	Minus pole of channel 0
3	I1+	Plus pole of channel 1
4	I1-	Minus pole of channel 1
5	I2+	Plus pole of channel 2
6	I2-	Minus pole of channel 2
7	I3+	Plus pole of channel 3
8	I3-	Minus pole of channel 3
9	---	Reserved
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	---	Reserved
14	---	Reserved
15	SG	Shield grounding
16	SG	Shield grounding
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 VDC)
20	ZP	Process voltage ZP (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module increases by 5 mA per AI563.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

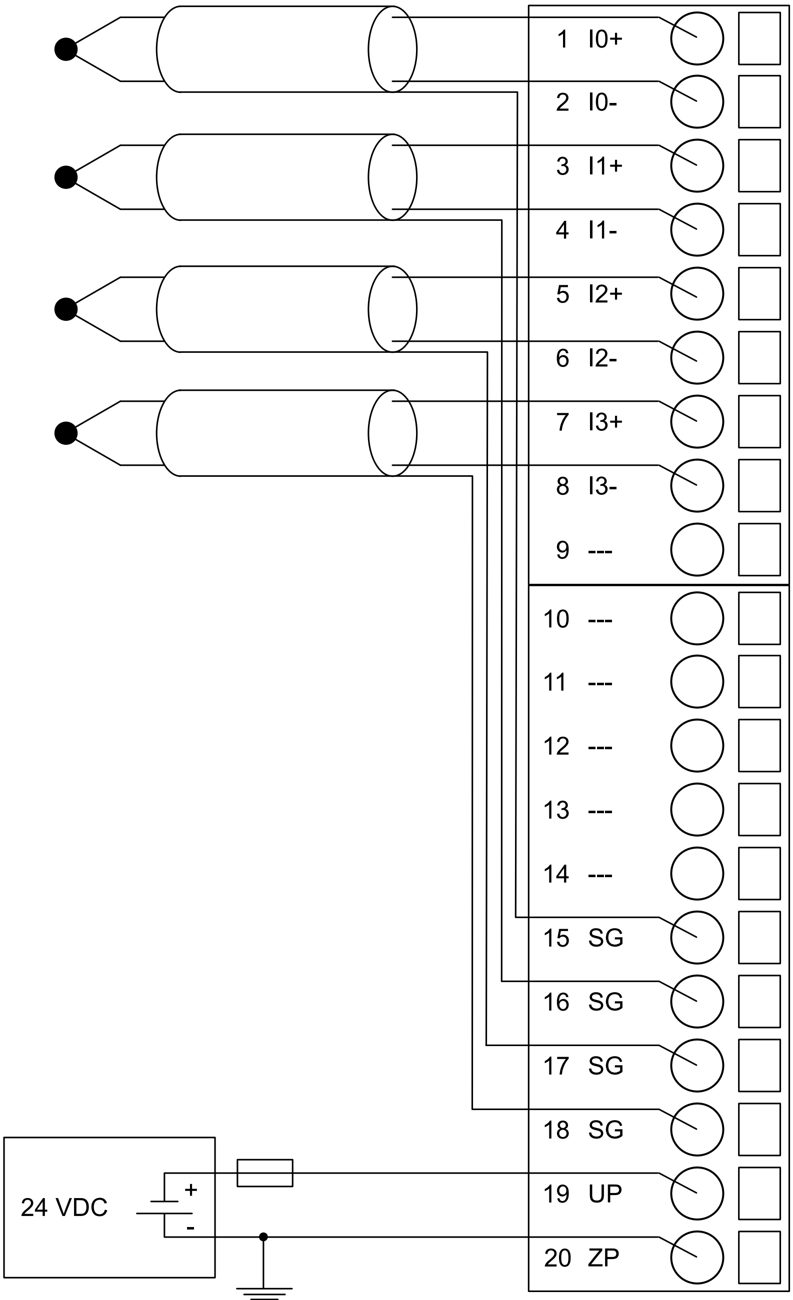
Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions ➮ *Chapter 1.5.2.1.3.6 “Diagnosis” on page 424*.

The following figure shows the electrical connection of thermocouples to the inputs of the module:



The meaning of the LEDs is described in Displays ➮ *Chapter 1.5.2.1.3.7 “State LEDs” on page 425* chapter.

I/O Configuration

The analog input module AI563 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6510 [1])	WORD	0x196E	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	6	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1]) with CS31 and addresses less than 70, the value is increased by 1 [2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)							

GSD file:

Ext_User_Prm_Data_Len =	0x09
Ext_User_Prm_Data_Const(0) =	0x6F, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input Channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 54: Channel Configuration ²)

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
21	Voltage -80 mV...+80 mV
24	Thermocouple J-type -210 °C...+1200 °C
25	Thermocouple K-type -270 °C...+1372 °C
26	Thermocouple R-type -50 °C...+1768 °C
27	Thermocouple S-type -50 °C...+1768 °C
28	Thermocouple T-type -270 °C...+400 °C
29	Thermocouple E-type -270 °C...+1000 °C
30	Thermocouple N-type -270 °C...+1300 °C

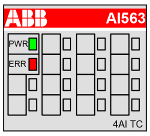
Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...3	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = expansion module 1...10, ADR = hard-ware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/ COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 VDC via terminal	Green	CPU module voltage or external 24 VDC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 VDC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring Ranges

AI563 needs 4 seconds for initialization after applying the process supply voltage to clamp UP/ZP. During these 4 seconds, the measurement values are set to '0'. After that, valid measurement values are provided by the module.

After an interruption of the process supply voltage > 10 ms, a re-initialization is performed by AI563.

Risk of invalid analog input values!
The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

When a wire break occurs on a sensor wire, the temperature measurement value of the corresponding channel changes to Overflow (Hexadecimal 7FFF).

Range	Type J -210 ... +1200 °C	Type K -270 ... +1372 °C	Type N -270 ... +1300 °C	Type T -270 ... +400 °C	Digital value	
					Decimal	Hex.
Overflow	> 1200.0 °C	> 1372.0 °C	> 1300.0 °C	> 400.0 °C	32767	7FFF
Normal range					17680	4510
		1372.0 °C			13720	3598
		:	1300.0 °C		13000	32C8
	1200.0 °C	:	:		12000	2EE0
	:	:	:	400.0 °C	4000	0FA0
	:	:	:	:	:	:
	0.1 °C	0.1 °C	0.1 °C	0.1 °C	1	1
	0.0 °C	0.0 °C	0.0 °C		0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:	:
	:	:	:	:	-500	FE0C
	-210.0 °C	:	:	:	-2100	F7CC
		-270.0 °C	-270.0 °C	-270.0 °C	-2700	F574
Underflow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -270.0 °C	-32768	8000

Range	-80 mV ... +80 mV	Type E -270 ... +1000 °C	Types R, S -50 ... +1768 °C	Digital value	
				Decimal	Hex.
Overflow	> +90 mV	> 1000.0 °C	> 1768.0 °C	32767	7FFF
Normal range	+80 mV			27648	6C00
			1768.0 °C	17680	4510
		1000.0 °C		10000	2710
				9000	2328
	:	:	:	:	:
	3 µV	0.1 °C	0.1 °C	1	1
	0 µV	0.0 °C	0.0 °C	0	0000
	-3 µV	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:
	:	:	-50.0 °C	-500	FE0C
	:	-270.0 °C		-2700	F574
	-80 mV			-27648	9400
Underflow	< -90 mV	< -270.0 °C	< -50.0 °C	-32768	8000

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 VDC) and terminal 20 for ZP (0 V)
	Rated value	24 VDC
	Current consumption	0.10 A
	Inrush current (at power-up)	0.07 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Not necessary
Current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module		Ca. 5 mA
Galvanic isolation		Yes, between the channels and the rest of the module
	Isolated groups	1 (4 channels per group)
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		2.6 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

> **!** **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		4 configurable thermocouple (TC) inputs
Distribution of channels into groups		1 (4 channels per group)
Resolution		
	Temperature	0.1 °C
	Voltage	15 bits plus sign
Connection of the signals I0+ to I3+		Terminals 1, 3, 5 and 7
Connection of the signals I0- to I3-		Terminals 2, 4, 6 and 8

Parameter	Value
Input type	Floating thermocouple
Galvanic isolation	Against internal power supply and other modules
Common mode rejection	> 120 dB at 120 VAC
Indication of the input signals	No
Module update time	All channels: < 1.6 s
Channel input resistance	On request
Input filter attenuation	-3 dB at 15 kHz
Cold junction error	±1.5 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.: 0.1 % of full-scale (voltage) Depending on thermocouple, see table *Chapter 1.5.2.1.3.9.1.1 “Accuracy of Thermocouple Ranges at 25 °C (with Cold Junction Compensation)” on page 428* at 25 °C
	Max.: ±2 % of full scale (T-Type: ±3 % for -240 °C...-270 °C) at 0 °C...60 °C
Relationship between input signal and hex code	*Chapter 1.5.2.1.3.8 “Measuring Ranges” on page 425*
Analog to digital conversion time	400 ms per channel
Unused inputs	Can be left open and should be configured as "unused"
Input data length	8 bytes
Overvoltage protection	Yes, up to 30 VDC
Repeatability	On request
Wire loop resistance	< 100 Ω
Max. cable length (conductor cross section > 0.14 mm^2)	
Unshielded wire	10 m
Shielded wire	100 m

Accuracy of Thermocouple Ranges at 25 °C (with Cold Junction Compensation)

Thermocouple Type	Range	Accuracy
E	-270 °C...-220 °C	±2 %
	-220 °C...+1000 °C	±0.6 %
J	-210 °C...+1200 °C	±0.6 %
K	-270 °C...-220 °C	±1.5 %
	-220 °C...+1372 °C	±0.6 %
N	-270 °C...-150 °C	±2 %
	-150 °C...+1300 °C	±0.6 %
R	-50 °C...+150 °C	±1.5 %
	+150 °C...+1768 °C	±0.6 %

Thermocouple Type	Range	Accuracy
S	-50 °C...+150 °C	±1.5 %
	+150 °C...+1768 °C	±0.6 %
T	-270 °C...-240 °C	±3 %
	-240 °C...-0 °C	±2 %
	0 °C...+400 °C	±0.6 %

These accuracy values are valid only for stable module temperatures.

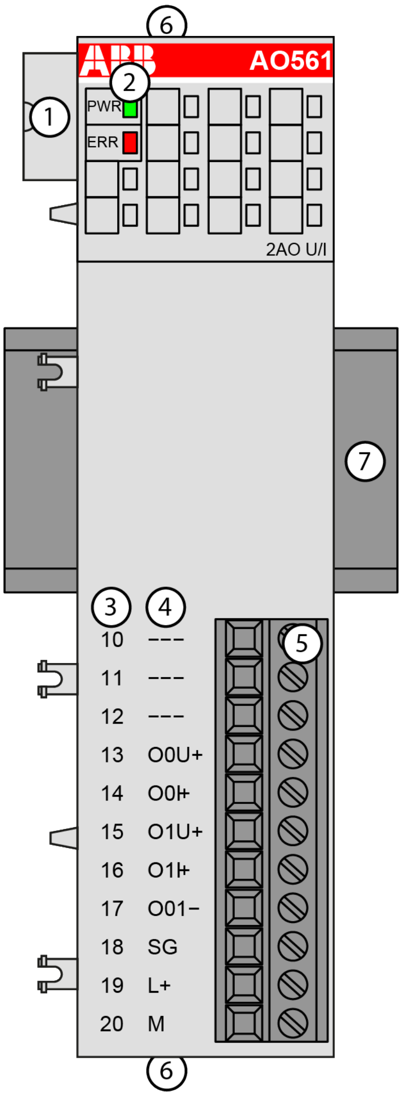
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R1103	AI563, analog input module, 4 AI, thermocouple	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.1.4 AO561 - Analog Output Module

- 2 configurable analog outputs (O0 and O1) in 1 group
- Resolution: 11 bits plus sign or 12 bit



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The outputs are not electrically isolated from each other.

The other electronic circuitry of the module is not electrically isolated from the outputs or from the I/O bus.

> *The I/O module must not be used as communication interface module at CI590-CS31-HA bus modules.*

Functionality

2 analog outputs, individually configurable for

- Not used (default setting)
- -10 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-10 V...+10 V)	11 bits plus sign
	Current (0 mA...20 mA; 4 mA...20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 VDC) and M (0 VDC); the M terminal is connected to the M terminal of the CPU via the I/O bus

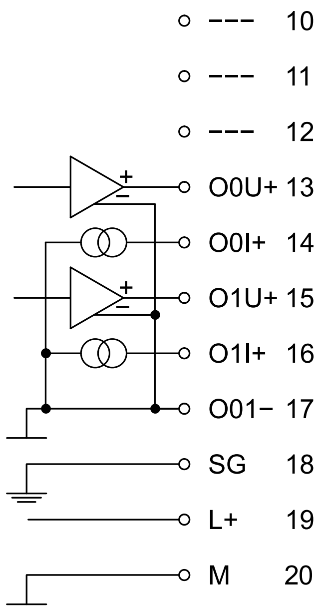
Electrical Connection

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter* *↯ Chapter 2.5 "AC500-eCo" on page 1194.*

> *If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.*

The electrical connection is carried out by using a removable 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw-type terminals, cable mounting from the front or from the side) *↯ Chapter 1.8.3.2 "TA563-TA565 - Terminal Blocks" on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the analog outputs:



The assignment of the terminals:

Terminal	Signal	Description
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	O0U+	Voltage output of channel 0
14	O0I+	Current output of channel 0
15	O1U+	Voltage output of channel 1
16	O1I+	Current output of channel 1
17	O01-	Negative pole of channels O0 and O1
18	SG	Shield grounding
19	L+	Process voltage L+ (24 VDC)
20	M	Process voltage M (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module increases by 5 mA per AO561.

The external power supply connection is carried out via the L+ (+24 VDC) and the M (0 VDC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/bus module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

NOTICE!

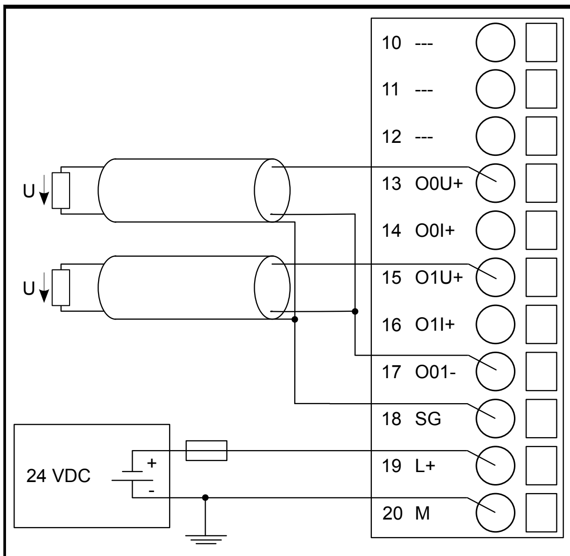
Risk of damaging the PLC modules!

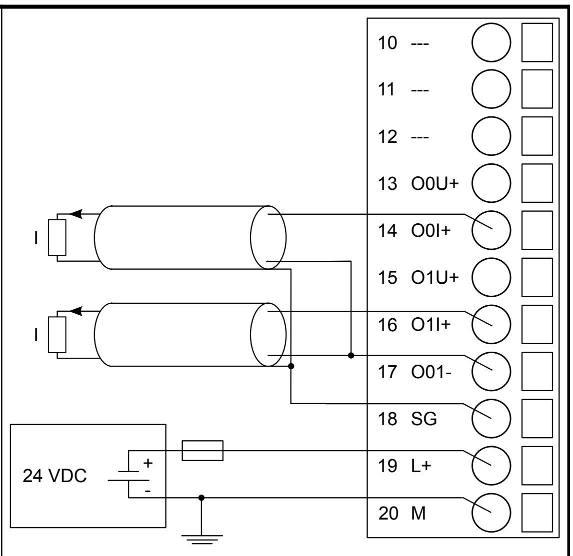
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 1.5.2.1.4.6 "Diagnosis" on page 435*.

The following figures show the electrical connection of analog actuators to the analog output module AO561.





Connection of analog voltage actuators	Connection of analog current actuators

The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behaviour and must be foreseen when planning the installation.

If the output is configured in current mode, the voltage output signal is undefined and must not be connected.

If the output is configured in voltage mode, the current output signal is undefined and must not be connected.

I/O Configuration

The analog output module AO561 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6515 [1])	WORD	0x1973	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x07
Ext_User_Prm_Data_Const(0) =	0x74, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Output Channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 55: Channel Configuration 2)

Internal value	Operating modes for the analog outputs, individually configurable
0	Not used (default)
128	-10 V...+10 V
129	0 mA...20 mA
130	4 mA...20 mA

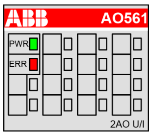
Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	3	0...1	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	3	0...1	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = expansion module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (3 = AO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 VDC via terminal	Green	CPU module voltage or external 24 VDC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 VDC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Output Ranges

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	>11.7589	>23.5178	>22.8142	32767	7FFF
Output value too high	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:
	10.0058	:	:	27664	6C10
	:	:	20.0058	27658	6C0A
	:	20.0058	:	27656	6C08
Normal range	10.0000	20.0000	20.0000	27648	6C00
Normal range or output value too low	:	:	:	:	:
	0.0058	:	:	16	0010
	:	:	4.0058	10	000A
	:	0.0058		8	0008
	0.0000	0	4	0	0000

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	Hex.
	: -0.0058 : : : -10.0000		3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Output value too low	-10.0058 : -11.7589			-27664 : -32512	93F0 : 8100
Underflow	<-11.7589		<0.0000	-32768	8000

The represented resolution corresponds to 12 bit respectively 11 bit plus sign.

Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 VDC) and terminal 20 for M (0 V)
	Rated value	24 VDC
	Current consumption	0.1 A + output load
	Inrush current (at power-up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Recommended
Current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module		Ca. 5 mA
Galvanic isolation		No
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		3.1 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

> **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Outputs

Parameter	Value
Number of channels per module	2 configurable voltage or current outputs
Distribution of channels into groups	1 (2 channels per group)
Connection of the signals O0U- and O1U+	Terminals 13 and 15
Connection of the signals O0I+ and O1I+	Terminals 14 and 16
Output type	Bipolar with voltage, unipolar with current
Resolution	12 bits or 11 bits plus sign
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. ±0.5 % of full scale at 25 °C
	Max. ±2 % of full scale at 0 °C...+60 °C or EMC disturbances
Indication of the output signals	No
Output Resistance (load) as current output	0 Ω...500 Ω
Output load ability as voltage output	±2 mA max.
Output data length	4 bytes
Relationship between output signal and hex code	*Chapter 1.5.2.1.4.8 “Output Ranges” on page 436*
Unused outputs	Must not be connected and must be configured as "unused"
Overvoltage protection	Yes, up to 30 VDC
Max. cable length (conductor cross section > 0.14 mm^2)	
Unshielded wire	10 m
Shielded wire	100 m

Ordering Data

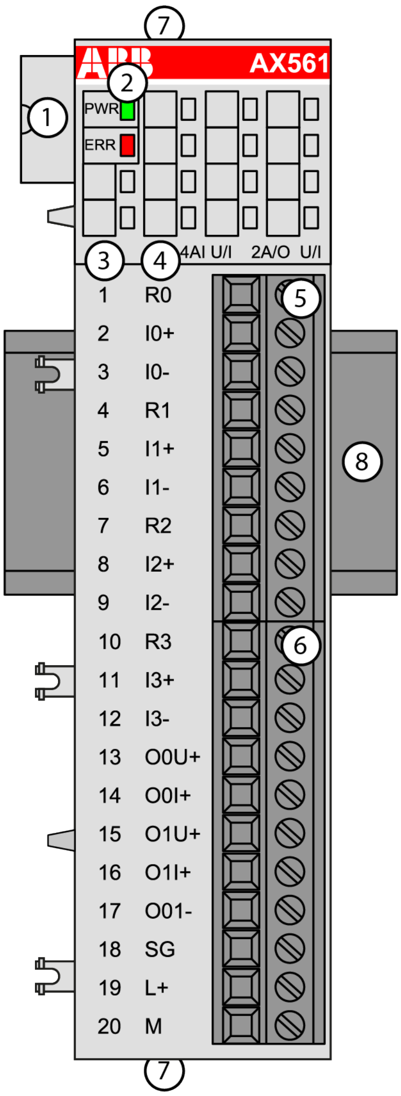
Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R1201	AO561, analog output module, 2 AO, U/I	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.1.5 AX561 - Analog Input/Output Module

- 4 configurable analog inputs (I0 to I3) in 1 group
- 2 configurable analog outputs (O0 and O1) in 1 group
- Resolution: 11 bits plus sign or 12 bits



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error

3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

The inputs are not electrically isolated from each other.

The outputs are not electrically isolated from each other.

All other circuitry of the module is not electrically isolated from the inputs/outputs or from the I/O bus.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.

Functionality

4 analog inputs, individually configurable for

- Not used (default)
- -2.5 V...+2.5 V
- -5 V...+ 5 V
- 0 V...+5 V
- 0 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA

2 analog outputs, individually configurable for

- Not used (default)
- -10 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V...+2.5 V; -5 V...+5 V)	11 bits plus sign
	Voltage unipolar (0 V...5 V; 0 V...10 V)	12 bits
	Current (0 mA...20 mA; 4 mA...20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages

Parameter	Value
Internal supply	Via I/O bus
External supply	Via the terminals L+ (process voltage 24 VDC) and M (0 VDC); the M terminal is connected to the M terminal of the CPU via the I/O bus

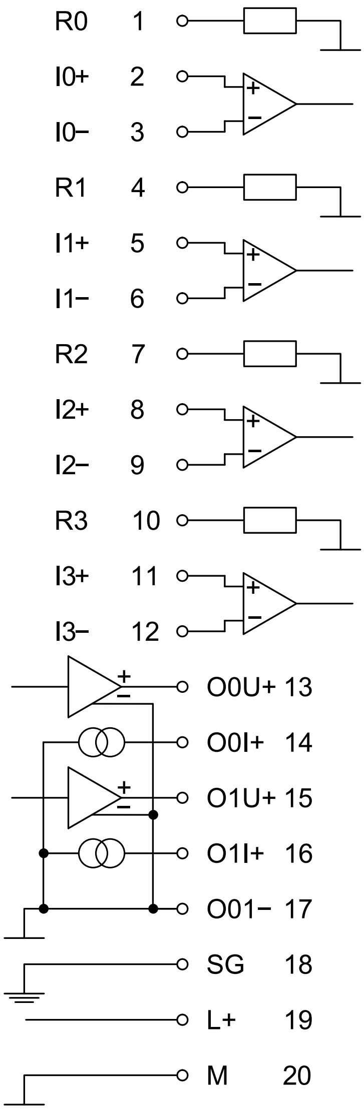
Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter *➪ Chapter 2.5 "AC500-eCo" on page 1194.*

If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.

The electrical connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, refer to terminal blocks for S500-eCo I/O modules *➪ Chapter 1.8.3.2 "TA563-TA565 - Terminal Blocks" on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the analog inputs and outputs:



The assignment of the terminals:

Terminal	Signal	Description
1	R0	Burden resistor for input signal 0 for current sensing
2	I0+	Positive pole of input signal 0
3	I0-	Negative pole of input signal 0
4	R1	Burden resistor for input signal 1 for current sensing
5	I1+	Positive pole of input signal 1
6	I1-	Negative pole of input signal 1
7	R2	Burden resistor for input signal 2 for current sensing
8	I2+	Positive pole of input signal 2
9	I2-	Negative pole of input signal 2
10	R3	Burden resistor for input signal 3 for current sensing
11	I3+	Positive pole of input signal 3
12	I3-	Negative pole of input signal 3
13	O0U+	Voltage output of channel 0
14	O0I+	Current output of channel 0

Terminal	Signal	Description
15	O1U+	Voltage output of channel 1
16	O1I+	Current output of channel 1
17	O01-	Negative pole of channels O0 and O1
18	SG	Shield grounding
19	L+	Process voltage L+ (24 VDC)
20	M	Process voltage M (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module increases by 5 mA per AX561.

The external power supply connection is carried out via the L+ (+24 VDC) and the M (0 VDC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/bus module.

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

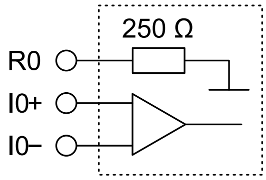
The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

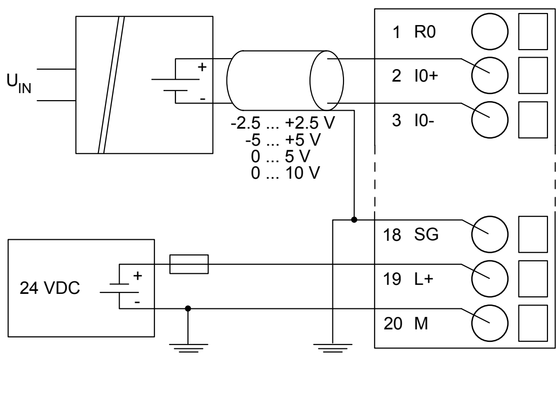
The module provides several diagnosis functions ↬ *Chapter 1.5.2.1.5.6 “Diagnosis” on page 447*.

The following figure is an example of the internal construction of the analog input AI0. The analog inputs AI1...AI3 are designed in the same way.

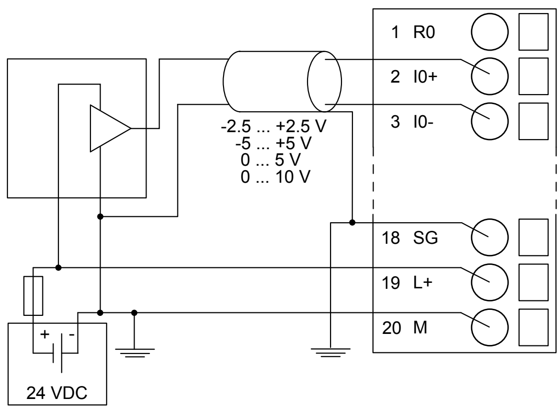


> **CAUTION!**
> **Risk of damaging the analog input!**
> The 250 Ω input resistor can be damaged by overcurrent.
>
> Make sure that the current through the resistor never exceeds 30 mA.

The following figures are an example of the electrical connection of analog sensors (voltage) to the input I0 of the analog input/output module AX561. Proceed with the inputs I1 to I3 in the same way.

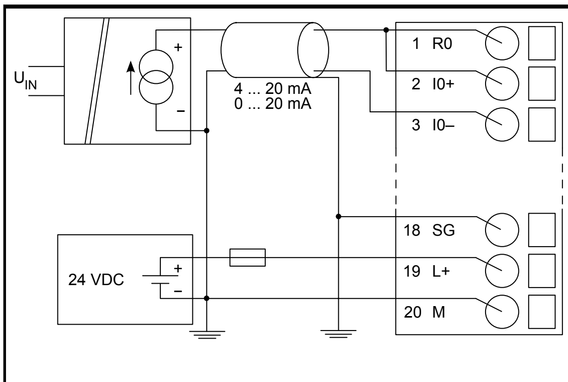


Connection of active-type analog sensors (voltage)

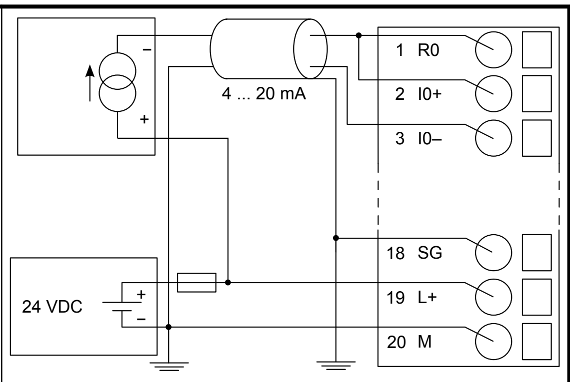


Connection of passive-type analog sensors (voltage)

The following figures are an example of the electrical connection of analog sensors (current) to the input I0 of the analog input/output module AX561. Proceed with the inputs I1 to I3 in the same way.

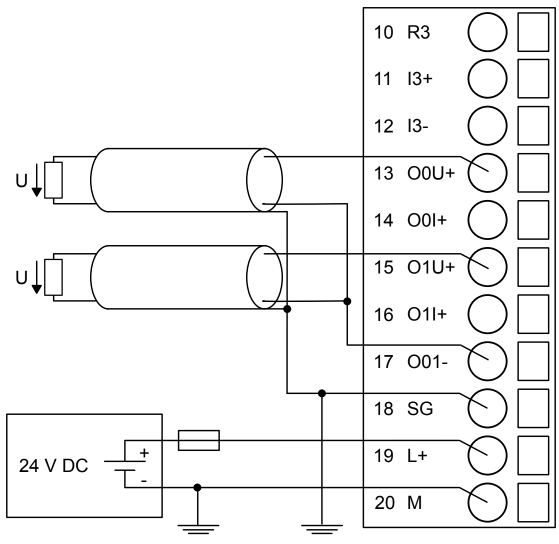


Connection of active-type analog sensors (current)

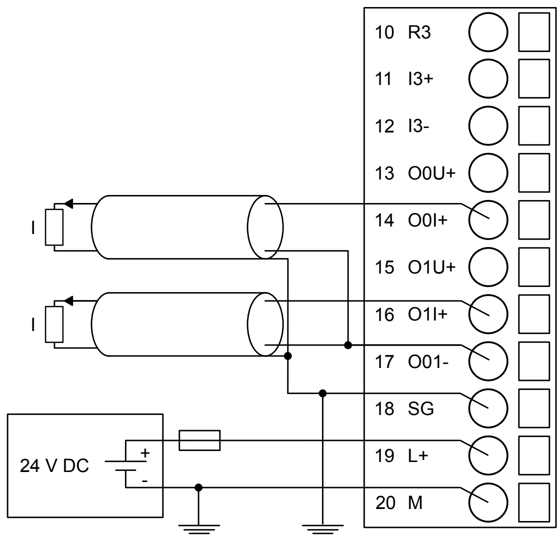


Connection of passive-type analog sensors (current)

The following figures are an example of the electrical connection of analog actuators to the analog input/output module AX561.



Connection of analog voltage actuators



Connection of analog current actuators

The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behaviour and must be foreseen when planning the installation.

If the output is configured in current mode, the voltage output signal is undefined and must not be connected.

If the output is configured in voltage mode, the current output signal is undefined and must not be connected.

The meaning of the LEDs is described in the displays chapter *Chapter 1.5.2.1.5.7 “State LEDs” on page 448*.

I/O Configuration

The IO module does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6520 [1])	WORD	0x1978	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Internal	8	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00			

[1]) With CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x0B 0x79, 0x19, 0x08, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00;

Input Channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configura-tion	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 56: Channel Configuration [2])

Internal value	Operating modes for the analog inputs, individually configu-rable
0	Not used (default)
1	0 V...+10 V
3	0 mA...20 mA
4	4 mA...20 mA
6	0 V...+5 V
7	-5 V...+5 V
20	-2.5 V...+2.5 V

Output Channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configura-tion	see see table 2)	see see table 2)	BYTE	0 0x00 see table 2)	0	65535

Table 57: Channel configuration 2)

Internal value	Operating modes for the analog outputs, individually configurable
0	Not used (default)
128	-10 V...+ 10 V
129	0 mA...20 mA
130	4 mA...20 mA

Diagnosis

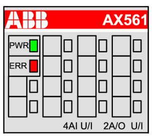
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...3	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<- Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
4	14	1...10	3	0...1	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	3	0...1	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (1 = AI, 3 = AO); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 VDC via terminal	Green	CPU module voltage or external 24 VDC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 VDC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring Ranges

> **CAUTION!**
> **Risk of wrong analog input values!**
> The analog input values may be wrong if the measuring range of the inputs are exceeded.
>
> Make sure that the analog signal at the connection terminals is always within the signal range.

Range	-2.5 ... +2.5 V	-5 ... +5 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
							Decimal	**Hex.**
Overflow	>2.9397	>5.8795	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397 : 2.5014	5.8795 : 5.0029	5.8795 : : : 5.0015	11.7589 : : : 10.0029	23.5178 : : : 20.0058	22.8142 : : 20.0058	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range Normal range or measured value too low	2.5000 : 0.0014	5.0000 : 0.0029	5.0000 : : : 0.0015	10.0000 : : : 0.0029	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	: -0.0014 : : : -2.5000	: -0.0029 : : : -5.0000				3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Measured value too low	-2.5014 : -2.9398	-5.0029 : -5.8795					-27664 : -32512	93F0 : 8100
Underflow	<-2.9398	<-5.8795	<-0.0300	<-0.0600	<-0.1200	<-0.1200	-32768	8000

The represented resolution corresponds to 12 bits respectively 11 bits plus sign.

Output Ranges

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	> 11.7589	> 23.5178	> 22.8142	32767	7FFF
Output value too high	11.7589 : 10.0058 : :	23.5178 : : : 20.0058	22.8142 : : 20.0058 :	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range Normal range or output value too low	10.0000 : 0.0058 : :	20,0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0	4	0	0000
	: -0.0058 : : : -10.0000		3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Output value too low	-10.0058 : -11.7589			-27664 : -32512	93F0 : 8100
Underflow	< -11.7589		<0.0000	-32768	8000

The represented resolution corresponds to 12 bits respectively 11 bits plus sign.

Technical Data

The System Data of AC500-eCo apply ↳ *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 VDC) and terminal 20 for M (0 V)
	Rated value	24 VDC
	Current consumption via L+ terminal	0.14 A + output load
	Inrush current (at power-up)	0.05 A
	Max. ripple	5 %
	Protection against reversed voltage	Yes

Parameter		Value
	Protection fuse for L+	Recommended
Current consumption from 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/Bus Module		Ca. 5 mA
Galvanic isolation		No
Surge-voltage (max.)		35 VDC for 0.5 s
Max. power dissipation within the module		4.9 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter		Value	
Number of channels per module		4 individually configurable voltage or current inputs	
Distribution of channels into groups		1 (4 channels per group)	
Resolution			
	Unipolar	Voltage: 0 V...+5 V; 0 V...+10 V: 12 bits Current 0 mA...20 mA; 4 mA...20 mA: 12 bits	
	Bipolar	Voltage -2.5 V...+2.5 V; -5 V...+5 V: 11 bits plus sign	
Connection of the signals I0- to I3-		Terminals 3, 6, 9, 12	
Connection of the signals I0+ to I3+		Terminals 2, 5, 8, 11	
Input type		Differential	
Galvanic isolation		No galvanic isolation between the inputs and the I/O bus	
Common mode input range		Signal voltage plus common mode voltage must be within ±12 V	
Indication of the input signals		No	
Channel input resistance		Voltage: >1 MΩ Current: ca. 250 Ω	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	±0.5 % of full scale (voltage) ±0.5 % of full scale (current 0 mA...20 mA) ±0.7 % of full scale (current 4 mA...20 mA) at 25 °C

Parameter	Value	
	Max.	±2 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Time constant of the input filter	Voltage: 300 µs Current: 300 µs	
Relationship between input signal and hex code	*Table on page 449*	
Analog to digital conversion time	Typ. 500 µs per channel	
Unused inputs	Can be left open and should be configured as "unused"	
Input data length	8 bytes	
Overvoltage protection	Yes, up to 30 VDC only for voltage input	
Max. cable length (conductor cross section > 0.14 mm²)		
Unshielded wire	10 m	
Shielded wire	100 m	

Technical Data of the Analog Outputs

Parameter	Value	
Number of channels per module	2 configurable voltage or current outputs	
Distribution of channels into groups	1 (2 channels per group)	
Connection of the signals O0U- and O1U+	Terminals 13 and 15	
Connection of the signals O0I+ and O1I+	Terminals 14 and 16	
Output type	Bipolar with voltage, unipolar with current	
Resolution	12 bits or 11 bits plus sign	
Indication of the output signals	No	
Output resistance (load) as current output	0 Ω...500 Ω	
Output load ability as voltage output	2 mA max.	
Relationship between input signal and hex code	Table Output Ranges *Table on page 450*	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale (voltage) ±0.5 % of full scale (current 0 mA...20 mA) ±0.7 % of full scale (current 4 mA...20 mA) at 25°C
	Max.	±2 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Unused outputs	Can be left open and should be configured as "unused"	
Output data length	4 bytes	
Overvoltage protection	Yes, up to 30 VDC	
Max. cable length (conductor cross section > 0.14 mm²)		

Parameter		Value
	Unshielded wire	10 m
	Shielded wire	100 m

Ordering Data

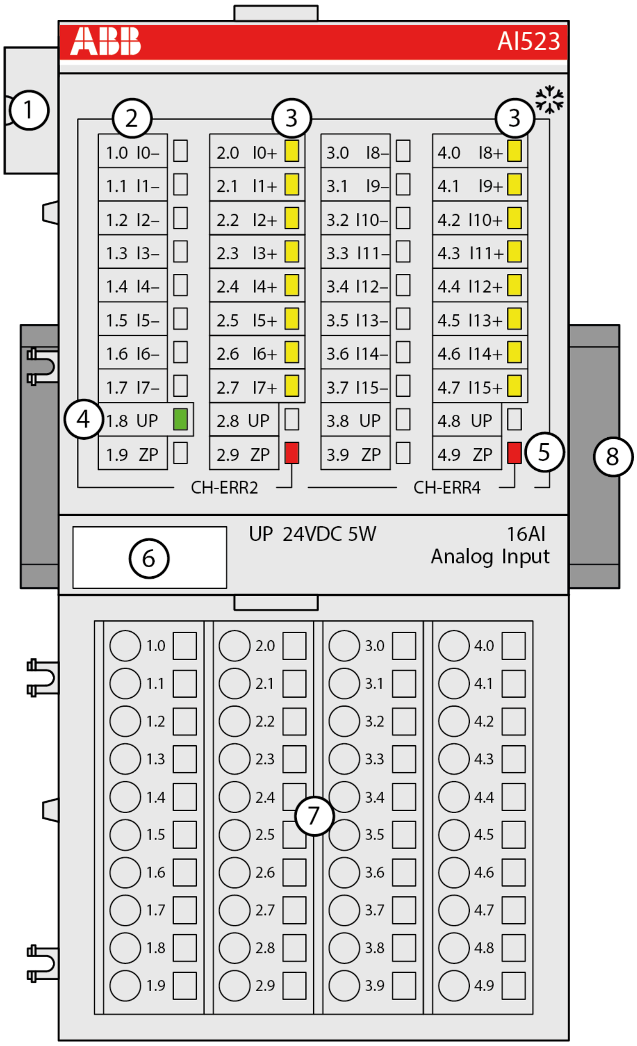
Part no.	Description	Product Life Cycle Phase *)
1TNE 968 902 R1301	AX561, analog input/output module, 4 AI, 2 AO, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.2 S500

1.5.2.2.1 AI523 - Analog Input Module

- 16 configurable analog inputs (I0 to I15) in 2 groups (1.0...2.7 and 3.0...4.7)
  Resolution 12 bits plus sign
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the analog inputs (I0 - I15)
4 1 green LED to display the state of the process supply voltage UP
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Functionality

16 analog inputs, individually configurable for

- Unused (default setting)
- 0 V...10 V
- -10 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA

- Pt100, -50 °C...+400 °C (2-wire)
- Pt100, -50 °C...+400 °C (3-wire), requires 2 channels
- Pt100, -50 °C...+70 °C (2-wire)
- Pt100, -50 °C...+70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C...+400 °C (2-wire)
- Pt1000, -50 °C...+400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C...+150 °C (2-wire)
- Ni1000, -50 °C...+150 °C (3-wire), requires 2 channels
- 0 V...10 V with differential inputs, requires 2 channels
- -10 V...+10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V... +10 V	12 bits plus sign
	Voltage 0 V...10 V	12 bits
	Current 0 mA...20 mA, 4 mA...20 mA	12 bits
	Temperature	0.1 °C
LED displays		19 LEDs for signals and error messages
Internal power supply		Via the expansion bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit		TU515 or TU516 ➥ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

Electrical Connection

The modules are plugged on an I/O terminal unit ➥ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ➥ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ➥ Chapter 2.6 “AC500 (Standard)” on page 1252.*

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, independent of the inserted module:

Terminals 1.8 to 4.8: process voltage UP = +24 VDC

Terminals 1.9 to 4.9: process voltage ZP = 0 V

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0- to I7-	Negative poles of the first 8 analog inputs
2.0 to 2.7	I0+ to I7+	Positive poles of the first 8 analog inputs
3.0 to 3.7	I8- to I15-	Negative poles of the following 8 analog inputs
4.0 to 4.7	I8+ to I15+	Positive poles of the following 8 analog inputs

CAUTION!
The negative poles of the analog inputs are electrically connected to each other. They form an "Analog Ground" signal for the module. The negative poles of the analog outputs are also electrically connected to each other to form an "Analog Ground" signal.

CAUTION!
There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be electrically isolated in order to avoid loops via the earth potential or the supply voltage.

CAUTION!
Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (cut wire), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per AI523.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

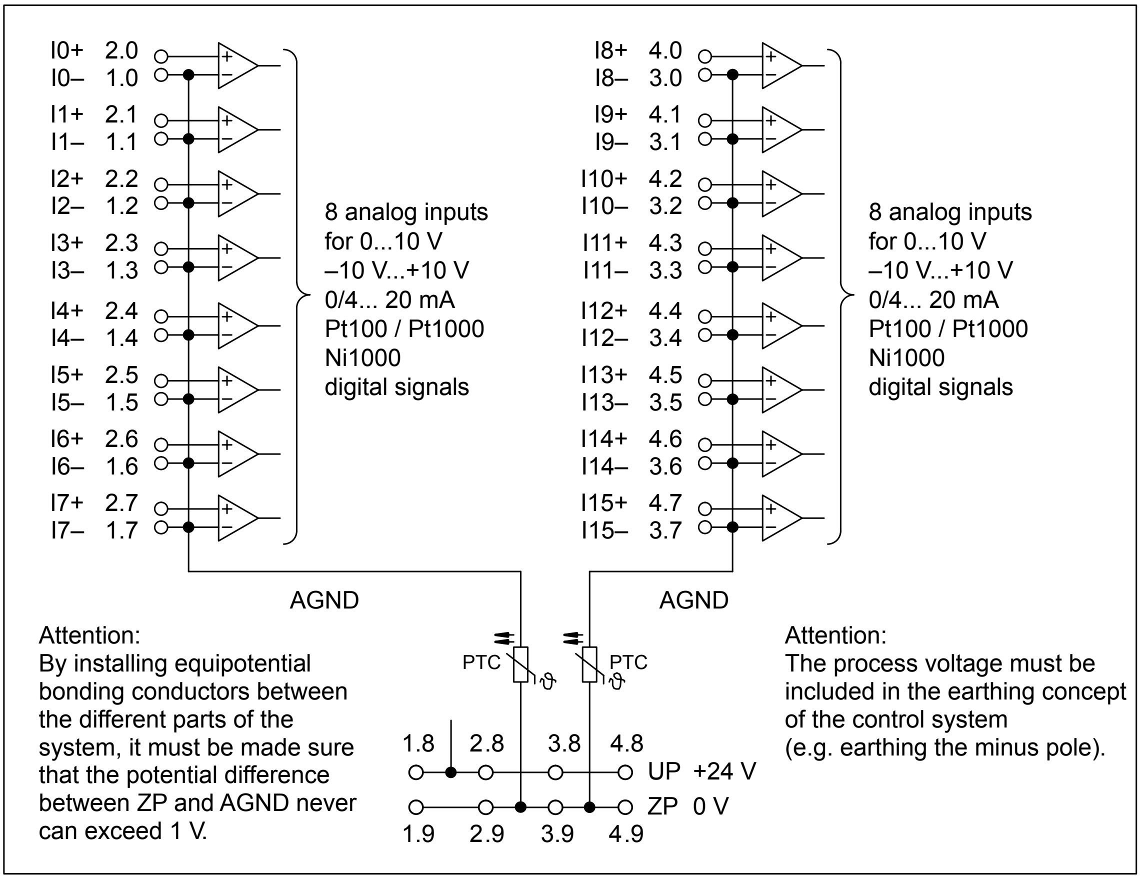
NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

- Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
- Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the electrical connection of the module:



The modules provide several diagnosis functions *Chapter 1.5.2.2.1.7 “Diagnosis” on page 468*.

Connection of Resistance Thermometers in 2-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI523 provides a constant current source which is multiplexed over the 8 analog channels.

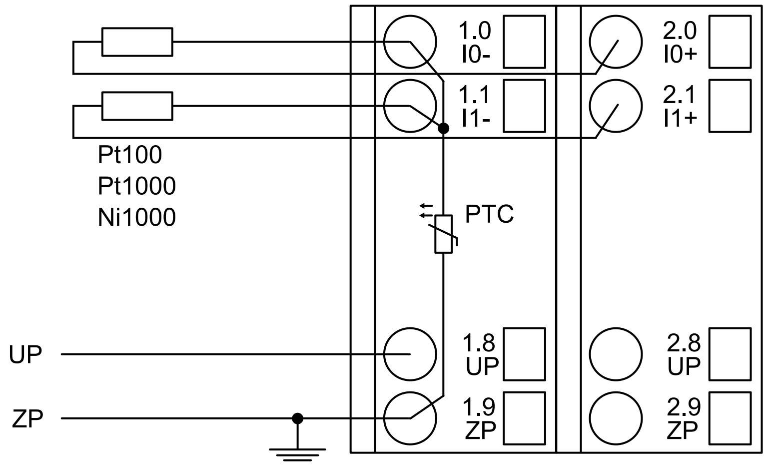


Fig. 32: Connection example

The following measuring ranges can be configured *Chapter 1.5.2.2.1.6 “Parameterization” on page 465*.

Pt100	-50 °C...+70 °C	2-wire configuration, one channel used
Pt100	-50 °C...+400 °C	2-wire configuration, one channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, one channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, one channel used

The function of the LEDs is described under Displays *Chapter 1.5.2.2.1.7 “Diagnosis” on page 468*.

The module AI523 performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI523 provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

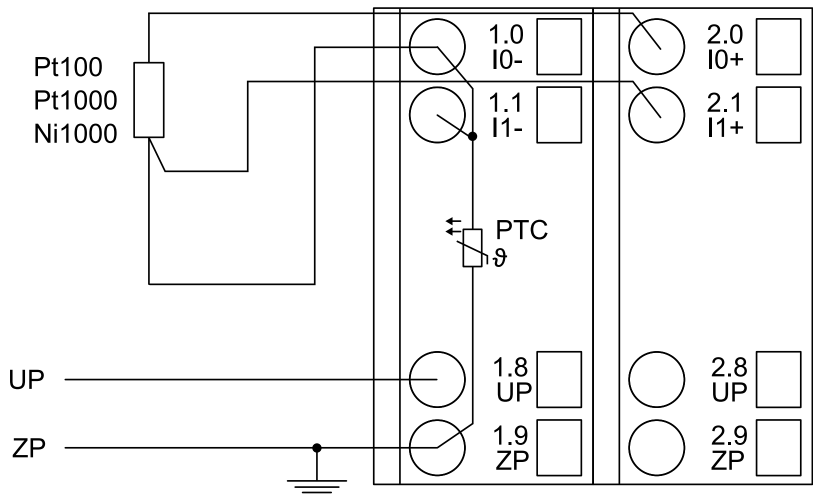


Fig. 33: Connection example

> *If several measuring points are adjacent to each other, the return line is necessary only once. This saves wiring costs.*

With 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.5.2.2.1.6 "Parameterization" on page 465*

Pt100	-50 °C...+70 °C	3-wire configuration, two channels used
Pt100	-50 °C...+400 °C	3-wire configuration, two channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, two channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, two channels used

The function of the LEDs is described under Displays *Chapter 1.5.2.2.1.7 "Diagnosis" on page 468*.

The module AI523 performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply

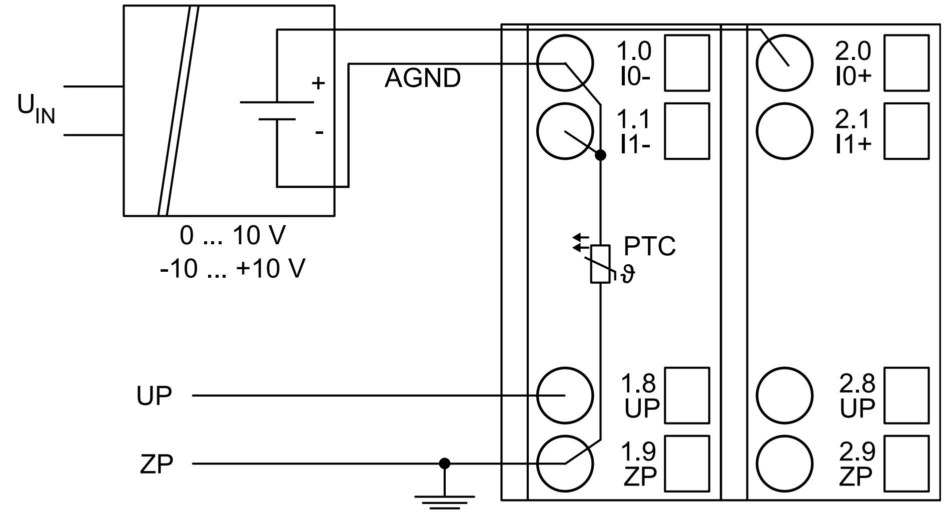


Fig. 34: Connection example

> *By connecting the sensor's negative pole of the output voltage to AGND, the electrically isolated voltage source of the sensor is referred to ZP.*

The following measuring ranges can be configured ⇨ *Chapter 1.5.2.2.1.6 “Parameterization” on page 465* ⇨ *Chapter 1.5.2.2.1.9 “Measuring Ranges” on page 470*

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Displays ⇨ *Chapter 1.5.2.2.1.7 “Diagnosis” on page 468*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply

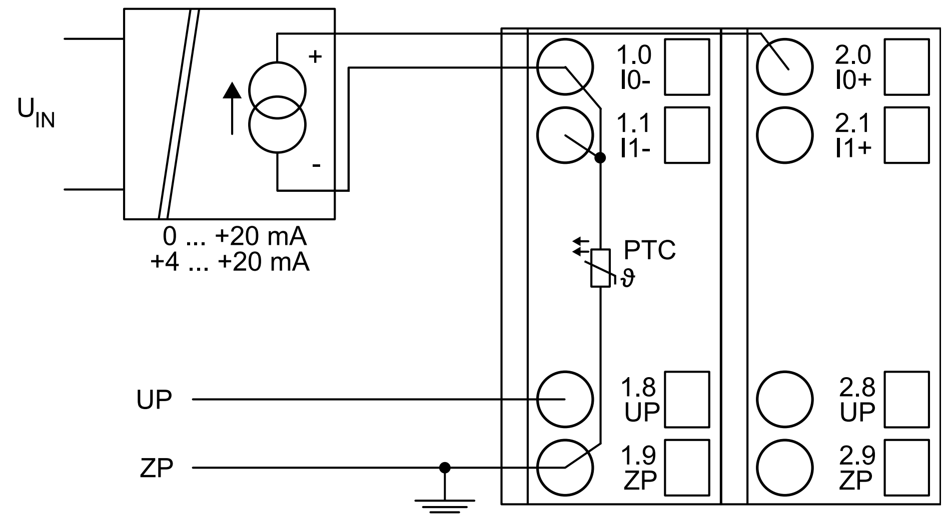


Fig. 35: Connection example

The following measuring ranges can be configured ✎ *Chapter 1.5.2.2.1.6 "Parameterization" on page 465* ✎ *Chapter 1.5.2.2.1.9 "Measuring Ranges" on page 470*

Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Displays ✎ *Chapter 1.5.2.2.1.7 "Diagnosis" on page 468*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply

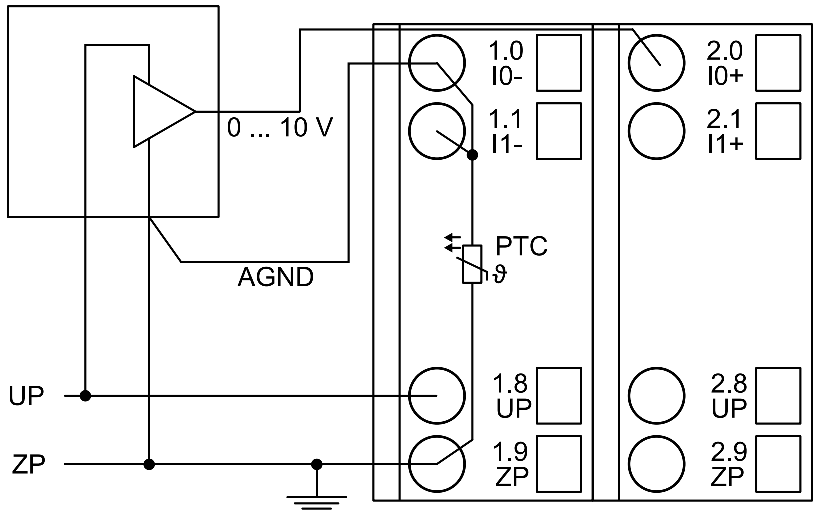


Fig. 36: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1 V, not even in case of long linesFig. .

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very low current flows over the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method has to be preferred.

The following measuring ranges can be configured ✎ *Chapter 1.5.2.2.1.9 "Measuring Ranges" on page 470*

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V *)	1 channel used
*) if the sensor can provide this signal range		

The function of the LEDs is described under Displays ✎ *Chapter 1.5.2.2.1.7 "Diagnosis" on page 468*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Passive-type Analog Sensors (Current)

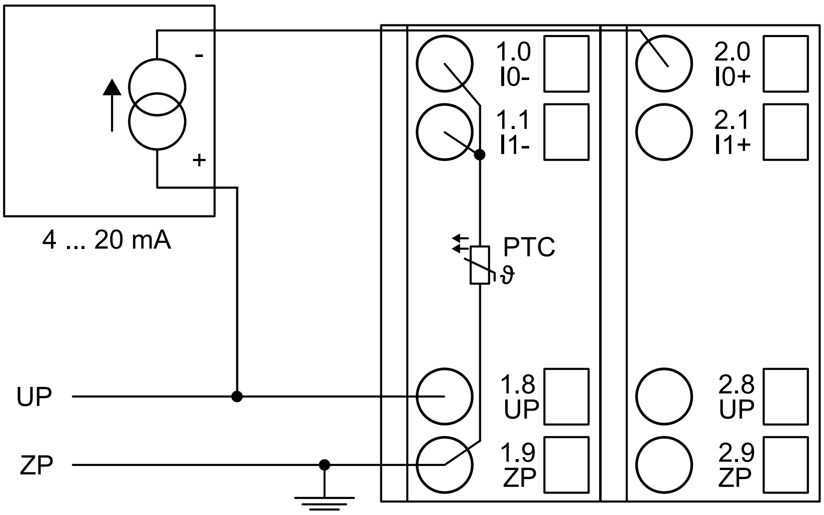


Fig. 37: Connection example

The following measuring ranges can be configured *Chapter 1.5.2.2.1.6 “Parameterization” on page 465* *Chapter 1.5.2.2.1.9 “Measuring Ranges” on page 470*

Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Displays *Chapter 1.5.2.2.1.7 “Diagnosis” on page 468*.

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second into an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10 volt Zener diode (in parallel to I+ and I-). But, in general, it is a better solution to use sensors with fast initialization or without current peaks higher than 25 mA.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely earthed) are used.

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
The earthing potential at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs.

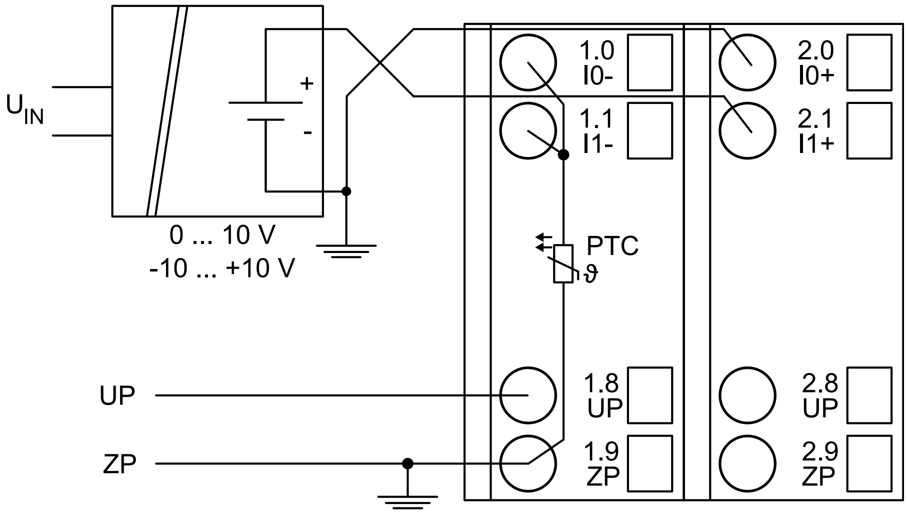


Fig. 38: Connection example

The negative pole of the sensor must be earthed next to the sensor.

The following measuring ranges can be configured *Chapter 1.5.2.2.1.6 “Parameterization” on page 465* *Chapter 1.5.2.2.1.9 “Measuring Ranges” on page 470*:

Voltage	0 V...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

The function of the LEDs is described under Displays *Chapter 1.5.2.2.1.7 “Diagnosis” on page 468*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

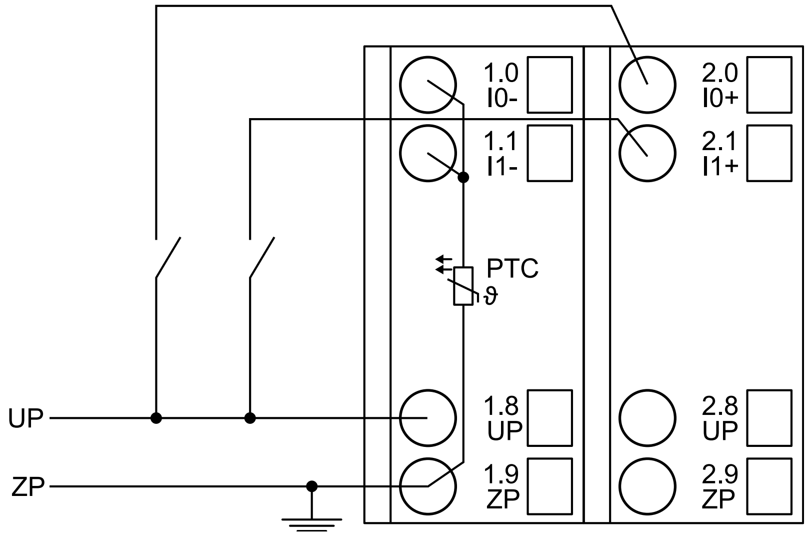


Fig. 39: Connection example

The following operating mode can be configured *Chapter 1.5.2.2.1.6 “Parameterization” on page 465* *Chapter 1.5.2.2.1.9 “Measuring Ranges” on page 470*

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

The function of the LEDs is described under Displays.

Internal Data Exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	16
Counter output data (words)	0

I/O Configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

That means replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1515 [1])	Word	1515 0x05eb	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	34	Byte	34-CPU 34-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Channel configuration Input channel 0	see table "Channel configuration"		Byte	Default 0x00	0	19	0x0Y05
7	Channel monitoring Input channel 0	see table " Channel monitoring"		Byte	Default 0x00	0	3	0x0Y06
8 to 35	Channel configuration and channel monitoring of the input channels 1 to 14	see tables "Channel configuration" and "Channel monitoring"		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y07 to 0x0Y22

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
36	Channel configuration Input channel 15	see table "Channel configuration"		Byte	Default 0x00	0	19	0x0Y23
37	Channel monitoring Input channel 15	see table "Channel monitoring"		Byte	Default 0x00	0	3	0x0Y24
[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1 [2]) Not with FBP								

GSD file:

Ext_User_Prm_Data_Len =	37
Ext_User_Prm_Data_Const(0) =	0x05, 0xec, 0x22, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Input Channel (16 x with AI523)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [2])	see table [2])	Byte	0 0x00 see [3])
2	Channel monitoring	see table [4])	see table [4])	Byte	0 0x00 see [5])

Table 58: Channel Configuration [2])

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default) [3])
1	Analog input 0 V...10 V

Internal value	Operating modes of the analog inputs, individually configurable
2	Digital input
3	Analog input 0 mA...20 mA
4	Analog input 4 mA...20 mA
5	Analog input -10 V...+10 V
8	Analog input Pt100, -50 °C...+400 °C (2-wire)
9	Analog input Pt100, -50 °C...+400 °C (3-wire), requires 2 channels *)
10	Analog input 0...10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V...+10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C...+70 °C (2-wire)
15	Analog input Pt100, -50 °C...+70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C...+400 °C (2-wire)
17	Analog input Pt1000, -50 °C...+400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C...+150 °C (2-wire)
19	Analog input Ni1000, -50 °C...+150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 59: Channel Monitoring [4])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit [5])
1	Open-circuit and short circuit
2	Plausibility
3	No monitoring

Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON -> OFF)	Process voltage ON
	11 / 12	ADR	1...10				

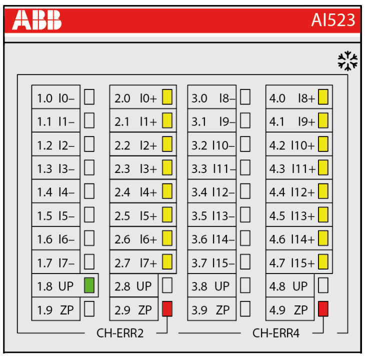
Channel error							
4	14	1...10	1	0...15	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...15	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				
4	14	1...10	1	0...15	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1..10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1..10 = expansion 1...10 Channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1..10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I7 and I8...I15	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 VDC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring Ranges

Input Ranges of Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	ON	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	OFF	0	0000
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< -1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input Ranges Resistance

The resolution corresponds to 16 bits.

Range	Pt100 / Pt 1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	**Hex.**
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high		450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1
			160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
	80.0 °C : 70.1 °C			800 : 701	0320 : 02BD

Range	Pt100 / Pt 1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	**Hex.**
Normal range	: : 70.0 °C : 0.1 °C	400.0 °C : : : 0.1 °C	: 150.0 °C : : 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Technical Data

The System Data of AC500 and S500 ➡ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ➡ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + output loads
Inrush current from UP (at power up)		0.050 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2		100 m

Parameter	Value
Weight	300 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter	Value	
Number of channels per module	16	
Distribution of channels into groups	2 groups of 8 channels each	
Connections of the channels I0- to I7- Connections of the channels I0+ to I7+	Terminals 1.0 to 1.7 Terminals 2.0 to 2.7	
Connections of the channels I8- to I15- Connections of the channels I8+ to I15+	Terminals 3.0 to 3.7 Terminals 4.0 to 4.7	
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V...10 V, -10 V...+10 V, 0/4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
Time constant of the input filter	Voltage: 100 µs Current: 100 µs	
Indication of the input signals	1 LED per channel	
Conversion cycle	2 ms (for 16 inputs), with Pt/Ni... 1 s	
Resolution	Range 0 V...10 V: 12 bits	
	Range -10 V...+10 V: 12 bits + sign	
	Range 0 mA...20 mA: 12 bits	
	Range 4 mA...20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance

Parameter	Value
Relationship between input signal and hex code	*Chapter 1.5.2.2.1.9.1 “Input Ranges of Voltage, Current and Digital Input” on page 470* *Chapter 1.5.2.2.1.9.2 “Input Ranges Resistance” on page 470*
Unused voltage inputs	Are configured as "unused"
Unused current inputs	Have a low resistance, can be left open-circuited
Overvoltage protection	Yes

Technical Data of the Analog Inputs, if used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 16
Distribution of channels into groups		2 groups of 8 channels each
Connections of the channels I0+ to I7+ Connections of the channels I8+ to I15+		Terminals 2.0 to 2.7 Terminals 4.0 to 4.7
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

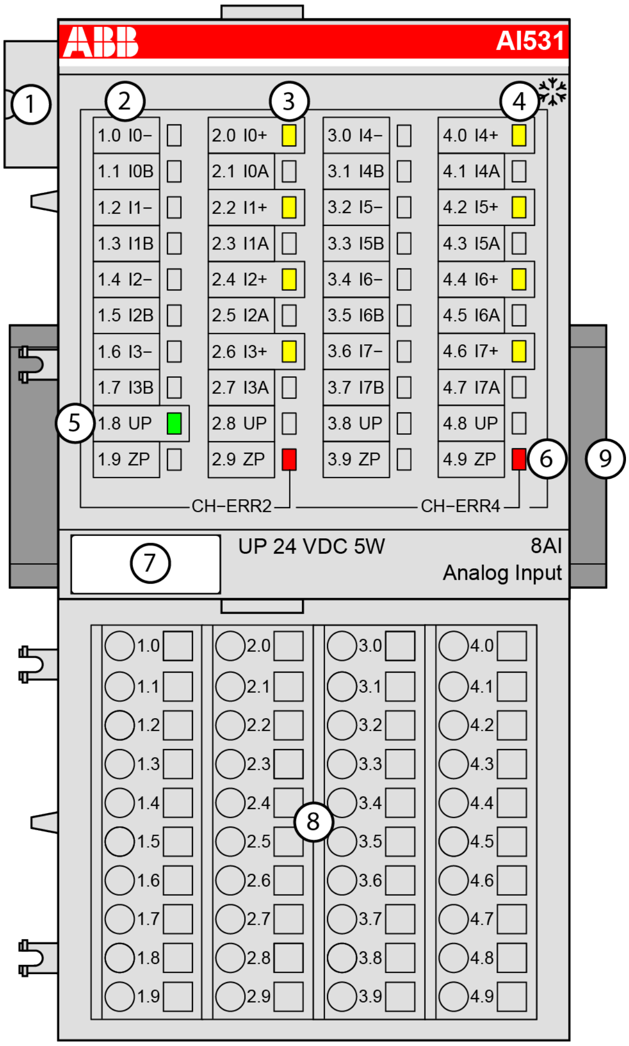
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 250 300 R0001	AI523, analog input module, 16 AI, U/I/Pt100, 12 bits + sign, 2-wires	Active
1SAP 450 300 R0001	AI523-XC, analog input module, 16 AI, U/I/Pt100, 12 bits + sign, 2-wires, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.2.2 AI531 - Analog Input Module

- 8 configurable analog inputs (I0 to I7) in 2 groups (1.0...1.7 and 2.0...2.7 as well as 3.0...3.7 and 4.0...4.7)
  Resolution 15 bits plus sign
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal names
3 4 yellow LEDs to display the states at the inputs I0 to I3
4 4 yellow LEDs to display the states at the inputs I4 to I7
5 1 green LED to display the process supply voltage UP
6 2 red LEDs to display errors (CH-ERR2 and CH-ERR4)
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Functionality

8 analog inputs, individually configurable for

- Unused (default setting)
- 0 V...5 V, 0 V...10 V
- -50 mV...+50 mV, -500 mV...+500 mV
- -1 V...+1 V, -5 V...+5 V, -10 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA
- -20 mA...20 mA
- Pt100, -50 °C...+70 °C or 400 °C (2-, 3- and 4-wire)
- Pt100, -200 °C...+850 °C (2-, 3- and 4-wire)
- Pt1000, -50 °C...+400 °C (2-, 3- and 4-wire)
- Ni1000, -50 °C...+150 °C (2-, 3- and 4-wire)
- Cu50 (1.426): -50 °C...+200 °C (2-, 3- and 4-wire)
- Cu50 (1.428): -200 °C...+200 °C (2-, 3- and 4-wire)
- 0 Ω...50 kΩ
- Thermocouples of types J, K, T, N, S
- Resistance measuring bridge
- Digital signals (digital input)

Parameter	Value
Resolution of the analog channels	
– Voltage and current, bipolar	15 bits plus sign
– Voltage and current, unipolar	15 bits
– Temperature	0.1 °C (0,01°C at Pt100 -50 °C...+70 °C)
LED displays	11 LEDs for signals and error messages
Internal power supply	through the expansion bus interface (I/O bus)
External power supply	via terminals (process voltage UP = 24 VDC)
Required terminal unit	TU515 or TU516 *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter Chapter 2.6 “AC500 (Standard)” on page 1252.

The modules are plugged on an I/O terminal unit *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8, 4.8, 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 VDC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V

The assignment of the other terminals:

Terminals	Signal	Description
2.0, 2.2, 2.4, 2.6	I0+ to I3+	Positive poles of the first 4 analog inputs
1.0, 1.2, 1.4, 1.6	I0- to I3-	Negative poles of the first 4 analog inputs
2.1, 2.3, 2.5, 2.7	I0A to I3A	Connections A (supply) of the first 4 analog inputs
1.1, 1.3, 1.5, 1.7	I0B to I3B	Connections B (analog ground) of the first 4 analog inputs
4.0, 4.2, 4.4, 4.6	I4+ to I7+	Positive poles of the following 4 analog inputs
3.0, 3.2, 3.4, 3.6	I4- to I7-	Negative poles of the following 4 analog inputs
4.1, 4.3, 4.5, 4.7	I4A to I7A	Connections A (supply) of the following 4 analog inputs
3.1, 3.3, 3.5, 3.7	I4B to I7B	Connections B (analog ground) of the following 4 analog inputs

CAUTION!
Analog sensors must be electrically isolated against the earth. In order to avoid inaccuracy with the measuring results, the analog sensors should also be isolated against the power supply.

The "IxB" clamps (x=0..7) of the analog inputs are electrically connected to each other. They form an "Analog Ground Signal" (AGND) for the module.

The negative poles of the analog inputs Ix- may accept a potential difference up to ±20 VDC with regard to the common reference potential IxB (AGND, ZP). Observing this maximum voltage difference, analog current inputs of one module can be switched in series to each other and also with current inputs of other modules.

For the open-circuit detection (cut wire), each positive analog input channel Ix+ is pulled up to "plus" by a high-resistance resistor and each negative analog input channel Ix- is pulled down to "minus" by a resistor. If cut wire occurs, a maximum voltage (overflow or underflow) will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per AI531.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

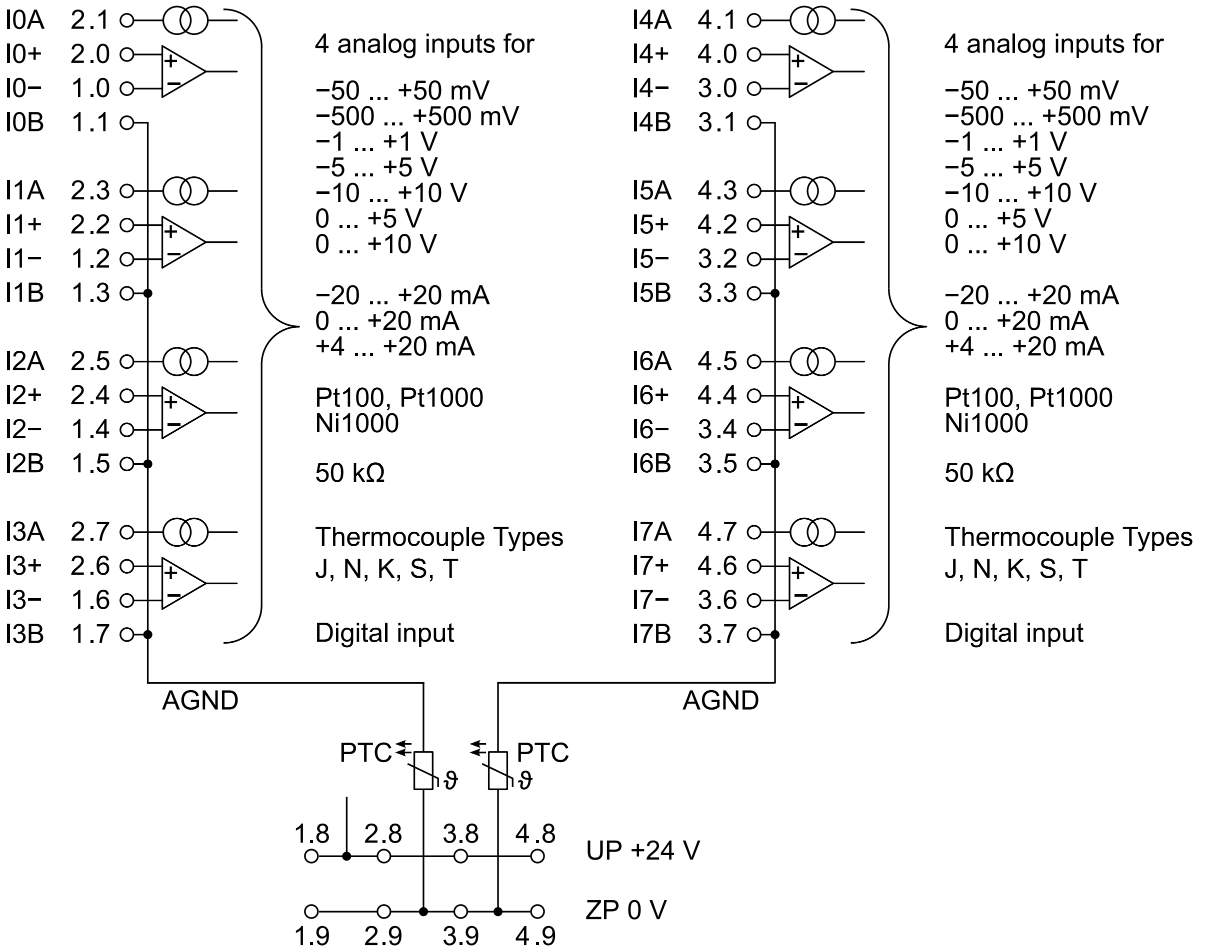


Fig. 40: Terminal assignment of the module

The module provides several diagnosis functions *Chapter 1.5.2.2.2.7 “Diagnosis” on page 494*.

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply

Standard Ranges

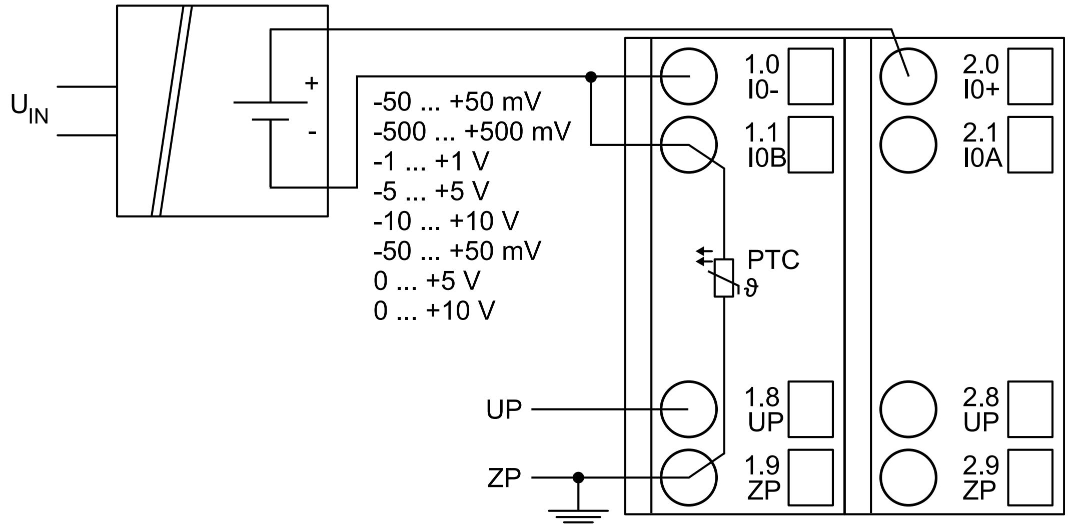


Fig. 41: Connection example

The measuring ranges can be configured ↬ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*:

Voltage	-50 mV...+50 mV	1 channel used
Voltage	-500 mV...+500 mV	1 channel used
Voltage	-1 V...+1 V	1 channel used
Voltage	-5 V...+5 V	1 channel used
Voltage	-10 V...+10 V	1 channel used
Voltage	0 V...+5 V	1 channel used
Voltage	0 V...+10 V	1 channel used

Common Mode Range (+/-20 V)

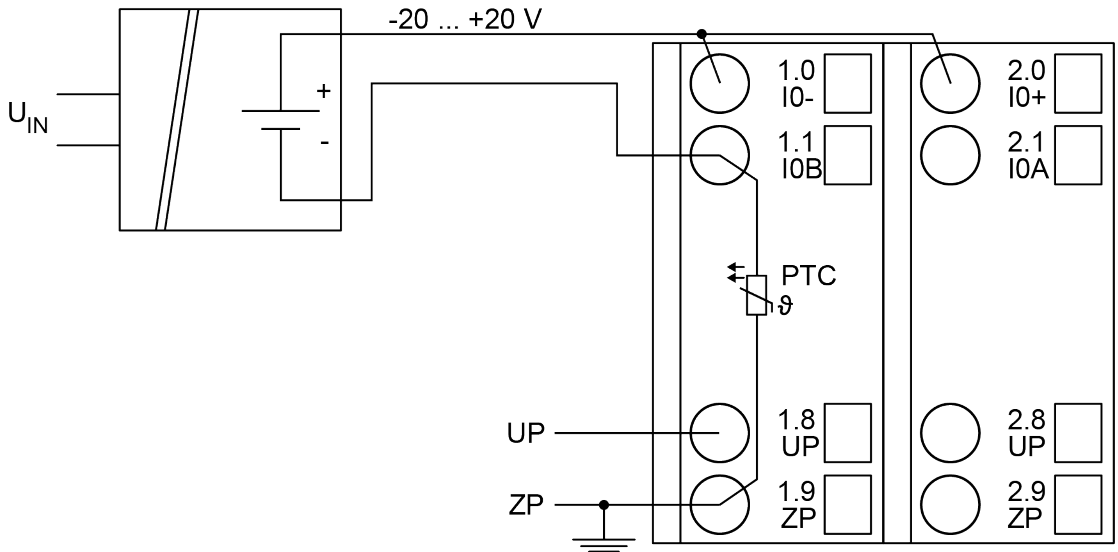


Fig. 42: Connection example

The measuring range can be configured ↬ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under Diagnosis and displays / displays *Chapter 1.5.2.2.2.7 “Diagnosis” on page 494*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply

Standard Ranges

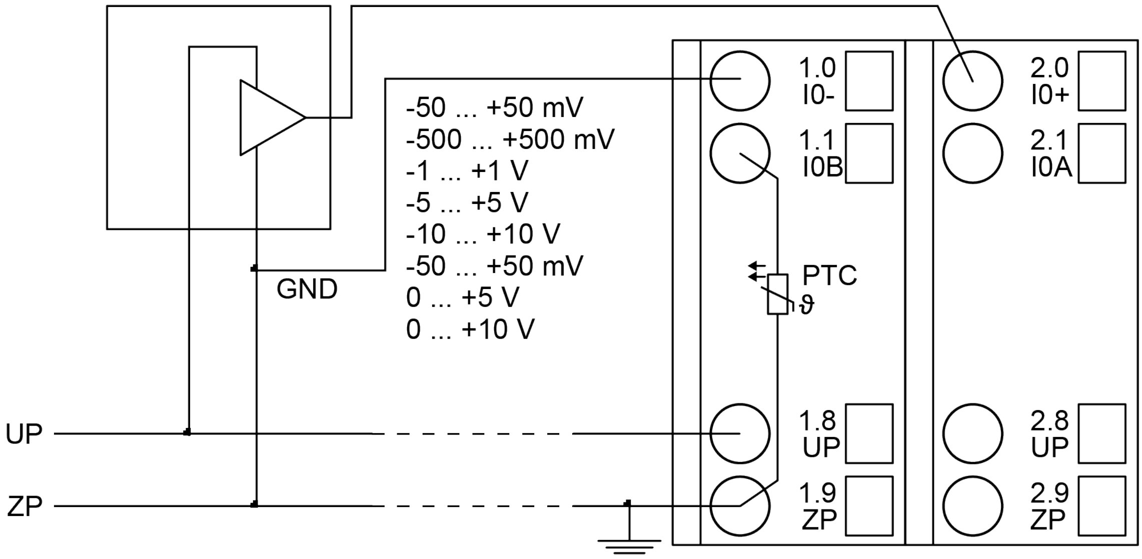


Fig. 43: Connection example

CAUTION!
If GND is not directly connected to ZP at the sensor, the supply current flows via the GND line to ZP. Measuring errors can only occur caused by voltage differences higher than ±20 VDC between GND and ZP.

The measuring ranges can be configured *Chapter 1.5.2.2.2.6 “Parameterization” on page 491* :

Voltage	-50 mV...+50 mV	1 channel used
Voltage	-500 mV...+500 mV	1 channel used
Voltage	-1 V...+1 V	1 channel used
Voltage	-5 V...+5 V	1 channel used
Voltage	-10 V...+10 V	1 channel used
Voltage	0 V...+5 V	1 channel used
Voltage	0 V...+10 V	1 channel used

Common Mode Range (+/-20 V)

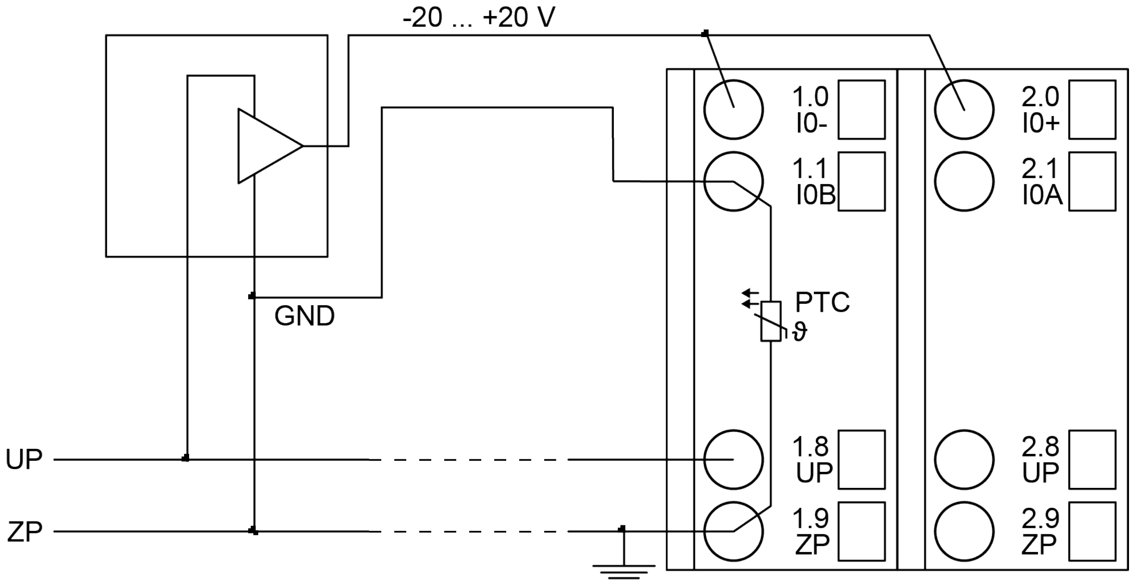


Fig. 44: Connection example

> **CAUTION!**
> If GND is not directly connected to ZP at the sensor, the supply current flows via the GND line to ZP. Measuring errors can only occur caused by voltage differences higher than ±20 VDC between GND and ZP.

The measuring range can be configured *Chapter 1.5.2.2.2.6 "Parameterization" on page 491*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under Diagnosis and displays / displays *Chapter 1.5.2.2.2.7 "Diagnosis" on page 494*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply

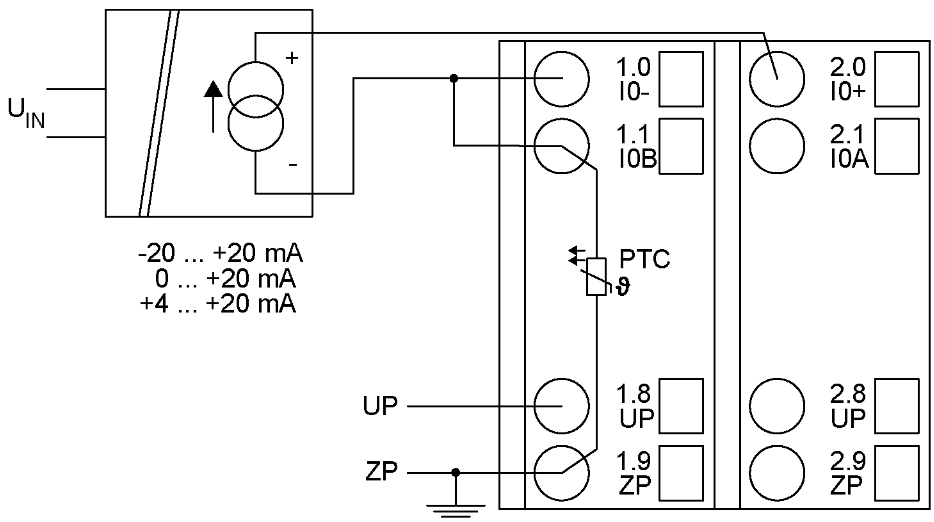


Fig. 45: Connection example

Figure:

The following measuring ranges can be configured ↬ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*:

Current	-20 mA...20 mA	1 channel used
Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / displays ↬ *Chapter 1.5.2.2.2.7 “Diagnosis” on page 494*.

Unused input channels can be left open, because they are of low resistance.

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply and Series-Connection of an Additional Input

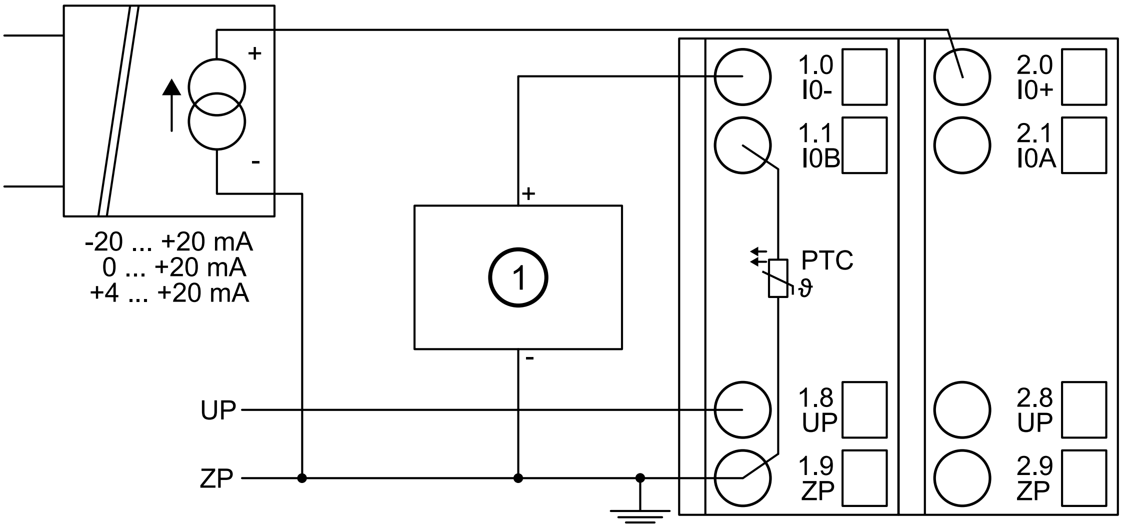


Fig. 46: Connection example

1 Analog input of the second device

> *If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).*

> *The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).*

The following measuring ranges can be configured ↬ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*:

Current	-20 mA...20 mA	1 channel used
Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

For a description of the functions of the LEDs, please refer to Diagnosis and displays / displays *Chapter 1.5.2.2.2.7 "Diagnosis" on page 494*.

Unused input channels can be left open, because they are of low resistance.

Connection of Passive-type Analog Sensors (Current)

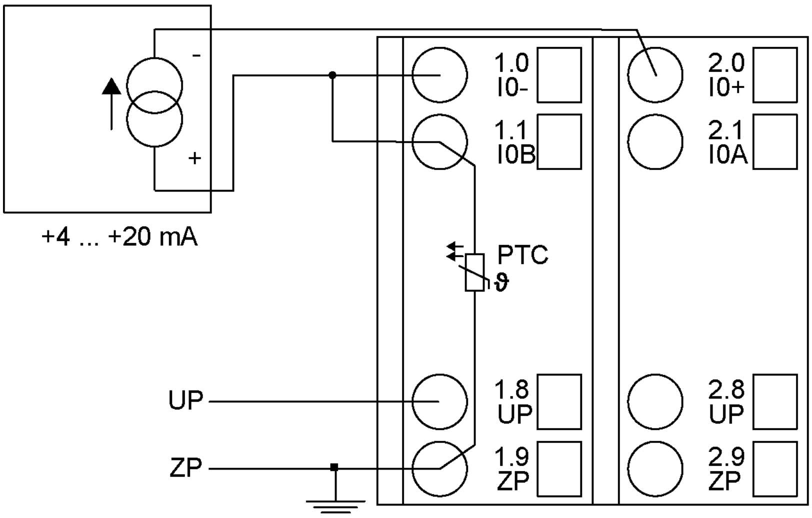


Fig. 47: Connection example

The following measuring ranges can be configured *Chapter 1.5.2.2.2.6 "Parameterization" on page 491*:

Current	-20 mA... 20 mA *)	1 channel used
Current	0 mA... 20 mA *)	1 channel used
Current	4 mA... 20 mA	1 channel used
*) This setting is not applicable with passive-type analog sensors (current).		

The function of the LEDs is described under Diagnosis and displays / displays *Chapter 1.5.2.2.2.7 "Diagnosis" on page 494*.

Unused input channels can be left open, because they are of low resistance.

Connection of Passive-type Analog Sensors (Current) and Series-Connection of an Additional Analog Sensor

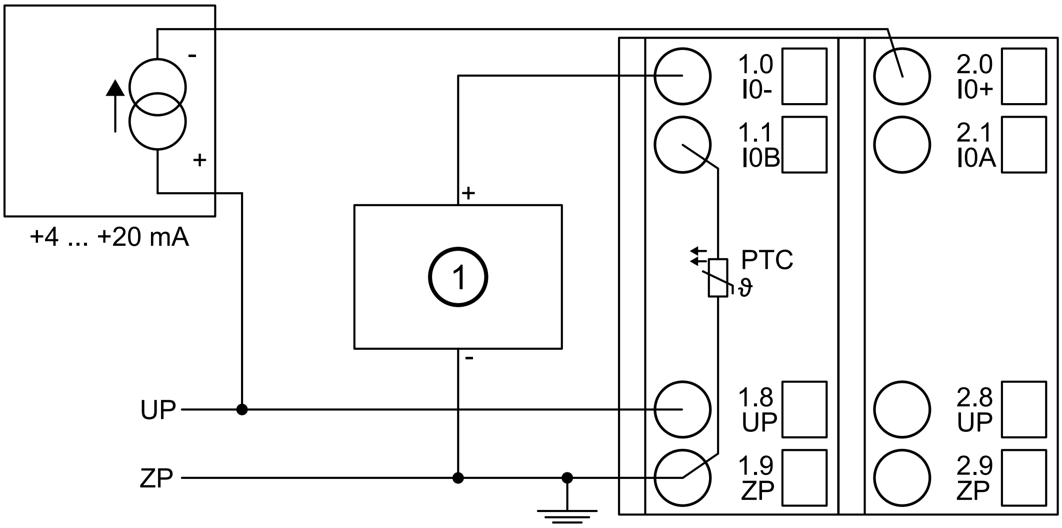


Fig. 48: Connection example

1 Analog input of the second device

> *If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).*

> *The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).*

The following measuring ranges can be configured *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*:

Current	-20 mA...20 mA *)	1 channel used
Current	0 mA...20 mA *)	1 channel used
Current	4 mA...20 mA	1 channel used
*) This setting is not applicable with passive-type analog sensors (current).		

The function of the LEDs is described under Diagnosis and displays / displays *Chapter 1.5.2.2.2.7 “Diagnosis” on page 494*.

Unused input channels can be left open, because they are of low resistance.

Connection of Digital Signal Sources at Analog Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

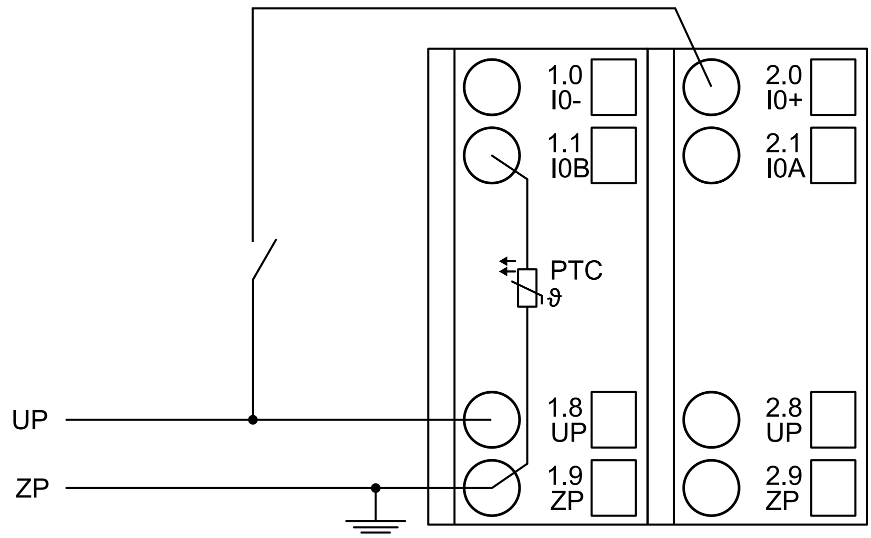


Fig. 49: Connection example

The following operating mode can be configured ✎ *Chapter 1.5.2.2.2.6 "Parameterization" on page 491* :

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays ✎ *Chapter 1.5.2.2.2.7 "Diagnosis" on page 494*.

Connection of Resistance Thermometers in 2-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

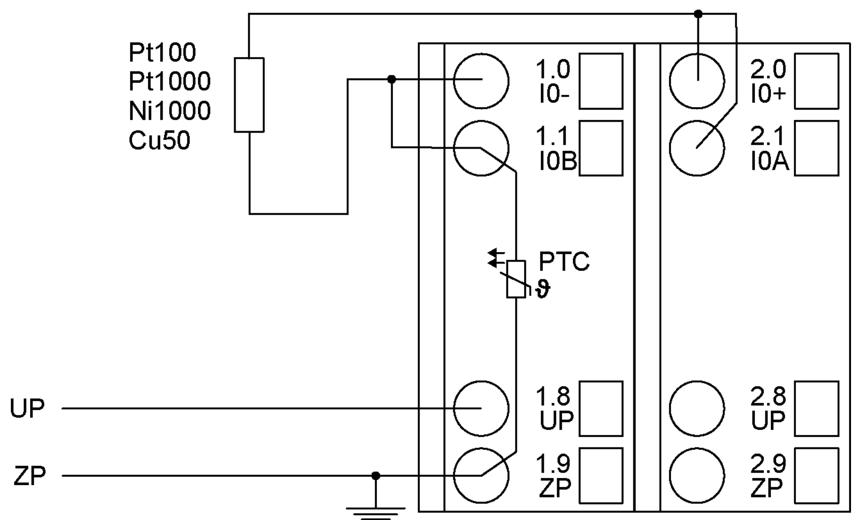


Fig. 50: Connection example

The following measuring ranges can be configured ✎ *Chapter 1.5.2.2.2.6 "Parameterization" on page 491*:

Pt100	-50 °C...+70 °C / +400 °C; -200 °C...+850 °C	1 channel used
Pt1000	-50 °C...+400 °C	1 channel used
Ni1000	-50 °C...+150 °C	1 channel used
Cu50	-50 °C...+200 °C (1.426); -200 °C...+200 °C (1.428)	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays ↳ *Chapter 1.5.2.2.2.7 “Diagnosis” on page 494*.

The module linearizes the resistance thermometer characteristics.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

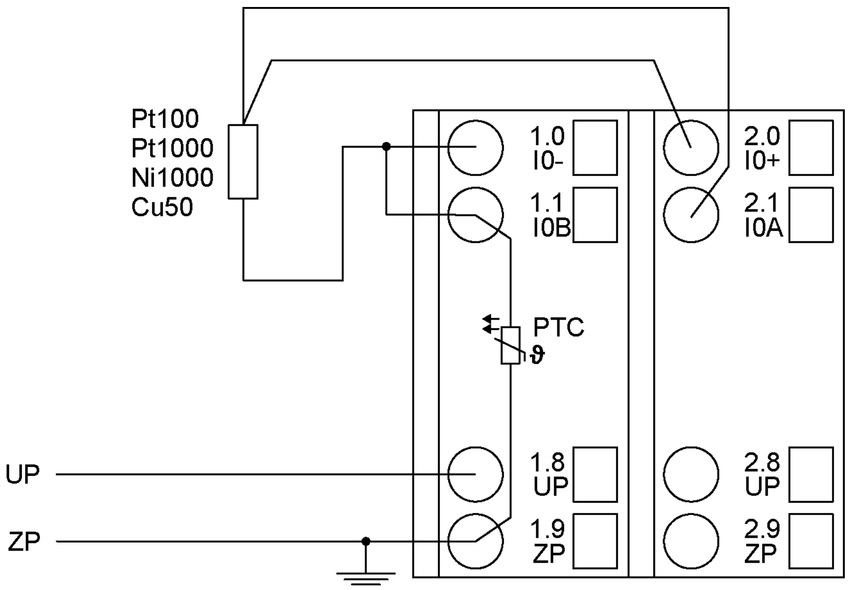


Fig. 51: Connection example

The following measuring ranges can be configured ↳ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*:

Pt100	-50 °C...+70 °C / +400 °C; -200 °C ... +850 °C	1 channel used
Pt1000	-50 °C...+400 °C	1 channel used
Ni1000	-50 °C...+150 °C	1 channel used
Cu50	-50 °C...+200 °C (1.426); -200 °C...+200 °C (1.428)	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays ↳ *Chapter 1.5.2.2.2.7 “Diagnosis” on page 494*.

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means to have all the involved conductors in the same cable. All the conductors must have the same cross section.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Resistance Thermometers in 4-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

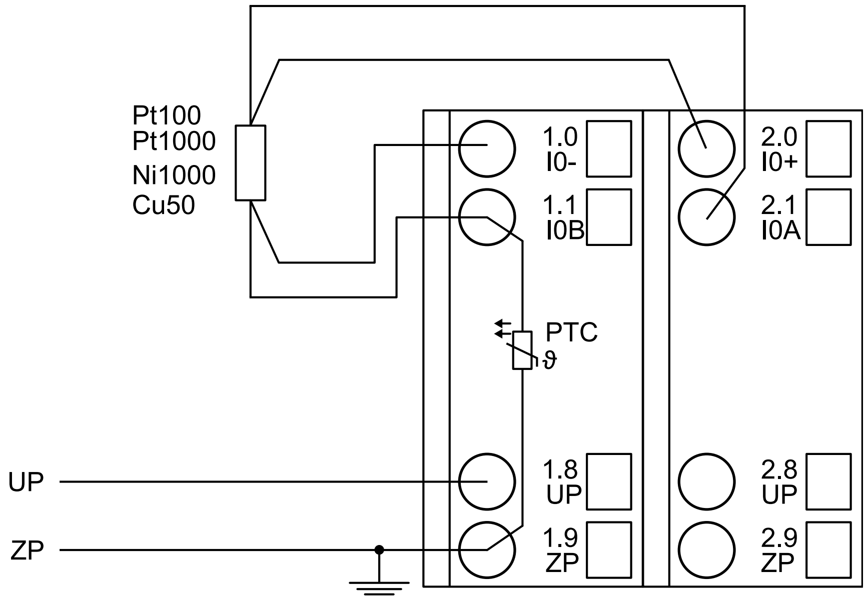


Fig. 52: Connection example

The following measuring ranges can be configured *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*:

Pt100	-50 °C...+70 °C / +400 °C; -200 °C...+850 °C	1 channel used
Pt1000	-50 °C...+400 °C	1 channel used
Ni1000	-50 °C...+150 °C	1 channel used
Cu50	-50 °C...+200 °C (1.426); -200 °C...+200 °C (1.428)	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays *Chapter 1.5.2.2.2.7 “Diagnosis” on page 494*.

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means, to have all the involved conductors in the same cable.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Resistors in 2-wire Configuration

For evaluating resistors, a constant current must flow through them to build the necessary voltage drop. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

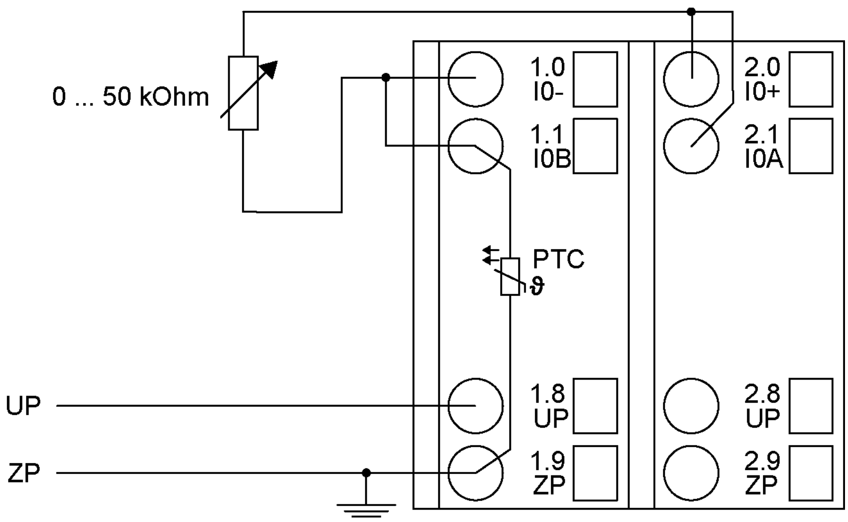


Fig. 53: Connection example

The following measuring ranges can be configured ⇘ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491* :

Resistor	50 kΩ	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of a Resistance Measuring Bridge with Internal Supply

When resistance measuring bridges are connected, the short-circuit-proof voltage output (internal supply) at pin I0A (or I2A, I4A, I6A) must be used. This supply voltage is activated as soon as "Voltage Measurement" is configured for the relevant channel.

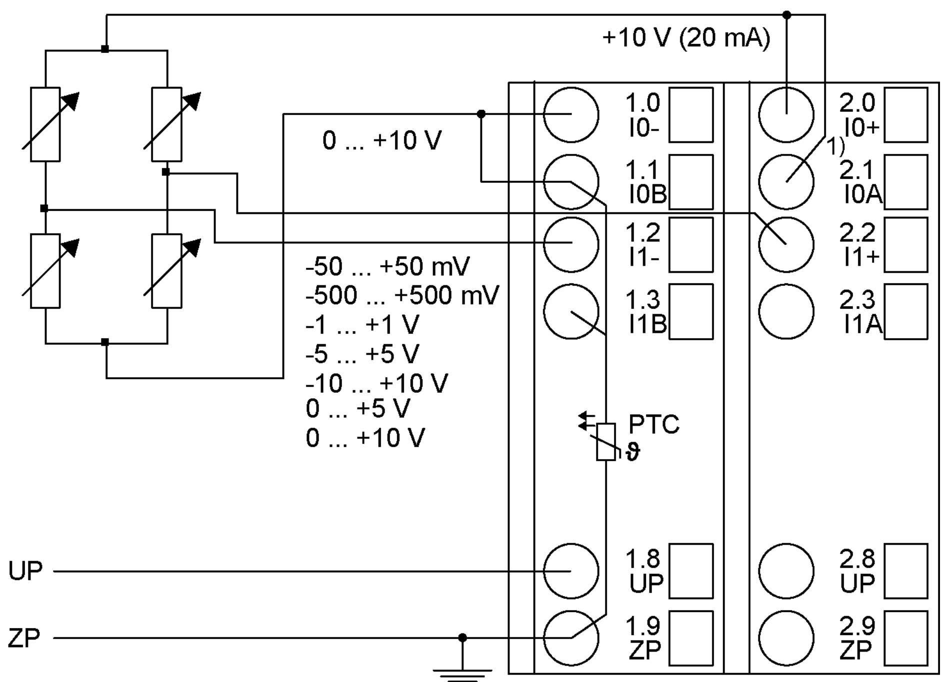


Fig. 54: Connection example

1 Internal supply

All voltage measuring ranges can be configured ↯ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491*.

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of a Resistance Measuring Bridge with external Supply

With the connection of a resistance measuring bridge with external supply, the supply voltage is provided separately.

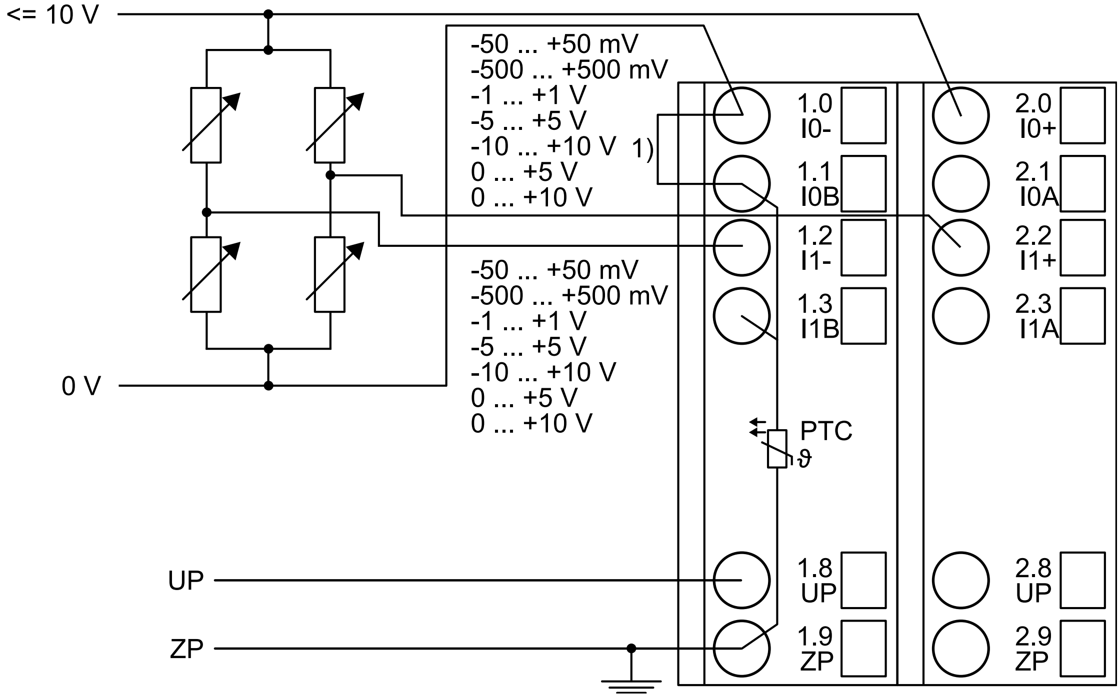


Fig. 55: Connection example

1 Bridge to IxB necessary with electrically isolated supply

All voltage measuring ranges can be configured ↯ *Chapter 1.5.2.2.2.6 “Parameterization” on page 491* .

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of Thermocouples

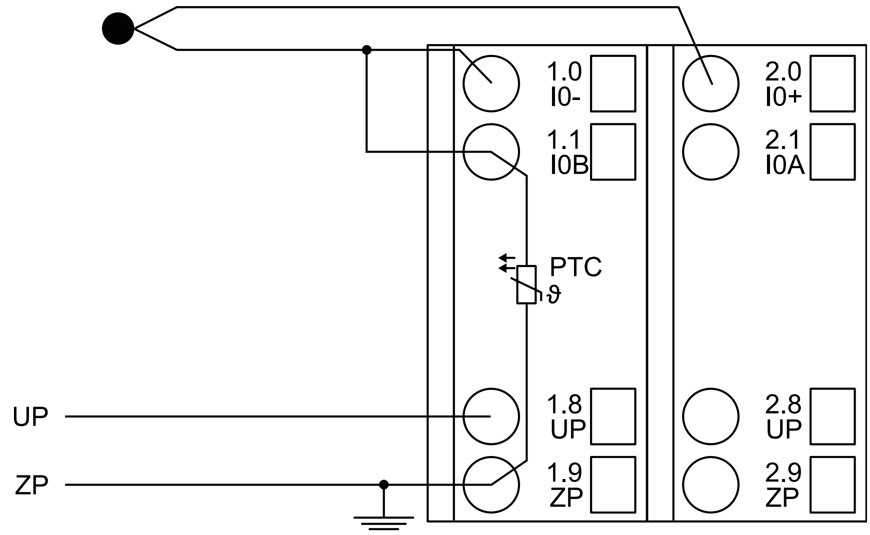


Fig. 56: Connection example

The following measuring ranges can be configured *Chapter 1.5.2.2.2.6 "Parameterization" on page 491* :

J type	-210 °C...1200 °C	Fe-CuNi	1 channel used
K type	-270 °C...1372 °C	Ni-CrNi	1 channel used
N type	-270 °C...1300 °C	NiCrSi-NiSi	1 channel used
S type	-50 °C...1768 °C	Pt10Rh-Pt	1 channel used
T type	-270 °C...400 °C	Cu-CuNi	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays *Chapter 1.5.2.2.2.7 "Diagnosis" on page 494*.

The module linearizes the thermocouple characteristics. It supports the following possibilities of temperature compensation and handling with cold junctions:

Internal Compensation

An internal temperature sensor which is located next to the terminal unit is used to detect the temperature of the cold junction. So the compensating cables must be connected directly to the terminal unit, where the cold junction is located.

The setting "Internal compensation (default)" for the parameter "Compensation channel" should be selected.

> *To get more precise temperature measurements, the use of an external compensation method is recommended.*

External Compensation with Temperature Input

The temperature for the cold junction can be determinated externally.

A measured or known temperature value (e.g. ambient temperature in the cabinet) is transferred to the module via the output data word to all required channels. The possible temperature range is from -25 °C to +60 °C and is monitored by the AI531.

The setting "External with temperature value" for the parameter "Compensation channel" should be selected.

External Compensation with Compensation Box

A compensation box balances the temperature difference between the cold junction and the reference temperature by generating a bridge voltage. The reference temperature is transferred via the output data word.

The compensation box must fit to the type of thermocouple and is located at the end of the compensating cables, where the cold junction is located. The cabling to the AI531 can be carried out with normal cables. The operating manual of the compensation box also has to be considered.

The setting "External with temperature value" for the parameter "Compensation channel" should be selected.

External Compensation with Flanking Channel

A flanking channel of the same input group can be used for compensation, e. g. for channel 3, the channels 0, 1 and 2 can be selected as reference channels. The type of sensor for the reference channel can be selected in the parameters for the flanking channel. For example, a RTD sensor which is located next to the thermocouple terminal can be used as reference point for other channels.

The setting "Channel x" for the parameter "Compensation channel" should be selected. Refer to Channel configuration *Chapter 1.5.2.2.2.6 “Parameterization” on page 491* for possible settings.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Internal Data Exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	8
Analog outputs (words)	1

I/O Configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

This means that replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1535 [1])	Word	1535 0x05ff	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length in bytes	Internal	36	Byte	36	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01			0x0Y03
Analog data format	Default	0	Byte	Default 0x00			0x0Y04

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	39
Ext_User_Prm_Data_Const(0) =	0x05, 0xff, 0x24, \
	0x01, 0x00, 0x00, 0x00 \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Input Channel (8x)

No.	Name	Value	Internal value	Internal value, Type	Default	EDS Slot Index
1	Channel configuration	see ⇘ *Table 60 "Channel Configuration" on page 492*	see ⇘ *Table 60 "Channel Configuration" on page 492*	Byte	0 0x00	0x0Y07
2	Channel monitoring	see ⇘ *Table 61 "Channel Monitoring" on page 493*	see ⇘ *Table 61 "Channel Monitoring" on page 493*	Byte	0 0x03	
3	Line frequency suppression	see ⇘ *Table 61 "Channel Monitoring" on page 493*	see ⇘ *Table 61 "Channel Monitoring" on page 493*	Byte	0 0x00	
4	Compensation channel	see ⇘ *Table 61 "Channel Monitoring" on page 493*	see ⇘ *Table 61 "Channel Monitoring" on page 493*	Byte	0 0x00	

Table 60: Channel Configuration

Internal value	Operating modes for the analog inputs, individually configurable
0	Unused (default)
2	Digital input
34	Analog input -50 mV...+50 mV
35	Analog input -500 mV...+500 mV
36	Analog input -1 V...+1 V
7	Analog input -5 V...+5 V
5	Analog input -10 V...+10 V
6	Analog input 0 V...+5 V
1	Analog input 0 V...+10 V
37	Analog input -20 mA...+20 mA
3	Analog input 0 mA...20 mA
4	Analog input 4 mA...20 mA
14	Analog input Pt100 (2-wire), -50 °C...+70 °C
15	Analog input Pt100 (3-wire), -50 °C...+70 °C
48	Analog input Pt100 (4-wire), -50 °C...+70 °C
57	Analog input Pt100 (2-wire), -50 °C...+70 °C (resolution: 0,01 K)
58	Analog input Pt100 (3-wire), -50 °C...+70 °C (resolution: 0,01 K)
59	Analog input Pt100 (4-wire), -50 °C...+70 °C (resolution: 0,01 K)
8	Analog input Pt100 (2-wire), -50 °C...+400 °C
9	Analog input Pt100 (3-wire), -50 °C...+400 °C
49	Analog input Pt100 (4-wire), -50 °C...+400 °C

Internal value	Operating modes for the analog inputs, individually configurable
45	Analog input Pt100 (2-wire), -200 °C...+850 °C
46	Analog input Pt100 (3-wire), -200 °C...+850 °C
47	Analog input Pt100 (4-wire), -200 °C...+850 °C
16	Analog input Pt1000 (2-wire), -50 °C...+400 °C
17	Analog input Pt1000 (3-wire), -50 °C...+400 °C
50	Analog input Pt1000 (4-wire), -50 °C...+400 °C
18	Analog input Ni1000 (2-wire), -50 °C...+150 °C
19	Analog input Ni1000 (3-wire), -50 °C...+150 °C
51	Analog input Ni1000 (4-wire), -50 °C...+150 °C
39	Analog input Cu50 1.426 (2-wire) -50 °C...+200 °C
40	Analog input Cu50 1.426 (3-wire) -50 °C...+200 °C
41	Analog input Cu50 1.426 (4-wire) -50 °C...+200 °C
42	Analog input Cu50 1.428 (2-wire) -200 °C...+200 °C
43	Analog input Cu50 1.428 (3-wire) -200 °C...+200 °C
44	Analog input Cu50 1.428 (4-wire) -200 °C...+200 °C
24	Analog input J-type thermocouple -210 °C...+1200 °C
25	Analog input K-type thermocouple -270 °C...+1372 °C
30	Analog input N-type thermocouple -270 °C...+1300 °C
27	Analog input S-type thermocouple -50 °C...+1768 °C
28	Analog input T-type thermocouple -270 °C...+400 °C
38	Analog input resistor 50 kΩ
52	Temperature-internal reference point
53	Common mode voltage

Table 61: Channel Monitoring

Internal value	Monitoring
0	Plausibility, open-circuit (cut wire) and short circuit (default)
3	No monitoring

Table 62: Line Frequency Suppression

Internal value	Line frequency suppression
0	50 Hz
1	60 Hz
2	No line frequency suppression

Table 63: Compensation Channel

Internal value	Compensation channel
0	Internal compensation (default)
1	Channel 0 (possible with channels 1, 2, 3)
2	Channel 1 (possible with channels 0, 2, 3)
3	Channel 2 (possible with channels 0, 1, 3)
4	Channel 3 (possible with channels 0, 1, 2)
5	Channel 4 (possible with channels 5, 6, 7)
6	Channel 5 (possible with channels 4, 6, 7)
7	Channel 6 (possible with channels 4, 5, 7)
8	Channel 7 (possible with channels 4, 5, 6)
9	External with temperature value

Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module, e.g. internal analog voltage is not correct	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diagnosis block	
Class	Interface	Device	Module	Channel	Error identifier	Error message	Remedy
	1)	2)	3)	4)			
	11 / 12	ADR	1...10				voltage
4	14	1...10	31	31	45	Process voltage is switched OFF (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...7	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	1	Possibly wrong measured value caused by inadmissible temperature of the compensation channel	Check the temperature compensation channel
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	2	Invalid measured value of the channel caused by overly high voltage difference	Check voltage difference; install equalizing conductors if necessary
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	11	Output voltage 10 V faulty	Check output load
	11 / 12	ADR	1...10				

Remarks:

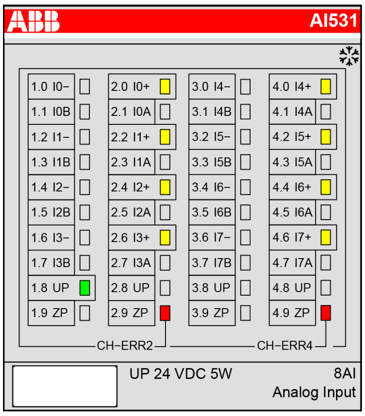
1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 expansion module 1...10, ADR = hardware address (e.g. of the DC551)

3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

States of the LEDs (see also section Diagnosis LEDs in the S500 system data):



LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I3 and I4...I7	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 VDC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, messages in groups (analog inputs combined into the groups 2 and 4)	Red	No error, or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs CH-ERR2 and CH-ERR4 light up together					

Measuring Ranges

Voltage Input Ranges

Bipolar Voltage Input Range, Measuring Bridge

Range	**-50 ... +50 mV**	**-500 ... +500 mV**	**-1 ... +1 V**	**-5 ... +5 V**	**-10 ... +10 V**	**Common Mode Voltage**
Overflow	> 58.7945	> 587.9449	> 1.17589	> 5.8794	> 11.7589	> 20.0000
Measured value too high	58.7945 : 50.0018	587.9449 : 500.0181	1.17589 : 1.00004	5.8794 : 5.0002	11.7589 : 10.0004	

Range	-50 ... +50 mV	-500 ... +500 mV	-1 ... +1 V	-5 ... +5 V	-10 ... +10 V	Common Mode Voltage
Normal range Normal range or Measured value too low	50.0000 : 0.0018	500.0000 : 0.0181	1.00000 : 0.00004	5.0000 : 0.0002	10.0000 : 0.0004	20.0000 : 0.0008
	0.0000	0.0000	0.0000	0.00000	0.0000	0.0000
	-0.0018 : -50.0000	-0.0181 : -500.0000	-0.00004 : -1.00000	-0.0002 : -5.0000	-0.004 : -10.0000	-0.0008 : -20.0000
Measured value too low	-50.0018 : -58.7945	-500.0181 : -587.9449	-1.00004 : -1.17589	-5.0002 : -5.8794	-10.0004 : -11.7589	
Underflow	< -58.7945	< -587.9449	< -1.17589	< -5.8794	< -11.7589	< -20.0000

The represented resolution corresponds to 16 bits.

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range Normal range or Measured value too low	27648 : 1	6C00 : 0001
	0	0000
	-1 : -27648	FFFF : 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	-32768	8000

Unipolar Voltage Input Range, Measuring Bridge, Digital Input

Range		0 ... +5 V	0 ... +10 V	Digital input
Measured value too high		5.8794 : 5.0002	11.7589 : 10.0004	
Normal range		5.0000 : 0.0002	10.0000 : 0.0004	ON
		0.0000	0.0000	OFF
Measured value too low		-0.0002 : -0.8794	-0.0004 : -1.1759	
Underflow		< -0.8794	< -1.1759	

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
Measured value too low	-1 : -4864	FFFF : ED00
Underflow	-32768	8000

Current Input Ranges

Range	-20 ... +20 mA	0 ... +20 mA	4 ... 20 mA
Overflow	> 23.5178	> 23.5178	> 22.8142
Measured value too high	23.5178 : 20.0007	23.5178 : 20.0007	22.8142 : 20.0006
Normal range	20.0000 : 0.0007	20.0000 : 0.0007	20.0000 : 4.0006
	0.0000	0.0000	4.0000

Range	-20 ... +20 mA	0 ... +20 mA	4 ... 20 mA
	-0.0007 : -20.0000		
Measured value too low		-0.0007 : -3.5178	3.9994 : 1.1852
	-20.0007 : -23.5178		
Underflow	< -23.5178	< -3.5178	< 1.1852

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 : -27648	FFFF : 9400
Measured value too low	-1 : -4864	FFFF : ED00
	-27649 : -32512	93FF : 8100
Underflow	-32768	8000

Resistance Thermometer Input Ranges

Range	Pt100 -50 ... +70 °C 1)	Pt100 / Pt1000 -50 ... +400 °C	Pt100 -200 ... +850 °C	Ni1000 -50 ... +150 °C	Cu50 -200 ... +200 °C
Overflow	> 80.0 °C	> 450.0 °C	> 850 °C	> 160.0 °C	> 200 °C
Measured value too high		450.0 °C : 400.1 °C			
				160.0 °C : 150.1 °C	
	80.0 °C : 70.1 °C				
Normal range	: : : : 70.0 °C : 0.1 °C	: 400.0 °C : : : : 0.1 °C	850.0 °C : : : : : 0.1 °C	: : : 150.0 °C : : 0.1 °C	: : 200.0 °C : : : 0.1 °C
	0.0 °C	0.0 °C	0.0 °C	0.0 °C	
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : : -200 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C 2) -200.0 °C 2)
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C		-50.1 °C : -60.0 °C	
Underflow	< -60.0 °C	< -60.0 °C	< -200 °C	< -60.0 °C	< -200 °C 2)

1) also possible with resolution 0.01 K

2) if Cu50 with 1.426, -50 °C is valid; if Cu50 with 1.428, -200.0 °C is valid

The represented resolution corresponds to 16 bits.

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1

Range	Digital value	
	Decimal	**Hex.**
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	8500 4000 2000 1500 700 : 1	2134 0FA0 07D0 05DC 02BC : 1
	0	0000
	-1 : -500 -2000	FFFF : FE0C F830
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Resistor Input Range

Range	Resistor [Ω]
Overflow	> 55000
Measured value too high	55000 : 50001
Normal range	50000 : 2 1 0

The represented resolution corresponds to 16 bits.

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	30413 : 27649	76CD : 6C01
Normal range	27648 : 1 1 0	6C00 : 0001 0001 0000

Thermocouple Input Ranges

Range	Typ J -210 ... +1200 °C	Typ K -270 ... +1372 °C	Typ N -270 ... +1300 °C	Typ S -50 ... +1768 °C	Typ T -270 ... +400 °C
Overflow	> 1200.0 °C	> 1372.0 °C	> 1300.0 °C	> 1768.0 °C	> 400.0 °C
Normal range				1768.0 °C	
		1372.0 °C		:	
		:	1300.0 °C	:	
	1200.0 °C	:	:	:	
	:	:	:	:	400.0 °C
	:	:	:	:	:
	0.1 °C	0.1 °C	0.1 °C	0.1 °C	0.1 °C
	0.0 °C	0.0 °C	0.0 °C	0.0 °C	
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C
	:	:	:	:	:
	:	:	:	-50.0 °C	:
	-210.0 °C	:	:	:	:
		-270.0 °C	-270.0 °C		-270.0 °C
Underflow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -50.0 °C	< -270.0 °C

The represented resolution corresponds to 16 bits.

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Normal range	17680	4510
	13720	3598
	13000	32C8
	12000	2EE0

Range	Digital value	
	Decimal	**Hex.**
	4000	0FA0
	:	:
	1	1
	0	0000
	-1	FFFF
	:	:
	-500	FE0C
	-2100	F7CC
	-2700	F574
Underflow	-32768	8000

Temperature-Internal Reference Point Ranges

Range	Value
Overflow	> +85 °C
Normal range	+85 °C
	0 °C
	-40 °C
Underflow	< -40 °C

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Normal range	850	0352
	0	0000
	-400	FE70
Underflow	-32768	8000

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	Current consumption from UP in normal operation	130 mA
	Inrush current from UP (at power up)	On request
Max. length of analog cables, conductor cross section > 0.14 mm^2		100 m
Weight		130 g
Mounting position		Horizontal or vertical with derating (max. temperature 40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

!

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter	Value
Number of channels per module	8
Distribution of channels into groups	2 groups of 4 channels each
Connections of the channels I0 to I3	Terminals 1.0 to 1.7 and terminals 2.0 to 2.7
Connections of the channels I4 to I7	Terminals 3.0 to 3.7 and terminals 4.0 to 4.7
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000/ Cu50/ resistor)
Galvanic isolation	Against internal supply and other mod-ules

Parameter	Value
Configurability	Digital input, -50 mV...+50 mV, -500mV...+500 mV, -1 V...+1 V, -5 V...+5 V, -10 V...+10 V, 0 V...+5 V, 0 V...+10 V, -20 mA...+20 mA, 0 mA...20 mA, 4 mA...20 mA, Pt100, Pt1000, Ni1000, Cu50, resistor, thermo-couple types J, K, N, S, T (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ, current: ca. 330 Ω
Time constant of the input filter	Line-frequency suppression 50 Hz, 60 Hz, none
Indication of the input signals	1 yellow LED per channel, the bright-ness depends on the value of the analog signal
Conversion time	1 ms (none), 100 ms (50 Hz / 60 Hz) per channel
Resolution	Range: unipolar 15 bits Range: bipolar 15 bits + sign
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolu-tion within the normal range	Typ.: ±0.1 % (voltage) ±0.3 % (current, resistor) at 25 °C Max.: ±0.7 % (voltage) ±0.9 % (current, resistor) ±0.5 % (thermocouple) 1.0 K (resistance temperature detectors) at 0 °C...60 °C or EMC disturb-ance
Maximum permanent allowed overload (no damage)	
Current input	When the input current exceeds the overflow value of the measurement range, the input impedance is switched to high impedance for protection. The maximum allowed overload is then 30 V. The digital value corresponds to the overflow value. Periodically, the input impedance is switched to the normal value and the input current is measured. If the input current is within the meas-urement range, the input impedance remains at the normal level and the dig-ital value corresponds to the measured current.
Voltage input	30 V
Relationship between input signal and hex code	*Table 61 “Channel Monitoring” on page 493*
Unused voltage inputs	Are configured as "unused"
Unused current inputs	Have a low resistance, can be left open-circuited
Overvoltage protection	Yes

Technical Data of the Analog Inputs if Used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		2 groups of 4 channels each
Connections of the channels I0+ to I3+ Connections of the channels I4+ to I7+		Terminals 2.0, 2.2, 2.4, 2.6 Terminals 4.0, 4.2, 4.4, 4.6
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input delay		Typ. 2 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	Typ. 3.1 mA
	Input voltage +30 V	< 7 mA
Input resistance		Ca. 4.8 kΩ

Ordering Data

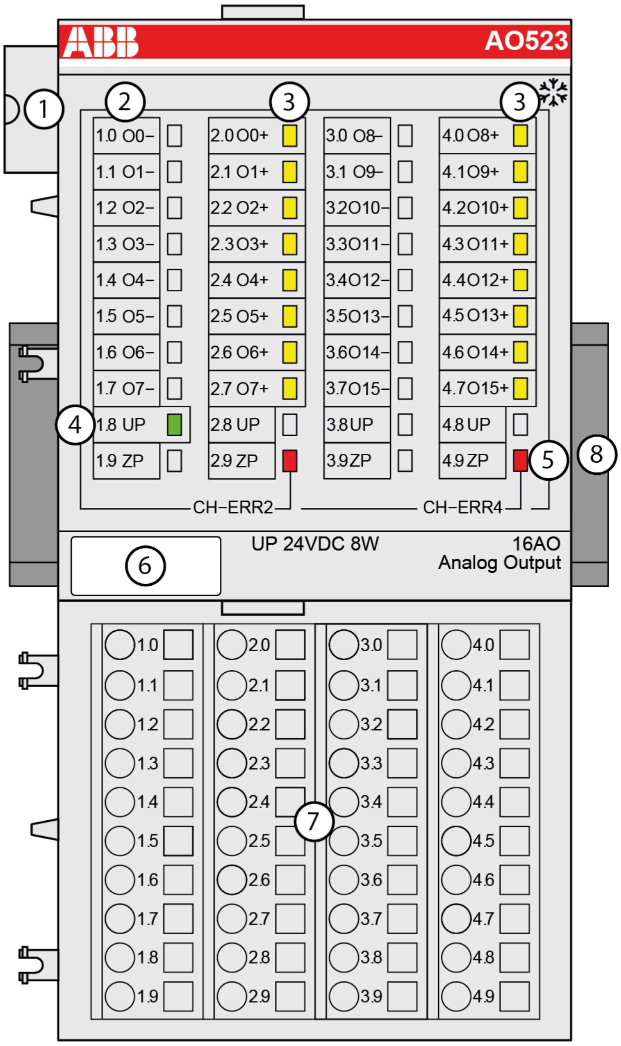
Part no.	Description	Product Life Cycle Phase *)
1SAP 250 600 R0001	AI531, analog input module, 8 AI, U/I/Pt100, TC, 15 bits + sign, 4-wires	Active
1SAP 450 600 R0001	AI531-XC, analog input module, 8 AI, U/I/Pt100, TC, 15 bits + sign, 4-wires, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.2.3 AO523 - Analog Output Module

- 16 analog outputs in two groups:
  - 8 channels configurable for voltage or currrent output
  - 8 channels for voltage output

  Resolution 12 bits plus sign
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the analog outputs (O0 - O15)
4 1 green LED to display the state of the process supply voltage UP
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Functionality

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V...+10 V	12 bits plus sign
	Current 0 mA...20 mA, 4 mA...20 mA	12 bits

Parameter	Value
LED displays	19 LEDs for signals and error messages
Internal power supply	Through the expansion bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit	TU515 or TU516 ➮ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ➮ Chapter 2.6 “AC500 (Standard)” on page 1252.

The modules are plugged on an I/O terminal unit ➮ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ➮ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, independent of the inserted module:

Terminals 1.8 to 4.8: process voltage UP = +24 VDC

Terminals 1.9 to 4.9: process voltage ZP = 0 VDC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	O0- to O7-	Negative poles of the first 8 analog outputs
2.0 to 2.7	O0+ to O7+	Positive poles of the first 8 analog outputs
3.0 to 3.7	O8- to O15-	Negative poles of the following 8 analog outputs
4.0 to 4.7	O8+ to O15+	Positive poles of the following 8 analog outputs

For the open-circuit detection (cut wire), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per AO523.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!

Risk of damaging the PLC modules!

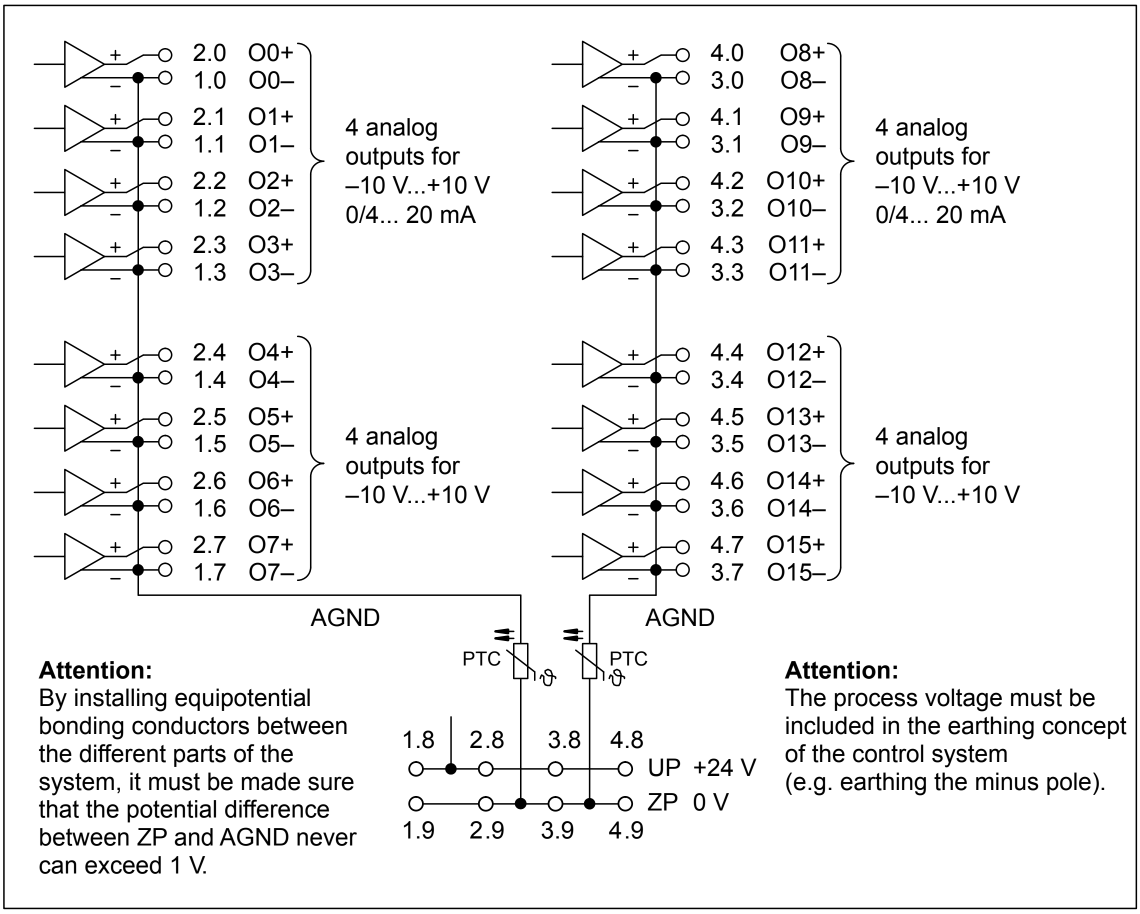
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the electrical connection of the module:



The modules provide several diagnosis functions *Chapter 1.5.2.2.3.7 “Diagnosis” on page 515*.

Connection of Analog Output Loads (Voltage, Current)

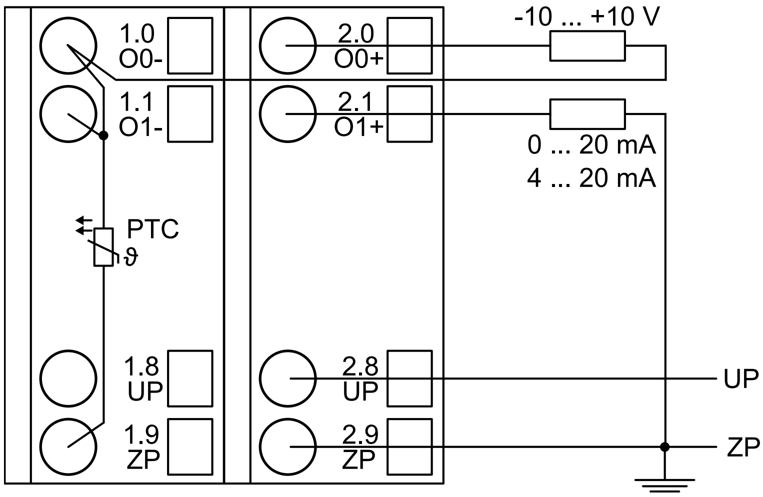


Fig. 57: Connection example

The following measuring ranges can be configured *Chapter 1.5.2.2.3.6 "Parameterization" on page 511*:

Voltage	-10 V...+10 V	Load max. ±10 mA	1 channel used
Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4...20 mA	Load 0 Ω...500 Ω	1 channel used

Only the channels 0...3 and 8...11 can be configured as current output (0 mA...20 mA or 4 mA...20 mA).

The function of the LEDs is described under Displays.

Unused analog outputs can be left open-circuited.

Internal Data Exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	0
Counter output data (words)	16

I/O Configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

That means replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1510 [1])	Word	1510 0x05e6	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length in bytes	Internal	39	Byte	39-CPU 39-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Output channel 0	see table "Channel configuration"		Byte	Default 0x00	0	130	0x0Y06
8	Channel monitoring Output channel 0	see table "Channel monitoring"		Byte	Default 0x00	0	3	0x0Y07

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
9	Substi-tute value Output channel 0	Output channel 0!	0...0xffff	Word	Default 0x0000	0	65535	0x0Y08
10 to 15	Channel configu-ration and channel moni-toring of the output channels 1 to 3	see tables "Channel configura-tion" and "Channel monitoring"		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y09 to 0x0Y0E
16 to 23	Channel configu-ration and channel moni-toring of the output channels 4 to 7	see tables "Channel configura-tion" and "Channel monitoring"		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y0F to 0x0Y16
24	Channel con-figura tion Output channel 8	see table "Channel configura-tion"		Byte	Default 0x00	0	130	0x0Y17
25	Channel moni-torin g Output channel 8	see table "Channel moni-toring"		Byte	Default 0x00	0	3	0x0Y18
26	Substi-tute value Output channel 8	Output channel 8!	0...0xffff	Word	Default 0x0000	0	65535	0x0Y19

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
27 to 32	Channel configuration and channel monitoring of the output channels 9 to 11	see tables "Channel configuration" and "Channel monitoring"		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y1A to 0x0Y1F
33 to 40	Channel configuration and channel monitoring of the output channels 12 to 15	see tables "Channel configuration" and "Channel monitoring"		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y20 to 0x0Y27
[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1 [2]) Not with FBP								

GSD file:

Ext_User_Prm_Data_Len =	42
Ext_User_Prm_Data_Const(0) =	0x05, 0xe7, 0x27, \
	0x01, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Output Channels 0 and 8 (2 channels, AO523)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see below *Table 64 “Channel Configuration 3)” on page 514*	see below *Table 64 “Channel Configuration 3)” on page 514*	Byte	see below *Table 64 “Channel Configuration 3)” on page 514*
2	Channel monitoring	see below *Table 65 “Channel Monitoring 4)” on page 514*	see below *Table 65 “Channel Monitoring 4)” on page 514* *8)	Byte	see below *Table 65 “Channel Monitoring 4)” on page 514*
3	Substitute value *Table 66 “Substitute Value” on page 515*	0...65535	0... 0xffff	Word	0

Output Channels 1...7 and 9...15 (14 channels, AO523)

No.	Name	Internal value, type
1	Channel configuration see table 3)	Byte
2	Channel monitoring see table 4)	Byte

Table 64: Channel Configuration 3)

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V...+10 V
129	Analog output 0 mA...20 mA (not with the channels 4...7 and 12...15)
130	Analog output 4 mA...20 mA (not with the channels 4...7 and 12...15)

Table 65: Channel Monitoring 4)

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit (default)
1	Open-circuit (broken wire) and short circuit
2	Plausibility
3	No monitoring

Table 66: Substitute Value

Intended behaviour of channel 0 when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	OFF	0
Last value	Last value	0
Substitute value	OFF or Last value	1...65535

Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000...063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON -> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	3	0...15	48	Analog value overflow at an analog output	Check output value

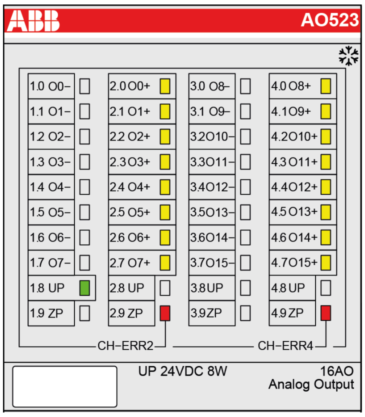
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
	11 / 12	ADR	1...10				
4	14	1...10	3	0...15	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (3 = AO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0...O7 and O8...O15	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 VDC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Output Ranges

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA
Overflow	> 11.7589 V	> 23.5178 mA	> 22.8142 mA
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	**Hex.**
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 "System Data AC500" on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 "System Data AC500-XC" on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	Current consumption from UP at normal operation	0.15 A + output loads

Parameter		Value
	Inrush current from UP (at power up)	0.040 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2		100 m
Weight		300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

!

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Outputs

Parameter		Value	
Number of channels per module		16, of which channnels O0...O3 and O8...O11 for voltage and current, and channels O4...7 and O12...15 only for voltage	
Distribution of channels into groups		2 groups of 8 channels each	
	Channels O0-...O7-	Terminals 1.0...1.7	
	Channels O0+...O7+	Terminals 2.0...2.7	
	Channels O8-...O15-	Terminals 3.0...3.7	
	Channels O8+...O15+	Terminals 4.0...4.7	
Output type		Bipolar with voltage, unipolar with current	
Galvanic isolation		Against internal supply and other modules	
Configurability		-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually), current outputs only channels 0...3 and 8...11	
Output resistance (load), as current output		0 Ω...500 Ω	
Output loadability, as voltage output		Max. ±10 mA	
Indication of the output signals		One LED per channel	
Resolution		12 bits (+ sign)	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	±0.5 % of full scale at 25 °C
		Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between output signal and hex code		*Chapter 1.5.2.2.3.9 “Output Ranges” on page 517*	
Unused outputs		Can be left open-circuited	

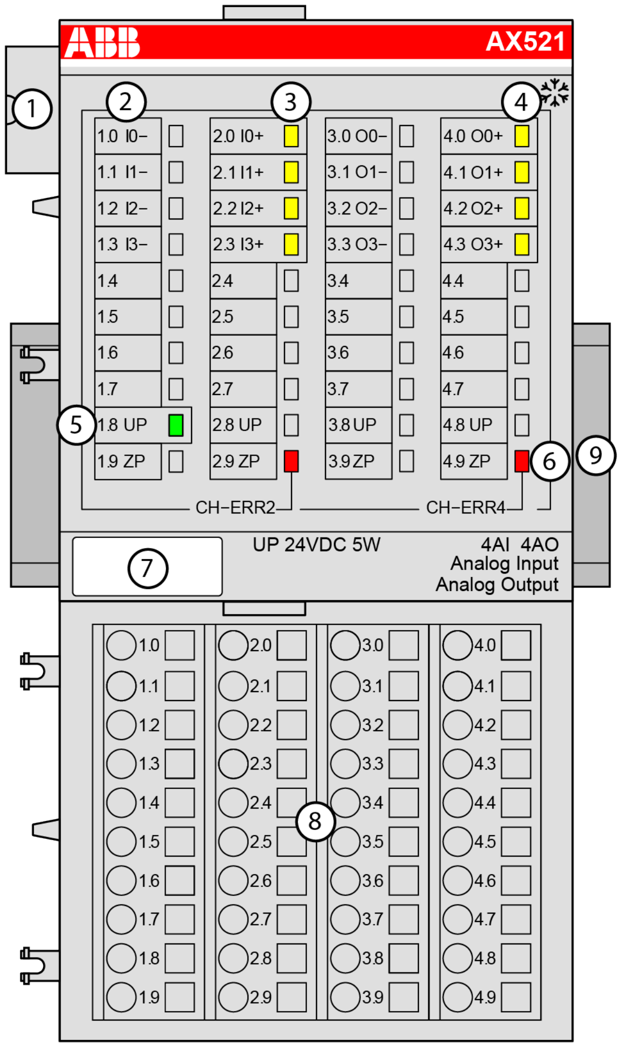
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 250 200 R0001	AO523, analog output module, 16 AO, U/I, 12 bits + sign, 2-wires	Active
1SAP 450 200 R0001	AO523-XC, analog output module, 16 AO, U/I, 12 bits + sign, 2-wires, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.2.4 AX521 - Analog Input/Output Module

- 4 configurable analog inputs (I0 to I3) in 1 group (1.0...2.3)
  Resolution 12 bits plus sign
- 4 configurable analog outputs (O0 to O3) in 1 group (3.0...4.3)
  Resolution 12 bits plus sign
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 4 yellow LEDs to display the signal states at the analog inputs (I0 - I3)
4 4 yellow LEDs to display the signal states at the analog outputs (O0 - O3)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Functionality

AX521 4 analog inputs, individually configurable for

- Unused (default setting)
- 0 V...10 V
- -10 V...+10 V
- 0 mA...20 mA

- 4 mA...20 mA
- Pt100, -50 °C...+400 °C (2-wire)
- Pt100, -50 °C...+400 °C (3-wire), requires 2 channels
- Pt100, -50 °C...+70 °C (2-wire)
- Pt100, -50 °C...+70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C...+400 °C (2-wire)
- Pt1000, -50 °C...+400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C...+150 °C (2-wire)
- Ni1000, -50 °C...+150 °C (3-wire), requires 2 channels
- 0 V...10 V with differential inputs, requires 2 channels
- -10 V...+10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

4 analog outputs, individually configurable for

- Unused (default setting)
- -10 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V... +10 V	12 bits plus sign
	Voltage 0 V...10 V	12 bits
	Current 0 mA...20 mA, 4 mA...20 mA	12 bits
	Temperature	0.1 °C
LED displays		11 LEDs for signals and error messages
Internal power supply		Via the expansion bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit		TU515 or TU516 *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The modules are plugged on an I/O terminal unit *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, irrespective of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 VDC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 VDC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.3	I0- to I3-	Negative poles of the 4 analog inputs
2.0 to 2.3	I0+ to I3+	Positive poles of the 4 analog inputs
3.0 to 3.3	O0- to O3-	Negative poles of the 4 analog outputs
4.0 to 4.3	O0+ to O3+	Positive poles of the 4 analog outputs

The negative poles of the analog inputs are electrically connected to each other to form an "Analog Ground" signal for the module.

The negative poles of the analog outputs are electrically connected to each other to form an "Analog Ground" signal for the module.

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the earth potential or the supply voltage.

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (cut wire), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per I/O module.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the electrical connection of the I/O module.

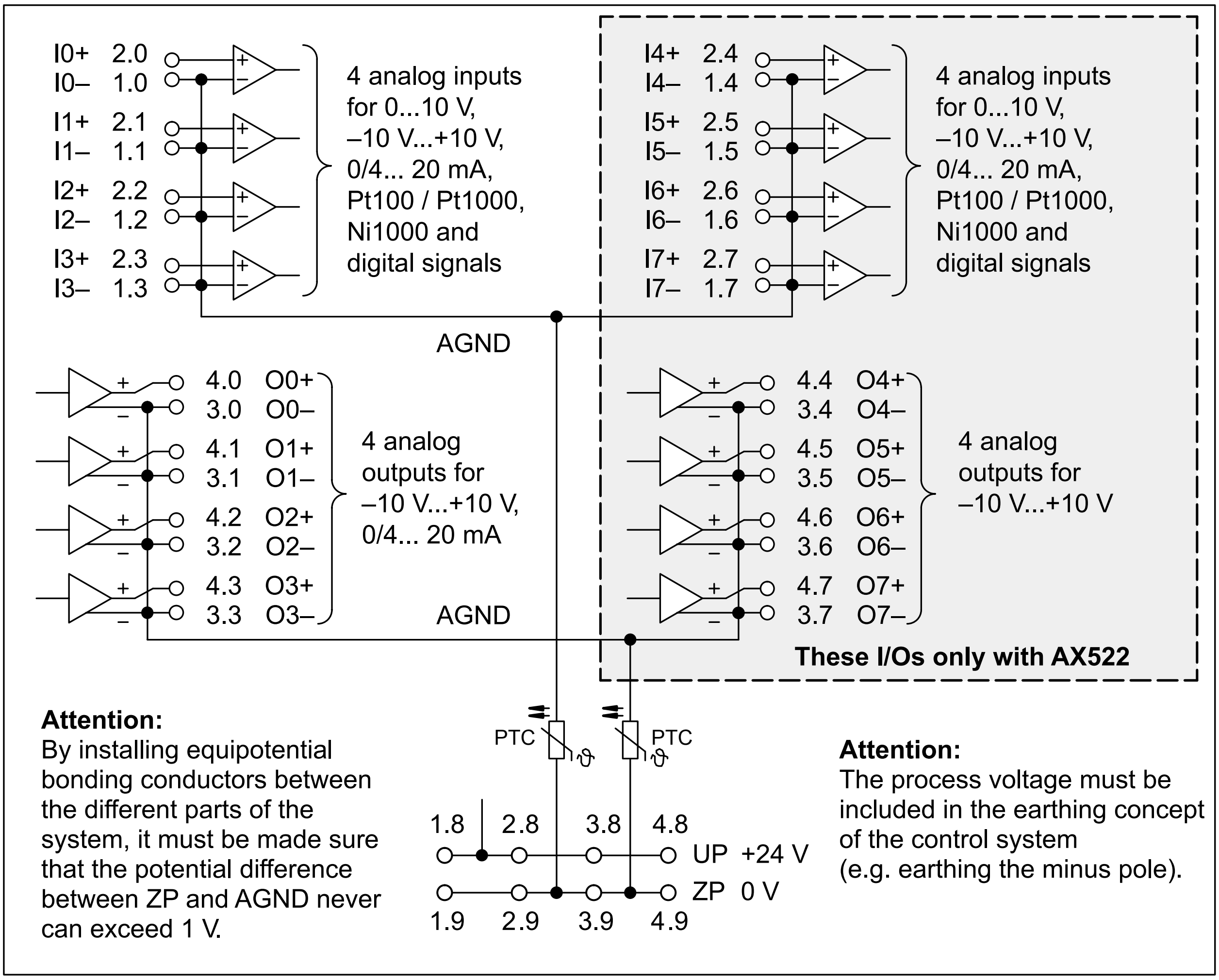


Fig. 58: Terminal assignment

Connection of Resistance Thermometers in 2-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.

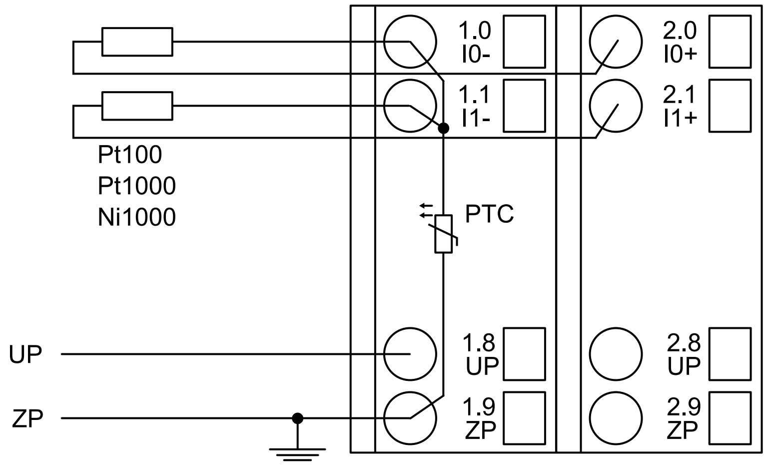


Fig. 59: Connection example

Pt100	-50 °C...+70 °C	2-wire configuration, one channel used
Pt100	-50 °C...+400 °C	2-wire configuration, one channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, one channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

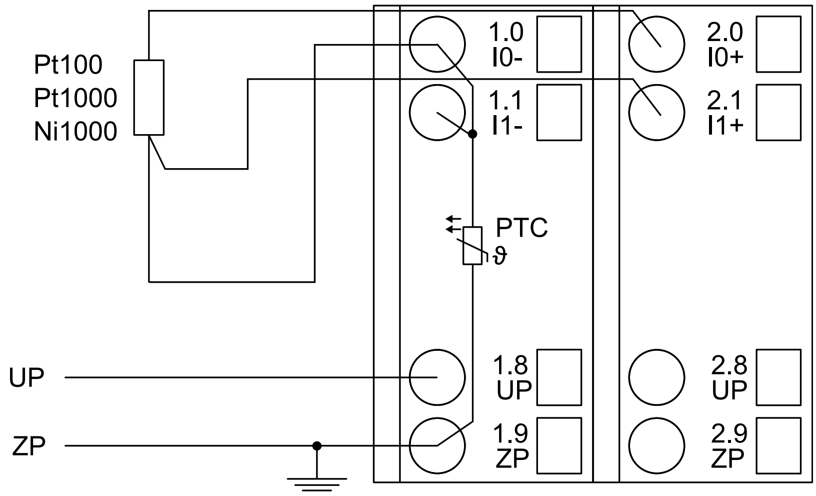


Fig. 60: Connection example

If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C...+70 °C	3-wire configuration, two channels used
Pt100	-50 °C...+400 °C	3-wire configuration, two channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, two channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply

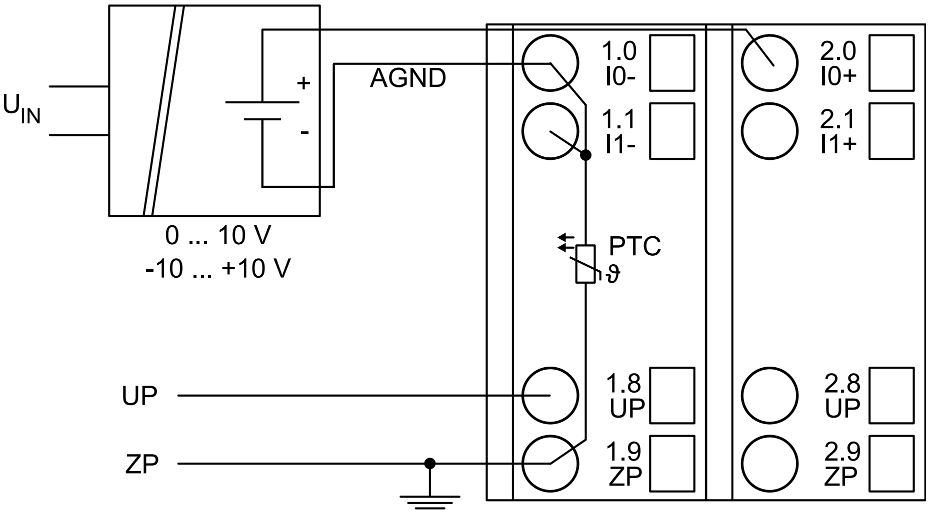


Fig. 61: Connection example

> *By connecting the sensor's negative pole of the output voltage to AGND, the electrically isolated voltage source of the sensor is referred to ZP.*

The following measuring ranges can be configured for AX521 ⇘ *Chapter 1.5.2.2.4.6 “Parameterization” on page 532* and for AX522 ⇘ *Chapter 1.5.2.2.5.6 “Parameterization” on page 556*:

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply

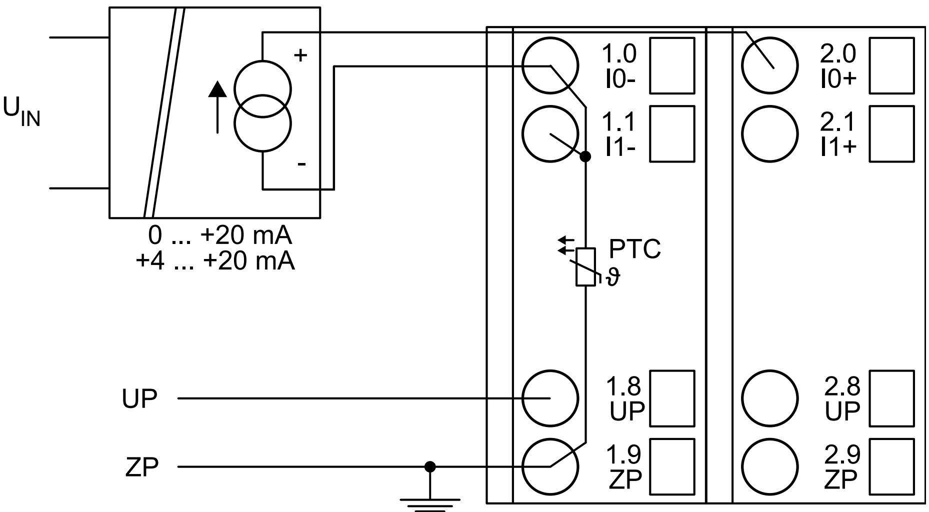


Fig. 62: Connection example

Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply

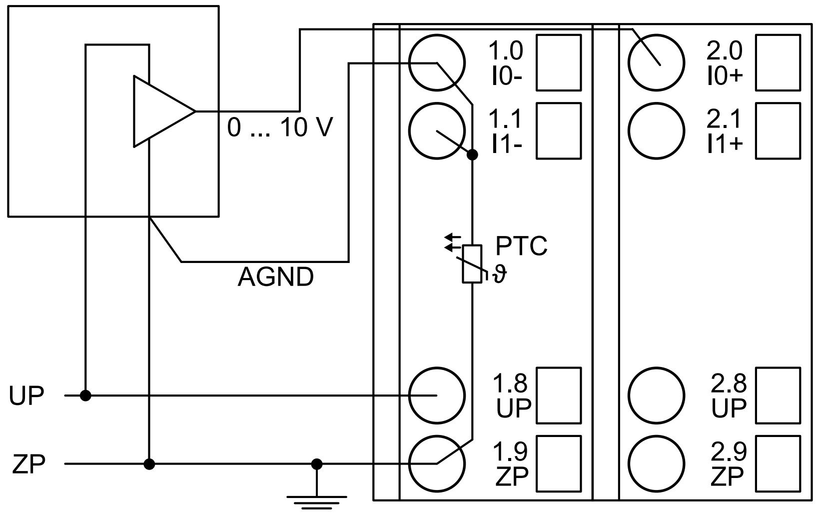


Fig. 63: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines (see figure Terminal Assignment).

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V *)	1 channel used

*) if the sensor can provide this signal range

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Passive-type Analog Sensors (Current)

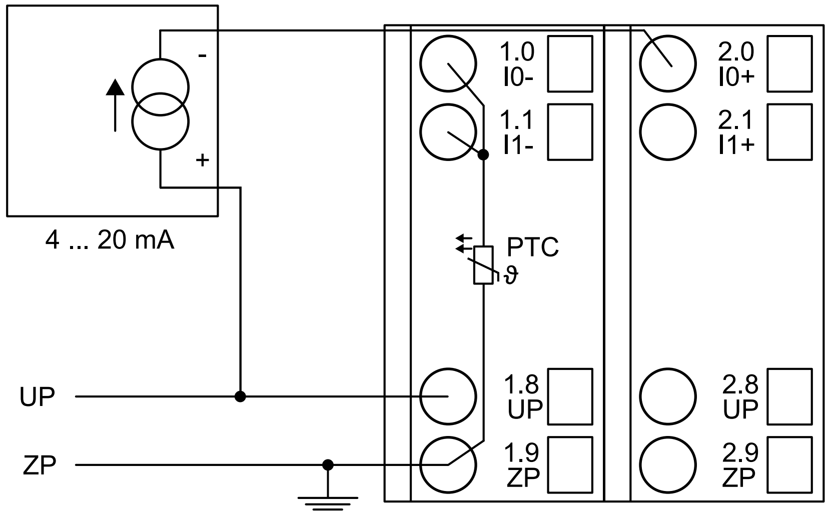


Fig. 64: Connection example

Current	4 mA...20 mA	1 channel used

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and I-). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely earthed).

The use of differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
The earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.

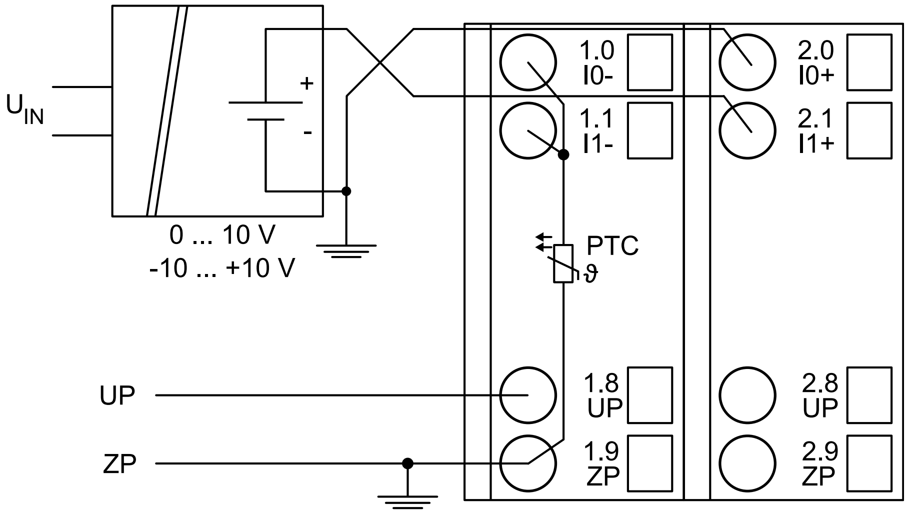


Fig. 65: Connection example

> *The negative pole of the sensor must be earthed next to the sensor.*

Voltage	0 V...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

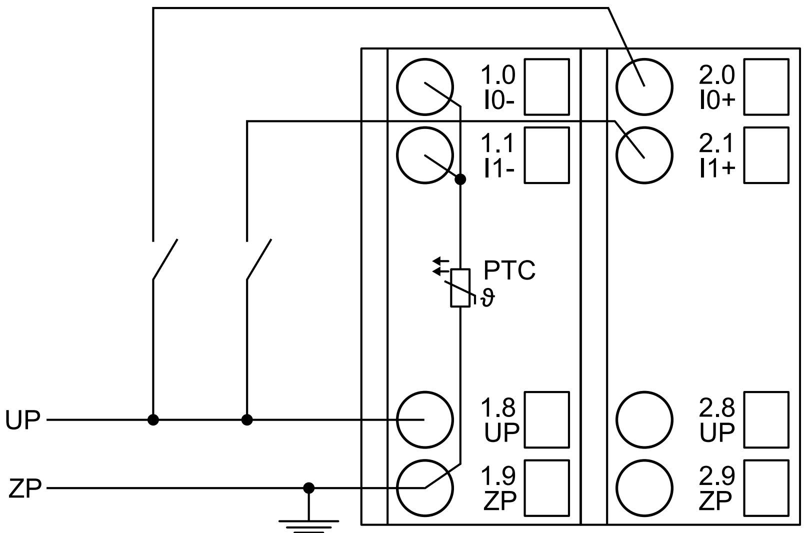


Fig. 66: Connection example

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of Analog Output Loads (Voltage, Current)

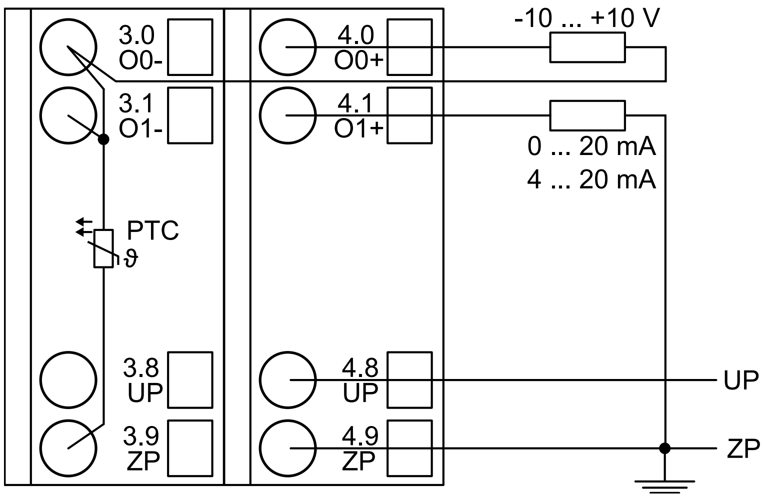


Fig. 67: Connection example

Voltage	-10 V...+10 V	Load max. ±10 mA	1 channel used
Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

Only the channels 0...3 can be configured as current output (0 mA...20 mA or 4 mA...20 mA).

Unused analog outputs can be left open-circuited.

Internal Data Exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	4
Counter output data (words)	4

I/O Configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1505 [1])	Word	1505 0x05E1	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length in bytes	Internal	21	Byte	21-CPU 21-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	see table "Channel configuration"		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	see table "Channel monitoring"		Byte	Default 0x00	0	3	0x0Y07

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
9 to 14	Channel configu-ration and channel moni-toring of the input channels 1 to 3	see tables "Channel configura-tion" and "Channel monitoring"		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y0D
15	Channel configu-ration Output channel 0	see table "Channel configura-tion"		Byte	Default 0x00	0	130	0x0Y0E
16	Channel moni-toring Output channel 0	see table "Channel moni-toring"		Byte	Default 0x00	0	3	0x0Y0F
17	Substi-tute value Output channel 0	only valid for output channel 0	0...0xffff	Word	Default 0x0000	0	65535	0x0Y10
18 to 21	Channel configu-ration and channel moni-toring of the output channels 1 to 2	see tables "Channel configura-tion" and "Channel monitoring"		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y11 to 0x0Y14
22	Channel configu-ration Output channel 3	see table "Channel configura-tion"		Byte	Default 0x00	0	130	0x0Y15
23	Channel moni-toring Output channel 3	see table "Channel moni-toring"		Byte	Default 0x00	0	3	0x0Y16
[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1 [2]) Not with FBP								

GSD file:

Ext_User_Prm_Data_Len =	24
Ext_User_Prm_Data_Const(0) =	0x05, 0xe2, 0x15, \
	0x01, 0x00, 0x00 \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 67: Input Channel (4x)

No.	Name	Internal value, type	Default
1	Channel configuration see table 2)	Byte	0 0x00 see table 2)
2	Channel monitoring see table 3)	Byte	0 0x00 see table 3)

Table 68: Channel Configuration 2)

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V...10 V
2	Digital input
3	Analog input 0 mA...20 mA
4	Analog input 4 mA...20 mA
5	Analog input -10 V...+10 V
8	Analog input Pt100, -50 °C...+400 °C (2-wire)
9	Analog input Pt100, -50 °C...+400 °C (3-wire), requires 2 channels *)
10	Analog input 0...10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V...+10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C...+70 °C (2-wire)
15	Analog input Pt100, -50 °C...+70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C...+400 °C (2-wire)
17	Analog input Pt1000, -50 °C...+400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C...+150 °C (2-wire)
19	Analog input Ni1000, -50 °C...+150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 69: Channel Monitoring [3])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 70: Output Channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel monitoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0...65535	0... 0xffff	Word	0

Table 71: Output Channels 1...3 (3x)

No.	Name	Internal value, type
1	Channel configuration see table [4])	Byte
2	Channel monitoring see table [6])	Byte

Table 72: Channel Configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V...+10 V
129	Analog output 0 mA...20 mA (not with the channels 4...7 and 12...15)
130	Analog output 4 mA...20 mA (not with the channels 4...7 and 12...15)

Table 73: Channel Monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 74: Substitute Value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

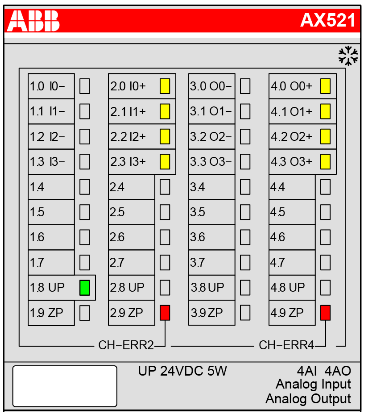
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
4	14	1...10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...3	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10	0...7			
4	14	1...10	1	0...3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10	0...7			
4	14	1...10	1	0...3	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1...10	0...7			
4	14	1...10	3	0...3	48	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1...10	0...7			
4	14	1...10	3	0...3	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1...10	0...7			

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I3	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	Outputs O0...O3	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 VDC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring Ranges

Input Ranges of Voltage, Current and Digital Input

The represented resolution corresponds to 16 bits.

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Overflow	>11.7589	>11.7589	>23.5178	>22.8142	
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006	
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	ON
	0.0000	0.0000	0	4	OFF
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994	

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Measured value too low		-10.0004 : -11.7589			
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858	

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	27648 : 1	6C00 : 0001
	0	0000
	-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	-32768	8000

Input Ranges Resistance

Range	Pt100 / Pt 1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C
Measured value too high		450.0 °C : 400.1 °C	
			160.0 °C : 150.1 °C
	80.0 °C : 70.1 °C		

Range	Pt100 / Pt 1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Normal range	: : 70.0 °C : 0.1 °C	400.0 °C : : : 0.1 °C	: 150.0 °C : : 0.1 °C
	0.0 °C	0.0 °C	0.0 °C
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	Digital value	
	Decimal	Hex.
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output Ranges Voltage and Current

The represented resolution corresponds to 16 bits.

Range	0...+10 V	-10...+10 V	0...20 mA	4...20 mA
Overflow	0 V	0 V	0 mA	0 mA
Measured value too high	11.5 V	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range		10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
		0.0000 V	0.0000 mA	4.0000 mA
		-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-1.5 V	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	**Hex.**
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm²		100 m
Weight		300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group of 4 channels
Connections of the channels I0- to I3-	Terminals 1.0 to 1.3

Parameter	Value	
Connections of the channels I0+ to I3+	Terminals 2.0 to 2.3	
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
Time constant of the input filter	Voltage: 100 µs Current: 100 µs	
Indication of the input signals	One LED per channel	
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s	
Resolution	Range 0 V...10 V: 12 bits Range -10 V...+10 V: 12 bits + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between input signal and hex code	See tables ↪ *Chapter 1.5.2.2.4.9.1 "Input Ranges of Voltage, Current and Digital Input" on page 538*	
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical Data of the Analog Inputs, if Used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels I0+ to I3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA

Parameter		Value
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter		Value	
Number of channels per module		4, all channels for voltage and current	
Distribution of channels into groups		1 group of 4 channels	
	Channels O0-...O3-	Terminals 3.0...3.3	
	Channels O0+...O3+	Terminals 4.0...4.3	
Output type		Bipolar with voltage, unipolar with current	
Galvanic isolation		Against internal supply and other modules	
Configurability		-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually), current outputs only channels 0...3	
Output resistance (load), as current output		0 Ω...500 Ω	
Output loadability, as voltage output		Max. ±10 mA	
Indication of the output signals		One LED per channel	
Resolution		12 bits (+ sign)	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	±0.5 % of full scale at 25 °C
		Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between output signal and hex code		See table *Chapter 1.5.2.2.4.9.3 “Output Ranges Voltage and Current” on page 541*	
Unused outputs		Can be left open-circuited	

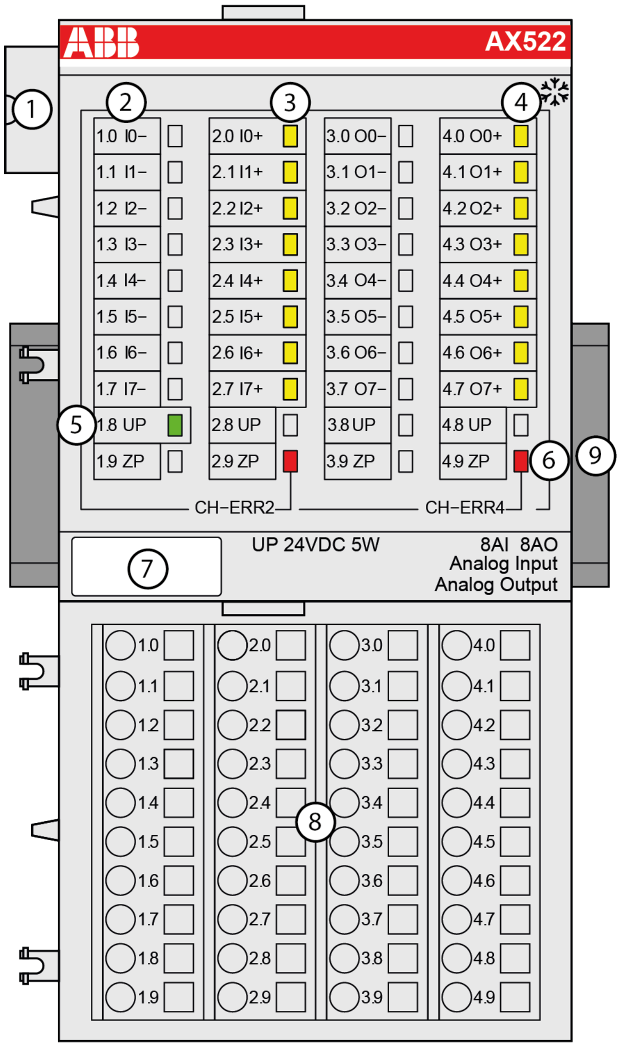
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 250 100 R0001	AX521, analog input/output module, 4 AI, 4 AO, U/I/Pt100, 12 bits + sign, 2-wires	Active
1SAP 450 100 R0001	AX521-XC, analog input/output module, 4 AI, 4 AO, U/I/Pt100, 12 bits + sign, 2-wires, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.2.2.5 AX522 - Analog Input/Output Module

- 8 configurable analog inputs (I0 to I7) in 1 group (1.0...2.7)
  Resolution 12 bits plus sign
- 8 configurable analog outputs (O0 to O7) in 1 group (3.0...4.7)
  Resolution 12 bits plus sign
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the analog inputs (I0 - I7)
4 8 yellow LEDs to display the signal states at the analog outputs (O0 - O7)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Functionality

8 analog inputs, individually configurable for

- Unused (default setting)
- 0 V...10 V
- -10 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA
- Pt100, -50 °C...+400 °C (2-wire)
- Pt100, -50 °C...+400 °C (3-wire), requires 2 channels
- Pt100, -50 °C...+70 °C (2-wire)
- Pt100, -50 °C...+70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C...+400 °C (2-wire)
- Pt1000, -50 °C...+400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C...+150 °C (2-wire)
- Ni1000, -50 °C...+150 °C (3-wire), requires 2 channels
- 0 V...10 V with differential inputs, requires 2 channels
- -10 V...+10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

4 analog outputs, individually configurable for

- Unused (default setting)
- -10 V...+10 V
- 0 mA...20 mA
- 4 mA...20 mA

4 analog outputs, individually configurable for

- Unused (default setting)
- -10 V...+10 V

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V...+10 V	12 bits plus sign
	Voltage 0 V...10 V	12 bits
	Current 0 mA...20 mA, 4 mA...20 mA	12 bits
	Temperature	0.1 °C
LED displays		19 LEDs for signals and error messages
Internal power supply		Via the expansion bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 VDC)
Required terminal unit		TU515 or TU516 *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The modules are plugged on an I/O terminal unit *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9,3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 VDC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 VDC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0- to I7-	Negative poles of the 8 analog inputs
2.0 to 2.7	I0+ to I7+	Positive poles of the 8 analog inputs
3.0 to 3.7	O0- to O7-	Negative poles of the 8 analog outputs
4.0 to 4.7	O0+ to O7+	Positive poles of the 8 analog outputs

The negative poles of the analog inputs are electrically connected to each other to form an "Analog Ground" signal for the module.

The negative poles of the analog outputs are electrically connected to each other to form an "Analog Ground" signal for the module.

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the earth potential or the supply voltage.

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (cut wire), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per I/O module.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the electrical connection of the I/O module.

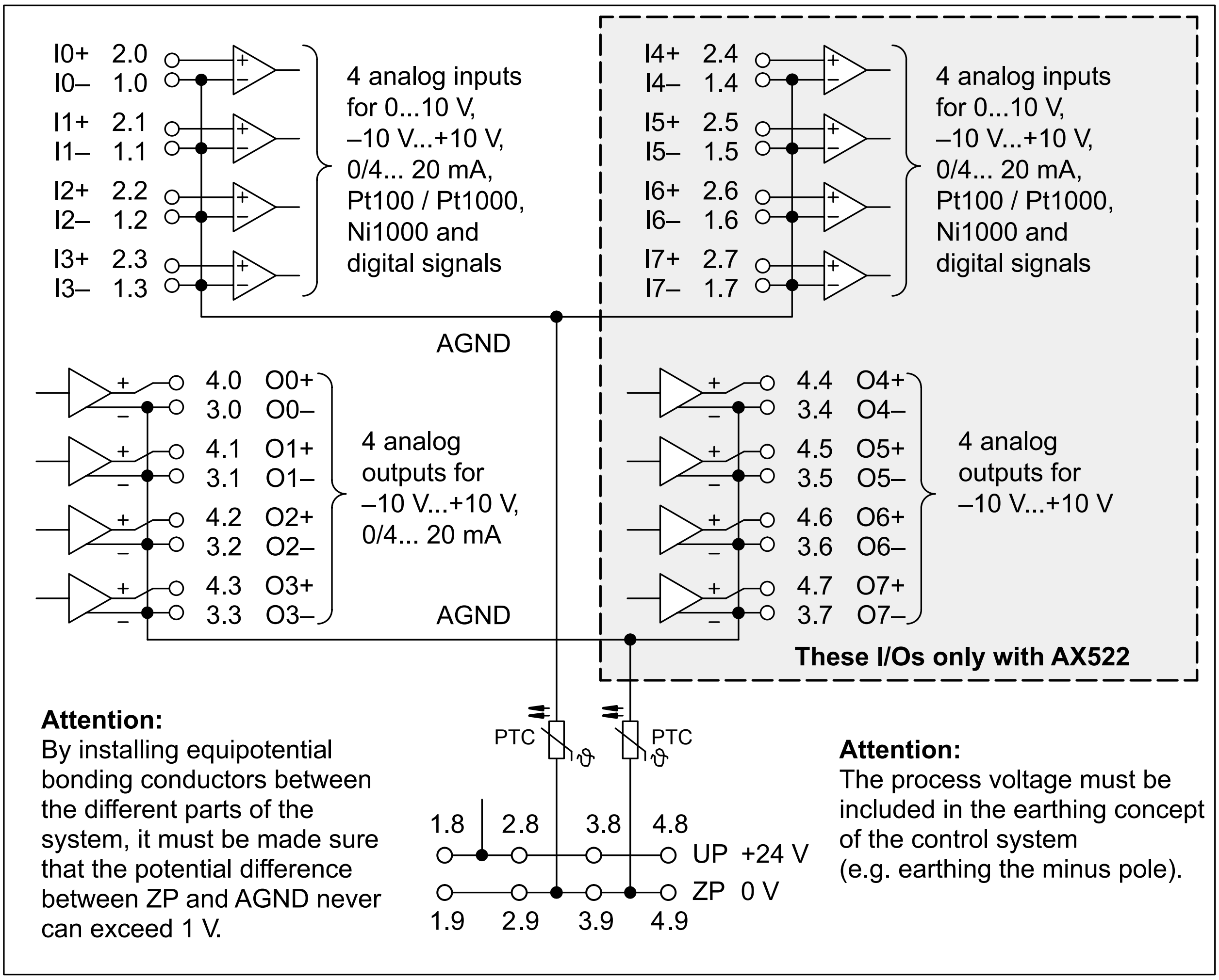


Fig. 68: Terminal assignment

Connection of Resistance Thermometers in 2-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.

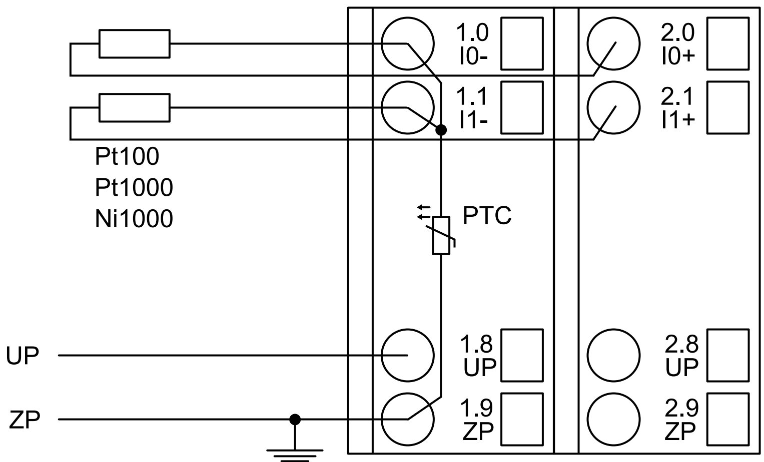


Fig. 69: Connection example

Pt100	-50 °C...+70 °C	2-wire configuration, one channel used
Pt100	-50 °C...+400 °C	2-wire configuration, one channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, one channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

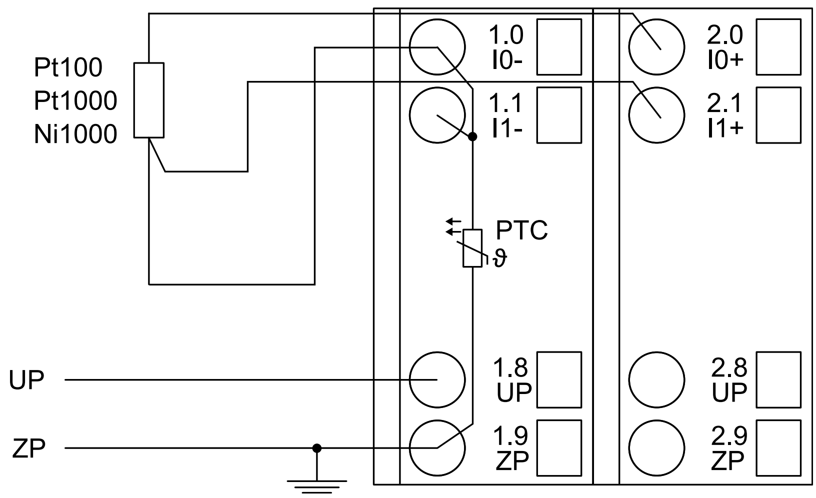


Fig. 70: Connection example

> *If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.*

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C...+70 °C	3-wire configuration, two channels used
Pt100	-50 °C...+400 °C	3-wire configuration, two channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, two channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply

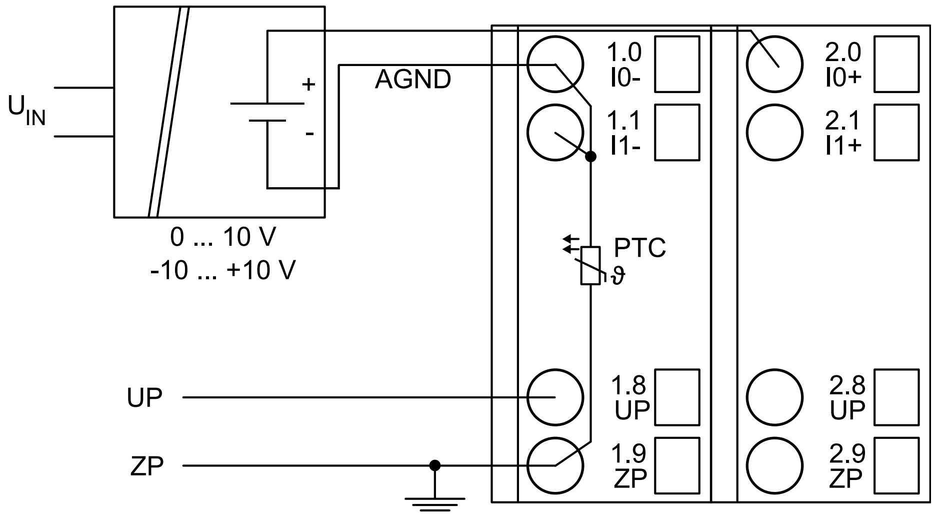


Fig. 71: Connection example

> *By connecting the sensor's negative pole of the output voltage to AGND, the electrically isolated voltage source of the sensor is referred to ZP.*

The following measuring ranges can be configured for AX521 *Chapter 1.5.2.2.4.6 “Parameterization” on page 532* and for AX522 *Chapter 1.5.2.2.5.6 “Parameterization” on page 556*:

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply

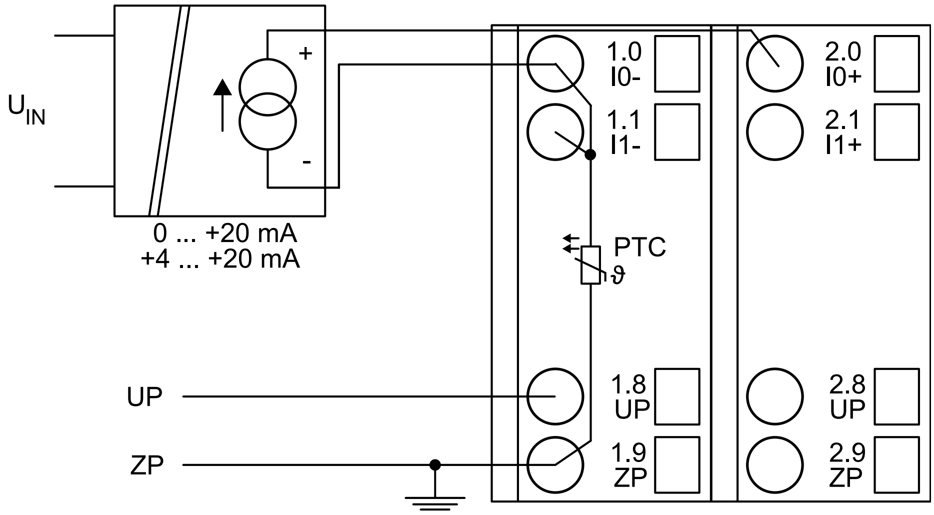


Fig. 72: Connection example

Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply

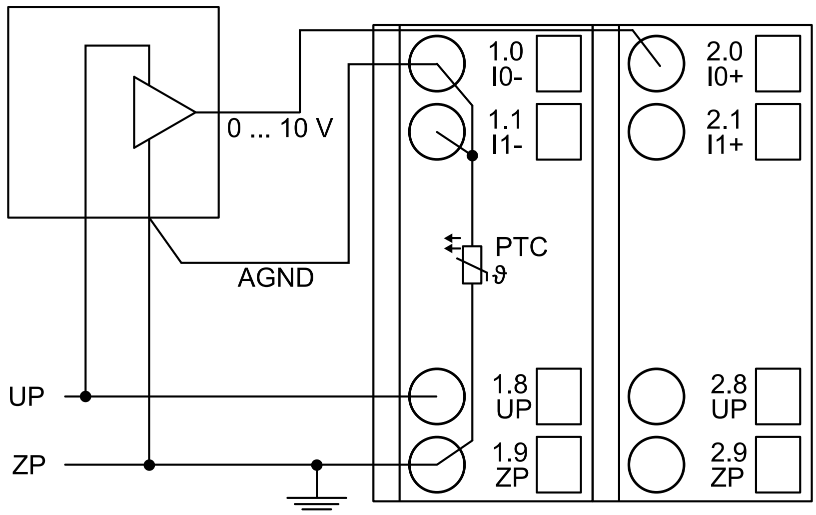


Fig. 73: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines (see figure Terminal Assignment).

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V *)	1 channel used

*) if the sensor can provide this signal range

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Passive-type Analog Sensors (Current)

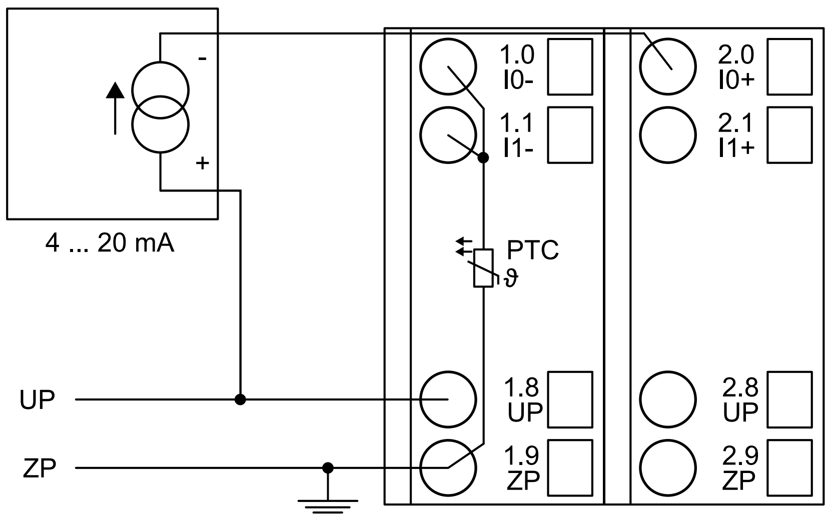


Fig. 74: Connection example

Current	4 mA...20 mA	1 channel used

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and I-). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely earthed).

The use of differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
The earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.

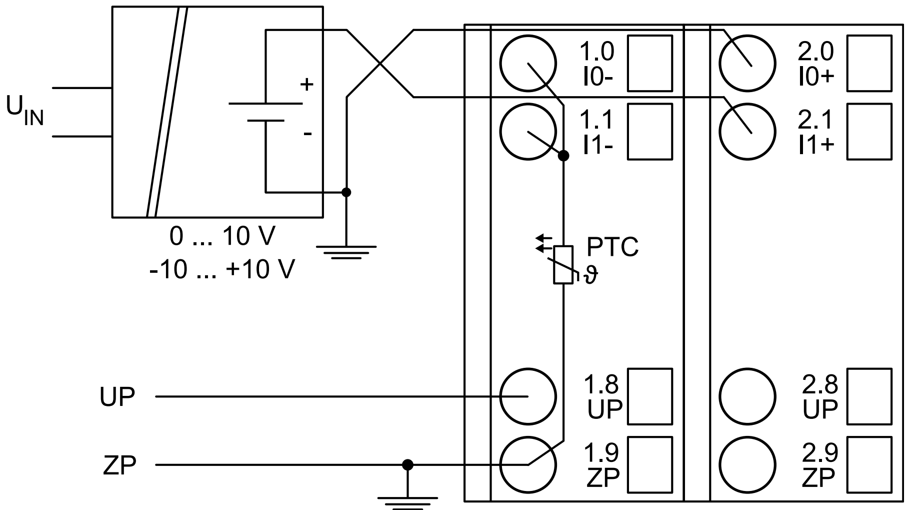


Fig. 75: Connection example

The negative pole of the sensor must be earthed next to the sensor.

Voltage	0 V...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

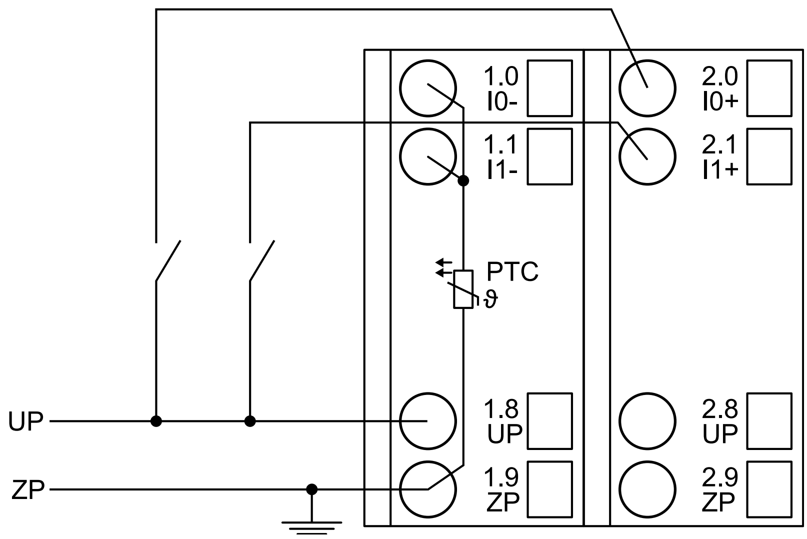


Fig. 76: Connection example

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of Analog Output Loads (Voltage, Current)

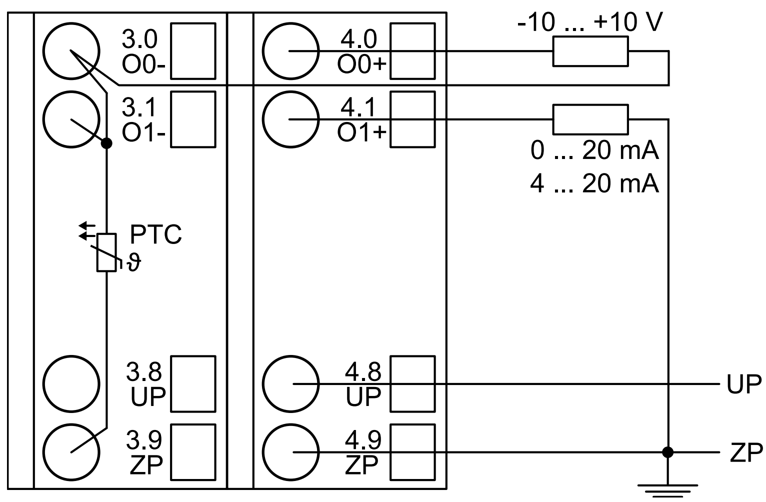


Fig. 77: Connection example

Voltage	-10 V...+10 V	Load max. ±10 mA	1 channel used
Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

Only the channels 0...3 can be configured as current output (0 mA...20 mA or 4 mA...20 mA).

Unused analog outputs can be left open-circuited.

Internal Data Exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	8
Counter output data (words)	8

I/O Configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module slot address: Y = 1...7

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1500 [1])	Word	1500 0x05dc	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	37	Byte	37-CPU 37-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	see table Channel configuration		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y07
9 to 22	Channel configuration and channel monitoring of the input channels 1 to 7	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	see table Channel configuration		Byte	Default 0x00	0	130	0x0Y16
24	Channel monitoring Output channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y17
25	Substitute value Output channel 0	only valid for output channel 0	0...0xffff	Word	Default 0x0000	0	65535	0x0Y18

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
26 to 31	Channel configuration and channel monitoring of the output channels 1 to 3	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E
32	Channel configuration Output channel 4	see table Channel configuration		Byte	Default 0x00	0	128	0x0Y1F
33	Channel monitoring Output channel 4	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configuration and channel monitoring of the output channels 5 to 7	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y21 to 0x0Y26

[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1

[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	24
Ext_User_Prm_Data_Const(0) =	0x05, 0xe2, 0x15, \ 0x01, 0x00, 0x00 \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 75: Input Channel (4x)

No.	Name	Internal value, type	Default
1	Channel configuration see table 2)	Byte	0 0x00 see table 2)
2	Channel monitoring see table 3)	Byte	0 0x00 see table 3)

Table 76: Channel Configuration 2)

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V...10 V
2	Digital input
3	Analog input 0 mA...20 mA
4	Analog input 4 mA...20 mA
5	Analog input -10 V...+10 V
8	Analog input Pt100, -50 °C...+400 °C (2-wire)
9	Analog input Pt100, -50 °C...+400 °C (3-wire), requires 2 channels *)
10	Analog input 0...10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V...+10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C...+70 °C (2-wire)
15	Analog input Pt100, -50 °C...+70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C...+400 °C (2-wire)
17	Analog input Pt1000, -50 °C...+400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C...+150 °C (2-wire)
19	Analog input Ni1000, -50 °C...+150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 77: Channel Monitoring 3)

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 78: Output Channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel monitoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0...65535	0... 0xffff	Word	0

Table 79: Output Channels 1...3 (3x)

No.	Name	Internal value, type
1	Channel configuration see table [4])	Byte
2	Channel monitoring see table [6])	Byte

Table 80: Channel Configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V...+10 V
129	Analog output 0 mA...20 mA (not with the channels 4...7 and 12...15)
130	Analog output 4 mA...20 mA (not with the channels 4...7 and 12...15)

Table 81: Channel Monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 82: Substitute Value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...3	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10	0...7			

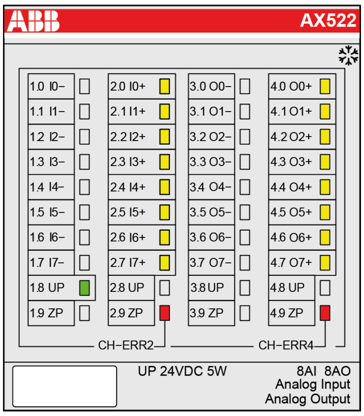
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	14	1...10	1	0...3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10	0...7			
4	14	1...10	1	0...3	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1...10	0...7			
4	14	1...10	3	0...3	48	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1...10	0...7			
4	14	1...10	3	0...3	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1...10	0...7			

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.



LED	State	Color	LED = OFF	LED = ON	LED flashes
Inputs I0...I7	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
Outputs O0...O7	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
UP	Process voltage 24 VDC via terminal	Green	Process voltage is missing	Process voltage OK	--
CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
CH-ERR4		Red			
CH-ERR *)	Module error	Red	--	Internal error	--
*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring Ranges

Input Ranges of Voltage, Current and Digital Input

The represented resolution corresponds to 16 bits.

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Overflow	>11.7589	>11.7589	>23.5178	>22.8142	
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006	
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	ON
Normal range or measured value too low	0.0000	0.0000	0	4	OFF
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994	

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Measured value too low		-10.0004 : -11.7589			
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858	

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	27648 : 1	6C00 : 0001
	0	0000
	-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	-32768	8000

Input Ranges Resistance

Range	Pt100 / Pt 1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C
Measured value too high		450.0 °C : 400.1 °C	
			160.0 °C : 150.1 °C
	80.0 °C : 70.1 °C		

Range	Pt100 / Pt 1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Normal range	: : 70.0 °C : 0.1 °C	400.0 °C : : : 0.1 °C	: 150.0 °C : : 0.1 °C
	0.0 °C	0.0 °C	0.0 °C
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	Digital value	
	Decimal	Hex.
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output Ranges Voltage and Current

The represented resolution corresponds to 16 bits.

Range	0...+10 V	-10...+10 V	0...20 mA	4...20 mA
Overflow	0 V	0 V	0 mA	0 mA
Measured value too high	11.5 V	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range		10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
		0.0000 V	0.0000 mA	4.0000 mA
		-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-1.5 V	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	Hex.
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 "System Data AC500" on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 "System Data AC500-XC" on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm²		100 m
Weight		300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

> **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Analog Inputs

Parameter	Value
Number of channels per module	8
Distribution of channels into groups	1 group of 8 channels
Connections of the channels I0- to I7-	Terminals 1.0 to 1.7

Parameter	Value	
Connections of the channels I0+ to I7+	Terminals 2.0 to 2.3	
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
Time constant of the input filter	Voltage: 100 µs current: 100 µs	
Indication of the input signals	One LED per channel	
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s	
Resolution	Range 0 V...10 V: 12 bits Range -10 V...+10 V: 12 bits + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical Data of the Analog Inputs, if used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels I0+ to I7+		Terminals 2.0 to 2.7
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA

Parameter	Value
Input voltage +30 V	< 9 mA
Input resistance	Ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter	Value
Number of channels per module	8, all channels for voltage, the first 4 channels also for current
Distribution of channels into groups	1 group of 8 channels
Channels O0-...O7-	Terminals 3.0...3.7
Channels O0+...O7+	Terminals 4.0...4.7
Output type	Bipolar with voltage, unipolar with current
Galvanic isolation	Against internal supply and other modules
Configurability	-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually), current outputs only channels 0...3
Output resistance (load), as current output	0 Ω...500 Ω
Output loadability, as voltage output	Max. ±10 mA
Indication of the output signals	One LED per channel
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. ±0.5 % of full scale at 25 °C
	Max. ±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between output signal and hex code	See table, *Chapter 1.5.2.2.4.9.3 “Output Ranges Voltage and Current” on page 541*
Unused outputs	Can be left open-circuited

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 250 000 R0001	AX522, analog input/output module, 8 AI, 8 AO, U/I/Pt100, 12 bits + sign, 2-wires	Active
1SAP 450 000 R0001	AX522-XC, analog input/output module, 8 AI, 8 AO, U/I/Pt100, 12 bits + sign, 2-wires, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

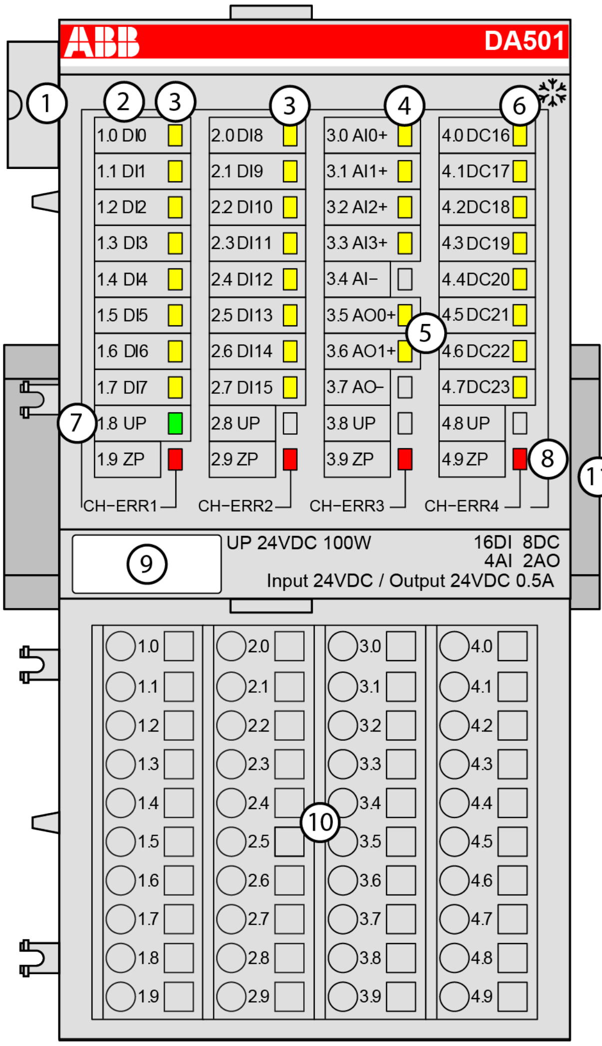
1.5.3 Digital/Analog I/O Modules

1.5.3.1 S500

1.5.3.1.1 DA501 - Digital/Analog Input/Output Module

- 16 digital inputs 24 VDC
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD.
  Resolution 12 bits plus sign
- 2 analog outputs, voltage and current
  Resolution 12 bits plus sign
- Fast counter

- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states of the digital inputs DI0 to DI15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 to AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 to AO1
6 8 yellow LEDs to display the signal state of the configurable digital inputs/outputs DC16 to DC23
7 1 green LED to display the state of the process supply voltage UP
8 4 red LEDs to display errors

9 Label
10 Terminal unit
11 DIN rail
❄ Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Functionality

- 16 digital inputs 24 VDC
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD.
  Resolution 12 bits plus sign
- 2 analog outputs, voltage and current
  Resolution 12 bits plus sign
- Fast counter

Parameter	Value
Fast Counter	Integrated, many configurable operating modes
Power supply	From the process supply voltage UP
LED displays	For system displays, signal states, errors and power supply
Internal supply voltage	Via the expansion bus interface (I/O bus)
External supply voltage	Via terminals UP and ZP (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU515 or TU516 *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

Electrical Connection

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter Chapter 2.6 “AC500 (Standard)” on page 1252.*

The electrical connection is carried out by using the 40 terminals of the terminal unit TU515/ TU516 *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*.

The assignment of the terminals:

Terminal	Signal	Description
1.0	DI0	Signal of the digital input DI0
1.1	DI1	Signal of the digital input DI1
1.2	DI2	Signal of the digital input DI2
1.3	DI3	Signal of the digital input DI3
1.4	DI4	Signal of the digital input DI4
1.5	DI5	Signal of the digital input DI5
1.6	DI6	Signal of the digital input DI6
1.7	DI7	Signal of the digital input DI7
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	AI0+	Positive pole of analog input signal 0
3.1	AI1+	Positive pole of analog input signal 1
3.2	AI2+	Positive pole of analog input signal 2
3.3	AI3+	Positive pole of analog input signal 3
3.4	AI-	Negative pole of analog input signals 0 to 3
3.5	AO0+	Positive pole of analog output signal 0
3.6	AO1+	Positive pole of analog output signal 1
3.7	AO-	Negative pole of analog output signals 0 and 1
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	C16	Signal of the configurable digital input/ output C16
4.1	C17	Signal of the configurable digital input/ output C17
4.2	C18	Signal of the configurable digital input/ output C18
4.3	C19	Signal of the configurable digital input/ output C19
4.4	C20	Signal of the configurable digital input/ output C20
4.5	C21	Signal of the configurable digital input/ output C21

Terminal	Signal	Description
4.6	C22	Signal of the configurable digital input/ output C22
4.7	C23	Signal of the configurable digital input/ output C23
4.8	UP	Process voltage UP (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DA501.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

CAUTION!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalization of a low resistance to avoid high potential differences between different parts of the plant.

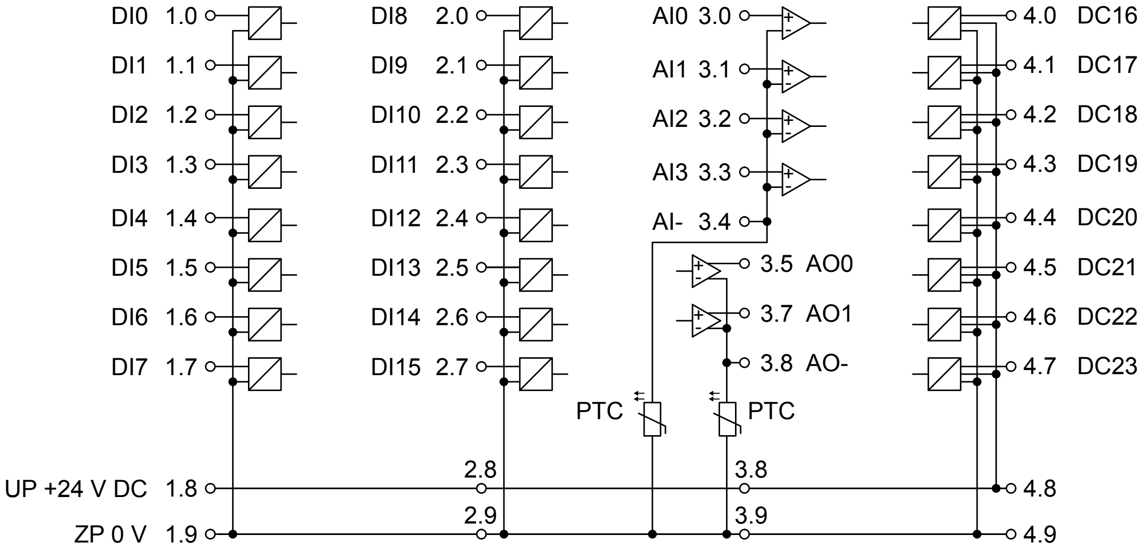


Fig. 78: Terminal assignment of the module

The module provides several diagnosis functions ✎ *Chapter 1.5.3.1.1.7 “Diagnosis” on page 590*.

Connection of the Digital Inputs

The following figure shows the electrical connection of the digital input DI0. Proceed with the digital inputs DI1 to DI15 in the same way.

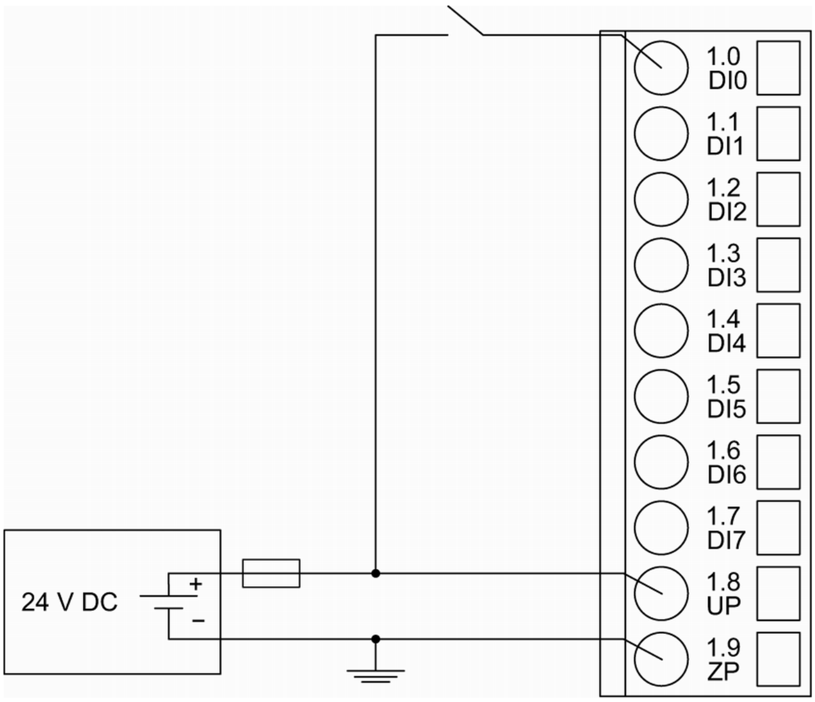


Fig. 79: Connection of the module

The meaning of the LEDs is described in the Displays ✎ *Chapter 1.5.3.1.1.8 “State LEDs” on page 593* chapter.

Connection of the Configurable Digital Inputs/Outputs

The following figure shows the electrical connection of the configurable digital input/output DC16 and DC17. DC16 is connected as an input and DC17 is connected as an output. Proceed with the configurable digital inputs/outputs DC18 to DC23 in the same way.

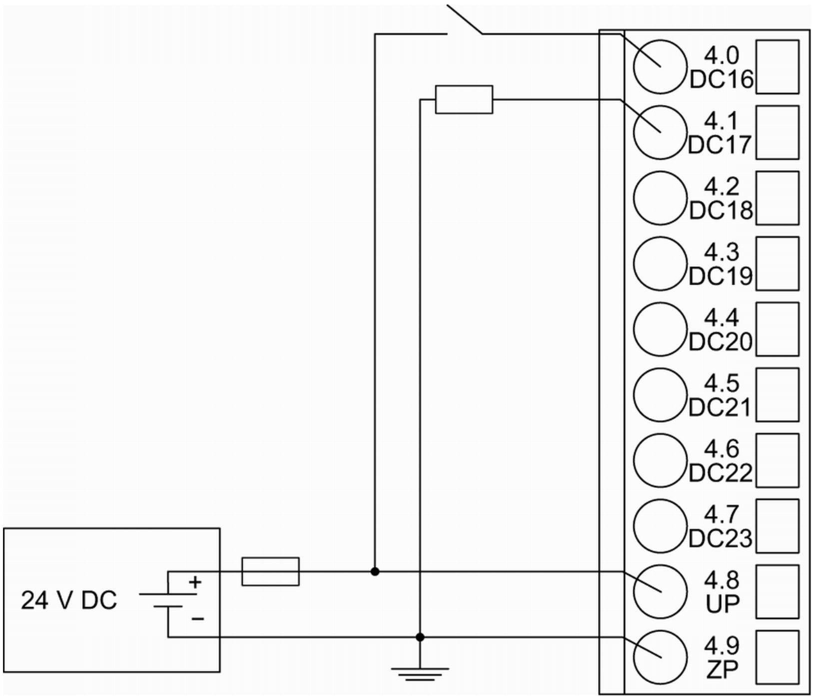


Fig. 80: Connection of configurable digital inputs/outputs to the module

CAUTION!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DA501.

If the inputs are used as fast counter inputs, connect a 470 Ω / 1 W resistor in series to inputs DC16/DC17.

Connection of Resistance Thermometers in 2-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA501 provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

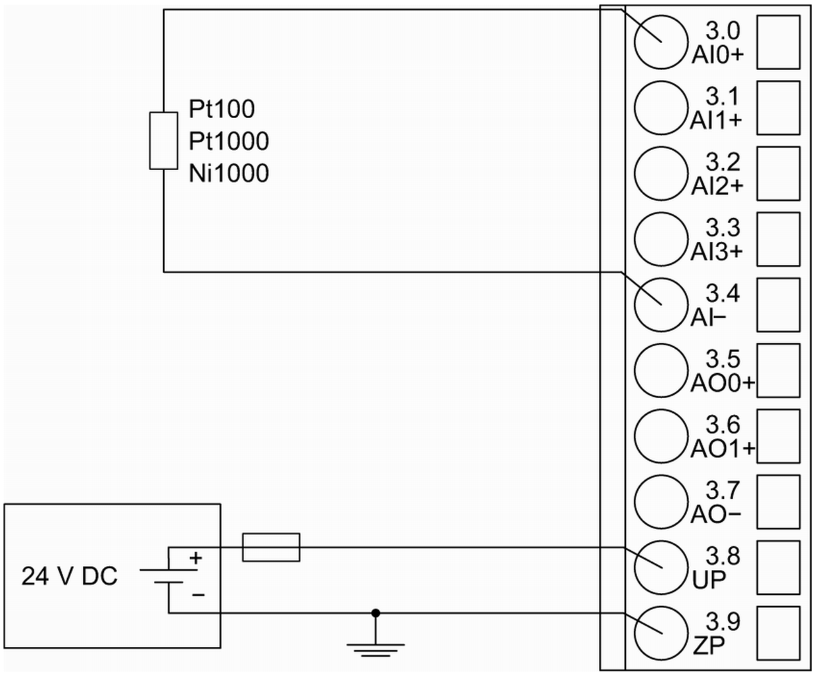


Fig. 81: Connection of resistance thermometers in 2-wire configuration to the analog inputs

The following measuring ranges can be configured *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

Pt100	-50 °C...+400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.5.3.1.1.8 “State LEDs” on page 593*.

The module DA501 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA501 provides a constant current source which is multiplexed over the max. 4 analog input channels.

0

The following figure shows the connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1. Proceed with the analog inputs AI2 and AI3 in the same way.

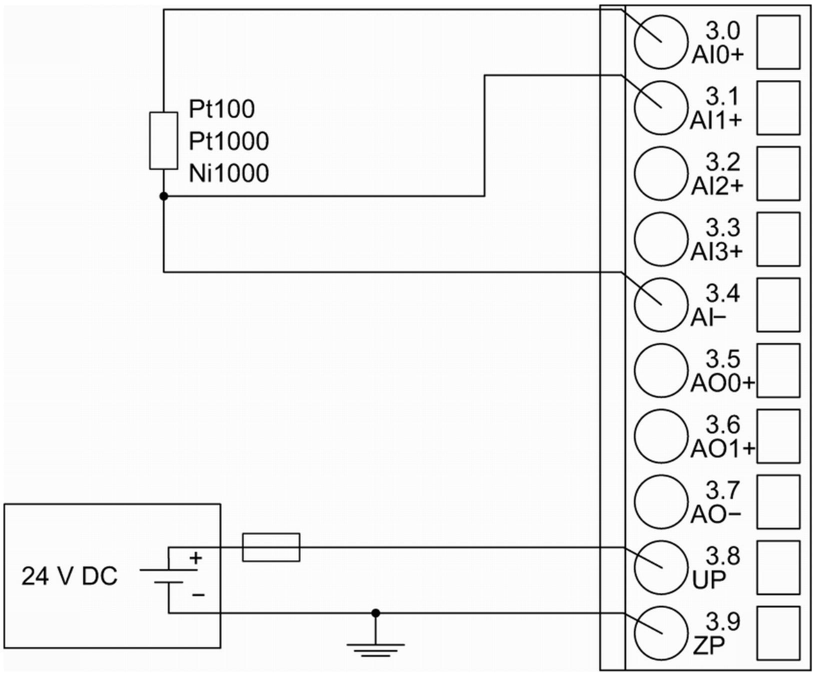


Fig. 82: Connection of resistance thermometers in 3-wire configuration to the analog inputs

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

Pt100	-50 °C...+400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.5.3.1.1.7 “Diagnosis” on page 590*.

0

The module DA501 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

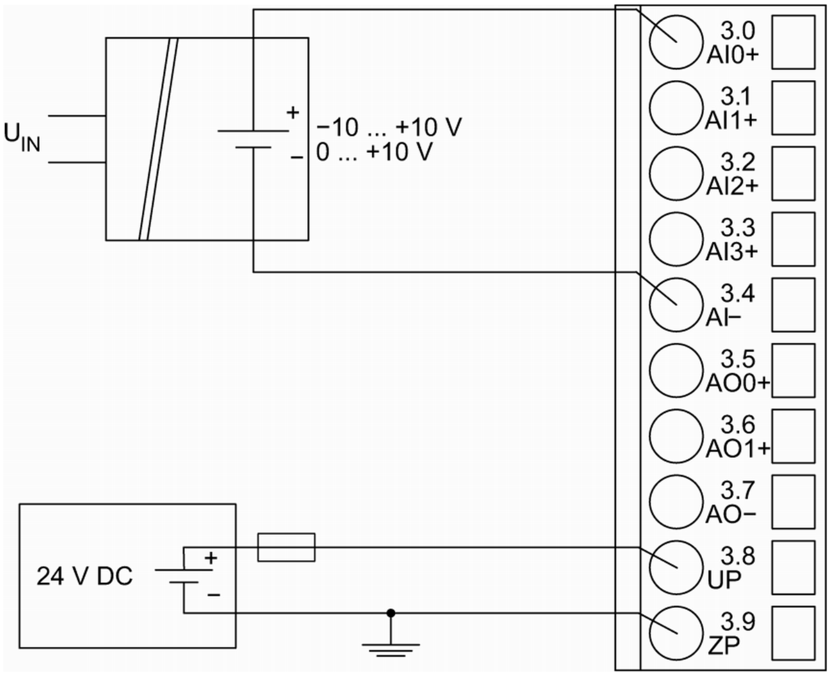


Fig. 83: Connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog inputs

The following measuring ranges can be configured ✎ *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ✎ *Chapter 1.5.3.1.1.8 “State LEDs” on page 593*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

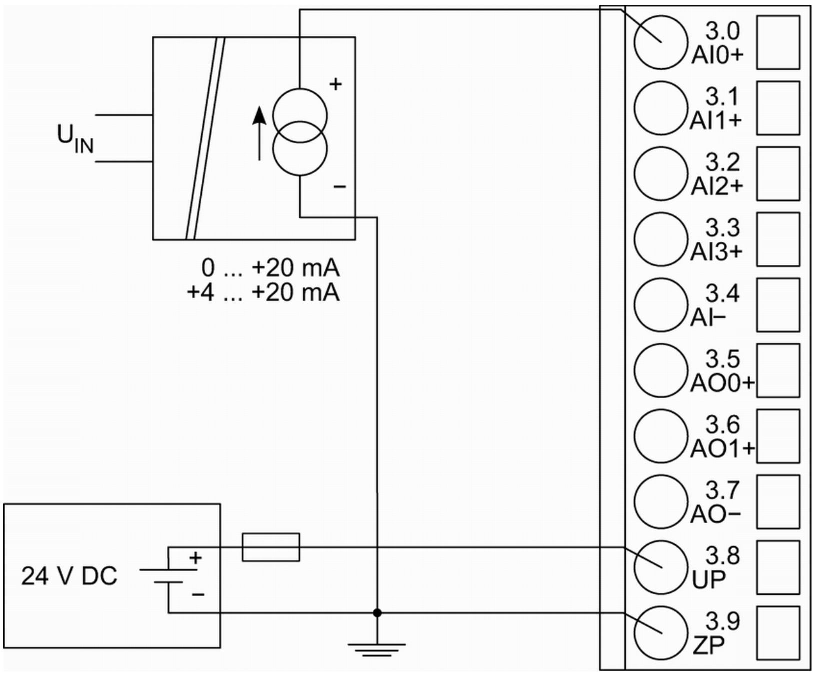


Fig. 84: Connection of active-type analog sensors (current) with electrically isolated power supply to the analog inputs

The following measuring ranges can be configured ➯ *Chapter 1.5.3.1.1.6 "Parameterization" on page 586*:

Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ➯ *Chapter 1.5.3.1.1.8 "State LEDs" on page 593*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with no electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

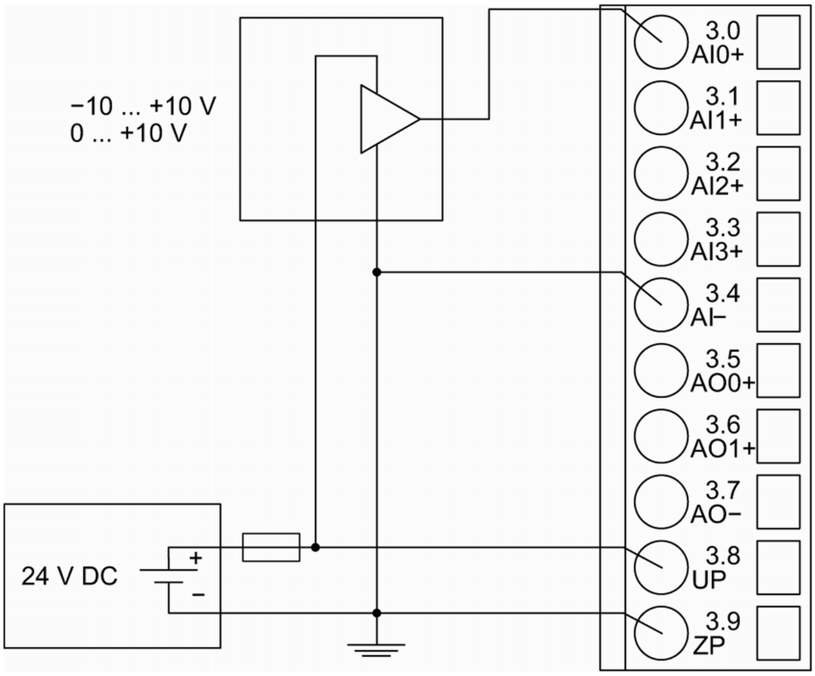


Fig. 85: Connection of active-type sensors (voltage) with no electrically isolated power supply to the analog inputs

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V within the full signal range).

Make sure that the potential difference never exceeds ±1 V.

The following measuring ranges can be configured *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter *Chapter 1.5.3.1.1.8 “State LEDs” on page 593*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type Analog Sensors (Current) to the Analog Inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

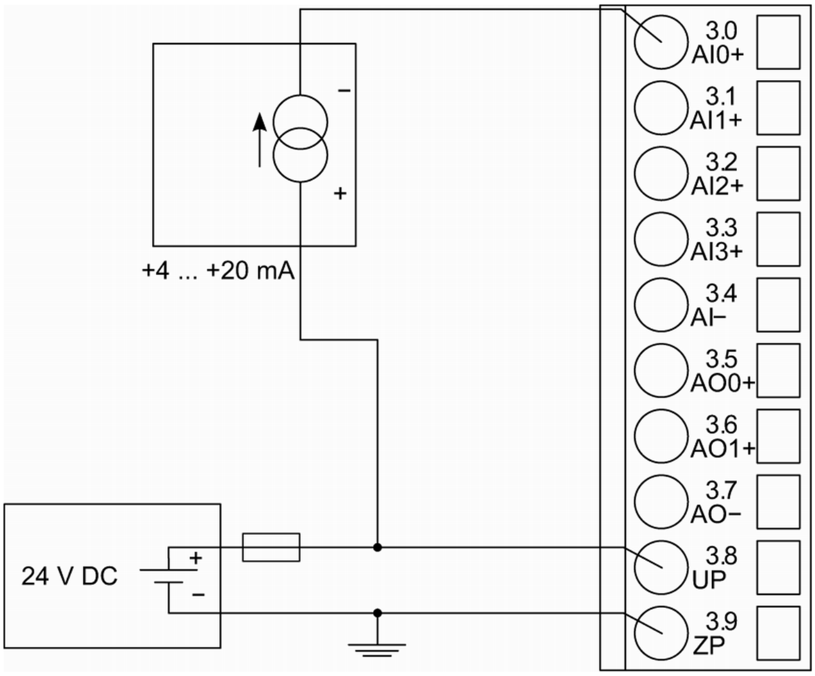


Fig. 86: Connection of passive-type analog sensors (current) to the analog inputs

The following measuring ranges can be configured ↳ *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

Current	4 mA...20 mA	1 channel used

For a description of function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ↳ *Chapter 1.5.3.1.1.8 “State LEDs” on page 593*.

CAUTION!
Risk of overloading the analog input!
If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and I-.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Analog Inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely earthed) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).

Make sure that the potential difference never exceeds ±1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

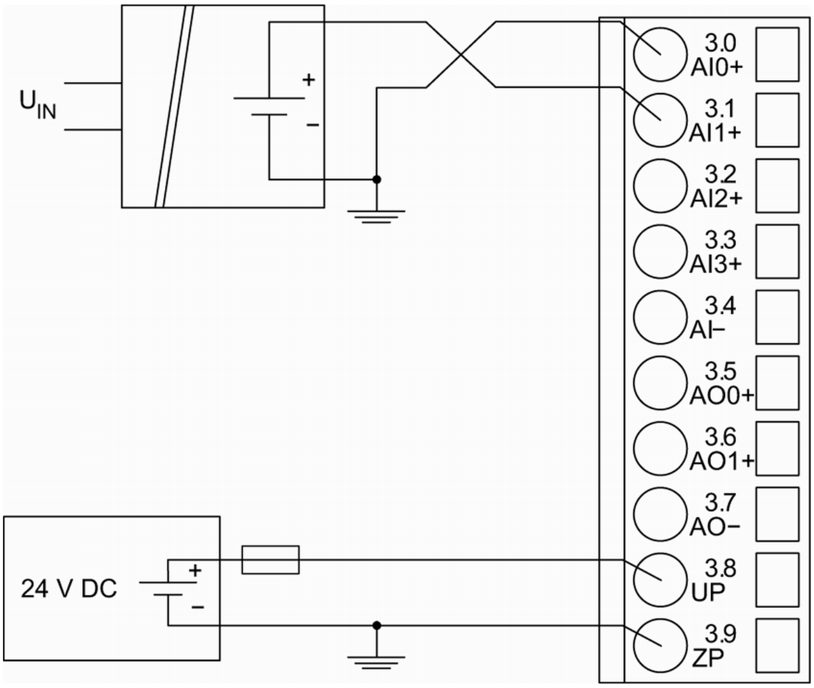


Fig. 87: Connection of active-type analog sensors (voltage) to differential analog inputs

The following measuring ranges can be configured *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

Voltage	0 V...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter *Chapter 1.5.3.1.1.8 “State LEDs” on page 593*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

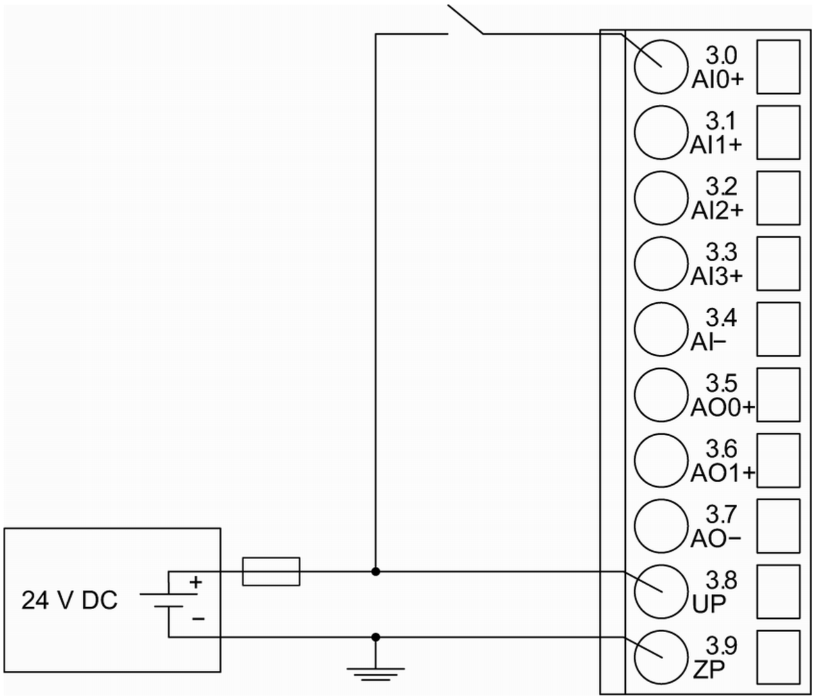


Fig. 88: Use of analog inputs as digital inputs

The following measuring ranges can be configured ✎ *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

Digital input	24 V	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ✎ *Chapter 1.5.3.1.1.8 “State LEDs” on page 593*.

Connection of Analog Output Loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

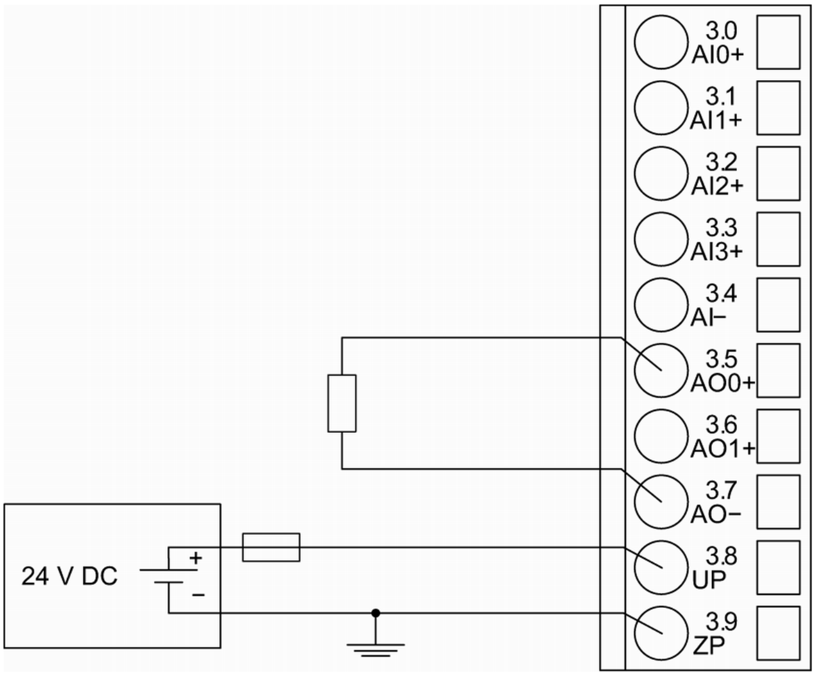


Fig. 89: Connection of analog output loads (voltage)

The following measuring ranges can be configured *Chapter 1.5.3.1.1.6 "Parameterization" on page 586* :

Voltage	-10 V...+10 V	Load ±10 mA max.	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter *Chapter 1.5.3.1.1.8 "State LEDs" on page 593*.

Unused analog outputs can be left open-circuited.

Connection of Analog Output Loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

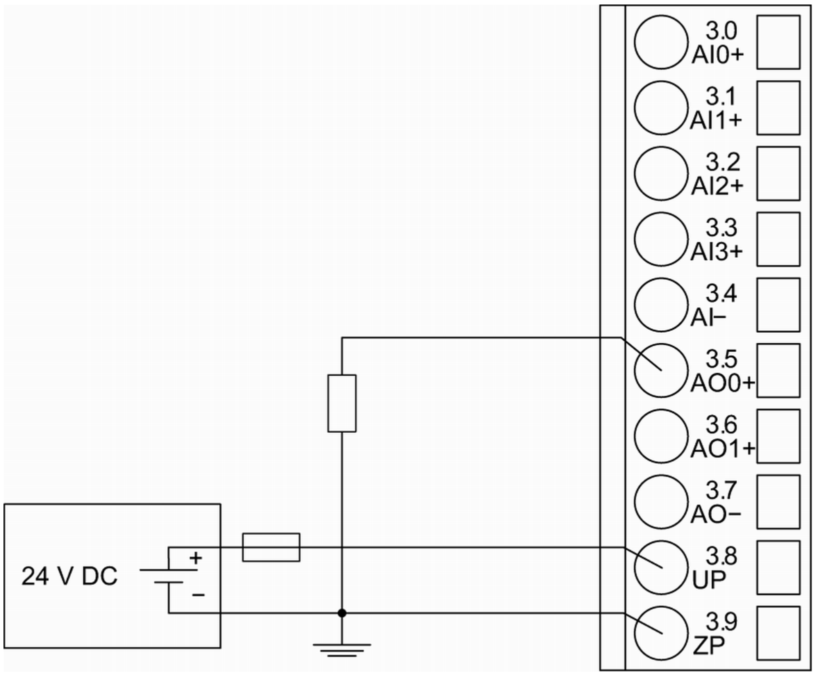


Fig. 90: Connection of analog output loads (current)

The following measuring ranges can be configured *Chapter 1.5.3.1.1.6 “Parameterization” on page 586*:

0

Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter *Chapter 1.5.3.1.1.8 “State LEDs” on page 593*.

Unused analog outputs can be left open-circuited.

Internal Data Exchange

	Without the Fast Counter	**With the Fast Counter (only with AC500)**
Digital inputs (bytes)	3	5
Digital outputs (bytes)	1	3
Analog inputs (words)	4	4
Digital outputs (words)	2	2
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Module ID [1])	Internal	1810	WORD	1810	0x0Y01
Ignore module see table [2])	Internal	Yes No	BYTE	No	not for FBP
Parameter length	Internal	8	BYTE	8	0xY02
Check supply	off	0	BYTE	1	0xY03
	on	1			
Fast counter [3])	0 : 10 [4])	0 : 10	BYTE	0	not for FBP
Behavior outputs at comm. error [5])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00	0x0Y07

[2])	Setting	Description
	On	Error LED lights up at errors of all error classes, Failsafe mode off
	Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
	Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off
	On +Failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)

[2])	Setting	Description
	Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
	Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

Remarks:

[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2]) Not for FBP

[3]) With FBP or CS31 without the parameter "Fast Counter"

> *The fast counter of the module does not work if the module is connected to an FBP interface module or CS31 bus module.*

[4]) For counter operating modes, please refer to the description of the fast counter *Chapter 1.5.1.2.10 “Fast Counter” on page 396*

[5]) The parameter Behavior outputs at comm. error is only analyzed if the Failsafe-mode is ON.

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0x0Y05
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01	0x0Y06
Substitute value at output	0...255	00h...FFh	BYTE	0 0x0000	0x0Y08

*) The parameters Behavior DO at comm. error is only analyzed if the Failsafe mode is ON.

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Analog data format	Standard Reserved	0 255	BYTE	0	0x0Y04

*) The parameter Behavior AO at comm. error is only analyzed if the Failsafe mode is ON.

Channel Parameters for the Analog Inputs (4x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 0, Channel configuration	see *Table 83 "Channel Configuration" on page 588*	see *Table 83 "Channel Configuration" on page 588*	BYTE	0	0x0Y09
Input 0, Check channel	see *Table 84 "Channel Monitoring" on page 589*	see *Table 84 "Channel Monitoring" on page 589*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	
Input 3, Channel configuration	see *Table 83 "Channel Configuration" on page 588*	see *Table 83 "Channel Configuration" on page 588*	BYTE	0	0x0Y0F
Input 3, Check channel	see *Table 84 "Channel Monitoring" on page 589*	see *Table 84 "Channel Monitoring" on page 589*	BYTE	0	0x0Y10

Table 83: Channel Configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V...10 V
2	Digital input
3	0 mA...20 mA
4	4 mA...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50 °C...+400 °C
9	3-wire Pt100 -50 °C...+400 °C *)
10	0 V...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C...+70 °C
15	3-wire Pt100 -50 °C...+70 °C *)
16	2-wire Pt1000 -50 °C...+400 °C
17	3-wire Pt1000 -50 °C...+400 °C *)
18	2-wire Ni1000 -50 °C...+150 °C

Internal value	Operating modes of the analog inputs, individually configurable
19	3-wire Ni1000 -50 °C...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 84: Channel Monitoring

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel Parameters for the Analog Outputs (2x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
0 Output 0, Channel configuration	see *Table 85 “Channel Configuration” on page 590*	see *Table 85 “Channel Configuration” on page 590*	BYTE	0	0x0Y11
Output 0, Check channel	see *Table 86 “Channel monitoring” on page 590*	see *Table 86 “Channel monitoring” on page 590*	BYTE	0	0x0Y12
Output 0, Substitute value	see *Table 87 “Substitute Value” on page 590*	see *Table 87 “Substitute Value” on page 590*	WORD	0	0x0Y13
Output 1, Channel configuration	see *Table 85 “Channel Configuration” on page 590*	see *Table 85 “Channel Configuration” on page 590*	BYTE	0	0x0Y14
Output 1, Check channel	see *Table 86 “Channel monitoring” on page 590*	see *Table 86 “Channel monitoring” on page 590*	BYTE	0	0x0Y15
Output 1, Substitute value	see *Table 87 “Substitute Value” on page 590*	see *Table 87 “Substitute Value” on page 590*	WORD	0	0x0Y16

Table 85: Channel Configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V...+10 V
129	0 mA...20 mA
130	4 mA...20 mA

Table 86: Channel monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 87: Substitute Value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behavior of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

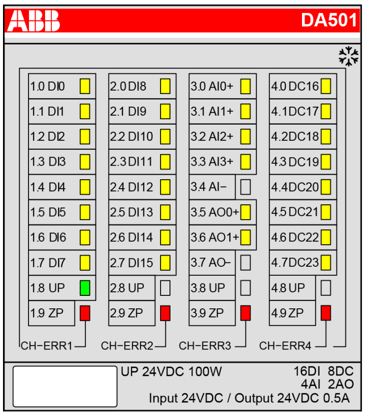
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
0	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
3	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error DA501							
4	14	1...10	2	22...29 [5])	47	Short circuit at a digital output	Check connection
	11 / 12	ADR	1...10				
Channel error DA501							
4	14	1...10	1	16...19 [6])	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	16...19 [6])	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				
4	14	1...10	1	16...19 [6])	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1...10				
4	14	1...10	3	20...21 [7])	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1...10				

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diag-nosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	1)	**2)**	**3)**	**4)**				
4	14	1...10	3	20...21 7)	7	Analog value underflow at an analog output		Check output value
	11 / 12	ADR	1...10					

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expan-sion 1...10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO, 4 = DC); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.
5)	Ch = 22...29 indicates the digital inputs/outputs DC16...DC23
6)	Ch = 16...19 indicates the analog inputs AI0...AI3
7)	Ch = 20...21 indicates the analog outputs AO0...AO1

State LEDs



LED	State	Color	LED = OFF	LED = ON	LED flashes
DI0 to DI15	Digital input	Yellow	Input is OFF	Input is ON [1])	--
DC16 to DC23	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON [1])	--
AI0 to AI3	Analog input	Yellow	Input is OFF	Input is ON [2])	--
AO0 to AO1	Analog output	Yellow	Output is OFF	Output is ON [2])	--
UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short circuit at an output)
CH-ERR2		Red			
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR [3])	Module error	Red	--	Internal error	--

[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.

[2]) Brightness depends on the value of the analog signal

[3]) All of the LEDs CH-ERR1 to CH-ERR4 light up together

Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142	
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006	
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	on
	0.0000	0.0000	0	4	off
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994 : 0	

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Measured value too low		-10.0004 : -11.7589			
Underflow	< 0.0000	< -11.7589	< 0.0000	< 0.0000	

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	27648 : 1	6C00 : 0001
	0	0000
	-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C
Measured value too high		450.0 °C : 400.1 °C	
			160.0 °C : 150.1 °C
	80.0 °C : 70.1 °C		

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Normal range	: : 70.0 °C : 0.1 °C	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C
	0.0 °C	0.0 °C	0.0 °C
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	Digital value	
	Decimal	Hex.
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA
Overflow	>11.7589 V	>23.5178 mA	>22.8142 mA
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	**Hex.**
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

Technical Data

Technical Data of the Module

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 VDC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 VDC)
	Protection against reverse voltage	yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 VDC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.5 A per output
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/Bus Module	ca. 2 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		Yes, per module
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal mounting or vertical with derating (output load reduced to 50 % at 40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	16
Distribution of the channels into groups	2 groups of 8 channels

Parameter		Value
Terminals of the channels DI0 to DI7		Terminals 1.0 to 1.7
Terminals of the channels DI8 to DI15		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC16...DC23	Terminals 4.0...4.7
If the channels are used as outputs		
	Channels DC16...DC23	Terminals 4.0...4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		Yes, per module

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 to DC23		Terminals 4.0 to 4.7
Reference potential for all inputs		Terminals 1.9...4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	shielded	1000 m
	unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC16 to DC23	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 1.9...4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)

Parameter		Value
Output delay (0->1 or 1->0)		On request
Output current		
	rated value per channel	500 mA at UP = 24 V
	max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
Fuse for UP		10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

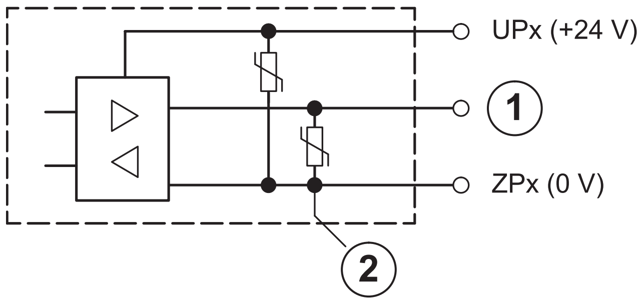


Fig. 91: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical Data of the Fast Counter

> *The fast counter of the module does not work if the module is connected to an FBP interface module or CS31 bus module.*

Parameter	Value
Used inputs	DC16 / DC17
Used outputs	DC18
Counting frequency	Max. 50 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 3.0 to 3.3
Reference potential for AI0+ to AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V...10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V...+10 V
Configurability		0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution		Range 0 V...10 V: 12 bits Range -10 V...+10 V: 12 bits + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 % For XC version below 0 °C and above 60 °C: on request

Parameter	Value
Relationship between input signal and hex code	*Chapter 1.5.3.1.1.9.1 "Input Ranges Voltage, Current and Digital Input" on page 593* *Chapter 1.5.3.1.1.9.2 "Input Range Resistor" on page 594*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical Data of the Analog Inputs, if used as Digital Inputs

Parameter	Value
Number of channels per module	Max. 4
Distribution of channels into groups	1 group of 4 channels
Connections of the channels AI0+ to AI3+	Terminals 3.0 to 3.3
Reference potential for the inputs	Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals	1 LED per channel
Input signal voltage	24 VDC
Signal 0	-30 V...+5 V
Undefined signal	+5 V...+13 V
Signal 1	+13 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 7 mA
Input voltage +5 V	Typ. 1.4 mA
Input voltage +15 V	Typ. 3.7 mA
Input voltage +30 V	< 9 mA
Input resistance	ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels
Connection of the channels AO0+...AO1+	Terminals 3.5 and 3.6
Reference potential for AO0+ to AO1+	Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type	
Unipolar	Current
Bipolar	Voltage
Galvanic isolation	Against internal supply and other modules
Configurability	-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually)

Parameter	Value
Output resistance (load) as current output	0 Ω...500 Ω
Output loadability as voltage output	±10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	*Chapter 1.5.3.1.1.9.3 “Output Ranges Voltage and Current” on page 596*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Internal Data Exchange

	Without the Fast Counter	With the Fast Counter (only with AC500)
Digital inputs (bytes)	3	5
Digital outputs (bytes)	1	3
Analog inputs (words)	4	4
Analog outputs (words)	2	2
Counter input data (words)	0	4
Counter output data (words)	0	8

Ordering Data

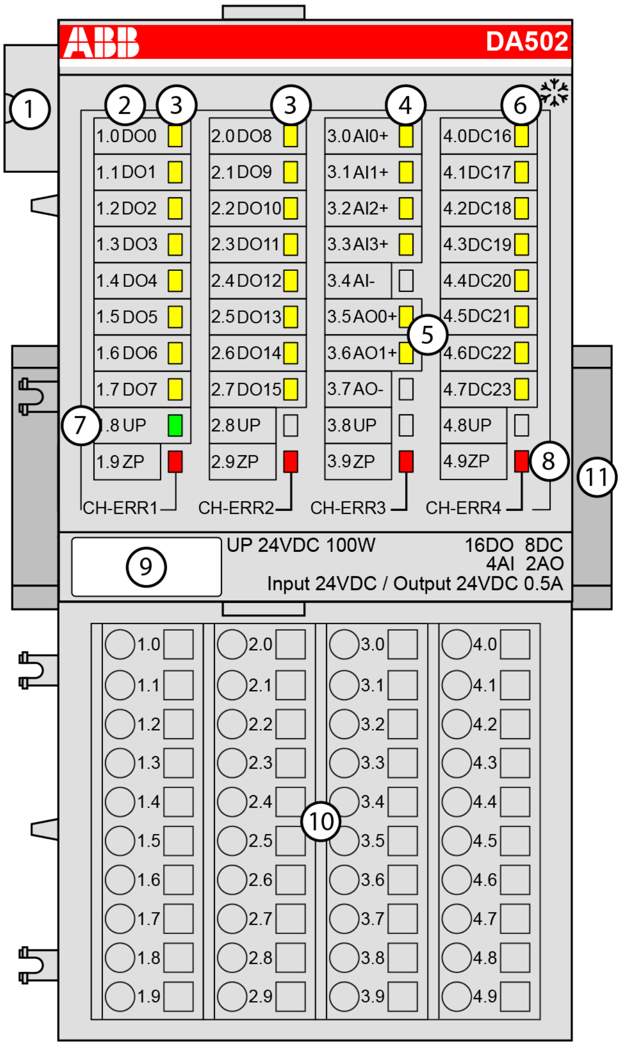
Part no.	Description	Product Life Cycle Phase *)
1SAP 250 700 R0001	DA501, digital/analog input/output module, 16 DI, 8 DC, 4 AI, 2 AO	Active
1SAP 450 700 R0001	DA501-XC, digital/analog input/output module, 16 DI, 8 DC, 4 AI, 2 AO, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.5.3.1.2 DA502 - Digital/Analog Input/Output Module

- 16 digital outputs, 24 VDC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD, resolution 12 bits plus sign
- 2 analog outputs, voltage and current, resolution 12 bits plus sign
- Fast counter

- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states of the digital outputs DO0 to DO15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 to AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 to AO1
6 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs DC16 to DC23
7 1 green LED to display the state of the process supply voltage UP
8 4 red LEDs to display errors
9 Label
10 Terminal unit
11 DIN rail
Sign for XC version

Intended Purpose

The device can be used as a decentralized I/O extension module for S500 Communication Interface Modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs (PM5xx).

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes
Power supply	From the process supply voltage UP
LED displays	For system displays, signal states, errors and power supply
Internal supply voltage	Via the expansion bus interface (I/O bus)
External supply voltage	Via terminals UP and ZP (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU515 or TU516 ⇘ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*

Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ⇘ Chapter 2.6 “AC500 (Standard)” on page 1252.

The electrical connection is carried out by using the 40 terminals of the terminal unit TU515/ TU516 ⇘ *Chapter 1.4.3 “TU515, TU516, TU541 and TU542 for I/O Modules” on page 152*.

The assignment of the terminals:

Terminal	Signal	Description
1.0	DO0	Signal of the digital output DO0
1.1	DO1	Signal of the digital output DO1
1.2	DO2	Signal of the digital output DO2
1.3	DO3	Signal of the digital output DO3
1.4	DO4	Signal of the digital output DO4
1.5	DO5	Signal of the digital output DO5
1.6	DO6	Signal of the digital output DO6
1.7	DO7	Signal of the digital output DO7
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	DO8	Signal of the digital output DO8
2.1	DO9	Signal of the digital output DO9
2.2	DO10	Signal of the digital output DO10
2.3	DO11	Signal of the digital output DO11
2.4	DO12	Signal of the digital output DO12
2.5	DO13	Signal of the digital output DO13
2.6	DO14	Signal of the digital output DO14

Terminal	Signal	Description
2.7	DO15	Signal of the digital output DO15
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	AI0+	Positive pole of analog input signal 0
3.1	AI1+	Positive pole of analog input signal 1
3.2	AI2+	Positive pole of analog input signal 2
3.3	AI3+	Positive pole of analog input signal 3
3.4	AI-	Negative pole of analog input signals 0 to 3
3.5	AO0+	Positive pole of analog output signal 0
3.6	AO1+	Positive pole of analog output signal 1
3.7	AO-	Negative pole of analog output signals 0 and 1
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	DC16	Signal of the configurable digital input/output DC16
4.1	DC17	Signal of the configurable digital input/output DC17
4.2	DC18	Signal of the configurable digital input/output DC18
4.3	DC19	Signal of the configurable digital input/output DC19
4.4	DC20	Signal of the configurable digital input/output DC20
4.5	DC21	Signal of the configurable digital input/output DC21
4.6	DC22	Signal of the configurable digital input/output DC22
4.7	DC23	Signal of the configurable digital input/output DC23
4.8	UP	Process voltage UP (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 2 mA per DA502.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

CAUTION!

Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalization of a low resistance to avoid high potential differences between different parts of the plant.

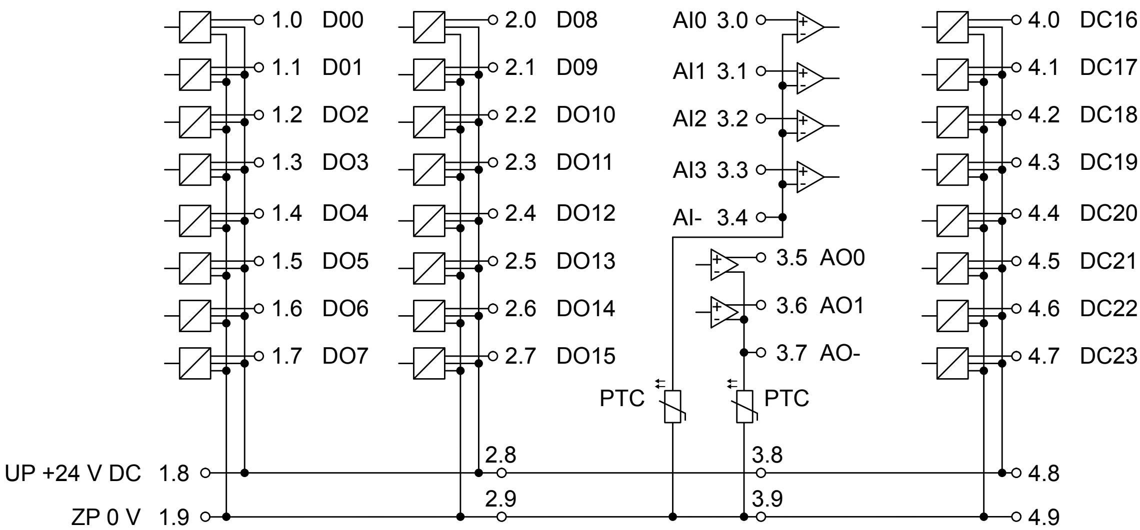
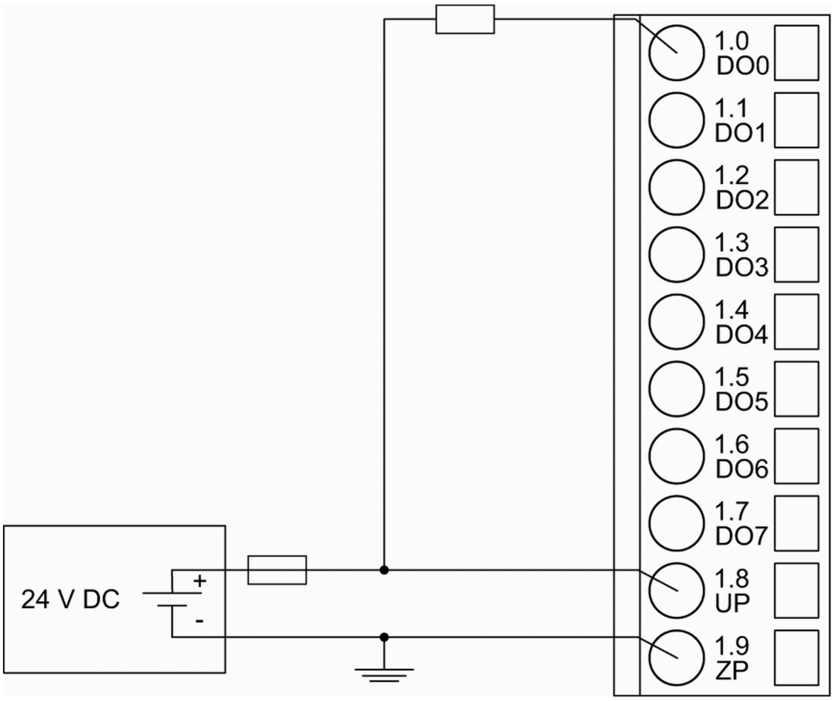


Fig. 92: Terminal assignment of the module

The module provides several diagnosis functions *Chapter 1.5.3.1.2.7 “Diagnosis” on page 623*.

Connection of the Digital Outputs

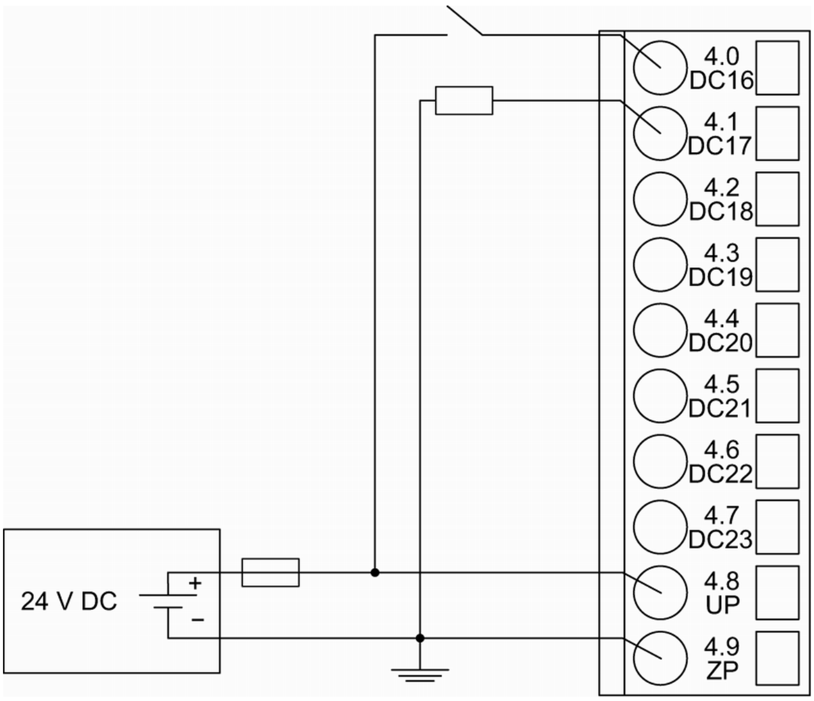
The following figure shows the electrical connection of the digital output DO0. Proceed with the digital outputs DO1 to DO15 in the same way.



For a description of the meaning of the LEDs, please refer to the Displays chapter ↳ *Chapter 1.5.3.1.2.8 “State LEDs” on page 626*.

Connection of the Configurable Digital Inputs/Outputs

The following figure shows the electrical connection of the configurable digital input/output DC16 and DC17. DC16 is connected as an input and DC17 is connected as an output. Proceed with the configurable digital inputs/outputs DC18 to DC23 in the same way.



NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DA502.

Connect a 470 Ω / 1 W resistor in series to inputs DC16/DC17 if they are used as fast counter inputs to avoid any influences.

For a description of tthe meaning of the LEDs, please refer to the Displays *Chapter 1.5.3.1.2.8 "State LEDs" on page 626* chapter.

Connection of Resistance Thermometers in 2-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA502 provides a constant current source which is multiplexed over max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

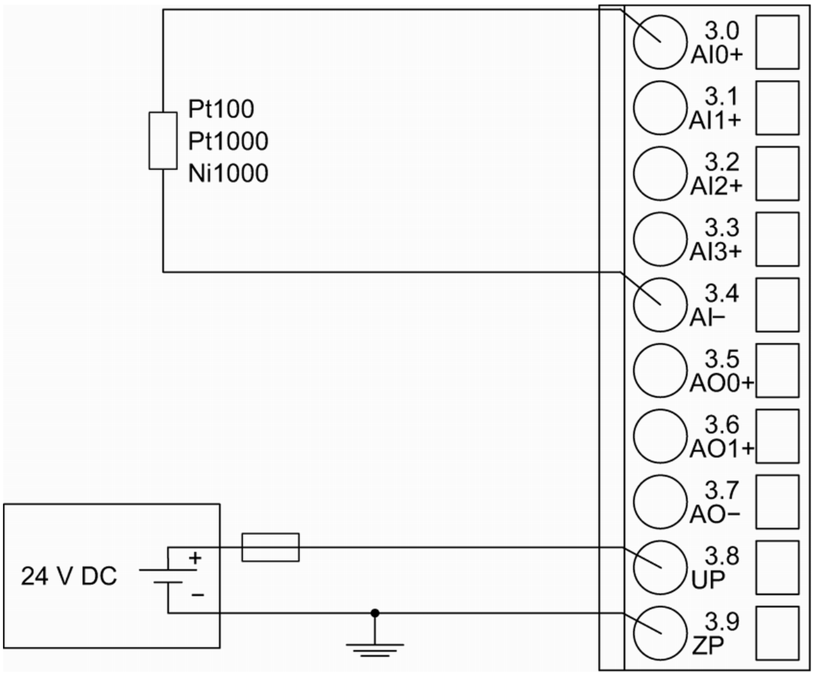


Fig. 93: Connection of resistance thermometers in 2-wire configuration to the analog inputs

The following measuring ranges can be configured *Chapter 1.5.3.1.2.6 "Parameterization" on page 619* *Chapter 1.5.3.1.2.9 "Measuring Ranges" on page 626*:

Pt100	-50 °C...+400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, 1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.5.3.1.2.8 "State LEDs" on page 626*.

The module DA502 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA502 provides a constant current source which is multiplexed over max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1. Proceed with the analog inputs AI2 and AI3 in the same way.

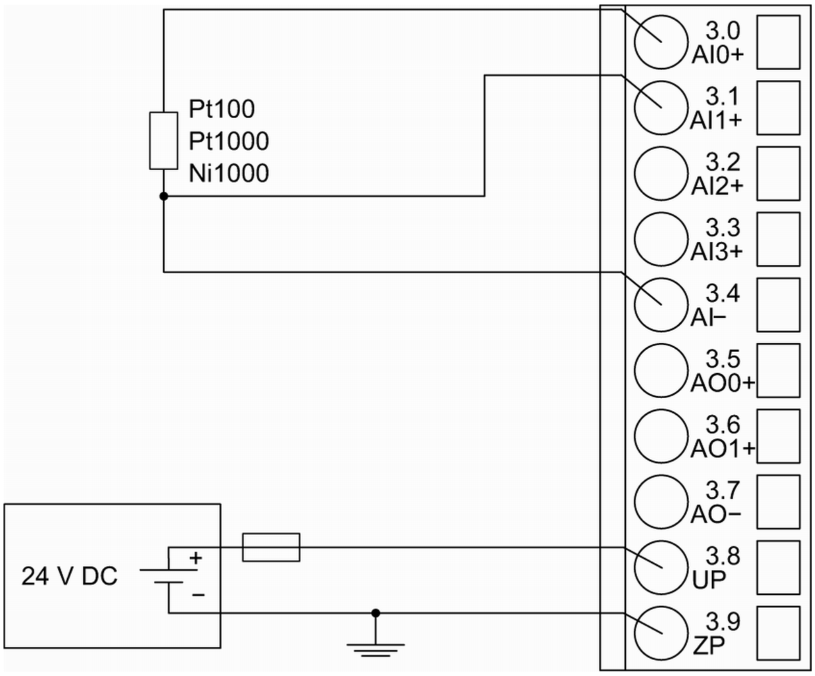


Fig. 94: Connection of resistance thermometers in 3-wire configuration to the analog inputs

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.5.3.1.2.6 “Parameterization” on page 619* *Chapter 1.5.3.1.2.9 “Measuring Ranges” on page 626*:

Pt100	-50 °C...+400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, 2 channels used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.5.3.1.2.8 “State LEDs” on page 626*.

The module DA502 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

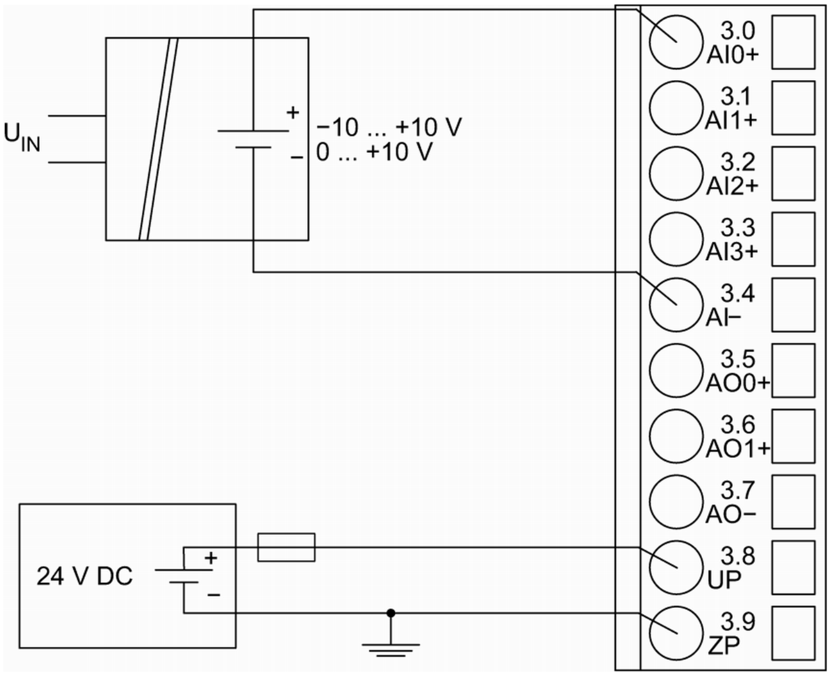


Fig. 95: Connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog inputs

The following measuring ranges can be configured ␥ *Chapter 1.5.3.1.2.6 "Parameterization" on page 619* ␥ *Chapter 1.5.3.1.2.9 "Measuring Ranges" on page 626*:

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ␥ *Chapter 1.5.3.1.2.8 "State LEDs" on page 626*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

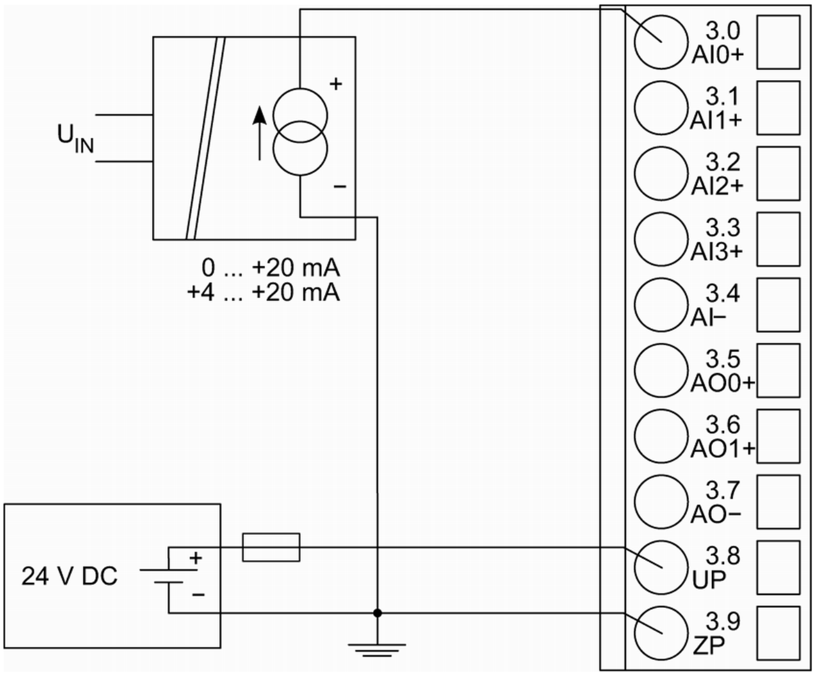


Fig. 96: Connection of active-type analog sensors (current) with electrically isolated power supply to the analog inputs

The following measuring ranges can be configured ↬ *Chapter 1.5.3.1.2.6 “Parameterization” on page 619* ↬ *Chapter 1.5.3.1.2.9 “Measuring Ranges” on page 626*:

Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ↬ *Chapter 1.5.3.1.2.8 “State LEDs” on page 626*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with no electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

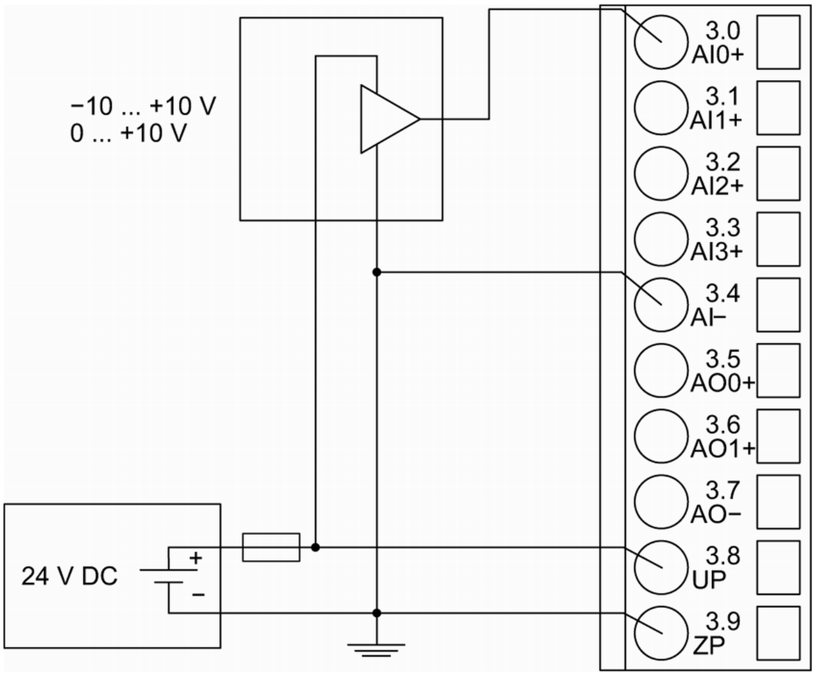


Fig. 97: Connection of active-type sensors (voltage) with no electrically isolated power supply to the analog inputs

> **CAUTION!**
> **Risk of faulty measurements!**
> The negative pole at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).
>
> Make sure that the potential difference never exceeds ±1 V.

The following measuring ranges can be configured *Chapter 1.5.3.1.2.6 "Parameterization" on page 619* *Chapter 1.5.3.1.2.9 "Measuring Ranges" on page 626*:

Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.5.3.1.2.8 "State LEDs" on page 626*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Passive-type Analog Sensors (Current) to the Analog Inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

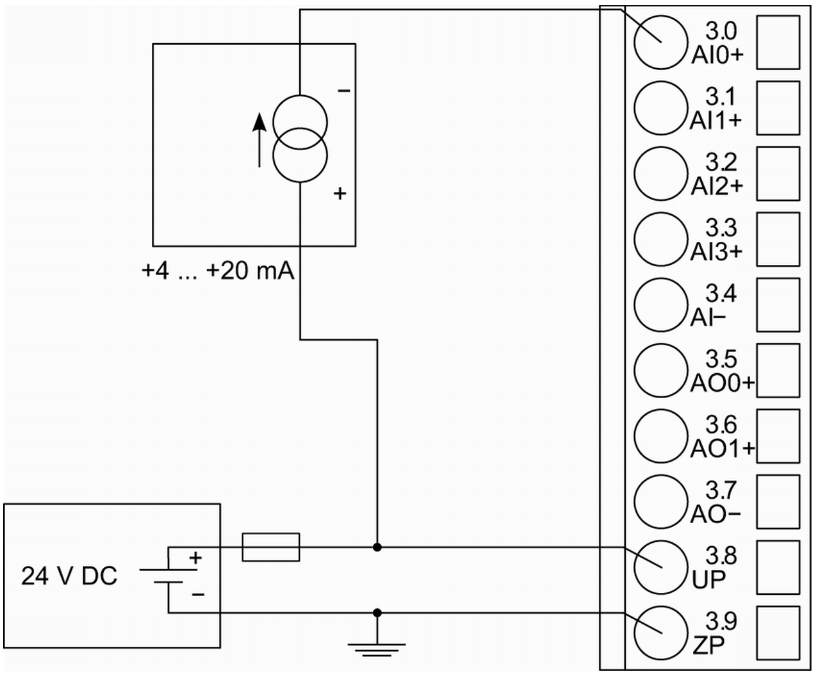


Fig. 98: Connection of passive-type analog sensors (current) to the analog inputs

The following measuring ranges can be configured ➜ *Chapter 1.5.3.1.2.6 "Parameterization" on page 619* ➜ *Chapter 1.5.3.1.2.9 "Measuring Ranges" on page 626*:

Current	4 mA...20 mA	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➜ *Chapter 1.5.3.1.2.8 "State LEDs" on page 626*.

NOTICE!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and I-.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Analog Inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely earthed) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).

Make sure that the potential difference never exceeds ±1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

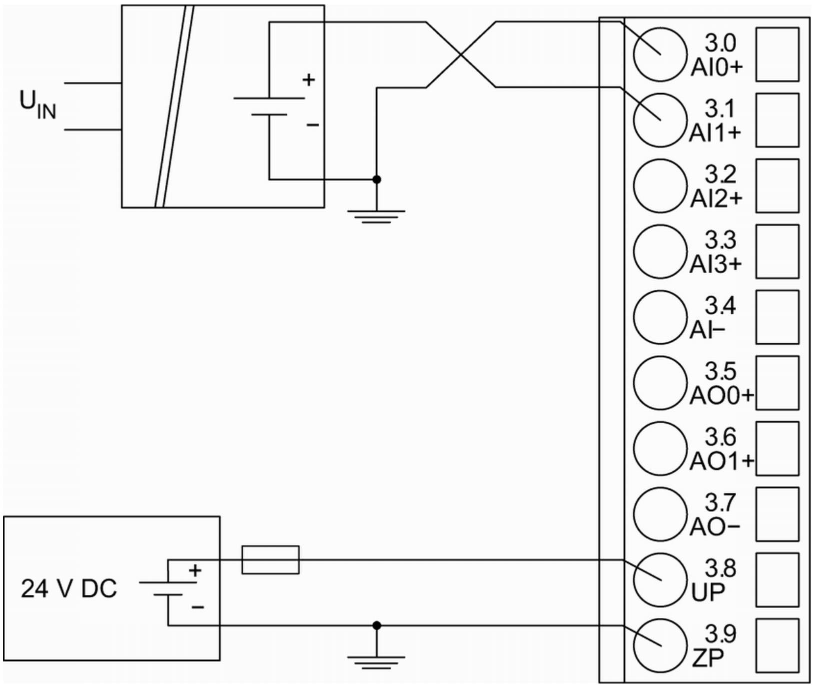


Fig. 99: Connection of active-type analog sensors (voltage) to differential analog inputs

The following measuring ranges can be configured *Chapter 1.5.3.1.2.6 "Parameterization" on page 619* *Chapter 1.5.3.1.2.9 "Measuring Ranges" on page 626*:

Voltage	0 V...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.5.3.1.2.8 "State LEDs" on page 626.*

To avoid error messages from unused analog input channels, configure them as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

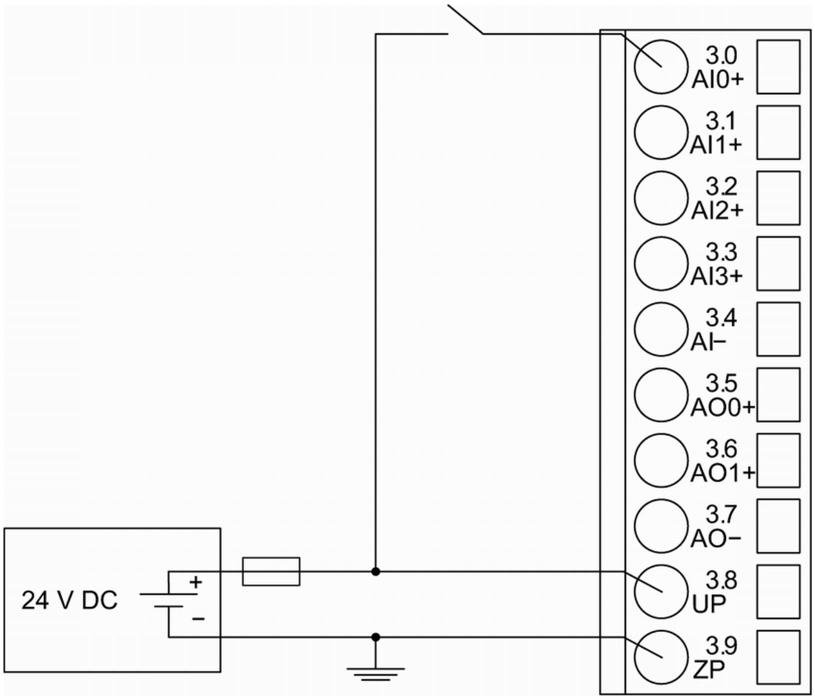


Fig. 100: Use of analog inputs as digital inputs

The following measuring ranges can be configured ➪ *Chapter 1.5.3.1.2.6 “Parameterization” on page 619* ➪ *Chapter 1.5.3.1.2.9 “Measuring Ranges” on page 626* :

Digital input	24 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➪ *Chapter 1.5.3.1.2.8 “State LEDs” on page 626*.

Connection of Analog Output Loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

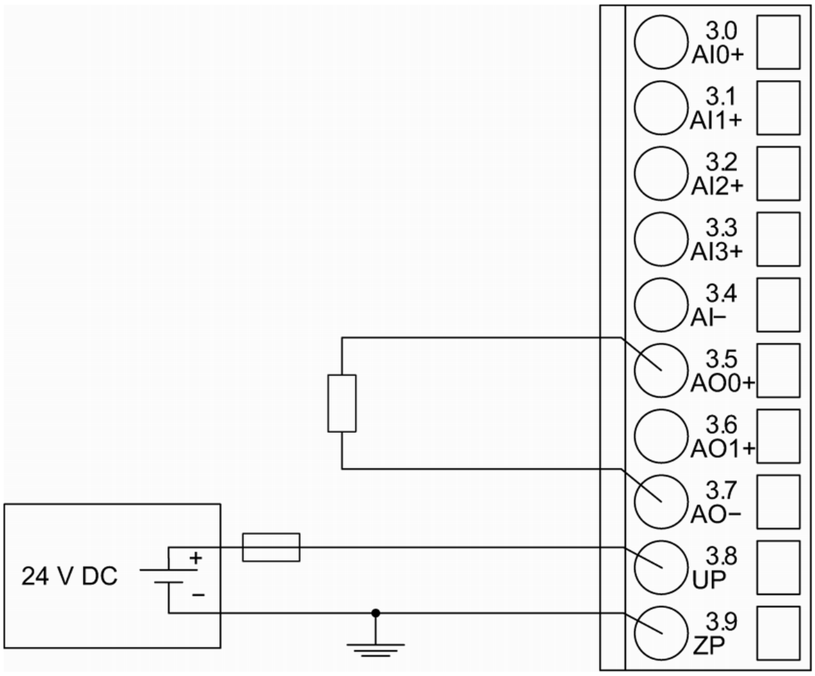


Fig. 101: Connection of analog output loads (voltage)

The following measuring ranges can be configured ➪ *Chapter 1.5.3.1.2.6 “Parameterization” on page 619* ➪ *Chapter 1.5.3.1.2.9 “Measuring Ranges” on page 626*:

Voltage	-10 V...+10 V	Load ±10 mA max.	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➪ *Chapter 1.5.3.1.2.8 “State LEDs” on page 626*.

Unused analog outputs can be left open-circuited.

Connection of Analog Output Loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

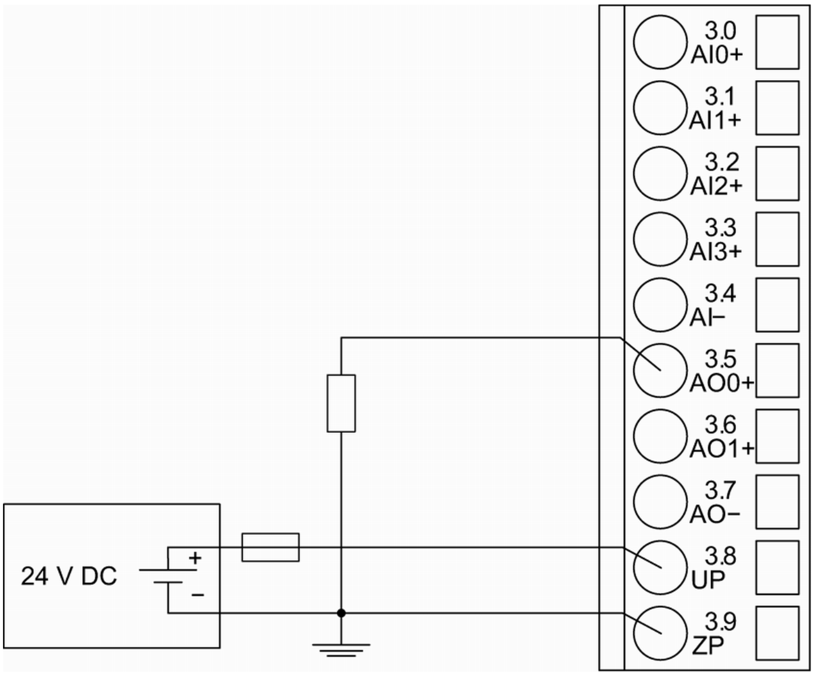


Fig. 102: Connection of analog output loads (current)

The following measuring ranges can be configured *Chapter 1.5.3.1.2.6 “Parameterization” on page 619* *Chapter 1.5.3.1.2.9 “Measuring Ranges” on page 626*:

Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.5.3.1.2.8 “State LEDs” on page 626*.

Unused analog outputs can be left open-circuited.

Internal Data Exchange

	Without the Fast Counter	With the Fast Counter (only with AC500)
Digital inputs (bytes)	3	5
Digital outputs (bytes)	1	3
Analog inputs (words)	4	4
Analog outputs (words)	2	2
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It draws its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Module ID [1])	Internal	1815	WORD	1815	0x0Y01
Ignore module	Internal	Yes No	BYTE	No	
Parameter length	Internal	8	BYTE	8	0xY02
Check supply	off	0	BYTE	1	0xY03
	on	1			
Fast counter [3])	0 : 10 [2])	0 : 10	BYTE	0	Not for FBP
Behavior outputs at comm. error [5])	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	Off 0x00	0x0Y07

[2])	Setting	Description
	On	Error LED lights up at errors of all error classes, Failsafe mode off
	Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
	Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off

[2])	Setting	Description
	On +Failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
	Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
	Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission

[2]) For a description of the counter operating modes, please refer to the Fast Counter section *Chapter 1.5.1.2.10 “Fast Counter” on page 396*

[3]) With CS31 without the parameter "Fast Counter"

The fast counter of the module does not work if the module is connected to a CS31 bus module.

[5]) The parameter Behavior outputs at comm. error is only analyzed if the Failsafe mode is ON.

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0x0Y05
Detect short circuit at out-puts	Off On	0 1	BYTE	On 0x01	0x0Y06
Substitute value at output	0...255	00h...FFh	BYTE	0 0x0000	0x0Y08

*) The parameters Behavior DO at comm. error is only analyzed if the Failsafe mode is ON.

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Analog data format	Standard Reserved	0 255	BYTE	0	0x0Y04

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe mode is ON.

Channel Parameters for the Analog Inputs (4x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 0, Channel configuration	see *Table 88 “Channel Configuration” on page 621*	see *Table 88 “Channel Configuration” on page 621*	BYTE	0	0x0Y09
Input 0, Check channel	see *Table 89 “Channel Monitoring” on page 622*	see *Table 89 “Channel Monitoring” on page 622*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	
Input 3, Channel configuration	see *Table 88 “Channel Configuration” on page 621*	see *Table 88 “Channel Configuration” on page 621*	BYTE	0	0x0Y0F
Input 3, Check channel	see *Table 89 “Channel Monitoring” on page 622*	see *Table 89 “Channel Monitoring” on page 622*	BYTE	0	0x0Y10

Table 88: Channel Configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V...10 V
2	Digital input
3	0 mA...20 mA
4	4 mA...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50 °C...+400 °C
9	3-wire Pt100 -50 °C...+400 °C *)
10	0 V...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C...+70 °C
15	3-wire Pt100 -50 °C...+70 °C *)
16	2-wire Pt1000 -50 °C...+400 °C
17	3-wire Pt1000 -50 °C...+400 °C *)
18	2-wire Ni1000 -50 °C...+150 °C

Internal value	Operating modes of the analog inputs, individually configurable
19	3-wire Ni1000 -50 °C...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 89: Channel Monitoring

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel Parameters for the Analog Outputs (2x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
0 Output 0, Channel configuration	see *Table 90 “Channel Configuration” on page 623*	see *Table 90 “Channel Configuration” on page 623*	BYTE	0	0x0Y11
Output 0, Check channel	see *Table 91 “Channel Monitoring” on page 623*	see *Table 91 “Channel Monitoring” on page 623*	BYTE	0	0x0Y12
Output 0, Substitute value	see *Table 92 “Substitute Value” on page 623*	see *Table 92 “Substitute Value” on page 623*	WORD	0	0x0Y13
Output 1, Channel configuration	see *Table 90 “Channel Configuration” on page 623*	see *Table 90 “Channel Configuration” on page 623*	BYTE	0	0x0Y14
Output 1, Check channel	see *Table 91 “Channel Monitoring” on page 623*	see *Table 91 “Channel Monitoring” on page 623*	BYTE	0	0x0Y15
Output 1, Substitute value	see *Table 92 “Substitute Value” on page 623*	see *Table 92 “Substitute Value” on page 623*	WORD	0	0x0Y16

Table 90: Channel Configuration

Internal value	Operating modes of the analog outputs, individually configu-rable
0 (default)	Not used
128	-10 V...+10 V
129	0 mA...20 mA
130	4 mA...20 mA

Table 91: Channel Monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 92: Substitute Value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behavior of outputs in case of a communication error"	Required setting of the channel parameter "Substi-tute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 s	0
Last value for 10 s and then turn off	Last value 10 s	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 s	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 s	Depending on configuration

Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

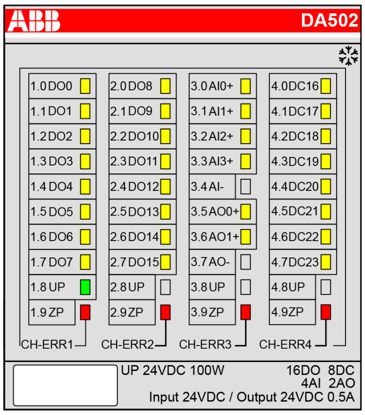
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout in the I/O module	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON –> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error DA502							
4	14	1...10	2	0...15	47	Short-circuit at a digital output	Check connection
	11 / 12	ADR	1...10	22...29 [5])			
Channel error DA502							
4	14	1...10	1	16...19 [6])	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	16...19 [6])	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				
4	14	1...10	1	16...19 [6])	47	Short circuit at an analog input	Check ter-minal
	11 / 12	ADR	1...10				
4	14	1...10	3	20...21 [7])	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1...10				

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	14	1...10	3	20...21 7)	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus: 31 = Module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus = module type (1 = AI, 3 = AO, 4 = DC); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = module itself" is output.
5)	Ch = 22...29 indicate the digital inputs/outputs DC16...DC23
6)	Ch = 16...19 indicates the analog inputs AI0...AI3
7)	Ch = 20...21 indicates the analog outputs AO0...AO1

State LEDs



LED	State	Color	LED = OFF	LED = ON	LED flashes
DO0 to DO15	Digital output	Yellow	Output is OFF	Output is ON	--
DC16 to DC23	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON 1)	--
AI0 to AI3	Analog input	Yellow	Input is OFF	Input is ON 2)	--
AO0 to AO1	Analog output	Yellow	Output is OFF	Output is ON 2)	--
UP	Process supply voltage 24 VDC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short circuit at an output)
CH-ERR2		Red			
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR 3)	Module error	Red	--	Internal error	--
1) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
2) Brightness depends on the value of the analog signal					
3) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 0.0000	< -11.7589	< 0.0000	< 0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	Hex.
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high		450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1
			160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
	80.0 °C : 70.1 °C			800 : 701	0320 : 02BD
Normal range	: : 70.0 °C : 0.1 °C	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	Hex.
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

Technical Data

Technical Data of the Module

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 VDC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V)
	Protection against reverse voltage	yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 VDC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.5 A per output
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	ca. 2 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		Yes, per module
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal mounting or vertical with derating (output load reduced to 50% at 40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		16 outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
Connection of the channels		
	DO0 to DO7	Terminals 1.0 to 1.7
	DO8 to DO15	Terminals 2.0 to 2.7
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
Monitoring point of output indicator		LED is controlled by process CPU

Parameter		Value
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (channels O0 to O15)	4 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC16...DC23	Terminals 4.0...4.7
If the channels are used as outputs		
	Channels DC16...DC23	Terminals 4.0...4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		Yes, per module

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 to DC23		Terminals 4.0 to 4.7
Reference potential for all inputs		Terminals 1.9...4.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC16 to DC23	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 1.9...4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)

Parameter		Value
Output delay (0->1 or 1->0)		On request
Output current		
	rated value per channel	500 mA at UP = 24 V
	max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
Fuse for UP		10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

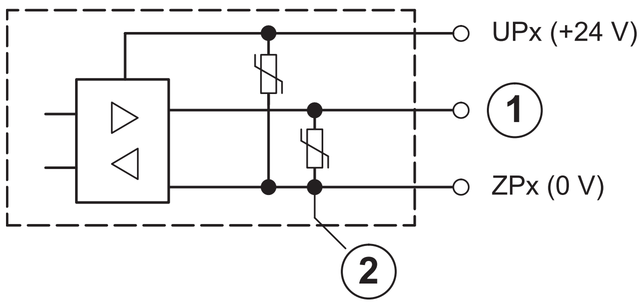


Fig. 103: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical Data of the Fast Counter

> *The fast counter of the module does not work if the module is connected to a CS31 bus module.*

Parameter	Value
Counting frequency	Max. 50 kHz
Used inputs	See *Fast Counter*
Used outputs	See *Fast Counter*
Operating modes	See *Operating modes*

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 3.0 to 3.3
Reference potential for AI0+ to AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V...10 V, current or Pt100/Pt1000/Ni1000
	Bipolar	Voltage -10 V...+10 V
Configurability		0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution		Range 0 V...10 V: 12 bits Range -10 V...+10 V: 12 bits + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 % For XC version below 0 °C and above 60 °C: on request
Relationship between input signal and hex code		*Chapter 1.5.3.1.2.9.1 “Input Ranges Voltage, Current and Digital Input” on page 626* *Chapter 1.5.3.1.2.9.2 “Input Range Resistor” on page 627*

Parameter	Value
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical Data of the Analog Inputs, if used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 3.0 to 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 3.5 and 3.6
Reference potential for AO0+ to AO1+		Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω...500 Ω
Output loadability, as voltage output		±10 mA max.

Parameter	Value
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	*Chapter 1.5.3.1.2.9.3 “Output Ranges Voltage and Current” on page 628*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 250 800 R0001	DA502, digital/analog input/output module, 16 DO, 8 DC, 4 AI, 2 AO	Active
1SAP 450 800 R0001	DA502-XC, digital/analog input/output module, 16 DO, 8 DC, 4 AI, 2 AO, XC version	Active

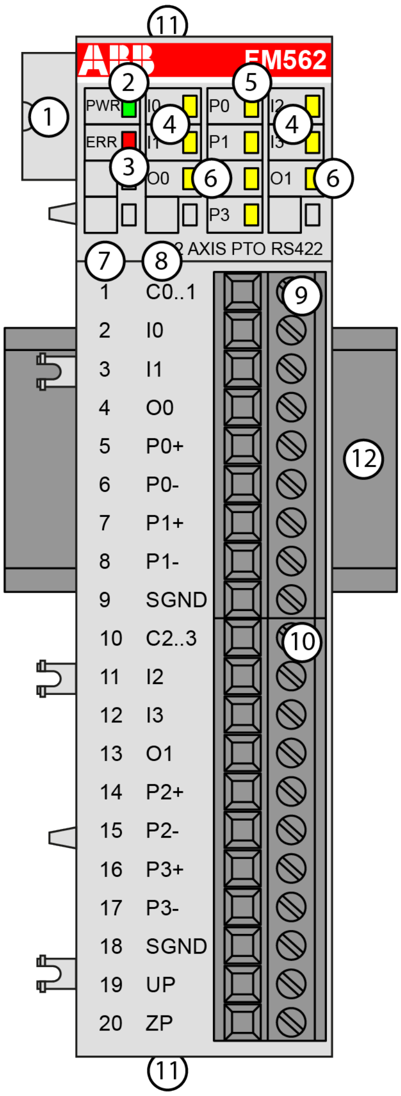
**) For planning and commissioning of new installations use modules in Active status only.*

1.6 Function Modules

1.6.1 S500-eCo

1.6.1.1 FM562 for Pulse Train Output

- 2 axes motion control
- 2 pulse train outputs per axis, RS-422
- 2 configurable digital inputs per axis, 24 VDC
- 32 bits registers for current position, registered position and speed value
- Group-wise electrically isolated



1 I/O bus
2 1 green LED to display power supply
3 1 red LED to display error
4 4 yellow LEDs to display the signal states of the inputs I0 to I3
5 4 yellow LEDs to display the signal states of the pulse train outputs P0 to P3
6 2 yellow LEDs to display the signal states of O0 to O1 (reserved)
7 Terminal number
8 Allocation of signal name
9 Terminal block for axis signals (9-pin)
10 Terminal block for axes signals and process supply voltage (11-pin)
11 2 holes for wall-mounting with screws
12 DIN rail

1.6.1.1.1 Intended Purpose

The function module FM562 for pulse train output (PTO) is used for simple positioning tasks with servo drives or stepper drives. FM562 provides 2 axes with 2 inputs and 2 pulse-train outputs each.

It can be used at the following devices:

- Communication interface modules (e. g. CI501-PNIO, CI541-DP)
- Processor modules

It contains the following features:

- 2 axes control
- 2 configurable discrete digital inputs per axis for enable and limit switches signal inputs
- PTO output type: RS-422 differential output (P0, P1, P2 and P3)
- PTO frequency: 10 Hz to 250kHz
- Configurable PTO output mode: CW/CCW (clockwise/counterclockwise), pulse/direction
- Position and speed control with built in motion profile generators. Integration in the application program by PLCopen Motion Control Function Blocks (PS552-MC-E motion control library is required for programming)

The pulse outputs of the 2 axes are not electrically isolated from each other.

The other circuitry of the module is electrically isolated from the inputs/outputs.

1.6.1.1.2 Electrical Connection

The pulse-train output module FM562 can be connected to the following devices via the I/O bus connector:

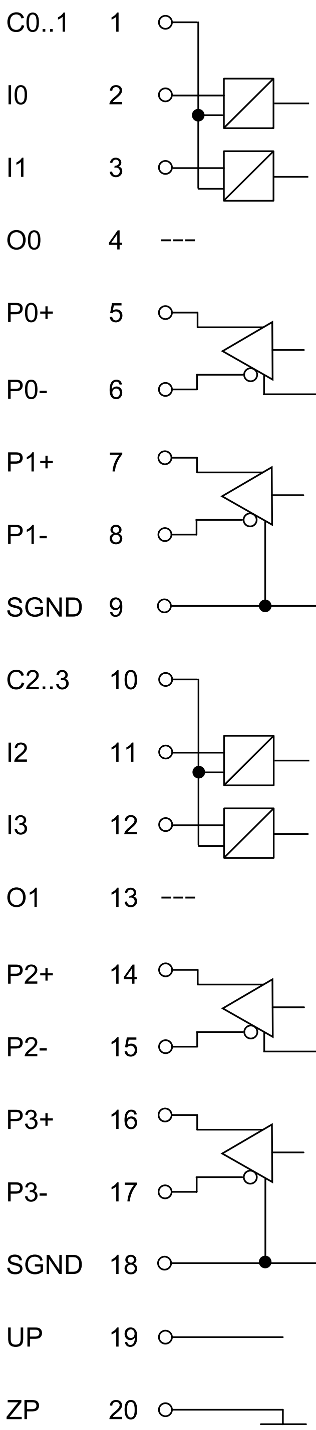
- S500 PROFIBUS and PROFINET bus modules (e. g. CI501-PNIO, CI541-DP)
- AC500 CPUs (PM5xx)
- Other AC500 I/O modules

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA bus modules.

The module must not be used as a decentralized communication interface module at CI58x-CN or CI59x-CS31.

The electrical connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter terminal blocks for S500-eCo I/O modules *Chapter 1.8.3.2 “TA563-TA565 - Terminal Blocks” on page 1166*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

The following block diagram shows the internal construction of the digital inputs and outputs:



The 2 SGND signals are internally interconnected.

The assignment of the terminals:

Terminal	Signal	Description
1	C0..1	Input common for signals I0 and I1
2	I0	Input signal I0 (axis enable and limit switch)

Terminal	Signal	Description
3	I1	Input signal I1 (stop)
4	O0	Reserved - do not connect
5	P0+	Pulse output P0+ (positive line)
6	P0-	Pulse output P0- (negative line)
7	P1+	Pulse or direction output P1+ (positive line)
8	P1-	Pulse or direction output P1- (negative line)
9	SGND	Signal ground for pulse output
10	C2..3	Input common for signals I2 and I3
11	I2	Input signal I2 (axis enable and limit switch)
12	I3	Input signal I3 (stop)
13	O1	Reserved - do not connect
14	P2+	Pulse output P2+ (positive line)
15	P2-	Pulse output P2- (negative line)
16	P3+	Pulse or direction output P3+ (positive line)
17	P3-	Pulse or direction output P3- (negative line)
18	SGND	Signal ground for pulse output
19	UP	Process voltage UP +24 VDC
20	ZP	Process voltage ZP 0 VDC

When wiring, the motor phase line and power line should be separated in order to avoid signal disturbances between each other.

For cable length ≤ 30 m, unshielded cable can be used with Baldor and BSD servo drives normally.

For cable length > 30 m, shielded cable must be used for surge purpose.

The earthing of the shield should take place at the switch-gear cabinet, see chapter System Data AC500 *Chapter 2.6.1 “System Data AC500” on page 1252**.*

The cable shields must be earthed at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a CPU). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the CPU/bus module increases by 5 mA per FM562.

The external power supply connection is carried out via the UP (+24 VDC) and ZP (0 VDC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of damaging the PLC modules!
Never connect any voltages or signals to reserved terminals (marked with --- or O0 / O1). Reserved terminals may carry internal voltages.

Be sure to connect the pulse output signals in the right order. Otherwise, the pulse number may be wrongly calculated and malfunctions may appear.

The module provides several diagnosis functions (see Diagnosis ✎ *Chapter 1.6.1.1.6 “Diagnosis” on page 648*).

The digital inputs can be used as source inputs or as sink inputs.

NOTICE!
Risk of malfunctions in the plant!
A ground closure, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

The following figure shows the electrical connection of the inputs to the pulse-train output module FM562:

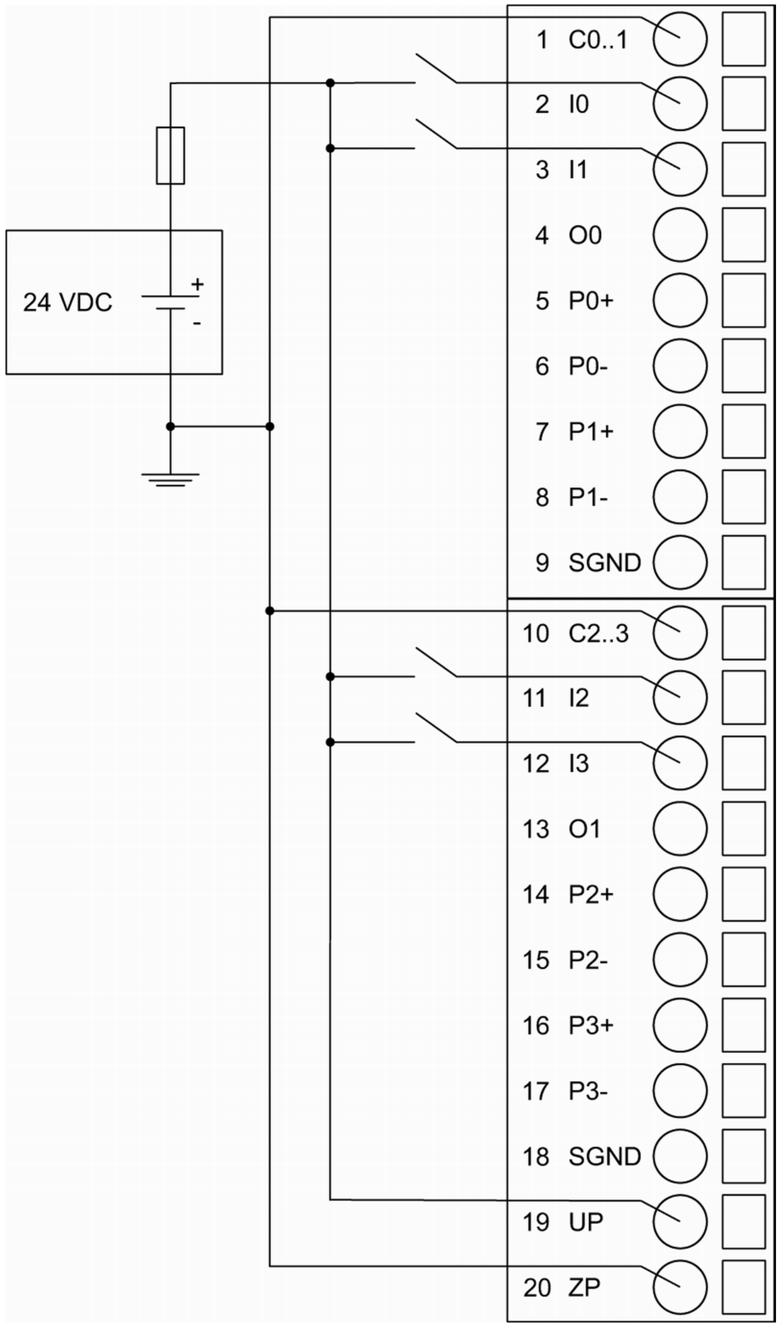


Fig. 104: Electrical connection of inputs to the FM562 - sink inputs

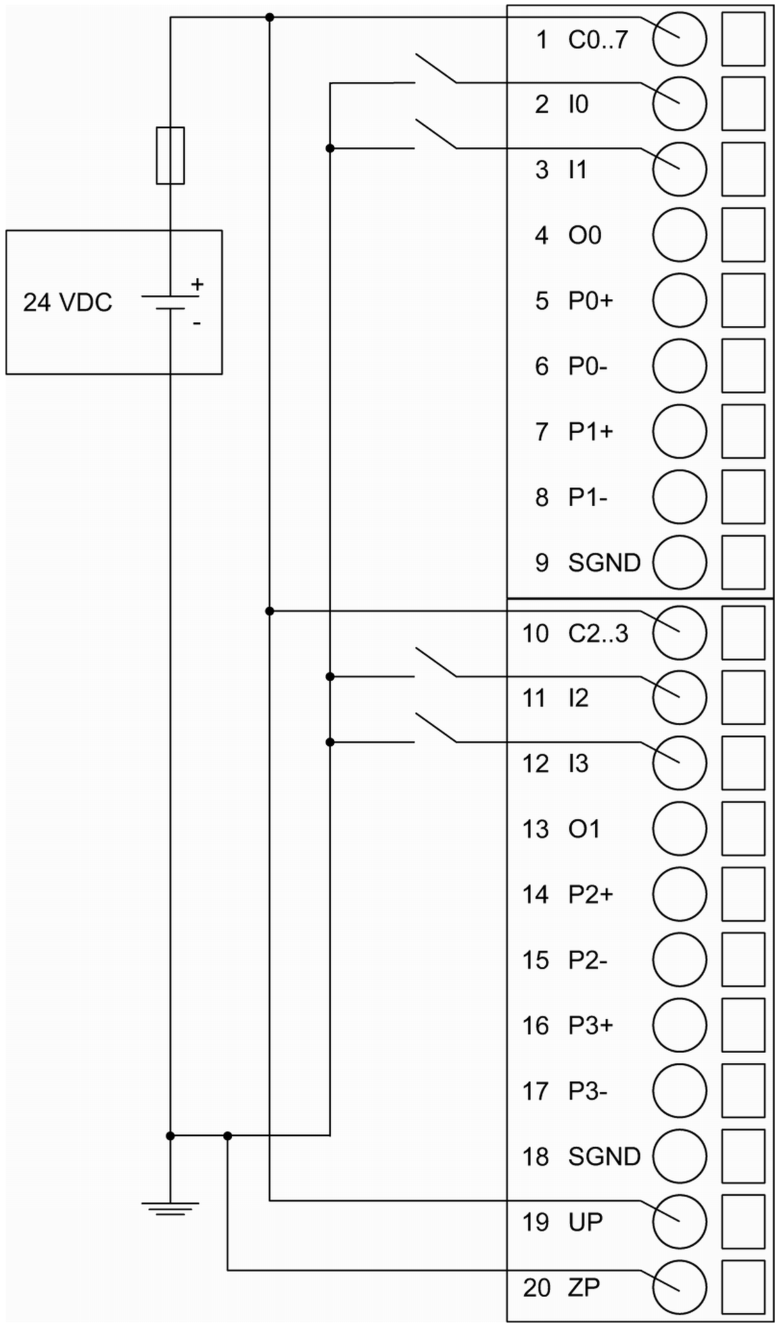


Fig. 105: Electrical connection of inputs to the FM562 - source inputs

The following figure shows the electrical connection of the pulse-train outputs of the FM562 to a servo amplifier:

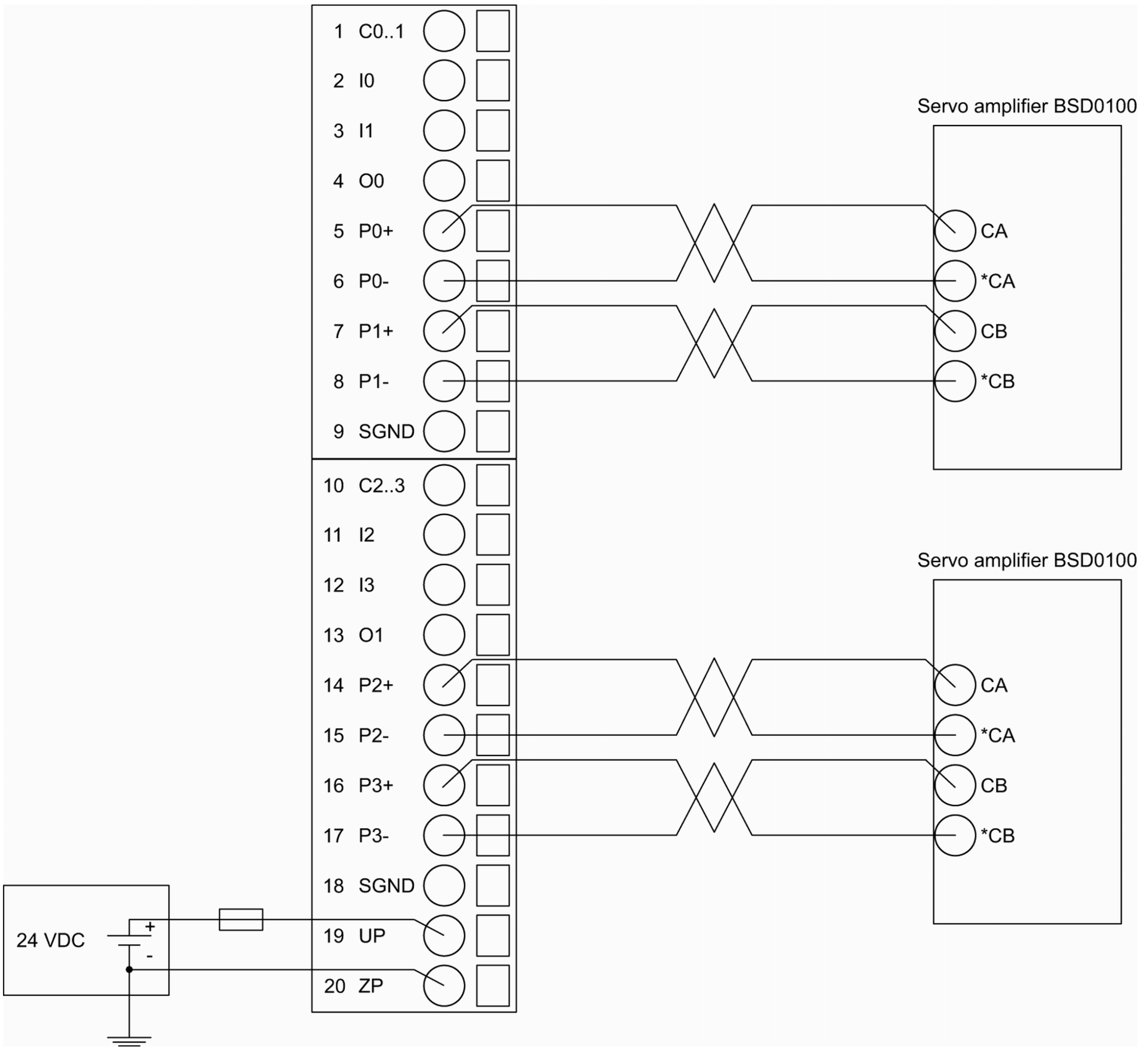


Fig. 106: Electrical connection (differential) of pulse train output

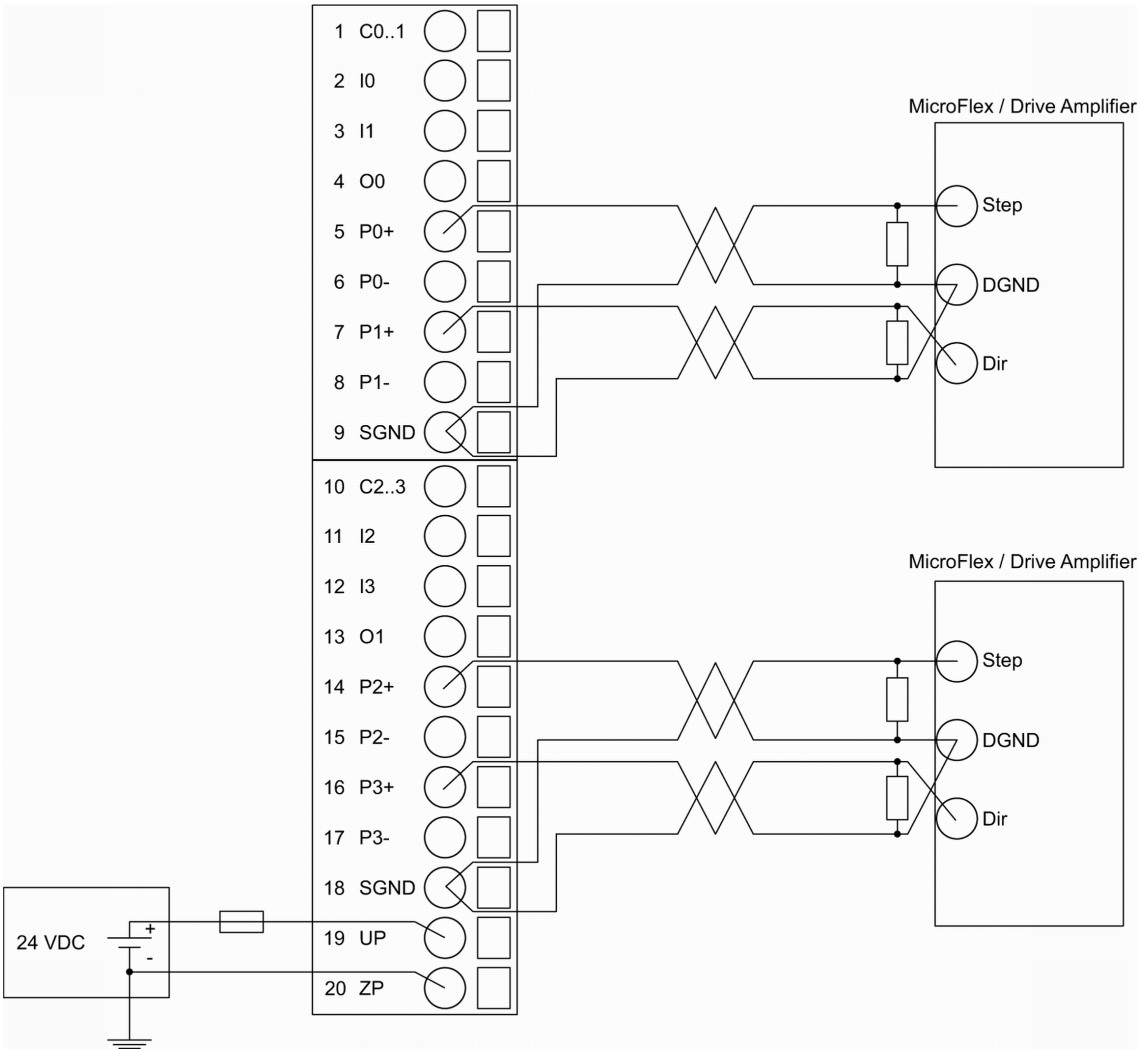


Fig. 107: Electrical connection (single-ended) of pulse train output

> *For drives/amplifiers with high-impedance pulse input interface like MicroFlex, the cable ends must be equipped with 100 Ω terminating resistors to eliminate signal reflections. Normally, the resistors are integrated in the interface connectors.*

1.6.1.1.3 Internal Data Exchange

Parameter	Value
Axes input data (words)	16
Axes output data (words)	16

1.6.1.1.4 I/O Configuration

The pulse-train output module FM562 does not store configuration data itself.

1.6.1.1.5 Parameterization

The arrangement of the parameter data is performed with Automation Builder.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

For programming, the library package PS552-MC-E is required. This library package is not part of Automation Builder and has to be purchased separately.

Module Parameters

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Module ID	Internal	1830	WORD	0x0726	0	65535
Ignore module	No Yes	0 1	BYTE	No 0x00		
Parameter length	Internal	19	BYTE	19	0	255
Check Supply	Off On	0 1	BYTE	On 0x01	0	255

Input Channels for Axis 1

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Input 0, channel configuration	No function Axis enable / limit switch	0 1	BYTE	No function 0x00	0	1
Input 0, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0	3
Input 1, channel configuration	No function Stop Registration *)	0 1 2	BYTE	No function 0x00	0	2
Input 1, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0	3

*) Reserved - do not use

Output Channel for Axis 1

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output 0, channel configuration	No function	0	BYTE	No function 0x00	0	2

Slot Parameters for Axis 1

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output mode	CW/CCW Pulse/Direction	0 1	BYTE	CW/CCW 0x00	0	1
Start frequency *)	0...65535	0...65535	WORD	0 0x00	0	65535

*) Unit is Hz

Input Channels for Axis 2

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Input 2, channel configuration	No function Axis enable / limit switch	0 1	BYTE	No function 0x00	0	1
Input 2, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1ms 0x00	0	3
Input 3, channel configuration	No function Stop Registration *)	0 1 2	BYTE	No function 0x00	0	2
Input 3, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0	3

*) Reserved - do not use

Output Channel for Axis 2

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output 1, channel configuration	No function	0	BYTE	No function 0x00	0	2

Slot Parameters for Axis 2

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output mode	CW/CCW Pulse/Direction	0 1	BYTE	CW/CCW 0x00	0	1
Start frequency *)	0...65535	0...65535	WORD	0 0x00	0	65535

*) Unit is Hz

GSD file:

Ext_User_Prm_Data_Len =	0x17
Ext_User_Prm_Data_Const(0) =	0x07, 0x27, 0x00, 0x13, 0x01\ 0x00, 0x00, 0x00, 0x00, 0x00\ 0x00, 0x00, 0x00, 0x00, 0x00\ 0x00, 0x00, 0x00, 0x00, 0x00\ 0x00, 0x00, 0x00;

1.6.1.1.6 Diagnosis

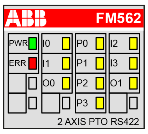
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
			Module error FM562				
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout inside the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON => OFF)	Process voltage ON
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1..10 = decentralized communication interface module 1..10, ADR = hardware address (e. g. of the DC551-CS31)

3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1..10 = expansion 1..10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1..10 = expansion 1..10
4)	In case of module errors, with channel "31 = Module itself" is output.

1.6.1.1.7 State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 VDC via terminal and process voltage via I/O bus	Green	CPU module voltage or external 24 VDC supply voltage is missing	I/O bus voltage and external 24 VDC supply voltage are present (LED is on after startup of the module (approx. 1 s))	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Serious error in the module	Axis related error
	P0...P3	Pulse output	Yellow	Output = OFF	Output = ON	LED follows the state of the outputs, depending on frequency
	I0...I3	Digital Input	Yellow	Input = OFF	Input = ON	---
	O0...O1	Reserved	Yellow	---	---	---

1.6.1.1.8 Technical Data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System Data AC500-eCo” on page 1194*

Only additional details are therefore documented below.

Parameter	Value
Digital inputs	4 inputs (2 per axis) 24 VDC, can be used as source inputs or as sink inputs
Input channels 0 and 2	Input signal used for axis enable and limit switch
Input channels 1 and 3	Stop, configurable
Input data length	32 bytes

Parameter	Value
Pulse outputs	Pulse specification ● 2 outputs for each axis, configurable ● Type: RS-422 differential signal ● Mode: CW & CCW or Pulse & Direction ● Frequency: 10 Hz to 250 kHz ● Pulse number: -2147483648 to 2147483647 (32 bits) ● Motion profiles generator
Output data lenth	32 bytes
LED displays	For power supply, errors and signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 VDC)

Process supply voltage UP	Value
Connections	Terminal 19 for UP (+24 VDC) and terminal 20 for ZP (0 V)
Rated value	24 VDC
Current consumption via UP terminal	42 mA
Max. ripple	5 %
Inrush current from UP (at power up)	0.067 A^2s
Protection against reversed voltage	Yes
Rated protection fuse for UP	Not necessary
Current consumption from 24 VDC power supply at the L+/UP and M/ZP terminals of the CPU/bus module	Ca. 5 mA
Galvanic isolation	Yes, between input groups and the output group and the rest of the module
Isolated groups	5 groups (2 groups for 4 input channels, 1 group for 4 pulse train output channels, 1 group for process supply voltage, 1 group for the rest of the module)
Surge-voltage (max.)	35 VDC for 0.5 s
Max. power dissipation within the module	1.2 W
Weight	Ca. 125 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical Data of the Digital Inputs

Parameter	Value	
Number of channels per module	4	
Distribution of the channels into axes	1 group of 2 channels for each axis	
Axis 1	Inputs I0...I1	
Axis 2	Inputs I2...I3	
Connections of the channels I0 to I1	Terminals 2 to 3	
Connections of the channels I1 to I3	Terminals 11 to 12	
Reference potential for the channels I0 to I1	Terminal 1 (Signal name C0..1)	
Reference potential for the channels I2 to I3	Terminal 10 (Signal name C2..3)	
Electrical isolation	Yes, per axis	
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)	
Input type according to EN 61131-2	Type 1 source	Type 1 sink
Input signal range	-24 VDC	+24 VDC
Signal 0	-5 V...+3 V	-3 V...+5 V
Undefined signal	-15 V...+ 5 V	+5 V...+15 V
Signal 1	-30 V...-15 V	+15 V...+30 V
Ripple with signal 0	-5 V...+3 V	-3 V...+5 V
Ripple with signal 1	-30 V...-15 V	+15 V...+30 V
Input current per channel		
Input voltage +24 V	Typ. 5 mA	
Input voltage +5 V	Typ. 1 mA	
Input voltage +15 V	> 2.5 mA	
Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)	1 mA	
Input delay (0->1 or 1->0)	Typ. 0.1 to 32 ms (configurable via software), default: 0.1 ms	
Max. cable length		
Shielded	500 m	
Unshielded	300 m	

Technical Data of the Pulse Outputs

Parameter	Value
Number of channels	2 per axis, 4 per module
Output type	RS-422
Output mode	Clockwise and counter-clockwise or pulse and direction
Output frequency	10 Hz to 250 kHz

Parameter		Value
Frequency accuracy		
	From 10 Hz to 500 Hz	± 2 %
	From 501 Hz to 250 kHz	± 1 %
Differential output voltage (at terminal block)		2.8 V at 140 Ω differential load 2.56 V at 100 Ω differen-tial load
Output voltage of positive output (P0+, P1+) referenced to SGND if used for single ended application		Max. 3.3 V without any load Typ. 2.5 V at 100 Ω load
Max. short circuit current		40 mA
Max. cable length		
	Shielded	300 m (at max. fre-quency, criterion: V ≥ 2 V, tested with 100 Ω termination)
	Unshielded	30 m

1.6.1.1.9 Ordering Data

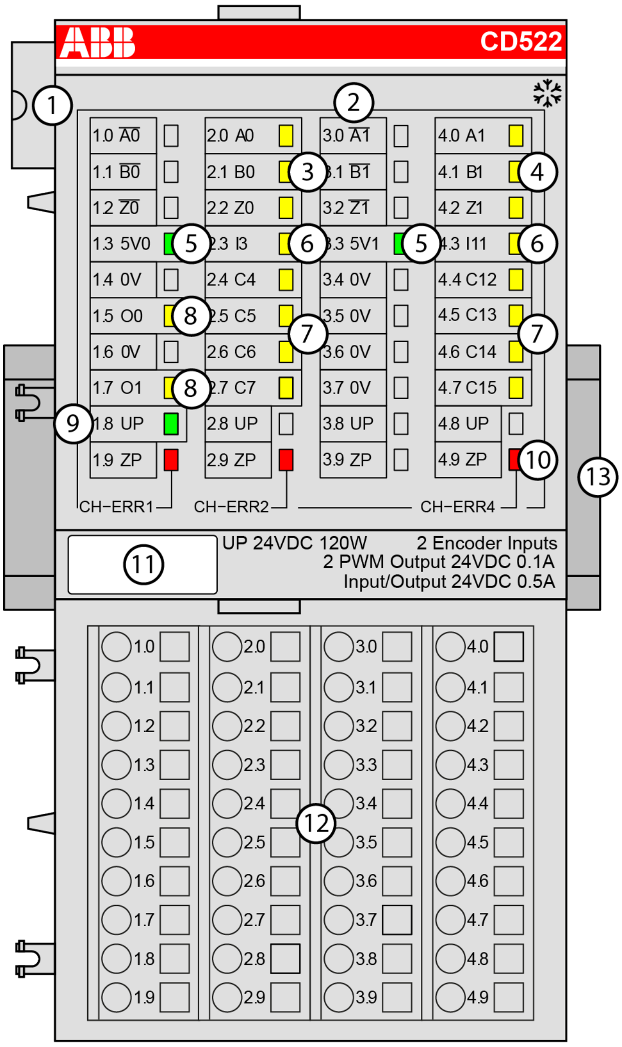
Part no.	Description	Product Life Cycle Phase *)
1SAP 233 100 R0001	FM562, pulse-train output module, 2 axes, RS-422, 4 DI, 24 VDC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.6.2 S500

1.6.2.1 CD522 - Encoder, Counter and PWM Module

- 2 encoder inputs with 2 integrated 5-V-power-supplies for the encoders
- 2 PWM outputs - 2 digital inputs 24 VDC
- 8 configurable digital inputs/outputs 24 VDC
- Fast counter
- Module-wise electrically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation of terminal No. and signal name
3 3 yellow LEDs to display the signal states of the encoder 0 input
4 3 yellow LEDs to display the signal states of the encoder 1 input
5 2 green LEDs to display the 5-V-power-supply states
6 2 yellow LEDs to display the signal state of the digital input I3 and I11
7 8 yellow LEDs to display the input/output signal states
8 2 yellow LEDs to display the signal states of the PWM/pulse outputs
9 1 green LED to display the process voltage UP
10 3 red LEDs to display errors
11 Label
12 Terminal unit
13 DIN rail
Sign for XC version

1.6.2.1.1 Intended Purpose

The encoder and PWM module CD522 can be used at the following devices:

- Communication interface modules (e. g. CI501-PNIO, CI541-DP)
- Processor modules

Features:

- 2 independent counting functions with up to 12 configurable modes (including incremental position encoder and frequency input up to 300 kHz)
- 2 independent PWM (pulse-width modulator) or pulse outputs with push-pull driver
- Dedicated inputs/outputs for specific counting functions (e.g. touch, set, reset)
- All unused inputs/outputs can be used with the specifications of standard inputs/outputs range

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Depending on the configuration used, some inputs and outputs are dedicated to specific counting functions (touch, set, reset…). All unused inputs and outputs can be used with the specification of standard inputs/outputs range.

1.6.2.1.2 Functionality

Digital inputs/outputs	24 VDC, dedicated inputs/outputs can be used for specific counting functions: - Catch/touch operation, counter value stored in separate variable on external event (rising or falling edge) - Set input to preset counter register with predefined value - Set input to reset counter register - End value output; the output is set when predefined value is reached - Reference point initialization (RPI) input for incremental encoder initialization All unused inputs/outputs can be used with the specification of standard input/output range. Effect of incorrect input terminal connection: Wrong or no signal detected, no damage up to 35 V.
Fast counter/encoder	integrated, 2 counters (hardware interface with +24 VDC, +5 VDC, differential and 1 Vpp sinus input) with up to 12 configurable operation modes: - 32 bits one counter mode - 16 bits two counter mode - Incremental position encoder - Absolute SSI encoder - Time frequency meter - Frequency input up to 300 kHz

PWM/pulse outputs	2 pulse-width-modulators or pulse outputs Output specification - Push-pull output: 24 VDC, 100 mA max. - Current limitation (thermal and over current) PWM specification - Frequency from 1 Hz to 100 kHz - Value from 0 to 100 % Pulse specification - Frequency from 1 Hz to 15 kHz - Pulse emission from 1 to 65535 pulses - Number of pulses emitted indicator (0 to 100 %) Frequency specification - Frequency output = 100 kHz when duty cycle set to 50 %
Power supply for encoders	2 5V power supplies, max. 100 mA
LED displays	For signal states, errors and supply voltage
Internal power supply	Via I/O bus
External power supply	Via the terminals UP (process voltage 24 VDC) and ZP (0 VDC)
Required Terminal Unit	TU515 or TU516 *Chapter 1.4.3 "TU515, TU516, TU541 and TU542 for I/O Modules" on page 152*

1.6.2.1.3 Electrical Connection

The function module CD522 can be connected to the following devices via the I/O bus connector:

- CS31 bus module DC551-CS31
- Processor module PM5xx
- Other AC500 I/O devices.

The electrical connection is carried out by using the 40 terminals of the Terminal Unit TU515/ TU516 *Chapter 1.4.3 "TU515, TU516, TU541 and TU542 for I/O Modules" on page 152*.

Table 93: Assignment of the terminals

Terminal	Signal	Description
1.0	/A0	Inverted input signal A of encoder 0
1.1	/B0	Inverted input signal B of encoder 0
1.2	/Z0	Inverted input signal Z of encoder 0
1.3	5V0	+5 VDC power supply output 0 for sensors
1.4	0V	0 V reference input
1.5	O0	Output signal of the fast output O0
1.6	0V	0 V reference input
1.7	O1	Output signal of the fast output O1
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)

Terminal	Signal	Description
2.0	A0	Input signal A of encoder 0
2.1	B0	Input signal B of encoder 0
2.2	Z0	Input signal Z of encoder 0
2.3	I3	Input signal I3 (standard input)
2.4...2.7	C4...C7	Signal of the configurable digital input/output C4...C7
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	/A1	Inverted input signal A of encoder 1
3.1	/B1	Inverted input signal B of encoder 1
3.2	/Z1	Inverted input signal Z of encoder 1
3.3	5V1	+5 VDC power supply output 1 for sensors
3.4...3.7	0V	0 V reference input
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	A1	Input signal A of encoder 1
4.1	B1	Input signal B of encoder 1
4.2	Z1	Input signal Z of encoder 1
4.3	I11	Input signal I11 (standard input)
4.4...4.7	C12...C15	Signal of the configurable digital input/output C12...C15
4.8	UP	Process voltage UP (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a bus module or a processor module). Thus, the current consumption from 24 VDC power supply at the terminals L+/UP and M/ZP of the processor/bus module increases by 2 mA per CD522.

The external power supply connection is carried out via the UP (+24 VDC) and the ZP (0 VDC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

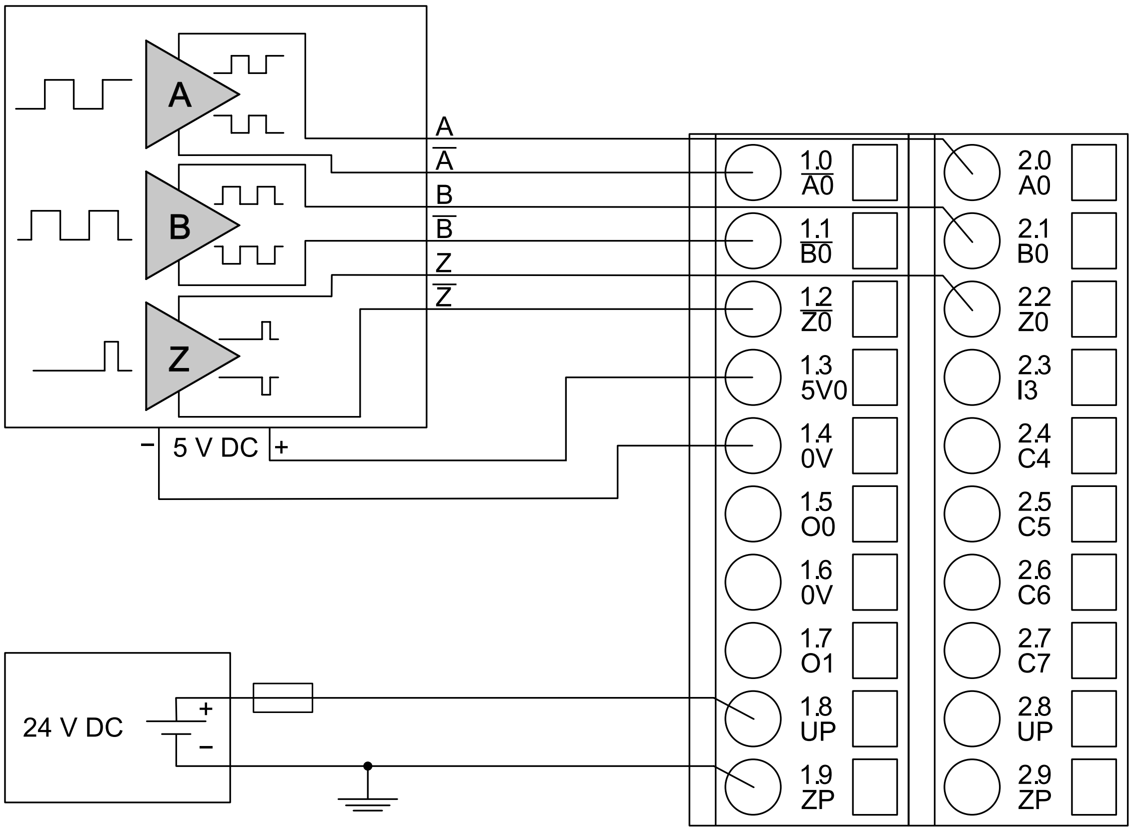
The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

- Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
- Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

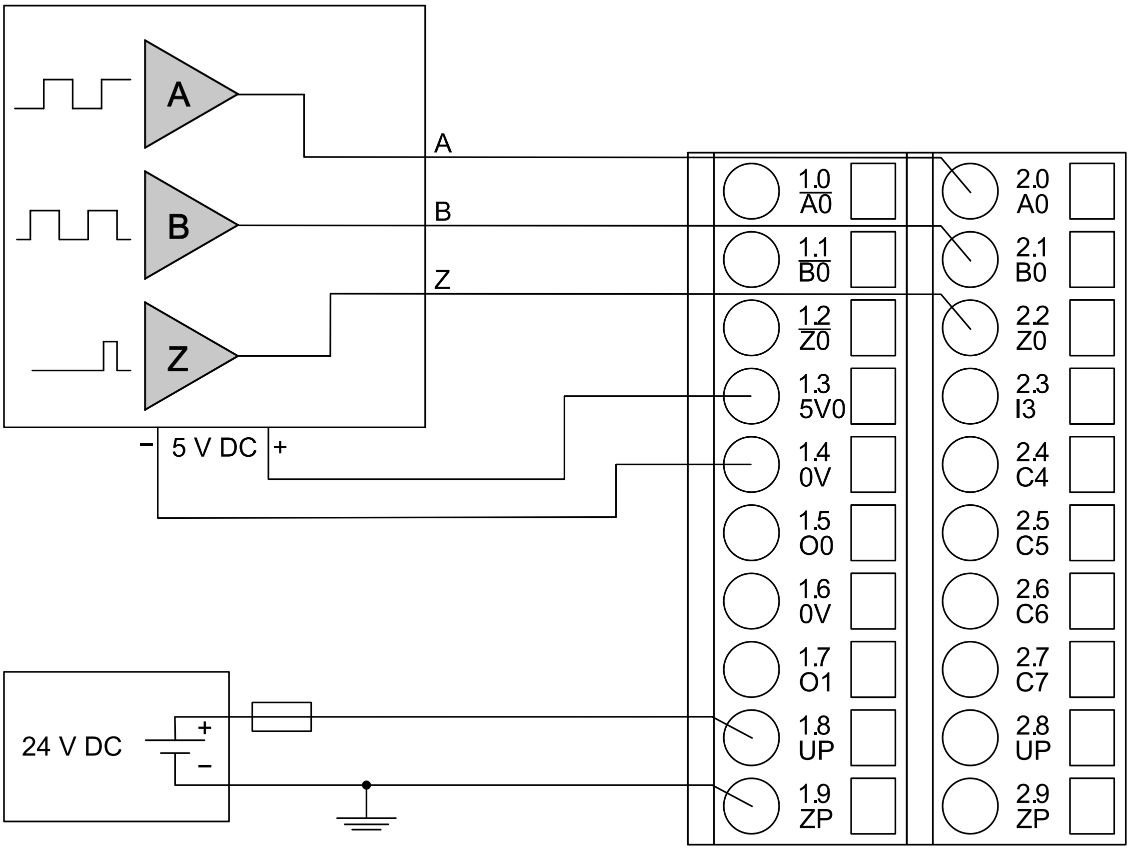
Connection of Encoders with Differential RS-422 Signal

The encoder is powered by the 5 V power supply which is integrated in CD522.

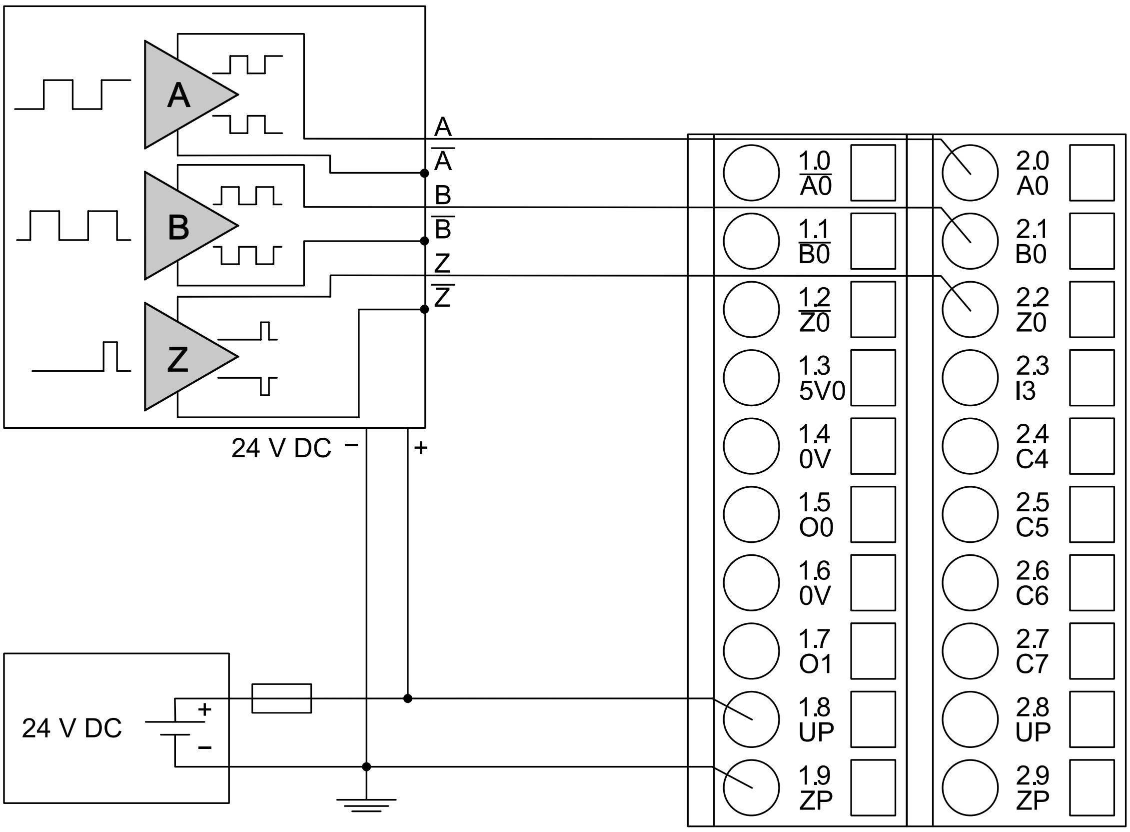


Connection of Encoders with 5 V TTL Signal

The encoder is powered by the 5 V power supply which is integrated in the CD522.



Connection of Encoders with 24 V Totem Pole Signal

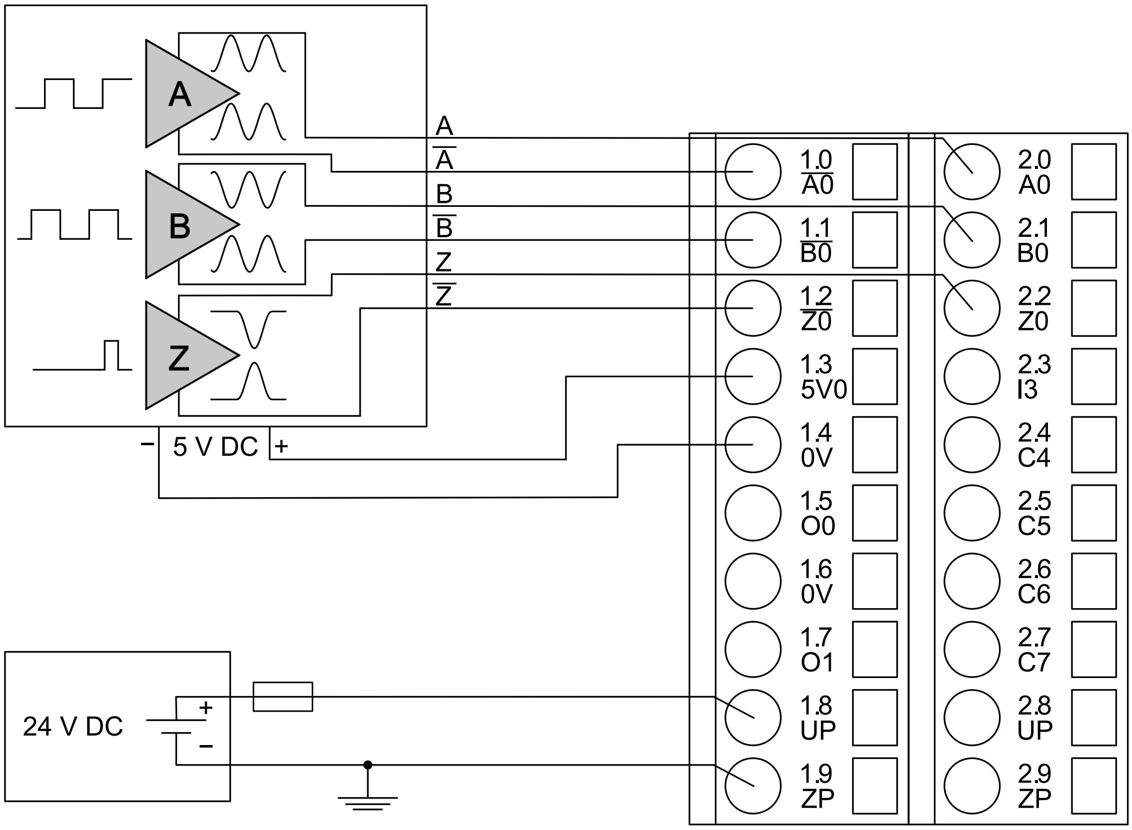


> *The wires A, B and Z need not to be connected to the module. They are left open.*

> *When using different power supplies for the encoder device and the CD522, make sure that the reference potentials of both power supplies are interconnected.*

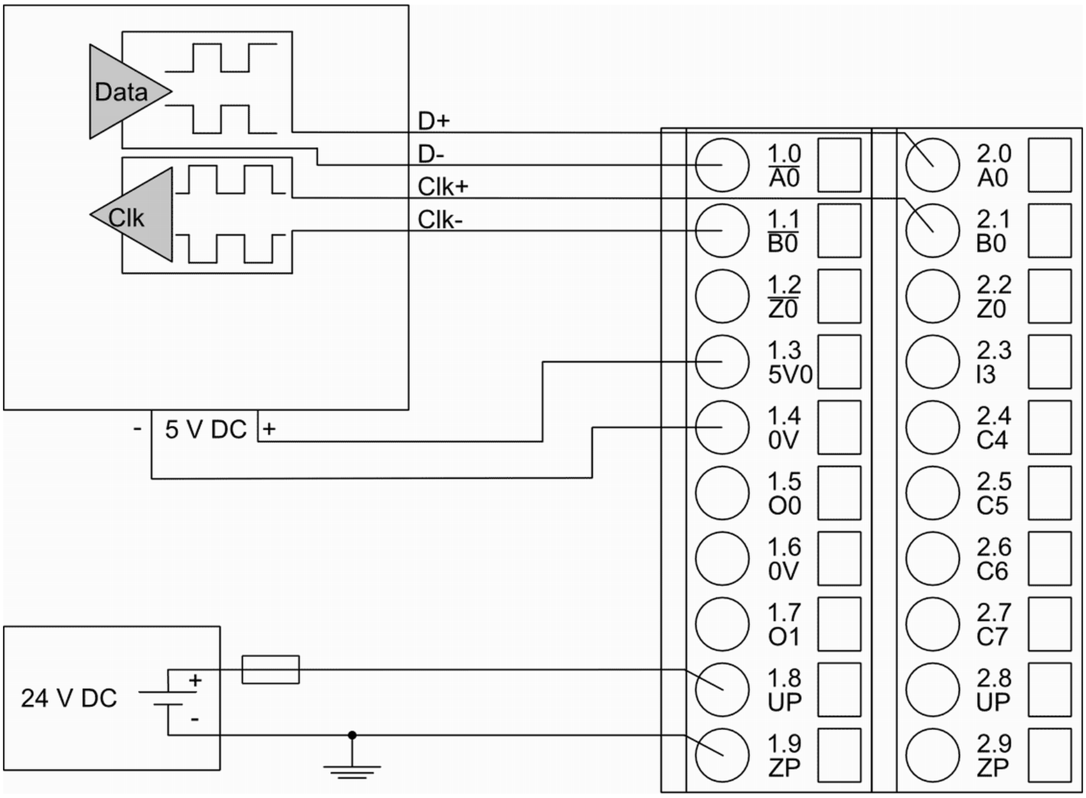
Connection of Encoders with 1 Vpp Sine Signal

The encoder is powered through the 5 V power supply which is integrated in the CD522.



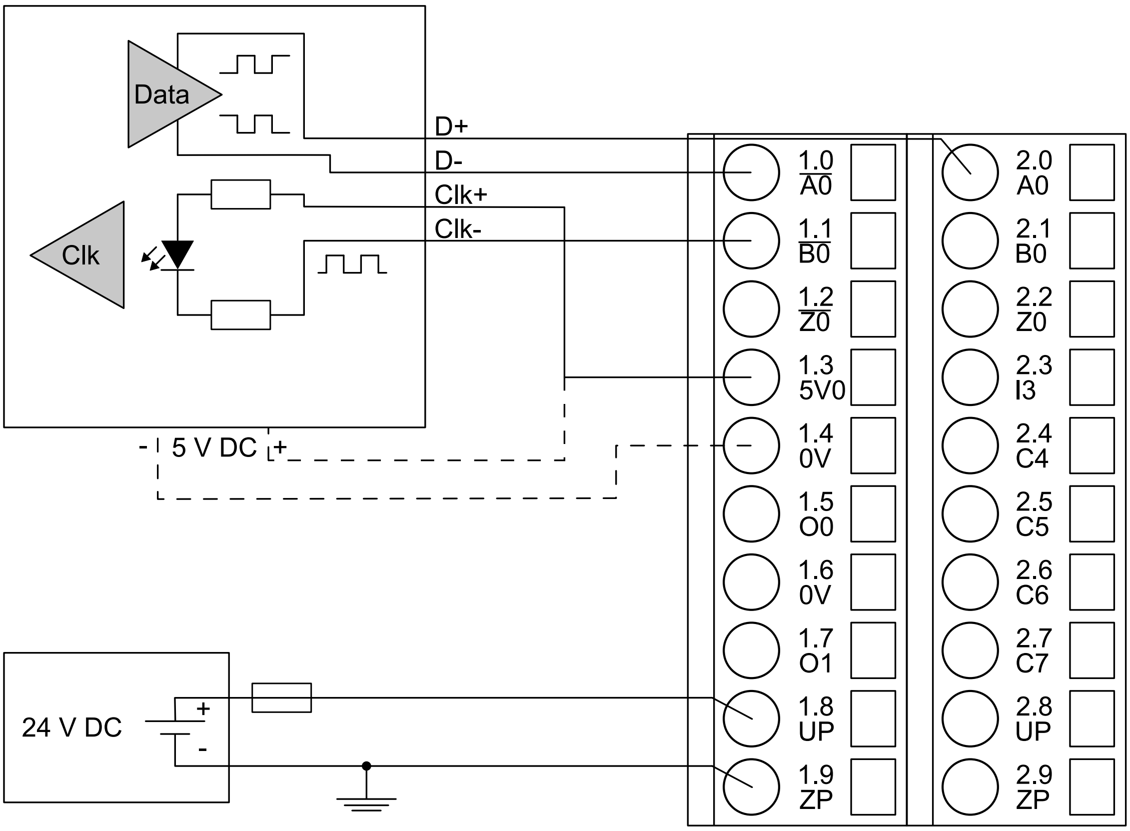
Connection of Absolute Encoders with SSI Interface and Differential RS-422 Signal

The encoder is powered by the 5 V power supply which is integrated in the CD522.

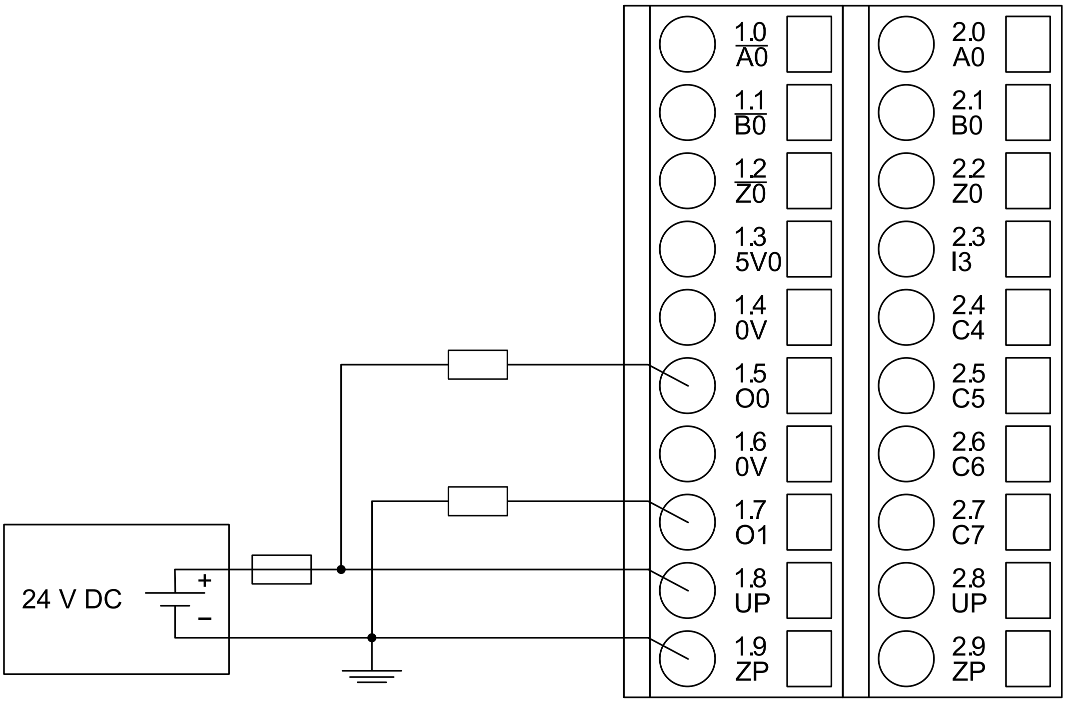


Connection of Absolute Encoders with an SSI Interface and an Opto-coupler Inter-face at CLK Input

The encoder can optionally be powered by the 5 V power supply which is integrated in the CD522.



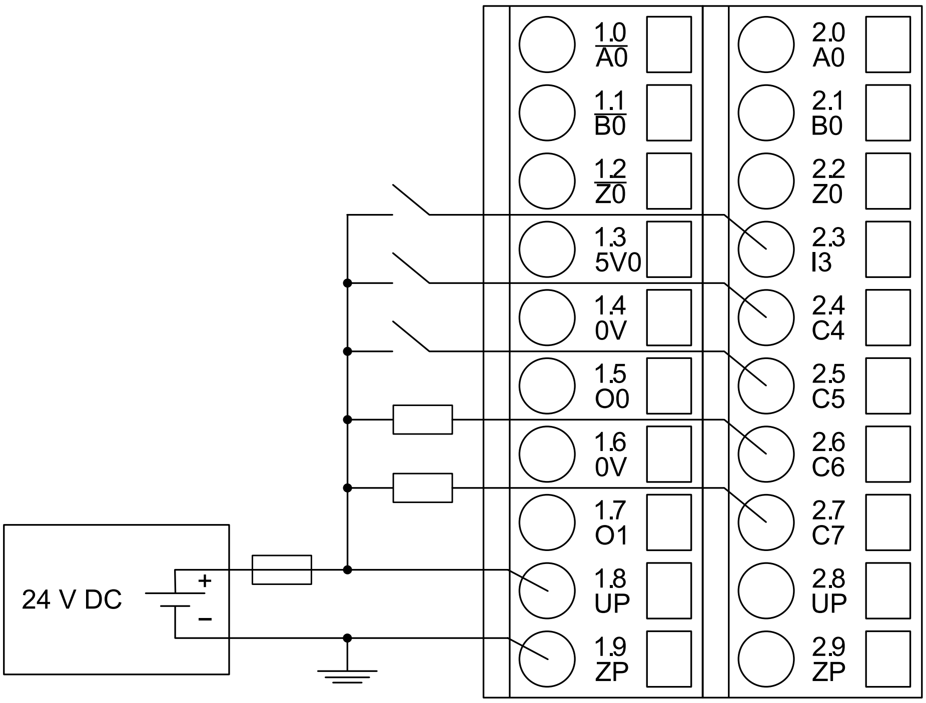
Connection of Output Loads to the PWM/Pulse Putputs



NOTICE!
Risk of damaging the Module
The PWM outputs have no protection against reverse polarity.

Connection of Standard Inputs/ Outputs

Proceed with the inputs/outputs I11 and C12-C15 in the same way.



Connection of Sensors with Frequency Outputs

Proceed with the A0, B0, A1, B1 and Z1 in the same way.

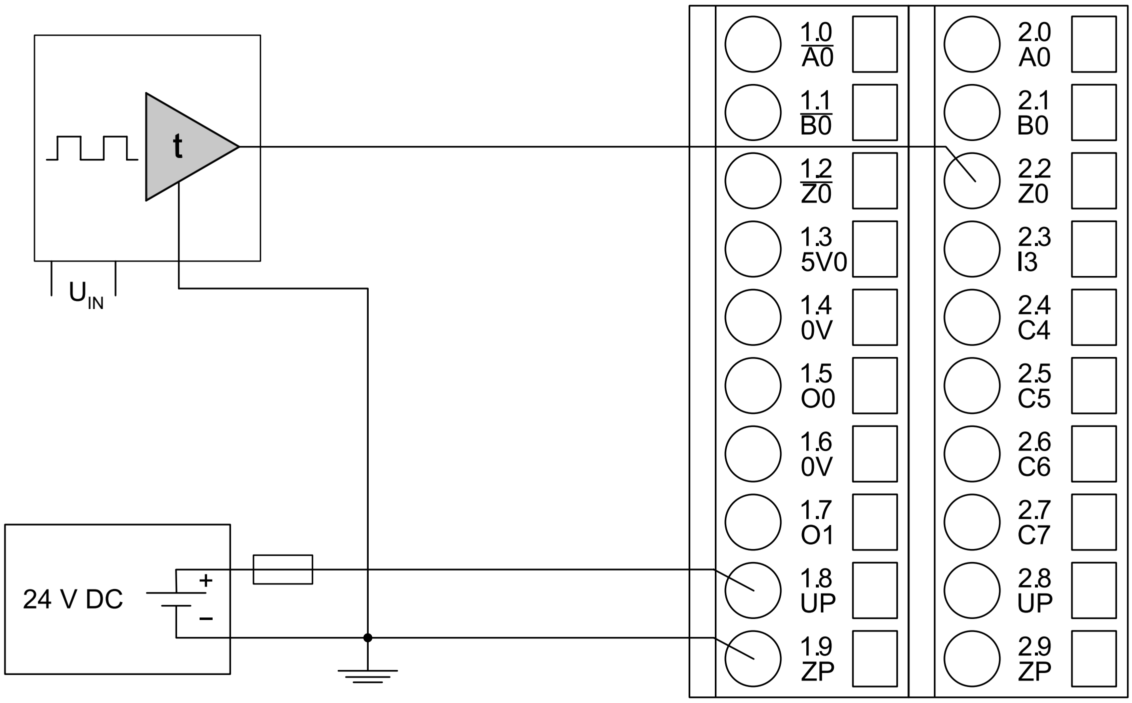


Fig. 108: Example of the electrical connection of sensors with frequency outputs to the input Z0 of the CD522

NOTICE!

Risk of malfunctions!

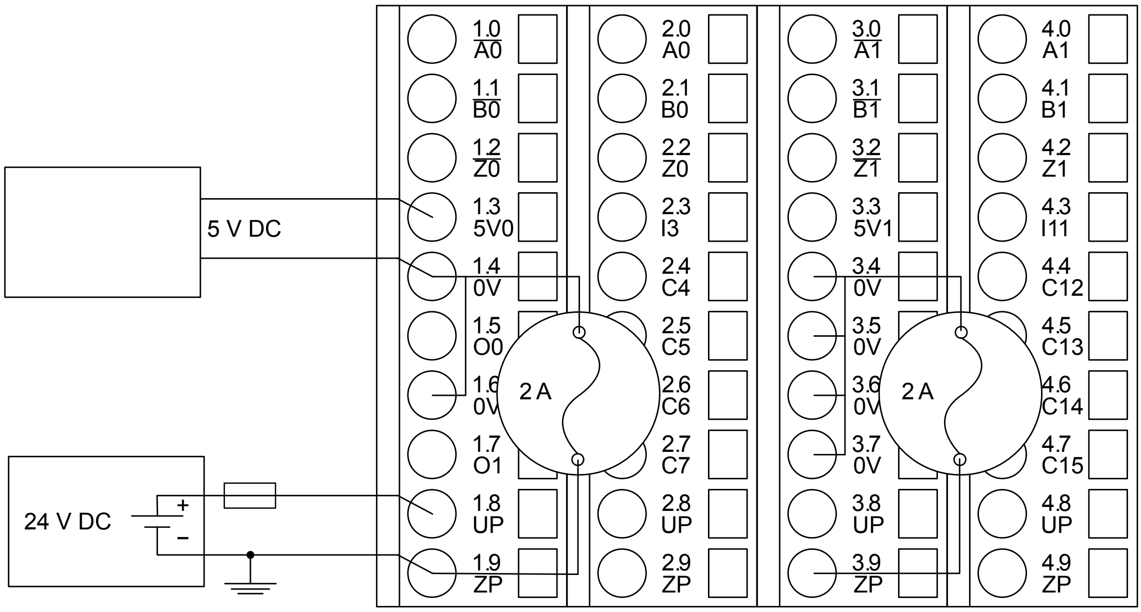
The edges of a signal must be strong enough (0.4 V/µs) to be recognized correctly by the module.

Put a 1 kΩ resistor between 0 V and the Z terminal when using a standard output as time generator.

Connection of Sensors to the 5 V Power Supply

Proceed with the 5 V power supply 1 in the same way.

Each 5-V-power supply provides a current of 100 mA max. It is possible to parallel both integrated power supplies. In this case, the max. current is 200 mA.



NOTICE!
Risk of Damaging the Module
The integrated 2 A fuse cannot be replaced. If it blows, the module must be replaced.

Ensure that the current per 0 V connection does not exceed 0.5 A.

NOTICE!
Risk of Damaging the Module
The two 5 V outputs have no protection against reverse polarity.

1.6.2.1.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	12
Analog outputs (words)	16

1.6.2.1.5 I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or bus module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

1.6.2.1.6 Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	1805 [1])	WORD	0x070D	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	BYTE	No 0x00			Not for FBP
Parameter length	Internal	42	BYTE	0	0	255	xx02 [3])
Check supply	Off On	0 1	BYTE	On 0x01			0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	8 ms 0x02	0	3	0x0Y04
Mode Counter 0	see table below	0	BYTE	0x00	0	15	0x0Y05
Counter 0 frequency limit	No filter 50 Hz 500 Hz 5 kHz 20 kHz	0 1 2 3 4	BYTE	No filter 0x00	0	4	0x0Y06
Counter 0 input level	0-24 V DC 0-5 V DC Differen-tial 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y07
SSI 0 frequency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	0	4	0x0Y08
SSI 0 resolution (in bit)	8 to 32 bit		BYTE	16 bit 16	8	32	0x0Y09
SSI 0 code type	Binary	0	BYTE	Binary 0	0	0	0x0Y0A

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
SSI 0 polling time	10 ms		BYTE	10	1	255	0x0Y0B
5 V sensor 0 supply	Off On	0	BYTE	Off 0x00	0	1	0x0Y0C
Mode Counter 1	see table below	0	BYTE	0x00	0	15	0x0Y0D
Counter 1 frequency limit	No filter 50 Hz 500 Hz 5 kHz 20 kHz	0 1 2 3 4	BYTE	No filter 0x00	0	4	0x0Y0E
Counter 1 input level	0-24 V DC 0-5 V DC Differen-tial 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y0F
SSI 1 fre-quency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	2	4	0x0Y10
SSI 1 res-olution (in bit)	8 to 32 bit		BYTE	16 bit 16	8	32	0x0Y11
SSI 1 code type	Binary	0	BYTE	Binary 0	0	0	0x0Y12
SSI 1 polling time	10 ms		BYTE	10	1	255	0x0Y13
5 V sensor 1 supply	Off On	0	BYTE	Off 0x00	0	1	0x0Y14
Detection SC on sensors	Off On	0	BYTE	Off 0x00	0	1	0x0Y15

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Output behaviour com fault	Off Last value Substitute Last value 5s Substitute 5s Last value 10s Sub-stitute 10s	0 1 2 3 4 5 6	BYTE	Off 0x00	0	1	0x0Y16
Substitute value	0	0	WORD	Default 0x0000	0	65536	0x0Y17

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

[2]) Not with FBP

[3]) Value is hexadecimal: HighByte is slot (xx: 1...10), LowByte is index (1...n)

Table 94: Operating modes for counters 0 and 1, configuration table

Internal value	Operating modes of counter
0	No counter / No PWM (default value)
1	1-1 UpDown counter (A)
2	2-1 UpDown with release input
3	3-2 UpDown counters (A, B)
4	4-2 UpDown (A, B on falling edges)
5	5-1 UpDown dynamic set (B) / rising edge
6	6-1 UpDown dynamic set (B) / falling edge
7	Not used
8	8-1 UpDown with release (B), 0 cross detection
9 - 19	Not used
20	11-1 Incremental encoder
21	12-2 Incremental encoder X2
22	13-1 Incremental encoder X4
30	14-1 SSI, absolute encoder
40	15-1 Time frequency meter

Table 95: GSD file

Ext_User_Prm_Data_Len =	25
Ext_User_Prm_Data_Const(0) =	0x07, 0x0E, 0x17, \
	0x01, 0x02, \
	0x00, 0x00, 0x00, 0x02, 0x10, 0x00, 0x0A, 0x00, \
	0x00, 0x00, 0x00, 0x02, 0x10, 0x00, 0x0A, 0x00, \
	0x00, 0x00, 0x00, 0x00;

1.6.2.1.7 Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

Table 96: Channel error CD522

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Channel error							
4	14	1...10	1	0...15	47	Output short circuit	Check output connection or terminal
	11 / 12	ADR	1..10				
4	14	1...10	1	0, 1, 8, 9	10	Input frequency too high	Check frequency filter parameter or sensor
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	2	PWM frequency too high	Clamp min/max value in program
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	10	PWM duty cycle out of range (0-1000)	Clamp min value to 0 in program
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	11	5 V sensor supply too low	Check wiring & sensor power
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	18	Internal fuse on 0 V has blown, 0 V not connected to GND	Check wiring, replace module
	11 / 12	ADR	1...10				

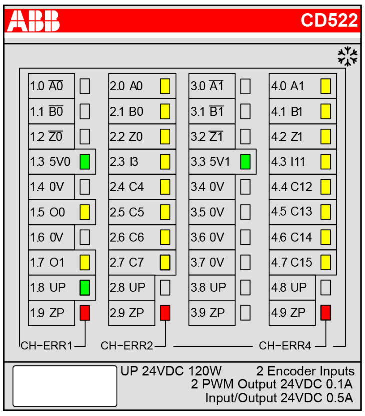
Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)

3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

1.6.2.1.8 State LEDs

During the power-on procedure, the module initializes automatically. All LEDs (except the LEDs for the signal states) are on during the initialization.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	A0, B0, Z0	Encoder 0 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
	A1, B1, Z1	Encoder 1 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
	I3 and I11	Digital inputs	Yellow	Input = ON (the input voltage is even dis-played if the supply voltage is OFF).	Input = OFF	---
	C4 to C7 and C12 to C15	Configurable digital inputs/ outputs	Yellow	Input/output = ON (the input voltage is even dis-played if the supply voltage is OFF).	Input/output = OFF	---
	O0 and O1	Digital PWM outputs	Yellow	Output = ON	Output = OFF	LED follows the state of the outputs, depending on frequency and operation mode
	5V0 and 5V1	Power supply for encoders	Green	Configura-tion ON and power 5-V-power ready	Configuration OFF or power failure	Power supply outputs are short-circuited
	UP	Process supply voltage	Green	Process voltage OK	Process voltage is missing	---

LED		State	Color	LED = OFF	LED = ON	LED flashes
	CH-ERR1, CH-ERR2, CH-ERR4		Red	Serious error within the corre-sponding group	No error or process voltage is missing	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR *)	Error indica-tion	Red	Internal error or con-figuration is not loaded	--	---
	*) All LEDs CH-ERR1, CH-ERR2 and CH-ERR4 light up simultaneously					

1.6.2.1.9 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 VDC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V)
	Protection against reverse voltage	Yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 VDC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.008 A per input + max. 0.5 A per output + 0.01 A for A, B and Z inputs
	Via I/O bus	Ca. 5 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		Yes, per module
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or vertical with derating (output load reduced to 50 % at 40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs/Outputs if Used as Standard Inputs

Parameter		Value
Number of channels		2 + 8 configurable digital inputs/outputs
Reference potential for all inputs		Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input data length		24 bytes
Input signal voltage		24 V DC
	Signal 0	-3 V...+5 V *
	Undefined signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V *
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if Used as Standard Outputs

Parameter		Value
Number of channels		8 configurable digital inputs/outputs
Reference potential for all outputs		Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8...4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		Typ. 10 µs
Output data length		32 bytes
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together, PWM included)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

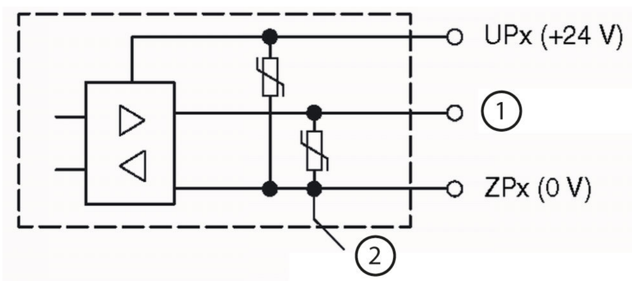


Fig. 109: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off

Technical Data of the High-Speed Inputs (A0, B0, Z0; A1, B1, Z1)

Parameter	Value
Number of channels per module	6
Reference potential for all inputs	Terminal 1.9, 2.9, 3.9 and 4.9 (negative pole of the process voltage, signal name ZP)

Parameter	Value	
Input Type	24 VDC	5 VDC / Differential Sinus 1 Vpp
Input current per channel		
Input voltage +24 V	Typ. 14 mA	
Input voltage +5 V	> 4.8 mA	
Input voltage +15 V	> 12 mA	
Input voltage +30 V	< 15 mA	
Input type acc. to EN 61131-2	Type 1	
Input frequency max. (fast counter)	300 kHz	300 kHz
Input frequency max. (frequency measurement)	5 kHz	5 kHz
Input signal voltage	24 VDC	5 VDC
Signal 0	-3 V...+5 V	-3 V...+0,5 V
Undefined signal	> +5 V...< +15 V	--
Signal 1	+15 V...+30 V	+0,5 V...+30 V
Ripple with signal 0	Within -3 V ... +5 V	Within -3 V...+0.5 V
Ripple with signal 1	Within +15 V...+30 V	Within +0,5 V...+30 V
Max. cable length		
Shielded	1000 m	
Unshielded	600 m	

Technical Data of the Fast Outputs O0 and O1

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8...4.8 (positive pole of the process supply voltage, signal name UP)
Indication of the output signals	Brightness of the LED depends on the number of pulses emitted (0 % to 100 %) (pulse output mode only)
Output voltage for signal 1	UP (-0.1 V)
Output voltage for signal 0	ZP (+0.3 V)
Output delay (0->1 or 1->0)	Typ. 1 μs
Output current	
Rated value, per channel	100 mA at UP = 24 V
Maximum value (all channels together, configurable outputs included))	8 A
Leakage current with signal 0	< 0.5 mA
Rated protection fuse on UP	10 A fast
De-magnetization when inductive loads are switched off	With varistors integrated in the module (see figure above)

Parameter		Value
Switching frequency		PWM: up to 100 kHz (min. step for PWM value: 2 µs) Pulse: up to 15 kHz
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.1x A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short-circuit/ overload
Resistance to feedback against 24 V signals		Yes
Resistance to feedback against reverse polarity		No
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Fast Outputs (SSI CLK Output B0, B1 for Optical Interface)

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8...4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 0	≤ 1.5 V at 10 mA
Output delay (0->1 or 1->0)	Typ. 0.3 µs
Output current	≤ 10 mA
Switching frequency	< 1 Mhz (depending on firmware)
Short-circuit-proof / overload-proof	Yes
Output current limitation	Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals	Yes
Resistance to feedback against reverse polarity	No
Max. cable length (shielded)	Typ. 12.5 m at 500 kHz (depending on sensor)

Technical Data of the Fast Outputs (SSI CLK Output Differential)

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8...4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1	≥ 2.9 V at 10 mA
Output voltage for signal 0	≤ 1.3 V at 10 mA
Output delay (0->1 or 1->0)	Typ. 0.3 µs

Parameter	Value
Output current	≤ 10 mA
Switching frequency	< 1 Mhz (depending on firmware)
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.1x A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short-circuit/ overload
Resistance to feedback against 24V signals	Yes
Resistance to feedback against reverse polarity	No
Max. cable length (shielded)	100 m

Technical Data of the 5 V Sensor Supply

Parameter	Value
Number of supplies	2, independently configuration
Voltage supply (outputs unloaded)	5 VDC +/- 5%
Resistance to feedback against reverse polarity	No
Output current	100 mA max. (independently) 200 mA max. (parallel use)
Output diagnosis	Yes, with diagnosis LED and error message

Technical Data of the 0 V Reference Input

Parameter		Value
Number of reference inputs (internally connected to ZP through internal fuse)		6
Max. current per connection		0.5 A
Internal fuse protection		
	Terminals 1.4 and 1.6	2 A
	Terminals 3.4 to 3.7	2 A

1.6.2.1.10 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 260 300 R0001	CD522, encoder & PWM module, 2 encoder inputs, 2 PWM outputs, 2 digital inputs 24 VDC, 8 digital outputs 24 VDC	Active
1SAP 460 300 R0001	CD522-XC, encoder & PWM module, 2 encoder inputs, 2 PWM outputs, 2 digital inputs 24 VDC, 8 digital outputs 24 VDC, XC version	Active

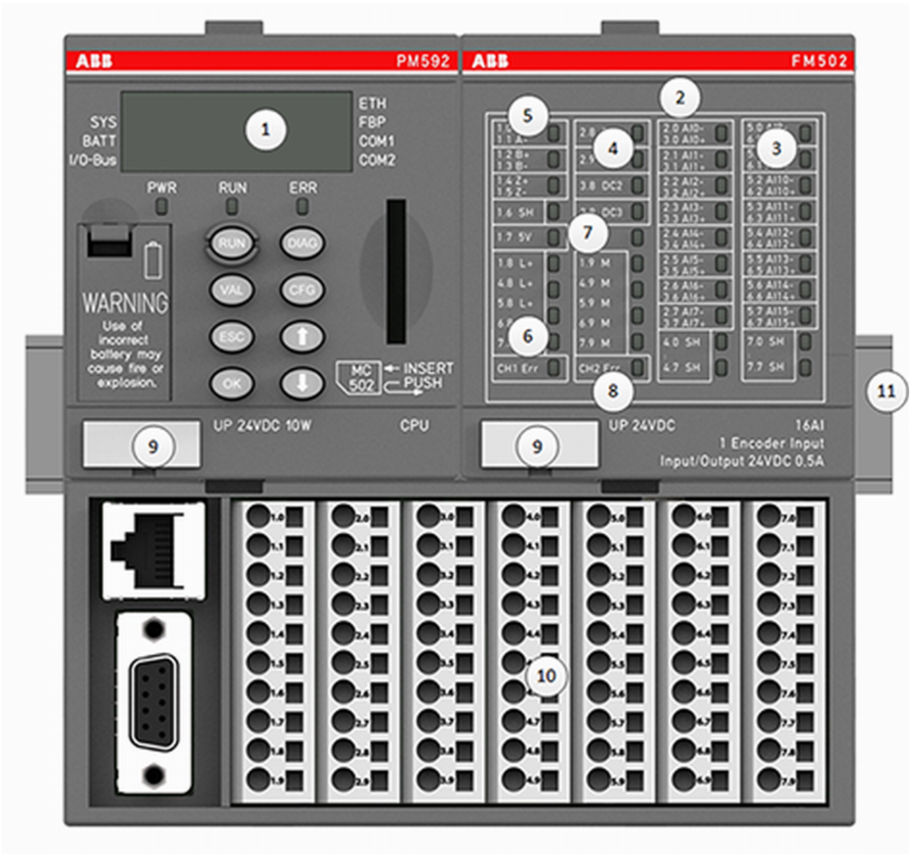
**) For planning and commissioning of new installations use modules in Active status only.*

1.6.2.2 FM502-CMS - Analog Measurements

- 16 fast analog inputs, up to 50k samples/s.
- Counting functions with different configurable modes, including incremental position encoder and frequency input.
- 4 dedicated inputs/outputs for specific counting measurement functions, e.g. touch, set, reset, start measurement.
- All unused inputs/outputs can be used with the specifications of standard inputs/outputs range.
- Synchronous sampling between all analog channels and the counting input.

FM502-CMS is used for condition monitoring via fast analog signals. For direct connection to processor module PM592-ETH and wiring, the function module terminal bases TF501-CMS or TF521-CMS are available, enabling AC500 communication modules and AC500 I/O modules *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64* *Chapter 1.1.2 “TF501-CMS and TF521-CMS - Function Module Terminal Bases ” on page 13*.

For usage in extreme ambient conditions a XC version is available.



1 Processor module PM592-ETH
2 Allocation between terminal no. and signal name
3 16 green/red LEDs to display the signal states at the analog inputs A0-A15
4 4 yellow LEDs to display digital inputs DI0, DI1 and digital inputs/outputs DC2,DC3
5 3 yellow LEDs display encoder/counter inputs
6 1 green LED to display the state of the process supply voltage L+
7 1 green LED to display the state of 5 V supply voltage for encoder
8 2 red LEDs to display errors
9 Label
10 Function module terminal base
11 DIN rail
Sign for XC version

1.6.2.2.1 Electrical Connection

FM502-CMS is plugged on the TF5x1-CMS together with PM592-ETH. The electrical connection is established using the terminals of the TF5x1-CMS. The FM502-CMS can be replaced without re-wiring the TF5x1-CMS *Chapter 1.1.2 “TF501-CMS and TF521-CMS - Function Module Terminal Bases ” on page 13*.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

Connection of IEPE Sensors

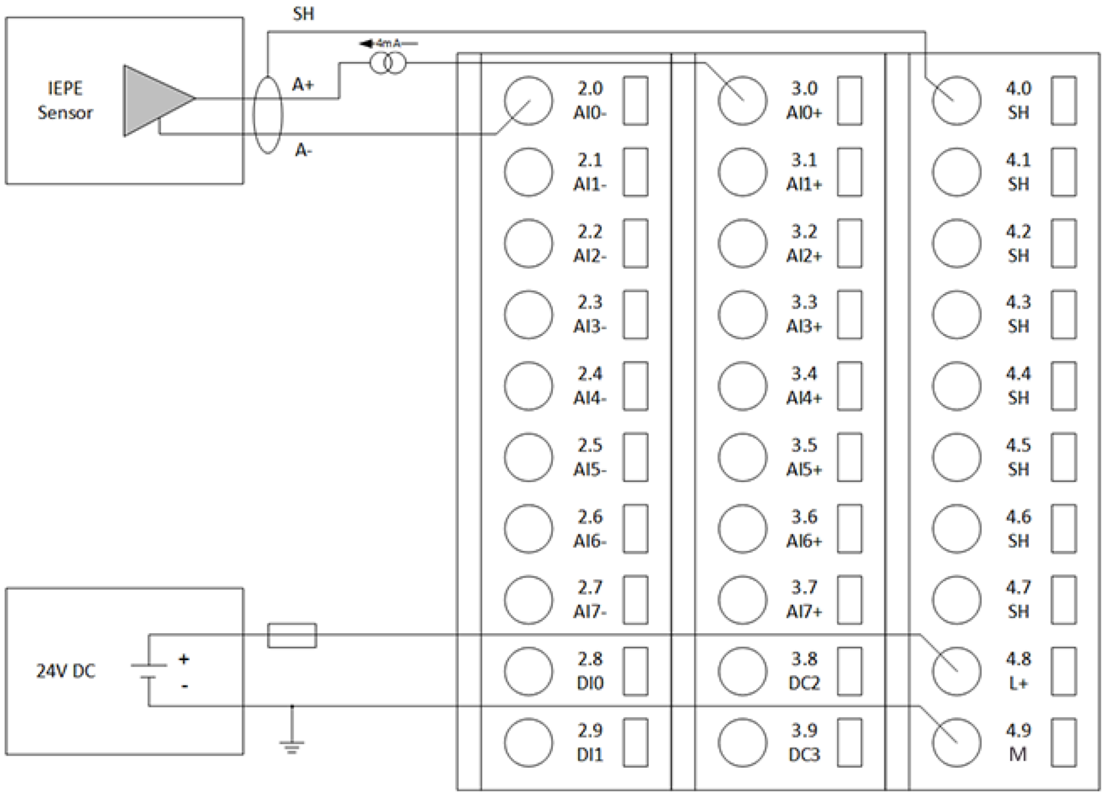
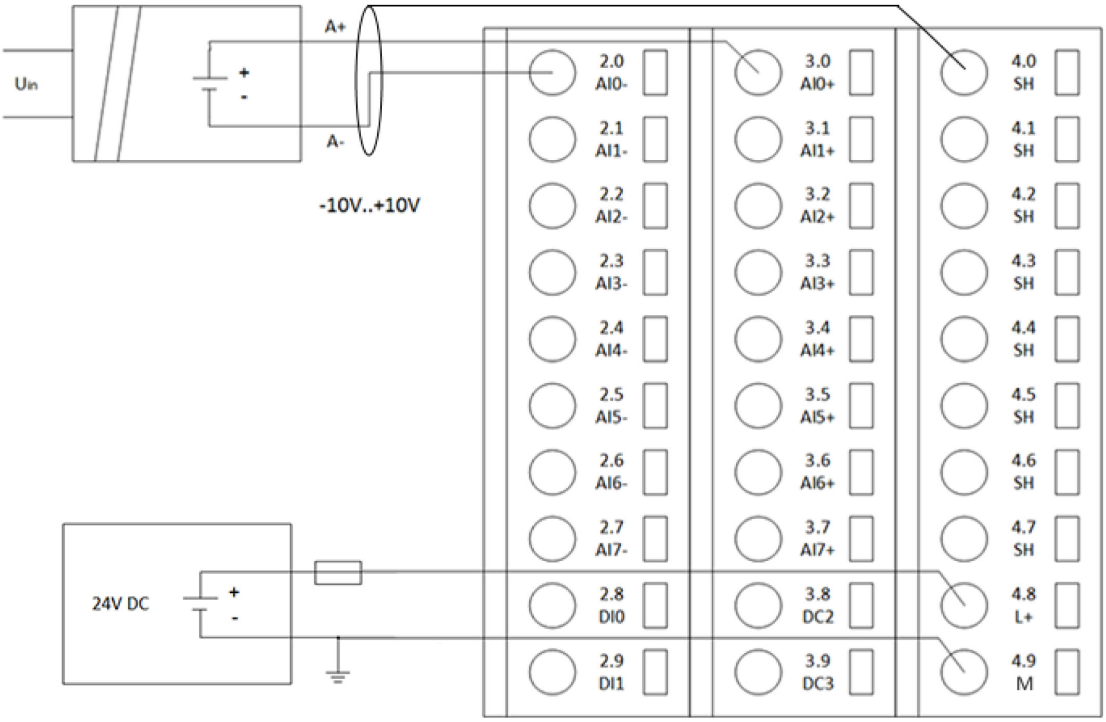


Fig. 110: Connection of IEPE sensor to the FM502-CMS

In order to avoid error messages or long processing times, we recommend to configure unused analog input channels as "unused".

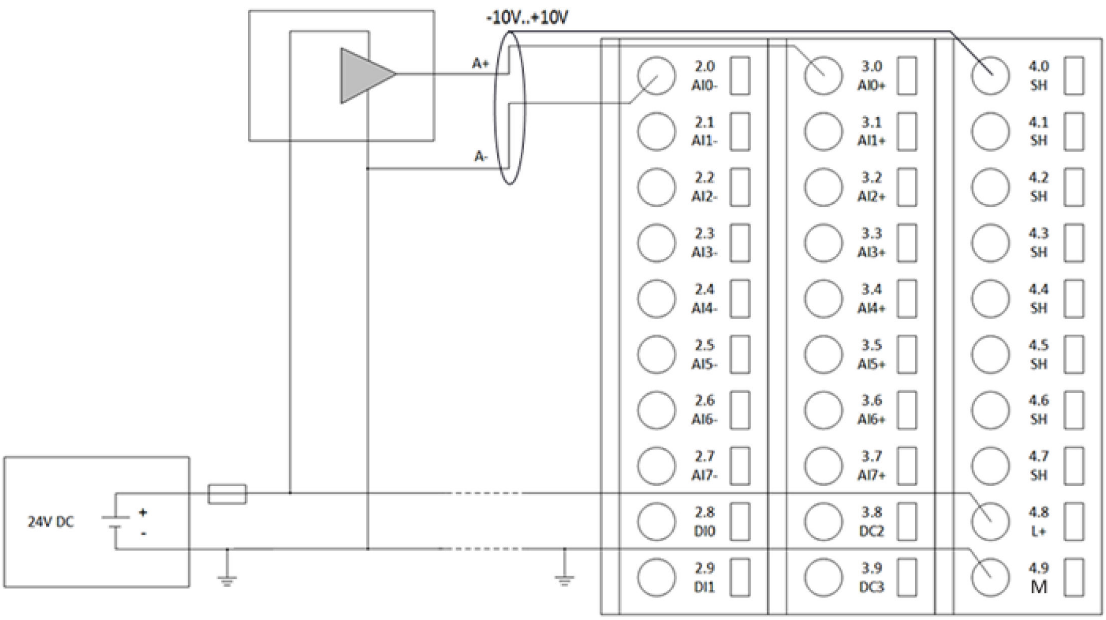
> *For the open-circuit detection (cut wire) in IEPE mode, each channel is pulled up to the positive supply rail by a high impedance. If nothing is connected, the maximum value will be read* *➪ Chapter 1.6.2.2.5 “Measuring Ranges” on page 692.*

Connection of Active-Type Analog Sensors (Voltage) with Electrically Isolated Power Supply



Every negative analog input is internally connected to M (0 V) via an individual low impedance (PTC) return current path for the sensor supply current in IEPE mode. This is important for applications where a high input impedance on the negative analog input is required. Example: Stain gauges, bridge network.

Connection of Active-Type Analog Sensors (Voltage) with no Electrically Isolated Power Supply



> **NOTICE!**
> Analog sensors should be electrically isolated against earth. In order to avoid inaccuracy with the measuring results, the analog sensors should also be isolated against the power supply.

NOTICE!
If A- is not connected directly to M at the sensor, the supply current flows via A- to M. Measuring errors can occur caused by voltage differences between M and A-.

NOTICE!
At system start up, the 4 mA current source on each analog input is active for < 10 s. During this limited time, a positive analog input will drift to < 21 V and no current is flowing, when a high impedance sensor is connected. When a low impedance sensor is connected to the analog input, the current is limited to 4 mA. For analog sensors other than standard IEPE, please make sure that the connected sensor will not be damaged under these conditions.

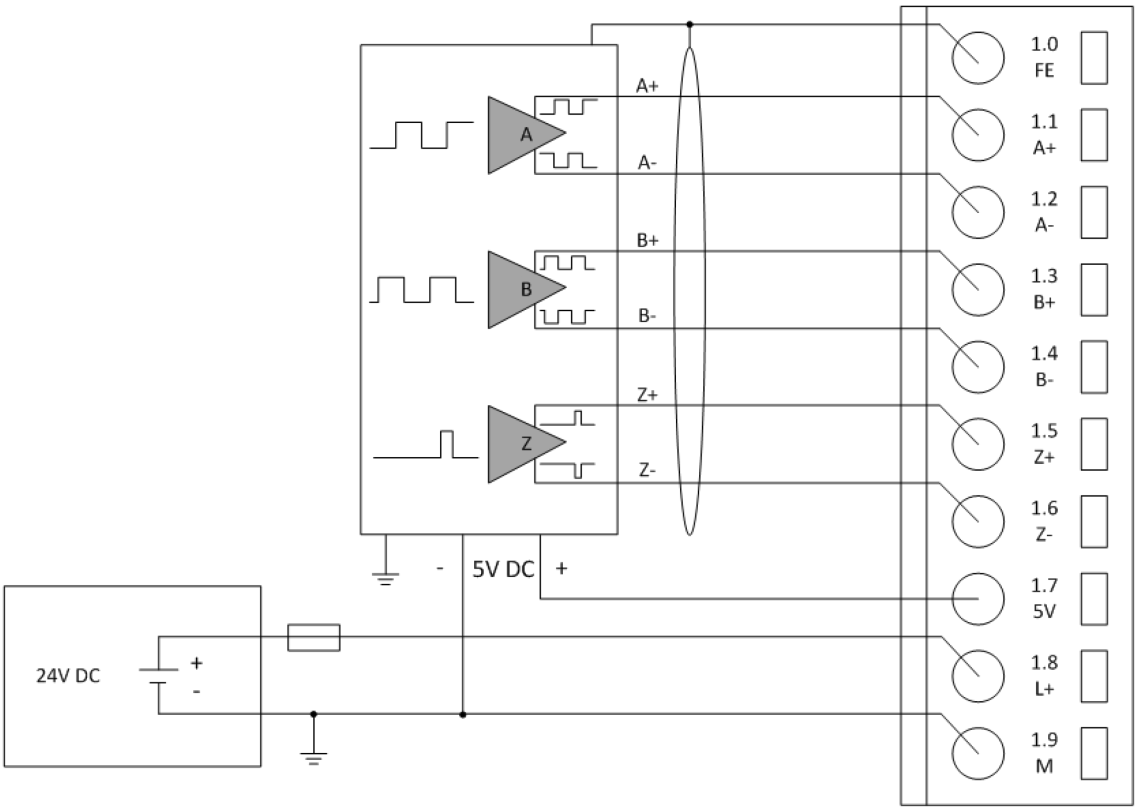
Analog signals must be laid in shielded cables. The analog cable shield must only be connected on the module side (SH terminals) to avoid relaxation currents influencing the measuring results, and for optimal robustness against external noise. The shield connection must be as short as possible (< 3 cm). The analog shield is capacitive coupled internally with functional earth (FE). Generally to avoid unacceptable potential differences between different parts of the installation, low-resistance equipotential bonding conductors must be laid.

In order to avoid error messages or long processing times, it is recommended to configure unused analog input channels as "unused".

In order to avoid inaccuracy in the analog measurement, the FM502-CMS should be in thermal balance > 15 minutes after power up and start of the PLC application, before measurements are started.

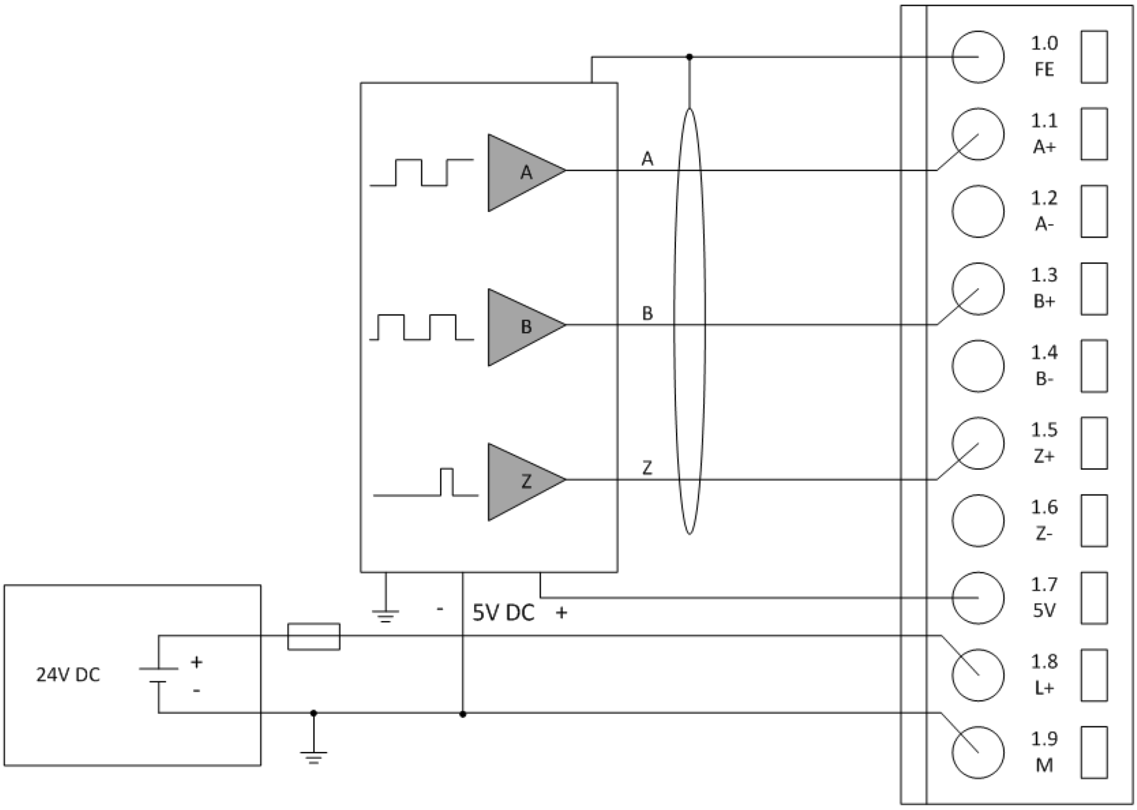
Connection of Encoders with Differential RS-422 Signal

The encoder is powered by the 5 V power supply which is integrated in the FM502-CMS.

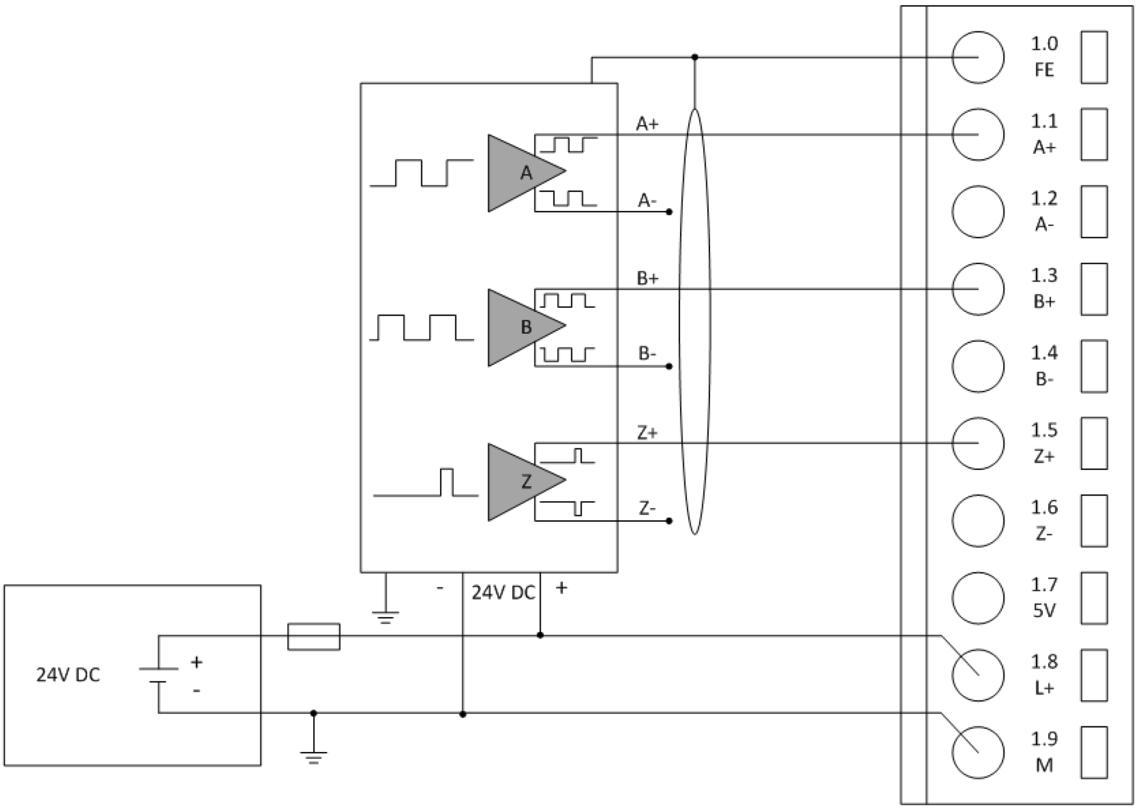


Connection of Encoders with 5 V TTL Signal

The encoder is powered through the 5 V power supply which is integrated in the FM502-CMS.



Connection of Encoders with 24 V Totem Pole Signal

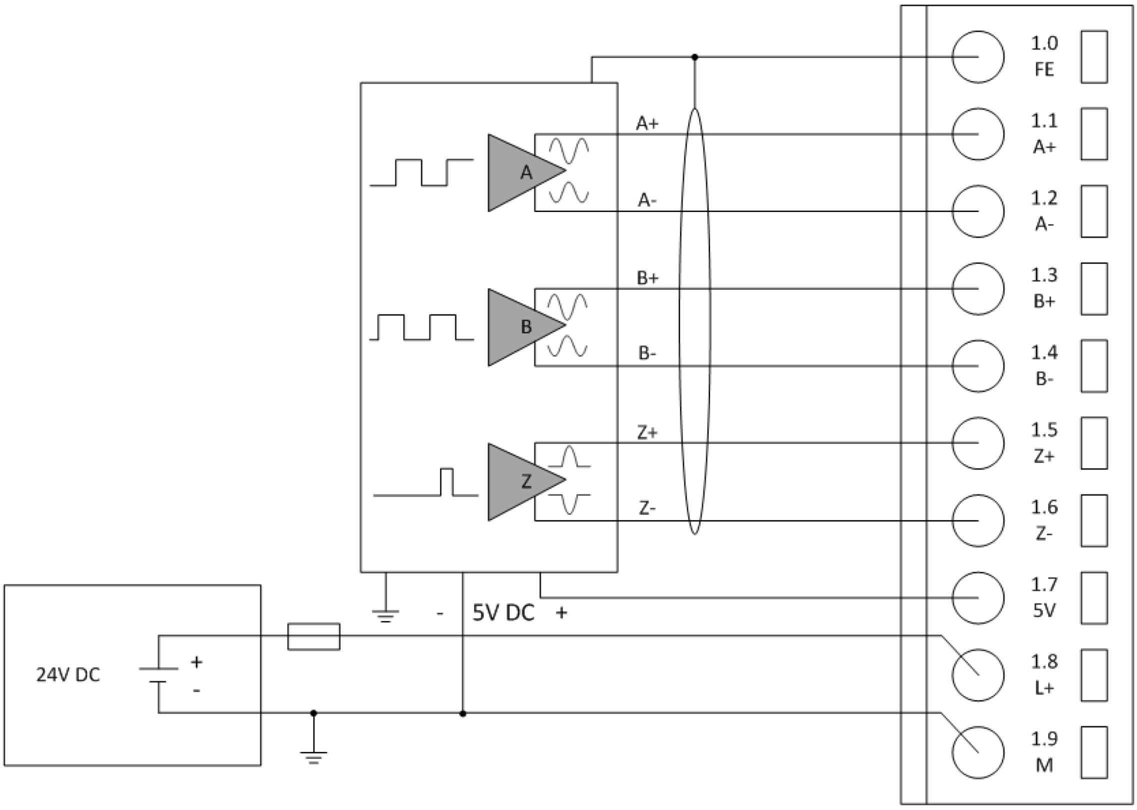


The wires A-, B- and Z- must not be connected to the module for single-ended operation. They are left open.

When using different power supplies for the encoder device and the FM502-CMS, make sure that the reference potentials of both power supplies are interconnected.

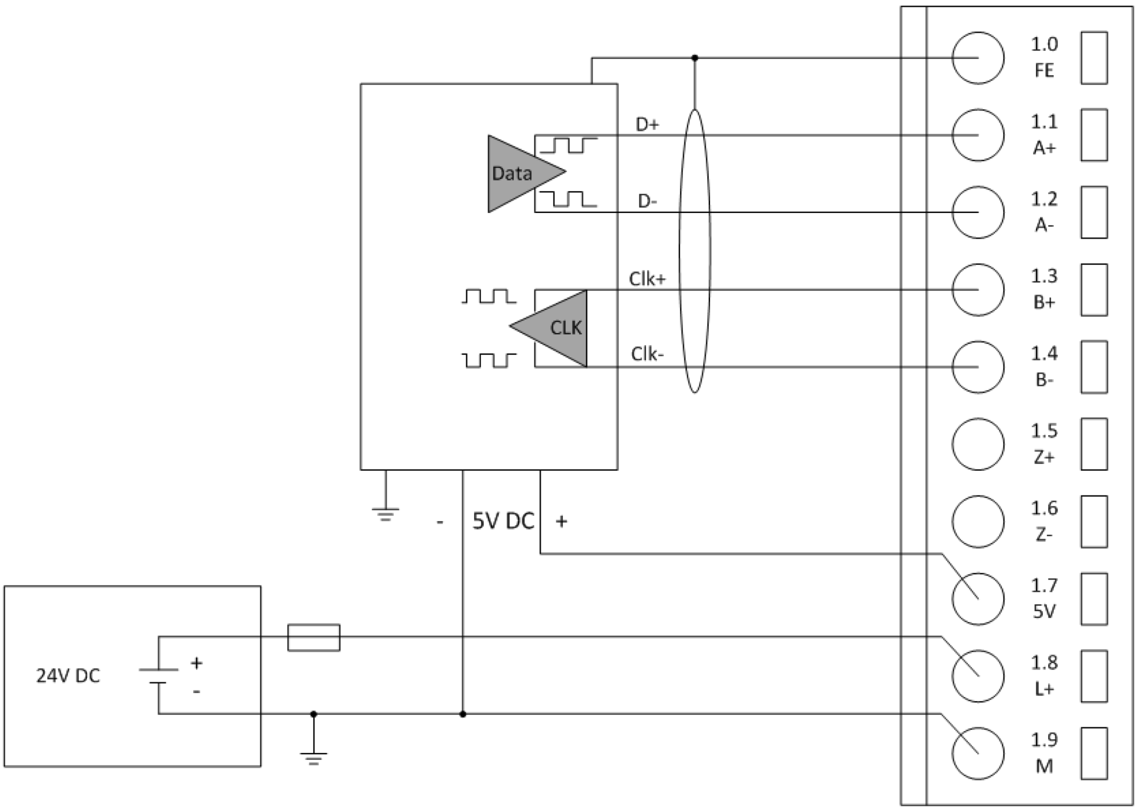
Connection of Encoders with 1 Vpp Sine Signal

The encoder is powered by the 5 V power supply which is integrated in the FM502-CMS.



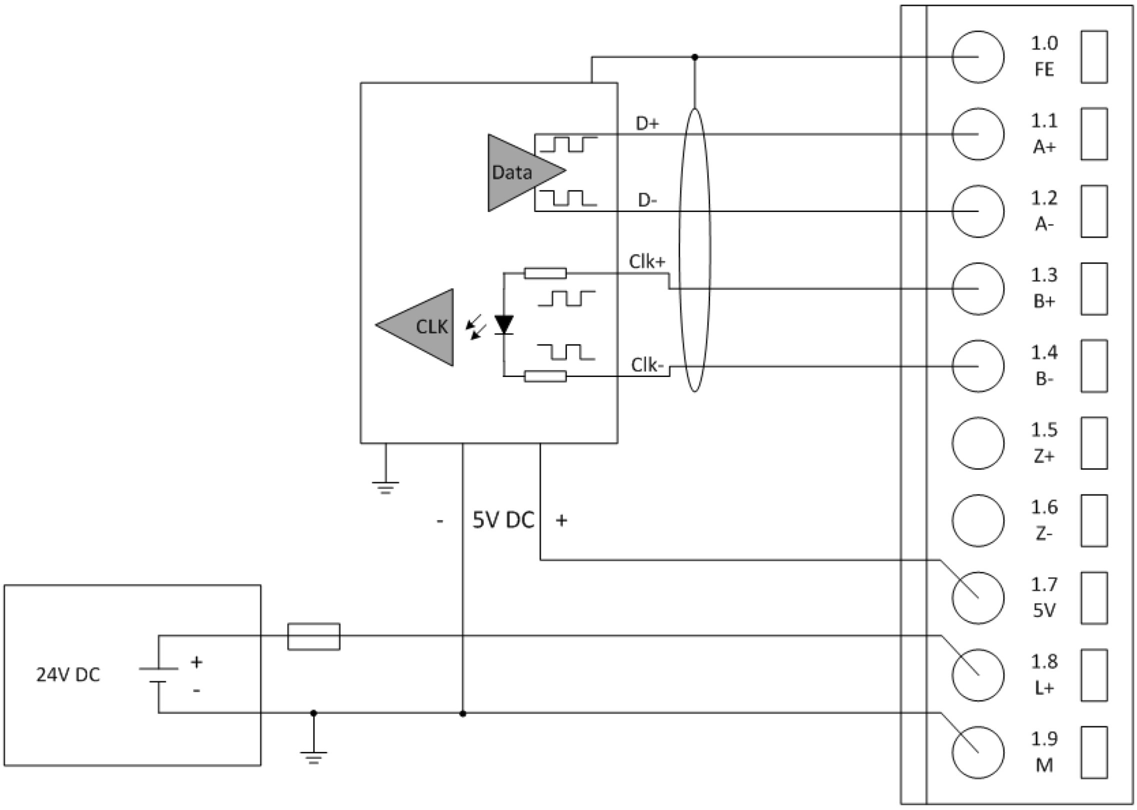
Connection of Absolute Encoders with RS-422 Differential SSI Interface

The encoder is powered by the 5 V power supply which is integrated in the FM502-CMS.



Connection of Absolute Encoders with Optical SSI Interface (opto-coupler at CLK input)

The encoder can optionally be powered by the 5-V-power-supply which is integrated in the FM502-CMS.

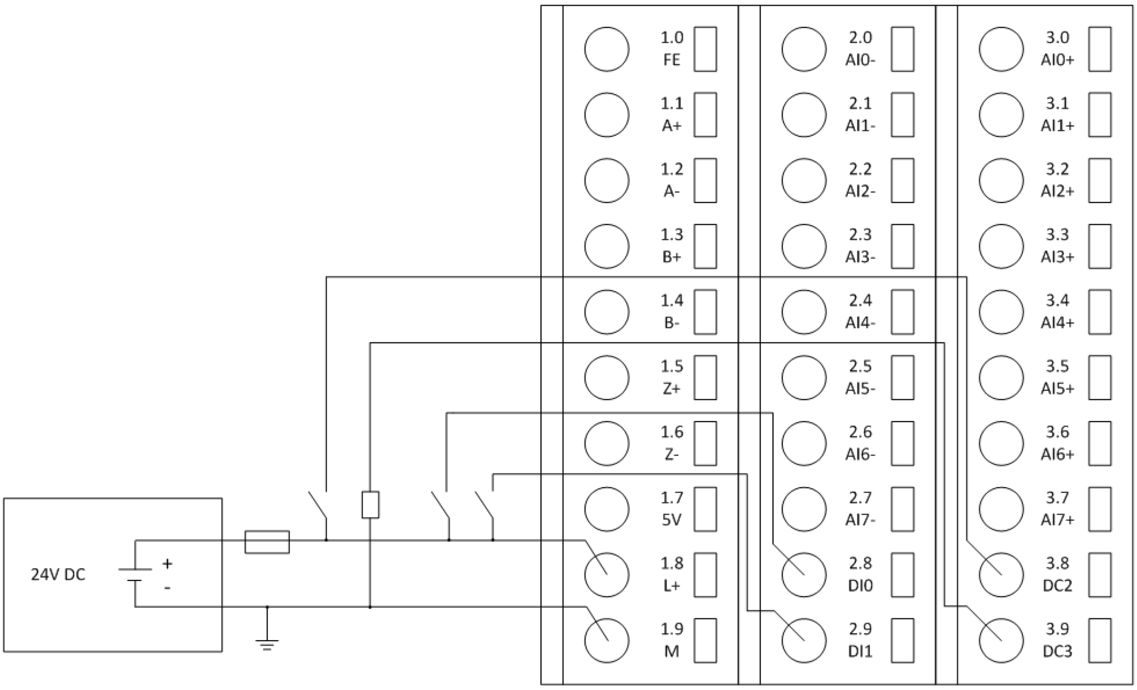


Encoder/counter signals must be laid in shielded cables. The cable shield must be earthed at both sides of the cable. In order to avoid unacceptable potential differences between different parts of the installation, low-resistance equipotential bonding conductors must be laid. Only for applications with low disturbance and/or cables length < 30 m the shield might be omitted.

The 5 V output provides a current of 100 mA max.

NOTICE!
Risk of damaging the FM502-CMS!
The 5 V output has no protection against reverse polarity.

Connection of Standard Inputs/ Outputs



Connection of Sensors with Frequency Outputs

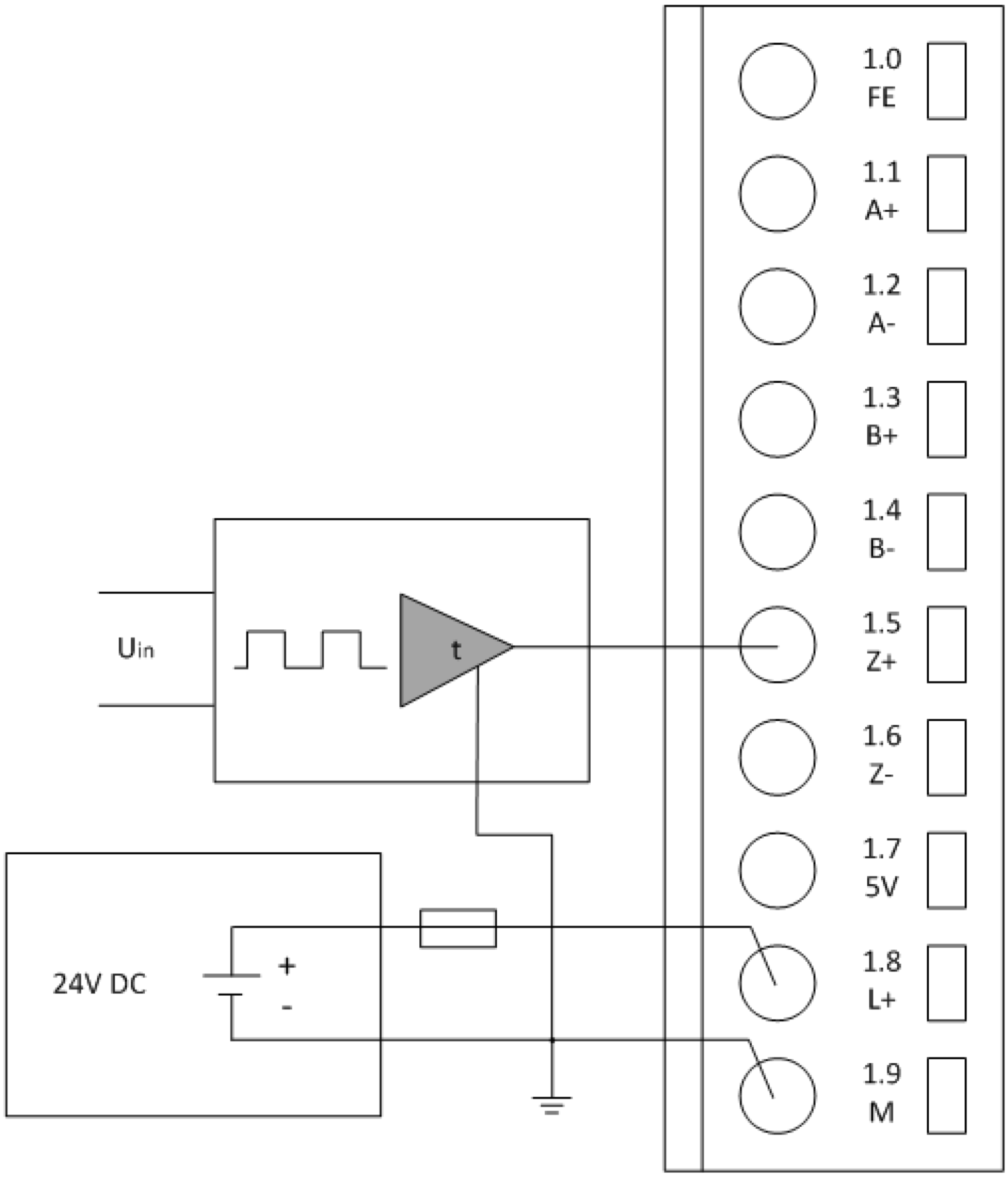


Fig. 111: Example for electrical connection of sensors with frequency outputs to the input Z+

1.6.2.2.2 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	4
Digital outputs (bytes)	8
Counter inputs (words)	4
Counter outputs (words)	2
Analog inputs (words)	16
Analog outputs (words)	0

1.6.2.2.3 Diagnosis

Table 97: Module Error FM502-CMS

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500 display	<-- Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error mes-sage**	**Online number**	**Remedy**
	1)	2)	3)	4)				
3	5	255	29	31	3	Timeout in the I/O module	184545219	Replace I/O module
3	5	255	29	31	11	Process voltage too low	184545227	Replace I/O module
4	5	255	29	31	13	FW update failed	184545229	Retry FW update
3	5	255	29	31	18	5 V sensor supply too low	184545234	Check wiring & sensor power, Replace I/O module
3	5	255	29	31	19	Checksum error in the I/O module	184545235	Replace I/O module
3	5	255	29	31	36	Internal data exchange failure	184545252	Replace I/O module
3	5	255	29	31	43	Internal error in the module	184545259	Replace I/O module
4	5	255	29	31	52	Production data missing	184545268	Call support

Table 98: Channel Error FM502-CMS

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<-- Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Online number**	**Remedy**
	1)	**2)**	**3)**	**4)**				
4	5	255	29	0..15	5	Analog value overflow at an analog input	184543237, 184543301, 184543365, 184543429, 184543493, 184543557, 184543621, 184543685, 184543749, 184543813, 184543877, 184543941, 184544005, 184544069, 184544133, 184544197	Check input value
4	5	255	29	0..15	7	Analog value underflow at an analog input	184543239, 184543303, 184543367, 184543431, 184543495, 184543559, 1845436	Check input value

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500 display	<-- Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error mes-sage**	**Online number**	**Remedy**
	[1])	[2])	[3])	[4])				
							23, 184543687, 184543751, 184543815, 184543879, 184543943, 184544007, 184544071, 184544135, 184544199	
4	5	255	29	0..1	10	Encounter/counter input fre-quency too high	184543242, 184543306	Check fre-quency filter param-eter or sensor

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<-- Display in	
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser		
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Online number**	**Remedy**
	1)	2)	3)	4)				
4	5	255	29	0..15	45	Cut wire at an analog input (only in IEPE mode)	184543277, 184543341, 184543405, 184543469, 184543533, 184543597, 184543661, 184543725, 184543789, 184543853, 184543917, 184543981, 184544045, 184544109, 184544173, 184544237	Check terminal

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<-- Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Online number**	**Remedy**
	1)	2)	3)	4)				
4	5	255	29	0..15	46	Short circuit at an analog input (only in IEPE mode)	184543278, 184543342, 184543406, 184543470, 184543534, 184543598, 184543662, 184543726, 184543790, 184543854, 184543918, 184543982, 184544046, 184544110, 184544174, 184544238	Check terminal
4	5	255	29	2..3	47	Short circuit at an digital output	184543407, 184543471	Check terminal or output connection

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1..10 = decentralized communication interface module 1..10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1..10 = expansion 1..10 channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1..10 = expansion 1..10
[4])	In case of module errors, with channel "31 = Module itself" is output.

1.6.2.2.4 State LEDs

During the power-on procedure, the module initializes automatically. All LEDs (except the LEDs for the signal states) are on during the initialization.

LED	State	Color	LED = ON	LED = OFF	LED flashing
AI0 - AI15	Analog channel state	Green	Channel activated and OK	Channel deactivated	CMS measurement running
		Red	Short circuit (only in IEPE mode) over- / undervoltage (only in +-10V mode)	-	Cable break (only in IEPE mode)
A, B, Z	Encoder 0 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
DI0, DI1, DC2, DC3	Digital inputs	Yellow	Input = ON (the input voltage is even displayed if the supply voltage is OFF).	Input = OFF	-
DC2, DC3	Digital outputs	Yellow	Output = ON	Output OFF	-
5 V	Power supply for encoders	Green	Configuration ON and power 5-V-power ready	Configuration OFF or power failure	Power supply outputs are short-circuited
L+	Process supply voltage	Green	Process voltage OK Initialization finished	Process voltage OFF	Firmware update
CH-ERR1, CH-ERR2		Red	Serious error within the corresponding group	No error or process voltage is missing	Error on one channel of the corresponding group (e.g. short circuit at an output)

1.6.2.2.5 Measuring Ranges

Table 99: Voltage input ranges

Range	IEPE	Digital value		-10 V...+10 V	Digital value	
		Decimal	Hex.		Decimal	Hex.
Open loop overflow	≥ 7.5	3145728	300000	≥ 12.0000	5033164	4CCCCC
Measured value too high	7.499997616... 6.00000238	3145727... 2516583	2FFFFF... 266667	11.99999762... 10.00000238	5033163... 4194305	4CCCCB... 400001
Normal range	6.00000... 0.00000238	2516582... 1	266666... 1	10.0000... 0,00000238	4194304... 1	400000... 1
	0.0000	0	0	0.0000	0	0
	-0.00000238... -6.00000	-1... -2516582	-1... -266666	-0.00000238... -10.0000	-1... -4194304	-1... -400000
Measured value too low	-6.00000238... -7.499997616	-2516583... -3145727	-266667... -2FFFFF	-10.00000238... -11.99999762	-4194305... -5033163	-400001... -4CCCCB
Short circuit / underflow	≤ -7.5	-3145728	-300000	≤ -12.0000	-5033164	-4CCCCC

1.6.2.2.6 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Table 100: Technical Data of Process Supply Voltage

Parameter	Value
Connections of terminals	The terminals 1.8, 4.8...7.8, 1.9, 4.9...7.9, 4.0...4.7, 7.0...7.7 are electrically interconnected within the TF5x1-CMS. Terminals 1.8, 4.8...7.8: process voltage L+ = +24 VDC Terminals 1.9, 4.9...7.9: process voltage M = 0 V Terminals 4.0...4.7, 7.0...7.7: analog shield clamps SH Terminal 1.0: FE shield clamp of encoder
Protection against reverse voltage	Yes
Rated protection fuse at UP	10 A fast
Rated value	24 VDC
Max. ripple	5 %

Parameter	Value
Current consumption from L+ (FM502-CMS and PM592-ETH, no communication module)	Max. 0.43 A + max. 0.5 A per output
Inrush current from L+ (at power up, FM502-CMS and PM592-ETH, no communication module)	1.2 A^2s
Galvanic isolation	Yes, PM592-ETH and FM502-CMS to other I/O bus modules
Max. power dissipation within the FM502-CMS	6.5 W (outputs unloaded)

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

For maritime applications a metal cabinet is required

Table 101: Technical Data of the Device

Parameter	Value
Weight FM502-CMS	215 g
Weight FM502-CMS-XC	220 g
Mounting position	Horizontal Vertical with derating: max. temperature 40 °C
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.
Deratings for operation of FM502-CMS-XC between +60 °C and +70 °C	No use of 24 V encoder mode. Analog inputs: maximum number of configured input channels limited to 75 % per group AI0...AI7 and AI8...AI15.
Required Terminal Base	TF501 or TF521 *Chapter 1.1.2 “TF501-CMS and TF521-CMS - Function Module Terminal Bases ” on page 13*

Table 102: Technical Data of the 5 V Encoder Supply

Parameter	Value
Number of supplies	1
Connections	Terminal 1.7

Parameter	Value
Rated value	5 VDC (+/- 5%)
Resistance to feedback against reverse polarity	No
Resistance to feedback against 24 V signals	Yes
Output current	100 mA max.
Output diagnosis	Yes, with diagnosis LED and error message

Table 103: Technical Data of the Digital Inputs

Parameter		Value
Number of channels		2 + 2 configurable inputs/outputs
Connections		Terminals 2.8, 2.9, 3.8, 3.9
Reference potential		Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Indication of the input signals		One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V Due to the direct connection to the output, the demagnetizing varistor is also effective at the input. This is why the difference between L+ and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. The input voltage must range from -12 V to +30 V when L+ = 24 V and from -6 V to +30 V when L+ = 30 V.
	Undefined signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
Shielded		1000 m
Unshielded		600 m

Table 104: Technical Data of Digital Outputs

Parameter	Value
Number of channels per module	2 configurable inputs/outputs
Connection	Terminal 3.8, 3.9
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)

Parameter		Value
Indication of the output signal		One LED per channel
Power supply voltage		Terminals 1.8, 4.8, 5.8, 6.8, 7.8 for L+ (+24 V)
Output voltage for signal 1		L+ (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel: 500 mA at UP = 24 V	500 mA at L+ = 24 V
	Maximum value: 1 A	1 A
Leakage current with signal 0		< 0.5 mA
Demagnetization when inductive loads are switched off		With varistors integrated in the module
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit proof / overload proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

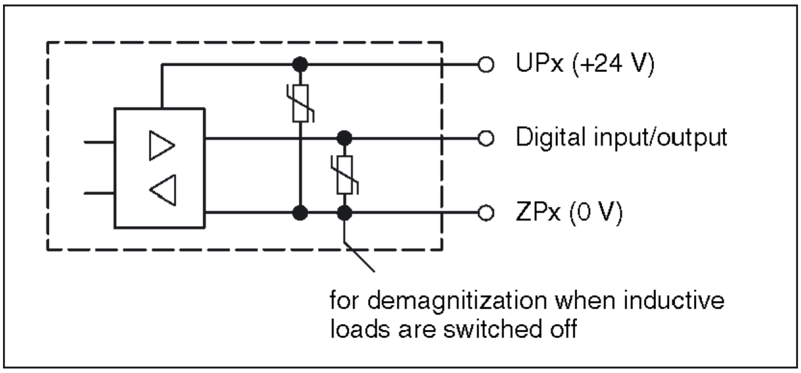


Fig. 112: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

Table 105: Technical Data of High Speed Input (Encoder, A/B/Z)

Parameter	Value
Number of channels per module	3 (sampled synchronously with IEPE inputs)
Connection	Terminals 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Indication of the input signals	One LED per channel

Parameter	Value		
Resolution	32 bits		
Input type	24 VDC	5 VDC	Differential RS-422 and 1 Vpp sine
Input current per channel			
Input voltage + 24 V	Typ. 6 mA		
Input voltage + 5 V	> 1 mA		
Input voltage + 15 V	> 5 mA		
Input voltage + 30 V	< 8 mA		
Input type acc. to EN61131-2	Type 1		
Input frequency max. (frequency measurement)	100 kHz (accuracy -0 %/+3 %)		
Input signal voltage	24 VDC	5 VDC	Differential
Input frequence max.	300 kHz	1 MHz	1 MHz
Signal 0	-30 V...+5 V	-30 V...+0.8 V	≤ 200 mV
Undefined signal	> +5 V...< +15 V	> +0.8 V...< +2.0 V	-
Signal 1	+15 V...+30 V	+2.0 V...+30 V	≥ +200 mV
Ripple with signal 0	Within -30 V...+5 V	Within -30 V...+0.8 V	-
Ripple with signal 1	Within +15 V...+30 V	Within +2.0 V...+30 V	-
Max. cable length, shielded (depending on sensor)	300 m	100 m	

Table 106: Technical Data of the Fast Outputs (SI CLK Output B for Optical Interface)

Parameter	Value
Number of channels	1
Connection	Terminals 1.3, 1.4
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Indication of output signal	One LED per channel, the LED is ON when SSI CLK output B is active
Differential output voltage for signal 1	> 2.4 V at 10 mA
Differential output voltage for signal 0	≤ -2.4 V at 10 mA
Output delay (0->1 or 1->0)	Max. 0.35 µs
Output current	≤ 10 mA
Switching frequency (selectable)	200 kHz, 500 kHz and 1 MHz
Short-circuit-proof/overload-proof	Yes
Output current limitation	Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals	Yes

Parameter	Value
Resistance to feedback against reverse polarity	Yes
Max. cable length, shielded (depending on sensor)	Typ. 12.5 m at 1MHz

Table 107: Technical Data of the Fast Outputs (SSI CLK output B, RS-422 Differential)

Parameter	Value
Number of channels	1
Connection	Terminals 1.3, 1.4
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Differential output voltage	≥ 2.4 V at 10 mA
Output delay (0->1 or 1->0)	Max. 0.35 µs
Switching frequency (selectable)	200 kHz, 500 kHz, 1 MHz
Short-circuit-proof/overload-proof	Yes
Output current limitation	Yes, automatic reactivation after short-circuit/ overload
Resistance to feedback against 24 V signals	Yes
Resistance to feedback against reverse polarity	Yes
Max. cable length, shielded (depending on sensor)	100 m

Table 108: Technical Data of Analog Inputs

Parameter	Value
Number of channels per module	16 (synchronous sampled)
Connection	Terminals 2.0...2.7, 5.0...5.1 for AI-, 3.0...3.7, 6.0...6.7 for AI+
Indication of the input signal	One bicolor LED per channel for signal and error mes-sages.
Measurement resolution	≥ 23 Bit
Resolution	32 bits external use
Accurracy at +25 °C	≤+/-0.1 %
Accurracy over operating tempera-ture and vibration	≤+/-0.5 %

Parameter	Value	
Sample rate/bandwidth high (0 dB)	50 kHz/20 kHz (min. -121 dB/22.5 kHz) 25 kHz/10 kHz (min. -116 dB/11.25kHz) 12.5 kHz/5 kHz (min. -116 dB/5.63 kHz) 6.25 kHz/2.5 kHz (min. -116 dB/2.81 kHz) 3.13 kHz/1.25 kHz (min. -116 dB/1.41 kHz) 1.56 kHz/0.625 kHz (min. -116 dB/0.70 kHz) 0.78 kHz/0.312 kHz (min. -120 dB/0.36 kHz) 0.39 kHz/0.156 kHz (min. -121 dB/0.18 kHz) 0.20 kHz/0.080 kHz (min. -121 dB/0.09 kHz) 0.10 kHz/0.040 kHz (min. -130 dB/0.05 kHz) selectable per channel	
Data storage	128 MB	
Measurement time	Selectable per channel	
Input type default setting	unused	
Input type (selectable per input)	IEPE	-10 V...+10 V
Bandwidth low	min. 3 dB/< 0.1 Hz	min. 3 dB/< 0.1 Hz or DC (selectable)
Dynamic range (SFDR)	> 100 dB	
SINAD (300 Hz/1 kHz sine, 50 k SPS)		
0 dB from full scale	< -90 dB	< -95 dB
-20 dB from full scale	< -75 dB	< -80 dB
-40 dB from full scale	< -55 dB	< -60 dB
Input range	+2 V...+18 V	-10 V...+10 V
Measurement range	+/-6 V (DC coupled)	-10 V...+10 V
Input DC bias range, common mode range	+8 V...+12 V	+/-1 V
Current source per channel	Typ. 4.2 mA (+/- 7 % over temperature)	-
Input resistance AI- to M	Typ. 27 Ohm (PTC)	
Channel input impedance (AI+/AI-)		
< 1 kHz	> 1 MOhm	> 2 MOhm
5 kHz	> 100 kOhm	> 40 kOhm
10 kHz	> 60 kOhm	> 25 kOhm
20 kHz	> 40 kOhm	> 8 kOhm
Error detection	Short circuit, open wire	-
Max. cable length, shielded (depending on sensor)	100 m	

1.6.2.2.7 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP260400R0001	Function module FM502-CMS	Active
1SAP460400R0001	Function module FM502-CMS-XC, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7 Communication Interface Modules (S500)

Hot swap

System requirements for hot swapping of I/O modules:

- *Hot-swappable terminal units have the appendix TU5xx**-H**.*
- *I/O modules as of index F0.*
- *Communication interface modules CI5xx as of index F0.*

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for Hot Swapping

- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

Hot Swap

Further Information about Hot Swap for V2 Products see System Technology.

Further Information about Hot Swap for V3 Products see System Technology.

1.7.1 CANopen

1.7.1.1 Comparison CI581 and CI582

CI581/CI582: Technical data

Parameter	Value
Interface	CAN
Protocol	CANopen
Power supply	From the process supply voltage UP

Parameter		Value
Supply of the electronic circuitry of the I/O modules attached		Through the expansion bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto baudrate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher netX100
Expandability		Max. 10 S500 I/O modules
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 ⇘ *Chapter 2.6.1 “System Data AC500” on page 1252* System data AC500 XC ⇘ *Chapter 2.7.1 “System Data AC500-XC” on page 1313*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)

Parameter	Value
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU509, TU510, TU517 or TU518 *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148* *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

The difference of those devices can be found in their input and output characteristics.

CI581-CN: Input/Output Characteristics

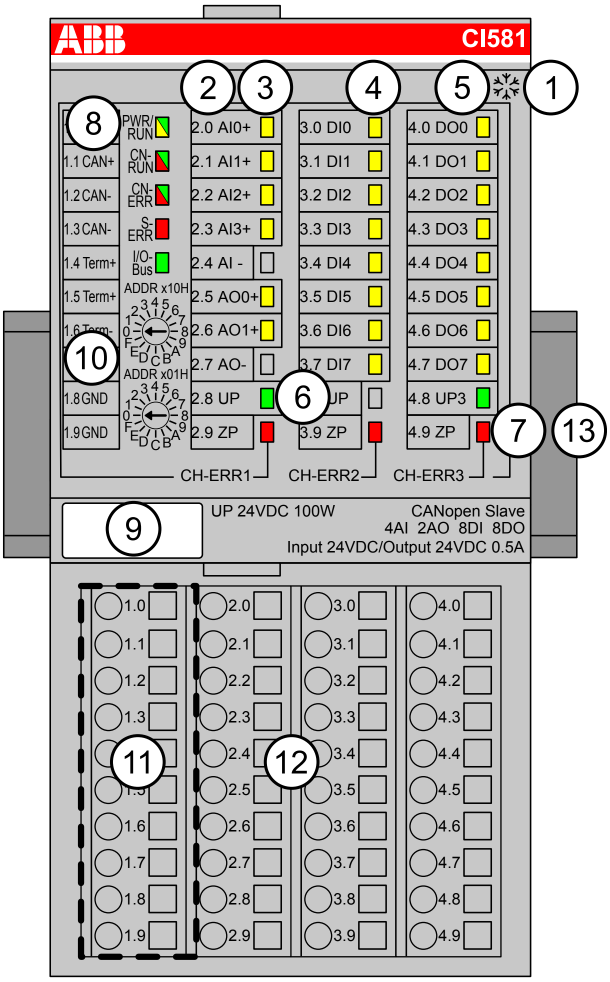
Parameter	Value
Inputs and outputs	8 digital inputs (24 VDC; delay time configurable via software) 8 digital transistor outputs (24 VDC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V...+10 V ● 0 V...+10 V ● -10 V...+10 V (differential voltage) ● 0 mA...20 mA ● 4 mA...20 mA ● Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire) ● 24 V digital input function 2 analog outputs, configurable as: ● -10 V...+10 V ● 0 mA...20 mA ● 4 mA...20 mA
Resolution of the analog channels	12 bits
Fast counter	Integrated, configurable operating modes

CI582-CN: Input/Output Characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 VDC) 8 digital transistor outputs (24 VDC, 0.5 A max.) 8 configurable digital inputs/outputs (24 VDC, 0.5 A max.)

1.7.1.2 CI581-CN

- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus sign)
- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max
- Module-wise electrically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal No. and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 - AI3, AO0 - AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 - DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 - DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, CN-RUN, CN-ERR, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the CANopen Node ID
11 10 terminals to connect the CANopen bus signals
12 Terminal unit
13 DIN rail
Sign for XC version

1.7.1.2.1 Intended Purpose

The CANopen bus module CI581-CN is used as decentralized I/O module in CANopen networks. Depending on the used terminal unit the network connection is performed either via 9-pin female D-sub connector or via 10 terminals (screw or spring terminals) which are integrated in the terminal unit. The bus module contains 22 I/O channels with the following properties:

- 4 analog inputs (2.0...2.3)
- 2 analog outputs (2.5...2.6)
- 8 digital inputs 24 VDC in 1 group (3.0...3.7)
- 8 digital outputs 24 VDC in 1 group (4.0...4.7)

The inputs/outputs are electrically isolated from the CANopen network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.1.2.2 Functionality

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the expansion bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto baudrate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher netX100
Expandability		Max. 10 S500 I/O modules
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 ⇘ *Chapter 2.6.1 “System Data AC500” on page 1252* System data AC500 XC ⇘ *Chapter 2.7.1 “System Data AC500-XC” on page 1313*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)

Parameter		Value
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148* *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

CI581-CN: Input/ Output Characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 VDC; delay time configurable via software) 8 digital transistor outputs (24 VDC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V...+10 V ● 0 V...+10 V ● -10 V...+10 V (differential voltage) ● 0 mA...20 mA ● 4 mA...20 mA ● Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire) ● 24 V digital input function 2 analog outputs, configurable as: ● -10 V...+10 V ● 0 mA...20 mA ● 4 mA...20 mA
Resolution of the analog channels	12 bits
Fast counter	Integrated, configurable operating modes

1.7.1.2.3 Electrical Connection

The CANopen bus module is plugged on the I/O terminal units TU517 ➪ *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157* or TU518 ➪ *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157* and accordingly TU509 ➪ *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148* or TU510 ➪ *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148*. Properly position the module and press until it locks in place.

The electrical connection of the I/O channels is established using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 VDC

Terminal 4.8: process supply voltage UP3 = +24 VDC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ➪ Chapter 2.6 “AC500 (Standard)” on page 1252.

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to the digital outputs!

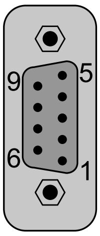
Reason: External voltages at an output or several outputs may cause other outputs to be supplied via that voltage instead of voltage UP3 (reverse voltage). This ist not the intended use.

CAUTION!
Risk of malfunctions by unintended use!
If the function cut off of the digital outputs should be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs DO0..DO7 and DC0..DC7.

Possibilities of Connection

Mounting on Terminal Units TU509 or TU510

The assignment of the 9-pin female D-sub connector for the CANopen signals



1	---	Reserved
2	CAN-	Inverted signal of the CAN Bus
3	CAN_GND	Ground potential of the CAN bus
4	---	Reserved
5	---	Reserved
6	---	Reserved
7	CAN+	Non-inverted signal of the CAN Bus
8	---	Reserved
9	---	Reserved
Shield	Cable shield	Functional earth

Bus Terminating Resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

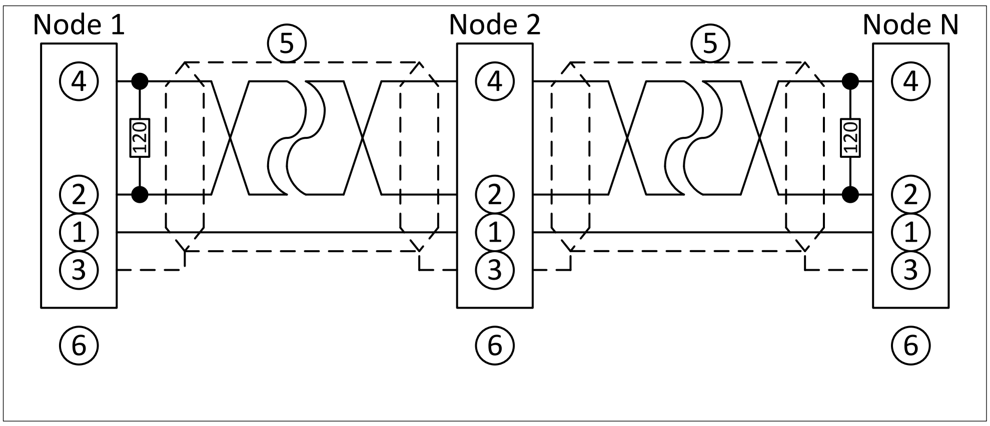


Fig. 113: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

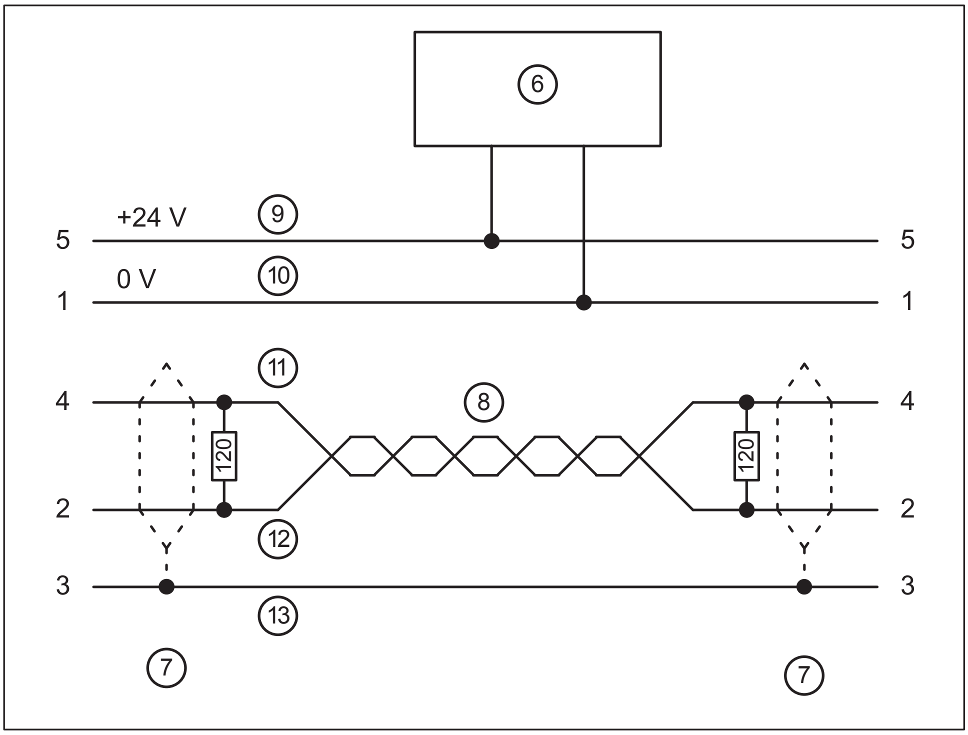


Fig. 114: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The earthing of the shield should take place at the switch-gear. Please refer to *Chapter 2.6.1 “System Data AC500” on page 1252.*

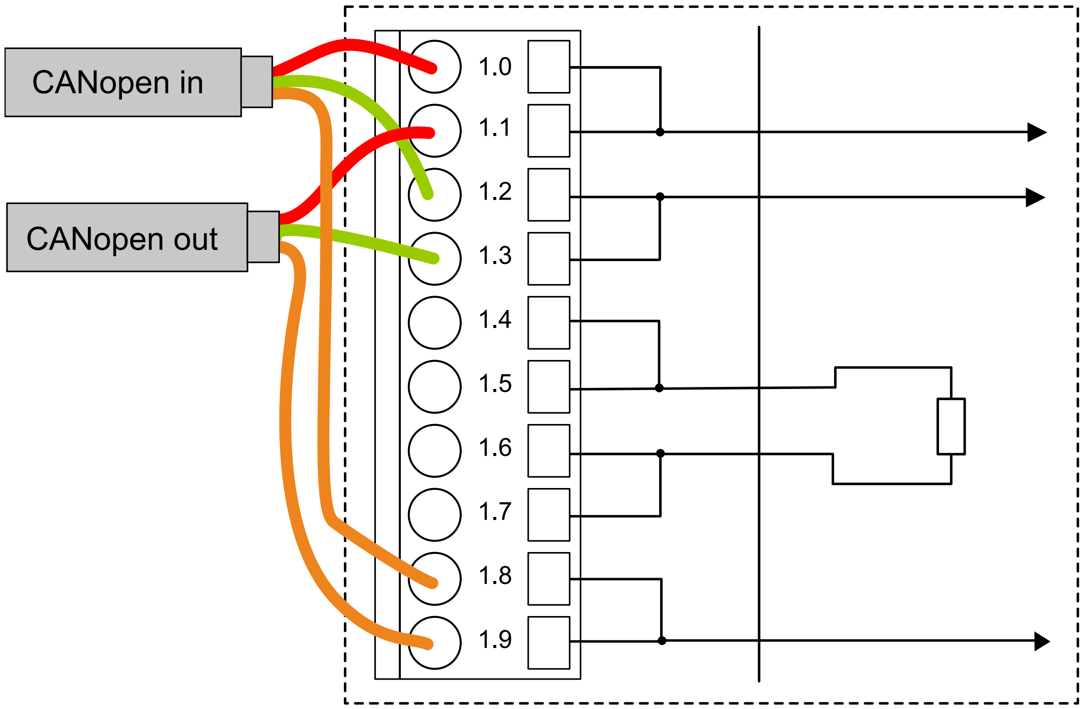
Mounting on Terminal Units TU517 or TU518

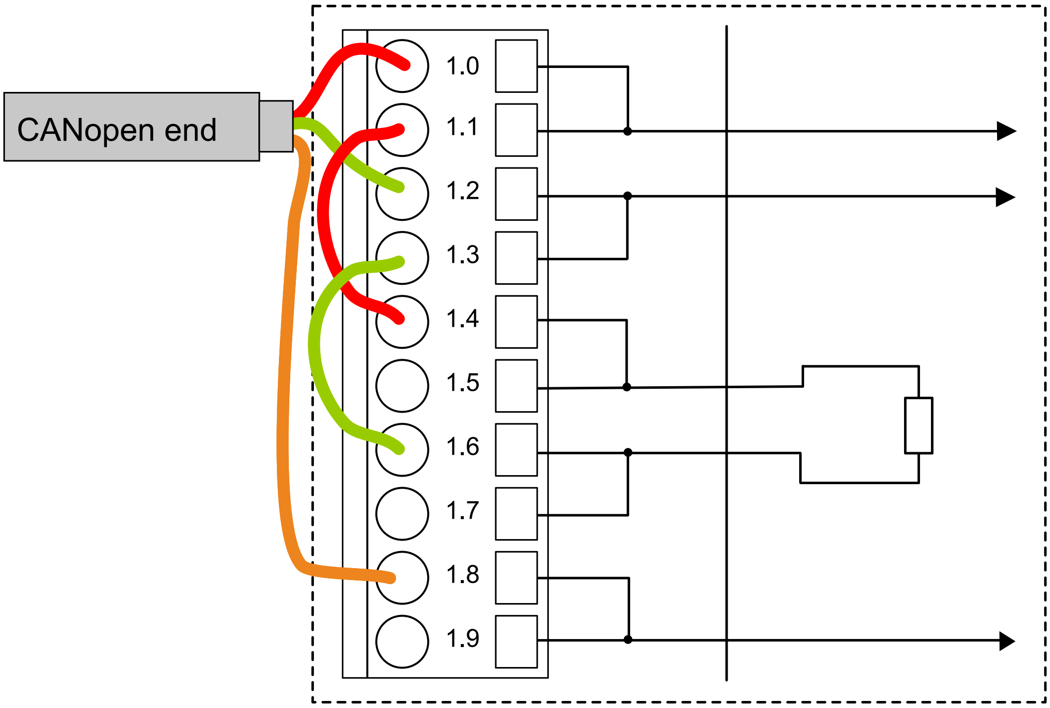
Table 109: Assignment of the terminals

Terminal	Signal	Description
1.0	CAN+	Non-inverted signal of the CAN Bus
1.1	CAN+	Non-inverted signal of the CAN Bus
1.2	CAN-	Inverted signal of the CAN Bus
1.3	CAN-	Inverted signal of the CAN Bus
1.4	Term+	CAN bus termination for CAN+ (for bus termination, Term+ must be connected with CAN+)
1.5	Term+	CAN bus termination for CAN+ (connecting alternative for terminal 1.4)
1.6	Term-	CAN bus termination for CAN- (for bus termination, Term- must be connected with CAN-)
1.7	Term-	CAN bus termination for CAN- (connecting alternative for terminal 1.6)
1.8	CAN-GND	Ground potential of the CAN bus
1.9	CAN-GND	Ground potential of the CAN bus

At the line ends of a bus segment, termination resistors must be connected. If TU517 or TU518 is used, the bus termination resistors can be enabled by connecting the terminals Term+ and Term- to the data lines CAN+ and CAN- (no external termination resistors are required, see illustration below).

The following figures show the different connection options for the CANopen bus module:





In the case of TU517/TU518, the termination resistors are not located inside the TU but inside the bus module CI581-CN. Hence, when removing the device from the TU, the bus termination resistors are no longer connected to the bus. The bus itself will not be disconnected if a device is removed.

The earthing of the shield should take place at the switch-gear cabinet. Please refer to the AC500 System-Data *Chapter 2.6.1 "System Data AC500" on page 1252**.*

Table 110: Assignment of the other Terminals

Terminal	Signal	Description
2.0	AI0+	Positive pole of analog input signal 0
2.1	AI1+	Positive pole of analog input signal 1
2.2	AI2+	Positive pole of analog input signal 2
2.3	AI3+	Positive pole of analog input signal 3
2.4	AI-	Negative pole of analog input signals 0 to 3
2.5	AO0+	Positive pole of analog output signal 0
2.6	AO1+	Positive pole of analog output signal 1
2.7	AI-	Negative pole of analog output signals 0 and 1
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI0	Signal of the digital input DI0
3.1	DI1	Signal of the digital input DI1
3.2	DI2	Signal of the digital input DI2
3.3	DI3	Signal of the digital input DI3

Terminal	Signal	Description
3.4	DI4	Signal of the digital input DI4
3.5	DI5	Signal of the digital input DI5
3.6	DI6	Signal of the digital input DI6
3.7	DI7	Signal of the digital input DI7
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO0	Signal of the digital output DO0
4.1	DO1	Signal of the digital output DO1
4.2	DO2	Signal of the digital output DO2
4.3	DO3	Signal of the digital output DO3
4.4	DO4	Signal of the digital output DO4
4.5	DO5	Signal of the digital output DO5
4.6	DO6	Signal of the digital output DO6
4.7	DO7	Signal of the digital output DO7
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (cut wire), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

Electrical connection of CANopen bus module CI581-CN:

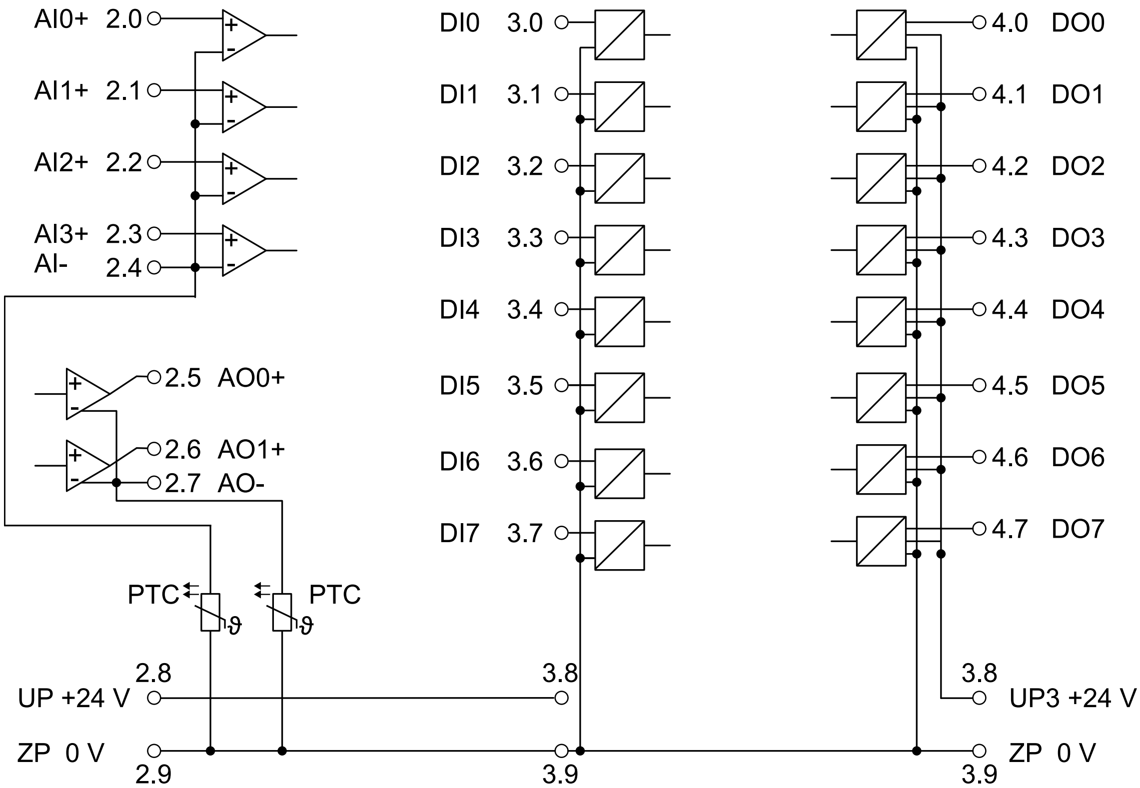


Fig. 115: Connection of the bus module CI581-CN

The module provides several diagnosis functions *Chapter 1.7.1.2.8 “Diagnosis” on page 726*.

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 “Measuring Ranges” on page 732* and Parameterization *Chapter 1.7.1.2.7 “Parameterization” on page 722*.

The meaning of the LEDs is described in the section for the state LEDs *Chapter 1.7.1.2.9 “State LEDs” on page 730*.

Bus Length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Connection of the Digital Inputs

The following figure shows the electrical connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.

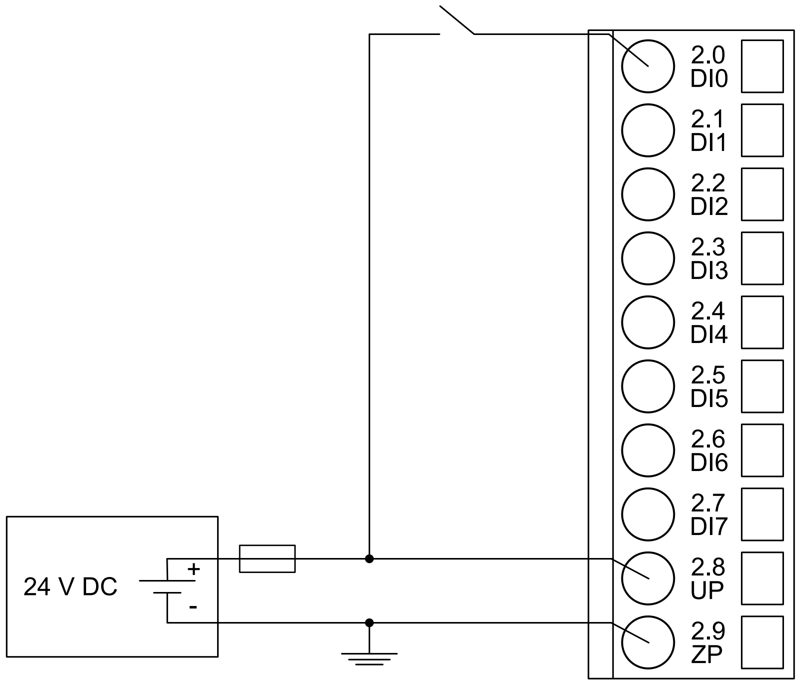


Fig. 116: Connection of the digital inputs to the module CI581-CN

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO0. Proceed with the digital outputs DO1 - DO7 in the same way.

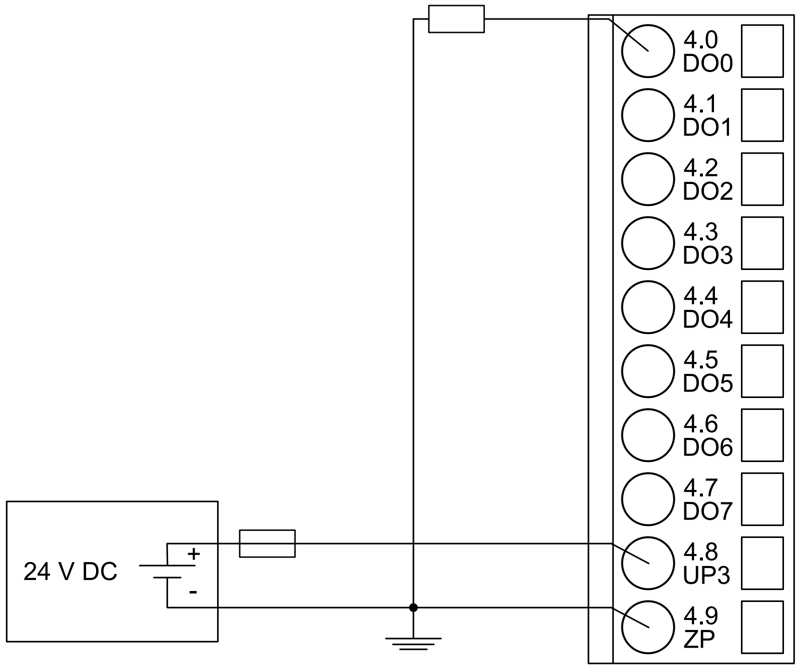


Fig. 117: Connection of configurable digital inputs/outputs to the module CI581-CN

Connection of Resistance Thermometers in 2-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI581-CN provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

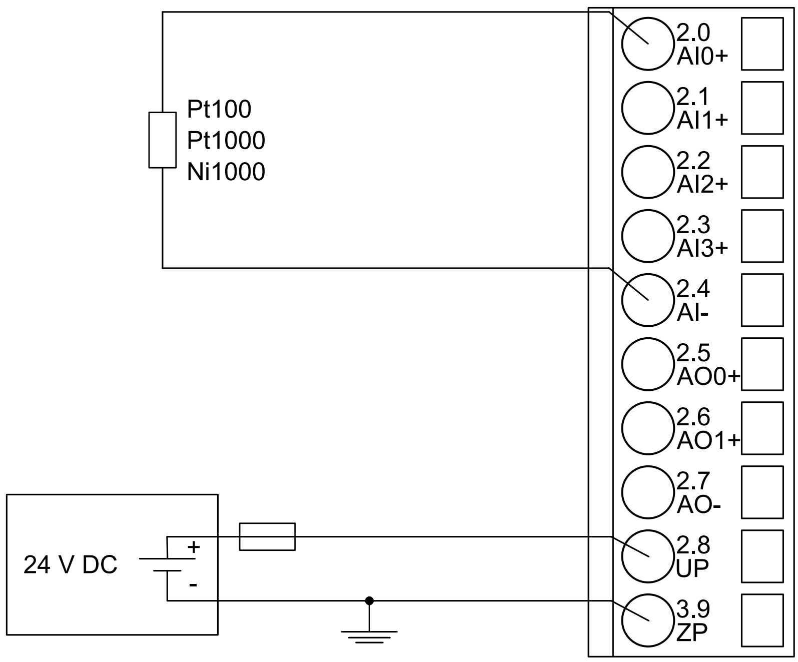


Fig. 118: Connection of resistance thermometers in 2-wire configuration to the analog inputs

Pt100	2-wire configuration, 1 channel used
Pt1000	2-wire configuration, 1 channel used
Ni1000	2-wire configuration, 1 channel used

For the measuring ranges that can be configured, please refer to sections Measuring Ranges *Chapter 1.7.1.2.10 “Measuring Ranges” on page 732* and Parameterization *Chapter 1.7.1.2.7 “Parameterization” on page 722*.

The module CI581-CN performs a linearization of the resistance characteristic.

To avoid error messages, configure unused analog input channels as "unused".

Connection of Resistance Thermometers in 3-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI581-CN provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1. Proceed with the analog inputs AI2 and AI3 in the same way.

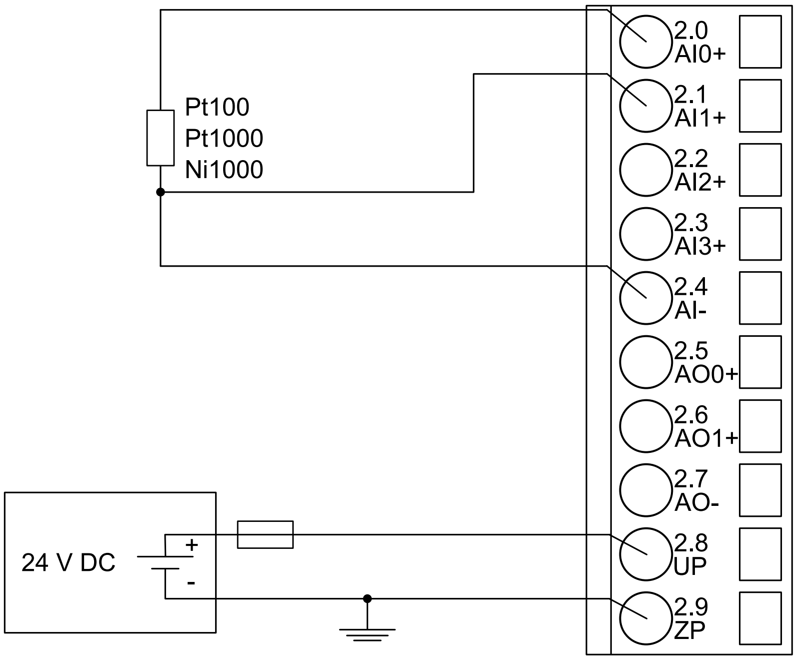


Fig. 119: Connection of resistance thermometers in 3-wire configuration to the analog inputs

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	3-wire configuration, 2 channels used
Pt1000	3-wire configuration, 2 channels used
Ni1000	3-wire configuration, 2 channels used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 “Measuring Ranges” on page 732* and Parameterization *Chapter 1.7.1.2.7 “Parameterization” on page 722*.

The module CI581-CN performs a linearization of the resistance characteristic.

To avoid error messages, configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

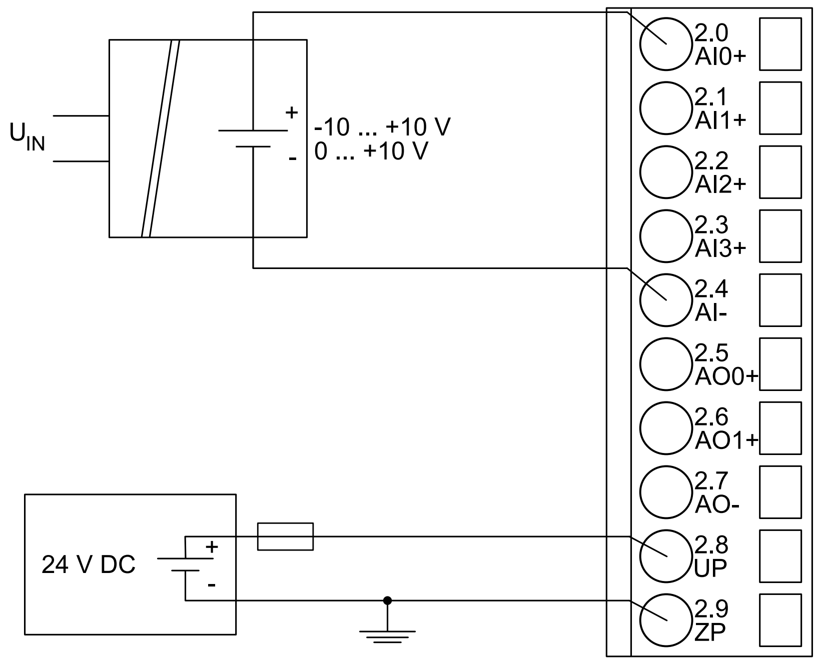


Fig. 120: Connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog inputs

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 “Measuring Ranges” on page 732* and Parameterization *Chapter 1.7.1.2.7 “Parameterization” on page 722*.

To avoid error messages, configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

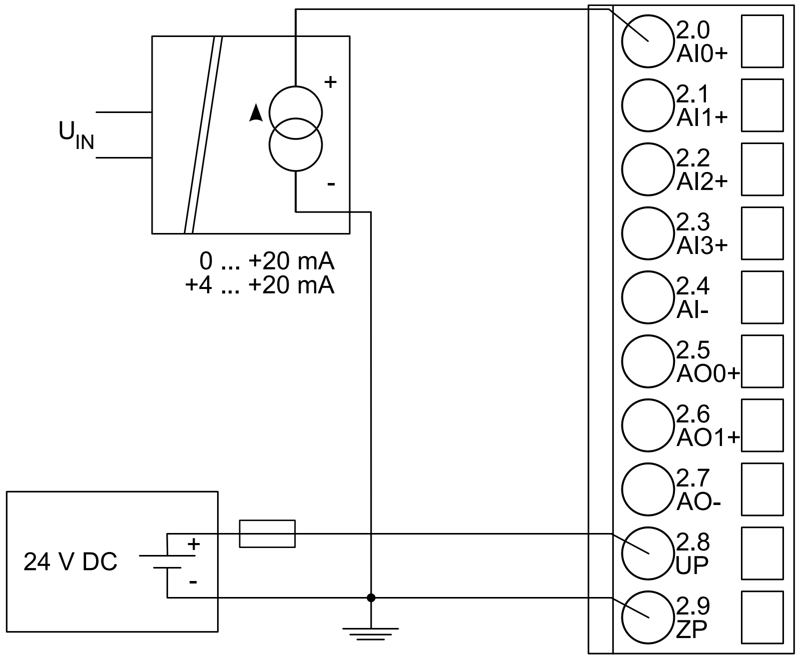


Fig. 121: Connection of active-type analog sensors (current) with electrically isolated power supply to the analog inputs

Current	0...20 mA	1 channel used
Current	4...20 mA	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ␖ *Chapter 1.7.1.2.10 "Measuring Ranges" on page 732* and Parameterization ␖ *Chapter 1.7.1.2.7 "Parameterization" on page 722*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with no electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

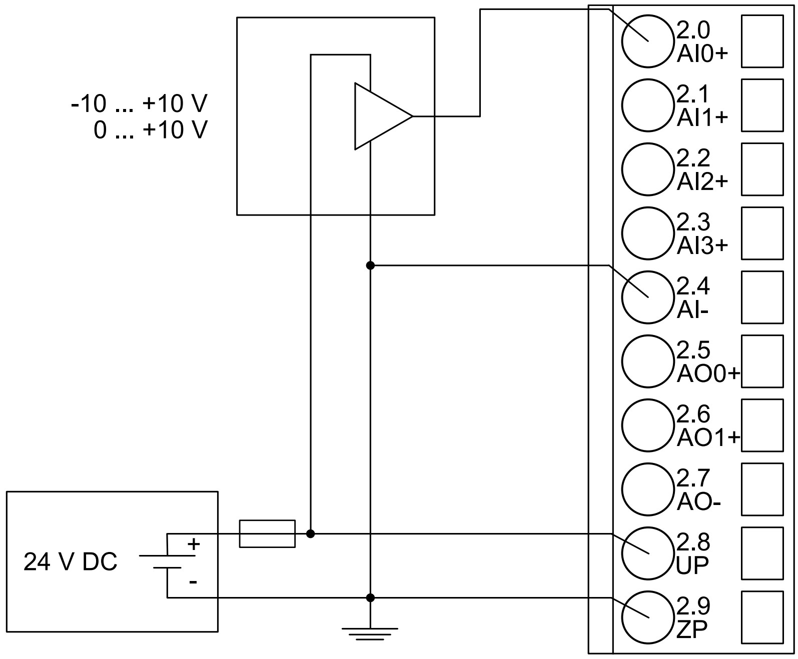


Fig. 122: Connection of active-type sensors (voltage) with no electrically isolated power supply to the analog inputs

NOTICE!

Risk of faulty measurements!

The negative pole/earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

For the measuring ranges that can be configured, plese refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 “Measuring Ranges” on page 732* and Parameterization *Chapter 1.7.1.2.7 “Parameterization” on page 722*.

To avoid error messages, configure unused analog input channels as "unused".

Connection of Passive-type Analog Sensors (Current) to the Analog Inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

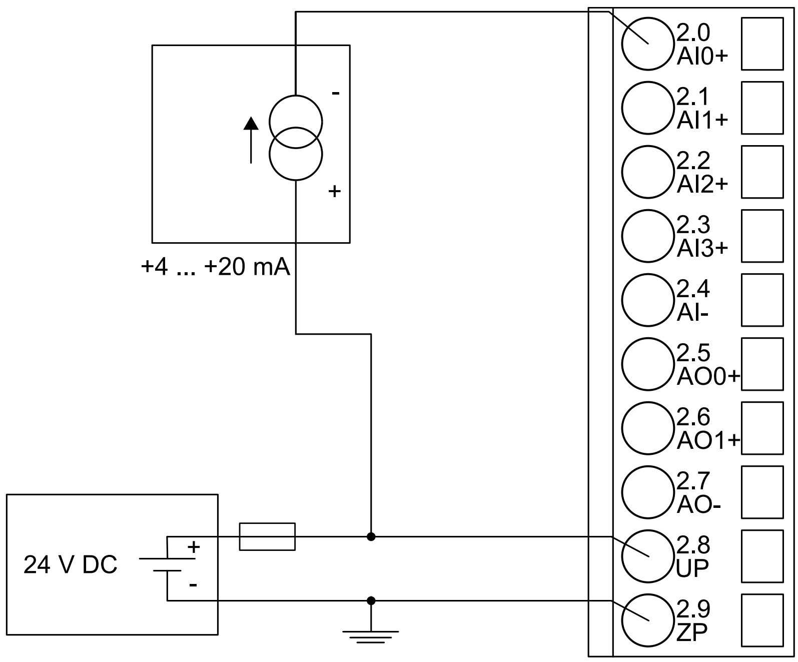


Fig. 123: Connection of passive-type analog sensors (current) to the analog inputs

Current	4...20 mA	1 channel used

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and I-.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Analog Inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely earthed) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

NOTICE!

Risk of faulty measurements!

The negative pole/earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

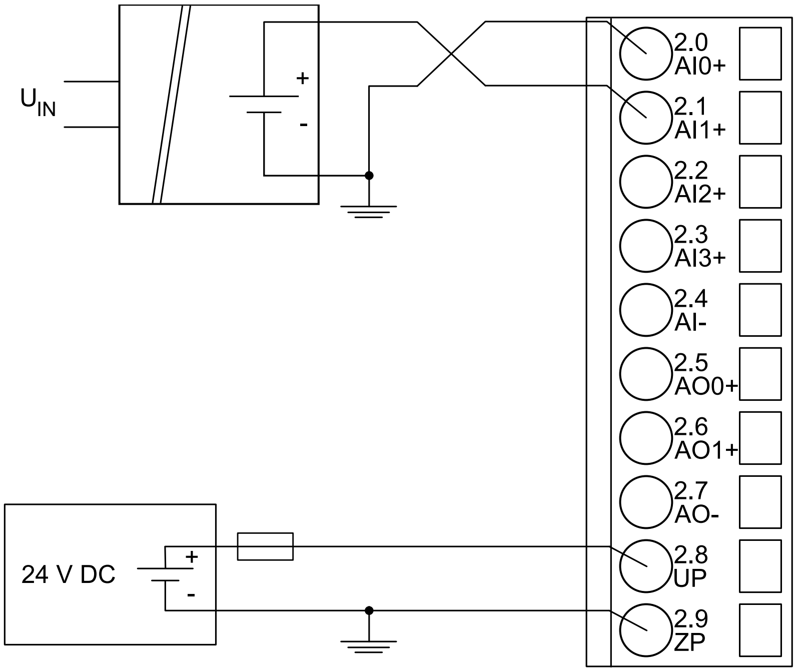


Fig. 124: Connection of active-type analog sensors (voltage) to differential analog inputs

Voltage	0...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 “Measuring Ranges” on page 732* and Parameterization *Chapter 1.7.1.2.7 “Parameterization” on page 722*.

To avoid error messages, configure unused analog input channels as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

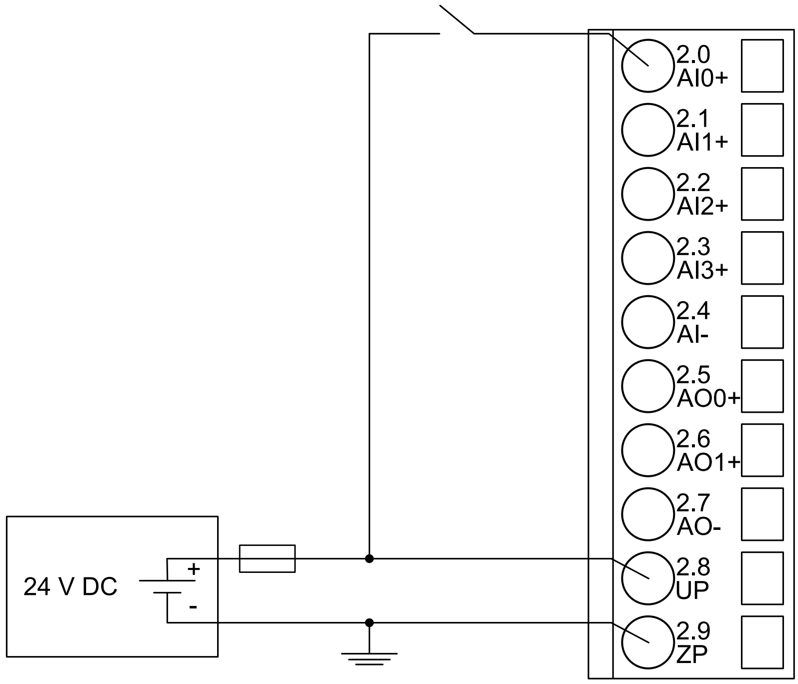


Fig. 125: Use of analog inputs as digital inputs

Digital input	24 V	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 "Measuring Ranges" on page 732* and Parameterization *Chapter 1.7.1.2.7 "Parameterization" on page 722*.

Connection of Analog Output Loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

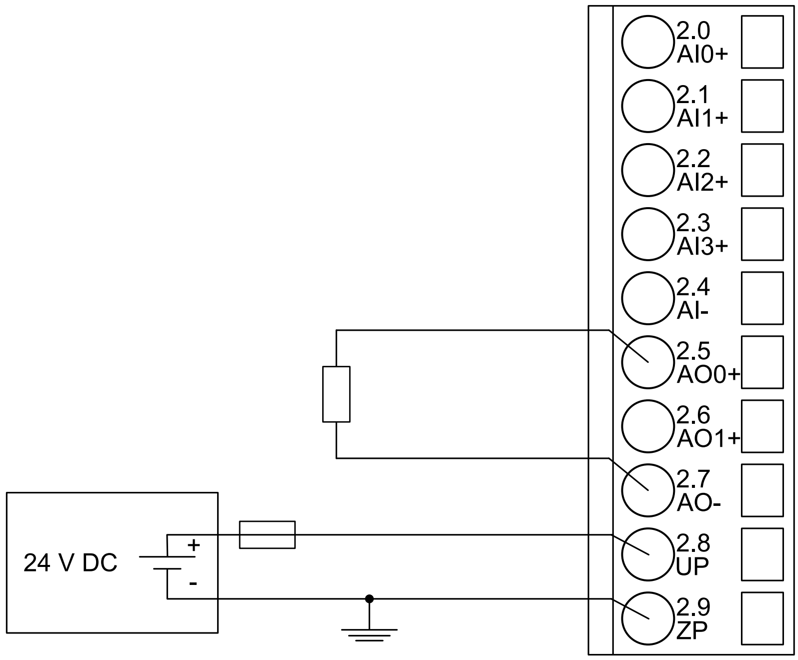


Fig. 126: Connection of analog output loads (voltage)

Voltage	-10 V...+10 V	Load ± 10 mA max.	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 "Measuring Ranges" on page 732* and Parameterization *Chapter 1.7.1.2.7 "Parameterization" on page 722*.

Unused analog outputs can be left open-circuited.

Connection of Analog Output Loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

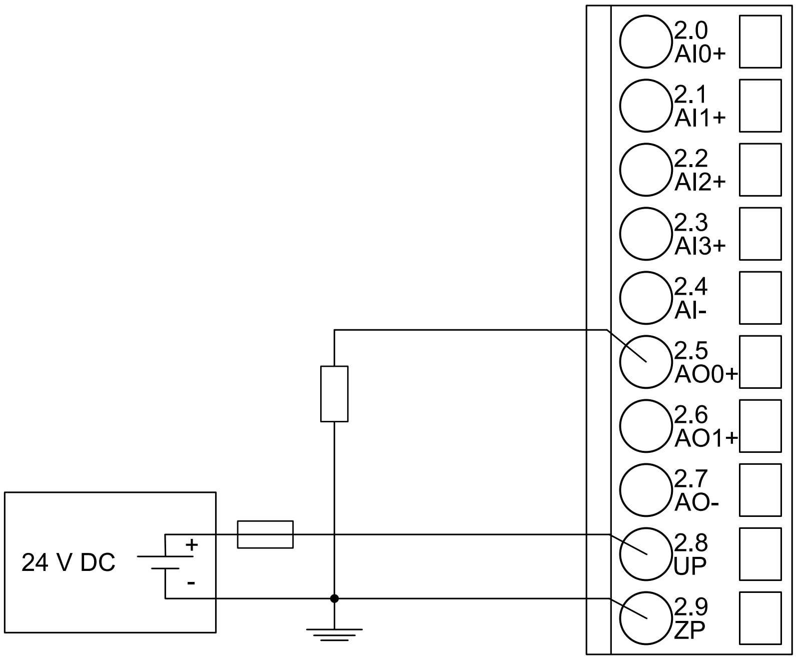


Fig. 127: Connection of analog output loads (current)

Current	0...20 mA	Load 0...500 Ω	1 channel used
Current	4...20 mA	Load 0...500 Ω	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.1.2.10 "Measuring Ranges" on page 732* and Parameterization *Chapter 1.7.1.2.7 "Parameterization" on page 722*.

Unused analog outputs can be left open-circuited.

1.7.1.2.4 Internal Data Exchange

Parameter	**Value**
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

1.7.1.2.5 Addressing

A detailed description concerning addressing can be found in the documentation of ABB Control Builder Plus Software.

> *The CANopen bus module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.*
>
> *The range of permitted CANopen slave addresses is 1 to 127. Setting a higher address (> 128) does not lead to an error response, but results in a special mode (DS401). In this special mode, the device creates the node address by subtracting the value 128 from the address switch's value.*

1.7.1.2.6 I/O Configuration

The CI582-CN CANopen bus configuration is handled by CANopen master with the exception of the slave node ID (via rotary switches) and the baud rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

1.7.1.2.7 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C84	WORD	0x1C84
Parameter length	Internal	54	BYTE	54
Error LED / Fail-safe function (table error LED / Failsafe function ⇨ *Further information on page 722*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	18		
Reserved	0	0	ARRAY of 24 BYTES	
Check supply (UP and UP3)	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2]) For a description of the counter operating modes, please refer to the Fast Counter section.

Table 111: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode on *)
*) The parameters Behavior analog outputs at communication error and Behavior digital outputs at communication error are only evaluated if the failsafe function is enabled.	

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behavior analog outputs at communication error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter behavior analog outputs at communication error is only analyzed if the failsafe mode is ON.				

Channel parameters for the Analog Inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Operation modes of analog inputs	Operation modes of analog inputs	BYTE	0
Input 0, Check channel	Settings channel monitoring	Settings channel monitoring	BYTE	0
:	:	:	:	:
:	:	:	:	:

Name	Value	Internal value	Internal value, type	Default
Input 3, Channel configuration	Operation modes of analog inputs	Operation modes of analog inputs	BYTE	0
Input 3, Check channel	Settings channel monitoring	Settings channel monitoring	BYTE	0

Table 112: Channel Configuration - Operating Modes of the Analog Inputs

Internal Value	Operating Modes (individually configurable)
0 (default)	Not used
1	0...10 V
2	Digital input
3	0...20 mA
4	4...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50...+400 °C
9	3-wire Pt100 -50...+400 °C *)
10	0...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50...+70 °C
15	3-wire Pt100 -50...+70 °C *)
16	2-wire Pt1000 -50...+400 °C
17	3-wire Pt1000 -50...+400 °C *)
18	2-wire Ni1000 -50...+150 °C
19	3-wire Ni1000 -50...+150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 113: Channel Monitoring

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel Parameters for the Analog Outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 0, Check channel	Channel monitoring	Channel monitoring	BYTE	0
Output 0, Substitute value	Substitute value	Substitute value	WORD	0
Output 1, Channel configuration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 1, Check channel	Channel monitoring	Channel monitoring	BYTE	0
Output 1, Substitute value	Substitute value	Substitute value	WORD	0

Table 114: Channel Configuration - Operating Modes of the Analog Outputs

Internal value	Operating Modes (individually configurable)
0 (default)	Not used
128	-10 V...+10 V
129	0...20 mA
130	4...20 mA

Table 115: Channel Monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 116: Substitute Value

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substi-tute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short cir-cuit at outputs	Off On	0 1	BYTE	On 0x01
Behavior digital outputs at com-muncation error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x00
Detect voltage overflow at out-puts [2])	Off On	0 1	BYTE	Off 0x00

[1]) The parameter Behavior digital outputs at communcation error is only analyzed if the failsafe mode is ON.

[2]) The state "externally voltage detected" appears if the output of a channel DC0..DC7 is to be switched on while an external voltage is connected *Chapter 1.7.1.2.3 “Electrical Connec-tion” on page 705*. In this case, the start-up is disabled as long as the external voltage is con-nected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".

1.7.1.2.8 Diagnosis

Structure of the Diagnosis Block via *CANOM_NODE_DIAG*

Byte Number	Description	Possible Values
1	Diagnosis byte, slot number	31 = CI581-CN (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**CANopen diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O device type on socket	Replace I/O module / check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Voltage feedback on deactivated dig-ital output [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7])	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0..1	4	Analog value over-flow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500, the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = position of the communication module;14 = I/O bus; 31 = module itself The identifier is not contained in the CI541-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = module itself; 1..10 = decentralized communication interface module
[3])	With "Module" the following allocation applies: 31 = module itself Channel error: module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears if external voltages at one or more terminals DO0..DO7 cause other digital outputs to be fed by that voltage (voltage feedback, description in Electrical Connection *Chapter 1.7.1.2.3 “Electrical Connection” on page 705*). All outputs of the digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage on digital outputs DO0..DO7 has overrun the process supply voltage UP3 (description in Electrical Connection *Chapter 1.7.1.2.3 “Electrical Connection” on page 705*). Diagnosis message appears for the whole module.
[6])	This message appears if the output of a channel DO0..DO7 is to be switched on while an external voltage is connected. In this case, start-up is disabled while the external voltage is connected. Otherwise, this could produce reverse voltage flowing from this output to other digital outputs. This diagnosis message appears for each channel.
[7])	Short circuit: After a short circuit has been detected, the output is deactivated for 100ms seconds. Subsequently, a new start-up will be executed. This diagnosis message appears for each channel.

1.7.1.2.9 State LEDs

The state LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, CN-RUN, CN-ERR, S-ERR and I/O bus) show the operation states of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
CN-RUN	Green	---	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running	Flashing: CANopen bus in PRE-OPERATIONAL state and slave is being configured Single flash: CANopen bus in STOPPED state. Flickering: Autodetect is active
CN-ERR	Red	No system error	CANopen Bus is OFF	Flashing: Configuration error Single flash: error counter overflow due to too many error frames Double flash: A node-guard or a heartbeat event occurred Flickering: Autodetect is active
S-ERR	Red	No error	Internal error	--
I/O bus	Green	No decentralized I/O modules connected or communication error	Decentralized I/O modules connected and operational	---

States of the 27 Process LEDs:

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--

LED	Color	OFF	ON	Flashing
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.1.2.10 Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
			Decimal	**Hex.**
Overflow	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high	450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
			Decimal	Hex.
		160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.7.1.2.11 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 to DI7	Terminals 3.0 to 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V
Undefined signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA

Parameter	Value
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	
Shielded	1000 m
Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

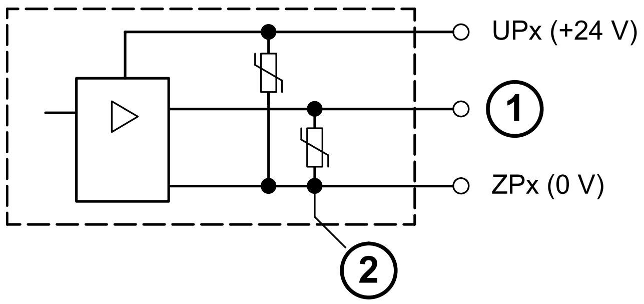


Fig. 128: Digital input/output (circuit diagram)

1	Digital output
2	Varistors for demagnetization when inductive loads are turned off

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 2.0 to2.3
Reference potential for AI0+ to AI3+		Terminal 2.4 (AI-) for voltage and RTD measurement Terminal 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0...10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10...+10 V
Galvanic isolation		Against CANopen Bus
Configurability		0...10 V, -10...+10 V, 0/4...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution		Range 0...10 V: 12 bits Range -10...+10 V: 12 bits + sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C

Parameter	Value
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Tables Input Ranges Voltage, Current ↻ *Chapter 1.7.1.2.10.1 “Input Ranges Voltage, Current and Digital Input” on page 732* and Digital Input and Input Range Resistor ↻ *Chapter 1.7.1.2.10.2 “Input Range Resistor” on page 732*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical Data of the Analog Inputs if Used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+15 V
	Signal 1	+15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 1.5...1.6
Reference potential for AO0+ to AO1+		Terminal 2.7 (AO-) for voltage output Terminal 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage

Parameter	Value
Galvanic isolation	Against internal supply and other modules
Configurability	-10...+10 V, 0...20 mA, 4...20 mA (each output can be configured individually)
Output resistance (load), as current output	0...500 Ω
Output loadability, as voltage output	±10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	See ➮ *Chapter 1.7.1.2.10.3 “Output Ranges Voltage and Current” on page 733*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0), 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	Fast Counter ➮ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*
Operating modes	Operating modes ➮ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*

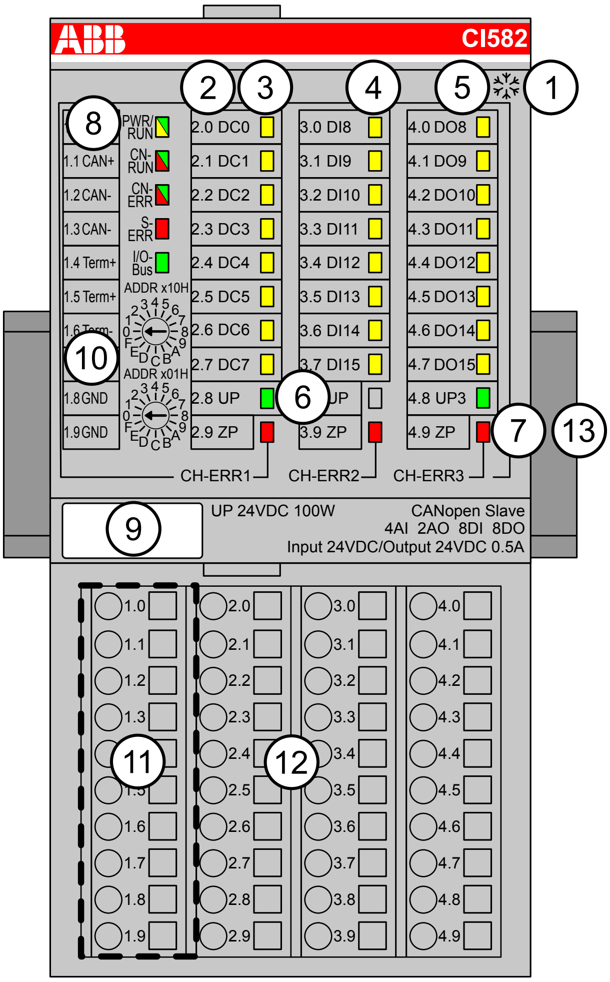
1.7.1.2.12 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 228 100 R0001	CI581-CN, CANopen bus module with 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 428 100 R0001	CI581-CN-XC, CANopen bus module with 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.1.3 CI582-CN

- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- Module-wise electrically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs (DC0 - DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 - DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 - DO15)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, CN-RUN, CN-ERR, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the CANopen node ID
11 10 terminals to connect the CANopen bus signals
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.1.3.1 Intended Purpose

The CANopen bus module CI582-CN is used as decentralized I/O module in CANopen networks. Depending on the terminal unit used, the network connection is performed either via a female 9-pin D-sub connector or via 10 terminals (screw or spring terminals) which are integrated in the terminal unit. The bus module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0...1.7)
- 8 digital inputs 24 VDC in 1 group (2.0...2.7)
- 8 digital outputs 24 VDC in 1 group (3.0...3.7)

The inputs/outputs are electrically isolated from the CANopen network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.1.3.2 Functionality

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the expansion bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto baudrate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher netX100
Expandability		Max. 10 S500 I/O modules
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 *Chapter 2.6.1 “System Data AC500” on page 1252* System data AC500 XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)

Parameter		Value
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148* *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

CI582-CN: Input/ Output Characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 VDC) 8 digital transistor outputs (24 VDC, 0.5 A max.) 8 configurable digital inputs/outputs (24 VDC, 0.5 A max.)

1.7.1.3.3 Electrical Connection

The CANopen bus module is plugged on the I/O terminal units TU517 ↳ *Chapter 1.4.4 "TU517 and TU518 for Communication Interface Modules" on page 157* or TU518 ↳ *Chapter 1.4.4 "TU517 and TU518 for Communication Interface Modules" on page 157* and accordingly TU509 ↳ *Chapter 1.4.2 "TU509 and TU510 for Communication Interface Modules" on page 148* or TU510 ↳ *Chapter 1.4.2 "TU509 and TU510 for Communication Interface Modules" on page 148*. Properly position the module and press until it locks in place.

The electrical connection of the I/O channels is established using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 VDC

Terminal 4.8: process supply voltage UP3 = +24 VDC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

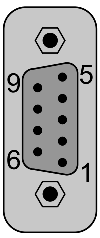
> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ↳ Chapter 2.6 "AC500 (Standard)" on page 1252.*

> *With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.*

Possibilities of Connection

Mounting on Terminal Units TU509 or TU510

The assignment of the 9-pin female D-sub connector for the CANopen signals



1	---	Reserved
2	CAN-	Inverted signal of the CAN Bus
3	CAN_GND	Ground potential of the CAN bus
4	---	Reserved
5	---	Reserved
6	---	Reserved
7	CAN+	Non-inverted signal of the CAN Bus
8	---	Reserved
9	---	Reserved
Shield	Cable shield	Functional earth

Bus Terminating Resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

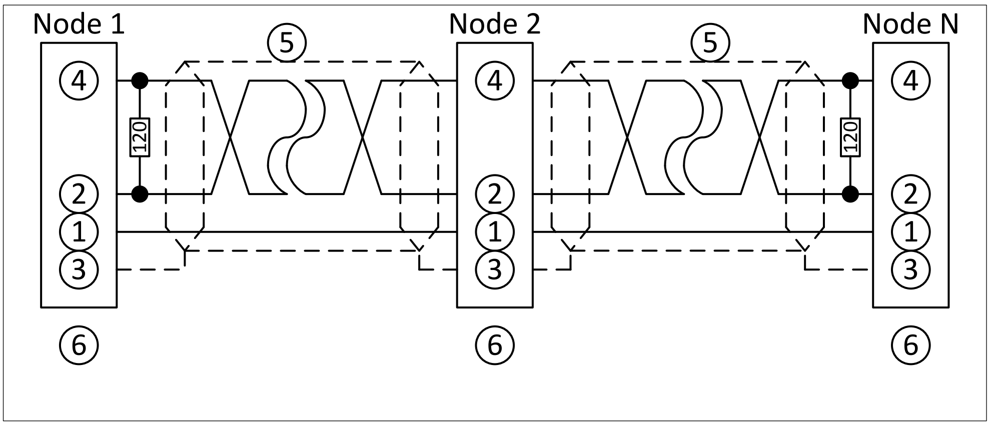


Fig. 129: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

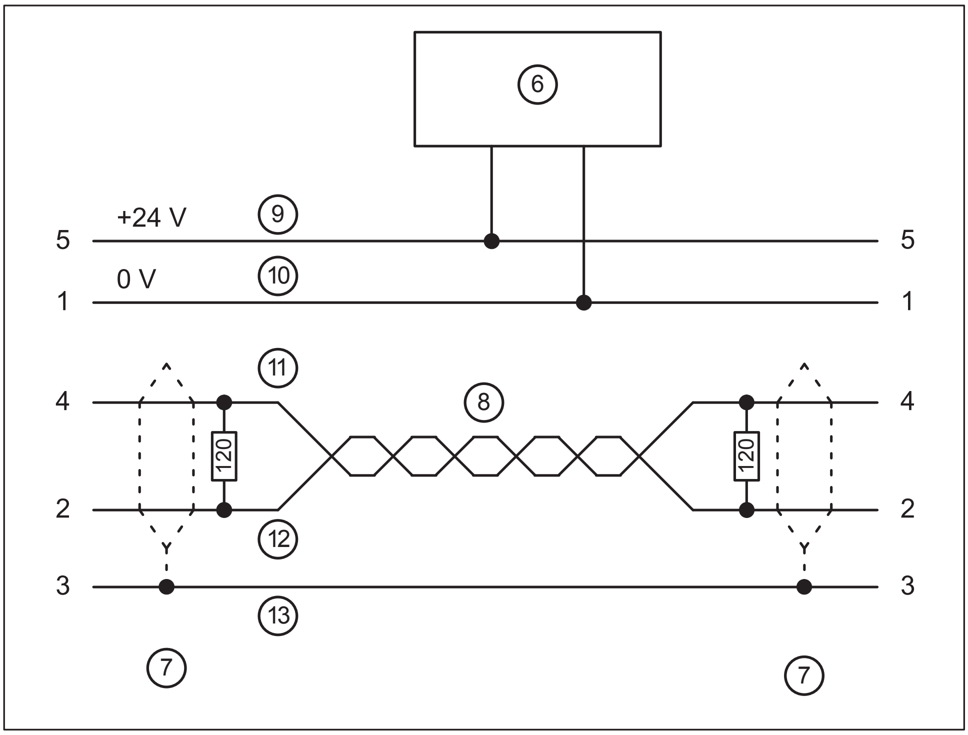


Fig. 130: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red

10	black
11	white
12	blue
13	bare

The earthing of the shield should take place at the switch-gear. Please refer to *Chapter 2.6.1 “System Data AC500” on page 1252.*

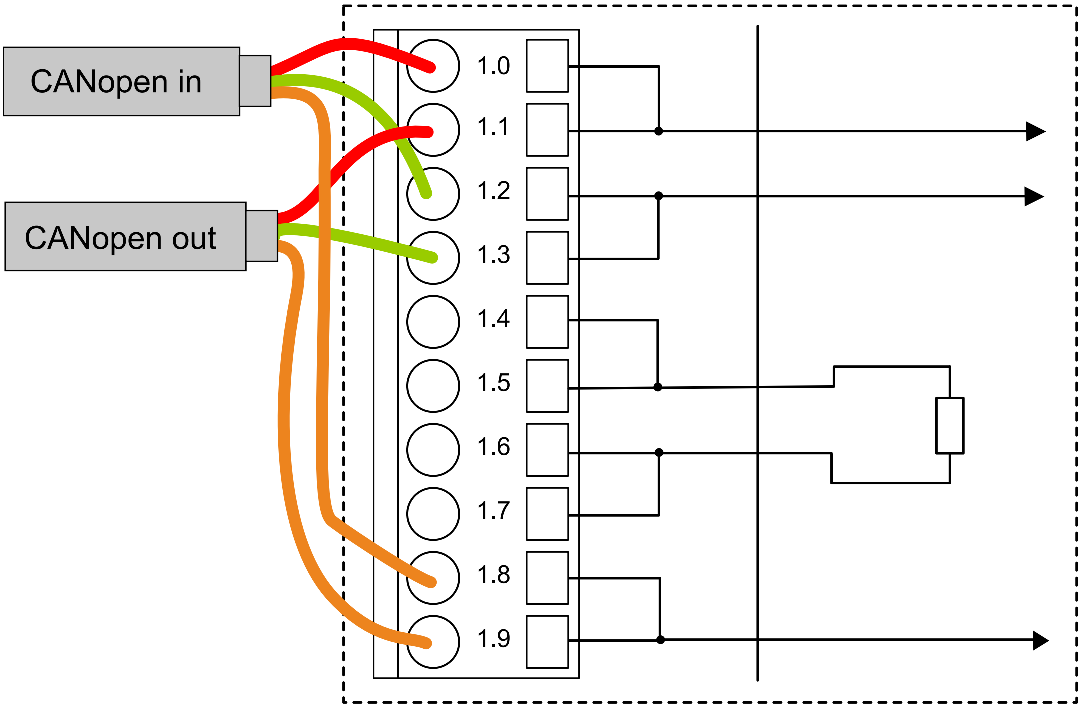
Mounting on Terminal Units TU517 or TU518

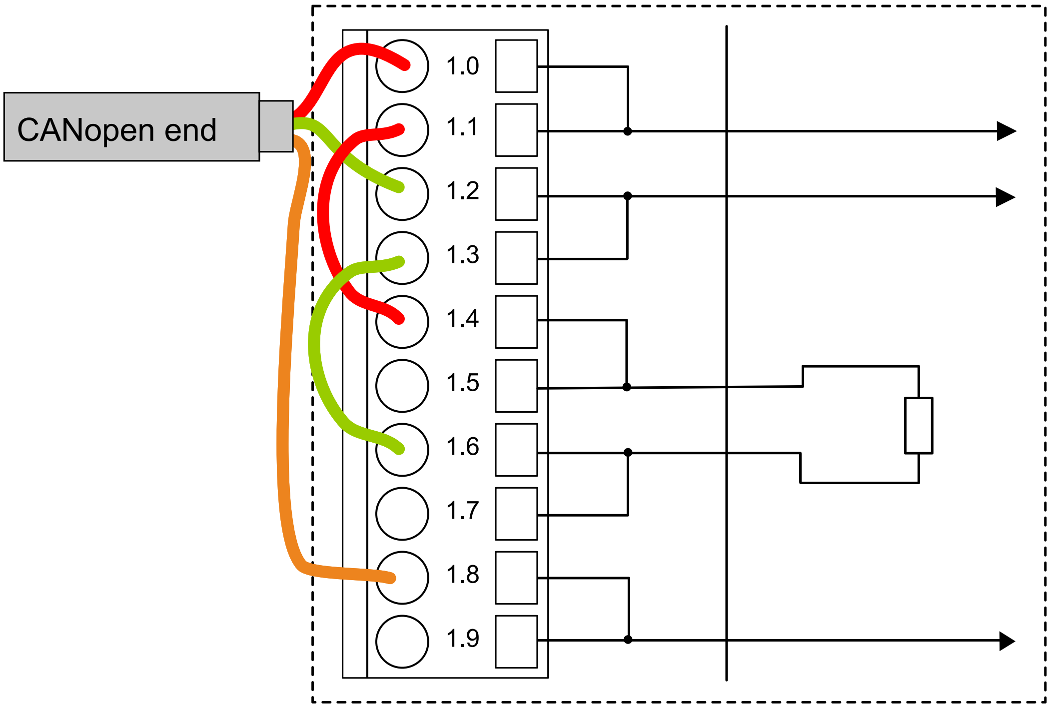
Table 117: Assignment of the terminals

Terminal	Signal	Description
1.0	CAN+	Non-inverted signal of the CAN Bus
1.1	CAN+	Non-inverted signal of the CAN Bus
1.2	CAN-	Inverted signal of the CAN Bus
1.3	CAN-	Inverted signal of the CAN Bus
1.4	Term+	CAN bus termination for CAN+ (for bus termination, Term+ must be connected with CAN+)
1.5	Term+	CAN bus termination for CAN+ (connecting alternative for terminal 1.4)
1.6	Term-	CAN bus termination for CAN- (for bus termination, Term- must be connected with CAN-)
1.7	Term-	CAN bus termination for CAN- (connecting alternative for terminal 1.6)
1.8	CAN-GND	Ground potential of the CAN bus
1.9	CAN-GND	Ground potential of the CAN bus

At the line ends of a bus segment, termination resistors must be connected. If TU517 or TU518 is used, the bus termination resistors can be enabled by connecting the terminals Term+ and Term- to the data lines CAN+ and CAN- (no external termination resistors are required, see illustration below).

The following figures show the different connection options for the CANopen bus module:





In the case of TU517/TU518, the termination resistors are not located inside the TU but inside the bus module CI581-CN. Hence, when removing the device from the TU, the bus termination resistors are no longer connected to the bus. The bus itself will not be disconnected if a device is removed.

The earthing of the shield should take place at the switch-gear cabinet. Please refer to the AC500 System-Data *Chapter 2.6.1 "System Data AC500" on page 1252**.*

Table 118: Assignment of the other Terminals

Terminal	Signal	Description
2.0	DC0	Signal of the configurable digital input/output DC0
2.1	DC1	Signal of the configurable digital input/output DC1
2.2	DC2	Signal of the configurable digital input/output DC2
2.3	DC3	Signal of the configurable digital input/output DC3
2.4	DC4	Signal of the configurable digital input/output DC4
2.5	DC5	Signal of the configurable digital input/output DC5
2.6	DC6	Signal of the configurable digital input/output DC6
2.7	DC7	Signal of the configurable digital input/output DC7
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	DI8	Signal of the digital input DI8
3.1	DI9	Signal of the digital input DI9
3.2	DI10	Signal of the digital input DI10
3.3	DI11	Signal of the digital input DI11
3.4	DI12	Signal of the digital input DI12
3.5	DI13	Signal of the digital input DI13
3.6	DI14	Signal of the digital input DI14
3.7	DI15	Signal of the digital input DI15
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	DO8	Signal of the digital output DO8
4.1	DO9	Signal of the digital output DO9
4.2	DO10	Signal of the digital output DO10
4.3	DO11	Signal of the digital output DO11
4.4	DO12	Signal of the digital output DO12
4.5	DO13	Signal of the digital output DO13
4.6	DO14	Signal of the digital output DO14
4.7	DO15	Signal of the digital output DO15
4.8	UP3	Process voltage UP3 (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Electrical connection of CANopen bus module CI582-CN:

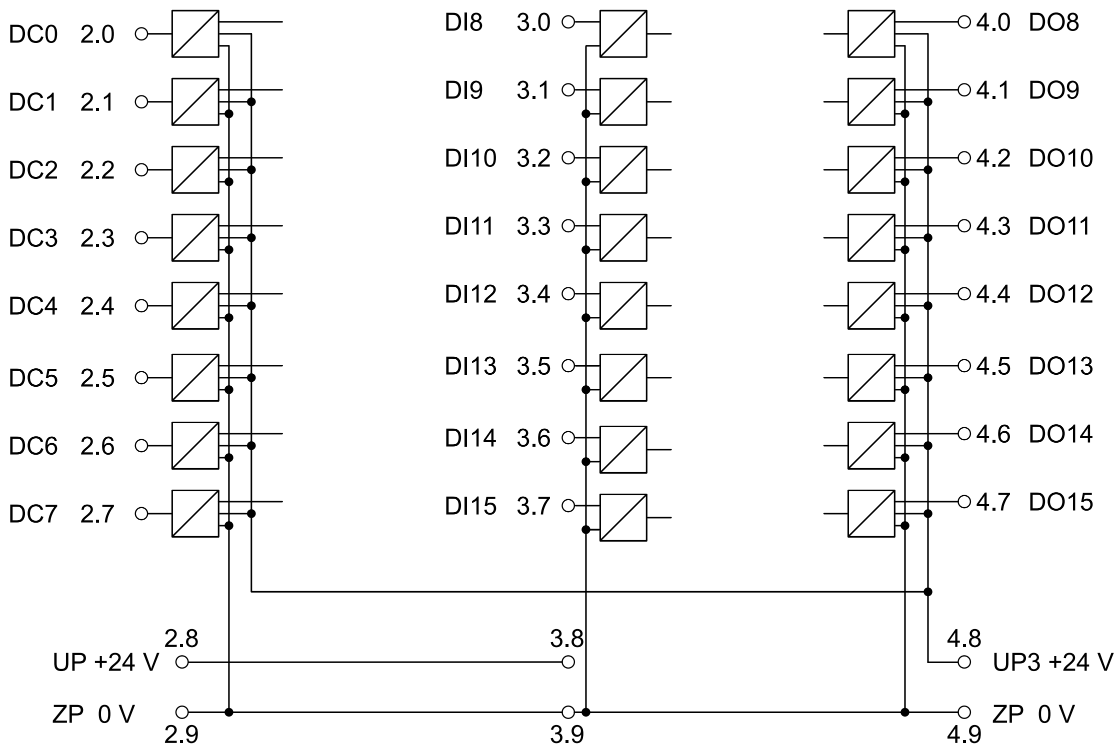


Fig. 131: Connection of the bus module CI582-CN

For a description of the meaning of the LEDs, please refer to the section for the state LEDs *Chapter 1.7.1.3.9 “State LEDs” on page 756.*

Bus Length The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Connection of the Digital Inputs

The following figure shows the electrical connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.

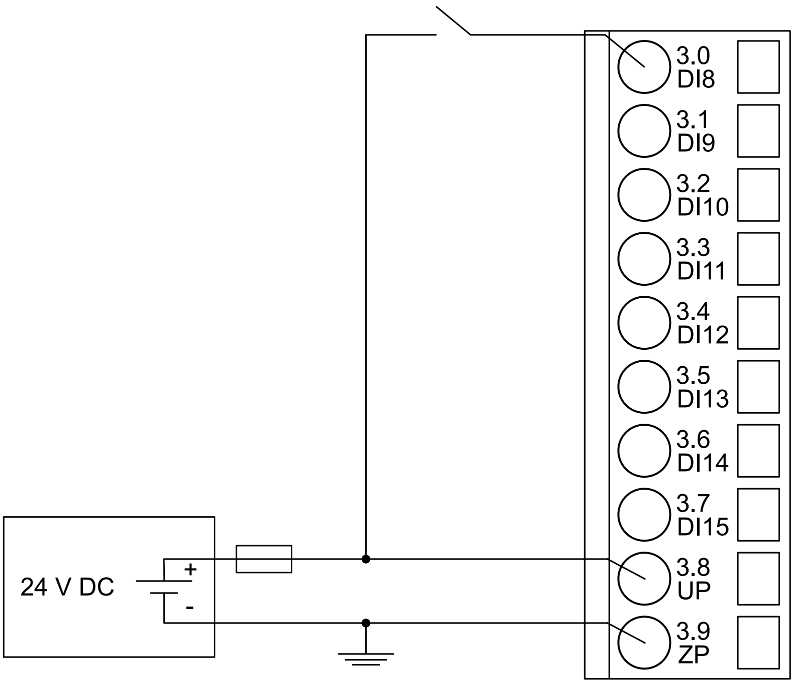


Fig. 132: Connection of the digital inputs to the module CI582-CN

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.

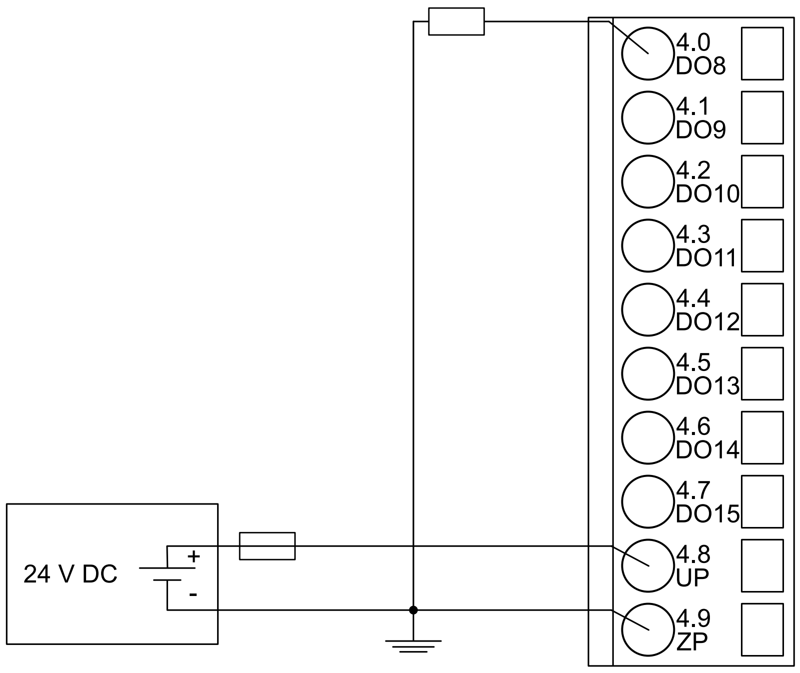


Fig. 133: Connection of configurable digital inputs/outputs to the module CI582-CN

Connection of the Configurable Digital Inputs/Outputs

The following figure shows the electrical connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 to DC7 in the same way.

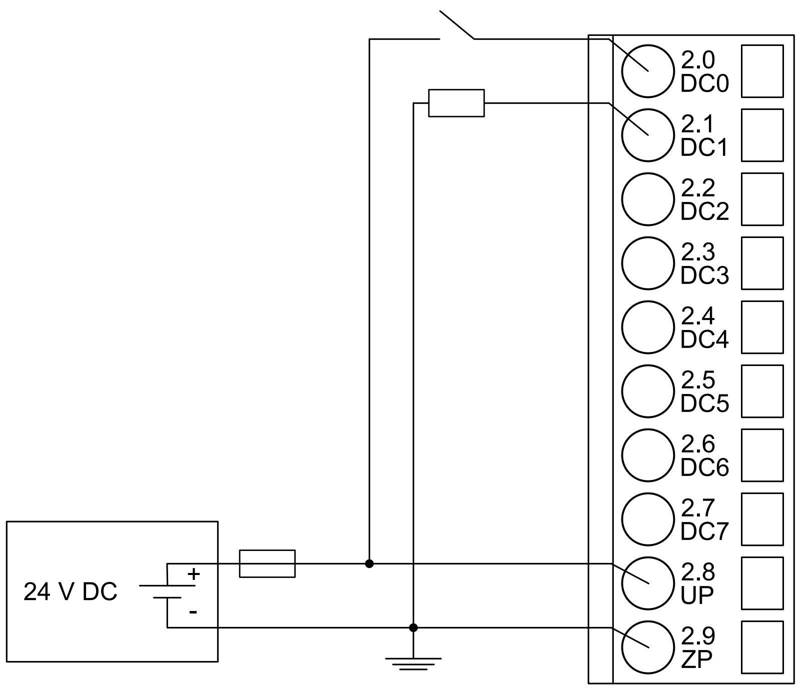


Fig. 134: Connection of configurable digital inputs/outputs to the module CI582-CN

1.7.1.3.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.7.1.3.5 Addressing

A detailed description concerning addressing can be found in the documentation of ABB Control Builder Plus Software.

> *The CANopen bus module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.*
>
> *The range of permitted CANopen slave addresses is 1 to 127. Setting a higher address (> 128) does not lead to an error response, but results in a special mode (DS401). In this special mode, the device creates the node address by subtracting the value 128 from the address switch's value.*

1.7.1.3.6 I/O Configuration

The CI582-CN CANopen bus configuration is handled by CANopen master with the exception of the slave node ID (via rotary switches) and the baud rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

1.7.1.3.7 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C89	WORD	0x1C89
Parameter length	Internal	38	BYTE	38
Error LED / fail-safe function table error LED / failsafe function ↻ *Table 119 “Error LED / Failsafe function” on page 751*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	18		
Reserved	0	0	ARRAY of 24 BYTES	
Check supply	On	0	BYTE	
	Off	1		1

Name	Value	Internal value	Internal value, type	Default
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.

[2]) For a description of the counter operating modes, please refer to the Fast Counter section *Chapter 1.5.1.2.10 “Fast Counter” on page 396*.

Table 119: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode on *)
*) The parameter Behavior DO at comm. error is only analyzed if the failsafe mode is ON.	

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01
Behavior DO at comm. error [1])	Off	0	BYTE	Off
	Last value	1		0x00
	Last value 5 sec	6		
	Last value 10 sec	11		
	Substitute value	2		
	Substitute value 5 sec	7		
	Substitute value 10 sec	12		

Name	Value	Internal value	Internal value, type	Default
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0..DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behavior DO at comm. error is applied to DC and DO channels and only analyzed if the failsafe mode is ON.
[2])	The state "externally voltage detected" appears if the output of a channel DC0..DC7 is to be switched on while an external voltage is connected. In this case, start-up is disabled while the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears if external voltage at digital outputs DC0..DC7 and DO0..DO7 has exceeded the process supply voltage UP3 (see Electrical Connection *Chapter 1.7.1.3.3 “Electrical Connection” on page 742*). The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters to "OFF". This parameter should only be disabled in exceptional cases as voltage overflow may produce reverse voltage.

1.7.1.3.8 Diagnosis

Structure of the diagnosis block via *CANOM_NODE_DIAG*

Byte Number	Description	Possible Values
1	Diagnosis byte, slot number	31 = CI582-CN (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to Bit 5, coded error description
5	Diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**CANopen diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error** **identi-fier**	**Error message**		**Remedy**
	1)	2)	3)	4)				
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		
3	-	31	31	31	43	Internal error in the module		
3	-	31	31	31	36	Internal data exchange failure		
3	-	31	31	31	9	Overflow diagnosis buffer		Restart
3	-	31	31	31	26	Parameter error		Check Master

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000..063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 Bit 6..7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0..5**	**CANopen diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**	
	1)	2)	3)	4)				
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage	
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage	
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module	
3	-	1...10	31	31	32	Wrong I/O device type on socket	Replace I/O module / check configu-ration	
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization	
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage	
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)	Check terminals	
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module	
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage	
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage	

E1..E4	d1	d2	d3	d4	Identi-fier 000..063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 4 Bit 6..7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0..5	CANopen diagnosis block	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1]	[2]	[3]	[4]			
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5]	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0..DO7 [6]	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0..DC7 [6]	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7]	Check terminals

Remarks:

[1]	In AC500, the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = position of the communication module;14 = I/O bus; 31 = module itself The identifier is not contained in the CI542-DP diagnosis block.
[2]	With "Device" the following allocation applies: 31 = module itself, 1..10 = decentralized communication interface module
[3]	With "Module" the following allocation applies depending on the master: Module error: 31 = module itself Channel error: module type (1 = AI, 2 = DO, 3 = AO)
[4]	This message appears if external voltages at one or more terminals DC0..DC7 or DO0..DO7 cause other digital outputs to be supplied by that voltage (voltage feedback, see Electrical Connection ␦ *Chapter 1.7.1.3.3 “Electrical Connection” on page 742*). All outputs of the digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5]	The voltage at digital outputs DC0..DC7 and DO0..DO7 has exceeded the process supply voltage UP3 (see Electrical Connection ␦ *Chapter 1.7.1.3.3 “Electrical Connection” on page 742*). A diagnosis message appears for the whole module.

6)	This message appears if the output of a channel DC0..DC7 or DO0..DO7 should be switched on while an external voltage is connected. In this case the start-up is disabled while the external voltage is connected. Otherwise, this could produce reverse voltage flowing from this output to other digital outputs. This diagnosis message appears for each channel.
7)	Short circuit: After a short circuit has been detected, the output is deactivated for 100ms. Subsequently, a new start-up will be executed. This diagnosis message appears for each channel.

1.7.1.3.9 State LEDs

The LEDs are located at the front of the module. There are 2 different groups:

- The 5 system LEDs (PWR, CN-RUN, CN-ERR, S-ERR and I/O bus) show the operation states of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O controller	Start-up / preparing communication
	Yellow	---	---	---
CN-RUN	Green	---	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running	Flashing: CANopen bus in PRE-OPERATIONAL state and slave is being configured Single flash: CANopen bus in STOPPED state. Flickering: Autodetect is active
CN-ERR	Red	No system error	CANopen Bus is OFF	Flashing: Configuration error Single flash: error counter overflow due to too many error frames Double flash: A node-guard or a heartbeat event occurred Flickering: Autodetect is active
S-ERR	Red	No error	Internal error	--
I/O bus	Green	No decentralized I/O modules connected or communication error	Decentralized I/O modules connected and operational	---

States of the 29 Process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/output is OFF	Input/output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.1.3.10 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 to DI7	Terminals 3.0 to 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V
Undefined signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V

Parameter	Value
Ripple with signal 0	Within -3 V...+5 V
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	

Parameter	Value
Shielded	1000 m
Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

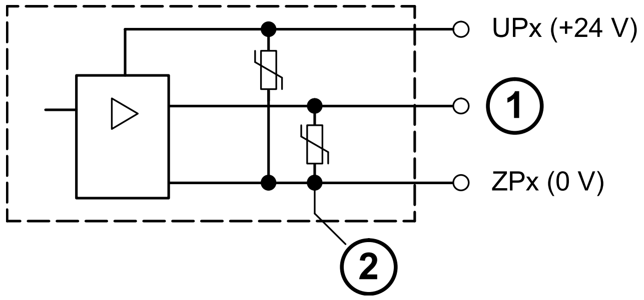


Fig. 135: Digital input/output (circuit diagram)

1	Digital output
2	Varistors for demagnetization when inductive loads are turned off

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group for 8 channels
If the channels are used as inputs	
Channels DC0...DC07	Terminals 2.0...2.7
If the channels are used as outputs	
Channels DC0...DC07	Terminals 2.0...2.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation	From the CANopen network

Technical data of the digital inputs/outputs if used as inputs

Please refer to the Technical Data of the Digital Inputs *Chapter 1.7.1.3.10 “Technical Data” on page 757*. Deviation:

Terminals of the channels DC0 to DC7: Terminals 2.0 to 2.7

Due to the direct connection to the output, the demagnetizing varistor is also effective at the input. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Please refer to the Technical Data of the Digital Outputs ↳ *Chapter 1.7.1.3.10 “Technical Data” on page 757*. Deviation:

Terminals of the channels DC0 to DC7: Terminals 2.0 to 2.7

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

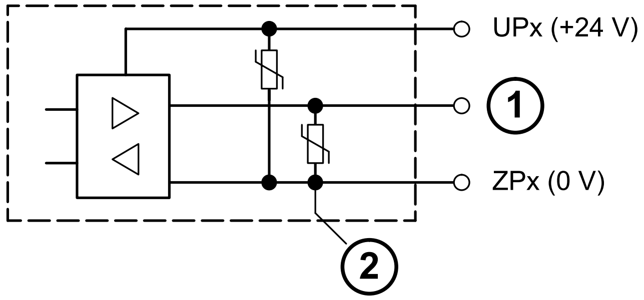


Fig. 136: Digital input/output (circuit diagram)

1	Digital input/output
2	For demagnetization when inductive loads are turned off

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 3.0 (DI8), 3.1 (DI9)
Used outputs	Terminal 4.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	Fast Counter ↳ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*
Operating modes	Operating modes ↳ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*

1.7.1.3.11 Ordering Data

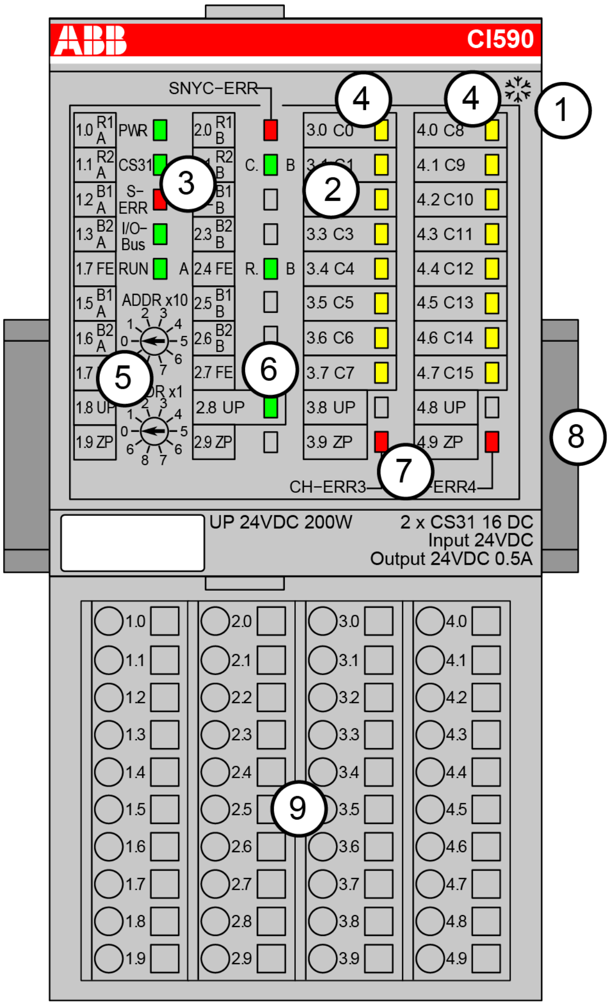
Part no.	Description	Product Life Cycle Phase *)
1SAP 228 200 R0001	CI582-CN, CANopen bus module with 8 DI, 8 DO and 8 DC	Active
1SAP 428 200 R0001	CI582-CN-XC, CANopen bus module with 8 DI, 8 DO and 8 DC, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.2 CS31

1.7.2.1 CI590-CS31-HA

- 16 configurable digital inputs/outputs 24 VDC
- CS31 bus connection
- Module-wise electrically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 5 system LEDs
4 16 yellow LEDs to display the signal states of the configurable digital inputs/outputs C0 to C15
5 2 rotary switches to set the module's address (00d to 99d)
6 1 green LED to display the process voltage UP
7 2 red LEDs to display errors
8 DIN rail
9 Terminal unit
Sign for XC version

1.7.2.1.1 Intended Purpose

The High Availability CS31 bus module CI590-CS31-HA is used as a decentralized I/O module on CS31 field buses. The CI590-CS31-HA contains two RS485 interfaces for connecting the module to two separate CS31 buses to have redundancy/backup or high availability. In addition, the CI590-CS31-HA provides 16 I/O channels with 16 configurable digital inputs/outputs (C0...C15) in one group. This group can be used as follows:

- 24 VDC input
- 24 VDC transistor output, 0.5 A (max.), short-circuit and overload protected
- re-readable output (combined input/output) with identical technical data of the digital inputs and outputs

The inputs and outputs are group-wise electrically isolated from the CS31 buses and from other modules. Each CS31 bus is electrically isolated from other terminals.

1.7.2.1.2 Functionality

Parameter	**Value**
Interface bus A	RS485, CS31 protocol, electrically isolated from other electronic.
Interface bus B	RS485, CS31 protocol, electrically isolated from other electronic.
Address switches	Two rotary switches for setting the CS31 bus address (00d to 99d).
I/O bus	I/O bus to connect S500 I/O modules (max. 7).
Digital inputs/outputs	16 configurable digital inputs/outputs in one group: 24 VDC, 0.5 A (max.), short-circuit and overload protected.
High-Speed Counter	Integrated, with many configurable operating modes.
LED displays	For system states, signal states, errors and power supply.
External power supply	Via UP and ZP terminal (process voltage: 24 VDC).
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU552-CS31 *Chapter 1.4.7 “TU551-CS31 and TU552-CS31 for CS31 Communication Interface Modules” on page 169*

1.7.2.1.3 Electrical Connection

The CS31-HA bus module CI590-CS31-HA is plugged on CS31 terminal unit TU551-CS31 or TU552-CS31. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with two screws plus the additional accessory for wall mounting (TA526).

> *Mounting, disassembling and electrical connection for the terminal units and the I/O modules are described in detail in the S500 system data chapters.*

The electrical connection is carried out by using the 40 terminals of the terminal unit TU551-CS31/TU552-CS31. It is possible to replace the CI590-CS31-HA without loosening the wiring.

Assignment of the terminals:

Terminal	Signal	Description
1.0	R1A	Integrated termination resistors for CS31 bus A, terminal 1
1.1	R2A	Integrated termination resistors for CS31 bus A, terminal 2
1.2	B1A	CS31 bus A, bus line 1
1.3	B2A	CS31 bus A, bus line 2
1.4	FE	Functional earth
1.5	B1A	CS31 bus A, bus line 1
1.6	B2A	CS31 bus A, bus line 2
1.7	FE	Functional earth
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	R1B	Integrated termination resistors for CS31 bus B, terminal 1
2.1	R2B	Integrated termination resistors for CS31 bus B, terminal 2
2.2	B1B	CS31 bus B, bus line 1
2.3	B2B	CS31 bus B, bus line 2
2.4	FE	Functional earth
2.5	B1B	CS31 bus B, bus line 1
2.6	B2B	CS31 bus B, bus line 2
2.7	FE	Functional earth
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	C0	Signal of the configurable digital input/output C0
3.1	C1	Signal of the configurable digital input/output C1
3.2	C2	Signal of the configurable digital input/output C2
3.3	C3	Signal of the configurable digital input/output C3
3.4	C4	Signal of the configurable digital input/output C4
3.5	C5	Signal of the configurable digital input/output C5
3.6	C6	Signal of the configurable digital input/output C6
3.7	C7	Signal of the configurable digital input/output C7
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	C8	Signal of the configurable digital input/output C8
4.1	C9	Signal of the configurable digital input/output C9
4.2	C10	Signal of the configurable digital input/output C10
4.3	C11	Signal of the configurable digital input/output C11
4.4	C12	Signal of the configurable digital input/output C12
4.5	C13	Signal of the configurable digital input/output C13
4.6	C14	Signal of the configurable digital input/output C14
4.7	C15	Signal of the configurable digital input/output C15

Terminal	Signal	Description
4.8	UP	Process voltage UP (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

CAUTION!
Risk of damaging the PLC modules!
The PLC modules must not be removed if the plant is powered on. Make sure that all voltage sources (supply and process voltage) are switched off before removing or replacing a module.

CAUTION!
Risk of damaging the PLC modules!
The PLC modules can be damaged by overvoltages and short circuits. Make sure that all voltage sources (supply and process voltage) are switched off before starting system operation.

The module provides several diagnostic functions (see chapter *Chapter 1.7.2.1.10 “Diagnosis” on page 772*).

The following figure demonstrates electrical connection of the configurable digital inputs/outputs. The digital input/output C0 is connected as an output and the digital input/output C1 is connected as an input. Connect the digital inputs/outputs C2...C15 in the same way.

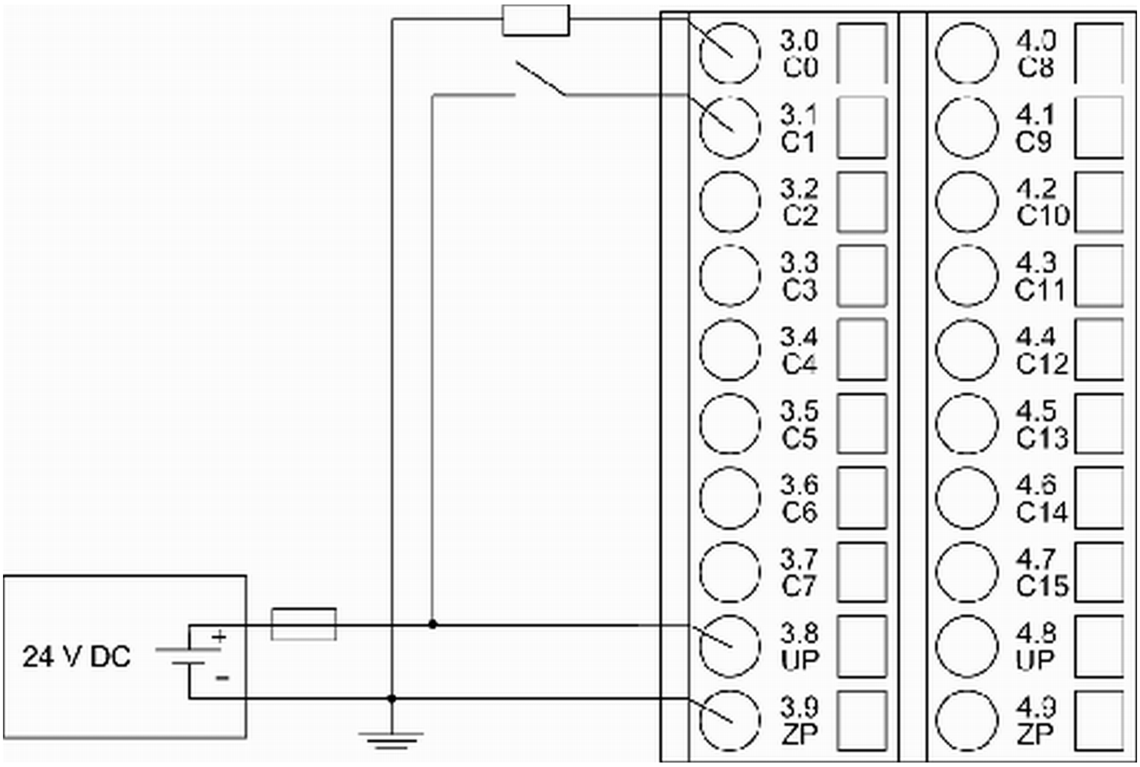


Fig. 137: CI590-02

CAUTION!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of CI590-CS31-HA. Connect a 470 Ω / 1 W resistor in series configurable inputs/outputs C8/C9 if using them as fast counter inputs to safely avoid any influences.

The meaning of the LEDs is described in the chapter *Chapter 1.7.2.1.11 "State LEDs" on page 774*.

1.7.2.1.4 CS31 Bus Connections

CS31 bus is connected with terminals 1.0 to 1.7 and 2.0 to 2.7 through the terminal unit. The end-of-line resistor can also be activated by using external wire jumpers.

The following pictures describe the different possibilities of connecting CS31 buses to the CI590-CS31-HA:

Option 1

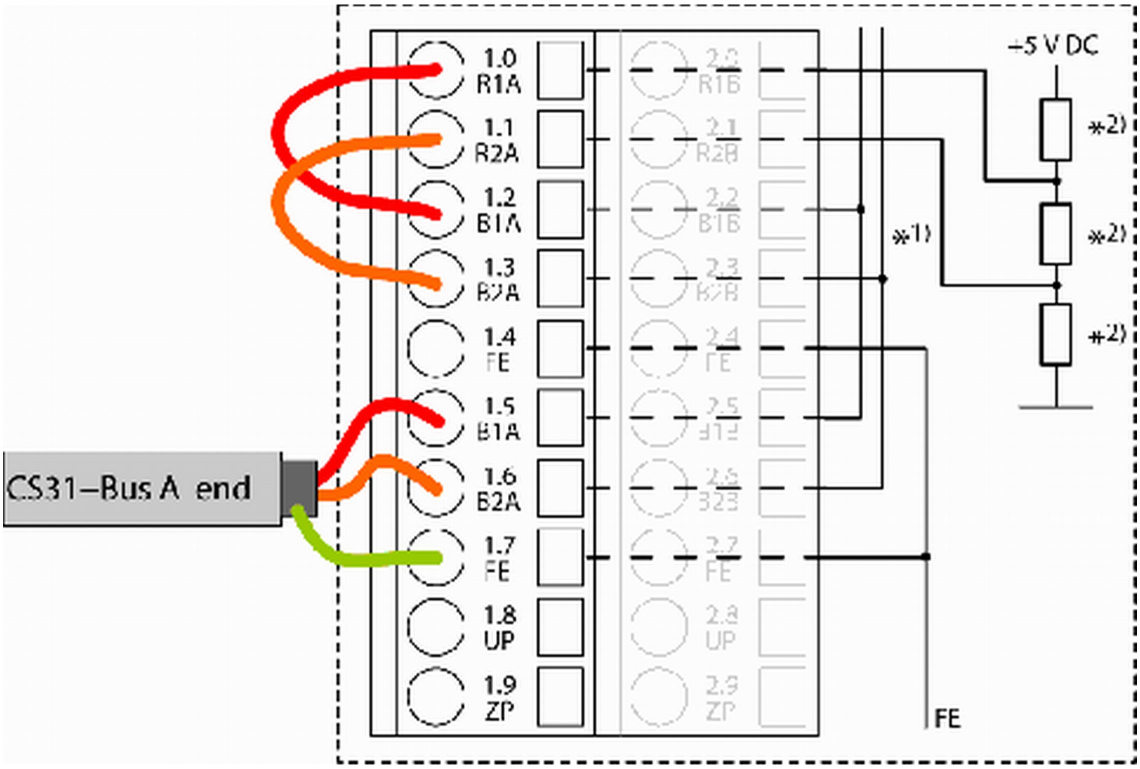


Fig. 138: Electrical connection of CS31 bus A with CI590-CS31-HA located at the bus end

1) Connection between the bus lines is located inside the terminal unit.
2) Termination resistors are located in the terminal unit TU551-CS31/TU552-CS31.

Option 2

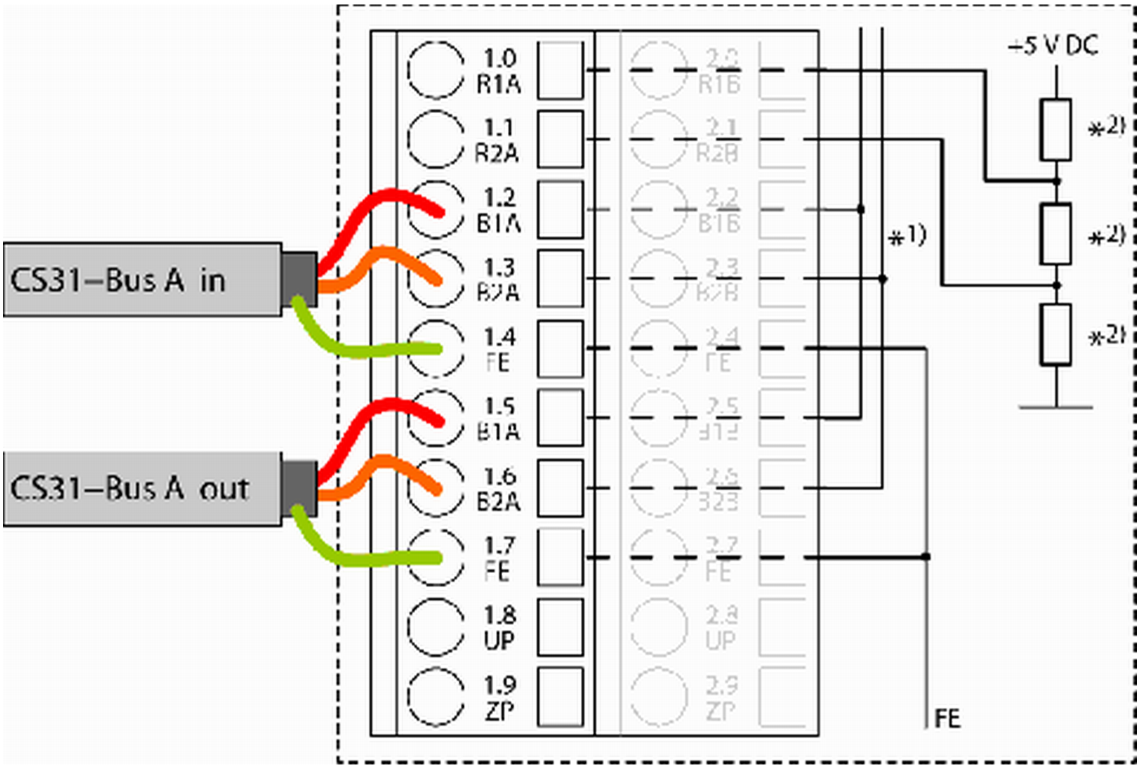


Fig. 139: Electrical connection of CS31 bus A with CI590-CS31-HA located in the middle of the bus

1) Connection between the bus lines is located inside the terminal unit.
2) Termination resistors are located in the terminal unit TU551-CS31/TU552-CS31.

Option 3

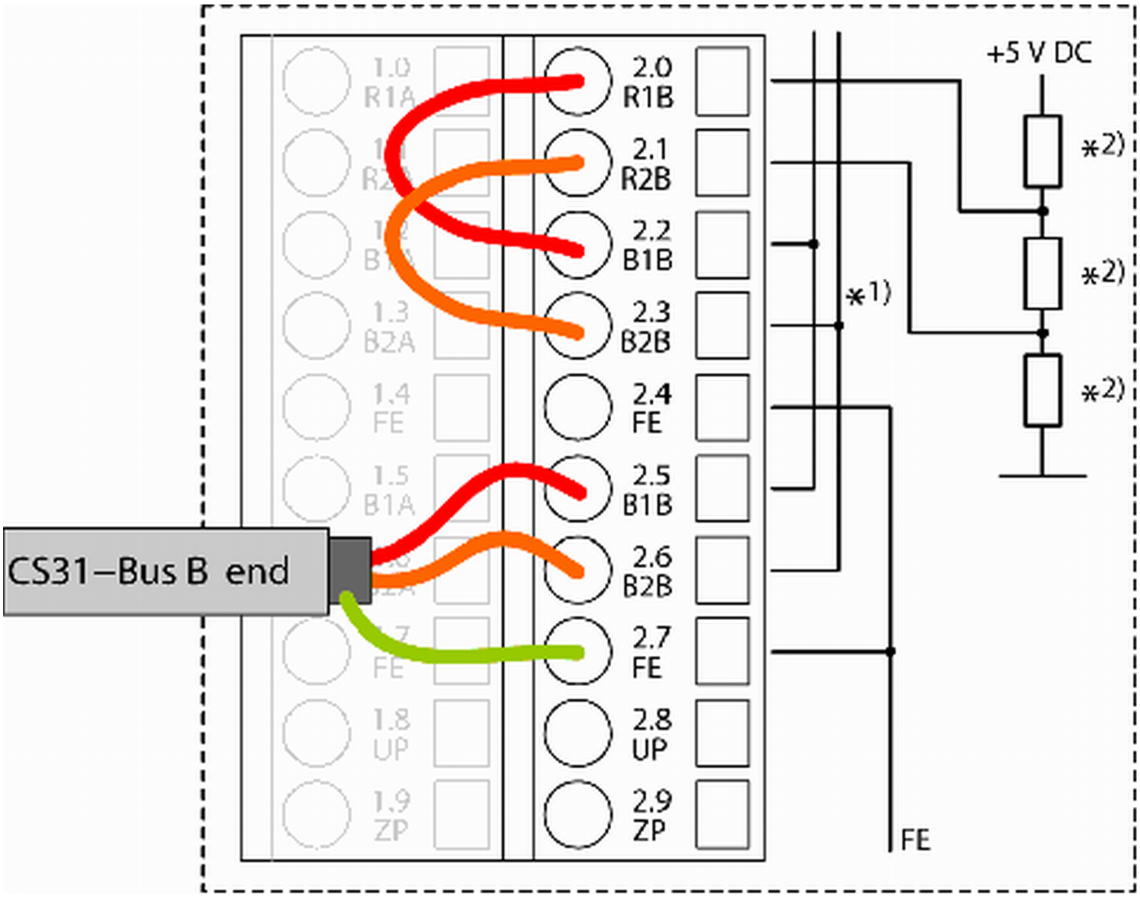


Fig. 140: Electrical connection of CS31 bus B with CI590-CS31-HA located at the bus end

[1]) Connection between the bus lines is located inside the CI590-CS31-HA module.
[2]) Termination resistors are located in the CI590-CS31-HA module.

Option 4

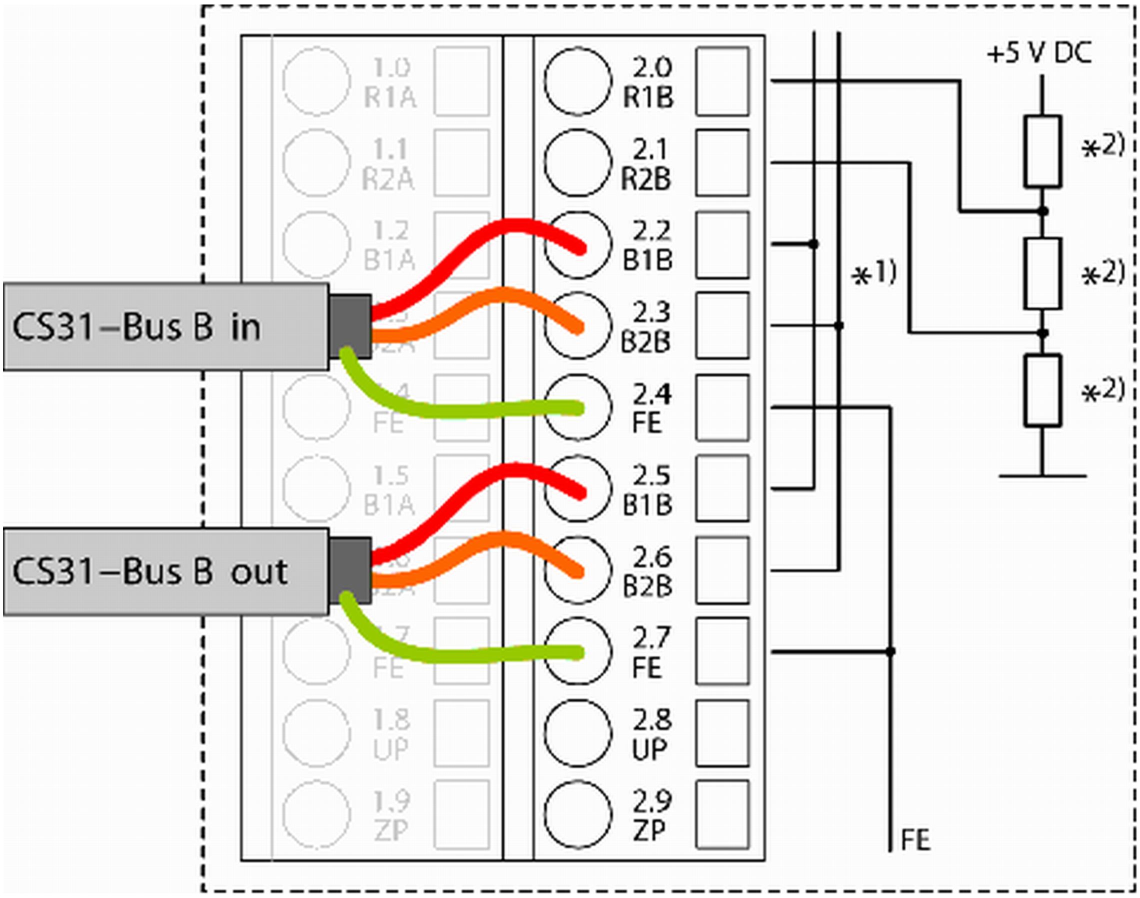


Fig. 141: Electrical connection of CS31 bus B with CI590-CS31-HA located in the middle of the bus

[1]) Connection between the bus lines is located inside the CI590-CS31-HA module.
[2]) Termination resistors are located in the CI590-CS31-HA module.

Details on CS31 wiring is described seperately *Chapter 2.6.4.8 “CS31 System Bus” on page 1286*.

1.7.2.1.5 Internal Data Exchange

Parameter	Without fast counter	With fast counter (only with AC500)
Digital inputs (bytes)	2 + expansion modules	5 + expansion modules
Digital outputs (bytes)	2 + expansion modules	5 + expansion modules
Counter input data (words)	0	4 (+4 AI)
Counter output data (words)	0	8 (+8 AO)

1.7.2.1.6 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

> *Only one address is used to identify the module on bus A and bus B.*

> *CI590-CS31-HA address must be set based on the “number of CS31 modules“ calculated by Automation Builder.*

The address (00d to 99d) is set with two rotary switches on the front panel of the module.

> *CS31 bus module reads the position of the address switches only during initialization after power on, i.e. changes of the settings during operation remain ineffective.*

1.7.2.1.7 CI590-CS31-HA Limitations

The following peculiarities concerning the CS31 bus in the AC500 must be observed when addressing S500 I/O devices at the CS31 bus:

- One CS31 software module can occupy a maximum of 15 bytes of inputs and 15 bytes of outputs in the digital area. This corresponds to 15 x 8 = 120 digital inputs and 120 outputs.
- One CS31 software module can allocate a maximum of eight words of inputs and eight words of outputs in the analog area.
- A maximum of 31 of these CS31 software modules are allowed for connection to the CS31 bus.
- If a device contains more than 15 bytes or eight words of inputs or outputs, it occupies two or more of the 31 CS31 software modules.
- The CI590-CS31 can internally manage two CS31 software modules in the digital area and five CS31 software modules in the analog area. This corresponds to a maximum of:
  - 240 digital inputs (2 x 15 bytes) and
  - 240 digital outputs (2 x 15 bytes) and
  - 40 analog inputs (5 x 8 words) and
  - 40 analog outputs (5 x 8 words).
- Address setting is done at the CI590-CS31 using two rotary switches at the module's front plate.
- To enable the fast counter of the CI590-CS31 the hardware address (HW_ADR) has to be set to the module address + 70. With activated fast counter, the module addresses 0...28 (hardware address setting 70...98) are allowed.

  Then, the CI590-CS31 registers contain two CS31 software modules using the module address (hardware address 70), once in the digital area and once in the analog area.
- CS31 software module 1 in digital area:
  -> registers using the module address.
  CS31 software module 2 in digital area:
  -> registers using module address+7 and bit "Channel ≥ 7" set.
  CS31 software module 1 in analog area:
  -> registers using the module address.
  CS31 software module 2 in analog area:
  -> registers using module address and bit "Channel ≥ 7" set.
  CS31 software module 3 in analog area:
  -> registers using the module address+1.
  CS31 software module 4 in analog area:
  -> registers using module address+1 and bit "Channel ≥ 7" set.

- The CI590-CS31 can manage a maximum of 255 parameters. This does not cause any restrictions in all configurations with the currently available S500 I/O devices.
- The next free address for a CI590-CS31 is derived from the highest address occupied in the digital area or the analog area of the previous CI590-CS31.
- When connecting several S500 expansion modules to a CI590-CS31 via the I/O Bus, their inputs and outputs follow the CI590-CS31s inputs and outputs without gap. Such a cluster can occupy up to six CS31 software modules.
- A maximum of seven S500 expansion modules (extensions) can be connected to a CI590-CS31.

1.7.2.1.8 I/O Configuration

The CI590-CS31-HA does not store configuration data itself. The 16 configurable digital inputs/outputs are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation with the user program.

1.7.2.1.9 Parametrization

Arrangement of parameter data is performed by your master configuration software Automation Builder.

> **CAUTION!**
>
> **Risk of configuration errors!**
>
> Contradictory parameter settings may cause configuration errors of the CI590-CS31-HA and attached I/O modules. Please make sure, the fast counter mode is not set to value 0 if the module is included with fast counter in PLC configuration.

The parameter data directly influences module functionality.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Module address	1	2740 [1]	BYTE	2740 0 x 0AB4	0	61
Ignore module	No Yes	0 1	BYTE	No (0 x 00)	-	-
Parameter length	Internal	8 7 [2]	BYTE	8 7 [2]	0	255
Check supply	Off On	0 1	BYTE	On 0 x 01	-	-

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Error LED / Failsafe Function	On Off by E4 Off by E3 On + Fail-safe Off by E4 + Failsafe Off by E3 + Failsafe	-	-	On	-	-
Stop behavior	Switch over Stop Both stop/ failsafe	0 1 2	BYTE	0	-	-
Output compare	No check Binary Analog ± 256 Analog ± 512 Binary + Analog 256 Binary + Analog 512	0 1 2 3 4 5	BYTE	0	-	-
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	8 ms 0 x 02	-	-
Fast counter	0 : 10 3)	0 : 10	BYTE	Mode 0 0 x 00	-	-
Detection short-circuit at outputs	Off On	0 1	BYTE	On 0 x 01	-	-
Behavior outputs at communi-cation fault	Off Last value Substitute value	0 1 2	BYTE	Off 0 x 00	-	-
Substitute value	0...65535	0...0xffff	WORD	0	-	-

1) with CS31 and addresses less than 70 and FBP, the value is increased by 1.

2) with CS31 and addresses less than 70, without the parameter "Fast Counter".

3) Counter operating modes, see description of the fast counter.

1.7.2.1.10 Diagnosis

Structure of CI590-CS31-HA Diagnosis Block

If a CI590-CS31-HA module is connected via a CS31 bus, then the field bus master receives diagnosis information by an extended diagnosis block. The following table specifies the structure of this information. In case of an error the user can get this information by the diagnosis system, see *Chapter 1.7.2.1.10.2 “Diagnosis Table CI590-CS31-HA” on page 773*.

Byte Number	Description	Possible values
1	Data length (header included)	18
2	Diagnosis byte	0 = Communication with CI590-CS31-HA OK 1 = Communication with CI590-CS31-HA failed
3	CI590-CS31-HA diagnosis byte, module number	0 = CI590-CS31-HA (e.g. error at the integrated 16 DC) 1 = 1st attached S500 I/O module 2 = 2nd attached S500 I/O module ... 7 = 7th attached S500 I/O module
4	CI590-CS31-HA diagnosis byte, slot	According to the I/O bus specification passed on by modules to the fieldbus master
5	CI590-CS31-HA diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	CI590-CS31-HA diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description passed on by modules to the fieldbus master
7	CI590-CS31-HA diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error Bit 5: 1 = diag reset Bit 2 to bit 4: reserved Bit 1: 1 = explicit acknowledgement Bit 0: 1 = static error passed on by modules to the fieldbus master Value = 0: static message for other systems, which do not have a coming/leaving evaluation
8ff	reserved	

Diagnosis Table CI590-CS31-HA

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**FBP diagnosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module Error							
3	11	ADR	31	31	3	Timeout in the I/O module	Replace I/O module
3	11	ADR	31	31	19	Checksum error in the I/O module	
3	11	ADR	31	31	36	Internal data exchange failure	
3	11	ADR	31	31	40	Different hard-/firm-ware versions in the module	
3	11	ADR	31	31	43	Internal error in the module	
3	11	ADR	31	31	9	Overflow diagnosis buffer	Restart
3	11	ADR	31	31	26	Parameter error	Check master
3	11	ADR	31	31	11	Process voltage too low	Check process voltage
3	11	ADR	1...7	31	17	No communication to the I/O module	Replace I/O module
3	11	ADR	31	31 31	28	Configurations from PLC A of PLC B are different	Check PLC CS31 module configuration
3	11	ADR ADR	31	31	36	Wait Com (Only 1 bus or 1 CPU is active/operational)	Check second CPU or other bus connection
4	11	ADR	31	31	45	Process voltage ON/OFF	Process voltage ON
4	11	ADR	31/ 1...7	31	34	Wait ready (No reply during initiali-zation of the I/O module)	Replace I/O module
4	11	ADR	31/ 1...7	31	32	Wrong I/O module in the slot	Replace I/O module or check configuration

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diagnosis block	
Class	Inter-face	Devic e	Module	Chann el	Error identi-fier	Error message	Remedy
	1)	2)	3)	4)			
4	11	ADR	31	31	54	CPU conflict ● Both CPUs are in STOP mode ● HA cycle time too small ● Mismatch in comparison of analog values	● Check CPU status ● Check HA cycle *Task Configuration* ● Check wiring between the analog mod-ules and the CPU
Channel Error CI590-CS31-HA							
4	11	ADR	31/ 1...7	8...23	47	Short circuit at a digital output	Check connec-tion

Remarks:

1)	In AC500 the following interface identifier applies: 11 = COM1 (protocol CS31 bus only possible with COM1)
2)	With "Device" and CS31 bus master, the hardware address of the CI590-CS31-HA (0...69) is output.
3)	With "Module" the following allocation applies: 31 = module itself, 1...7 = Expansion 1...7
4)	In case of module errors, with channel "31 = Module itself" is output.

1.7.2.1.11 State LEDs

Table 120: States of the LEDs:

LED	Status	Color	LED = OFF	LED = ON	LED Flashes
PWR	System voltage	Green	System firm-ware is not running	System firm-ware is run-ning	--
CS31 A	CS31 commu-nication	Green	No communi-cation at CS31 bus A	Communica-tion at CS31 bus A OK	10 Hz: Not bit lifetime man-agement
C. B	CS31 commu-nication	Green	No communi-cation at CS31 bus B	Communica-tion at CS31 bus B OK	10 Hz: Not bit lifetime man-agement

LED	Status	Color	LED = OFF	LED = ON	LED Flashes
S-ERR	Sum Error	Red	--	Internal error detected	2 Hz: Diagnostic event happened
I/O-Bus	Communication via the I/O bus	Green	No I/O bus communication	Expansion modules connected	2 Hz: Error I/O bus
RUN A	CPU active	Green	CPU A is not primary	CPU A is primary	RUN B LED off: CI590-CS31-HA primary self selection. No primary order from both PLC. PLC A has been selected as primary. RUN B LED on: 2 primary orders. PLC B is primary.
R. B	CPU active	Green	CPU B is not primary	CPU B is primary	RUN A LED off: CI590-CS31-HA primary self selection. No primary order from both PLC. PLC B has been selected as primary. RUN A LED on: 2 primary orders. PLC A is primary.
SYNC-ERR	Outputs from CPU A and CPU B	Red	--	Configuration conflict detected	10 Hz: Not parameterized 2 Hz: Switchover has occured
C0...C15	Digital inputs/outputs	Yellow	Input/output = OFF	Input/output = ON (the input voltage is even displayed if the supply voltage is OFF)	--
UP	Process supply voltage and initialization	Green	Process voltage is missing	Process voltage OK and initialization completed	Module was not initialized correctly

LED	Status	Color	LED = OFF	LED = ON	LED Flashes
CH-ERR3		Red	No error	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short-circuit at an output)
CH-ERR4		Red	No error	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short-circuit at an output)
CH-ERR *)	Module error	Red	No error or process voltage is missing	Internal error	--
*) All LEDs CH-ERR2 to CH-ERR4 light up together					

1.7.2.1.12 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Rated supply voltage of the module		24 VDC (UP/ZP)
Current consumption of the module (UP)		50 mA
Process voltage UP:		
	Rated value	24 VDC (for inputs and outputs)
	Max. current loadability for the supply terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse at UP	10 A fast
	Electrical isolation	CS31 bus A interface from the rest of the module CS31 bus B interface from the rest of the module
	Inrush current from UP (at power-up)	0.040 A^2s
	Current consumption from UP at normal operation / with outputs	0.1 A + max. 0.008 A per input + max. 0.5 A per output
	Connections	Terminals 1.8 - 4.8 for +24 V (UP) and 1.9 - 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W (outputs unloaded)

Parameter	Value
Number of configurable digital inputs/outputs	16
Reference potential for all digital inputs and outputs	Minus pole of the supply voltage, signal name ZP
Address setting	
Diagnosis, refer to ␣ *Chapter 1.7.2.1.10 “Diagnosis” on page 772*	With two rotary switches on the front panel
Operating and error displays	27 LEDs altogether
Weight (without terminal unit)	Approx. 125 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Configurable Digital Inputs/Outputs

Each of the configurable digital I/O inputs/outputs is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	16 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 16 channels
Connection of the channels C0 to C7	Terminals 3.0 to 3.7
Connection of the channels C8 to C15	Terminals 4.0 to 4.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON if the input/output signal is high (signal 1)
Electrical isolation	Yes, between the I/O channels and the rest of the module

Digital Inputs/Outputs if Used as Inputs

Parameter		Value
Number of channels per module		16 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (minus pole of the process supply voltage, signal name ZP)
Input current per channel:		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 VDC
Signal 0		-3 V...+5 V *)
Undefined signal		> +5 V...<+15 V
Signal 1		+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V *)
Ripple with signal 1		Within +15 V...+30 V
Max. cable length:		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V to +30 V if UPx = 24 V and from -6 V to +30 V if UPx = 30 V.

Digital Inputs/Outputs if Used as Outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (minus pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (plus pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current:		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	10 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast

Parameter		Value
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency:		
	With resistive loads	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after approx. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length:		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization if inductive loads are switched off.

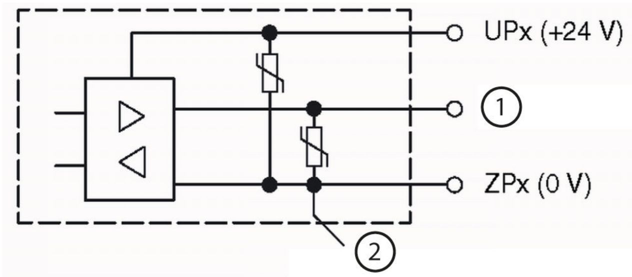


Fig. 142: Digital input/output (circuit diagram)

Technical Data of the Fast Counter

Parameter	Value
Used inputs	C8 / C9
Used outputs	C10
Counting frequency	Max. 50 kHz
Detailed description / Operating modes	For further information refer to *fast counters in chapter system technology*.

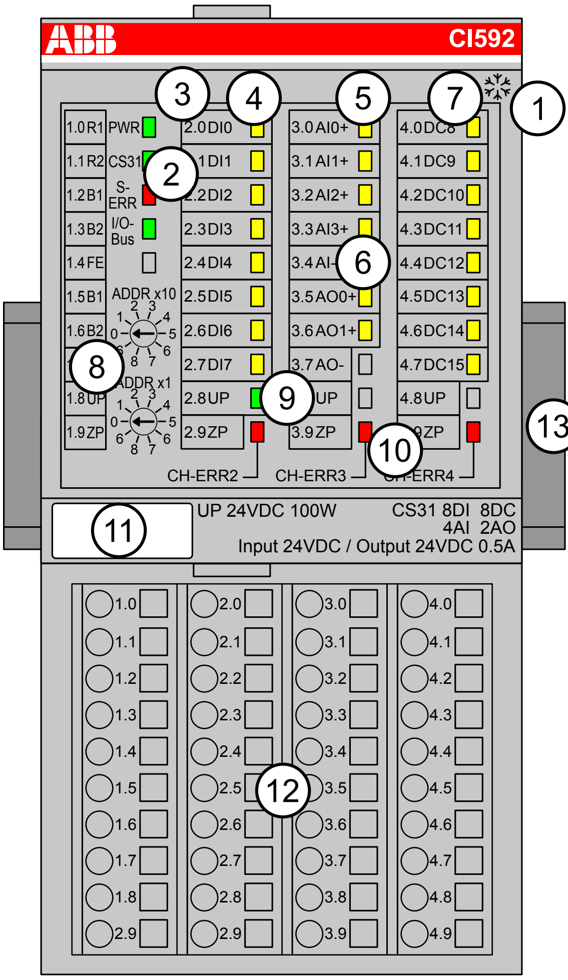
1.7.2.1.13 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 221 100 R0001	CI590-CS31-HA, CS31 redundant bus module, 16 DC	Active
1SAP 421 100 R0001	CI590-CS31-HA-XC, CS31 redundant bus module, 16 DC, XC version	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

1.7.2.2 CI592-CS31 - Digital and Analog Inputs and Outputs

- 8 digital inputs 24 VDC
- 8 configurable digital inputs/outputs 24 VDC
- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus sign)
- CS31 bus connection
- Module-wise electrically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 4 system LEDs
3 Allocation between terminal number and signal name
4 8 yellow LEDs to display the signal states of the digital inputs DI0 to DI7
5 4 yellow LEDs to display the signal states of the analog inputs AI0 to AI3
6 2 yellow LEDs to display the signal states of the analog outputs AO0 to AO1
7 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs DC8 to DC15
8 2 rotary switches to set the module's address (00d to 99d)

9 1 green LED to display the process voltage UP
10 3 red LEDs to display errors
11 Label
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.2.2.1 Intended Purpose

The CS31 Bus Module is used as a decentralized I/O module on CS31 field buses. The bus connection is performed on a RS485 serial interface, which allows the connection of this module to all existing CS31 buses. In addition, the CS31 Bus Module provides 22 I/O channels with the following properties:

- 8 digital inputs, 24 VDC
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD, resolution 12 bits plus sign
- 2 analog outputs, voltage and current, resolution 12 bits plus sign

The configuration is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.2.2.2 Functionality

Interface	RS485, CS31 protocol
Address switches	For setting the module's address (00d to 99d)
Digital inputs	8 (24 VDC; delay time configurable via software)
Configurable digital inputs/outputs	8 (24 VDC, 0.5 A max.)
Analog inputs	4 (configurable via software), resolution 12 bits plus sign, voltage, current and RTD input
Analog outputs	2 (configurable via software), resolution 12 bits plus sign, voltage and current output
Fast Counter	Integrated, many configurable operating modes
LED displays	For system displays, signal statuses, errors and power supply
External supply voltage	Via terminals UP and ZP (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU551-CS31 or TU552-CS31 *Chapter 1.4.7 “TU551-CS31 and TU552-CS31 for CS31 Communication Interface Modules” on page 169*

1.7.2.2.3 Electrical Connection

The CS31 bus module CI592-CS31 is plugged on the CS31 terminal unit TU551-CS31 or TU552-CS31 ↳ *Chapter 1.4.7 “TU551-CS31 and TU552-CS31 for CS31 Communication Interface Modules” on page 169*. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ↳ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ↳ Chapter 2.6 “AC500 (Standard)” on page 1252.

The electrical connection is carried out by using the 40 terminals of the terminal unit TU551-CS31/TU552-CS31. It is possible to replace the CI592-CS31 without loosening the wiring.

The assignment of the terminals:

Terminal	Signal	Description
1.0	R1	Integrated termination resistors for CS31-Bus, Terminal 1
1.1	R2	Integrated termination resistors for CS31-Bus, Terminal 2
1.2	B1	CS31-Bus, bus line 1
1.3	B2	CS31-Bus, bus line 2
1.4	FE	Functional earth
1.5	B1	CS31-Bus, bus line 1
1.6	B2	CS31-Bus, bus line 2
1.7	FE	Functional earth
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	AI0+	Plus pole of analog input signal 0
3.1	AI1+	Plus pole of analog input signal 1
3.2	AI2+	Plus pole of analog input signal 2
3.3	AI3+	Plus pole of analog input signal 3
3.4	AI-	Minus pole of analog input signals 0 to 3
3.5	AO0+	Plus pole of analog output signal 0
3.6	AO1+	Plus pole of analog output signal 1

Terminal	Signal	Description
3.7	AO-	Minus pole of analog output signals 0 and 1
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	C8	Signal of the configurable digital input/output C8
4.1	C9	Signal of the configurable digital input/output C9
4.2	C10	Signal of the configurable digital input/output C10
4.3	C11	Signal of the configurable digital input/output C11
4.4	C12	Signal of the configurable digital input/output C12
4.5	C13	Signal of the configurable digital input/output C13
4.6	C14	Signal of the configurable digital input/output C14
4.7	C15	Signal of the configurable digital input/output C15
4.8	UP	Process voltage UP (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

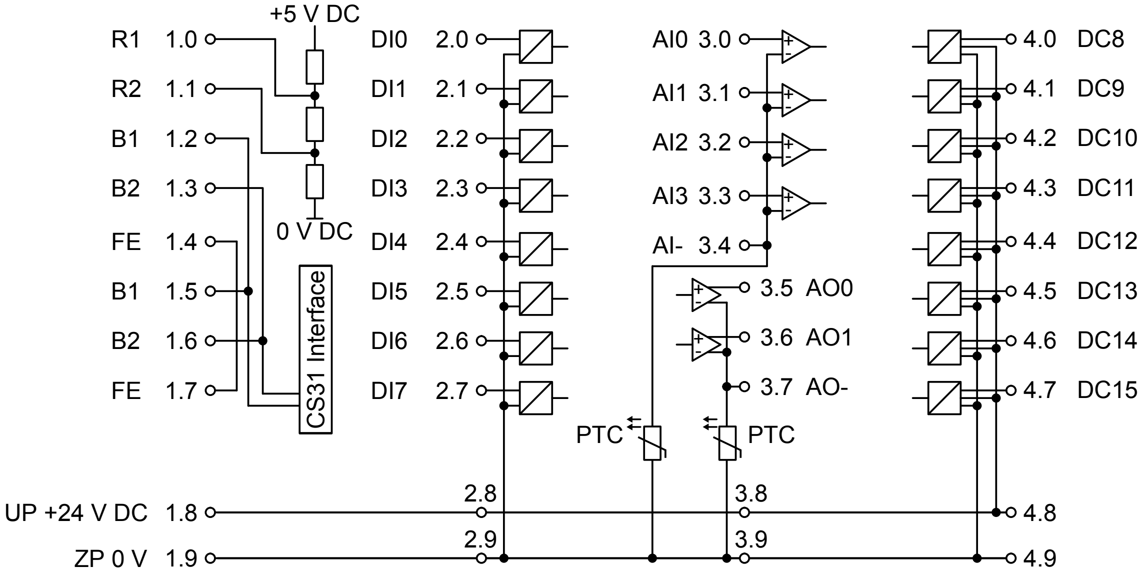


Fig. 143: Terminal assignment of the CS31 bus module CI592-CS31

The module provides several diagnosis functions *Chapter 1.7.2.2.9 “Diagnosis” on page 801*.

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.2.2.8 “Parameterization” on page 796* *Chapter 1.7.2.2.11 “Measuring Ranges” on page 804*:

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.7.2.2.10 “State LEDs” on page 803*.

Connection of the Digital Inputs

The following figure shows the electrical connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.

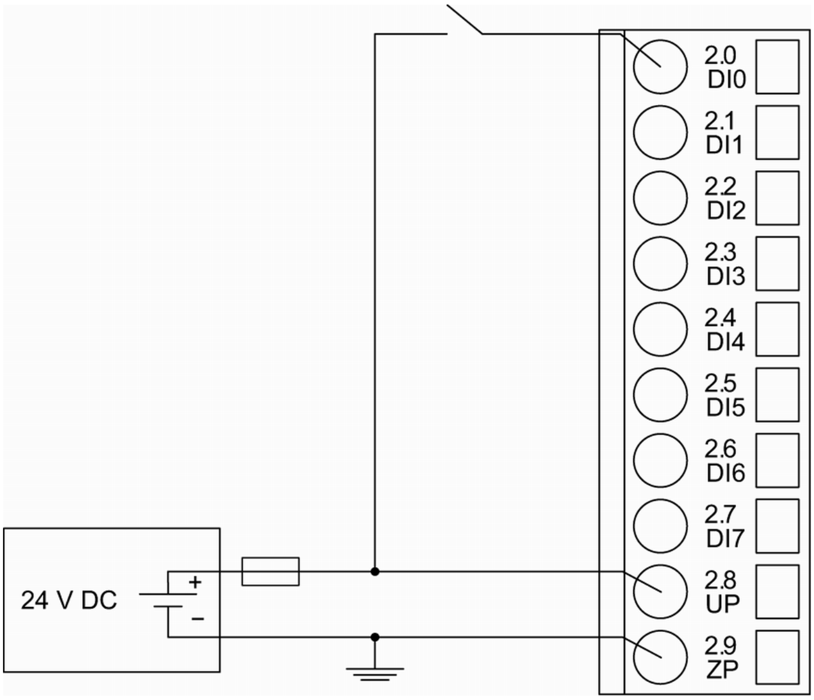


Fig. 144: Connection of the digital inputs

Connection of the Configurable Digital Inputs/Outputs

The following figure shows the electrical connection of the configurable digital input/output DC8 and DC9. DC8 is connected as an input and DC9 is connected as an output. Proceed with the configurable digital inputs/outputs DC10 to DC15 in the same way.

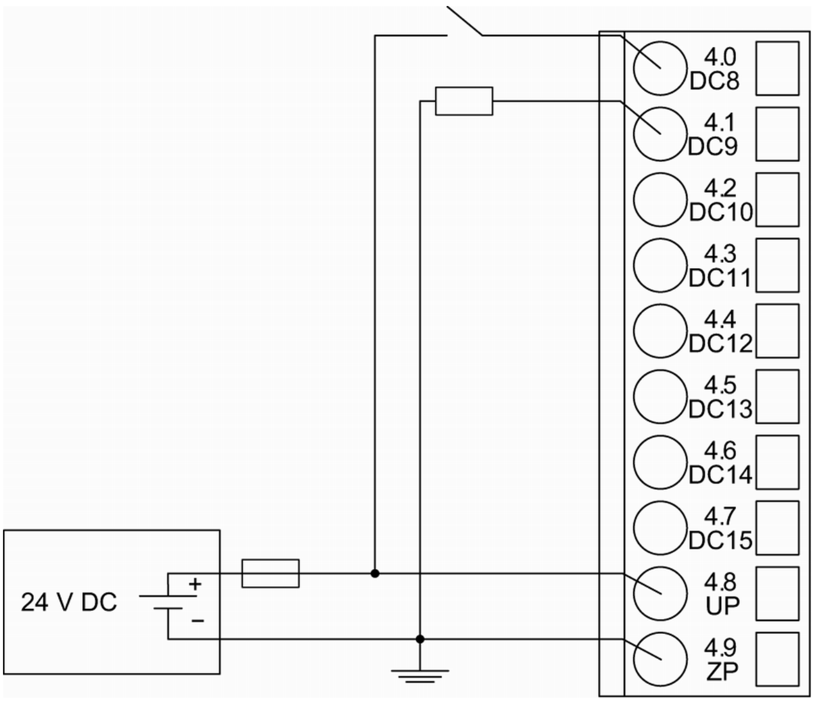


Fig. 145: Connection of configurable digital inputs/outputs

CAUTION!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of CI592-CS31.

If using inputs as Fast Counter inputs, connect a 470 Ω / 1 W resistor in series to configurable inputs/outputs DC8/DC9.

Connection of Resistance Thermometers in 2-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI592-CS31 provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

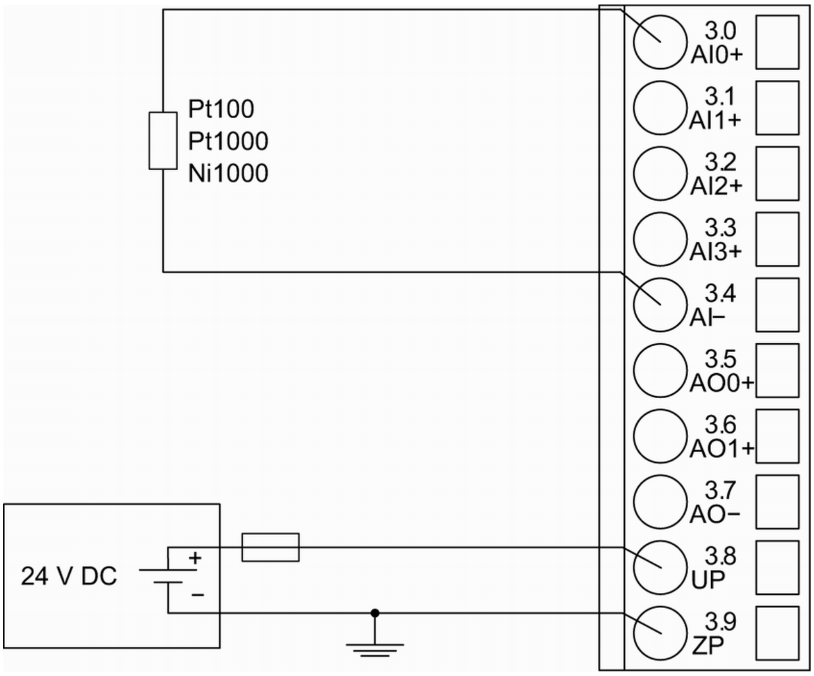


Fig. 146: Connection of resistance thermometers in 2-wire configuration to the analog inputs

Pt100	-50 °C...+400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, 1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.2.2.8 “Parameterization” on page 796* *Chapter 1.7.2.2.11 “Measuring Ranges” on page 804*:

The module CI592-CS31 performs a linearization of the resistance characteristic.

Configure unused analog input channels as "unused".

Connection of Resistance Thermometers in 3-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI592-CS31 provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1. Proceed with the analog inputs AI2 and AI3 in the same way.

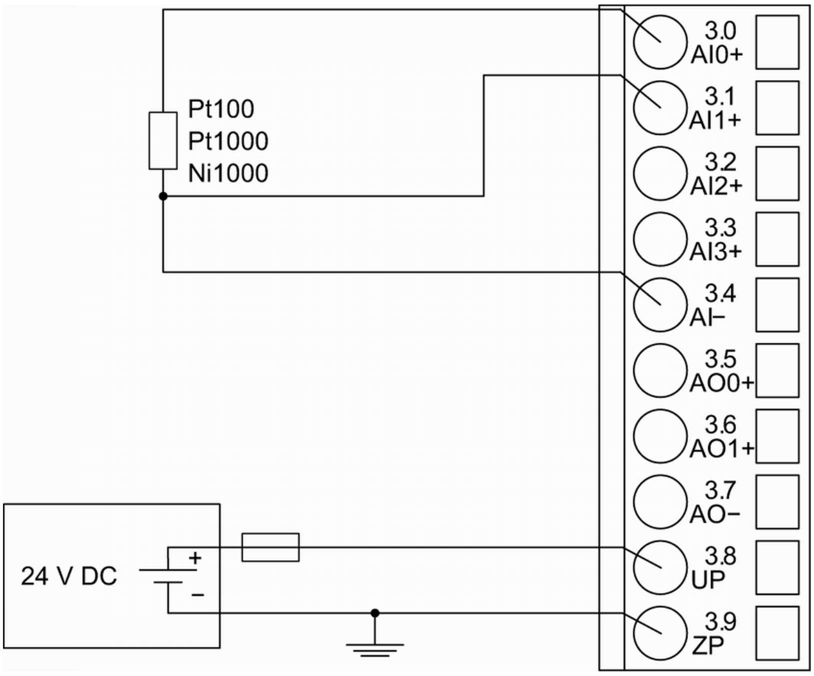


Fig. 147: Connection of resistance thermometers in 3-wire configuration to the analog inputs

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	3-wire configuration, 2 channels used
Pt1000	3-wire configuration, 2 channels used
Ni1000	3-wire configuration, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.2.2.8 “Parameterization” on page 796* *Chapter 1.7.2.2.11 “Measuring Ranges” on page 804*:

The module CI592-CS31 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

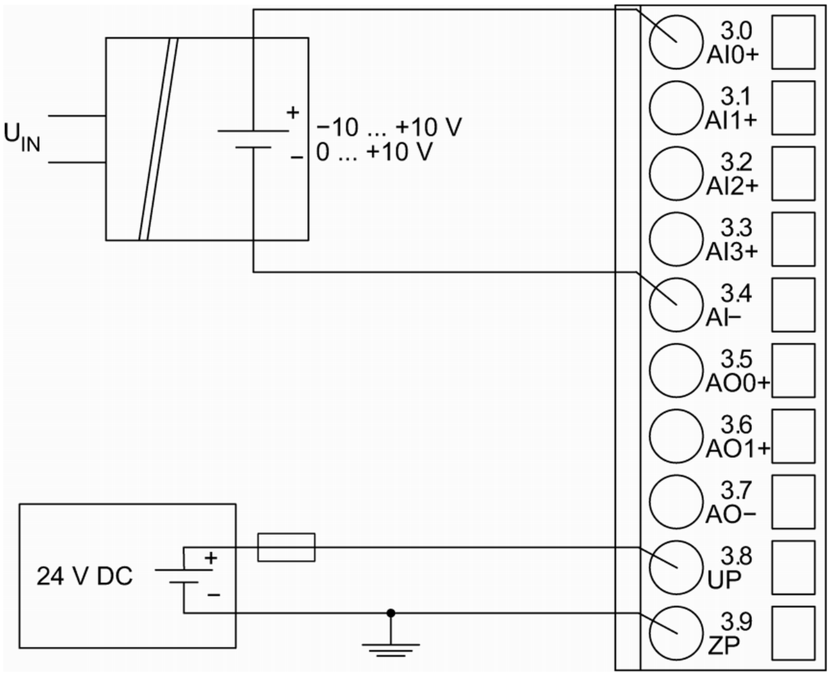


Fig. 148: Connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog inputs

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.2.2.8 “Parameterization” on page 796* *Chapter 1.7.2.2.11 “Measuring Ranges” on page 804*:

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

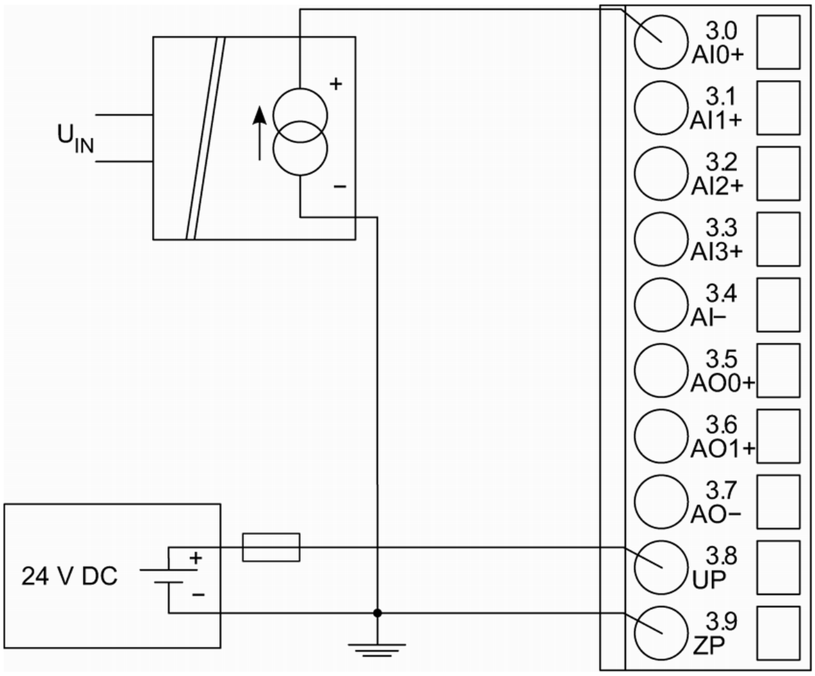


Fig. 149: Connection of active-type analog sensors (current) with electrically isolated power supply to the analog inputs

Current	0...20 mA	1 channel used
Current	4...20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 1.7.2.2.8 "Parameterization" on page 796* ↳ *Chapter 1.7.2.2.11 "Measuring Ranges" on page 804*:

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with no electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

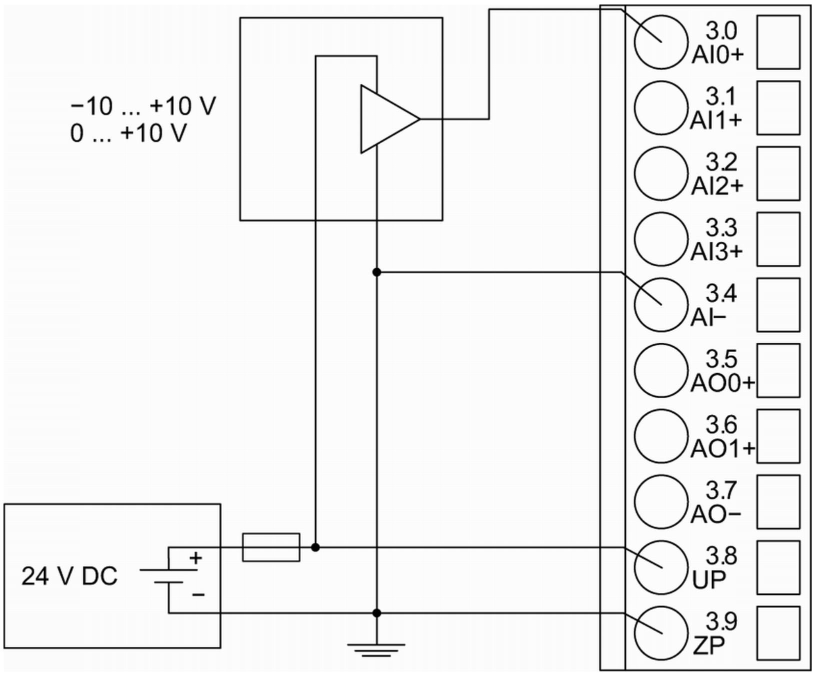


Fig. 150: Connection of active-type sensors (voltage) with no electrically isolated power supply to the analog inputs

> **NOTICE!**
> **Risk of faulty measurements!**
> The negative pole/earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).
>
> Make sure that the potential difference never exceeds ± 1 V.

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.2.2.8 "Parameterization" on page 796* *Chapter 1.7.2.2.11 "Measuring Ranges" on page 804*:

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Passive-type Analog Sensors (Current) to the Analog Inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

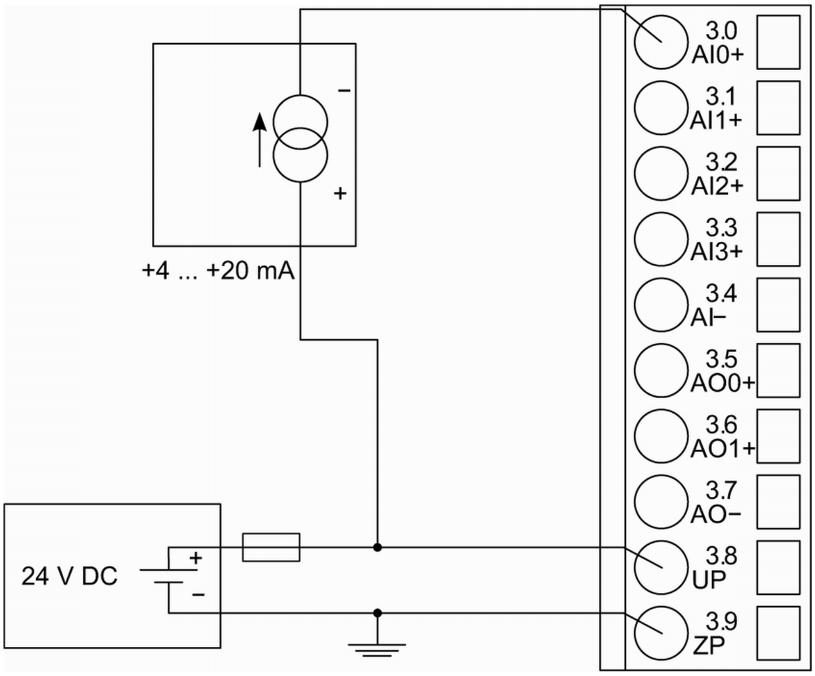


Fig. 151: Connection of passive-type analog sensors (current) to the analog inputs

Current	4...20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.2.2.8 "Parameterization" on page 796* *Chapter 1.7.2.2.11 "Measuring Ranges" on page 804*:

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to I+ and I-.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Analog Inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely earthed).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

NOTICE!
Risk of faulty measurements!
The negative pole/earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

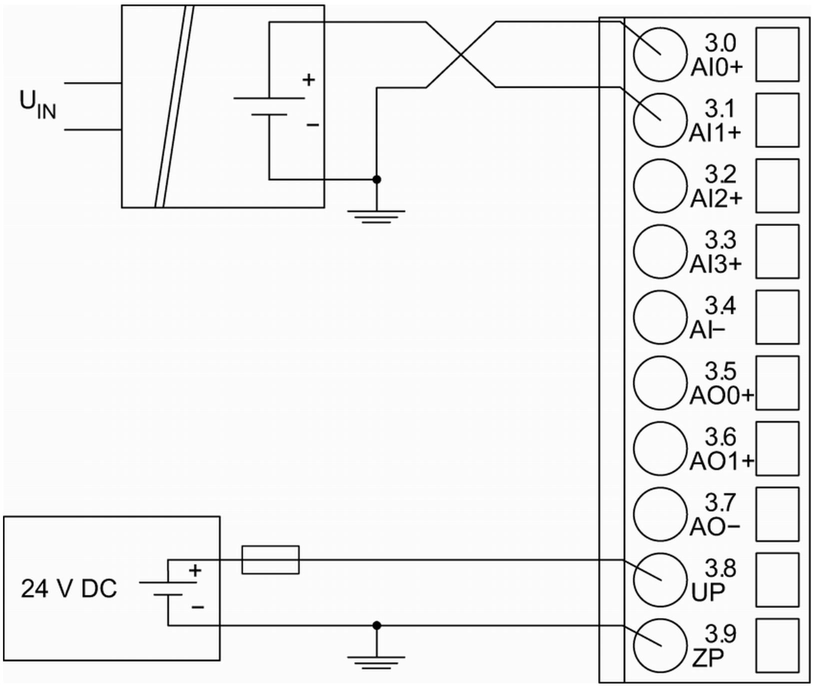


Fig. 152: Connection of active-type analog sensors (voltage) to differential analog inputs

Voltage	0...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.2.2.8 “Parameterization” on page 796* *Chapter 1.7.2.2.11 “Measuring Ranges” on page 804*:

To avoid error messages from unused analog input channels, configure them as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

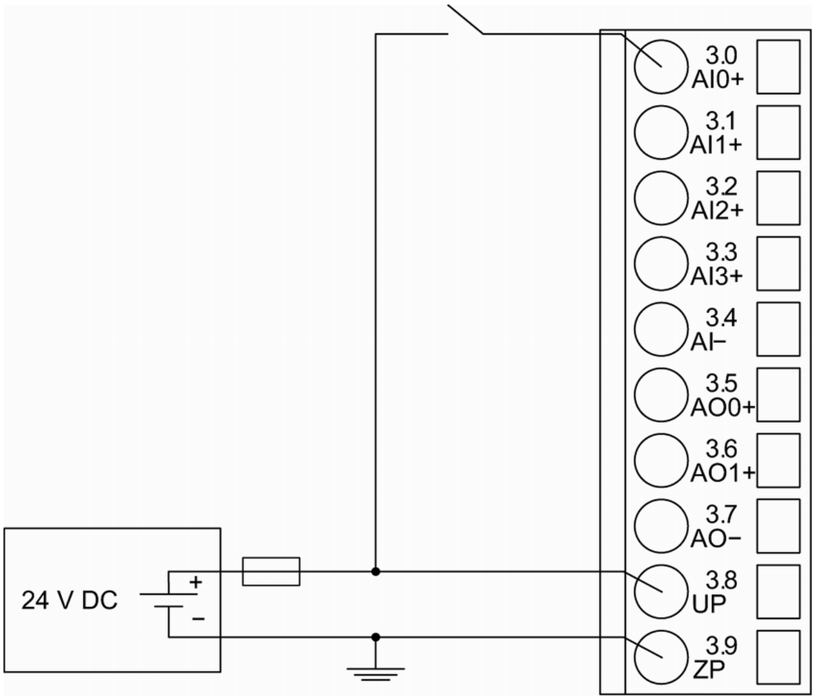


Fig. 153: Use of analog inputs as digital inputs

Digital input	24 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ↬ *Chapter 1.7.2.2.8 "Parameterization" on page 796* ↬ *Chapter 1.7.2.2.11 "Measuring Ranges" on page 804*:

Connection of Analog Output Loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

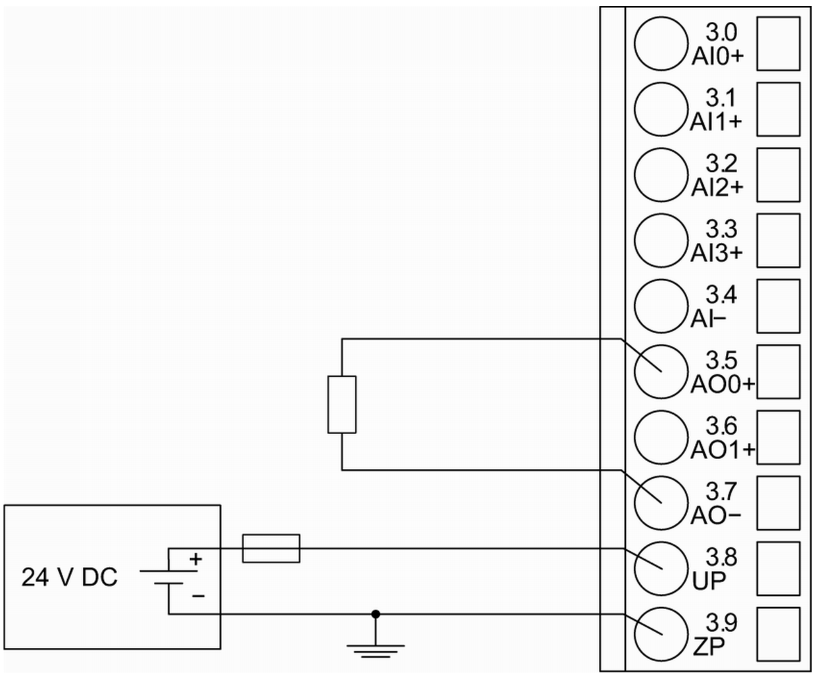


Fig. 154: Connection of analog output loads (voltage)

Voltage	-10 V...+10 V	Load ±10 mA max.	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 1.7.2.2.8 “Parameterization” on page 796* ↳ *Chapter 1.7.2.2.11 “Measuring Ranges” on page 804*:

Unused analog outputs can be left open-circuited.

Connection of Analog Output Loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

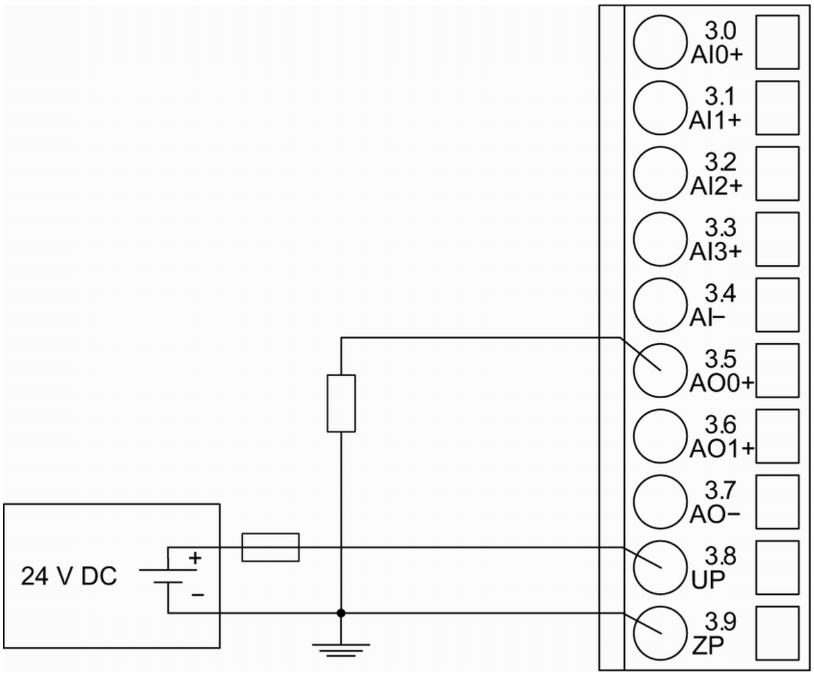


Fig. 155: Connection of analog output loads (current)

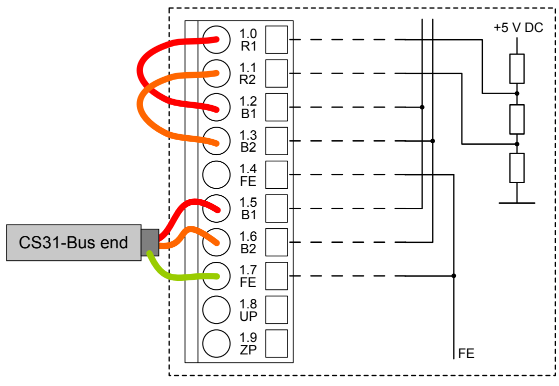
Current	0...20 mA	Load 0...500 Ω	1 channel used
Current	4...20 mA	Load 0...500 Ω	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 1.7.2.2.8 “Parameterization” on page 796* ↳ *Chapter 1.7.2.2.11 “Measuring Ranges” on page 804*:

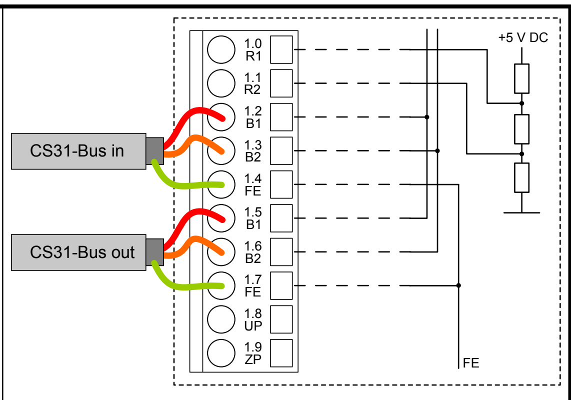
Unused analog outputs can be left open-circuited.

1.7.2.2.4 CS31 Bus Connections

The following figures show the different possibilities of connecting the CS31 buses to the CI592-CS31:



Electrical connection of CS31-Bus - the CI592-CS31 is located at the bus end



Electrical connection of CS31-Bus - the CI592-CS31 is located at the middle of the bus

Details on CS31 wiring is described seperately *Chapter 2.6.4.8 “CS31 System Bus” on page 1286*.

1.7.2.2.5 Internal Data Exchange

	without the Fast Counter	**with the Fast Counter (only with AC500)**
Digital inputs (bytes)	2 + expansion modules	4 + expansion modules
Digital outputs (bytes)	1 + expansion modules	3 + expansion modules
Analog inputs (words)	4 + expansion modules	4 + expansion modules
Analog outputs (words)	2 + expansion modules	2 + expansion modules
Counter input data (words)	0	4
Counter output data (words)	0	8

1.7.2.2.6 I/O Configuration

The CI592-CS31 module does not store configuration data itself. The configurable channels are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation by the user program.

1.7.2.2.7 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

A detailed description concerning "addressing" can be found in the chapters "Addressing" of the CPUs and Communication Modules.

The address (00d to 99d) is set with two rotary switches on the front panel of the module.

The CS31 Bus Module reads the position of the address switches only during the initialization after power ON, i.e. changes of the setting during operation remain ineffective.

1.7.2.2.8 Parameterization

Parameters of the Module - if used with Fast Counter

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	2725	WORD	2725
Parameter length	Internal	22	BYTE	22
Error LED / Fail-safe function [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Check supply	off	0	BYTE	
	on	1		1

If the bus module is configured as a Fast Counter module and '0 - no Counter' in Automation Builder is selected the channel ERR LEDs stays on and the module does not start up. The address was adjusted with '71'.

Only the '0- no Counter' mode does not operate. If any other counter is selected e.g. '1-1 Up counter' the module starts up and can be utilized.

Parameters of the Module - if used without Fast Counter

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	2726	WORD	2726
Parameter length	Internal	23	BYTE	23
Error LED / Fail-safe function [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Check supply	Off	0	BYTE	
	On	1		1

Remarks:

[1]) With a faulty Module ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2]) Error LED/Failsafe function:

Setting	Description
On	Error-LED lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off
On +Failsafe	Error-LED lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

*) The parameters behaviourAOatCommunicationFault and behaviourDOatCommunicationFault are only analyzed if the Failsafe mode is ON.

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Fast counter	No counter	0	BYTE	0
	1 Up counter	1		
	1 Up counter with release input	2		
	2 UpDown counters	3		
	2 UpDown (2. On falling edges)	4		
	1 Updown dynamic set/ rising edge	5		
	1 Updown dynamic set/ falling edge	6		
	1 UpDown directional discriminator	7		
	Reserved	8		
	1 UpDown directional discriminator x2	9		
	1 UpDown directional discriminator x4	10		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0...255	00h...FFh	BYTE	0 0x0000

*) The parameters Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.

Channel Parameters for the Analog Inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	see table [1])	see table [1])	BYTE	0
Input 0, Check channel	see table [2])	see table [2])	BYTE	0
:	:	:	:	:
:	:	:	:	:

Name	Value	Internal value	Internal value, type	Default
Input 3, Channel configuration	see table 1)	see table 1)	BYTE	0
Input 3, Check channel	see table 2)	see table 2)	BYTE	0

Table 121: Channel Configuration 1)

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0...10 V
2	Digital input
3	0...20 mA
4	4...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50...+400 °C
9	3-wire Pt100 -50...+400 °C *)
10	0...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50...+70 °C
15	3-wire Pt100 -50...+70 °C *)
16	2-wire Pt1000 -50...+400 °C
17	3-wire Pt1000 -50...+400 °C *)
18	2-wire Ni1000 -50...+150 °C
19	3-wire Ni1000 -50...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 122: Channel Monitoring 2)

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel Parameters for the Analog Outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configu- ration	see table 3)	see table 3)	BYTE	0
Output 0, Check channel	see table 4)	see table 4)	BYTE	0
Output 0, Substi- tute value	see table 5)	see table 5)	WORD	0
Output 1, Channel configu- ration	see table 3)	see table 3)	BYTE	0
Output 1, Check channel	see table 4)	see table 4)	BYTE	0
Output 1, Substi- tute value	see table 5)	see table 5)	WORD	0

Table 123: Channel Configuration 3)

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V...+10 V
129	0...20 mA
130	4...20 mA

Table 124: Channel Monitoring 4)

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 125: Substitute Value 5)

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behav- iour of outputs in case of a communication error"	Required setting of the channel parameter "Substi- tute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

1.7.2.2.9 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module errors CI592-CS31							
3	11	ADR	31	31	19	Checksum error in the I/O module	Replace I/O module
3	11	ADR	31	31	3	Timeout in the I/O module	
3	11	ADR	31	31	40	Different hard-/firmware versions in the module	
3	11	ADR	31	31	43	Internal error in the module	
3	11	ADR	31	31	36	Internal data exchange failure	
3	11	ADR	31	31	9	Overflow diagnosis buffer	Restart
3	11	ADR	31	31	26	Parameter error	Check Master
3	11	ADR	31	31	11	Process voltage UP too low	Check process supply voltage
3	11	ADR	31/1...7	31	17	No communication with I/O device	Replace I/O module
3	11	ADR	1...7	31	32	Wrong I/O device type on socket	Replace I/O module / Check configuration
4	11	ADR	31	31	45	Process voltage UP OFF	Turn process voltage ON

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<- Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	PNIO diagnosis block	
Class	Interface	Device	Module	Channel	Error identifier	Error message	Remedy
	1)	2)	3)	4)			
4	11	ADR	1...7	31	31	At least one module does not support failsafe function	Check modules and parameterization
4	11	ADR	31/1...7	31	34	No response during initialization of the I/O module	Replace I/O module
Channel error digital CI592-CS31							
4	11	ADR	31/1...7	14...21 5)	47	Short circuit at digital output	Check terminals
Channel error analog CI592-CS31							
4	11	ADR	31/1...7	8...11 6)	48	Analog value overflow or broken wire at an analog input	Check value or check terminals
4	11	ADR	31/1...7	8...11 6)	7	Analog value underflow at an analog input	Check value
4	11	ADR	31/1...7	8...11 6)	47	Short-circuit at an analog input	Check terminals
4	11	ADR	31/1...7	12...13 7)	4	Analog value overflow at an analog output	Check output value
4	11	ADR	31/1...7	12...13 7)	7	Analog value underflow at an analog output	Check output value

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1...7 = Expansion module 1...7, ADR = Hardware address (e.g. of the DC551)

3)	With "Module" the following allocation applies: 31 = Module itself; 1...7 = Expansion 1...7
4)	In case of module errors, with channel "31 = Module itself" is output.
5)	Ch = 14...21 indicates the digital inputs/outputs DC8...DC15
6)	Ch = 8...11 indicates the analog inputs AI0...AI3
7)	Ch = 12...13 indicates the analog outputs AO0...AO1

1.7.2.2.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 4 system LEDs (PWR, CS31, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 26 process LEDs (UP, inputs, outputs, CH-ERR2 to CH-ERR4) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 126: State of the 4 System-LEDs:

LED	State	Color	OFF	ON	Flashing
PWR/RUN	System voltage	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
CS31	CS31 communication	Green	No communication at the CS31 bus module	Communication at the CS31 bus OK	Diagnosis mode
S-ERR	Sum Error	Red	No error	Internal error	--
I/O-Bus	Communication via the I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---

Table 127: State of the 27 Process LEDs:

LED	State	Color	OFF	ON	Flashing
DI0 to DI7	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DC8 to DC15	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON (the input voltage is even displayed if the supply voltage is OFF)	--

LED	State	Color	OFF	ON	Flashing
AI0 to AI3	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
CH-ERR2	Channel Error, error messages in groups (digital inputs/outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short-circuit at an output)
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR *)	Module Error	Red	--	Internal error	--
*) All of the LEDs CH-ERR2 to CH-ERR4 light up together					

1.7.2.2.11 Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
			Decimal	**Hex.**
Overflow	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high	450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1
		160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.7.2.2.12 Technical Data

The System Data of AC500 and S500 ↳ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ↳ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Technical Data of the Module

Parameter		Value
Process supply voltage UP:		
	Rated value	24 VDC
	Protection against reverse voltage	Yes
	Rated protection fuse at UP	10 A fast
Current consumption		

Parameter		Value
	From UP	0.07 A + max. 0.5 A per output
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/Bus module (depending on system architecture)	5 mA
	Inrush current from UP (power-up)	0.040 A^2s
Interface		RS485
Protocol		CS31
Electrical isolation		Yes, CS31 bus from the rest of the module
Max. power dissipation within the module		6 W (outputs unloaded)
Rotary switch		2 rotary switches on the front panel for setting the module's address
Operating and error displays		30 LEDs (totally)
Weight (without terminal unit)		Approx. 125 g

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 to DI7		Terminals 1.0 to 1.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA

Parameter	Value
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group for 8 channels
If the channels are used as inputs	
Channels DC8...DC15	Terminals 4.0...4.7
If the channels are used as outputs	
Channels DC8...DC15	Terminals 4.0...4.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Electrical isolation	Yes, per module

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC8 to DC15	Terminals 4.0 to 4.7
Reference potential for all inputs	Terminals 1.9...4.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 VDC
0-Signal	-3 V...+5 V *)
Undefined Signal	> +5 V...< +15 V
1-Signal	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V *)
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA

Parameter	Value
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

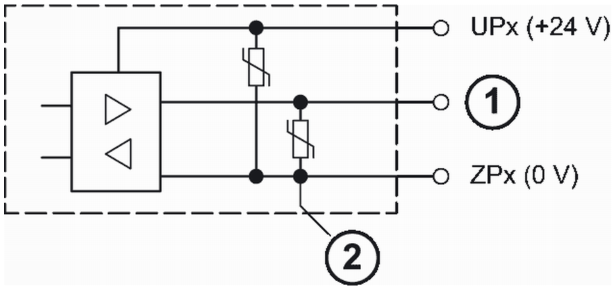
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC8 to DC15	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 1.9...4.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (plus pole of the supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical Data of the Fast Counter

Parameter	Value
Used inputs	DC8 / DC9
Used outputs	DC10
Counting frequency	Max. 50 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 3.0 to 3.3
Reference potential for AI0+ to AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V...10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V...+10 V
Configurability		0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω

Parameter	Value
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution	Range 0 V...10 V: 12 bits Range -10 V...+10 V: 12 bits + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Tables Input Ranges Voltage, Current and Digital Input ⇘ *Chapter 1.7.2.2.11.1 “Input Ranges Voltage, Current and Digital Input” on page 804* and Input Range Resistor ⇘ *Chapter 1.7.2.2.11.2 “Input Range Resistor” on page 805*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical Data of the Analog Inputs, if used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 3.0 to 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels
Connection of the channels AO0+...AO1+	Terminals 3.5 and 3.6
Reference potential for AO0+ to AO1+	Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type	
Unipolar	Current
Bipolar	Voltage
Electrical isolation	Against internal supply and other modules
Configurability	-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually)
Output resistance (load), as current output	0 Ω...500 Ω
Output loadability, as voltage output	±10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Table Output Ranges Voltage and Current *Chapter 1.7.2.2.11.3 “Output Ranges Voltage and Current” on page 806*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

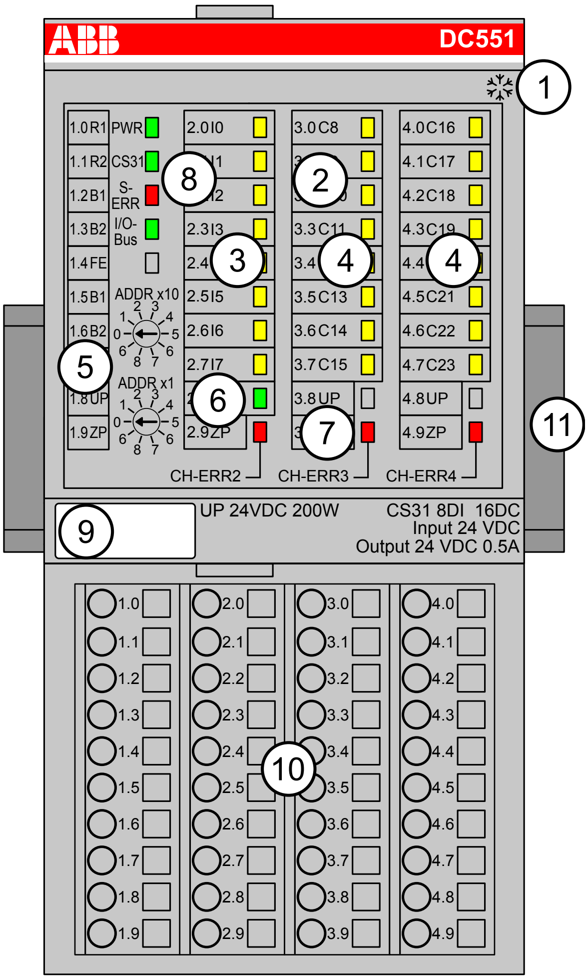
1.7.2.2.13 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 221 200 R0001	CI592-CS31, CS31 bus module with 8 DI, 8 DC, 4 AI, 2 AO	Active
1SAP 421 200 R0001	CI592-CS31-XC, CS31 bus module with 8 DI, 8 DC, 4 AI, 2 AO, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.2.3 DC551-CS31 - Digital Inputs and Output

- 8 digital inputs 24 VDC, 16 configurable digital inputs/outputs
- Module-wise electrically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital inputs I0 to I7
4 16 yellow LEDs to display the signal states of the digital inputs/outputs C8 to C23
5 2 rotary switches to set the module's address (00d to 99d)
6 1 green LED to display the process voltage UP
7 3 red LEDs to display errors
8 4 system LEDs
9 Label
10 Terminal unit
11 DIN rail
Sign for XC version

1.7.2.3.1 Intended Purpose

> *The CS31 bus module DC551-CS31 can only be used together with the AC500 CPUs and dedicated PS501 control builder.*

The CS31 bus module is used as a decentralized I/O module on CS31 field buses. The bus connection is performed on a RS-485 serial interface, which allows the connection of this module to all existing CS31 buses. In addition, the CS31 bus module provides 24 I/O channels with the following properties:

- 8 digital inputs 24 VDC in one group (2.0...2.7)
- 16 digital inputs/outputs in one group (3.0...4.7), of which each can be used
- as an input,
- as a transistor output with short circuit and overload protection, 0.5 A rated current or
- as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.

The inputs and output are electrically isolated from the other electronic circuitry of the module.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.2.3.2 Functionality

Interface	RS-485, CS31 protocol
Supply of the module's electronic circuitry	From UP and ZP (power supply)
Supply of the electronic circuitry of the I/O modules attached	Through the bus interface (I/O bus)
Address switches	For setting the CS31 field bus address (0 to 99)
Digital inputs	8 (24 VDC)
Digital inputs/outputs	16 (24 VDC)
Fast Counter	Integrated, many configurable operating modes
LED displays	For system displays, signal statuses, errors and power supply
External supply voltage	Via the terminals ZP and UP (process voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU551-CS31 or TU552-CS31 *Chapter 1.4.7 “TU551-CS31 and TU552-CS31 for CS31 Communication Interface Modules” on page 169*

1.7.2.3.3 Electrical Connection

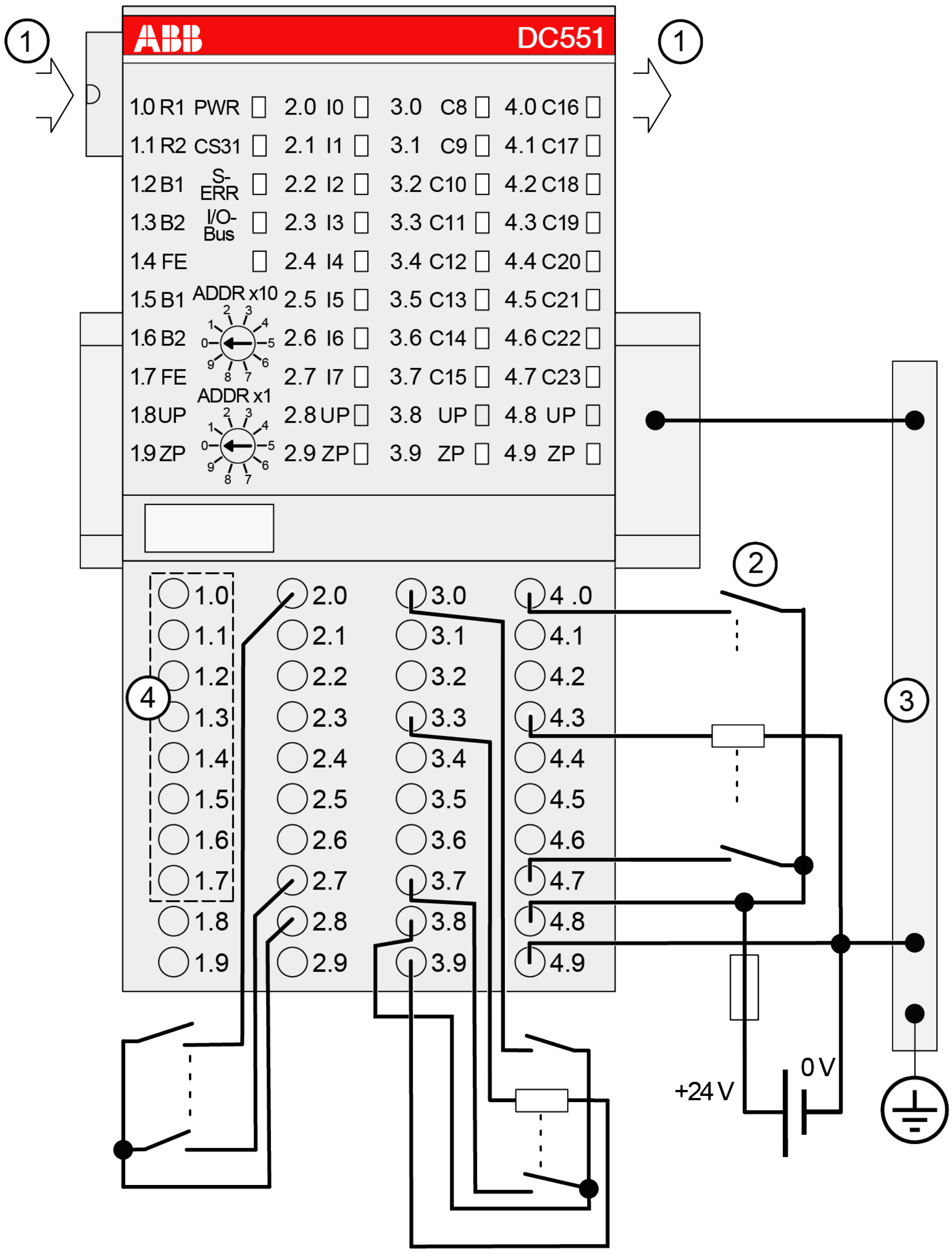
The CS31 bus module is plugged on the CS31 terminal unit TU551 or TU552 *Chapter 1.4.7 “TU551-CS31 and TU552-CS31 for CS31 Communication Interface Modules” on page 169*. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 40 terminals of the CS31 terminal unit. It is possible, to replace CS31 bus modules and I/O modules without loosening the wiring.

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 to 4.8: process voltage UP = +24 VDC
- Terminals 1.9 to 4.9: process voltage ZP = 0 V

The assignment of the other terminals depends on the inserted CS31 bus module.



1 I/O bus
2 4.0 - 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Switch-gear cabinet earth
4 1.0 - 1.7: *Chapter 1.7.2.3.4 “CS31 Bus Connections” on page 816*

Assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	RS-485	CS31 bus interface
2.0 to 2.7	I0 to I7	8 digital inputs
3.0 to 4.7	C8 to C23	16 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the earthing concept (e. g. earthing of the minus pole).

The supply voltage 24 VDC for the module's electronic circuitry comes from the ZP/UP terminals.

The module provides several diagnosis functions *Chapter 1.7.2.3.11 “Diagnosis” on page 822*).

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

CAUTION!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC551-CS31.

Connect a 470 Ω / 1 W resistor in series to inputs C16/C17 if using them as Fast Counter inputs to safely avoid any influences.

1.7.2.3.4 CS31 Bus Connections

The CS31 bus is connected through the Terminal Unit with the terminals 1.0 to 1.7. The end-of-line resistor can also be activated by using external wire jumpers.

The following figure shows a CS31 bus module at the end of the CS31 bus (end-of-line resistor activated).

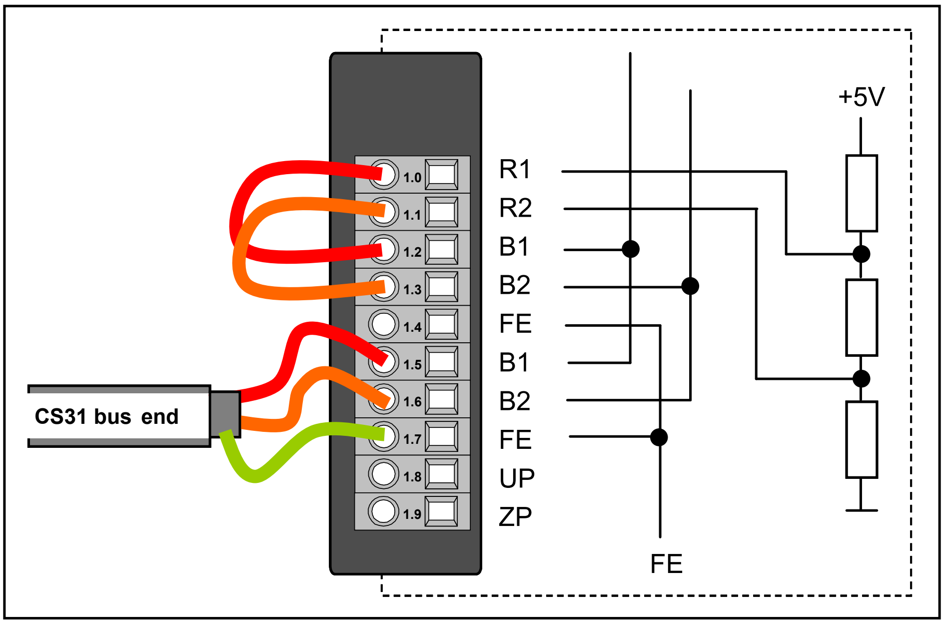


Fig. 156: CS31 bus module at the end of the CS31 Bus

The following figure shows a CS31 Bus module in the middle of a CS31 Bus (end-of-line resistor not activated).

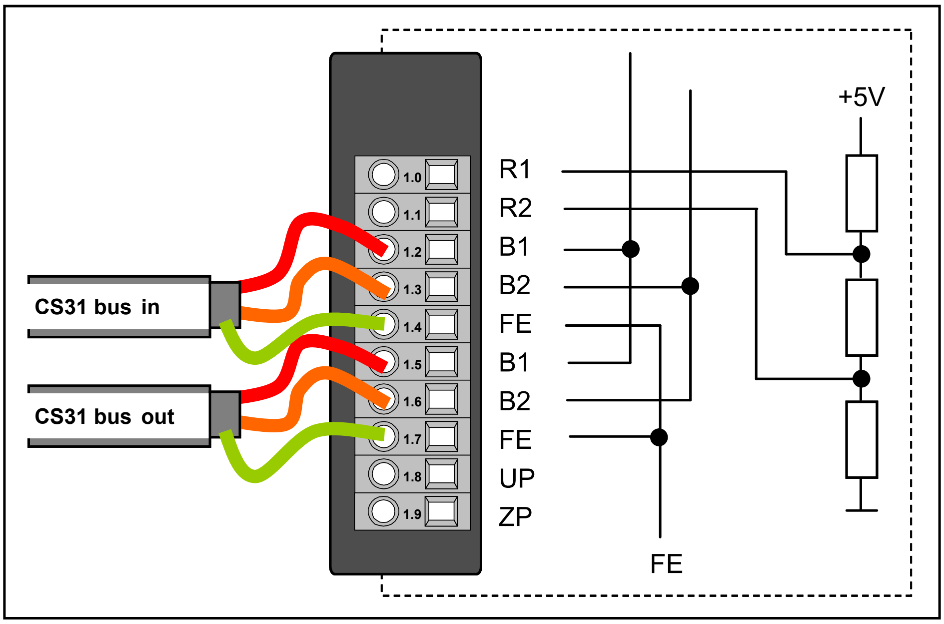


Fig. 157: CS31 Bus module in the middle of the CS31 Bus

Details on CS31 wiring is described seperately *Chapter 2.6.4.8 “CS31 System Bus” on page 1286*.

1.7.2.3.5 Internal Data Exchange

	without the Fast Counter	**with the Fast Counter (only with AC500)**
Digital inputs (bytes)	3 + expansion modules (see above)	5 + expansion modules (see above)
Digital outputs (bytes)	2 + expansion modules (see above)	4 + expansion modules (see above)

	without the Fast Counter	with the Fast Counter (only with AC500)
Counter input data (words)	0	5 (16 DI + 4 AI)
Counter output data (words)	0	9 (16 DO + 8 AO)

1.7.2.3.6 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

The address (00 to 99) is set with two rotary switches on the front panel of the module.

CS31 Bus Module reads the position of the address switches only during the initialization after power ON, i.e. changes of the setting during operation remain ineffective.

1.7.2.3.7 DC551-CS31 Limitations

Digital I/O

DC551-CS31 is able to manage up to 240 digital I/O channels. It uses 2 digital bus addresses in this case.

The physical address to identify the I/O is	address n (switch address) for the 1st module (120 I/O)
	address n + 7 + bit 8/15 = 1 for the 2nd module

To be compatible with old CPU and EC500 using this physical address, to address I/O in user program: Use only 6 I/O modules with 32 DI.

Analog I/O

Analog limitation to 40 AI/AO with 4 bus addresses used.

Case of DC551-CS31 with Fast Counter

An additional bus address is used for "double word" values of the Fast Counter.

The maximum configuration is shown in the following table.

DC551-CS31 8DI + 16 DC + counter	16 AI	16 AI	DC532	DC532	DC532	DC532	DC532

The following configuration uses 7 bus addresses (the Fast Counter needs 16 DI + 16 DO + 4 AI + 8 AO):

2 bus addresses for digital I/O (24 + 16 + 5x32)DI + (16 + 16 + 5x16)DO = 200 DI (>120) + 112 DO

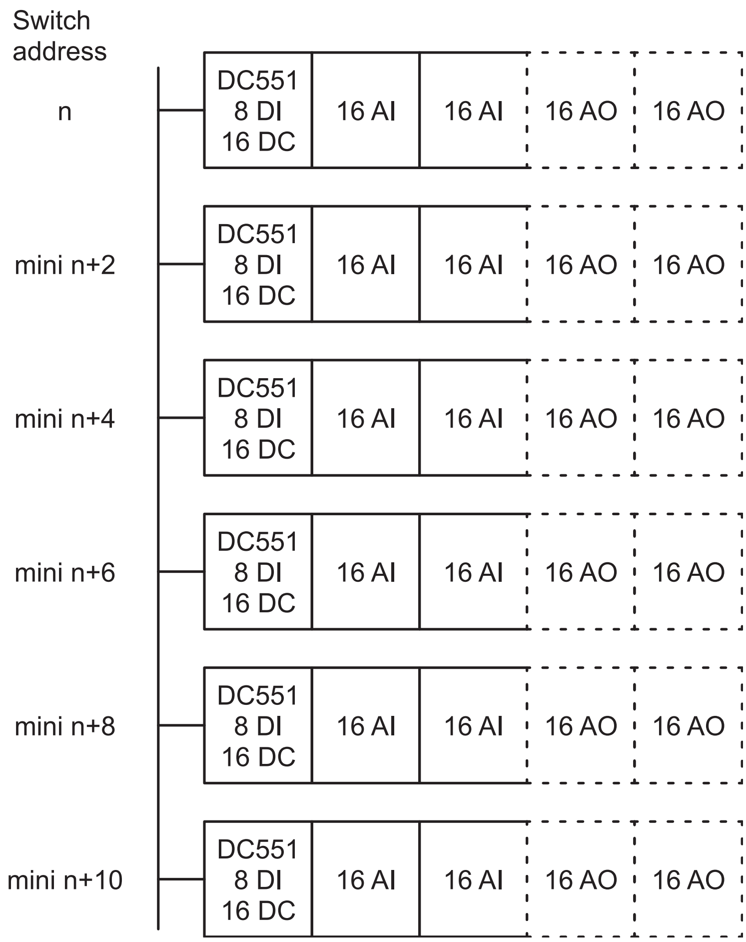
5 bus addresses for analog I/O (4 + 2x16)AI + 8 AO = 36 AI + 8 AO

If the bus module is configured as a Fast Counter module and '0 - no Counter' in Automation Builder is selected the channel ERR LEDs stays on and the module does not start up. The address was adjusted with '71'.

Only the '0- no Counter' mode does not operate. If any other counter is selected e.g. '1-1 Up counter' the module starts up and can be utilized.

Small Overview of the Addressing Possibilities

Configuration example with 32 analog inputs with or without 32 analog outputs (Fast Counter not used) = 5 bus addresses by the bus module



If the number of analog outputs is less than the number of analog inputs, no additional address is necessary. Change the type from "analog in" to "analog I/O".

- 30 bus addresses used, 1 bus address free
- 192 analog inputs (+ 192 analog outputs)
- 48DI / 96DC (144 DI / 96 DO for CS31 and user program)
- Switch address incremented to avoid control overlap.

In CPU table module switch address n will be seen as (idem for AC500 or old CPU):

- Address n, type digital I/O, 8 DI/16 DC
- Address n, type analog I or I/O, 8 AI (+ 8 AO)
- Address n + bit 8/15=1, type analog I or I/O, 8 AI (+ 8 AO)
- Address n+1, type analog I or I/O, 8 AI (+ 8 AO)
- Address n+1 + bit 8/15=1, type analog I or I/O, 8 AI (+ 8 AO)

1.7.2.3.8 I/O Configuration

The DC551-CS31 module does not store configuration data itself. The 16 configurable channels are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation by the user program.

1.7.2.3.9 Parameterization

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.
1	Module ID	Internal	2715 [1])	Word	2715 0x0a9b	0	65535
2	Ignore module	No Yes	0 1	Byte	No 0x00		
14	Parameter length	Internal	8 (7 [4])	Byte	8 (7 [4])	0	255
16	Check supply	Off On	0 1	Byte	On 0x01		
17	Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02		
18	Fast counter	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00		
Nr.+1	Detection short-circuit at outputs	Off On	0 1	Byte	On 0x01		
Nr.+1	Behaviour outputs at communication errors	Off Last value Substitute value	0 1 2	Byte	Off 0x00		
Nr.+1	Substitute value outputs Bit 15 = Output 15 Bit 0 = Output 0	0...65535	0...0xffff	Word	0		

[1]) With CS31 and addresses less than 70, the value is increased by 1

[3]) Counter operating modes ↳ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*, description of the Fast Counter ↳ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*

[4]) With CS31 and addresses less than 70, without the parameter Fast Counter

1.7.2.3.10 Structure of the Diagnosis Block of the DC551-CS31

If a DC551-CS31 module is connected via a CS31 bus, then the field bus master receives diagnosis information by an extended diagnosis block. The following table shows the structure of this diagnosis block:

Byte number	Description	Possible values
1	Data length (header included)	18
2	Diagnosis byte	0 = Communication with DC551-CS31 OK 1 = Communication with DC551-CS31 failed
3	DC551-CS31 diagnosis byte, module number	0 = DC551 (e.g. error at the integrated 8DI/16DC) 1 = 1st attached S500 I/O module ... 7 = 7th attached S500 I/O module
4	DC551-CS31 diagnosis byte, slot	According to the I/O bus specification passed on by modules to the fieldbus master
5	DC551-CS31 diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	DC551-CS31 diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description passed on by modules to the fieldbus master
7	DC551-CS31 diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error Bit 5: 1 = Diag reset Bit 2 to bit 4: reserved Bit 1: 1 = explicit acknowledgement Bit 0: 1 = static error Passed on by modules to the fieldbus master Value = 0: static message for other systems, which do not have a coming/leaving evaluation
8ff	Reserved	

1.7.2.3.11 Diagnosis

In case of overload or short-circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000..063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6..7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0..5**	**FBP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	11	ADR	31	31	19	Checksum error in the I/O module	Replace I/O module
3	11	ADR	31	31	3	Timeout in the I/O module	
3	11	ADR	31	31	40	Different hard-/firm-ware versions in the module	
3	11	ADR	31	31	43	Internal error in the module	
3	11	ADR	31	31	36	Internal data exchange failure	
3	11	ADR	31	31	9	Overflow diagnosis buffer	New start
3	11	ADR	31	31	26	Parameter error	Check master
3	11	ADR	31	31	11	Process voltage too low	Check process voltage
3	11	ADR	1...7	31	17	No communication to the I/O module	Replace I/O module
4	11	ADR	31	31	45	Process voltage ON/OFF	Process voltage ON
4	11	ADR	31/1..7	31	34	No reply at initiali-zation of the I/O module	Replace I/O module

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6..7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0..5**	**FBP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	11	ADR	31/1.7	31	32	Wrong I/O module in the slot	Replace I/O module or check configu-ration
Channel error DC551-CS31							
4	11	ADR	31/1..7	8..23	47	Short-circuit at a digital output	Check connec-tion

Remarks:

1)	In AC500 the following interface identifier applies: 11 = COM1 (protocol CS31 bus only possible with COM1)
2)	With "Device" and CS31 bus master, the hardware address of the DC551-CS31 (0...69) is output.
3)	With "Module" the following allocation applies: 31 = Module itself, 1...7 = Expansion 1...7
4)	In case of module errors, with channel "31 = Module itself" is output.

1.7.2.3.12 Status LEDs

The LEDs are on the front panels of the modules. There are two different groups:

- The 4 system LEDs (PWR, S-ERR, CS31 and I/O-Bus) show the operating status of the module and indicate possible errors.
- The 28 process LEDs (UP, inputs, outputs, CH-ERR2 to CH-ERR4) display the supply voltage and signal statuses of the inputs and outputs and indicate possible errors.

All of the S500 modules have LEDs to display operating statuses and errors.

LED	Status	Color	LED = OFF	LED = ON	LED flashes
PWR	System voltage	Green	Missing internal system voltage or field bus supply is missing	Internal system voltage is OK	--
CS31	CS31 communication	Green	No communication at the CS31 bus module	Communication at the CS31 bus OK	Diagnosis mode
S-ERR	Sum Error	Red	No error or system voltage is missing	Internal error (storing can be parameterized)	--
I/O-Bus	Communication via the I/O bus	Green	No I/O modules connected or data error	I/O modules connected	Error I/O bus
Reserved	Not defined	-	-	-	-
I0...I7	Digital inputs	Yellow	Input = OFF	Input = ON (the input voltage is even displayed if the supply voltage is OFF)	-
C8...C23	Digital inputs/ outputs	Yellow	Input/output = OFF	Input/output = ON (the input voltage is even displayed if the supply voltage is OFF)	-
UP	Process supply voltage and initialization	Green	Process voltage is missing	Process voltage OK	--
CH-ERR2	Channel Error, error messages in groups (digital inputs/outputs combined into the groups 2 to 4)	Red	No error	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short-circuit at an output)
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR *)	Module Error	Red	No error or process voltage is missing	Internal error	--
*) All LEDs CH-ERR2 to CH-ERR4 light up together					

The status of the LEDs concerning the CS31 bus module in connection with the I/O modules is described in detail in the S500 system data.

1.7.2.3.13 Technical Data

The System Data of AC500 and S500 ➥ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ➥ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Rated supply voltage of the module		24 V DC (UP/ZP)
Current consumption of the module (UP)		15 mA
Process voltage UP		
	Rated value	24 VDC (for inputs and outputs)
	Max. current loadability for the supply terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse at UP	10 A fast
	Electrical isolation	CS31 bus interface from the rest of the module
	Inrush current from UP (at power-up)	0.040 A^2s
	Current consumption from UP at normal operation / with outputs	0.1 A + max. 0.008 A per input + max. 0.5 A per output
	Connections	Terminals 1.8 - 4.8 for +24 V (UP) and 1.9 - 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W (outputs unloaded)
Number of digital inputs		8
Number of configurable digital inputs/outputs		16
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Address setting		With 2 rotary switches on the front panel
Diagnosis		Diagnosis and Displays ➥ *Chapter 1.7.2.3.11 “Diagnosis” on page 822*
Operating and error displays		32 LEDs altogether
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40°C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels I0 to I7		2.0 to 2.7
Terminals of the channels C8 to C23		3.0 to 4.7
Reference potential for all inputs		Terminals 1.9...4.9 (Minus pole of the process supply voltage, signal name ZP)
Electrical isolation		From the CS31 system bus
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1-> 0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V...+5 V
	Undefined signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

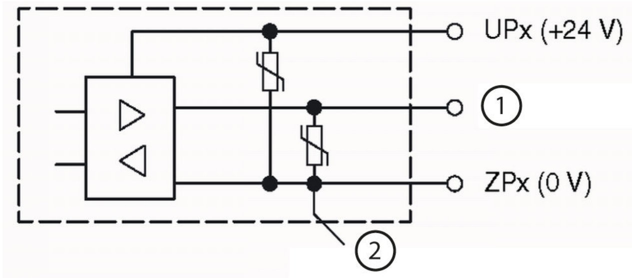
Parameter		Value
Number of channels per module		16 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
If the channels are used as inputs		
	Channels I8...I23	Terminals 3.0...4.7
If the channels are used as outputs		
	Channels Q8...Q23	Terminals 3.0...4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Electrical isolation		From the CS31 system bus

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9...4.9 (minus pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8...4.8 (plus pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	10 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive loads	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital input/output
2 For demagnitization when inductive loads are switched off

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter		Value
Number of channels per module		Max. 16 digital inputs
Reference potential for all inputs		Terminals 1.9...4.9 (minus pole of the process supply voltage, signal name ZP)
Input current, per channel		Technical Data of the Digital Inputs
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V *)
	Undefined signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		within -3 V...+5 V *)
Ripple with signal 1		within +15 V...+30 V
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Fast Counter

Parameter	Value
Used inputs	C16 / C17
Used outputs	C18

Parameter	Value
Counting frequency	Max. 50 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

1.7.2.3.14 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 220 500 R0001	DC551-CS31, CS31 bus module, 8 DI and 16 DC	Active
1SAP 420 500 R0001	DC551-CS31-XC, CS31 bus module, 8 DI and 16 DC, XC version	Active

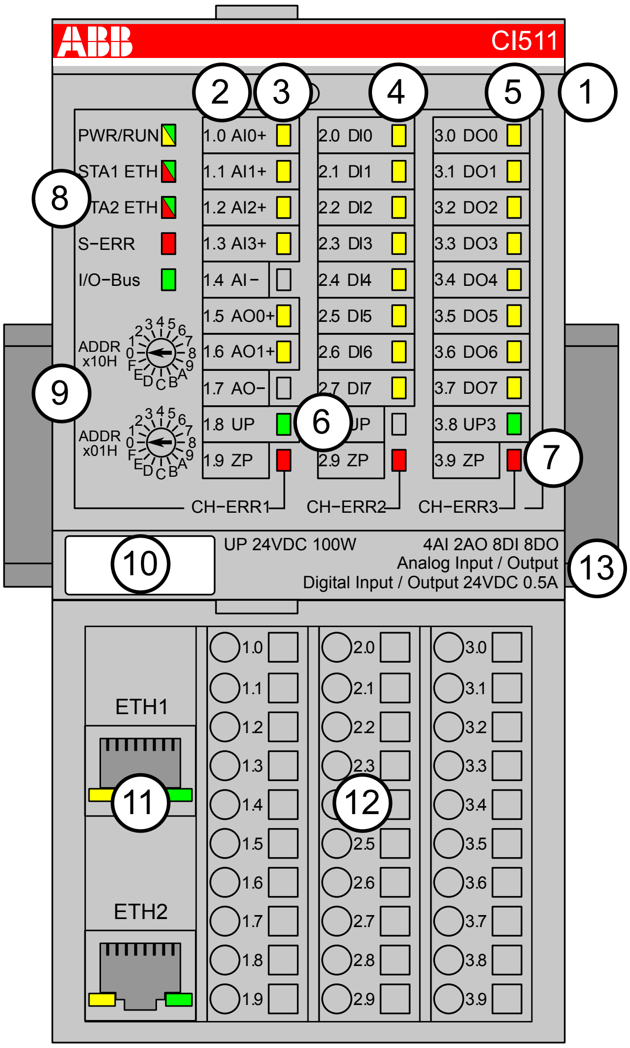
**) For planning and commissioning of new installations use modules in Active status only.*

1.7.3 EtherCAT

1.7.3.1 CI511-ETHCAT

- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus sign)
- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max.
- Cam switch functionality (see also Extended Cam Switch Library)
- Extended Cam switch functionality *) (see also Extended Cam Switch Library)
- Module-wise electrically isolated - Expandability with up to 10 S500 I/O Modules *)

*) Applicable for device index C0 and above.



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 - AI3, AO0 - AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 - DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 - DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, NET, DC, S-ERR, I/O-Bus
9 2 rotary switches (reserved for future extensions)
10 Label
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail

1.7.3.1.1 Intended Purpose

The EtherCAT bus module CI511-ETHCAT is used as decentralized I/O module in EtherCAT networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The bus module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0...1.3)
- 2 analog outputs (1.5...1.6)
- 8 digital inputs 24 VDC in 1 group (2.0...2.7)
- 8 digital outputs 24 VDC in 1 group (3.0...3.7)
- Cam switch functionality

The inputs/outputs are electrically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

1.7.3.1.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	EtherCAT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	Not used; reserved for future extensions
Analog inputs	4 (configurable via software)
Analog outputs	2 (configurable via software)
Digital inputs	8 (24 VDC; delay time configurable via software)
Digital outputs	8 (24 VDC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*

1.7.3.1.3 Electrical Connection

The Ethernet bus module CI511-ETHCAT is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526).

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 VDC

Terminal 3.8: Process supply voltage UP3 = +24 VDC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

The assignment of the other terminals:

Terminal	Signal	Description
1.0 to 1.3	AI0 to AI3	Plus poles of the 4 analog inputs
1.4	AI-	Minus pole of the analog inputs
1.5 to 1.6	AO0 to AO1	Plus poles of the 2 analog outputs
1.7	AO-	Minus pole of the analog outputs
2.0 to 2.7	DI0 to DI7	8 digital inputs
3.0 to 3.7	DO0 to DO7	8 digital outputs

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

CAUTION!

There is no electrical isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be electrically isolated in order to avoid loops via the earth potential or the supply voltage.

CAUTION!

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (cut wire), each channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Analog signals are always laid in shielded cables. The cable shields are earthed at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

For simple applications (low disturbances, no high requirement on precision), the shielding can also be omitted.

The following figures show the electrical connection of the Ethernet bus module CI511-ETHCAT.

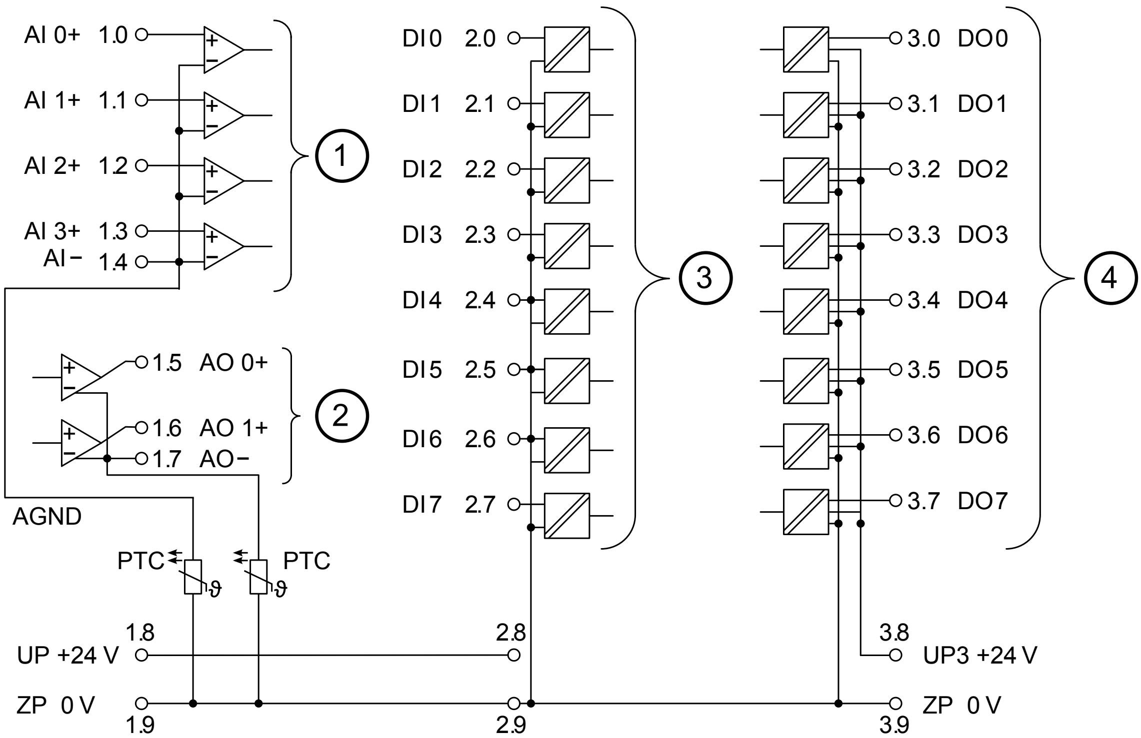


Fig. 158: Connection of the bus module CI511-ETHCAT

1 4 analog inputs, configurable for 0...10 V, -10...+10 V, 0/4...20 mA, Pt100/Pt1000, Ni1000 and digital signals
2 2 analog outputs, configurable for -10...+10 V, 0/4...20 mA
3 8 digital inputs 24 VDC
4 8 digital outputs 24 VDC, 0.5 A max.

In case of voltage feedback, 2 cases are distinguished:

1. The outputs are already active

The output group will be switched off. A diagnosis message will appear. After 5 seconds, the module tries automatic reactivation.

2. The outputs are not active

Only the output with voltage feedback will not be set to active. A diagnosis message will appear.

NOTICE!

Risk of faulty measurements!

The negative pole/earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

CAUTION!

The process supply voltage must be included within the earthing concept of the plant (e. g. earthing of the minus pole).

The module provide several diagnosis functions ↳ *Chapter 1.7.3.1.8 “Diagnosis” on page 850*.

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 1.7.3.1.7 “Parameterization” on page 844* ↳ *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

The function of the LEDs is described in the section State LEDs ↳ *Chapter 1.7.3.1.8 “Diagnosis” on page 850*.

Connection of Resistance Thermometers in 2-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI511-ETHCAT provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration.

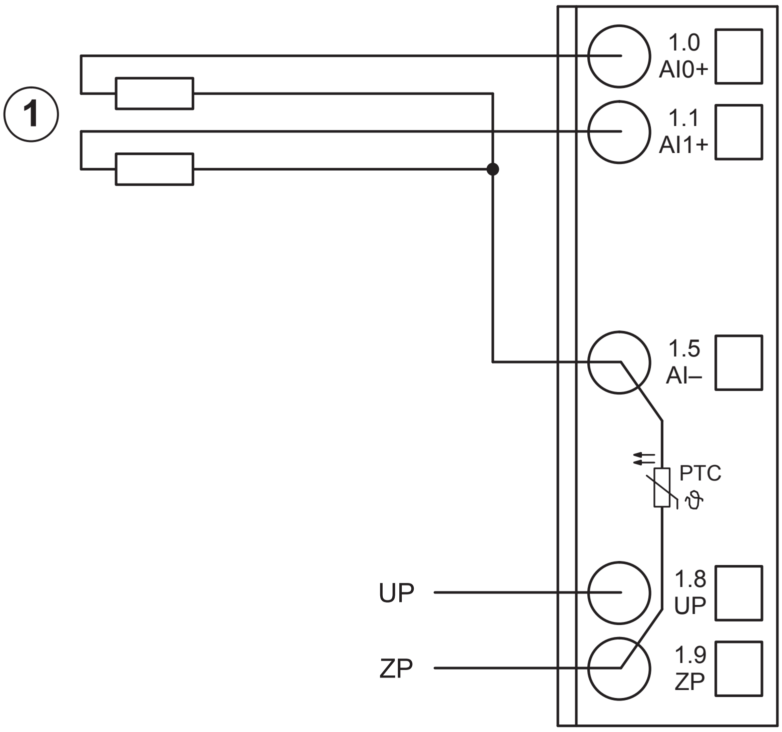


Fig. 159: Connection of resistance thermometers in 2-wire configuration

1 Pt100 (2-wire), Pt1000 (2-wire), Ni1000 (2-wire); 1 analog sensor requires 1 channel

Pt100	-50 °C...+400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, 1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.3.1.7 “Parameterization” on page 844* *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

The module CI511-ETHCAT performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI511-ETHCAT provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 3-wire configuration.

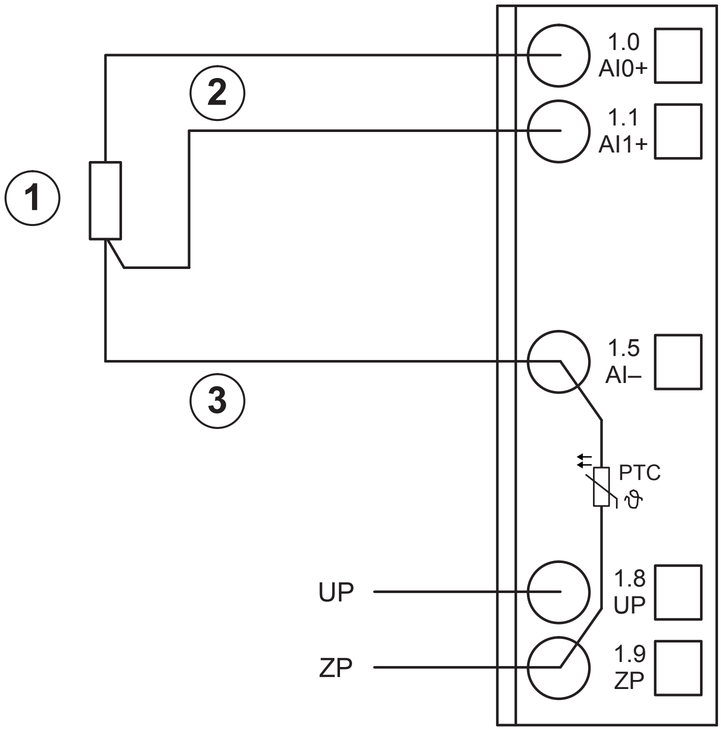


Fig. 160: Connection of resistance thermometers in 3-wire configuration

1 Pt100 (3-wire), Pt1000 (3-wire), Ni1000 (3-wire); 1 analog sensor requires 2 channels
2 Twisted pair within the cable
3 Return line: The return line is only needed once if measuring points are adjacent to each other. This saves wiring costs.

With 3-wire configuration, two adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary, to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C...+400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.3.1.7 “Parameterization” on page 844* *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

The module CI511-ETHCAT performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply

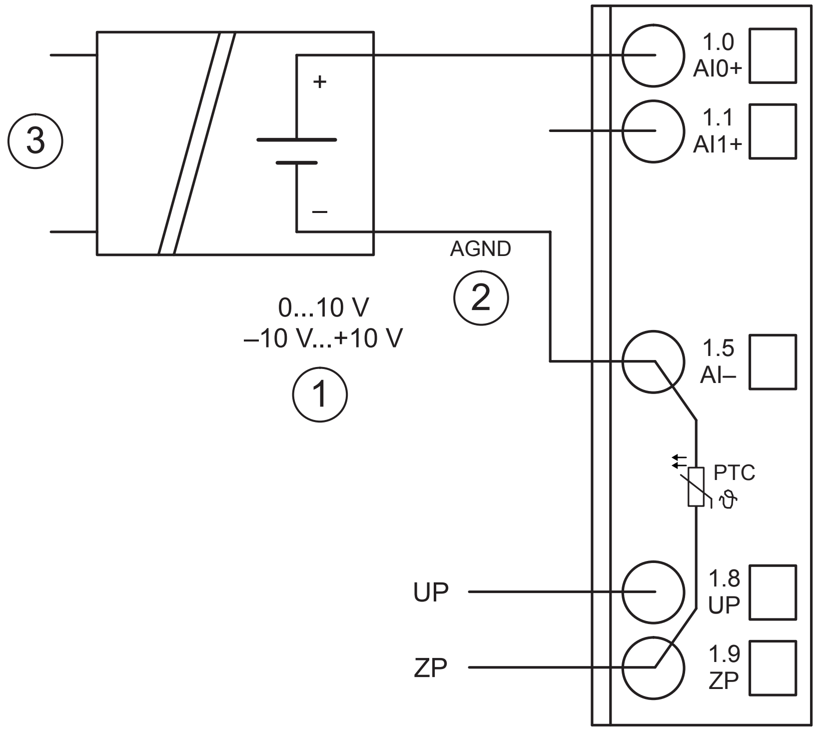


Fig. 161: Connection of active-type analog sensors (voltage) with electrically isolated power supply

1 1 analog sensor requires 1 channel
2 By connecting to AI-, the electrically isolated voltage source of the sensor is referred to ZP
3 Electrically isolated power supply for the analog sensor

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 1.7.3.1.7 “Parameterization” on page 844* ↳ *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply.

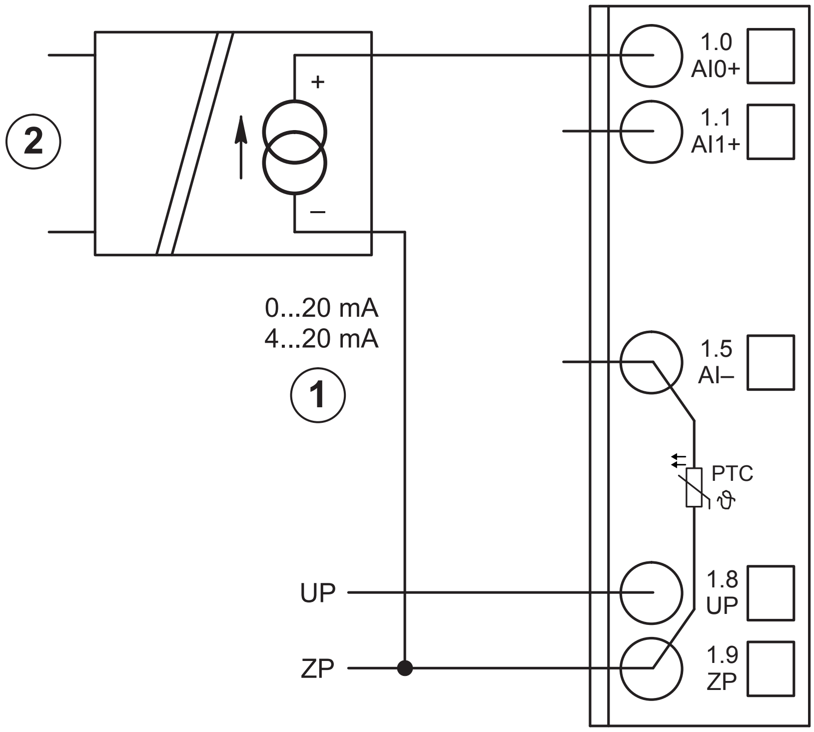


Fig. 162: Connection of active-type analog sensors (current) with electrically isolated power supply

1 1 analog sensor requires 1 channel
2 Electrically isolated power supply for the analog sensor

Current	0...20 mA	1 channel used
Current	4...20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 1.7.3.1.7 “Parameterization” on page 844* ↳ *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply

The following figure shows the connection of active-type sensors (voltage) with no electrically isolated power supply.

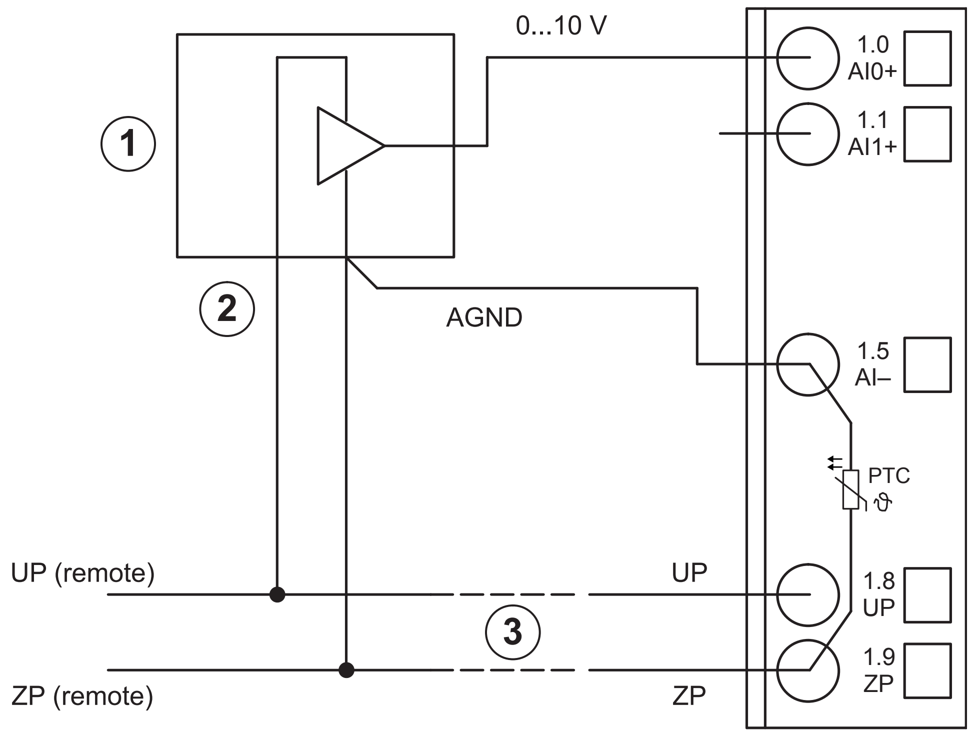


Fig. 163: Connection of active-type sensors (voltage) with no electrically isolated power supply

1 1 analog sensor requires 1 channel
2 Power supply not electrically isolated
3 The connection between the minus pole of the sensor and ZP has to be performed
4 Long cable

> **NOTICE!**
> **Risk of faulty measurements!**
> The negative pole/earthing potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).
>
> Make sure that the potential difference never exceeds ± 1 V.

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V *)	1 channel used

*) if the sensor can provide this signal range

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.3.1.7 “Parameterization” on page 844* *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853.*

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of Passive-type Analog Sensors (Current)

The following figure shows the connection of passive-type analog sensors (current).

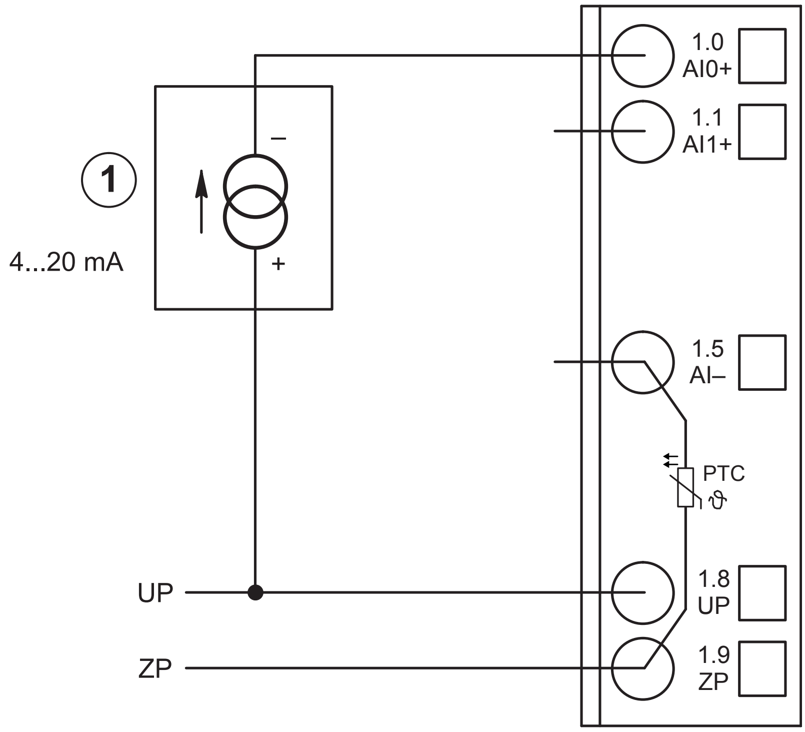


Fig. 164: Connection of passive-type analog sensors (current)

1 1 analog sensor requires 1 channel

Current	4...20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges ⇘ *Chapter 1.7.3.1.7 “Parameterization” on page 844* ⇘ *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second into an analog input, this input is switched off by the module (input protection). In such cases, it is recommended, to protect the analog input by a 10-volt zener diode (in parallel to I+ and I-). But, in general, it is a better solution to prefer sensors with fast initialization or without current peaks higher than 25 mA.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of Active-type Analog Sensors (Voltage) to Differential Inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely earthed).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

Important: The earthing potential at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs

The following figure shows the connection of active-type analog sensors (voltage) to differential inputs.

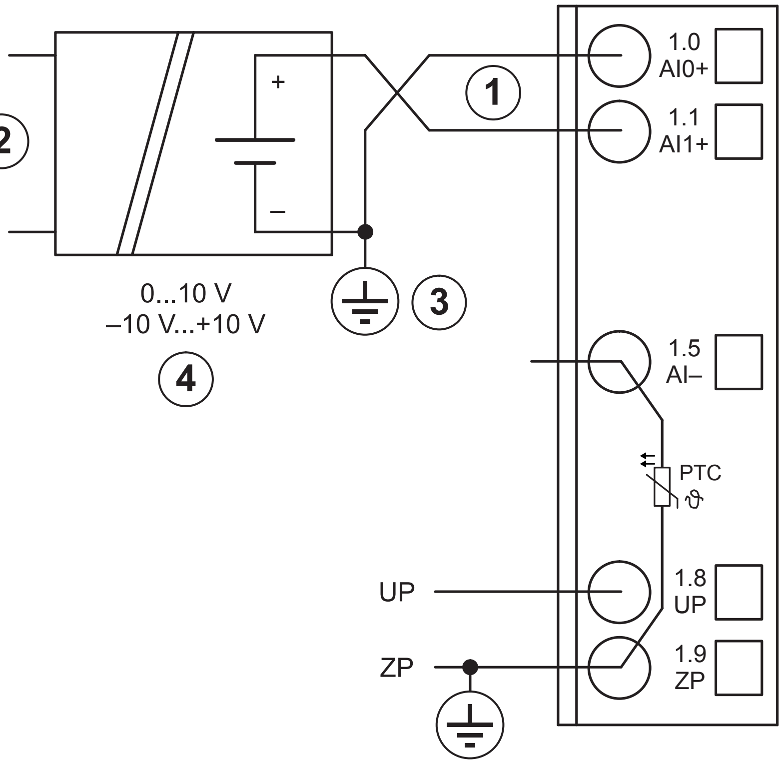


Fig. 165: Connection of active-type analog sensors (voltage) to differential inputs

1 1 analog sensor requires 2 channels
2 Electrically isolated power supply for the analog sensor
3 Earthing at the sensor
4 0 V...10 V / -10 V...+10 V connected to differential inputs

Voltage	0 V...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.3.1.7 “Parameterization” on page 844* *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital input. The inputs are not electrically isolated against the other analog channels.

The following figure shows the use of analog inputs as digital inputs.

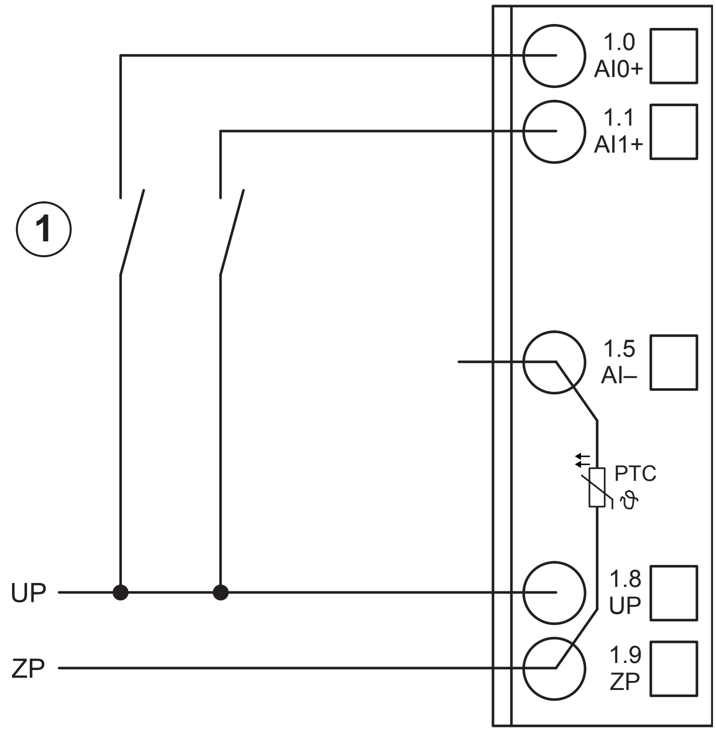


Fig. 166: Use of analog inputs as digital inputs

1 1 digital signal requires 1 channel

Digital input	24 V	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.3.1.7 “Parameterization” on page 844* *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

Connection of Analog Output Loads (Voltage, Current)

The following figure shows the connection of analog output loads (voltage, current).

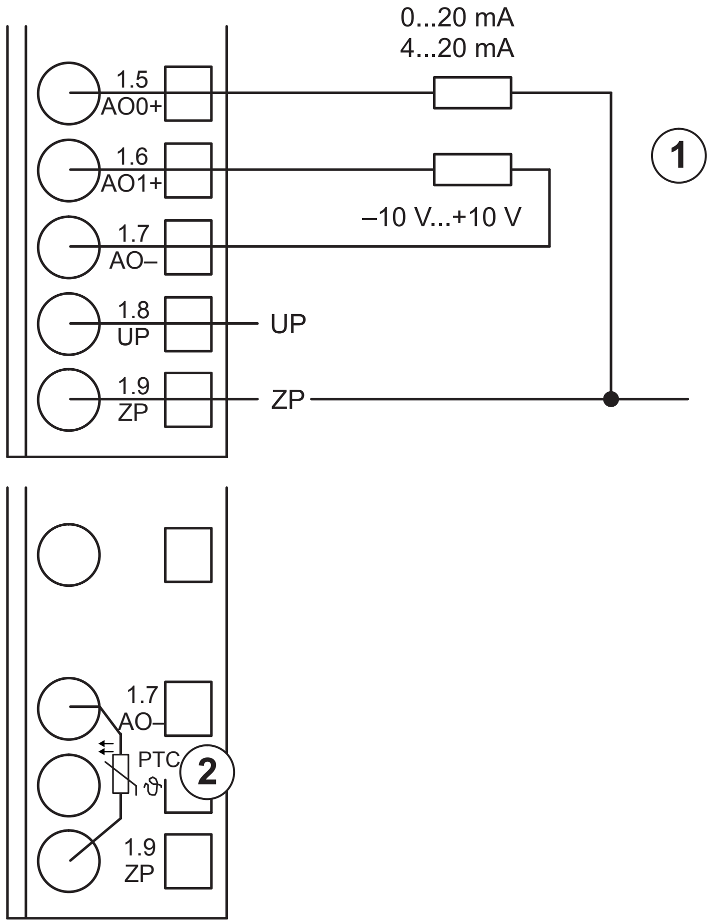


Fig. 167: Connection of analog output loads (voltage, current)

1 1 analog load requires 1 channel

Voltage	-10 V...+10 V	Load ±10 mA max.	1 channel used
Current	0...20 mA	Load 0...500 Ω	1 channel used
Current	4...20 mA	Load 0...500 Ω	1 channel used

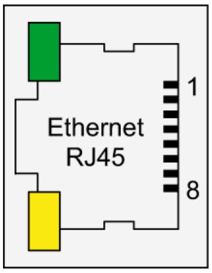
The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.3.1.7 “Parameterization” on page 844* *Chapter 1.7.3.1.10 “Measuring Ranges” on page 853*.

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet Ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment. The pin assignment is used for the EtherCAT master (communication module CM5xy-ETHCAT) as well.

Table 128: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet ⇨ Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

1.7.3.1.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Analog inputs (words)	4
Analog outputs (words)	2

1.7.3.1.5 Addressing

The Ethernet bus module CI511-ETHCAT does not consider the position of the rotary switches at the front side of the module. The function of the rotary switches is reserved for future expansions.

1.7.3.1.6 I/O Configuration

In order to be able to use the CI51X-ETHCAT with device index C0 or above properly, please download the corresponding device description (.xml-)files from http://www.abb.com/plc and install them to the device repository of your Automation Builder. This will allow you to use up to 10 Expandable S500 I/O modules as well as the Extended Cam Switch Library with your CI51X-ETHCAT device.

The CI511-ETHCAT does not store configuration data itself.

The analog I/O channels are configured via software.

1.7.3.1.7 Parameterization

Module Parameter

Name	Value	Internal value	Internal value, type	Default
Module ID	Internal	48155	WORD	48155
Parameter length	Internal	28	BYTE	28
Error LED / Failsafe function [1])	On Off by E4 Off by E3 On + failsafe Off by E4 + failsafe Off by E3 + failsafe	0 1 3 16 17 19	BYTE	0
Check Supply	Off On	0 1	BYTE	1

Table 129: Error LED / Failsafe function [1])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafemode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode off
Off by E3	Error LED lights up at errors of error classes E1 and E2 auf, Failsafemode off
On + failsafe	Error LED lights up at errors of all error classes, Failsafemode on *)
Off by E4 + failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode on *)
Off by E3 + failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafemode on *)

*) The parameters behaviourAOatCommunicationFault and behaviourDOatCommunicationFault are only analyzed if the Failsafe-mode is ON.

Group Parameters of the Cam Switch

Name	Value	Internal value	Internal value, type	Default
numOfUsed-Cams 1)	0 ... 32 128...160	0 ... 32 218...160	WORD	0
resolution 2)	0 ... 2 -1	0 ... 2 -1	DWORD	36000
zeroShift 3)	0 ... 2 -1	0 ... 2 -1	DWORD	0
EncoderBitReso-lution 4)	8 ... 32	8 ... 32	WORD	18
Reserve	-	-	WORD	-

1) The parameter numOfUsedCams defines the interrupt cycle time (Therefore, it takes effect to the accuracy of the track) and the behaviour of the module if the DC information is lost.

Parameter setting for numOfUsed-Cams	Number of cams used	Interrupt cycle time	Behaviour if DC information is lost
0	0	50 µs	Module changes to "safe-operational" state; the outputs are activated trough the user program
1...8	1...8	80 µs	
9...16	9...16	100 µs	
17...32	17...32	200 µs	
128	0	50 µs	Module keeps in "operational" state; the outputs are activated trough the user program
129...136	1...8	80 µs	Module keeps in "operational" state; the cam switch outputs are activated according to an interpolated timing information
137...144	9...16	100 µs	
145...170	17...32	200 µs	

2) The parameter resolution defines the angle resolution of the track. The value gives the number of increments related to 360°; e. g. the value 36,000 corresponds to an angle resolution of 0.01°.

3) The parameter zeroShift defines the zero shift. With it the encoder can be adjusted to the mounting position. The value of zeroShift is set in encoder-increments. It is not assigned to the parameter resolution of the cam switch.

4) The parameter EncoderBitResolution defines the resolution of the used encoder (in bits), e. g. with the default setting 18 bits the encoder has 196,608 divisions.

Channel Parameters for the Cam Switch (max. 32x)

Name	Value	Internal value	Internal value, type	Default
camToTrack0 *)	Digital Output 0 ... 7, none	0 ... 7, FF	BYTE	FF
:	:	:	:	:
camToTrack31	Digital Output 0 .. .7, none	0 ... 7, FF	BYTE	FF

*) The value of the parameter camToTrack# defines which DO (digital output) is assigned to the track. camToTrack0 = 3 for example means that track 0 is assigned to the digital output 3. If the value FFh is set to a track, no digital output is assigned to it.

Name	Value	Referred FB from extended Cam Switch Library [2])	Internal value	Internal value, type	Default
cam-Type[0] [1]) ...	Common Pulsed Timed Comfort Cam shift Binary shift Multiturn cam Time timed Reference Multiturn timed	MCX_CamSwitchSimple_c MCX_CamSwitchSimple_dc MCX_PulseSwitch_dc MCX_CamSwitchTimed_dc MCX_CamSwitchCom-fort_dc MCX_CamShift_dc MCX_BinaryShift_dc MCX_CamSwitchMulti_dc MCX_SwitchTimeTimed_dc MCX_BinaryReference_dc MCX_CamSwitchMulti-Timed_dc	0 1 2 3 4 5 6 7 8 9	BYTE	0

[1]) camType additionally to camToTrack identifies the type of each cam switch and enables the use of a specific Function Block from the Extended Cam Switch Library.

[2]) camType parameters and the *Extended Camswitch Library* are only available for CI511-ETHCAT and CI512-ETHCAT with device index C0 and above.

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard	0	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.

Channel Parameters for the Analog Inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, channel configuration	see [1])	see [1])	BYTE	0
Input 0, check channel	see [2])	see [2])	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, channel configuration	see [1])	see [1])	BYTE	0
Input 3, channel configuration	see [2])	see [2])	BYTE	0

Channel Configuration [1])

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0...10 V
2	Digital input
3	0...20 mA
4	4...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50...+400 °C
9	3-wire Pt100 -50...+400 °C *)
10	0 V...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50...+70 °C
15	3-wire Pt100 -50...+70 °C *)

Internal value	Operating modes of the analog inputs, individually configurable
16	2-wire Pt1000 -50...+400 °C
17	3-wire Pt1000 -50...+400 °C *)
18	2-wire Ni1000 -50...+150 °C
19	3-wire Ni1000 -50...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 130: Channel Monitoring 2)

Internal Value	Check channel
0	Plausib(ility), cut wire, short circuit
3	not used

Channel Parameters for the Analog Outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, channel configu-ration	see 3)	see 3)	BYTE	0
Output 0, check channel	see 4)	see 4)	BYTE	0
Output 0, substi-tute value	see 5)	see 5)	WORD	0
Output 1, channel configu-ration	see 3)	see 3)	BYTE	0
Output 1, check channel	see 4)	see 4)	BYTE	0
Output 1, substi-tute value	see 5)	see 5)	WORD	0

Table 131: Channel Configuration 3)

Internal value	Operating modes of the analog outputs, individually configu-rable
0	Not used (default)
128	-10 V...+10 V
129	0...20 mA
130	4...20 mA

Table 132: Channel Monitoring [4])

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 133: Substitute Value [5])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s	Last value 5 s	0
Last value for 10 s	Last value 10 s	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s	Substitute value 5 s	Depending on configuration
Substitute value for 10 s	Substitute value 10 s	Depending on configuration

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.01 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.01 ms 0x00
Detect short circuits at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute 5 sec Substitute 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000

*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.

1.7.3.1.8 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6..7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0..5**	**ETHCAT Diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	20	Slave-to-Slave mal-function	Check configu-ration
3	-	31	31	31	41	Distributed Clock malfunction	Check configu-ration
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage UP
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	34	No response during initialization of the I/O module	Replace I/O module

E1..E4	d1	d2	d3	d4	Identi-fier 000..063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6..7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0..5**	**ETHCAT Diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
4	-	31	31	31	46	Voltage feedback on activated digital outputs [4])	Check terminals
Channel error digital							
4	-	31	2	0..7	46	Voltage feedback on deactivated dig-ital output [5])	Check terminals
4	-	31	2	0..7	47	Short circuit at dig-ital output	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0..1	48	Analog value over-flow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI511-ETHCAT diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself or ADR = Hardware address (e. g. of the DC551)

3)	With "Module" the following allocation applies dependent of the master: 31 = Module itself (Module error) or Module type (1=AI, 2=DO, 3=AO; channel error)
4)	Diagnosis message appears for the whole output group and not per channel. The message occurs if the output channel is already active.
5)	Diagnosis message appears per channel. The message occurs if the output channel is not active.

1.7.3.1.9 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, NET, DC, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 134: States of the 5 System LEDs

LED	Color	Off	On	Flashing	1x Flash	2x Flash
PWR/RUN	Green	Error in the internal supply voltage or process voltage missing	Internal supply voltage OK	Module is not configured	--	--
	Yellow	--	--	--	--	--
NET	Green	Init	Operational	Pre-operational	Safe-operational	--
	Red	No error	PDI Watchdog Timeout	Invalid Configuration	Unsolicited State Change	Application time out
DC *)	Green	Distributed Clock not active	Distributed Clock active	--	--	--
	Red	--	--	--	--	--
S-ERR	Red	No error	Internal error	--	--	--
I/O-Bus	Green	No expansion modules connected or communication error	---	---	--	--
ETH1	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--

LED	Color	Off	On	Flashing	1x Flash	2x Flash
ETH2	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--

*) The state of this LED is only significant if the camswitch functionality is enabled

Table 135: States of the 27 Process LEDs

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.3.1.10 Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On	27648 : 1	6C00 : 0001

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
			Decimal	**Hex.**
Overflow	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high	450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1
		160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
			Decimal	Hex.
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.7.3.1.11 Technical Data

The System Data of AC500 and S500 ⇘ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ⇘ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Bus connection	2 x RJ45
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)

Parameter	Value
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability (S500 I/O Modules)	Up to 10 S500 I/O Modules (Index C0 and above), Not available(Index below C0)
Indicators	5 LEDs for state indication
Adjusting elements	2 rotary switches (used for future topology extensions)
Quantity of input/output data	CI512-ETHCAT: 10 bytes input and 14 bytes output CI511-ETHCAT: 18 bytes input and 18 bytes output
Acyclic services	SDO (1500 bytes max.) Emergency *ECAT_SLV_DIAG*
Protective functions (according to CODESYS)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Electrical isolation to network

Technical Data of the Module

Parameter		Value
Process supply voltage UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2

Parameter	Value
Reference potential for all digital inputs and outputs	Minus pole of the supply voltage, signal name ZP
Diagnosis	See Diagnosis and Displays *Chapter 1.7.3.1.8 "Diagnosis" on page 850*
Operation and error displays	32 LEDs (totally)
Weight (without terminal unit)	ca. 125 g
Mounting position	Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 to DI7		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA

Parameter		Value
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 to DO7		Terminals 3.0 to 3.7
Reference potential for all outputs		Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

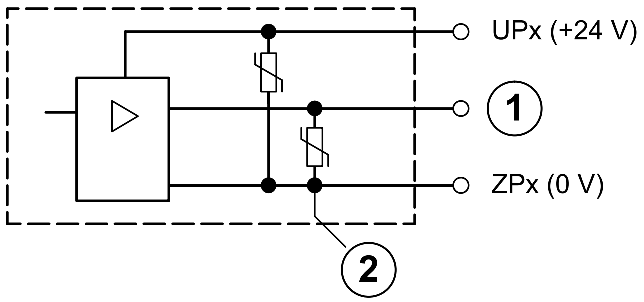


Fig. 168: Digital input/output (circuit diagram)

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 1.0 to 1.3
Reference potential for AI0+ to AI3+		Terminal 1.4 (AI-) for voltage and RTD measurement Terminals 1.9, 2.9 and 3.9 for current measurement
Input type		
	Unipolar	Voltage 0 V...10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V...+10 V
Electrical isolation		Against Ethernet network
Configurability		0 V...10 V, -10 V...+10 V, 0/4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution		Range 0...10 V: 12 bits Range -10...+10 V: 12 bits + sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	Tables Input Ranges Voltage, Current and Digital Input ␗ *Chapter 1.7.3.1.10.1 “Input Ranges Voltage, Current and Digital Input” on page 853* and Input Range Resistor ␗ *Chapter 1.7.3.1.10.2 “Input Range Resistor” on page 854*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical Data of the Analog Inputs, if used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 1.0 to 1.3
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 1.5...1.6
Reference potential for AO0+ to AO1+		Terminal 1.7 (AO-) for voltage outputTerminals 1.9, 2.9 and 3.9 (ZP) for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Electrical isolation		Against Ethernet network
Configurability		-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually)

Parameter	Value
Output resistance (load), as current output	0 ... 500 Ω
Output loadability, as voltage output	± 10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Table Output Ranges Voltage and Current *Chapter 1.7.3.1.10.3 “Output Ranges Voltage and Current” on page 855*
Unused outputs	Are configured as unused (default value) and can be left open-circuited

1.7.3.1.12 Ordering Data

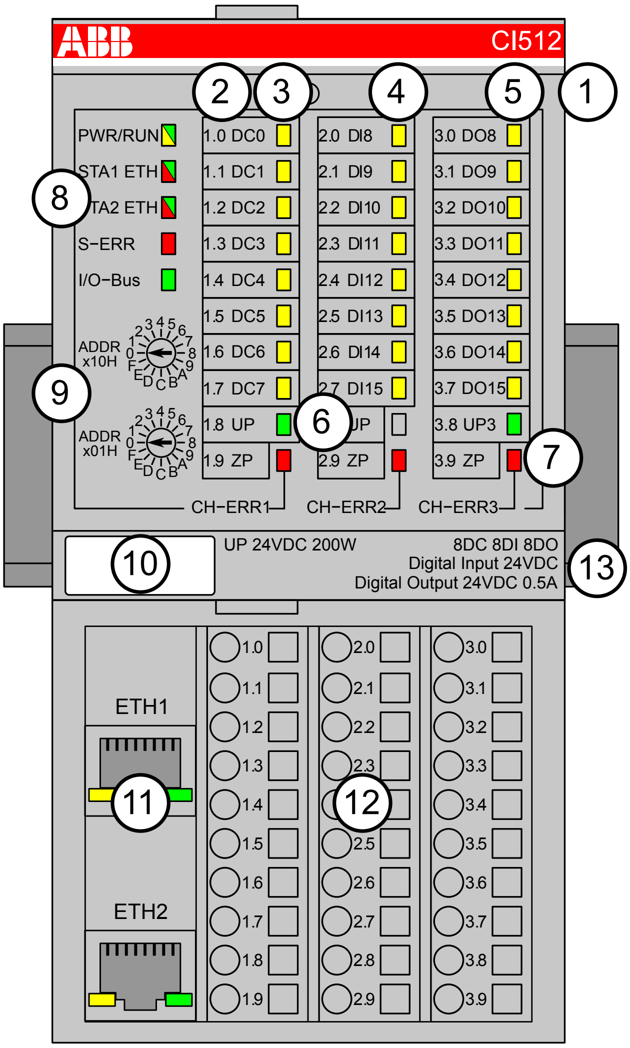
Part no.	Description	Product Life Cycle Phase *)
1SAP 220 900 R0001	CI511-ETHCAT, EtherCAT bus module, 8 DI, 8 DO, 4 AI and 2 AO	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.3.2 CI512-ETHCAT

- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- Cam switch functionality (see also Extended Cam Switch Library)
- Extended Cam switch functionality *)
  (see also Extended Cam Switch Library)
- Module-wise electrically isolated
- Expandability with up to 10 S500 I/O modules *)

*) Applicable for device index C0 and above.



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 - DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 - DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 - DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, NET, DC, S-ERR, I/O-Bus
9 2 rotary switches (reserved for future extensions)
10 Label
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail

1.7.3.2.1 Intended Purpose

The EtherCAT bus module CI512-ETHCAT is used as decentralized I/O module in EtherCAT networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The bus module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0...1.7)
- 8 digital inputs 24 VDC in 1 group (2.0...2.7)
- 8 digital outputs 24 VDC in 1 group (3.0...3.7)
- Cam switch functionality

The inputs/outputs are electrically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

1.7.3.2.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	EtherCAT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	Not used; reserved for future extensions
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 VDC; delay time configurable via software)
Digital outputs	8 (24 VDC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*

1.7.3.2.3 Electrical Connection

The Ethernet bus module CI512-ETHCAT is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526).

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter* *Chapter 2.5 “AC500-eCo” on page 1194.*

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 VDC

Terminal 3.8: Process supply voltage UP3 = +24 VDC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

> *With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.*

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	DC0 to DC7	8 digital inputs/outputs (configurable via software)
2.0 to 2.7	DI0 to DI7	8 digital inputs (delay time configurable via software)
3.0 to 3.7	DO0 to DO7	8 digital outputs

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figures show the electrical connection of the Ethernet bus module CI512-ETHCAT.

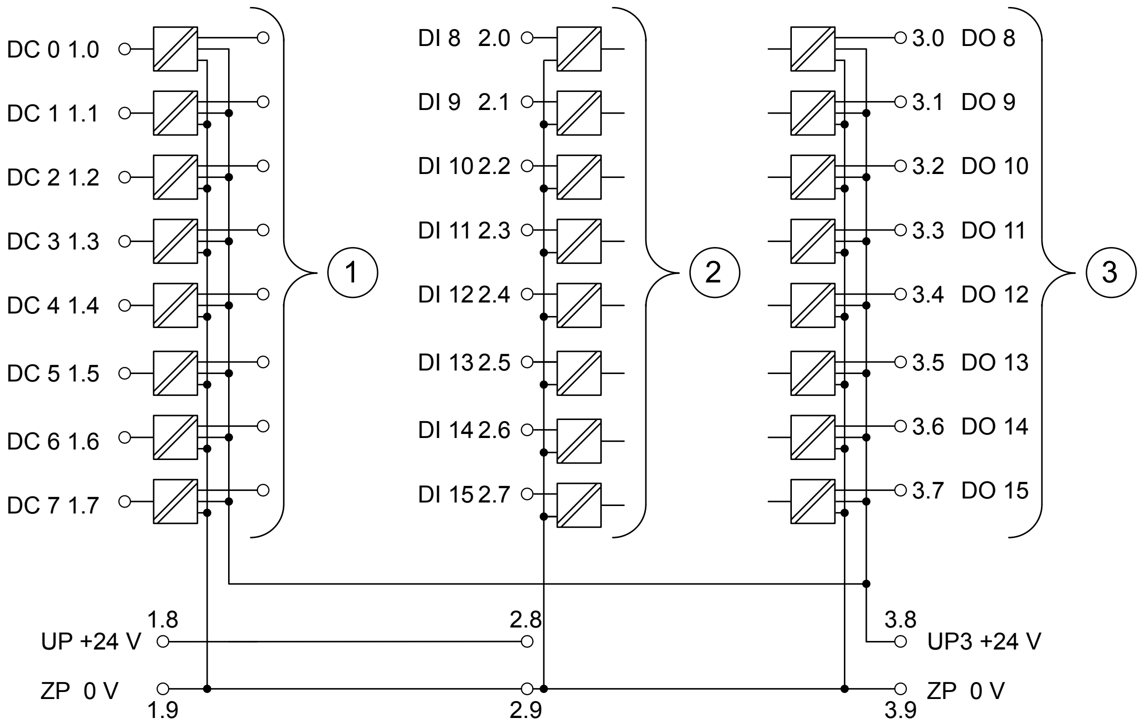


Fig. 169: Connection of the bus module CI512-ETHCAT

1 8 digital configurable inputs/outputs 24 VDC
2 8 digital inputs 24 VDC
3 8 digital outputs 24 VDC

In case of voltage feedback, 2 cases are distinguished:

1. The outputs are already active

The output group will be switched off. A diagnosis message will appear. After 5 seconds, the module tries automatic reactivation.

2. The outputs are not active

Only the output with voltage feedback will not be set to active. A diagnosis message will appear.

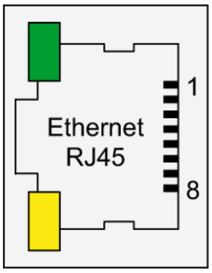
CAUTION!
The process supply voltage must be included within the earthing concept of the plant (e. g. earthing of the minus pole).

The module provide several diagnosis functions *Chapter 1.7.3.2.9 “Diagnosis” on page 870*.

1.7.3.2.4 Assignment of the Ethernet Ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment. The pin assignment is used for the EtherCAT master (communication module CM5xy-ETHCAT) as well.

Table 136: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

1.7.3.2.5 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Configurable digital inputs/outputs (bytes)	1 + 1

1.7.3.2.6 Addressing

The Ethernet bus module CI512-ETHCAT does not consider the position of the rotary switches at the front side of the module. The function of the rotary switches is reserved for future expansions.

1.7.3.2.7 I/O Configuration

> *In order to be able to use the CI51X-ETHCAT with device index C0 or above properly, please download the corresponding device description (.xml-)files from http://www.abb.com/plc and install them to the device repository of your Automation Builder. This will allow you to use up to 10 Expandable S500 I/O modules as well as the Extended Cam Switch Library with your CI51X-ETHCAT device.*

The CI512-ETHCAT does not store configuration data itself.

The analog I/O channels are configured via software.

1.7.3.2.8 Parameterization

Module Parameter

Name	Value	Internal value	Internal value, type	Default
Module ID	Internal	49435	WORD	49435
Parameter length	Internal	10	BYTE	10
Error LED / Fail-safe function [1])	On Off by E4 Off by E3 On + failsafe Off by E4 + failsafe Off by E3 + failsafe	0 1 3 16 17 19	BYTE	0
Check Supply	Off On	0 1	BYTE	1

Table 137: Error LED / Failsafe function [1])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2 auf, Failsafe mode off
On + failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.

Group Parameters of the Cam Switch

Name	Value	Internal value	Internal value, type	Default
numOfUsed-Cams [1])	0 ... 32 128...160	0 ... 32 218...160	WORD	0
resolution [2])	0 ... 2 -1	0 ... 2 -1	DWORD	36000
zeroShift [3])	0 ... 2 -1	0 ... 2 -1	DWORD	0
EncoderBitReso-lution [4])	8 ... 32	8 ... 32	WORD	18
Reserve	-	-	WORD	-

Remarks:

[1]) The parameter numOfUsedCams defines the interrupt cycle time (Therefore, it takes effect to the accuracy of the track) and the behaviour of the module if the DC information is lost.

Parameter setting for numOfUsed-Cams	Number of cams used	Interrupt cycle time	Behaviour if DC information is lost
0	0	50 µs	Module changes to "safe-operational" state; the outputs are activated trough the user program
1...8	1...8	80 µs	
9...16	9...16	100 µs	
17...32	17...32	200 µs	
128	0	50 µs	Module keeps in "operational" state; the outputs are activated trough the user program
129...136	1...8	80 µs	Module keeps in "operational" state; the cam switch outputs are activated according to an interpolated timing information
137...144	9...16	100 µs	
145...170	17...32	200 µs	

[2]) The parameter resolution defines the angle resolution of the track. The value gives the number of increments related to 360°; e. g. the value 36,000 corresponds to an angle resolution of 0.01°.

[3]) The parameter zeroShift defines the zero shift. With it the encoder can be adjusted to the mounting position. The value of zeroShift is set in encoder-increments. It is not assigned to the parameter resolution of the cam switch.

[4]) The parameter EncoderBitResolution defines the resolution of the used encoder (in bits), e. g. with the default setting 18 bits the encoder has 196,608 divisions.

Channel Parameters for the Cam Switch (max. 32x)

Name	Value	Internal value	Internal value, type	Default
camToTrack0 [1])	Digital Output 0 ... 15, none	0 ... 15, FF	BYTE	FF
:	:	:	:	:
camToTrack31	Digital Output 0 ... 15, none	0 ... 15, FF	BYTE	FF

[1]) The value of the parameter camToTrack# defines which DO (digital output) is assigned to the track. camToTrack0 = 3 for example means that track 0 is assigned to the digital output 3. If the value FFh is set to a track, no digital output is assigned to it.

Name	Value	Referred FB from extended Cam Switch Library [2])	Internal value	Internal value, type	Default
cam-Type[0] [1]) ...	Common	MCX_CamSwitchSimple_c	0	BYTE	0
	Pulsed	MCX_CamSwitchSimple_dc			
	Timed	MCX_PulseSwitch_dc	1		
	Comfort	MCX_CamSwitchTimed_dc	2		
	Cam shift	MCX_CamSwitchComfort_dc	3		
	Binary shift	MCX_CamShift_dc	4		
	Multiturn cam	MCX_BinaryShift_dc	5		
	Time timed	MCX_CamSwitchMulti_dc	6		
	Reference	MCX_SwitchTimeTimed_dc	7		
	Multiturn timed	MCX_BinaryReference_dc	8		
		MCX_CamSwitchMulti-Timed_dc	9		

[1]) camType additionally to camToTrack identifies the type of each cam switch and enables the use of a specific Function Block from the Extended Cam Switch Library.

[2]) camType parameters and the Extended Camswitch Library *Extended Camswitch Library* are only available for CI511-ETHCAT and CI512-ETHCAT with device index C0 and above.

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.01 ms	0	BYTE	0.01 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute values DO	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.				

1.7.3.2.9 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	d1	d2	d3	d4	Identifier 000..063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6..7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0..5**	**ETHCAT Diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
Module error							
3	-	31	31	31	43	Internal error in the module	Replace I/O module
3	-	31	31	31	20	Slave-to-Slave malfunction	Check configuration
3	-	31	31	31	41	Distributed Clock malfunction	Check configuration
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6..7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0..5**	**ETHCAT Diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)	Check terminals
Channel error digital							
4	-	31	2	0..15	46	Voltage feedback on deactivated digital output 5)	Check terminals
4	-	31	2	0..15	47	Short circuit at digital output	Check terminals

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O-Bus; 31 = Module itself The identifier is not contained in the CI512-ETHCAT diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself or ADR = Hardware address (e. g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: 31 = Module itself (Module error) or Module type (1=AI, 2=DO, 3=AO; channel error)
4)	Diagnosis message appears for the whole output group and not per channel. The message occurs if the output channel is already active.
5	Diagnosis message appears per channel. The message occurs if the output channel is not active.

1.7.3.2.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, NET, DC, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 138: States of the 5 System LEDs

LED	Color	Off	On	Flashing	1x flash	2x flash
PWR/RUN	Green	Error in the internal supply voltage or process voltage missing	Internal supply voltage OK	Module is not config-ured	--	--
	Yellow	--	--	--	--	--
NET	Green	Init	Operational	Pre-opera-tional	Safe-opera-tional	--
	Red	No error	PDI Watchdog Timeout	Invalid Con-figuration	Unsolicited State Change	Application time out
DC *)	Green	Distributed Clock not active	Distributed Clock active	--	--	--
	Red	--	--	--	--	--
S-ERR	Red	No error	Internal error	--	--	--
I/O-Bus	Green	No expan-sion mod-ules con-nected or communica-tion error	---	---	--	--
ETH1	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--
ETH2	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--
*) The state of this LED is only significant if the camswitch functionality is enabled						

Table 139: States of the 29 Process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--

LED	Color	OFF	ON	Flashing
DO8 to DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.3.2.11 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Parameter	Value
Bus connection	2 x RJ45
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability (S500 I/O Modules)	Up to 10 S500 I/O Modules (Index C0 and above), Not available(Index below C0)
Indicators	5 LEDs for state indication
Adjusting elements	2 rotary switches (used for future topology extensions)
Quantity of input/output data	CI512-ETHCAT: 10 bytes input and 14 bytes output CI511-ETHCAT: 18 bytes input and 18 bytes output
Acyclic services	SDO (1500 bytes max.) Emergency *ECAT_SLV_DIAG*
Protective functions (according to CODESYS)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Electrical isolation to network

Technical Data of the Module

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Diagnosis		See Diagnosis and Displays *Chapter 1.7.3.2.9 “Diagnosis” on page 870*
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hin-dered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 to DI7	Terminals 2.0 to 2.7
Reference potential for all inputs	Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 VDC
0-Signal	-3 V...+5 V
undefined Signal	> +5 V...< +15 V
1-Signal	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 3.0 to 3.7
Reference potential for all outputs	Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA

Parameter		Value
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

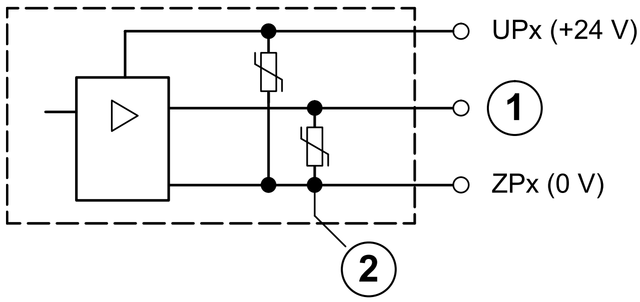


Fig. 170: Digital input/output (circuit diagram)

1 Digital Output
2 Varistors for demagnetization when inductive loads are turned off

Figure:

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0...DC07	Terminals 1.0...1.7
If the channels are used as outputs		
	Channels DC0...DC07	Terminals 1.0...1.7

Parameter	Value
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Electrical isolation	From the Ethernet network

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 to DC7		Terminals 1.0 to 1.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V *)
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V *)
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 1.0 to 1.7

Parameter		Value
Reference potential for all outputs		Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

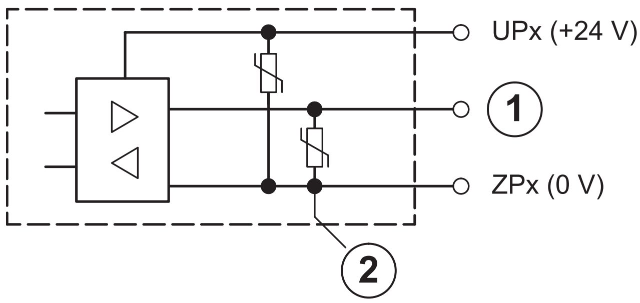


Fig. 171: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

1.7.3.2.12 Ordering Data

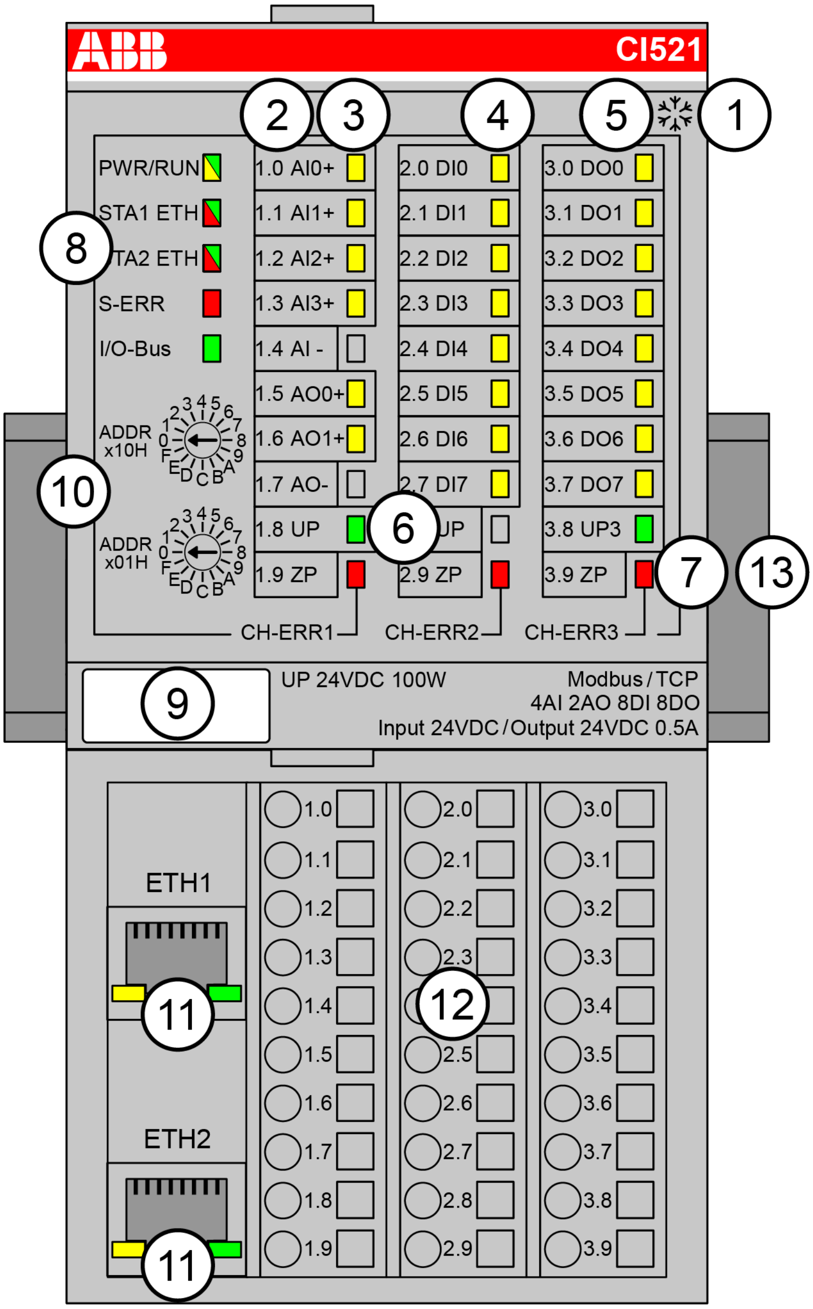
Part no.	Description	Product Life Cycle Phase *)
1SAP 221 000 R0001	CI512-ETHCAT, EtherCAT bus module, 8 DI, 8 DO and 8 DC	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.4 Modbus

1.7.4.1 CI521-MODTCP

- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus sign)
- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max.
- Module-wise electrically isolated
- Fast Counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 - AI3, AO0 - AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 - DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 - DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the IP address
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.4.1.1 Intended Purpose

The Modbus TCP bus module CI521-MODTCP is used as decentralized I/O module in Modbus TCP networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The bus module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0...1.3)
- 2 analog outputs (1.5...1.6)
- 8 digital inputs 24 V DC in 1 group (2.0...2.7)
- 8 digital outputs 24 V DC in 1 group (3.0...3.7)

The inputs/outputs are electrically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.4.1.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	Modbus TCP
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	for setting the last BYTE of the IP (00h to FFh)
Analog inputs	4 (configurable via software)
Analog outputs	2 (configurable via software)
Digital inputs	8 (24 VDC; delay time configurable via software)
Digital outputs	8 (24 VDC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Required terminal unit	TU507 or TU508 ➯ *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*

1.7.4.1.3 Electrical Connection

The Ethernet bus module CI521-MODTCP is plugged on the I/O terminal unit TU507-ETH or TU508-ETH ➯ *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ➯ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 VDC

Terminal 3.8: Process supply voltage UP3 = +24 VDC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Conditions for undisturbed operating with older I/O expansion modules

All I/O expansion modules that are attached to the CI52x-MODTCP must be powered up together with the CI52x-MODTCP if the firmware version of these I/O expansion modules is V1.9 or lower.

The firmware version is related to the index. The index is printed on the module type label on the right side.

Modules as of index listed in the following table can be powered up independently.

S500 I/O module type	First index with firmware version above 1.9
AI523	D0
AI523-XC	D0
AI531	A3
AI531-XC	A0
AO523	D0
AO523-XC	D0
AX521	D0
AX521-XC	D0
AX522	D0
AX522-XC	D0
CD522	A2
CD522-XC	A0
DA501	A2
DA501-XC	A0
DA502	A1
DA502-XC	A1
DC522	D0
DC522-XC	D0
DC523	D0

S500 I/O module type	First index with firmware version above 1.9
DC523-XC	D0
DC532	D0
DC532-XC	D0
DI524	D0
DI524-XC	D0
DO524	A2
DO524-XC	A2
DX522	D0
DX522-XC	D0
DX531	D0
AC522	D0
PD501	D0

Do not connect any voltages externally to digital outputs!

Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

CAUTION!
Risk of malfunction by not intended usage!
If the function cut off of the digital outputs should be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0..DO7.

The assignment of the other terminals:

Terminal	Signal	Description
1.0	AI0+	Plus pole of analog input signal 0
1.1	AI1+	Plus pole of analog input signal 1
1.2	AI2+	Plus pole of analog input signal 2
1.3	AI3+	Plus pole of analog input signal 3
1.4	AI-	Minus pole of analog input signals 0 to 3
1.5	AO0+	Plus pole of analog output signal 0
1.6	AO1+	Plus pole of analog output signal 1
1.7	AI-	Minus pole of analog output signals 0 and 1
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4

Terminal	Signal	Description
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	DO0	Signal of the digital output DO0
3.1	DO1	Signal of the digital output DO1
3.2	DO2	Signal of the digital output DO2
3.3	DO3	Signal of the digital output DO3
3.4	DO4	Signal of the digital output DO4
3.5	DO5	Signal of the digital output DO5
3.6	DO6	Signal of the digital output DO6
3.7	DO7	Signal of the digital output DO7
3.8	UP3	Process voltage UP3 (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (cut wire), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

> *Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.*
>
> *Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.*

The following figures show the electrical connection of the Ethernet bus module CI521-MODTCP.

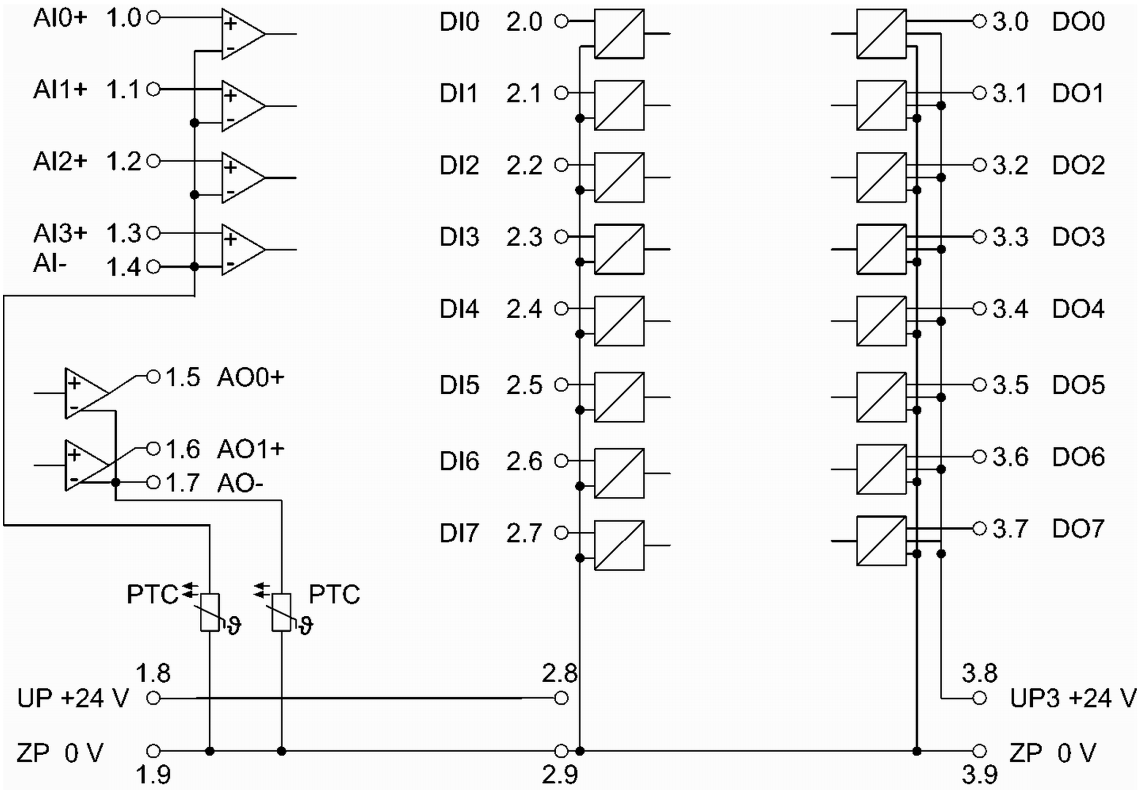


Fig. 172: Connection of the bus module CI521-MODTCP

Further information is provided in the System Technology chapter *CI52x-MODTCP*.

Connection of the Digital Inputs

The following figure shows the electrical connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.

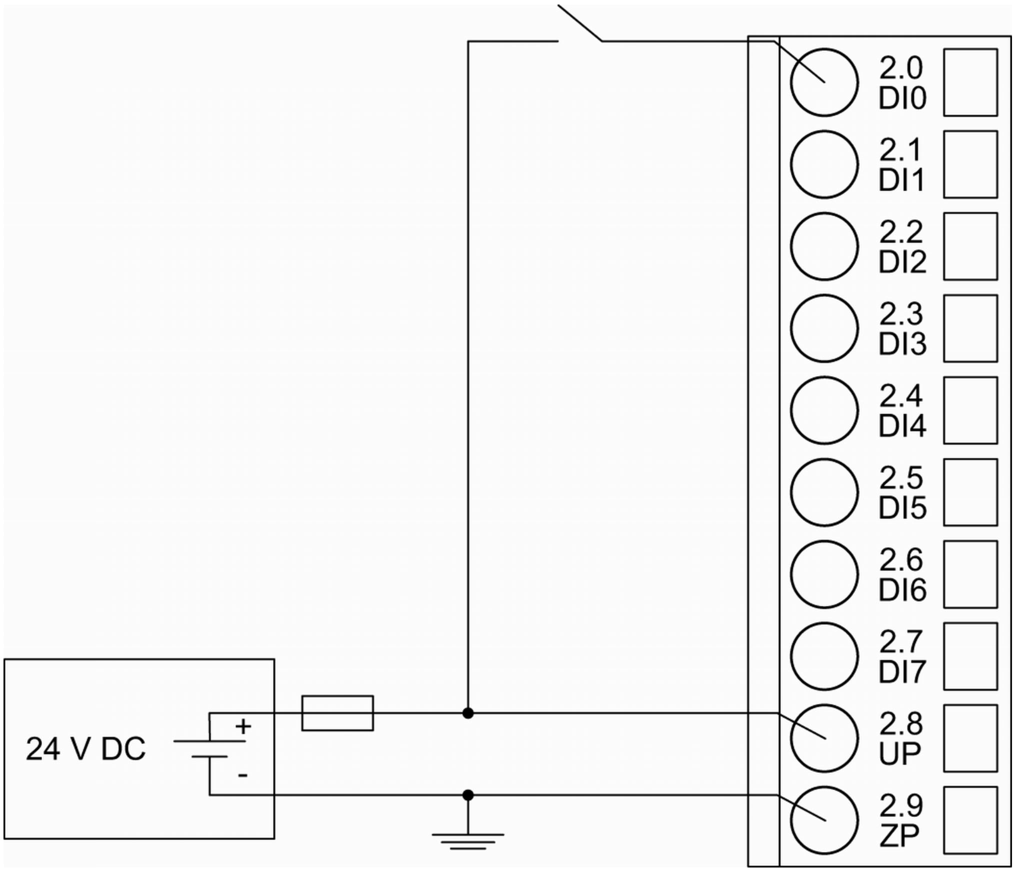


Fig. 173: Connection of the digital inputs to the module CI521-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.7.4.1.8.2 “State LEDs” on page 909*.

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO0. Proceed with the digital outputs DO1 - DO7 in the same way.

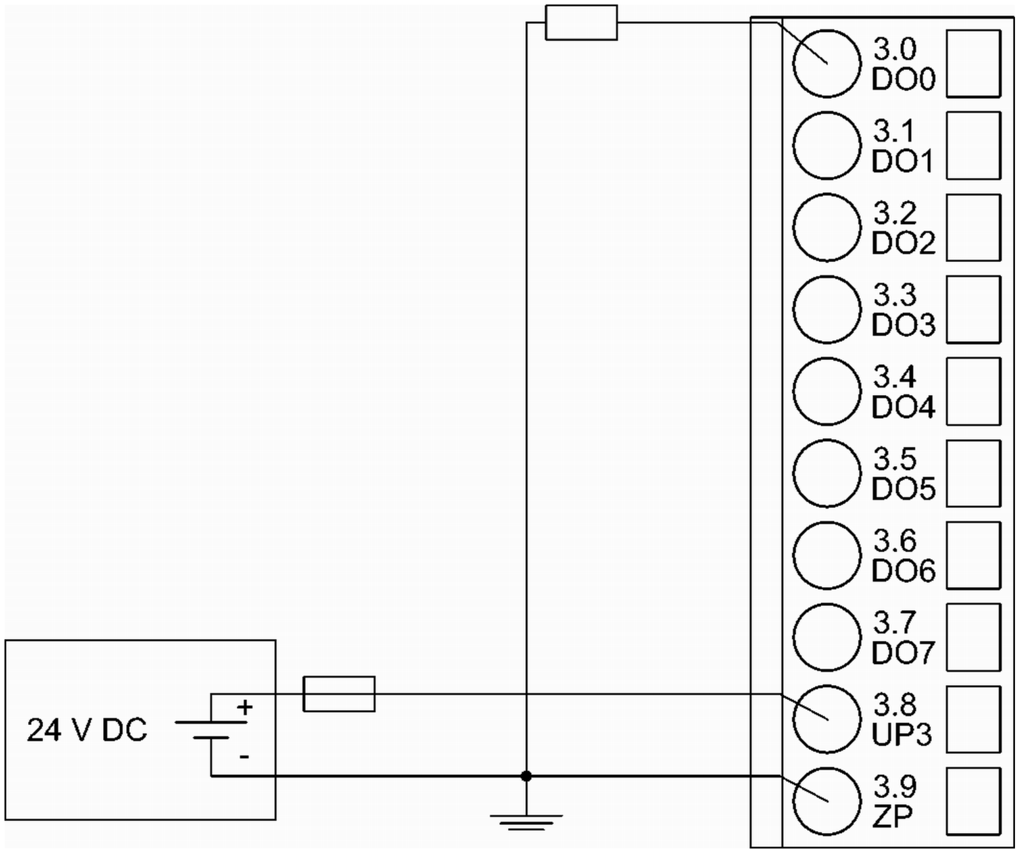


Fig. 174: Connection of configurable digital inputs/outputs to the module CI521-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.7.4.1.8.2 "State LEDs" on page 909*.

Connection of Resistance Thermometers in 2-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI521-MODTCP provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

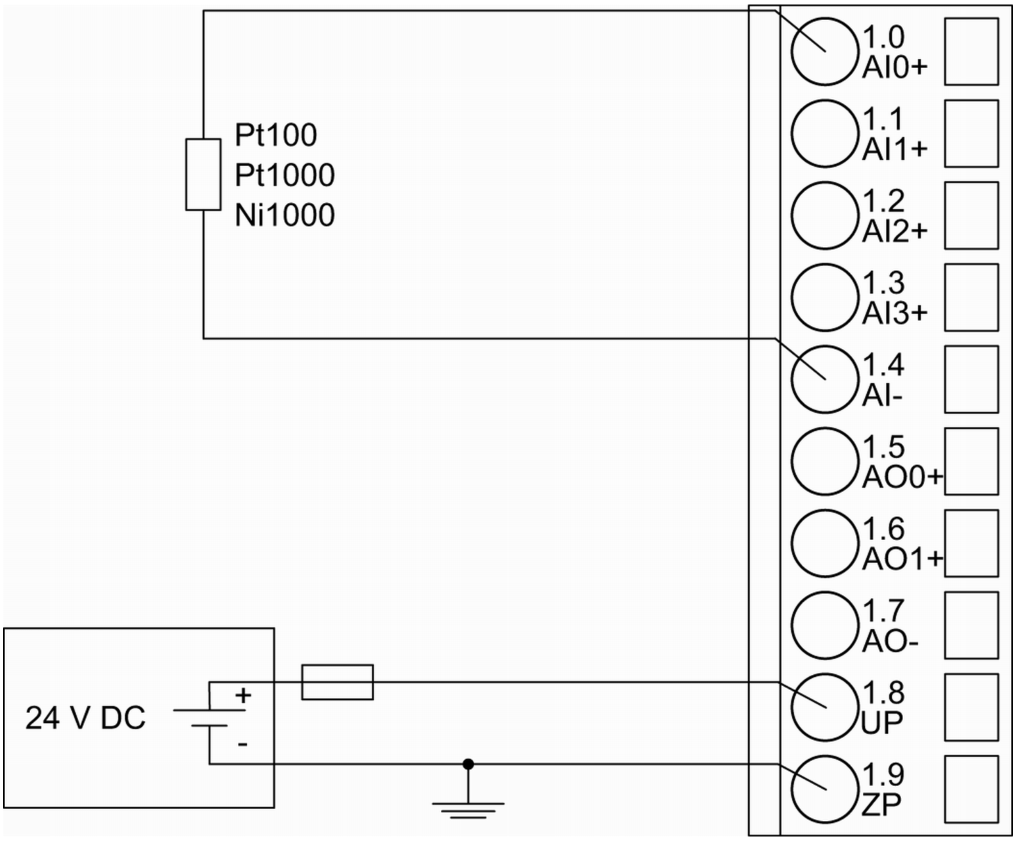


Fig. 175: Connection of resistance thermometers in 2-wire configuration to the analog inputs

The following measuring ranges can be configured ↯ *Chapter 1.7.4.1.7 "Parameterization" on page 899* and ↯ *Chapter 1.7.4.1.9 "Measuring Ranges" on page 911*:

Pt100	-50 °C...+70 °C	2-wire configuration, 1 channel used
Pt100	-50 °C...+400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↯ *Chapter 1.7.4.1.8 "Diagnosis and State LEDs" on page 905*.

The module CI521-MODTCP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI521-MODTCP provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1. Proceed with the analog inputs AI2 and AI3 in the same way.

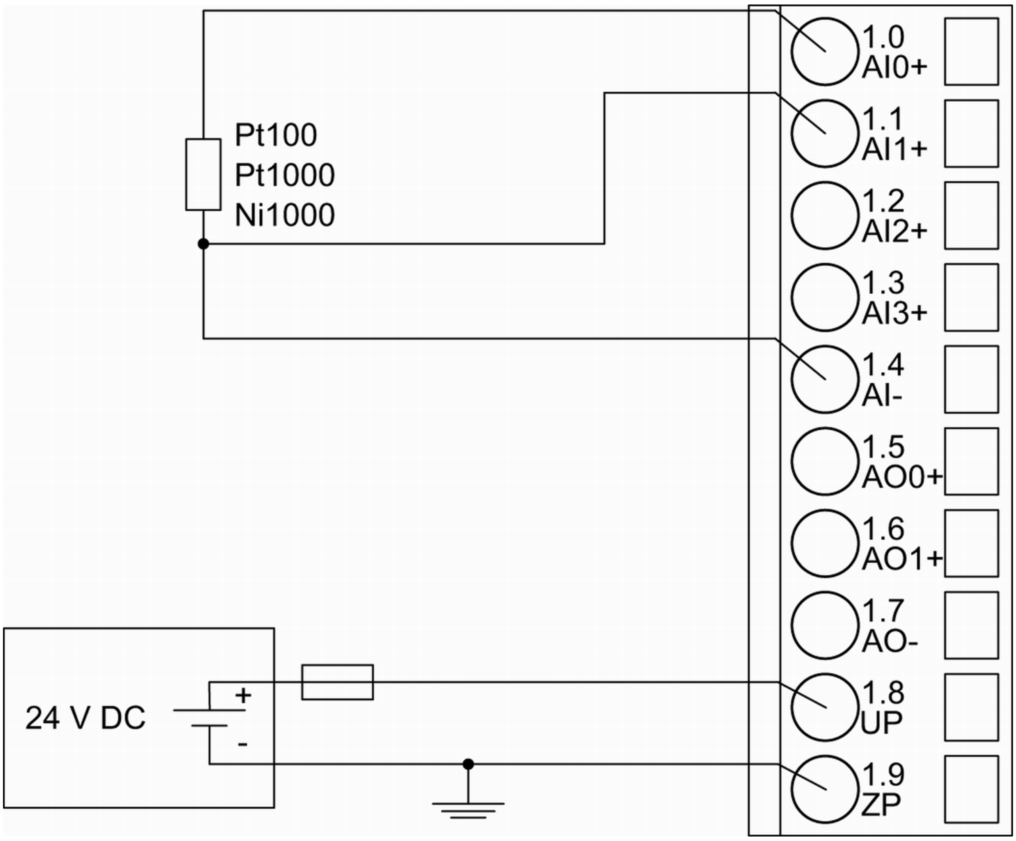


Fig. 176: Connection of resistance thermometers in 3-wire configuration to the analog inputs

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured ✎ *Chapter 1.7.4.1.7 “Parameterization” on page 899* and ✎ *Chapter 1.7.4.1.9 “Measuring Ranges” on page 911*:

Pt100	-50 °C...+70 °C	3-wire configuration, 2 channels used
Pt100	-50 °C...+400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays ✎ *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*.

The module CI521-MODTCP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (voltage) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

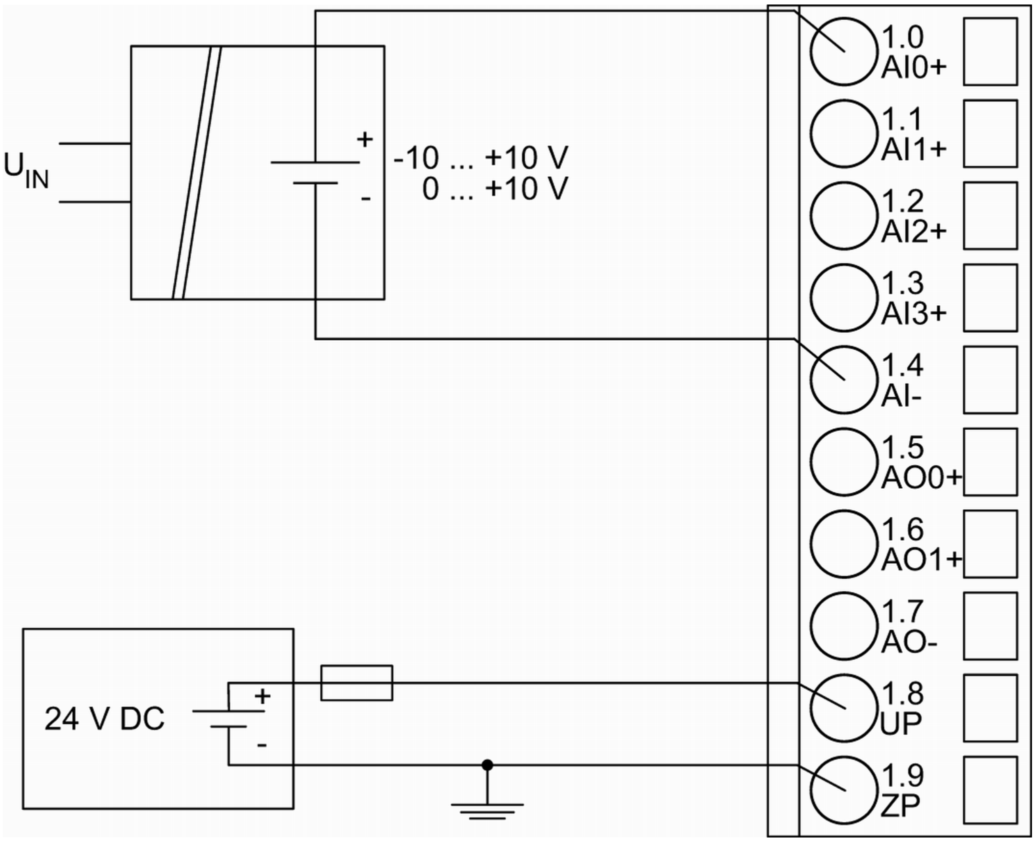


Fig. 177: Connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog inputs

The following measuring ranges can be configured *Chapter 1.7.4.1.7 “Parameterization” on page 899* and *Chapter 1.7.4.1.9 “Measuring Ranges” on page 911*:

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

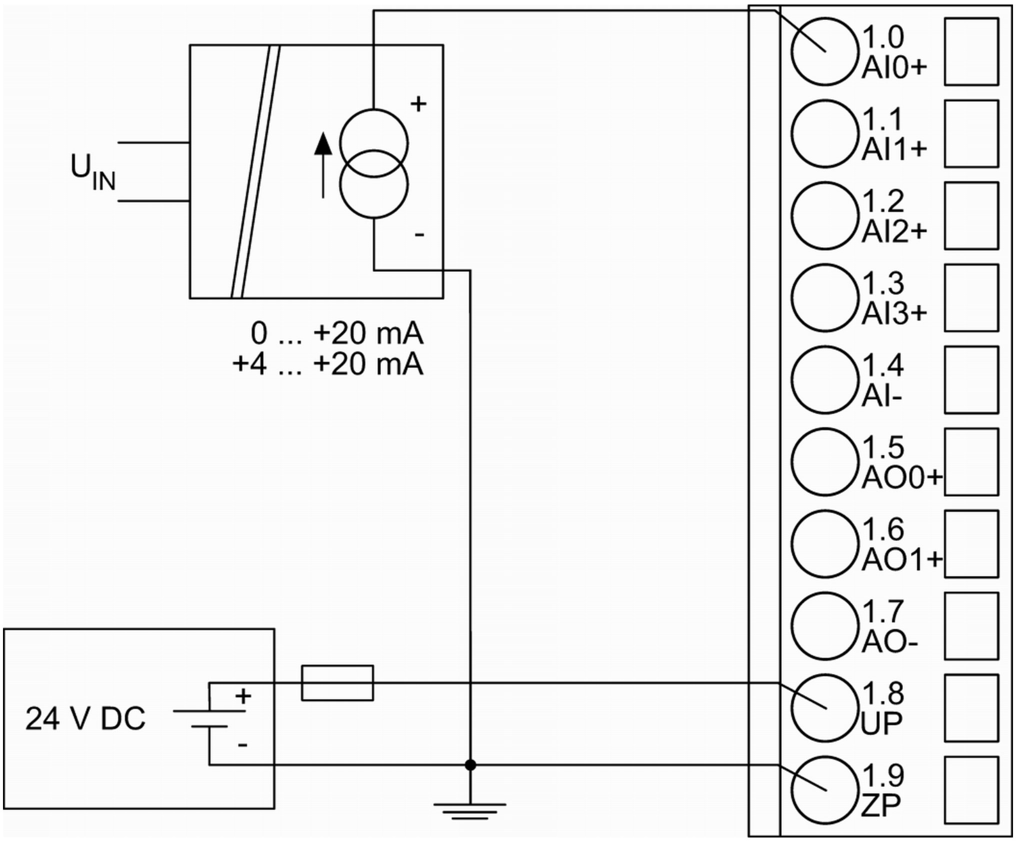


Fig. 178: Connection of active-type analog sensors (current) with electrically isolated power supply to the analog inputs

The following measuring ranges can be configured *Chapter 1.7.4.1.7 “Parameterization” on page 899* and *Chapter 1.7.4.1.9 “Measuring Ranges” on page 911*:

Current	0...20 mA	1 channel used
Current	4...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4...20 mA, these channels should be configured as "Not used".

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with no electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

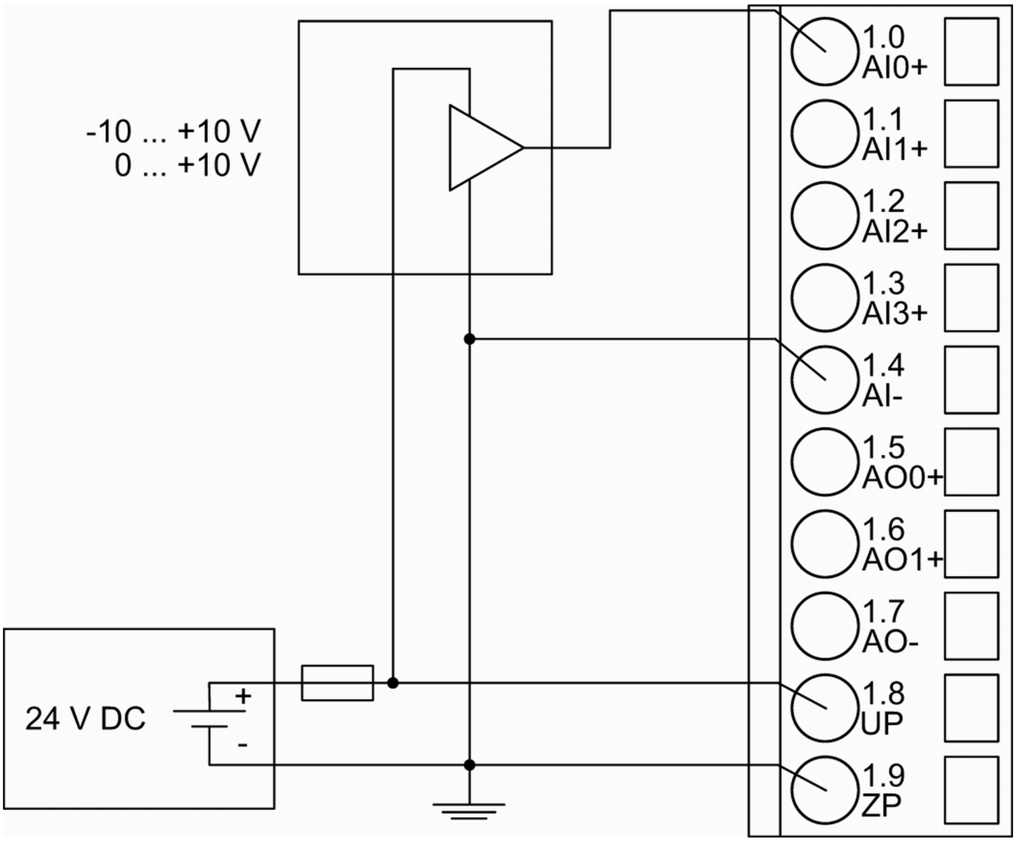


Fig. 179: Connection of active-type sensors (voltage) with no electrically isolated power supply to the analog inputs

CAUTION!
Risk of faulty measurements!
The minus pole at the sensors must not have a too big potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

The following measuring ranges can be configured ➪ *Chapter 1.7.4.1.7 “Parameterization” on page 899* and ➪ *Chapter 1.7.4.1.9 “Measuring Ranges” on page 911*.

Voltage	0...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ➪ *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Passive-type Analog Sensors (Current) to the Analog Inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

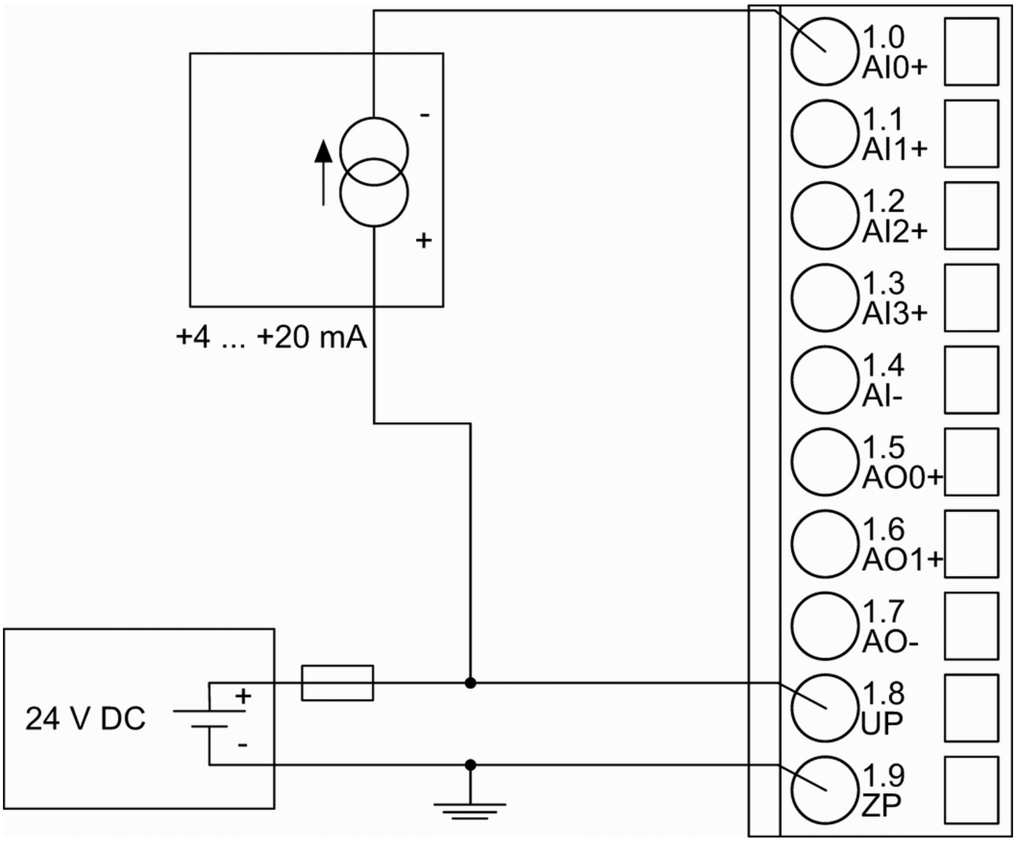


Fig. 180: Connection of passive-type analog sensors (current) to the analog inputs

The following measuring ranges can be configured *Chapter 1.7.4.1.7 "Parameterization" on page 899* and *Chapter 1.7.4.1.9 "Measuring Ranges" on page 911*:

Current	4...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.4.1.8 "Diagnosis and State LEDs" on page 905*.

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4...20 mA, these channels should be configured as "Not used".

Connection of Active-type Analog Sensors (Voltage) to Differential Analog Inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely earthed).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
Risk of faulty measurements!
The minus pole at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V).

Make sure that the potential difference never exceeds ±1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

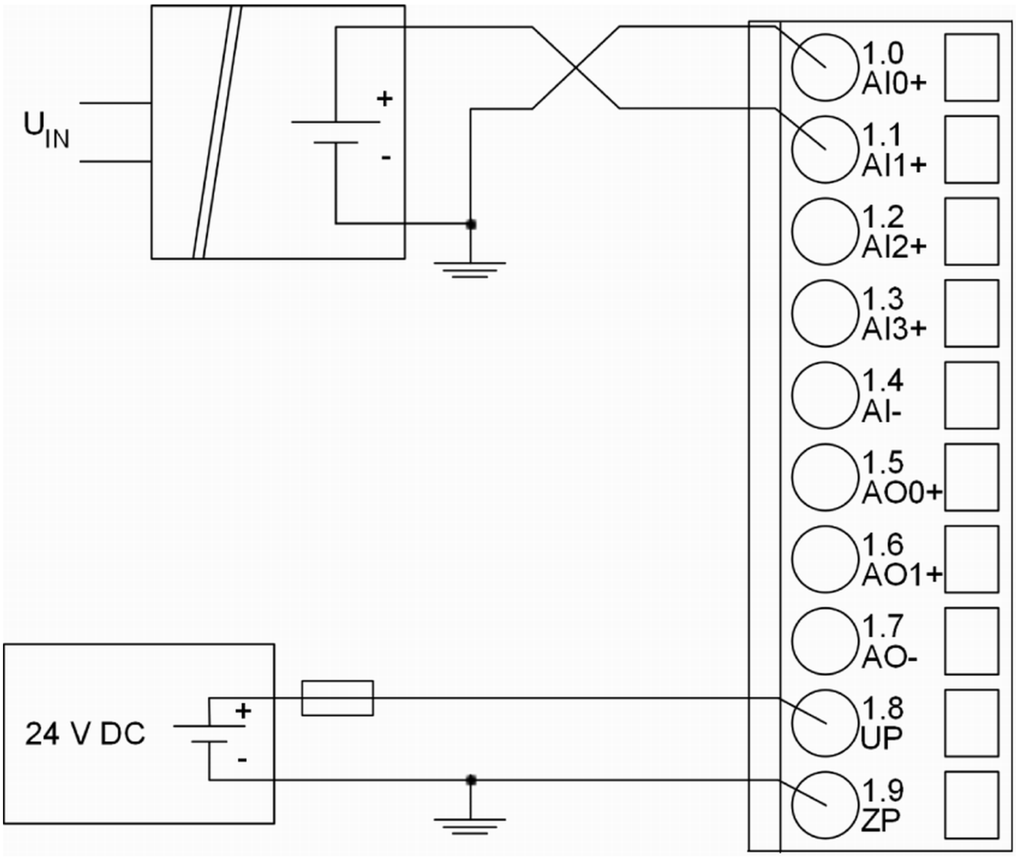


Fig. 181: Connection of active-type analog sensors (voltage) to differential analog inputs

The following measuring ranges can be configured ⇘ *Chapter 1.7.4.1.7 "Parameterization" on page 899* and ⇘ *Chapter 1.7.4.1.9 "Measuring Ranges" on page 911*:

Voltage	0...10 V	With differential inputs, 2 channels used
Voltage	-10 V...+10 V	With differential inputs, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.4.1.8 "Diagnosis and State LEDs" on page 905*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs ↻ *Chapter 1.7.4.1.10.5 “Technical Data of the Analog Inputs if used as Digital Inputs” on page 917*. The inputs are not electrically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

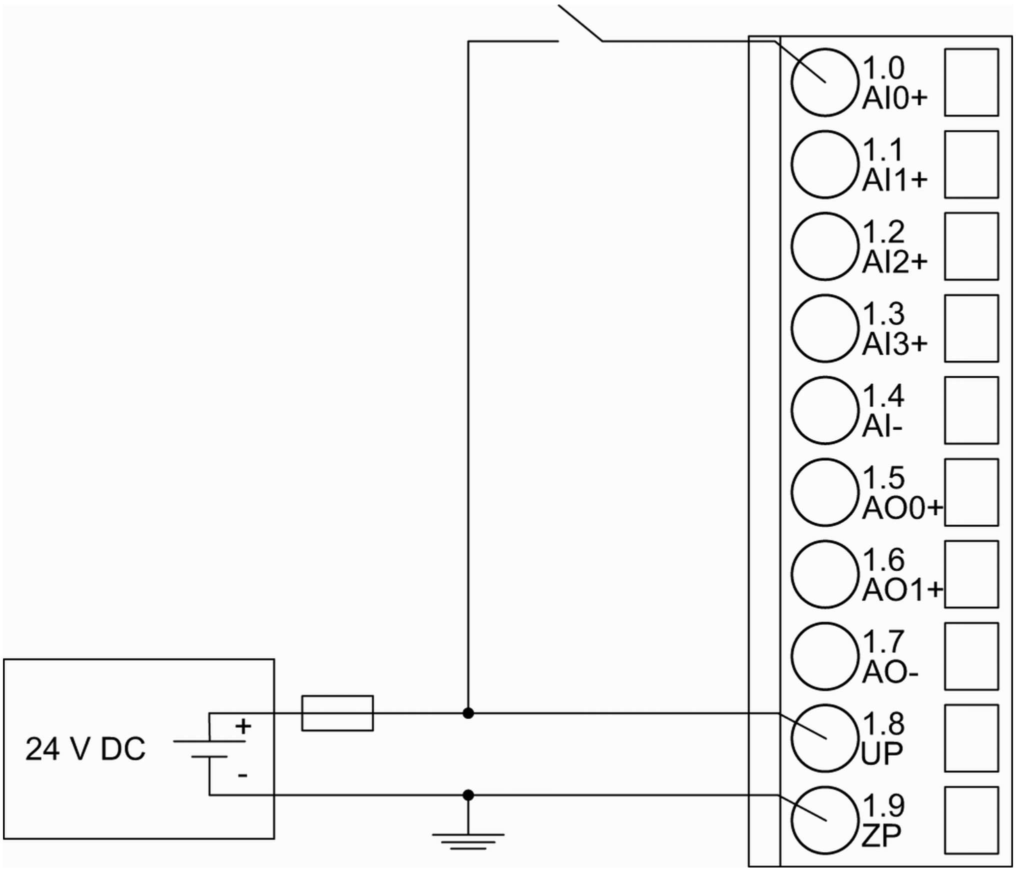


Fig. 182: Use of analog inputs as digital inputs

The following measuring ranges can be configured ↻ *Chapter 1.7.4.1.7 “Parameterization” on page 899* and ↻ *Chapter 1.7.4.1.9 “Measuring Ranges” on page 911* :

Digital input	24 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↻ *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*.

Connection of Analog Output Loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

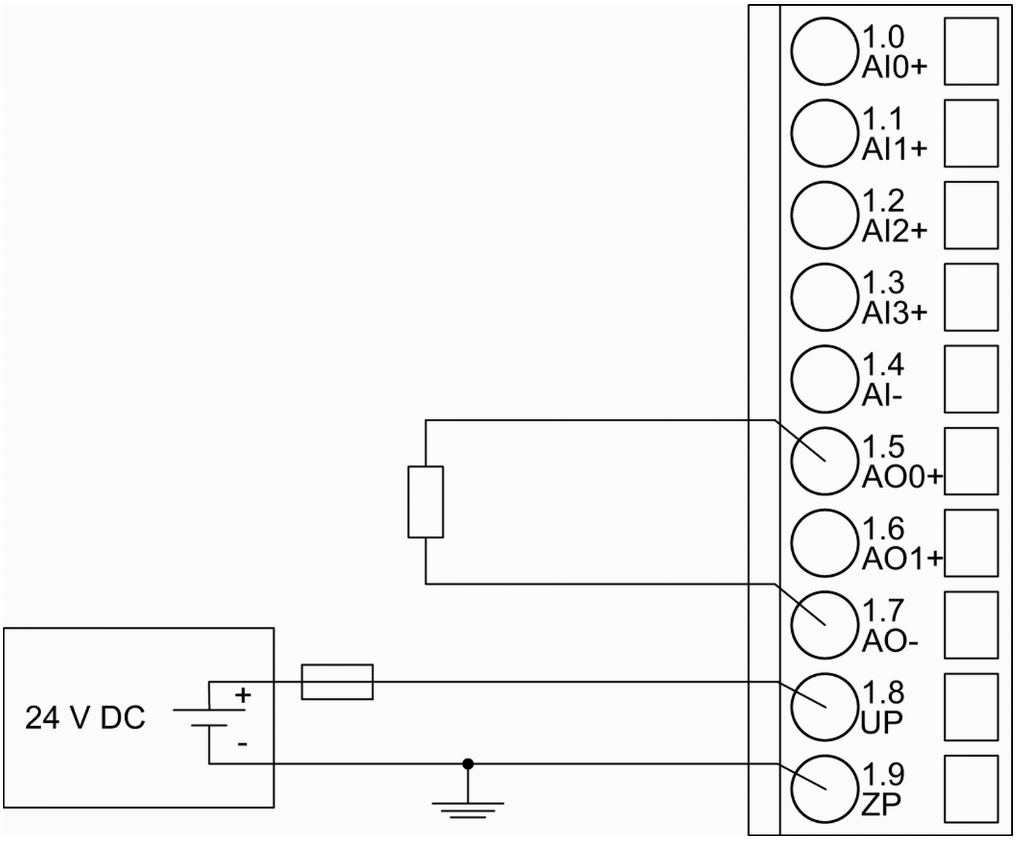


Fig. 183: Connection of analog output loads (voltage)

The following measuring ranges can be configured ✎ *Chapter 1.7.4.1.7 “Parameterization” on page 899* and ✎ *Chapter 1.7.4.1.9 “Measuring Ranges” on page 911*

Voltage	-10 V...+10 V	Load ±10 mA max.	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ✎ *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*.

Unused analog outputs can be left open-circuited.

Connection of Analog Output Loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

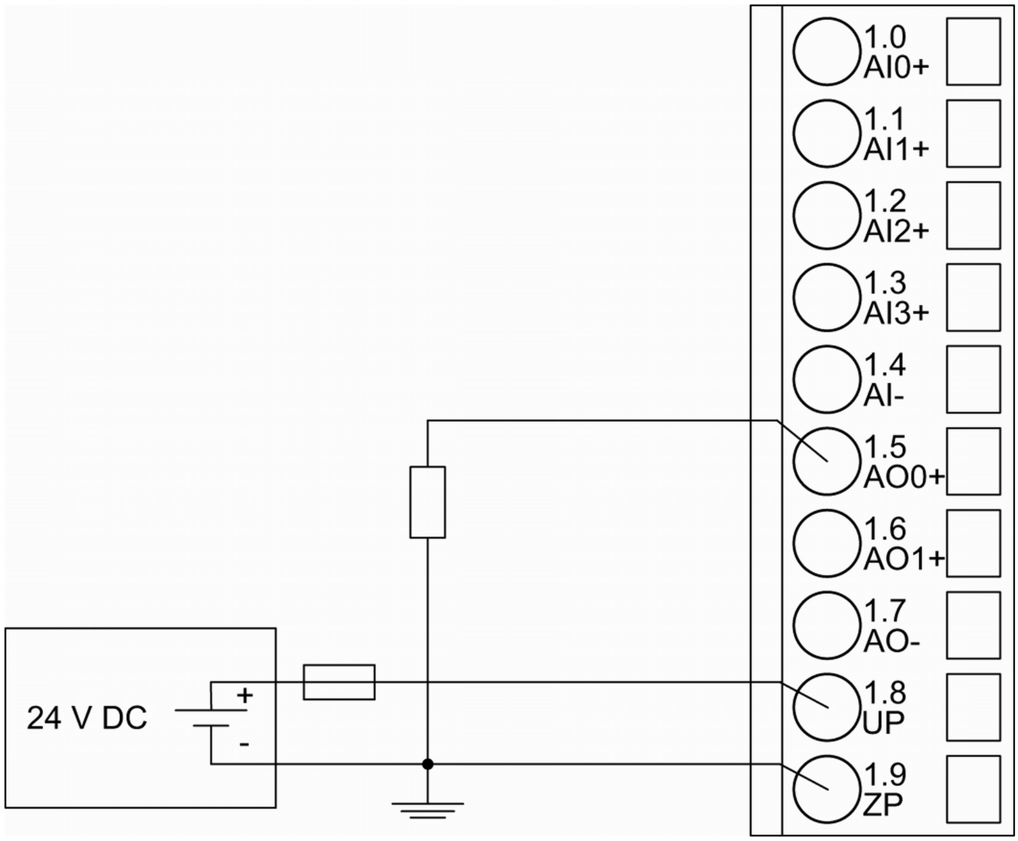


Fig. 184: Connection of analog output loads (current)

The following measuring ranges can be configured ↳ *Chapter 1.7.4.1.7 “Parameterization” on page 899* and ↳ *Chapter 1.7.4.1.9 “Measuring Ranges” on page 911*:

Current	0...20 mA	Load 0...500 Ω	1 channel used
Current	4...20 mA	Load 0...500 Ω	1 channel used

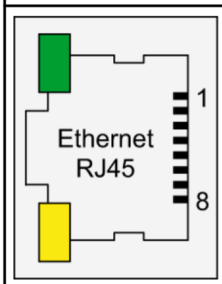
The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*.

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet Ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Table 140: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used

Interface	Pin	Signal	Description
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet *⇨ Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.*

1.7.4.1.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

1.7.4.1.5 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

The IP address of the CI521-MODTCP Module can be set with the *“ABB IP Configuration Tool”*.

If the last byte of the IP is set to 0, the address switch will be used instead.

Address switch position 255 is mapped to fixed IP 192.168.0.254 independent of other stored settings. This is a backup so the module can always get a valid IP address and can be configured by the “ABB IP Configuration Tool”.

Address switch position 0 is mapped to last byte equal 1 and DHCP enabled.

The factory setting for the IP is 192.168.0.x (last byte is address switch).

1.7.4.1.6 I/O Configuration

The CI521-MODTCP stores configuration parameters (IP address configuration, module parameters).

The analog/digital I/O channels are configured via software.

Details about configuration are described in Parameterization *⇨ Chapter 1.7.4.1.7 “Parameterization” on page 899*.

1.7.4.1.7 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7400	WORD	7000
Ignore Module	Internal	0	BYTE	0
Parameter length	Internal	63	BYTE	63
Error LED / Fail-safe function see table Error LED / Failsafe function *Table 141 "Error LED / Failsafe function" on page 900*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Timeout for Bus supervision	No supervision 10 ms timeout 20 ms timeout	0 1 2	BYTE	No supervision
IO Mapping Structure [3])	Fixed Mapping Dynamic Mapping	0 1	BYTE	0
Reserved	Internal	0	ARRAY[0..2] OF BYTE	0,0,0

Name	Value	Internal value	Internal value, type	Default
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [3])	0 : 10	BYTE	0

[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission.

[2]) Counter operating modes, see description of the *Fast Counter*.

[3]) Fixed Mapping means each module has its own Modbus registers for data transfer independent of the IO bus constellation. See *Modbus TCP Registers* description for details.

Dynamic mapping means the structure of the IO Date is dependent on the I/O bus constellation. Each I/O bus expansion module starts directly after the module before on the next Word adress.

[4]) If none of the parameters is set all masters / clients in the network have read and write rights on the CI52x-MODTCP device and its connected expansion modules.

If at least one parameter is set only the configured masters / clients have write rights on the CI52x-MODTCP device, all other masters / clients still have read access to the CI52x-MODTCP device.

Table 141: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)

*) The parameters Behaviour AO at comm. error and Behaviour DO at comm. error are only analyzed if the Failsafe-mode is ON.

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.				

Channel Parameters for the Analog Inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Table Operating modes of the analog inputs *Table 142 “Channel Configuration” on page 902*	Table Operating modes of the analog inputs *Table 142 “Channel Configuration” on page 902*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 143 “Channel Monitoring” on page 902*	Table Channel montoring *Table 143 “Channel Monitoring” on page 902*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 142 “Channel Configuration” on page 902*	Table Operating modes of the analog inputs *Table 142 “Channel Configuration” on page 902*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 143 “Channel Monitoring” on page 902*	Table Channel montoring *Table 143 “Channel Monitoring” on page 902*	BYTE	0

Table 142: Channel Configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0...10 V
2	Digital input
3	0...20 mA
4	4...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50...+400 °C
9	3-wire Pt100 -50...+400 °C *)
10	0...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50...+70 °C
15	3-wire Pt100 -50...+70 °C *)
16	2-wire Pt1000 -50...+400 °C
17	3-wire Pt1000 -50...+400 °C *)
18	2-wire Ni1000 -50...+150 °C
19	3-wire Ni1000 -50...+150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 143: Channel Monitoring

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel Parameters for the Analog Outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Table Operating modes of the analog outputs *Table 144 "Channel Configuration" on page 903*	Table Operating modes of the analog outputs *Table 144 "Channel Configuration" on page 903*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 145 "Channel Monitoring" on page 903*	Table Channel monitoring *Table 145 "Channel Monitoring" on page 903*	BYTE	0

Name	Value	Internal value	Internal value, type	Default
Output 0, Substitute value	Table Substitute value *Table 146 "Substitute Value" on page 903*	Table Substitute value *Table 146 "Substitute Value" on page 903*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs *Table 144 "Channel Configuration" on page 903*	Table Operating modes of the analog outputs *Table 144 "Channel Configuration" on page 903*	BYTE	0
Output 1, Check channel	Table Channel monitoring *Table 145 "Channel Monitoring" on page 903*	Table Channel monitoring *Table 145 "Channel Monitoring" on page 903*	BYTE	0
Output 1, Substitute value	Table Substitute value *Table 146 "Substitute Value" on page 903*	Table Substitute value *Table 146 "Substitute Value" on page 903*	WORD	0

Table 144: Channel Configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V...+10 V
129	0...20 mA
130	4...20 mA

Table 145: Channel Monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 146: Substitute Value

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01
Behaviour DO at comm. error [1])	Off	0	BYTE	Off
	Last value	1		0x00
	Last value 5 sec	6		
	Last value 10 sec	11		
	Substitute value	2		
	Substitute value 5 sec	7		
	Substitute value 10 sec	12		
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000
Detect voltage overflow at outputs [2])	Off	0	BYTE	On
	On	1		0x01

[1]) The parameters Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.

[2]) The state "externally voltage detected" appears, if the output of a channel DC0..DC7 should be switched on while an externally voltage is connected *Chapter 1.7.4.1.3 “Electrical Connection” on page 881*. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".

1.7.4.1.8 Diagnosis and State LEDs

Structure of the Diagnosis Block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI521-MODTCP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

For diagnosis firmware version ≥ 3.2.6 is required.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6..7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0..5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error- Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	No process voltage UP	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6..7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0..5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
4	-	1...10	31	5	8	I/O module removed from hot-swap terminal unit or defective module on hot-swap ter-minal unit [9])	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot-swap terminal unit [9])	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot-swap terminal unit [9])	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])	Power off system and replace I/O module
4	-	1...10	31	6	42	No communication with hot-swap ter-minal unit [9])	Restart, if error persists replace terminal unit
4	-	31	31	31	46	Voltage feedback on activated digital outputs DO0...DO7 on UP3 [4])	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	No process voltage UP3	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Externally voltage detected at digital output DO0...DO7 [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7])	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0..1	4	Analog value over-flow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI521-MODTCP diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself; 1..10 = Expansion module
3)	With "Module" the following allocation applies: 31 = Module itself Module type (1 = AI, 2 = DO, 3 = AO)
4)	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage ➮ *Chapter 1.7.4.1.3 “Electrical Connection” on page 881*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
5)	The voltage on digital outputs DO0...DO7 has overrun the process supply voltage UP3 ➮ *Chapter 1.7.4.1.3 “Electrical Connection” on page 881*. Diagnosis message appears for the whole module.
6)	This message appears, if the output of a channel DO0...DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
7)	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
8)	In case of an I/O module doesn’t support hot swapping, do not perform any hot-swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
9)	Diagnosis for hot swap available as of version index F0.

State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 147: States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	Device configured, acyclic data exchange running

LED	Color	OFF	ON	Flashing
	Red	---	Communication error (timeout) appeared	IP address error
STA2 ETH (System LED "SF")	Green	Device has valid parameters	Device is running parameterization sequenze	Device has no parameters
	Red	---	---	Device has invalid parame-ters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules con-nected or com-munication error	Expansion mod-ules connected and operational	---
ETH1	Green	No connection at Ethernet inter-face	Connected to Ethernet inter-face	---
	Yellow	---	Device is trans-mitting telegrams	Device is trans-mitting telegrams
ETH2	Green	No connection at Ethernet inter-face	Connected to Ethernet inter-face	---
	Yellow	---	Device is trans-mitting telegrams	Device is trans-mitting telegrams

Table 148: States of the 27 Process LEDs

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--

LED	Color	OFF	ON	Flashing
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.4.1.9 Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
Normal range or measured value too low	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	Hex.
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high		450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	Hex.
			160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
	80.0 °C : 70.1 °C			800 : 701	0320 : 02BD
Normal range	70.0 °C : 0.1 °C	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
Normal range	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.7.4.1.10 Technical Data

The System Data of AC500 and S500 ✎ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ✎ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Ethernet		10/100 base-TX, internal switch, 2 x RJ45 socket

Parameter	Value
Setting of the IP address	With ABB IP config tool and 2 rotary switches at the front side of the module
Diagnose	See Diagnosis and Displays ⇨ *Chapter 1.7.4.1.8 “Diagnosis and State LEDs” on page 905*
Operation and error displays	32 LEDs (totally)
Weight (without terminal unit)	Ca. 125 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Extended ambient temperature (XC version)	> 60 °C on request
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 to DI7		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 to DO7		Terminals 3.0 to 3.7
Reference potential for all outputs		Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

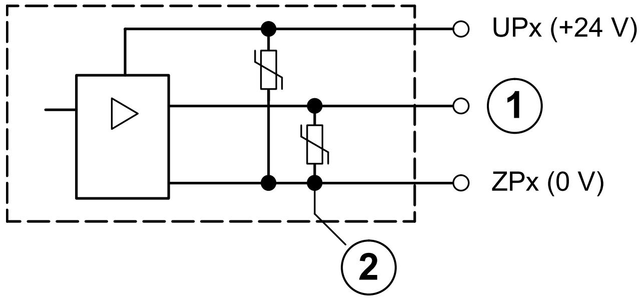


Fig. 185: Digital input/output (circuit diagram)

1 Digital Output
2 Varistors for demagnetization when inductive loads are turned off

Technical Data of the Analog Inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 1.0 to1.3
Reference potential for AI0+ to AI3+		Terminal 1.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9 and 3.9 for current measurement
Input type		
	Unipolar	Voltage 0 ... 10 V, current or Pt100/Pt1000/Ni1000
	Bipolar	Voltage -10 ... +10 V
Electrical isolation		Against Ethernet network
Configurability		0...10 V, -10...+10 V, 0/4...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution		Range 0...10 V: 12 bits Range -10...+10 V: 12 bits + sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	Tables Input ranges voltage, current and digital input ✎ *Chapter 1.7.4.1.9.1 “Input Ranges Voltage, Current and Digital Input” on page 911* and Input range resistor ✎ *Chapter 1.7.4.1.9.2 “Input Range Resistor” on page 911*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical Data of the Analog Inputs if used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 1.0 to 1.3
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 1.5...1.6
Reference potential for AO0+ to AO1+		Terminal 1.7 (AO-) for voltage outputTerminal 1.9, 2.9 and 3.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Electrical isolation		Against internal supply and other modules
Configurability		-10...+10 V, 0...20 mA, 4...20 mA (each output can be configured individually)
Output resistance (load), as current output		0...500 Ω

Parameter	Value
Output loadability, as voltage output	±10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Table Output ranges voltage and current *Chapter 1.7.4.1.9.3 “Output Ranges Voltage and Current” on page 912*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 2.0 (DI0), 2.1 (DI1)
Used outputs	Terminal 3.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

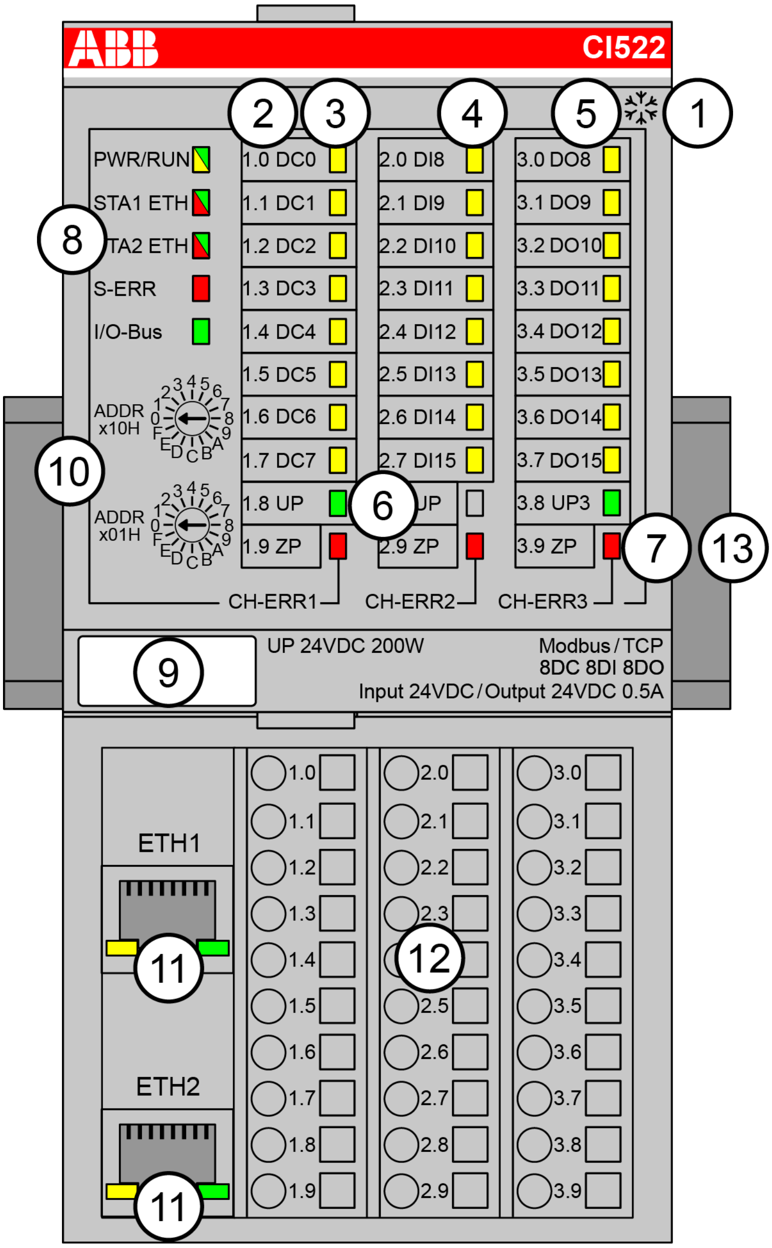
1.7.4.1.11 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 222 100 R0001	CI521-MODTCP, Modbus TCP bus module, 4 AI, 2 AO, 8 DI and 8 DO	Active
1SAP 422 100 R0001	CI521-MODTCP-XC, Modbus TCP bus module, 4 AI, 2 AO, 8 DI and 8 DO, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.4.2 CI522-MODTCP

- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- Module-wise electrically isolated
- Fast Counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 - DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 - DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 - DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the IP address

11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.4.2.1 Intended Purpose

Modbus TCP bus module CI522-MODTCP is used as decentralized I/O module in Modbus TCP networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The bus module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0...1.7)
- 8 digital inputs 24 VDC in 1 group (2.0...2.7)
- 8 digital outputs 24 VDC in 1 group (3.0...3.7)

The inputs/outputs are electrically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.4.2.2 Functionality

Interface	Ethernet
Protocol	Modbus TCP
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	for setting the last BYTE of the IP ADDRESS (00h to FFh)
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 VDC; delay time configurable via software)
Digital outputs	8 (24 VDC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Required terminal unit	TU507 or TU508 *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*

1.7.4.2.3 Electrical Connection

The Ethernet bus module CI522-MODTCP is plugged on the I/O terminal unit TU507-ETH *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144* or TU508-ETH *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ⇨ Chapter 2.6 “AC500 (Standard)” on page 1252.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 VDC

Terminal 3.8: Process supply voltage UP3 = +24 VDC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Conditions for undisturbed operating with older I/O expansion modules

All I/O expansion modules that are attached to the CI52x-MODTCP must be powered up together with the CI52x-MODTCP if the firmware version of these I/O expansion modules is V1.9 or lower.

The firmware version is related to the index. The index is printed on the module type label on the right side.

Modules as of index listed in the following table can be powered up independently.

S500 I/O module type	First index with firmware version above 1.9
AI523	D0
AI523-XC	D0
AI531	A3
AI531-XC	A0
AO523	D0
AO523-XC	D0
AX521	D0
AX521-XC	D0
AX522	D0
AX522-XC	D0
CD522	A2
CD522-XC	A0
DA501	A2
DA501-XC	A0
DA502	A1
DA502-XC	A1
DC522	D0
DC522-XC	D0
DC523	D0

S500 I/O module type	First index with firmware version above 1.9
DC523-XC	D0
DC532	D0
DC532-XC	D0
DI524	D0
DI524-XC	D0
DO524	A2
DO524-XC	A2
DX522	D0
DX522-XC	D0
DX531	D0
AC522	D0
PD501	D0

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0...DC7 or DO8...DO15 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

This limitation does not apply for the input channels DI0..DI7.

CAUTION!

Risk of malfunction by not intended usage!

If the function cut off of the digital outputs should be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO8...DO15 and DC0...DC7.

The assignment of the other terminals:

Terminal	Signal	Description
1.0	DC0	Signal of the configurable digital input/output DC0
1.1	DC1	Signal of the configurable digital input/output DC1
1.2	DC2	Signal of the configurable digital input/output DC2
1.3	DC3	Signal of the configurable digital input/output DC3
1.4	DC4	Signal of the configurable digital input/output DC4
1.5	DC5	Signal of the configurable digital input/output DC5

Terminal	Signal	Description
1.6	DC6	Signal of the configurable digital input/output DC6
1.7	DC7	Signal of the configurable digital input/output DC7
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	DO8	Signal of the digital output DO8
3.1	DO9	Signal of the digital output DO9
3.2	DO10	Signal of the digital output DO10
3.3	DO11	Signal of the digital output DO11
3.4	DO12	Signal of the digital output DO12
3.5	DO13	Signal of the digital output DO13
3.6	DO14	Signal of the digital output DO14
3.7	DO15	Signal of the digital output DO15
3.8	UP3	Process voltage UP3 (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

- Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
- Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the Ethernet bus module CI522-MODTCP.

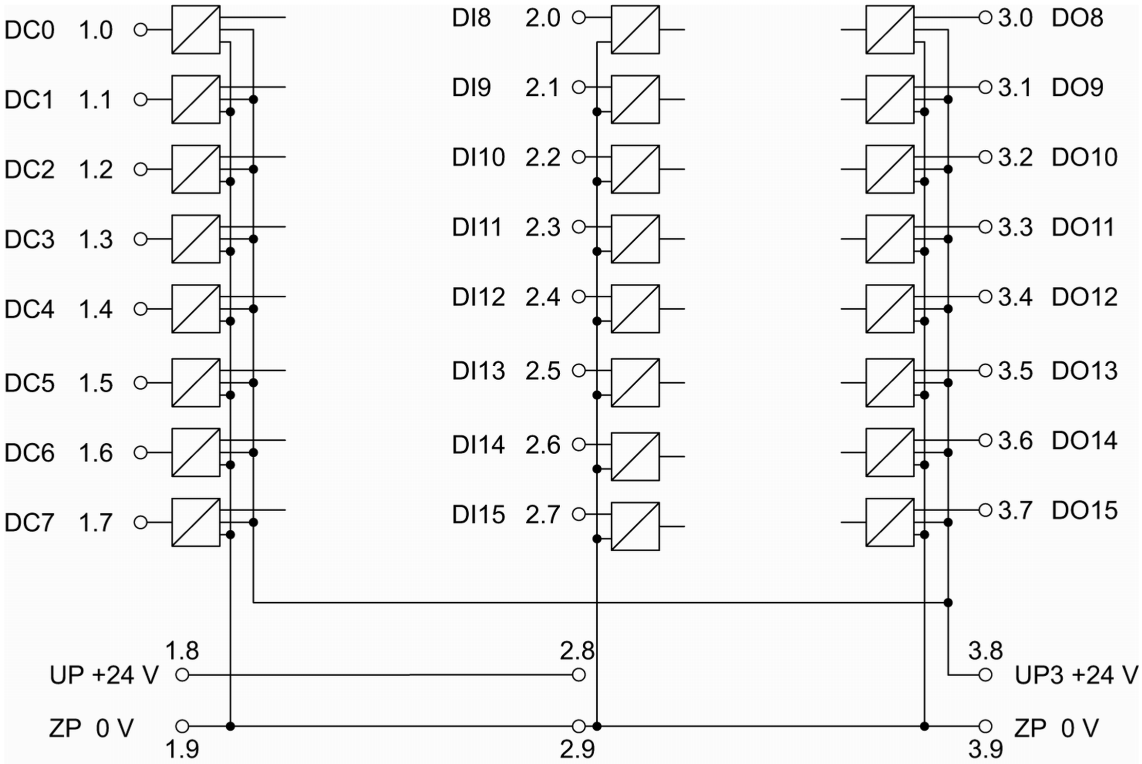


Fig. 186: Connection of the bus module CI522-MODTCP

Further information is provided in the System Technology chapter *CI52x-MODTCP*.

Connection of the Digital Inputs

The following figure shows the electrical connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.

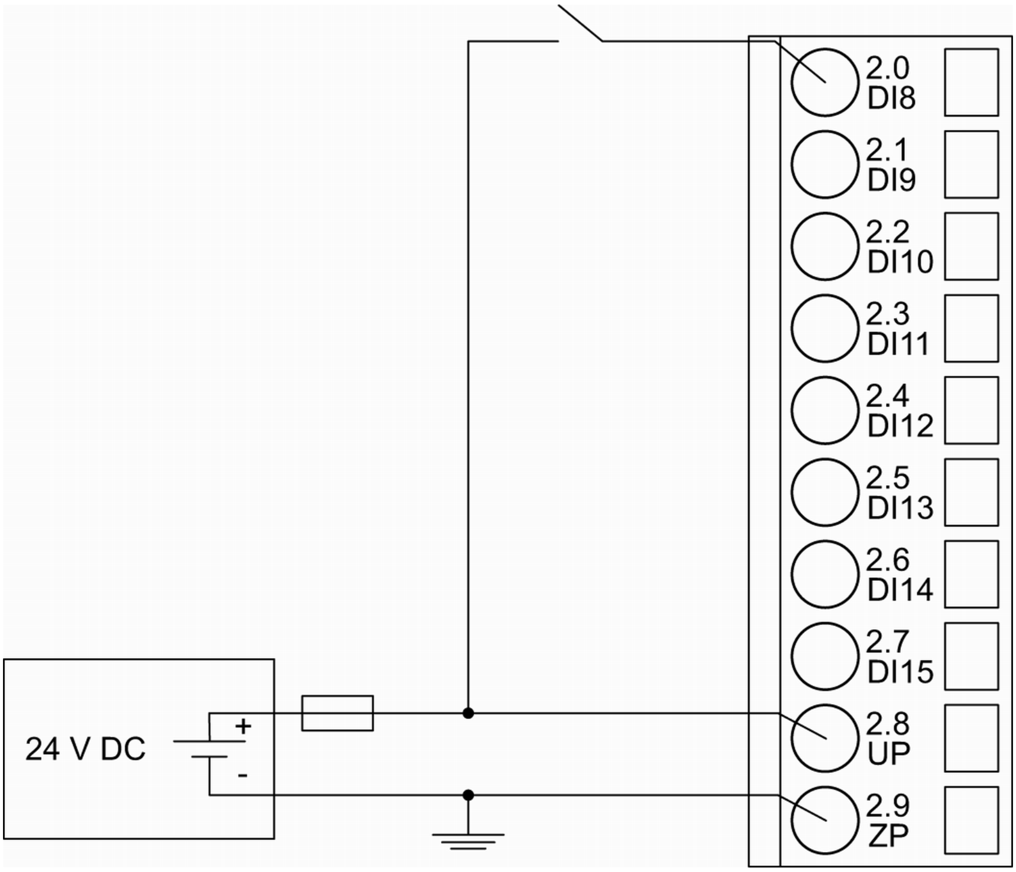
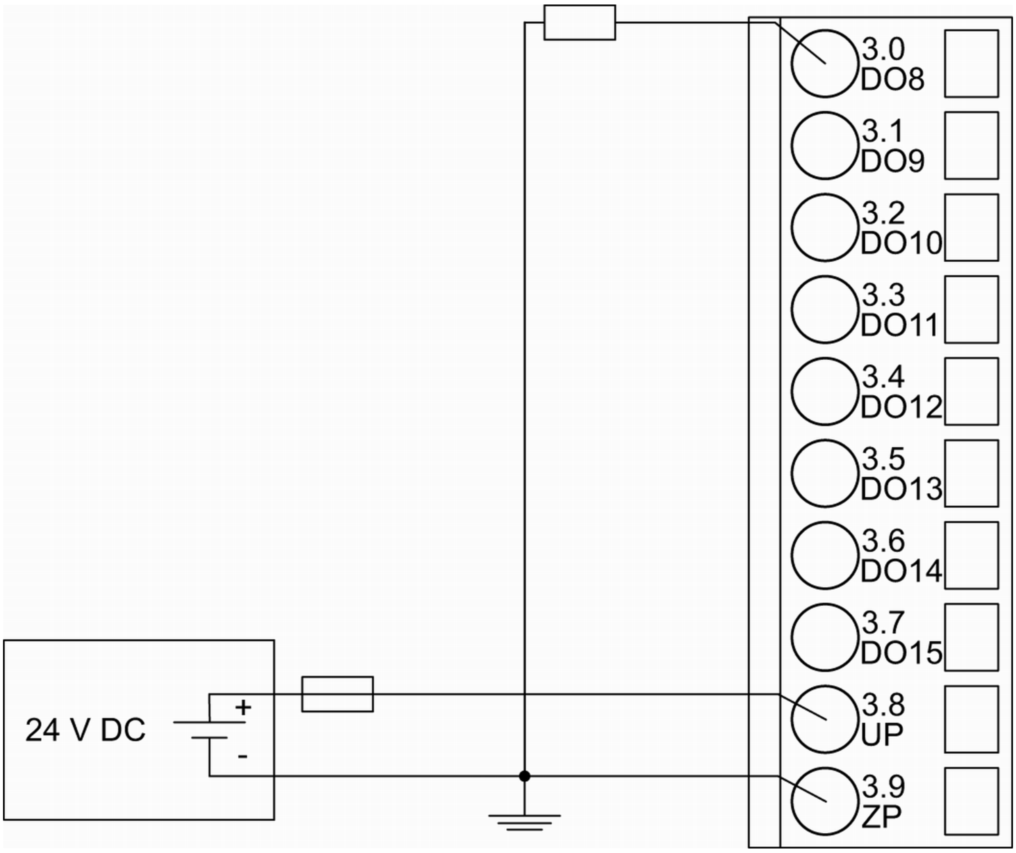


Fig. 187: Connection of the digital inputs to the module CI522-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.7.4.2.8.1 “State LEDs” on page 936*.

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.



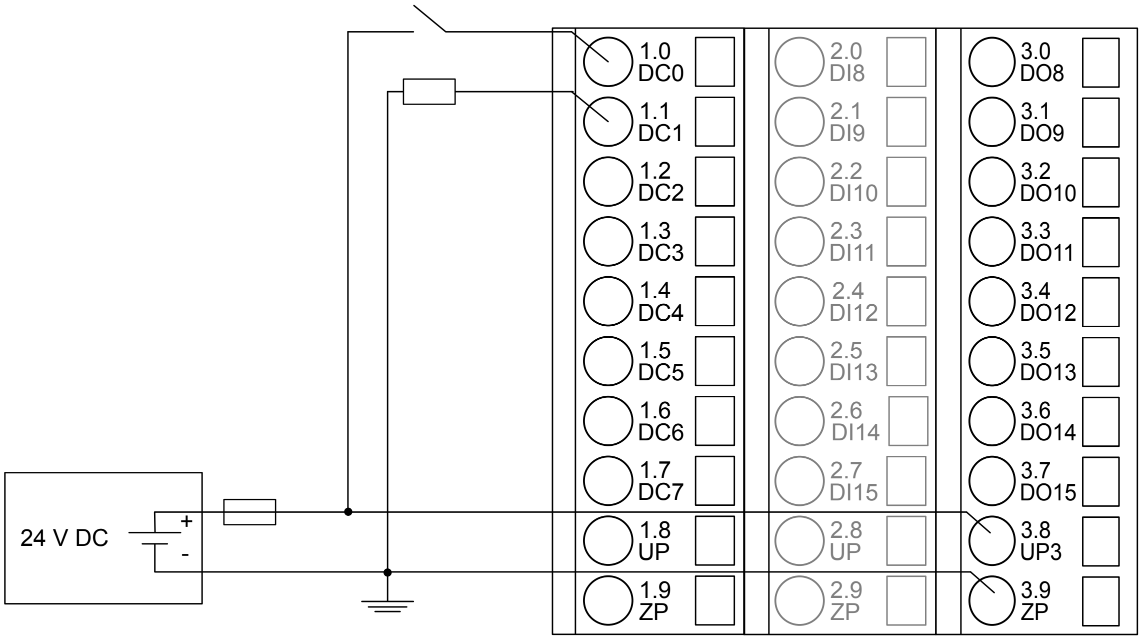
The meaning of the LEDs is described in Displays *Chapter 1.7.4.2.8.1 “State LEDs” on page 936*.

Connection of the configurable Digital Inputs/Outputs

The following figure shows the electrical connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 to DC7 in the same way.

CAUTION!

If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device *Chapter 1.7.4.2.3 “Electrical Connection” on page 920*.

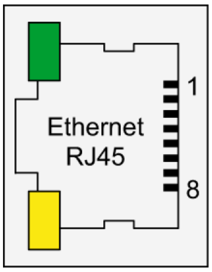


The meaning of the LEDs is described in Displays *Chapter 1.7.4.2.8.1 “State LEDs” on page 936*.

Assignment of the Ethernet Ports

The terminal unit for the Communication Interface Module provides two Ethernet interfaces with the following pin assignment:

Table 149: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet *Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.*

1.7.4.2.4 Internal Data Exchange

Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.7.4.2.5 Addressing

The IP address of the CI5221-MODTCP Module can be set with the *“ABB IP Configuration Tool”*.

If the last byte of the IP is set to 0, the address switch will be used instead.

Address switch position 255 is mapped to fixed IP 192.168.0.254 independent of other stored settings. This is a backup so the module can always get a valid IP address and can be configured by the “ABB IP Configuration Tool”.

Address switch position 0 is mapped to last byte equal 1 and DHCP enabled.

The factory setting for the IP is 192.168.0.x (last byte is address switch).

> *The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.*

1.7.4.2.6 I/O Configuration

The CI522-MODTCP stores configuration parameters (IP address configuration, module parameters).

The digital I/O channels are configured via software.

Details about configuration are described in Parameterization ➥ *Chapter 1.7.4.2.7 “Parameterization” on page 928*.

1.7.4.2.7 Parameterization

Parameters of the Module

Name	**Value**	**Internal value**	**Internal value, type**	**Default**
Module ID [1])	Internal	7405	WORD	7405
Ignore Module	Internal	0	BYTE	0
Parameter length	Internal	47	BYTE	47
Error LED / Failsafe function (Table Error LED / Failsafe function ➥ *Table 150 “ Table Error LED / Failsafe function” on page 930*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	19		

Name	Value	Internal value	Internal value, type	Default
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Timeout for Bus supervision	No supervision 10 ms timeout 20 ms timeout	0 1 2	BYTE	No supervision
IO Mapping Structure [3])	Fixed Mapping Dynamic Mapping	0 1	BYTE	0
Reserved	Internal	0	ARRAY[0..2] OF BYTE	0,0,0
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [2])	0 : 10	BYTE	0

Remarks:

[1])	With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.
[2])	Counter operating modes *Chapter 1.5.1.2.10 “Fast Counter” on page 396*

3)	Fixed Mapping means each module has its own Modbus registers for data transfer independent of the I/O bus constellation. See *Modbus TCP Registers* description for details. Dynamic mapping means the structure of the IO Date is dependent on the I/O bus constellation. Each I/O bus expansion module starts directly after the module before on the next Word adress.
4)	If none of the parameters is set all masters / clients in the network have read and write rights on the CI52x-MODTCP device and its connected expansion modules. If at least one parameter is set only the configured masters / clients have write rights on the CI52x-MODTCP device, all other masters / clients still have read access to the CI52x-MODTCP device.

Table 150: Table Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.	

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0..DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0...DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0...DC7 and accordingly DO8...DO15 has exceeded the process supply voltage UP3 *Chapter 1.7.4.2.3 "Electrical Connection" on page 920* (see description in section). The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage.

1.7.4.2.8 Diagnosis

Structure of the Diagnosis Block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI502-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error
6	Reserved	0

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

For diagnosis firmware version ≥ 3.2.6 is required.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization

E1..E4	d1	d2	d3	d4	Identi-fier 000..063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 4 Bit 6..7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0..5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error-Identi-fier	Error message	Remedy
	[1])	[2])	[3])				
4	-	1...10	31	5	8	I/O module removed from hot-swap terminal unit or defective module on hot-swap ter-minal unit [9])	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot-swap terminal unit [9])	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot-swap terminal unit [9])	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])	Power off system and replace I/O module
4	-	1...10	31	6	42	No communication with hot-swap ter-minal unit [9])	Restart, if error persists replace terminal unit
4	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work	Check cabeling
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
4	-	31	31	31	46	Reverse voltage from digital outputs DO8...DO15 to UP3 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) 5)	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8..15	46	Externally voltage detected at digital output DO8...DO15 6)	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0...DC7 6)	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output 7)	Check terminals

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI502-PNIO diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself, 1..10 = Expansion module
3)	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
4)	This message appears, if externally voltages at one or more terminals DC0...DC7 oder DO8...DO15 cause that other digital outputs are supplied through that voltage (voltage feedback, see description in Electrical Connection *Chapter 1.7.4.2.3 "Electrical Connection" on page 920*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
5)	The voltage at digital outputs DC0...DC7 and accordingly DO8...DO15 has exceeded the process supply voltage UP3 *Chapter 1.7.4.2.3 "Electrical Connection" on page 920*. Diagnosis message appears for the whole module.
6)	This message appears, if the output of a channel DC0...DC7 or DO8...DO15 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
7)	Short circuit: After a detected short circuit, the output is deactivated for 2000ms. Then a new start up will be executed. This diagnosis message appears per channel.
8)	In case of an I/O module doesn't support hot swapping, do not perform any hot-swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
9)	Diagnosis for hot swap available as of version index F0.

State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 151: States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	Device configured, acyclic data exchange running

LED	Color	OFF	ON	Flashing
	Red	---	Communication error (timeout) appeared	IP address error
STA2 ETH (System LED "SF")	Green	Device has valid parameters	Device is running parameterization sequenze	Device has no parameters
	Red	---	---	Device has invalid parameters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 152: States of the 29 Process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.4.2.9 Technical Data

The System Data of AC500 and S500 ✎ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Ethernet		10/100 base-TX, internal switch, 2 x RJ45 socket
Setting of the IO Device identifier		With 2 rotary switches at the front side of the module
Diagnosis		See Diagnosis and Displays *Chapter 1.7.4.2.8 “Diagnosis” on page 931*
Operation and error displays		34 LEDs (totally)
Weight (without Terminal Unit)		Ca. 125 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40°C per group)
Extended ambient temperature (XC version)		> 60 °C on request
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI8 to DI15		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO8 to DO15		Terminals 3.0 to 3.7
Reference potential for all outputs		Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

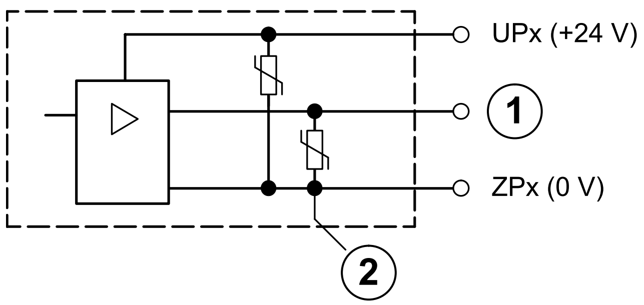


Fig. 188: Digital input/output (circuit diagram)

1 Digital Output
2 Varistors for demagnetization when inductive loads are turned off

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0...DC7	Terminals 1.0...1.7
If the channels are used as outputs		
	Channels DC0...DC7	Terminals 1.0...1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Electrical isolation		From the Ethernet network

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 to DC7		Terminals 1.0 to 1.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V *)
	Undefined Signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V *)
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 to DC7		Terminals 1.0 to 1.7
Reference potential for all outputs		Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0,8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

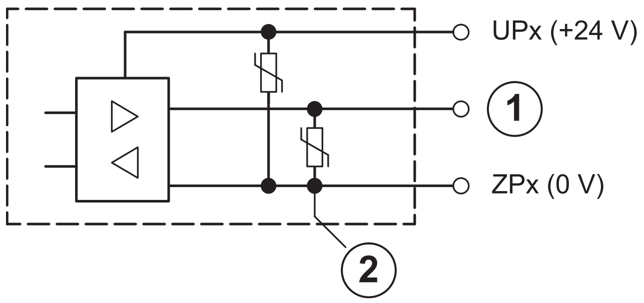


Fig. 189: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 2.0 (DI8),Terminal 2.1 (DI9)
Used outputs	Terminal 3.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

1.7.4.2.10 Ordering Data

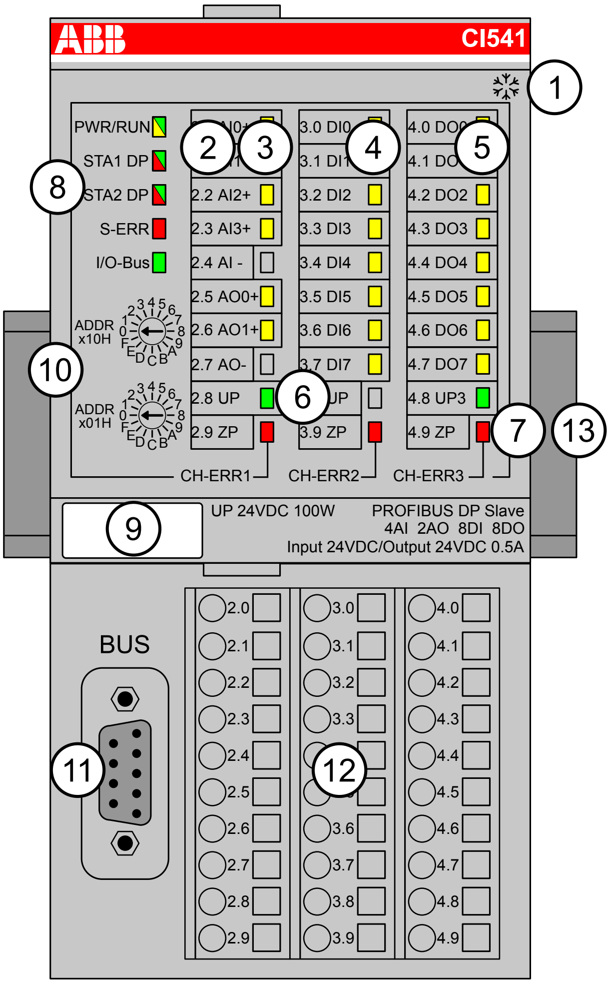
Ordering No.	Scope of delivery	Product Life Cycle Phase *)
1SAP 222 200 R0001	CI522-MODTCP, Modbus TCP bus module, 8 DC, 8 DI and 8 DO	Active
1SAP 422 200 R0001	CI522-MODTCP-XC, Modbus TCP bus module, 8 DC, 8 DI and 8 DO, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.5 PROFIBUS

1.7.5.1 CI541-DP

- 4 configurable analog inputs (2-wire/single-ended) or 2 configurable analog inputs (3-wire/differential)
  Resolution 12 bits plus sign
- 2 analog outputs
  Resolution 12 bits plus sign
- 8 digital inputs 24 VDC in 1 group
- 8 digital outputs 24 VDC in 1 group, 0.5 A max.
- Fast counter
- Module-wise electrically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 - AI3, AO0 - AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 - DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 - DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 DP, STA2 DP, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the PROFIBUS ID
11 9-pole D-SUB connector to connect the PROFIBUS DP signals

12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.5.1.1 Intended Purpose

The PROFIBUS DP bus module is used as decentralized I/O module in PROFIBUS DP networks. Depending on the used terminal unit the network connection is performed either via 9-pole female D-SUB connector or via 10 terminals (screw-type or spring terminals) which are integrated in the terminal unit. The bus module contains 22 I/O channels.

The inputs/outputs are electrically isolated from the PROFIBUS DP network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

- 4 configurable analog inputs (2-wire/single-ended) or 2 configurable analog inputs (3-wire/differential)
  Resolution 12 bits plus sign
- 2 analog outputs
  Resolution 12 bits plus sign
- 8 digital inputs 24 VDC in 1 group
- 8 digital outputs 24 VDC in 1 group, 0.5 A max.
- Fast counter
- Module-wise electrically isolated
- XC version for usage in extreme ambient conditions available

1.7.5.1.2 Functionality

Parameter	Value
Interface	PROFIBUS
Protocol	PROFIBUS DP (DP-V0 and DP-V1)
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	For setting the PROFIBUS ID for configuration purposes (00h to FFh)
Fast counter	Integrated, configurable operating modes
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU509, TU510, TU517 or TU518 *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148* *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157*

1.7.5.1.3 Electrical Connection

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter ➪ Chapter 2.6 “AC500 (Standard)” on page 1252.

The PROFIBUS DP bus module CI541-DP is plugged on the I/O terminal units TU509 ➪ *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148* or TU510 ➪ *Chapter 1.4.2 “TU509 and TU510 for Communication Interface Modules” on page 148* and accordingly TU517 ➪ *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157* or TU518 ➪ *Chapter 1.4.4 “TU517 and TU518 for Communication Interface Modules” on page 157*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ➪ *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8 and 3.8 as well as 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 2.8 and 3.8: Process supply voltage UP = +24 VDC

Terminal 4.8: Process supply voltage UP3 = +24 VDC

Terminals 2.9, 3.9 and 4.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

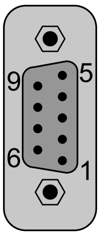
Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

CAUTION!
Risk of malfunction by not intended usage!
If the function cut off of the digital outputs should be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0..DO7.

Possibilities of Connection

Connection on Terminal Units TU509 or TU510

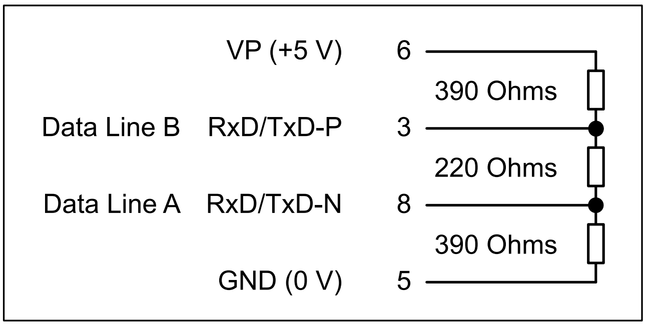
The assignment of the 9-pole female D-SUB connector for the PROFIBUS signals:



1	---	Reserved
2	---	Reserved
3	B	Data line B (receive and send line, positive)
4	---	Reserved
5	DGND	Reference potential for data transmissions and +5 V
6	VP (5 V)	+5 V (Power supply voltage for termination resistors)
7	---	Reserved
8	A	Data line A (receive and send line, negative)
9	---	Reserved
Shield	Shield	Shield, functional earth

Bus Termination

The line ends of the bus segment must be equipped with bus termination resistors. Normally, these resistors are integrated in the interface connectors.



The earthing of the shield should take place at the switch-gear cabinet, see System Data AC500 ➜ Chapter 2.6.1 “System Data AC500” on page 1252.

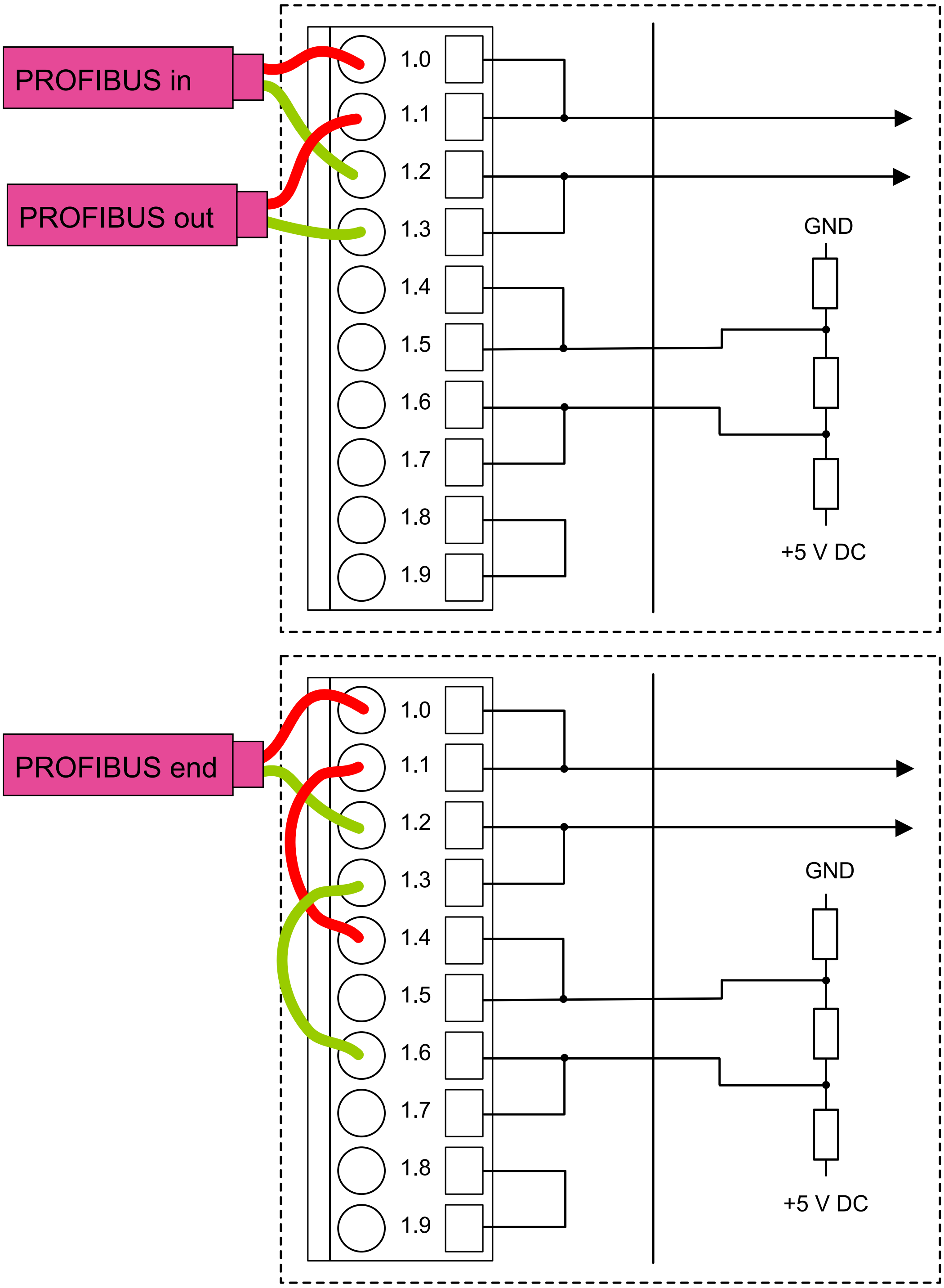
Mounting on Terminal Units TU517 or TU518

The assignment of the terminals 1.0 - 1.9:

Terminal	Signal	Description
1.0	B	Data line B (receive and send line, positive)
1.1	B	Data line B (receive and send line, positive)
1.2	A	Data line A (receive and send line, negative)
1.3	A	Data line A (receive and send line, negative)
1.4	TermB	Bus termination data line B
1.5	TermB	Bus termination data line B
1.6	TermA	Bus termination data line A

Terminal	Signal	Description
1.7	TermA	Bus termination data line A
1.8	DGND	Reference potential for data transmission
1.9	DGND	Reference potential for data transmission

At the line ends of a bus segment, termination resistors must be connected. If using TU517/TU518, the bus termination resistors can be enabled by connecting the terminals TermA and TermB to the data lines A and B (no external termination resistors are required, see illustration below).



If using TU517/TU518, note that the termination resistors are not located inside the TU, but inside the bus module CI541-DP. I. e. when removing the device from the TU, the bus termination resistors are not connected to the bus any more. The bus itself will not be disconnected if a device is removed.

If using TU517/TU518 the max. permitted baud rate is limited to 1.5 MBaud.

The earthing of the shield should take place at the switch-gear cabinet, see System Data AC500 *➪ Chapter 2.6.1 “System Data AC500” on page 1252.*

Technical Data Bus Cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135...165 Ω
Cable capacity	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm^2
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable Length

The maximum possible cable length of a PROFIBUS subnet within a segment depends on the baud rate (transmission rate).

Baud rate	Maximum cable length
9.6 kBaud to 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

The assignment of the other terminals:

Terminal	Signal	Description
2.0	AI0+	Plus pole of analog input signal 0
2.1	AI1+	Plus pole of analog input signal 1
2.2	AI2+	Plus pole of analog input signal 2
2.3	AI3+	Plus pole of analog input signal 3
2.4	AI-	Minus pole of analog input signals 0 to 3
2.5	AO0+	Plus pole of analog output signal 0

Terminal	Signal	Description
2.6	AO1+	Plus pole of analog output signal 1
2.7	AI-	Minus pole of analog output signals 0 and 1
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	DI0	Signal of the digital input DI0
3.1	DI1	Signal of the digital input DI1
3.2	DI2	Signal of the digital input DI2
3.3	DI3	Signal of the digital input DI3
3.4	DI4	Signal of the digital input DI4
3.5	DI5	Signal of the digital input DI5
3.6	DI6	Signal of the digital input DI6
3.7	DI7	Signal of the digital input DI7
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	DO0	Signal of the digital output DO0
4.1	DO1	Signal of the digital output DO1
4.2	DO2	Signal of the digital output DO2
4.3	DO3	Signal of the digital output DO3
4.4	DO4	Signal of the digital output DO4
4.5	DO5	Signal of the digital output DO5
4.6	DO6	Signal of the digital output DO6
4.7	DO7	Signal of the digital output DO7
4.8	UP3	Process voltage UP3 (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

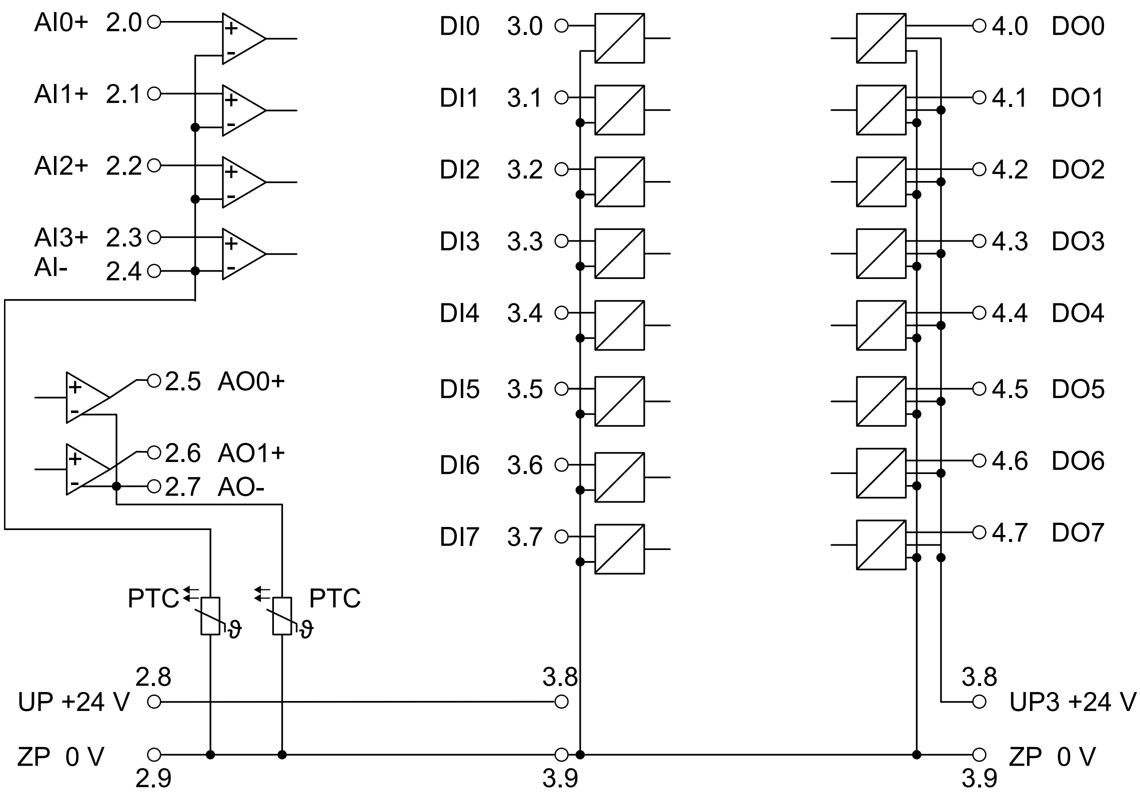
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (cut wire), each channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Analog signals are always laid in shielded cables. The cable shields are earthed at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

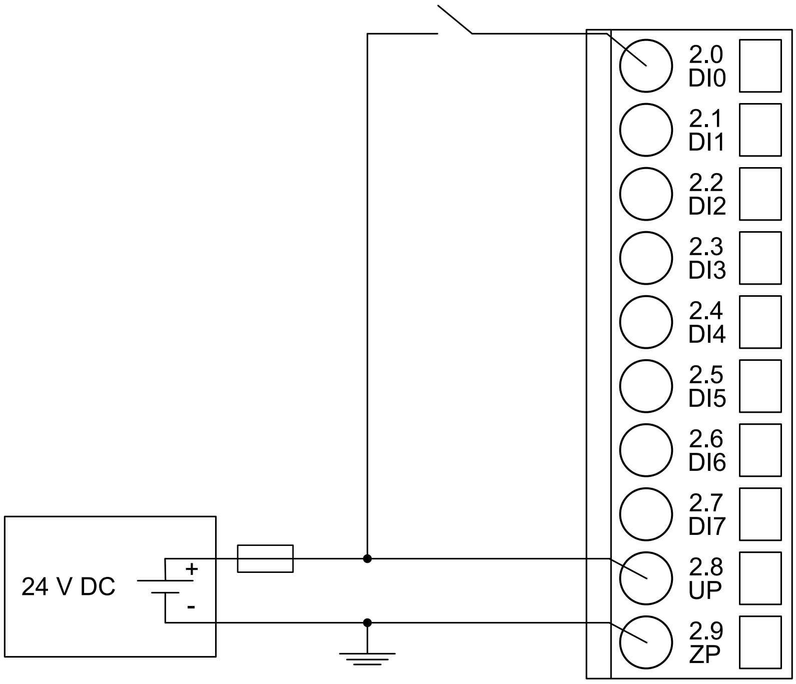
For simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figures show the electrical connection of the PROFIBUS DP bus module CI541-DP.



Connection of the Digital Inputs

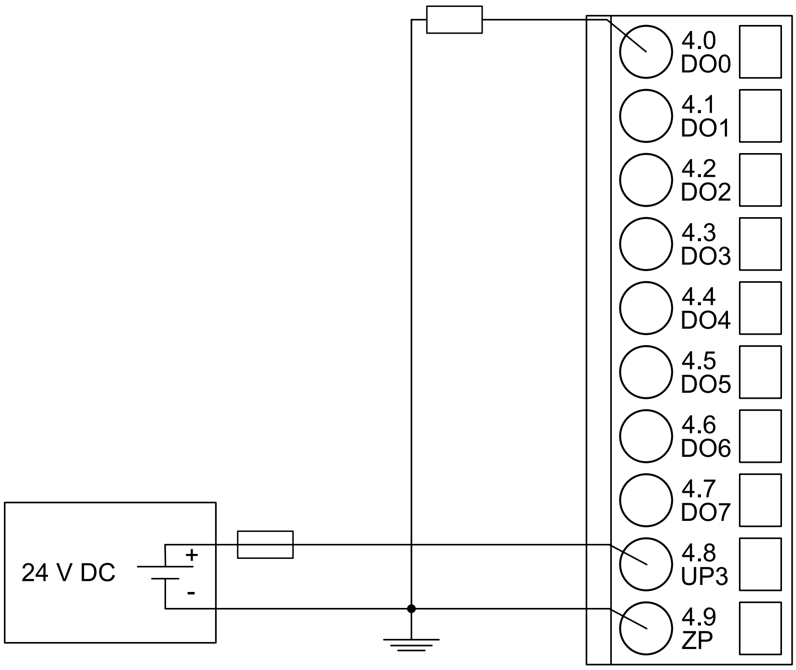
The following figure shows the electrical connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.



The meaning of the LEDs is described in Displays ↯ *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO0. Proceed with the digital outputs DO1 - DO7 in the same way.

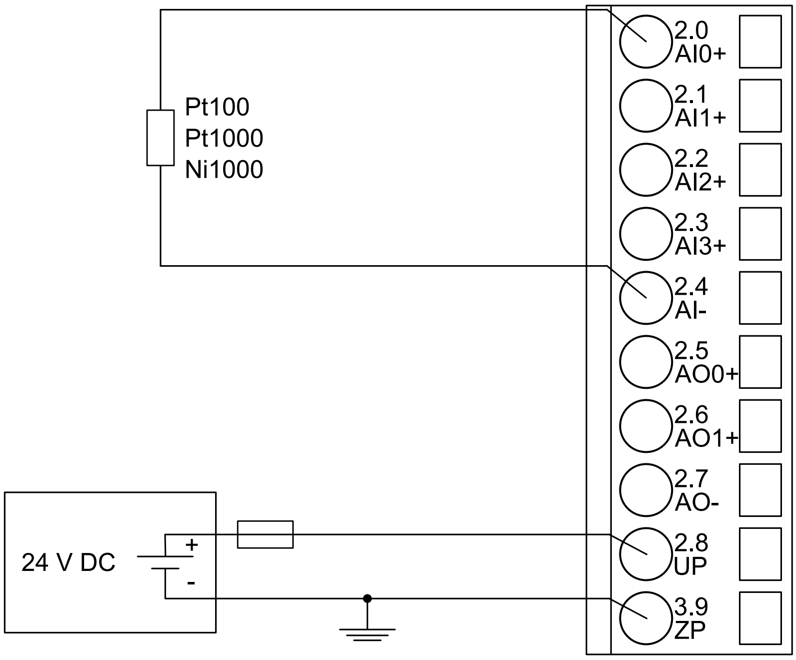


The meaning of the LEDs is described in Displays ↯ *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

Connection of Resistance Thermometers in 2-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI541-DP provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ✎ *Chapter 1.7.5.1.7 “Parameterization” on page 962* ✎ *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*:

Pt100	-50 °C...+400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ✎ *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

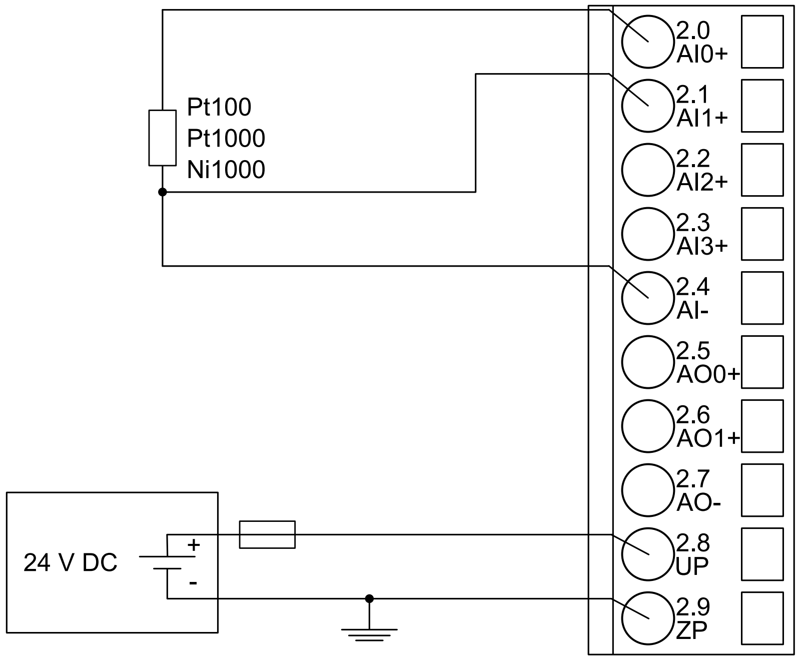
The module CI541-DP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI541-DP provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1. Proceed with the analog inputs AI2 and AI3 in the same way.



With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.7.5.1.7 “Parameterization” on page 962* *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*:

Pt100	-50 °C...+400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, 2 channels used

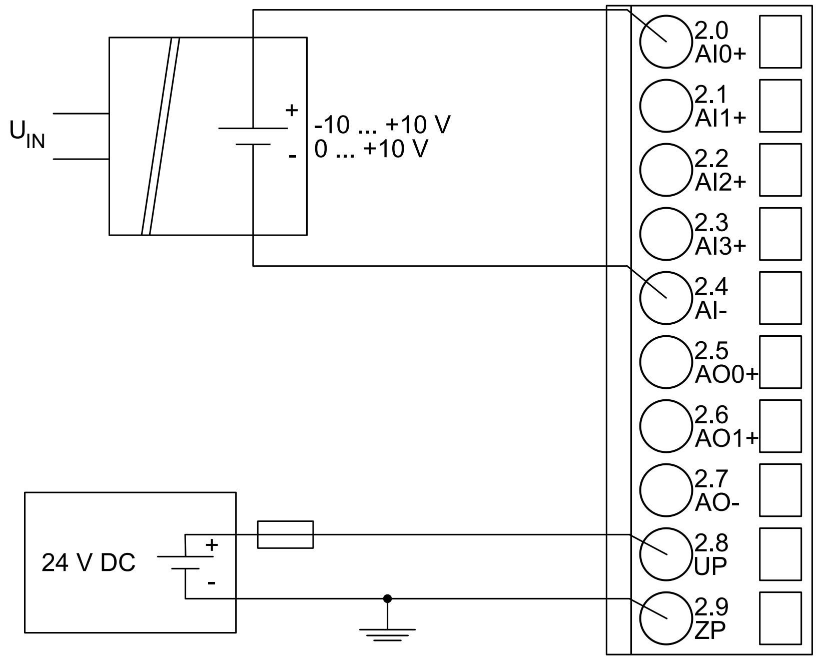
The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

The module CI541-DP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ✎ *Chapter 1.7.5.1.7 “Parameterization” on page 962* ✎ *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*:

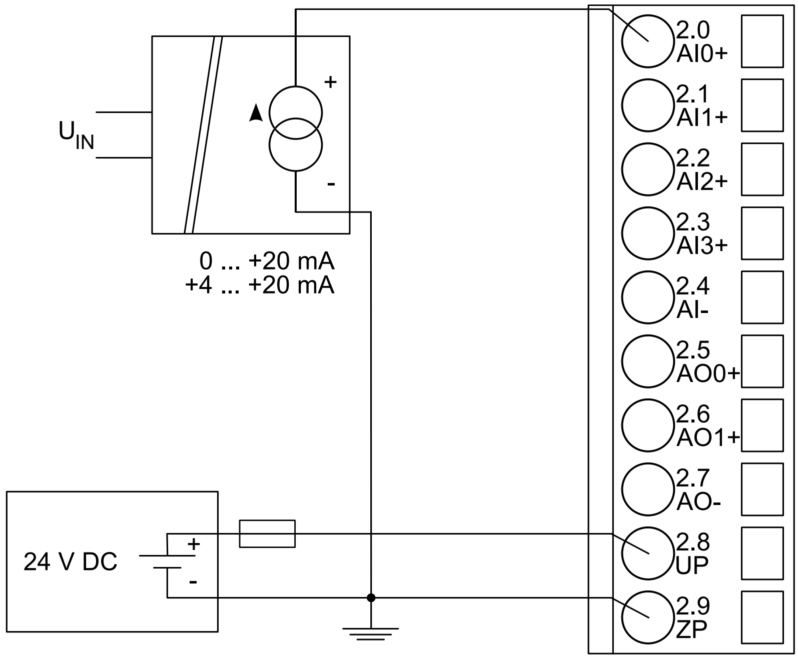
Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ✎ *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ➡ *Chapter 1.7.5.1.7 “Parameterization” on page 962* ➡ *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*:

Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

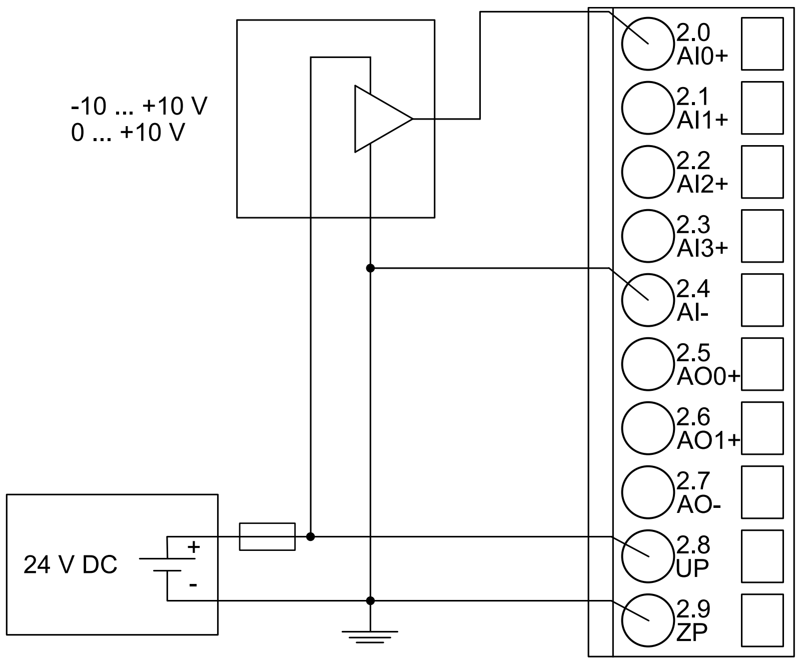
The function of the LEDs is described under ➡ *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4...20 mA, these channels should be configured as "Not used".

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with no electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



CAUTION!

Risk of faulty measurements!

The minus pole at the sensors must not have a too big potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

The following measuring ranges can be configured *Chapter 1.7.5.1.7 "Parameterization" on page 962* *Chapter 1.7.5.1.10 "Measuring Ranges" on page 973*:

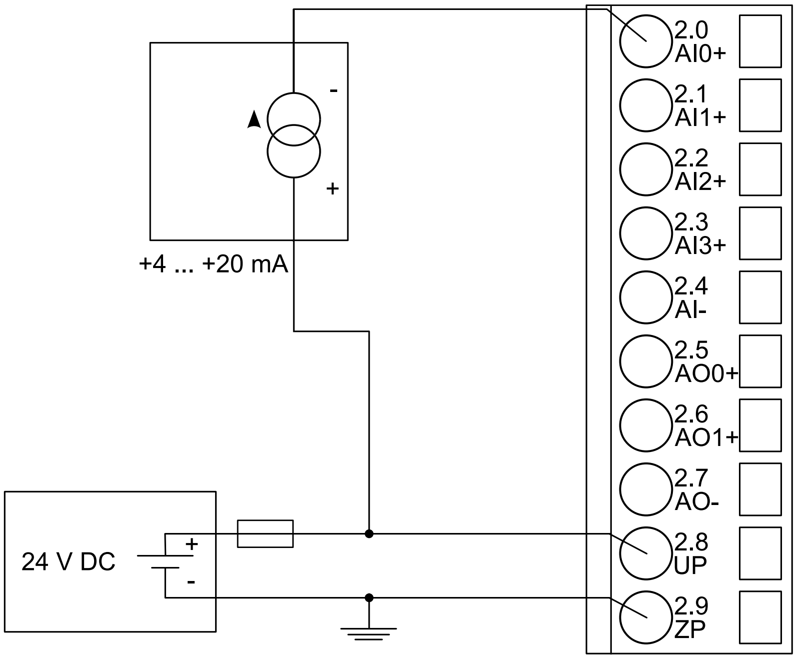
Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.5.1.9 "State LEDs" on page 972*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Passive-type Analog Sensors (Current) to the Analog Inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured *Chapter 1.7.5.1.7 "Parameterization" on page 962* *Chapter 1.7.5.1.7 "Parameterization" on page 962* :

Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.5.1.9 "State LEDs" on page 972*.

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA...20 mA, these channels should be configured as "Not used".

Connection of Active-type Analog Sensors (Voltage) to Differential Analog Inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely earthed).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

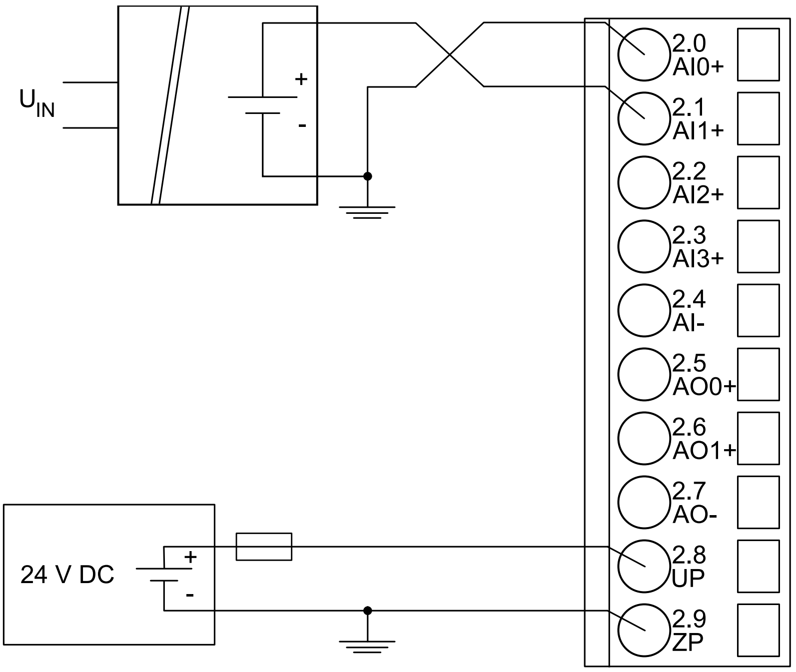
CAUTION!

Risk of faulty measurements!

The minus pole at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V).

Make sure that the potential difference never exceeds ±1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.



The following measuring ranges can be configured ⇘ *Chapter 1.7.5.1.7 “Parameterization” on page 962* ⇘ *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*:

Voltage	0 V...10 V	with differential inputs, 2 channels used
Voltage	-10 V...+10 V	with differential inputs, 2 channels used

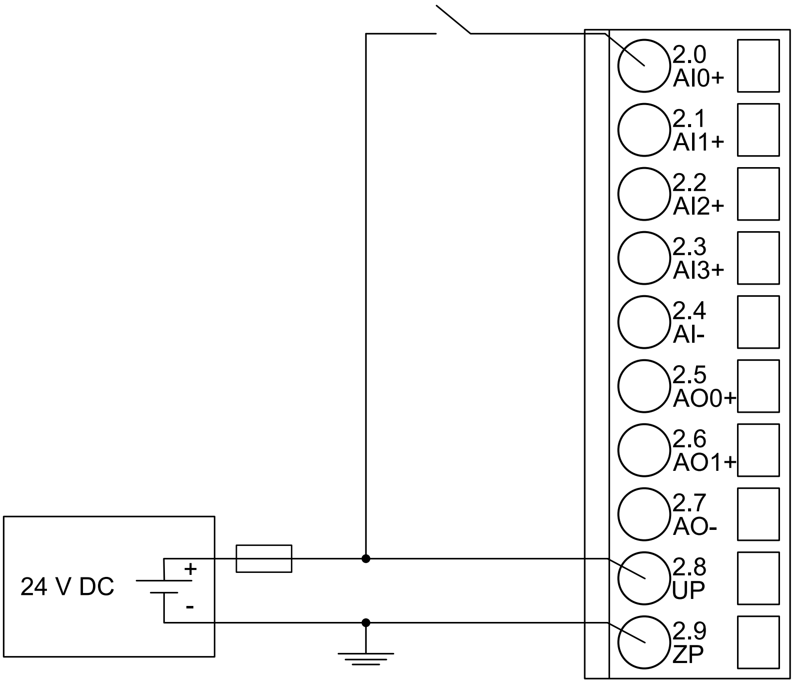
The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



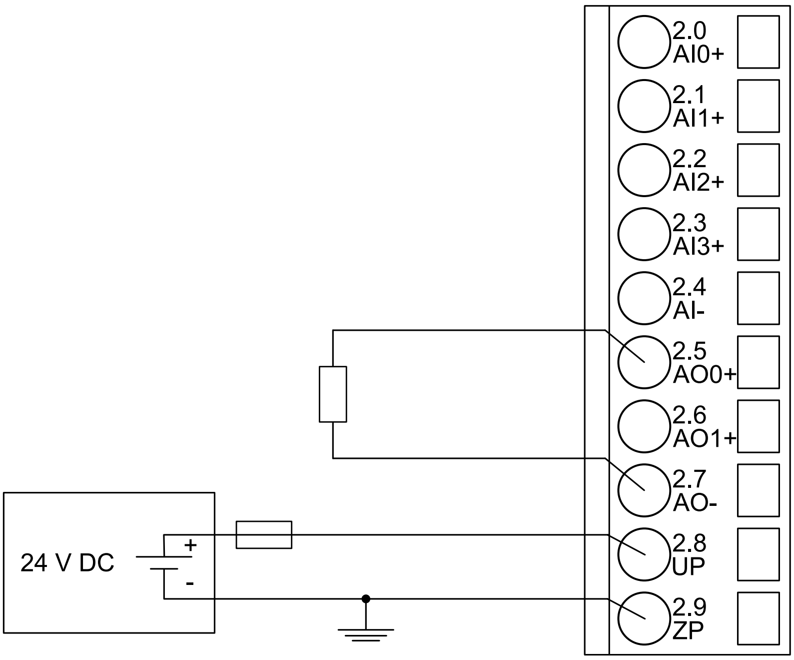
The following measuring ranges can be configured ␁ *Chapter 1.7.5.1.7 “Parameterization” on page 962* ␁ *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*:

Digital input	24 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ␁ *Chapter 1.7.5.1.9 “State LEDs” on page 972*.

Connection of Analog Output Loads (Voltage)

The following figure shows the connection of analog output loads (voltage) to the analog output AO0. Proceed with the analog output AO1 in the same way.



The following measuring ranges can be configured ␁ *Chapter 1.7.5.1.7 “Parameterization” on page 962* ␁ *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*:

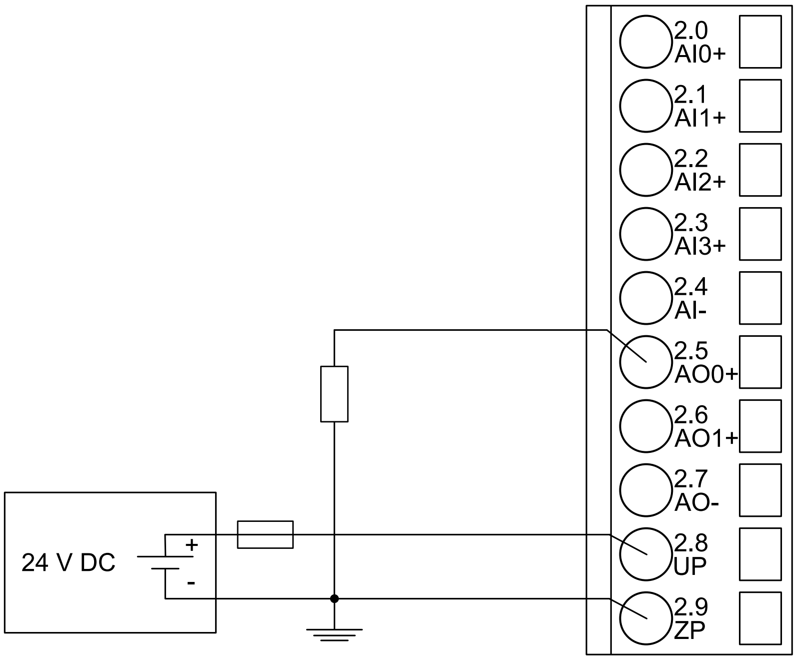
Voltage	-10 V...+10 V	Load ±10 mA max.	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.5.1.9 "State LEDs" on page 972*.

Unused analog outputs can be left open-circuited.

Connection of Analog Output Loads (Current)

The following figure shows the connection of analog output loads (current) to the analog output AO0. Proceed with the analog output AO1 in the same way.



The following measuring ranges can be configured *Chapter 1.7.5.1.7 "Parameterization" on page 962* *Chapter 1.7.5.1.10 "Measuring Ranges" on page 973*:

Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.5.1.8 "Diagnosis" on page 967*.

Unused analog outputs can be left open-circuited.

1.7.5.1.4 Internal Data Exchange

Parameter	**Value**
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

1.7.5.1.5 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

1.7.5.1.6 I/O Configuration

The CI541-DP PROFIBUS DP Bus configuration is handled by PROFIBUS DP Master with the exception of the slave bus ID (via rotary switches) and the baud rate (automatic detection).

The analog/digital I/O channels and the fast counter are configured via software.

Details about configuration are described in Parameterization *Chapter 1.7.5.1.7 “Parameterization” on page 962*.

1.7.5.1.7 Parameterization

Parameters of the Module

Table 153: Parameters of the Module:

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C20	WORD	0x1C20
Parameter length	Internal	47	BYTE	47
Reserved (1 byte)	0	0	BYTE	0
Error LED / Fail-safe function (see *Table 154 “Settings "Error LED / Failsafe function"” on page 963*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	18		
Reserved (20 bytes)	0	0	BYTE	0
Check supply (UP and UP3)	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2]) Counter operating modes, see description of the Fast Counter *Chapter 1.5.1.2.10 “Fast Counter” on page 396*.

Table 154: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Fail-safe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Fail-safe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode on *)
*) The parameters Behaviour analog outputs at communication error and Behaviour digital outputs at communication error are only evaluated if failsafe function is enabled.	

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour analog outputs at communication error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour analog outputs at communication error is only analyzed if the Fail-safe mode is ON.				

Channel Parameters for the Analog Inputs (4x)

Name	**Value**	**Internal value**	**Internal value, type**	**Default**
Input 0, Channel configuration	Operation modes of analog inputs *Table 155 "Operation modes of analog inputs:" on page 964*	Operation modes of analog inputs *Table 155 "Operation modes of analog inputs:" on page 964*	BYTE	0
Input 0, Check channel	Settings channel monitoring *Further information on page 965*	Settings channel monitoring *Further information on page 965*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Operation modes of analog inputs *Table 155 "Operation modes of analog inputs:" on page 964*	Operation modes of analog inputs *Table 155 "Operation modes of analog inputs:" on page 964*	BYTE	0
Input 3, Check channel	Settings channel monitoring *Further information on page 965*	Settings channel monitoring *Further information on page 965*	BYTE	0

Channel Configuration

Table 155: Operation modes of analog inputs:

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0...10 V
2	Digital input
3	0 mA...20 mA
4	4 mA...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50 °C...+400 °C
9	3-wire Pt100 -50 °C...+400 °C *)
10	0 V...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C...+70 °C
15	3-wire Pt100 -50 °C...+70 °C *)
16	2-wire Pt1000 -50 °C...+400 °C
17	3-wire Pt1000 -50 °C...+400 °C *)
18	2-wire Ni1000 -50 °C...+150 °C

19	3-wire Ni1000 -50 °C...+150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Channel Monitoring

Table 156: Table Settings channel monitoring:

Internal Value	**Check Channel**
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel Parameters for the Analog Outputs (2x)

Name	**Value**	**Internal value**	**Internal value, type**	**Default**
Output 0, Channel configu-ration	Operation modes of analog outputs *Table 157 “Table Operation modes of analog outputs:” on page 966*	Operation modes of analog outputs *Table 157 “Table Operation modes of analog outputs:” on page 966*	BYTE	0
Output 0, Check channel	Channel moni-toring *Table 158 “ Table channel monitoring:” on page 966*	Channel moni-toring *Table 158 “ Table channel monitoring:” on page 966*	BYTE	0
Output 0, Substi-tute value	Substitute value *Table 159 “ Table Substitute value:” on page 966*	Substitute value *Table 159 “ Table Substitute value:” on page 966*	WORD	0
Output 1, Channel configu-ration	Operation modes of analog outputs *Table 157 “Table Operation modes of analog outputs:” on page 966*	Operation modes of analog outputs *Table 157 “Table Operation modes of analog outputs:” on page 966*	BYTE	0
Output 1, Check channel	Channel moni-toring *Table 158 “ Table channel monitoring:” on page 966*	Channel moni-toring *Table 158 “ Table channel monitoring:” on page 966*	BYTE	0
Output 1, Substi-tute value	Substitute value *Table 159 “ Table Substitute value:” on page 966*	Substitute value *Table 159 “ Table Substitute value:” on page 966*	WORD	0

Channel Configuration

Table 157: Table Operation modes of analog outputs:

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V...+10 V
129	0 mA...20 mA
130	4 mA...20 mA

Channel Monitoring

Table 158: Table channel monitoring:

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Substitute Value

Table 159: Table Substitute value:

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	depending on configuration

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour digital outputs at com-muncation error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0...255	00h...FFh	BYTE	0 0x00
Detect voltage overflow at out-puts [2])	Off On	0 1	BYTE	Off 0x00
[1]) The parameters Behaviour digital outputs at communcation error is only analyzed if the Fail-safe-mode is ON. [2]) The state "externally voltage detected" appears, if the output of a channel DC0..DC7 should be switched on while an externally voltage is connected *Chapter 1.7.5.1.3 “Electrical Con-nection” on page 946*. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".				

1.7.5.1.8 Diagnosis

Structure of the Diagnosis Block via *DPM_SLV_DIAG* Function Block.

Byte Number	Description	Possible Values
1	Data length (header included)	7
2	PROFIBUS DP V1 coding: Vendor specific	129
3	Diagnosis Byte, slot number	31 = CI541-DP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
4	Diagnosis Byte, module number	According to the I/O Bus specification passed on by modules to the fieldbus master
5	Diagnosis Byte, channel	According to the I/O Bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
6	Diagnosis Byte, error code	According to the I/O Bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
7	Diagnosis Byte, flags	According to the I/O Bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O device type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot-swap terminal unit or defective module on hot-swap ter-minal unit 9)	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot-swap terminal unit 9)	Remove wrong I/O module and plug pro-jected I/O module

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PROFIBUS DP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-** **Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	1...10	31	5	42	No communication with I/O module on hot-swap terminal unit 9)	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap 8) 9)	Power off system and replace I/O module
4	-	1...10	31	6	42	No communication with hot-swap terminal unit 9)	Restart, if error persists replace terminal unit
4	-	31	31	31	46	Reverse voltage from digital outputs DO0...DO7 to UP3 4)	Check connection
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) 5)	Check terminals/ check process supply voltage

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
Channel error digital							
4	-	31	2	0...7	46	Externally voltage detected on digital output DO0...DO7 [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7])	Check terminals
Channel error analog							
4	-	31	1	0...3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0...3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0...3	47	Short-circuit at an analog input	Check terminals
4	-	31	3	0...1	4	Analog value over-flow at an analog output	Check output value
4	-	31	3	0...1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0...4 or 10 = Position of the Communication Module;14 = I/O-Bus; 31 = Module itself The identifier is not contained in the CI541-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself; 1...10 = Expansion module
[3])	With "Module" the following allocation applies: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)

4)	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage (voltage feedback, see description in section Electrical Connection *Chapter 1.7.5.1.3 “Electrical Connection” on page 946*). All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
5)	The voltage on digital outputs DO0...DO7 has overrun the process supply voltage UP3 (see description in section Electrical Connection *Chapter 1.7.5.1.3 “Electrical Connection” on page 946*). Diagnosis message appears for the whole module.
6)	This message appears, if the output of a channel DO0...DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
7)	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
8)	In case of an I/O module doesn’t support hot swapping, do not perform any hot-swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
9)	Diagnosis for hot swap available as of version index F0.

1.7.5.1.9 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1-DP, STA2-DP, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 160: States of the 5 System LEDs:

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1-DP	Green	---	PROFIBUS running	Invalid device parameters
STA2-DP	Red	No error	Bus timeout	No communication to Master
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---

Table 161: States of the 27 Process LEDs:

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin- ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.5.1.10 Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Overflow	>11.7589	>11.7589	>23.5178	>22.8142	
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006	
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On
	0.0000	0.0000	0	4	Off
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994 : 0	

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Measured value too low		-10.0004 : -11.7589			
Underflow	< -1.7593	<-11.7589	<0.0000	<0.0000	

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	27648 : 1	6C00 : 0001
	0	0000
	-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C
Measured value too high		450.0 °C : 400.1 °C	
			160.0 °C : 150.1 °C

Range	**Pt100 / Pt1000** **-50...70 °C**	**Pt100 / Pt1000** **-50...400 °C**	**Ni1000** **-50...150 °C**
Normal range		400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C
		0.0 °C	0.0 °C
		-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low		-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	**Digital value**	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA
Overflow	>11.7589 V	>23.5178 mA	>22.8142 mA
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	**Hex.**
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.7.5.1.11 Technical Data

The System Data of AC500 and S500 ✎ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	PROFIBUS interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Configurable digital inputs/outputs		8
Number of digital inputs		8
Number of digital outputs		8
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Setting of the PROFIBUS DP identifier		With 2 rotary switches at the front side of the module
Diagnose		See Diagnosis *Chapter 1.7.5.1.8 “Diagnosis” on page 967*
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hin-dered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Technical Data of the Digital Inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 to DI7		Terminals 3.0 to 3.7
Reference potential for all inputs		Terminals 2.9 ... 4.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

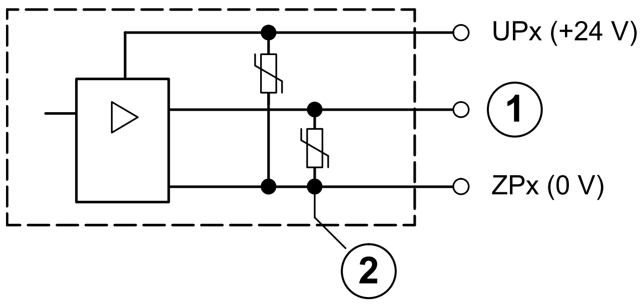
Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)

Parameter		Value
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The module provides several diagnosis functions ↳ *Chapter 1.7.5.1.8 “Diagnosis” on page 967*.

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical Data of the Analog Inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group with 4 channels
Connection if channels AI0+ to AI3+	Terminals 2.0 to 2.3

Parameter		Value
Reference potential for AI0+ to AI3+		Terminal 2.4 (AI-) for voltage and RTD measurement Terminal 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V...10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V...+10 V
Electrical isolation		Against PROFIBUS
Configurability		0 V...10 V, -10 V...+10 V, 0/4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution		Range 0...10 V: 12 bits Range -10...+10 V: 12 bits + sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Tables Input Ranges Voltage, Current and Digital Input and Input Range Resistor *Chapter 1.7.5.1.10 “Measuring Ranges” on page 973*
Unused inputs		Are configured as "unused" (default value)
Overvoltage protection		Yes

Technical Data of the Analog Inputs if used as Digital Inputs

Parameter	Value
Number of channels per module	Max. 4
Distribution of channels into groups	1 group of 4 channels
Connections of the channels AI0+ to AI3+	Terminals 2.0 to 2.3
Reference potential for the inputs	Terminals 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals	1 LED per channel
Input signal voltage	24 VDC

Parameter		Value
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V ... +15 V
	Signal 1	+15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 2.5 ... 2.6
Reference potential for AO0+ to AO1+		Terminal 2.7 (AO-) for voltage output Terminal 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Electrical isolation		Against PROFIBUS
Configurability		-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually)
Output resistance (load), as current output		0...500 Ω
Output loadability, as voltage output		±10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Table Output Ranges Voltage and Current ↯ *Chapter 1.7.5.1.10.3 “Output Ranges Voltage and Current” on page 976*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0), 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

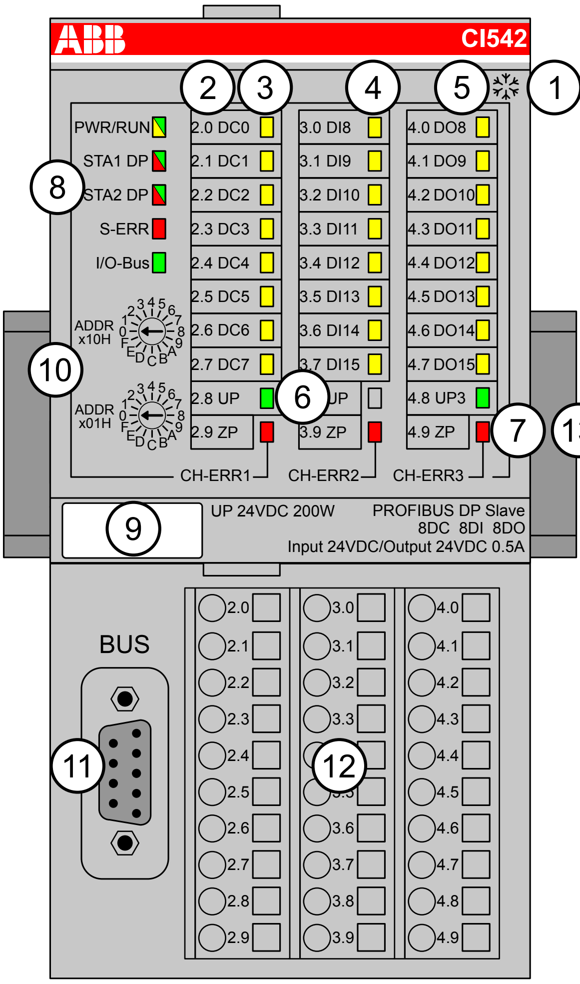
1.7.5.1.12 Ordering Data

Ordering No.	Scope of delivery	Product Life Cycle Phase *)
1SAP 224 100 R0001	CI541-DP, PROFIBUS DP bus module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 424 100 R0001	CI541-DP-XC, PROFIBUS DP bus module, 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.5.2 CI542-DP

- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- Module-wise electrically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs (DC0 - DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 - DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 - DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 DP, STA2 DP, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the PROFIBUS ID
11 9-pole D-SUB connector to connect the PROFIBUS DP signals
12 Terminal unit
13 DIN rail
Sign for XC version

1.7.5.2.1 Intended Purpose

The PROFIBUS DP bus module is used as decentralized I/O module in PROFIBUS networks. Depending on the used terminal unit the network connection is performed either via 9-pole female D-SUB connector or via 10 terminals (screw-type or spring terminals) which are integrated in the terminal unit.

The inputs/outputs are electrically isolated from the PROFIBUS network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.5.2.2 Functionality

Parameter	Value
Interface	PROFIBUS
Protocol	PROFIBUS DP (DP-V0 and DP-V1)
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	For setting the PROFIBUS ID for configuration purposes (00h to FFh)
Fast counter	Integrated, configurable operating modes
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU509, TU510, TU517 or TU518 ➪ *Chapter 1.4.2 "TU509 and TU510 for Communication Interface Modules" on page 148* ➪ *Chapter 1.4.4 "TU517 and TU518 for Communication Interface Modules" on page 157*

1.7.5.2.3 Electrical Connection

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly chapter ➪ Chapter 2.5 "AC500-eCo" on page 1194.*

The PROFIBUS DP bus module CI542-DP is plugged on the I/O terminal units TU509 ➪ *Chapter 1.4.2 "TU509 and TU510 for Communication Interface Modules" on page 148* or TU510 ➪ *Chapter 1.4.2 "TU509 and TU510 for Communication Interface Modules" on page 148* and accordingly TU517 ➪ *Chapter 1.4.4 "TU517 and TU518 for Communication Interface Modules" on page 157* or TU518 ➪ *Chapter 1.4.4 "TU517 and TU518 for Communication Interface Modules" on page 157*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ➪ *Chapter 1.8.2.4 "TA526 - Wall Mounting Accessory" on page 1154*).

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8 and 3.8 as well as 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 2.8 and 3.8: Process supply voltage UP = +24 VDC

Terminal 4.8: Process supply voltage UP3 = +24 VDC

Terminals 2.9, 3.9 and 4.9: Process supply voltage ZP = 0 V

> *With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.*

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0...DC7 or DO0...DO7 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

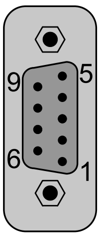
This limitation does not apply for the input channels DI0...DI7.

CAUTION!
Risk of malfunction by not intended usage!
If the function cut off of the digital outputs should be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0...DO7 and DC0...DC7.

Possibilities of Connection

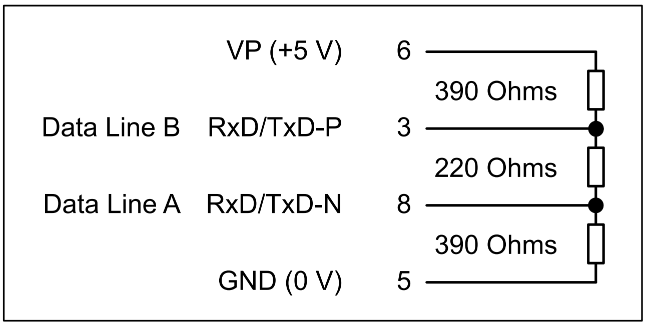
Mounting on terminal units TU509 or TU510:

The assignment of the 9-pole female D-SUB connector for the PROFIBUS DP signals.

Serial Interface	Pin	Signal	Description
	1	---	Reserved
	2	---	Reserved
	3	B	PROFIBUS DP signal B
	4	---	Reserved
	5	DGND	Ground for 5 V power supply
	6	VP (5 V)	5 V power supply
	7	---	Reserved
	8	A	PROFIBUS DP signal A
	9	---	Reserved
	Shield	Cable shield	Functional earth

Bus Termination

The line ends of the bus segment must be equipped with bus termination resistors. Normally, these resistors are integrated in the interface connectors.



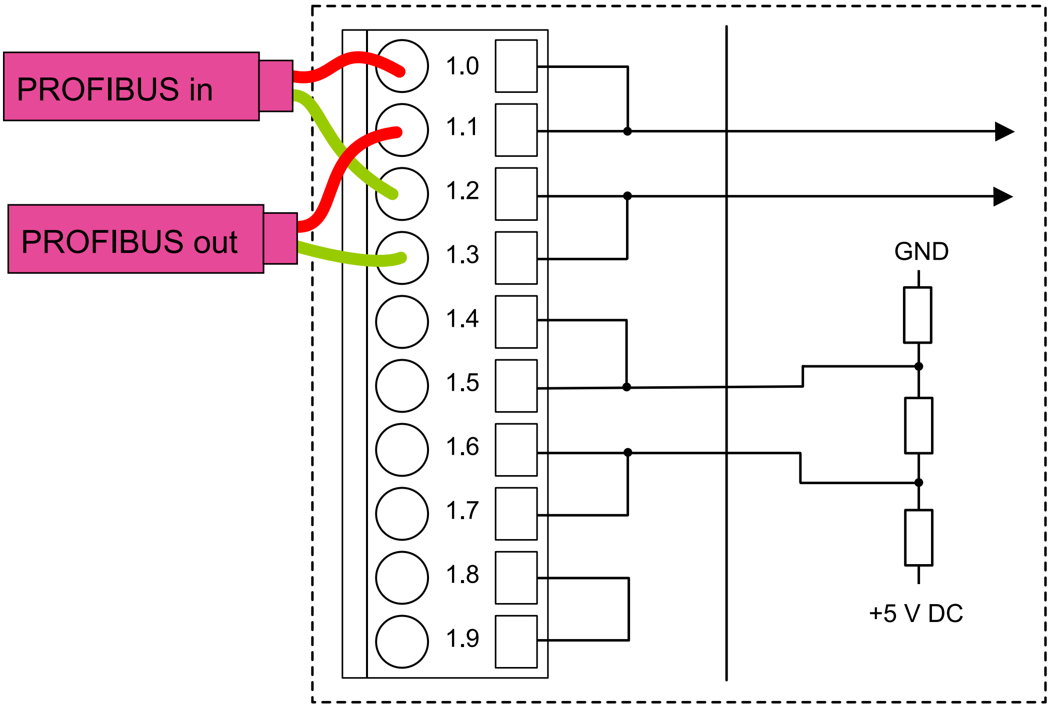
The earthing of the shield should take place at the switch-gear cabinet, see System-Data AC500 *⇘ Chapter 2.6.1 "System Data AC500" on page 1252.*

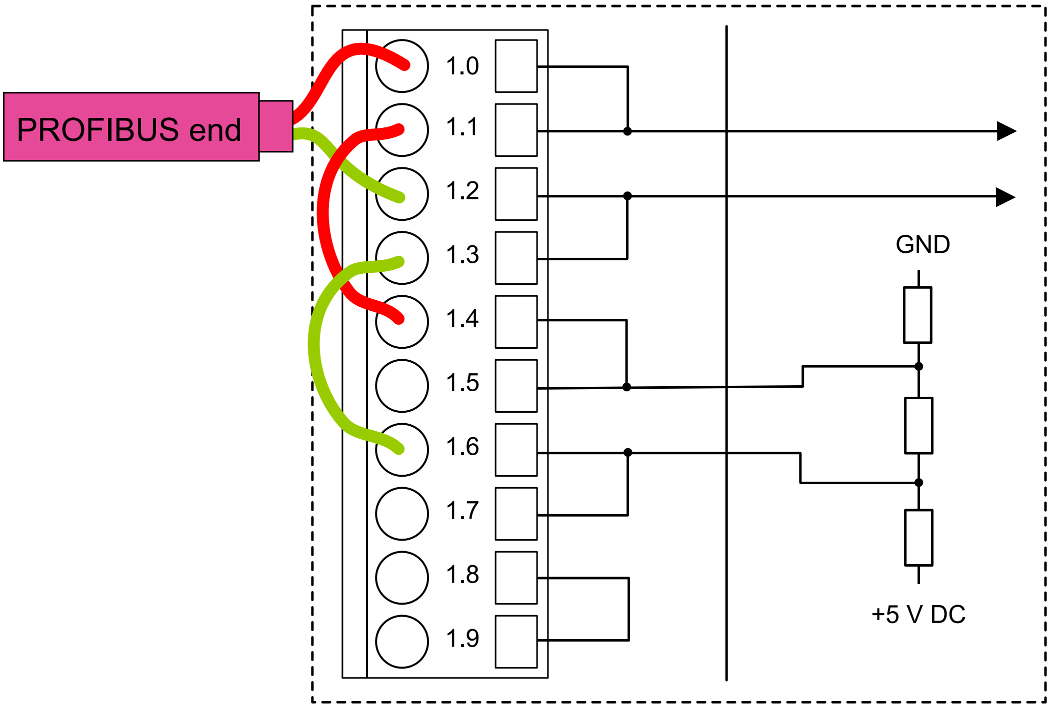
Mounting on terminal units TU517 or TU518:

The assignment of the terminals 1.0 - 1.9:

Terminal	Signal	Description
1.0	B	Data line B (receive and send line, positive)
1.1	B	Data line B (receive and send line, positive)
1.2	A	Data line A (receive and send line, negative)
1.3	A	Data line A (receive and send line, negative)
1.4	TermB	Bus termination data line B
1.5	TermB	Bus termination data line B
1.6	TermA	Bus termination data line A
1.7	TermA	Bus termination data line A
1.8	DGND	Reference potential for data transmission
1.9	DGND	Reference potential for data transmission

At the line ends of a bus segment, termination resistors must be connected. If using TU517/ TU518, the bus termination resistors can be enabled by connecting the terminals TermA and TermB to the data lines A and B (no external termination resistors are required, see illustration below).





If using TU517/TU518, note that the termination resistors are not located inside the TU, but inside the bus module CI541-DP. I. e. when removing the device from the TU, the bus termination resistors are not connected to the bus any more. The bus itself will not be disconnected if a device is removed.

If using TU517/TU518 the max. permitted baud rate is limited to 1.5 MBaud.

Technical Data Bus Cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω...165 Ω
Cable capacity	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm^2
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable Length

The maximum possible cable length of a PROFIBUS subnet within a segment depends on the baud rate (transmission rate).

Baud rate	Maximum cable length
9.6 kBaud to 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

The assignment of the other terminals:

Terminal	Signal	Description
2.0	DC0	Signal of the configurable digital input/output DC0
2.1	DC1	Signal of the configurable digital input/output DC1
2.2	DC2	Signal of the configurable digital input/output DC2
2.3	DC3	Signal of the configurable digital input/output DC3
2.4	DC4	Signal of the configurable digital input/output DC4
2.5	DC5	Signal of the configurable digital input/output DC5
2.6	DC6	Signal of the configurable digital input/output DC6
2.7	DC7	Signal of the configurable digital input/output DC7
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	DI8	Signal of the digital input DI8
3.1	DI9	Signal of the digital input DI9
3.2	DI10	Signal of the digital input DI10
3.3	DI11	Signal of the digital input DI11
3.4	DI12	Signal of the digital input DI12
3.5	DI13	Signal of the digital input DI13
3.6	DI14	Signal of the digital input DI14

Terminal	Signal	Description
3.7	DI15	Signal of the digital input DI15
3.8	UP	Process voltage UP (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)
4.0	DO8	Signal of the digital output DO8
4.1	DO9	Signal of the digital output DO9
4.2	DO10	Signal of the digital output DO10
4.3	DO11	Signal of the digital output DO11
4.4	DO12	Signal of the digital output DO12
4.5	DO13	Signal of the digital output DO13
4.6	DO14	Signal of the digital output DO14
4.7	DO15	Signal of the digital output DO15
4.8	UP3	Process voltage UP3 (24 VDC)
4.9	ZP	Process voltage ZP (0 VDC)

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

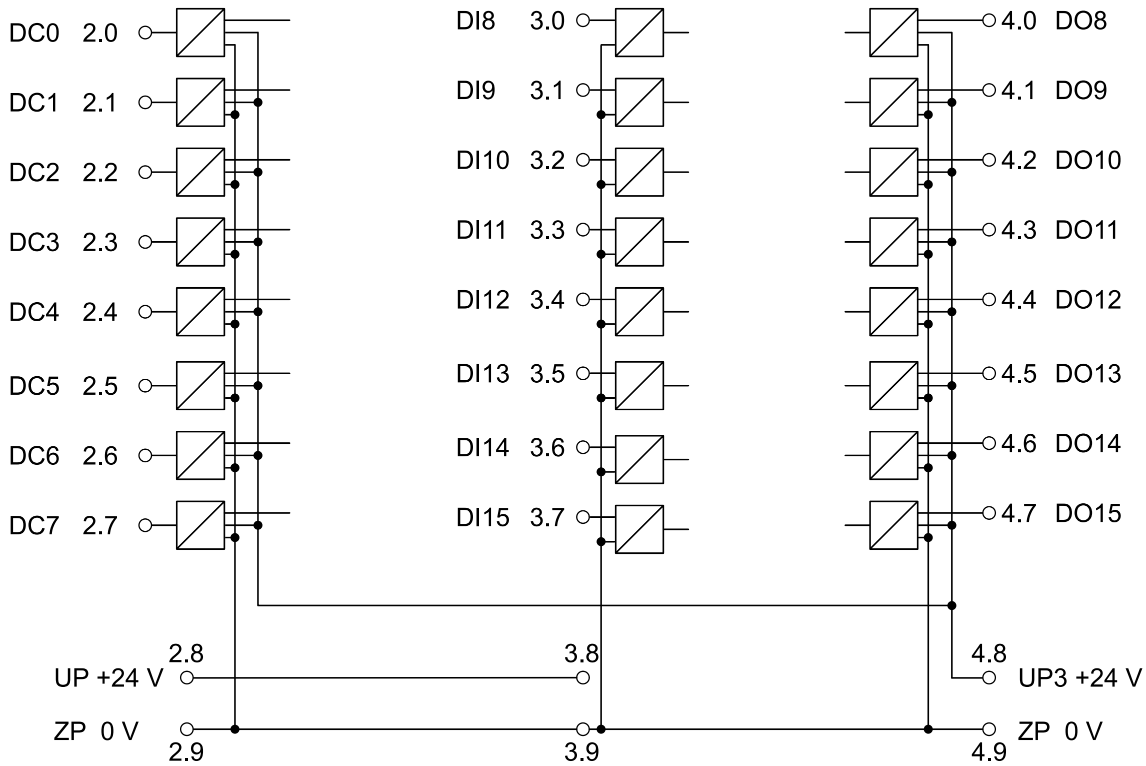
Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

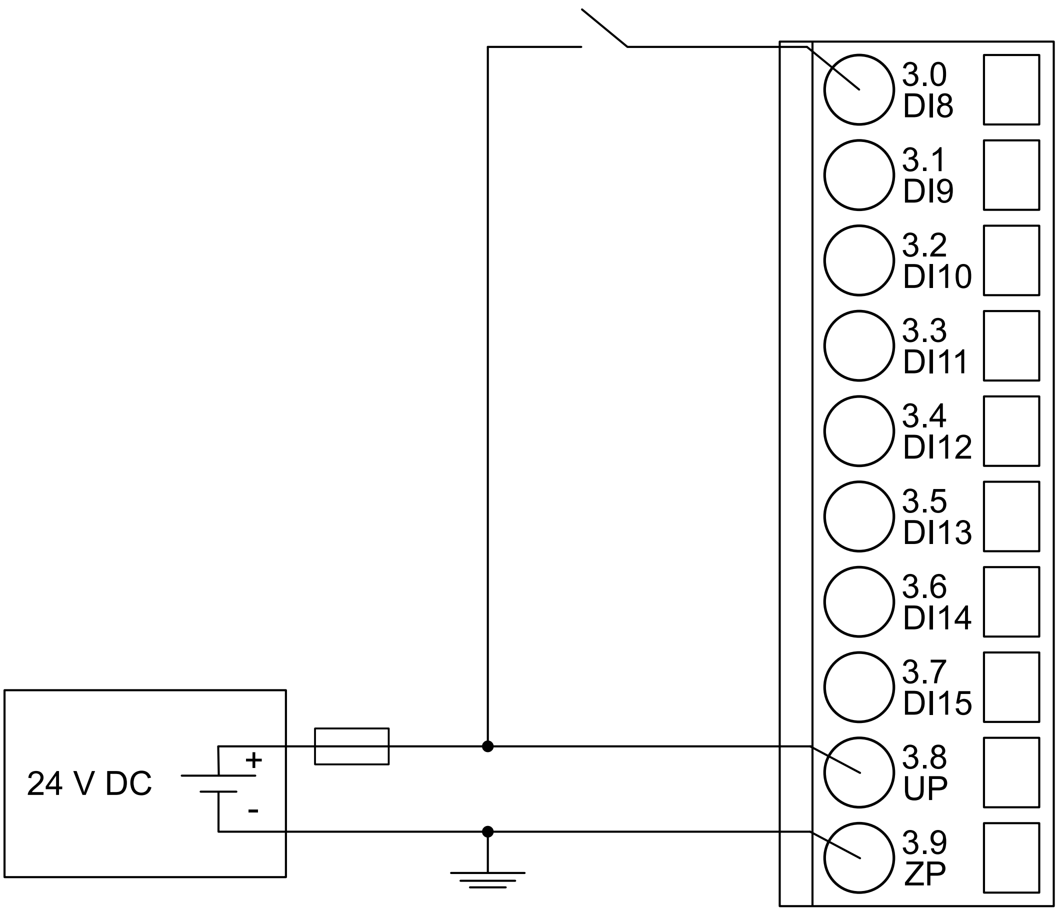
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figures show the electrical connection of the PROFIBUS DP bus module CI542-DP.



Connection of the Digital Inputs

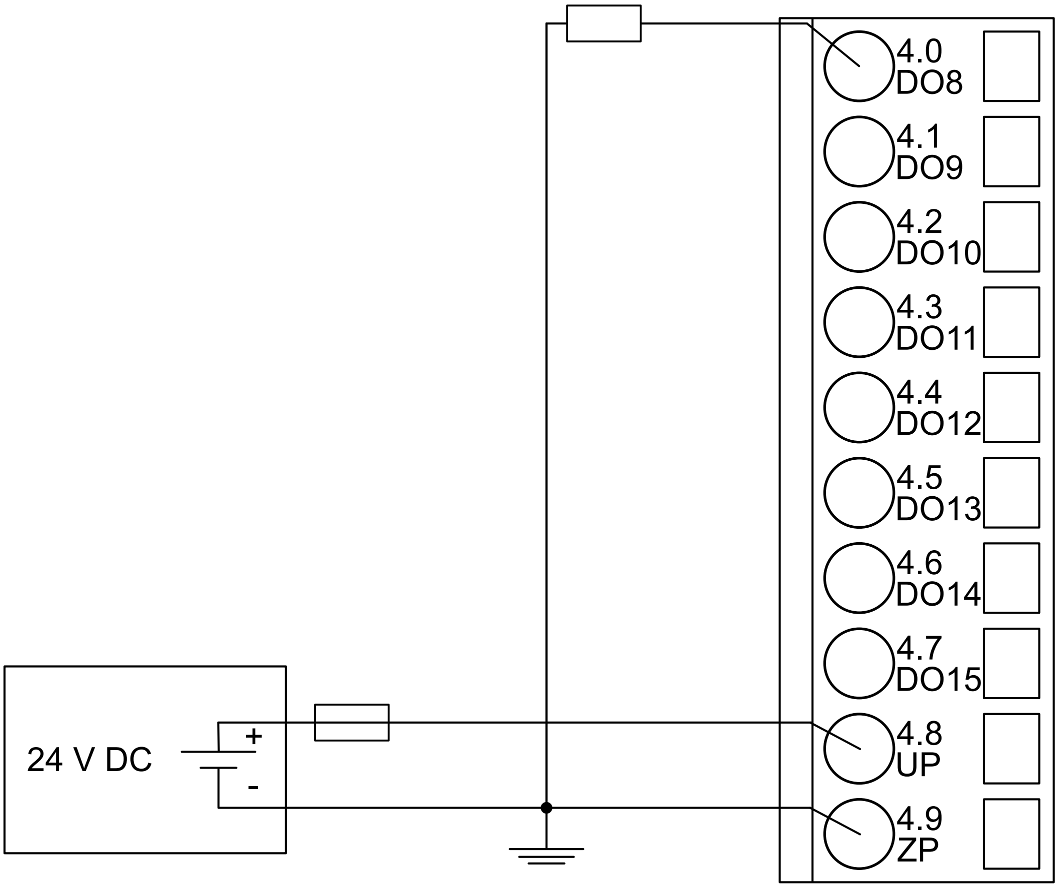
The following figure shows the electrical connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.



The meaning of the LEDs is described in Displays ↻ *Chapter 1.7.5.2.9 "State LEDs" on page 999*.

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.

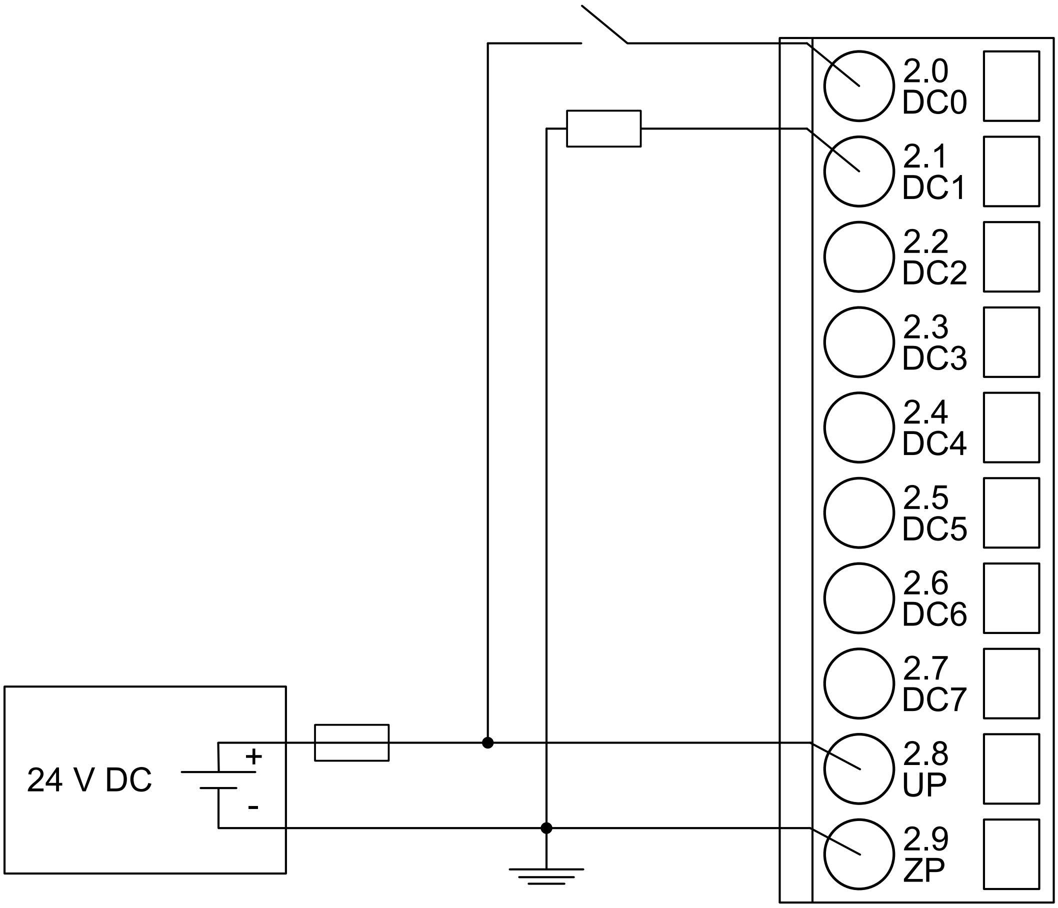


The meaning of the LEDs is described in Displays ↻ *Chapter 1.7.5.2.9 "State LEDs" on page 999*.

Connection of the Configurable Digital Inputs/Outputs

The following figure shows the electrical connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 to DC7 in the same way.

CAUTION!
If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device ↻ *Chapter 1.7.5.2.3 "Electrical Connection" on page 984*.



The meaning of the LEDs is described in Displays *Chapter 1.7.5.2.9 “State LEDs” on page 999*.

1.7.5.2.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.7.5.2.5 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

1.7.5.2.6 I/O Configuration

The CI542-DP PROFIBUS DP bus configuration is handled by PROFIBUS DP master with the exception of the slave bus ID (via rotary switches) and the baud rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

Details about configuration are described in Parameterization.

1.7.5.2.7 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C25	WORD	0x1C25
Parameter length	Internal	31	BYTE	31
Reserved (1 byte)	0	0	BYTE	0
Error LED / Fail-safe function ⇘ *Table 162 "Settings "Error LED / Failsafe function"" on page 993* (see table)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	18		
Reserved (20 bytes)	0	0	BYTE	0
Check supply	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		
[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission. [2]) Counter operating modes, see Fast Counter ⇘ *Chapter 1.5.1.2.10 "Fast Counter" on page 396*.				

Table 162: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe mode is ON.	

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0...65535	0000h...FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0..DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0..DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0..DC7 and accordingly DO0..DO7 has exceeded the process supply voltage UP3 *Chapter 1.7.5.2.3 “Electrical Connection” on page 984*. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage.

1.7.5.2.8 Diagnosis

Structure of the Diagnosis Block via *DPM_SLV_DIAG* Function Block.

Byte Number	Description	Possible Values
1	Data length (header included)	7
2	PROFIBUS DP V1 coding: Vendor specific	129
3	Diagnosis Byte, slot number	31 = CI542-DP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
4	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
5	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
7	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O device type on socket	Replace I/O module / Check configu-ration

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	PROFIBUS DP diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error-Identi-fier	Error message	Remedy
	1)	2)	3)				
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot-swap terminal unit or defective module on hot-swap ter-minal unit 9)	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot-swap terminal unit 9)	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot-swap terminal unit 9)	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap 8) 9)	Power off system and replace I/O module
4	-	1...10	31	6	42	No communication with hot-swap ter-minal unit 9)	Restart, if error persists replace terminal unit
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	31	31	31	46	Reverse voltage from digital outputs DO0..DO7 to UP3 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) 5)	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0..DO7 6)	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0..DC7 6)	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output 7)	Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O-Bus; 31 = Module itself The identifier is not contained in the CI542-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1..10 = Expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DC0..DC7 oder DO0..DO7 cause that other digital outputs are supplied through that voltage. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0..DC7 and accordingly DO0..DO7 has exceeded the process supply voltage UP3 *Chapter 1.7.5.2.3 "Electrical Connection" on page 984*. Diagnosis message appears for the whole module.
[6])	This message appears, if the output of a channel DC0..DC7 or DO0..DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn't support hot swapping, do not perform any hot-swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

1.7.5.2.9 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 DP, STA2 DP, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 163: States of the 5 System LEDs:

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1-DP	Green	---	PROFIBUS running	Invalid device parameters
STA2-DP	Red	No error	Bus timeout	No communication to Master

LED	Color	OFF	ON	Flashing
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---

Table 164: States of the 29 Process LEDs:

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.5.2.10 Technical Data

The System Data of AC500 and S500 ➾ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ➾ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	PROFIBUS interface against the rest of the module
	Inrush current from UP (at power up)	On request

Parameter		Value
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Setting of the PROFIBUS DP identifier		With 2 rotary switches at the front side of the module
Diagnose		See Diagnosis *Chapter 1.7.5.2.8 “Diagnosis” on page 994*
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 to DI7	Terminals 3.0 to 3.7

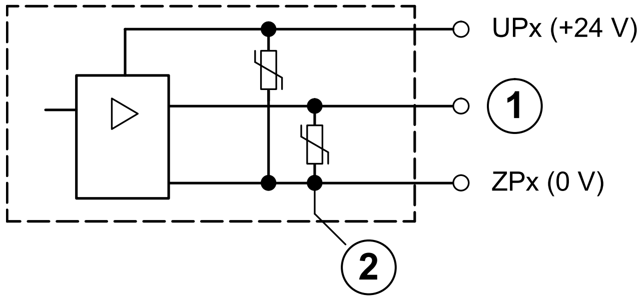
Parameter	Value
Reference potential for all inputs	Terminals 2.9 ... 4.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V
Undefined Signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical Data of the Digital Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request

Parameter		Value
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0...DC07	Terminals 2.0...2.7
If the channels are used as outputs		
	Channels DC0...DC07	Terminals 2.0...2.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Electrical isolation		From the PROFIBUS network

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 2.0 to 2.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V
Undefined Signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

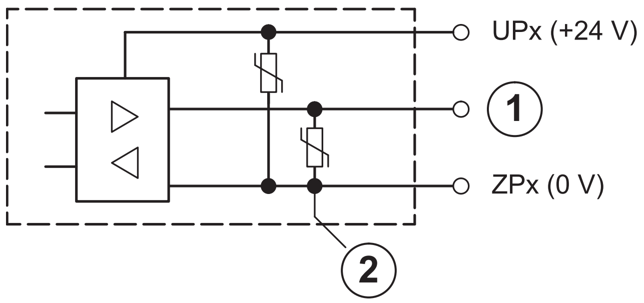
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 2.0 to 2.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	

Parameter		Value
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0),Terminal 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

1.7.5.2.11 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 224 200 R0001	CI542-DP, PROFIBUS DP bus module, 8 DI, 8 DO and 8 DC	Active
1SAP 424 200 R0001	CI542-DP-XC, PROFIBUS DP bus module, 8 DI, 8 DO and 8 DC, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.6 PROFINET

1.7.6.1 Comparison of the CIxyz-PNIO Modules

The PROFINET IO devices combine the advantages of decentralized I/O modules with the reaction time of AC500 mounted central I/O modules. The devices for PROFINET provide the extension -PNIO in the device name.

The Communication Module CM579-PNIO acts as IO Controller in a PROFINET network. It is connected to the Processor Module via an internal communication bus. Depending on the Terminal Base, several Communication Modules can be used for one Processor Module.

The Communication Interface Modules CIxyz-PNIO act as IO Devices in a PROFINET network.

Additionally the communication module CM589-PNIO(-4) can be used to setup a AC500 PLC to act as IO Device in a PROFINET network.

The difference of the CIxyz-PNIO devices can be found in their input and output characteristics *Chapter 1.7.6.1.1.1 “Characteristics of CI50x-PNIO” on page 1006*. The characteristics for CM589-PNIO(-4) can be found in the device description for CM589-PNIO *Further information on page 142*.

1.7.6.1.1 PROFINET IO Devices CI50x-PNIO

Characteristics of CI50x-PNIO

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name

Parameter	Value
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Electrical isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Input/Output Characteristics of CI501-PNIO

The PROFINET Bus Module CI501-PNIO is used as decentralized I/O module in PROFINET networks. The network connection is performed via 2 RJ45 connectors which are integrated in the Terminal Unit. The Bus Module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0...1.3), configurable as:
  - -10 ... +10 V
  - 0 ... +10 V
  - -10 ... +10 V (differential voltage)
  - 0 ... 20 mA
  - 4 ... 20 mA
  - Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire)
  - 24 V digital input function
- 2 analog outputs (1.5...1.6), configurable as:
  - -10 ... +10 V
  - 0 ... 20 mA
  - 4 ... 20 mA
- 8 digital inputs 24 V DC in 1 group (2.0...2.7)
- 8 digital transistor outputs 24 V DC (0.5 A max.) in 1 group (3.0...3.7)
- Resolution of the analog channels: 12 bits

The inputs/outputs are electrically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Input/Output Characteristics of CI502-PNIO

- 8 digital inputs 24 V DC
- 8 digital transistor outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise electrically isolated
- XC version for usage in extreme ambient conditions available

Technical Data of the Serial Interfaces of CI504-PNIO

Parameter	Value
Number of serial interfaces	3
Connectors for serial interfaces	X11 for COM1 X12 for COM2 X13 for COM3
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Baudrate	Configurable from 300 bit/s to 115.200 bit/s

Technical Data of the Serial Interfaces of CI506-PNIO

Parameter	Value
Number of serial interfaces	2
Connectors for serial interfaces	X11 for COM1 X12 for COM2
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Baudrate	Configurable from 300 bit/s to 115.200 bit/s

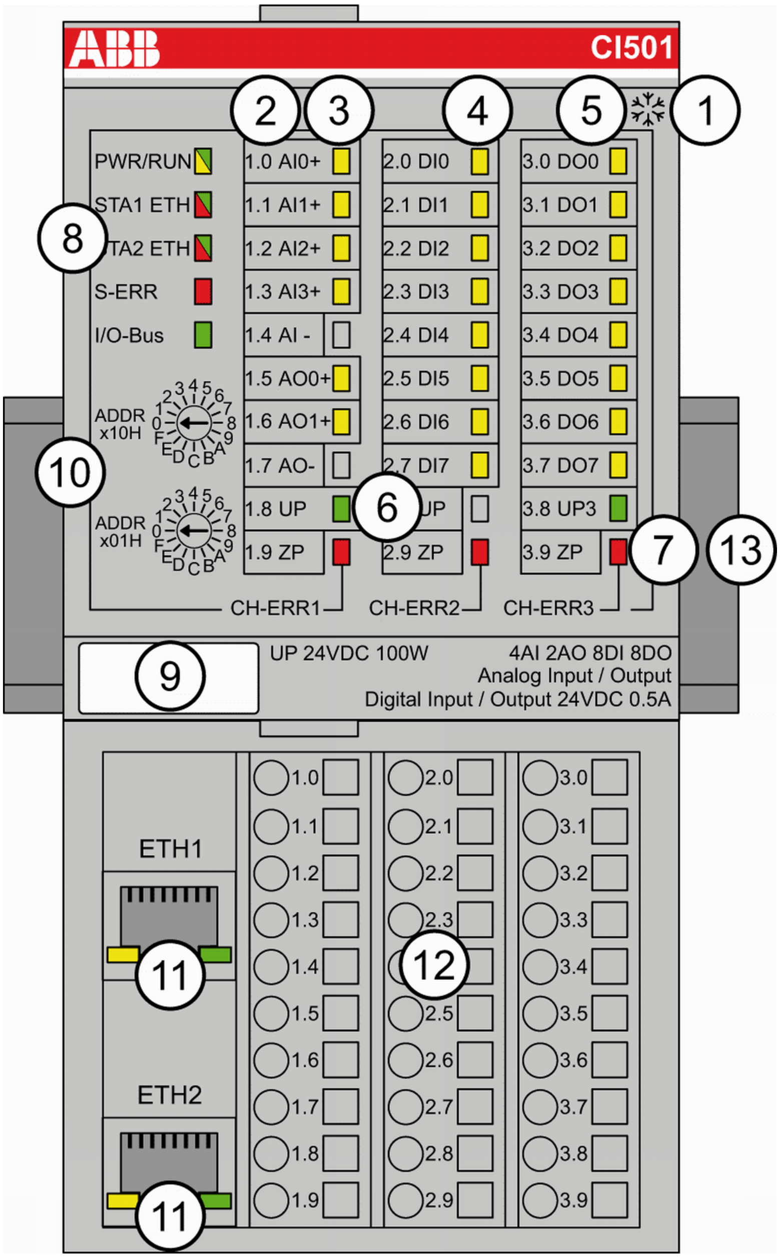
Technical Data of the CANopen Interfaces (CI506-PNIO)

Parameter	Value
Number of CANopen interfaces	1
Connector for CANopen Interface	X13
Baudrate	Up to 1 Mbit/s

1.7.6.2 CI501-PNIO

- 4 analog inputs, 2 analog outputs, 8 digital inputs, 8 digital outputs
- Resolution 12 bits plus sign

- Module-wise electrically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 - AI3, AO0 - AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 - DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 - DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the I/O device identifier
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.6.2.1 Intended Purpose

The PROFINET bus modules CI501-PNIO and CI502-PNIO are used as communication interface modules in PROFINET networks. The network connection is performed by Ethernet cables which are inserted in the RJ45 connectors in the terminal unit. An Ethernet switch in the communication interface module allows daisy chaining of the network.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.6.2.2 Functionality

The bus module contains 22 I/O channels with the following properties:

- 4 configurable analog inputs (2-wire / single-ended) or 2 configurable analog inputs (3-wire / differential) (1.0...1.3)
- 2 analog outputs (1.5...1.6)
- 8 digital inputs 24 VDC in 1 group (2.0...2.7)
- 8 digital outputs 24 VDC, 0.5 A max. in 1 group (3.0...3.7)

The inputs/outputs are electrically isolated from the PROFINET network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

Parameter	**Value**
Interface	Ethernet
Protocol	PROFINET IO RT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	For setting the I/O device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*

1.7.6.2.3 Electrical Connection

The Ethernet bus module CI501-PNIO is plugged on the I/O terminal unit TU507-ETH or TU508-ETH *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 VDC

Terminal 3.8: Process supply voltage UP3 = +24 VDC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

CAUTION!
Risk of malfunction by not intended usage!
If the function cut off of the digital outputs should be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0...DO7.

The assignment of the other terminals:

Terminal	Signal	Description
1.0	AI0+	Plus pole of analog input signal 0
1.1	AI1+	Plus pole of analog input signal 1
1.2	AI2+	Plus pole of analog input signal 2
1.3	AI3+	Plus pole of analog input signal 3
1.4	AI-	Minus pole of analog input signals 0 to 3
1.5	AO0+	Plus pole of analog output signal 0
1.6	AO1+	Plus pole of analog output signal 1
1.7	AI-	Minus pole of analog output signals 0 and 1
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5

Terminal	Signal	Description
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	DO0	Signal of the digital output DO0
3.1	DO1	Signal of the digital output DO1
3.2	DO2	Signal of the digital output DO2
3.3	DO3	Signal of the digital output DO3
3.4	DO4	Signal of the digital output DO4
3.5	DO5	Signal of the digital output DO5
3.6	DO6	Signal of the digital output DO6
3.7	DO7	Signal of the digital output DO7
3.8	UP3	Process voltage UP3 (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

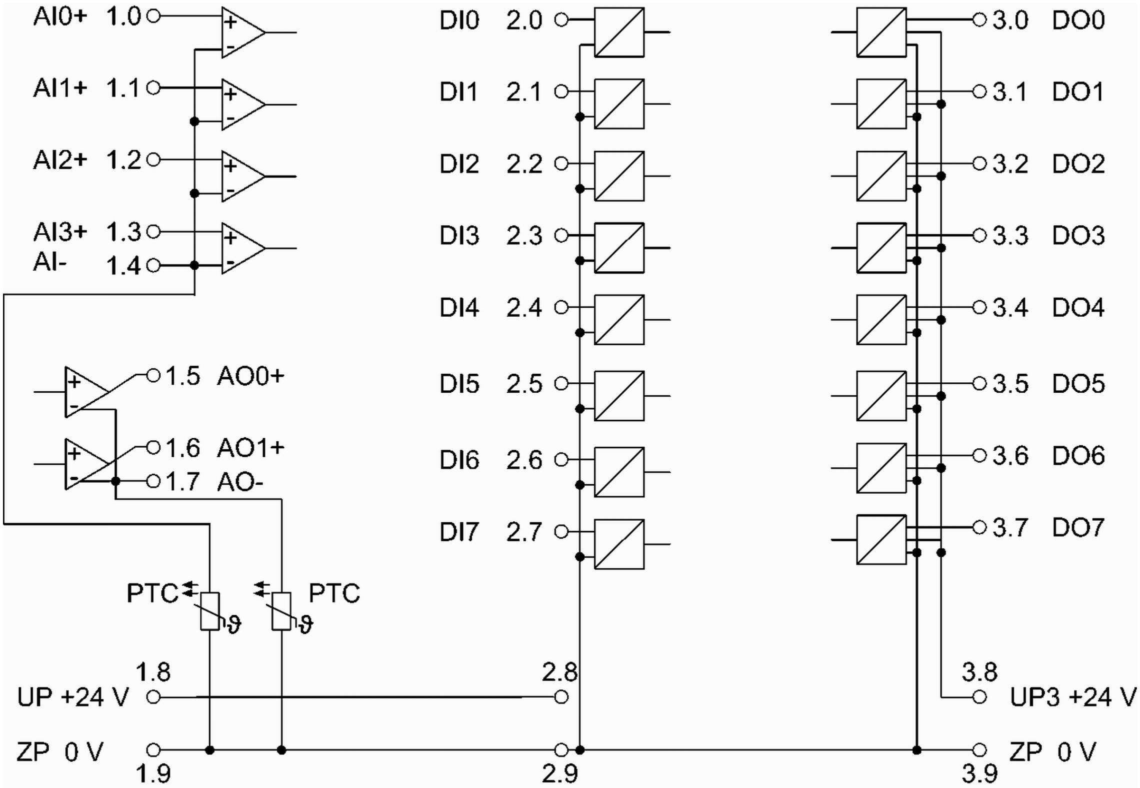
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (cut wire), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be earthed at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

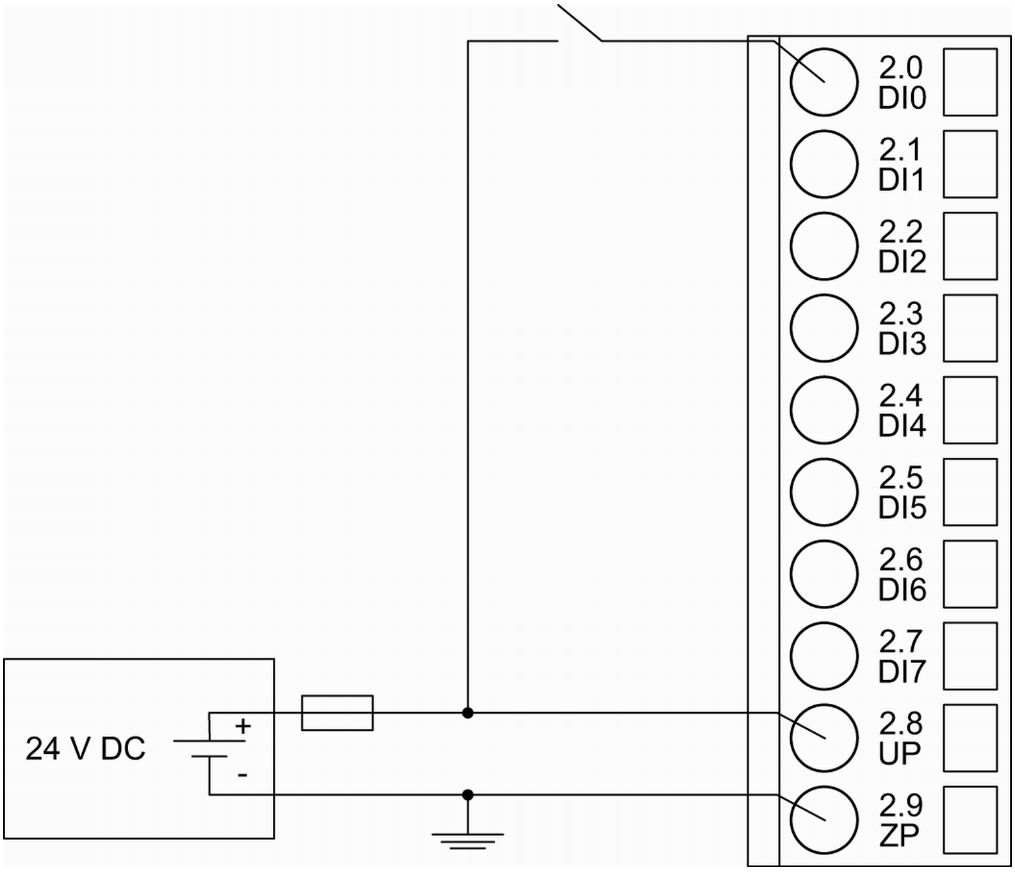
The following figures show the electrical connection of the Ethernet bus module CI501-PNIO.



Further information is provided in the System Technology chapter *PROFINET*.

Connection of the Digital Inputs

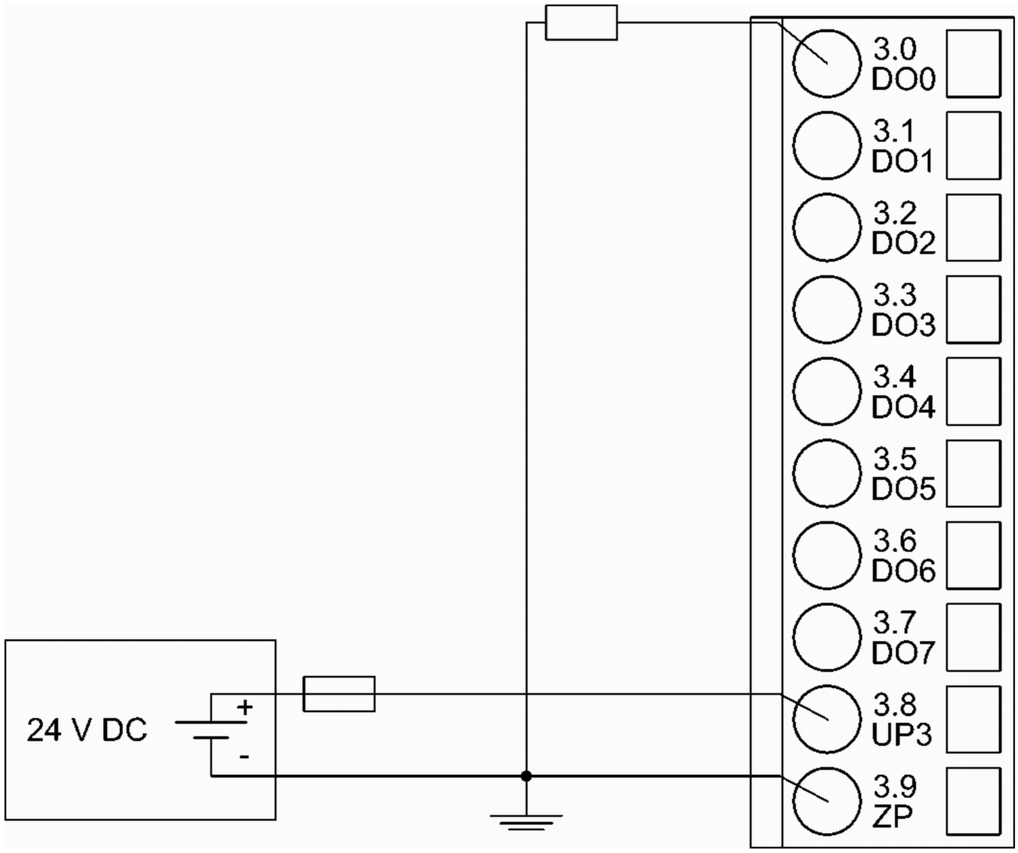
The following figure shows the electrical connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.



The meaning of the LEDs is described in Displays *Chapter 1.7.6.2.8.2 “State LEDs” on page 1037*.

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO0. Proceed with the digital outputs DO1 - DO7 in the same way.

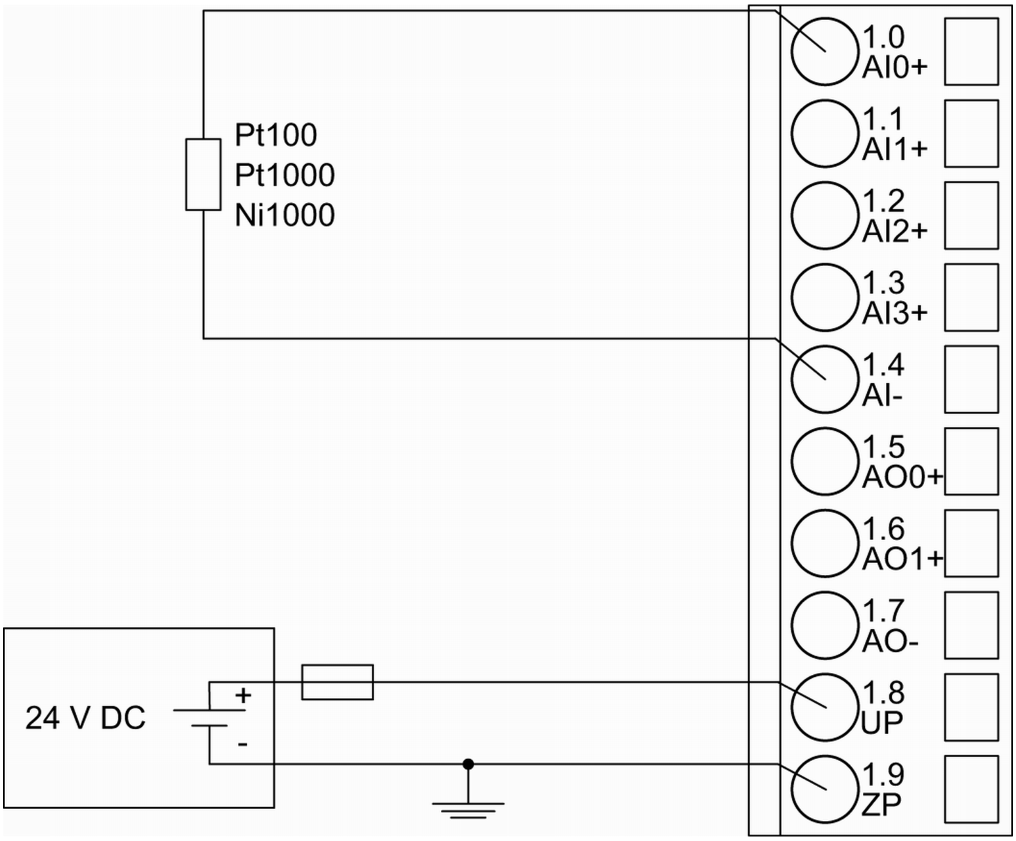


The meaning of the LEDs is described in Displays ➪ *Chapter 1.7.6.2.8.2 “State LEDs” on page 1037*.

Connection of Resistance Thermometers in 2-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI501-PNIO provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ⇘ *Chapter 1.7.6.2.7 “Parameterization” on page 1026* ⇘ *Chapter 1.7.6.2.9.1 “Input Ranges Voltage, Current and Digital Input” on page 1039*:

Pt100	-50 °C...+400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.6.2.8 “Diagnosis and State LEDs” on page 1032*.

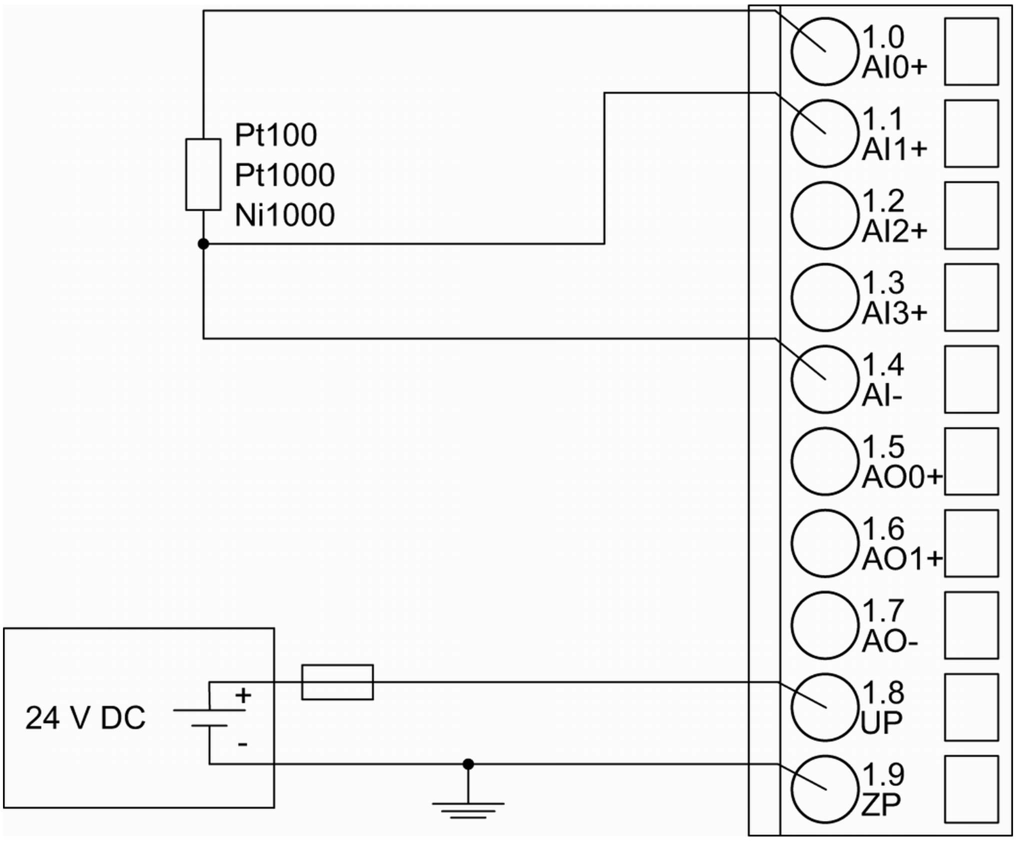
The module CI501-PNIO performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Resistance Thermometers in 3-wire Configuration to the Analog Inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI501-PNIO provides a constant current source which is multiplexed over the max. 4 analog input channels.

The following figure shows the connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1. Proceed with the analog inputs AI2 and AI3 in the same way.



With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.7.6.2.7 “Parameterization” on page 1026* *Chapter 1.7.6.2.9.1 “Input Ranges Voltage, Current and Digital Input” on page 1039*:

Pt100	-50 °C...+70 °C	3-wire configuration, 2 channels used
Pt100	-50 °C...+400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C...+400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C...+150 °C	3-wire configuration, 2 channels used

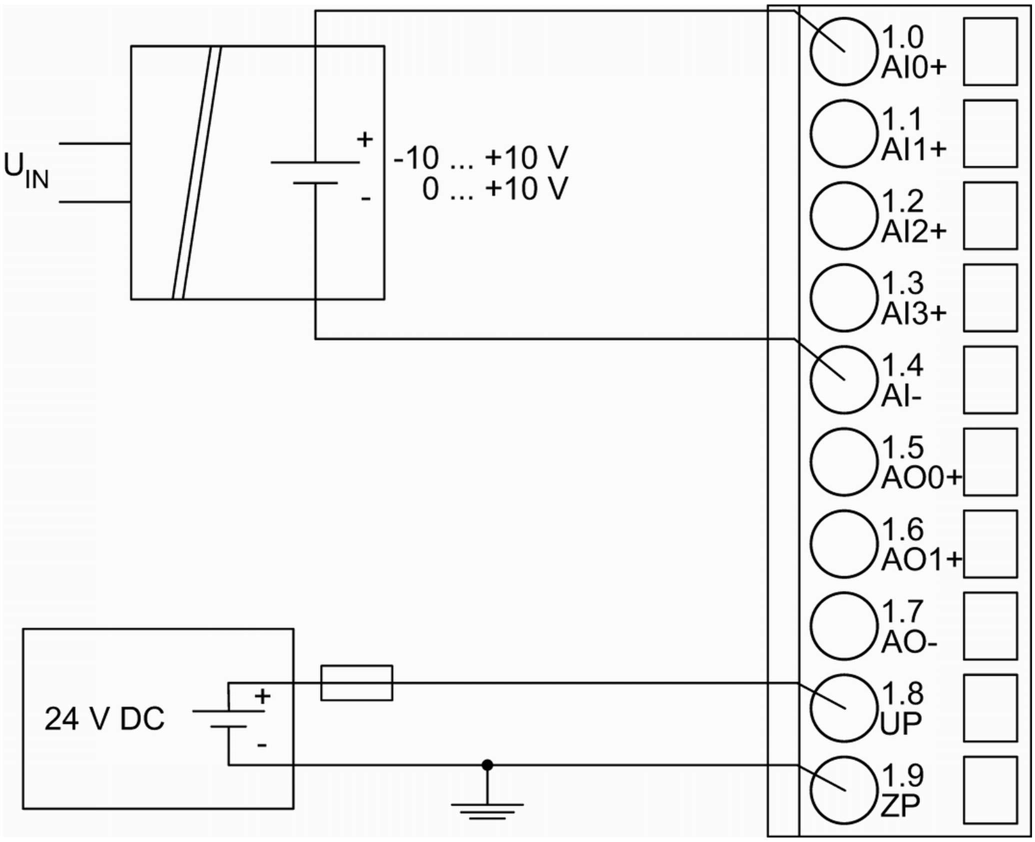
The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.6.2.8 “Diagnosis and State LEDs” on page 1032*.

The module CI501-PNIO performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Voltage) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured *Chapter 1.7.6.2.7 “Parameterization” on page 1026* *Chapter 1.7.6.2.9.1 “Input Ranges Voltage, Current and Digital Input” on page 1039*:

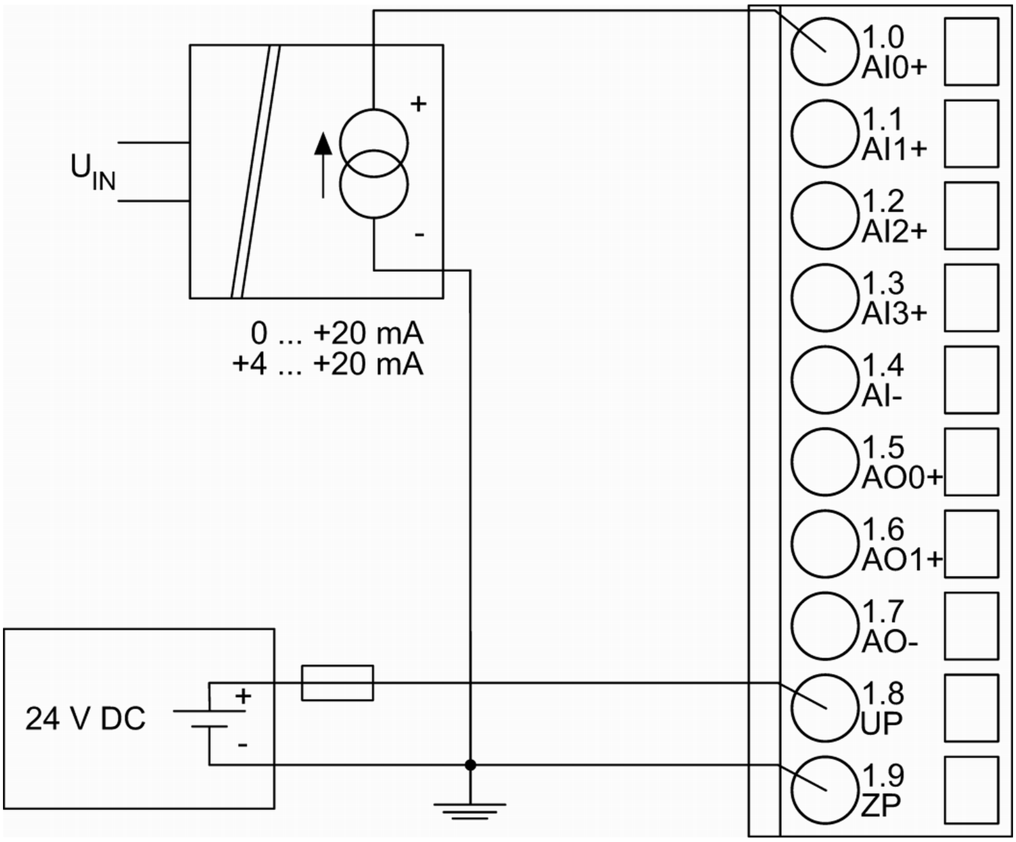
Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.6.2.8 “Diagnosis and State LEDs” on page 1032.*

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Active-type Analog Sensors (Current) with Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (current) with electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ␓ *Chapter 1.7.6.2.7 “Parameterization” on page 1026* ␓ *Chapter 1.7.6.2.9.1 “Input Ranges Voltage, Current and Digital Input” on page 1039*:

Current	0 mA...20 mA	1 channel used
Current	4 mA...20 mA	1 channel used

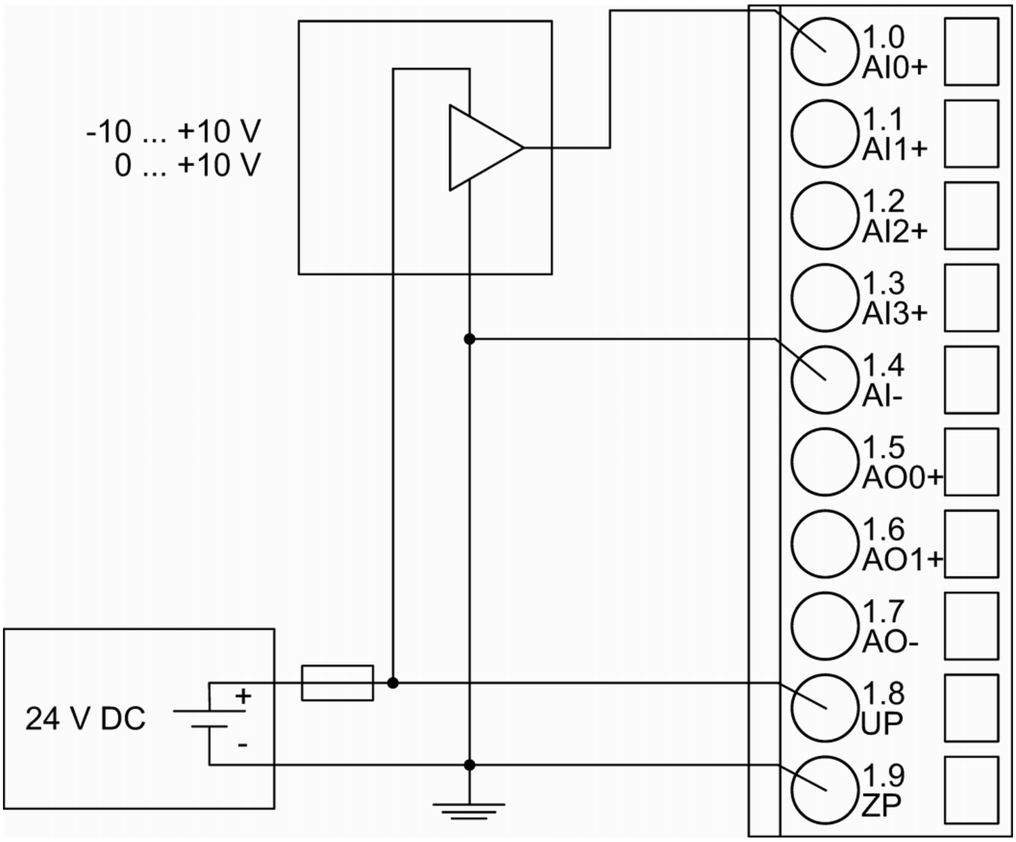
The function of the LEDs is described under Diagnosis and displays / Displays ␓ *Chapter 1.7.6.2.8 “Diagnosis and State LEDs” on page 1032*.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA...20 mA, these channels should be configured as "Not used".

Connection of Active-type Analog Sensors (Voltage) with no Electrically Isolated Power Supply to the Analog Inputs

The following figure shows the connection of active-type analog sensors (voltage) with no electrically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



CAUTION!
Risk of faulty measurements!
The minus pole at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V).

Make sure that the potential difference never exceeds ±1 V (also not with long cable lengths).

The following measuring ranges can be configured ⇘ *Chapter 1.7.6.2.7 "Parameterization" on page 1026* ⇘ *Chapter 1.7.6.2.7 "Parameterization" on page 1026*:

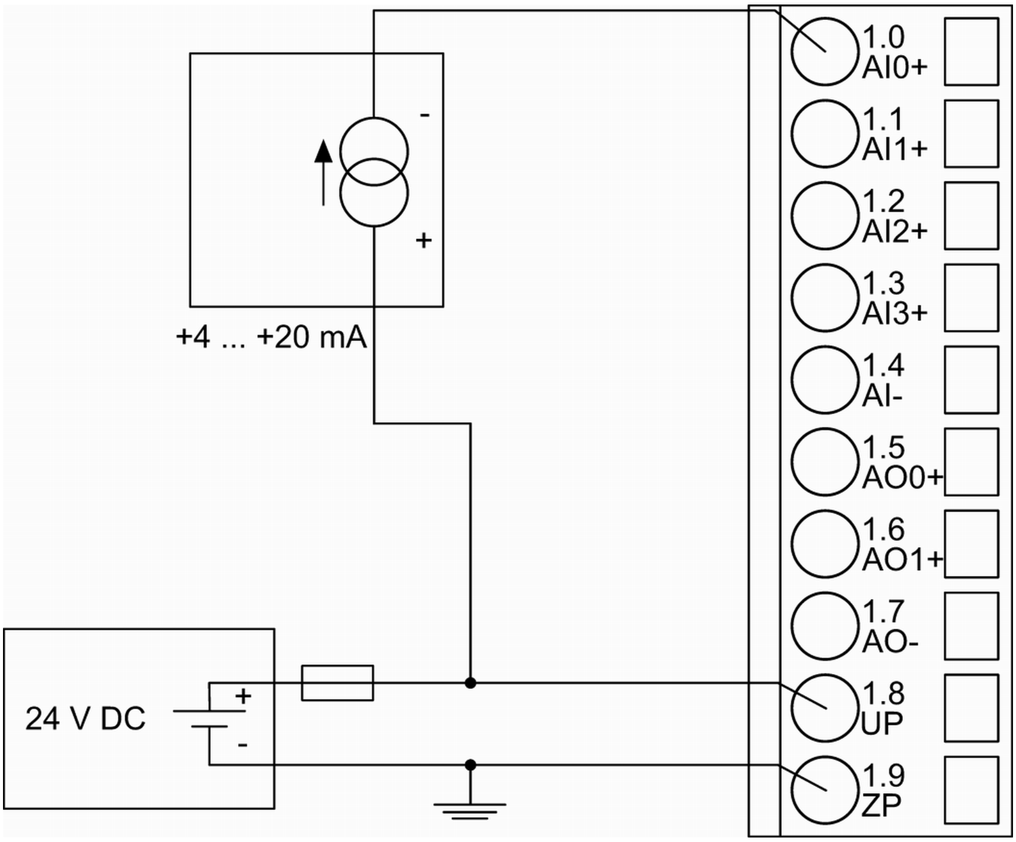
Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.6.2.8 "Diagnosis and State LEDs" on page 1032*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of Passive-type Analog Sensors (Current) to the Analog Inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured *Chapter 1.7.6.2.7 "Parameterization" on page 1026* *Chapter 1.7.6.2.9.1 "Input Ranges Voltage, Current and Digital Input" on page 1039*:

Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.6.2.8 "Diagnosis and State LEDs" on page 1032*.

CAUTION!
Risk of overloading the analog input!
If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA...20 mA, these channels should be configured as "Not used".

Connection of Active-type Analog Sensors (Voltage) to Differential Analog Inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely earthed).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid earthing loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

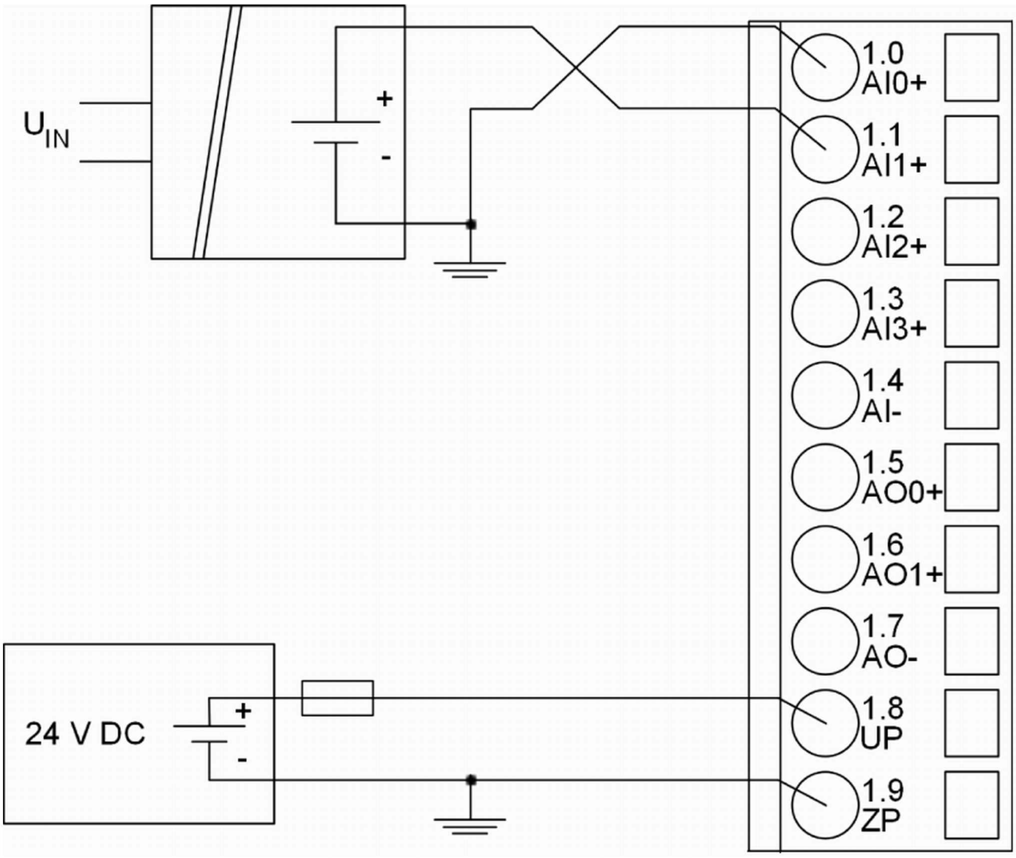
The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
Risk of faulty measurements!
The minus pole at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V).

Make sure that the potential difference never exceeds ±1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.



The following measuring ranges can be configured *Chapter 1.7.6.2.7 "Parameterization" on page 1026* *Chapter 1.7.6.2.9.1 "Input Ranges Voltage, Current and Digital Input" on page 1039*:

Voltage	0 V...10 V	With differential inputs, 2 channels used
Voltage	-10 V...+10 V	With differential inputs, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.6.2.8 "Diagnosis and State LEDs" on page 1032*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of Analog Inputs as Digital Inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not electrically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

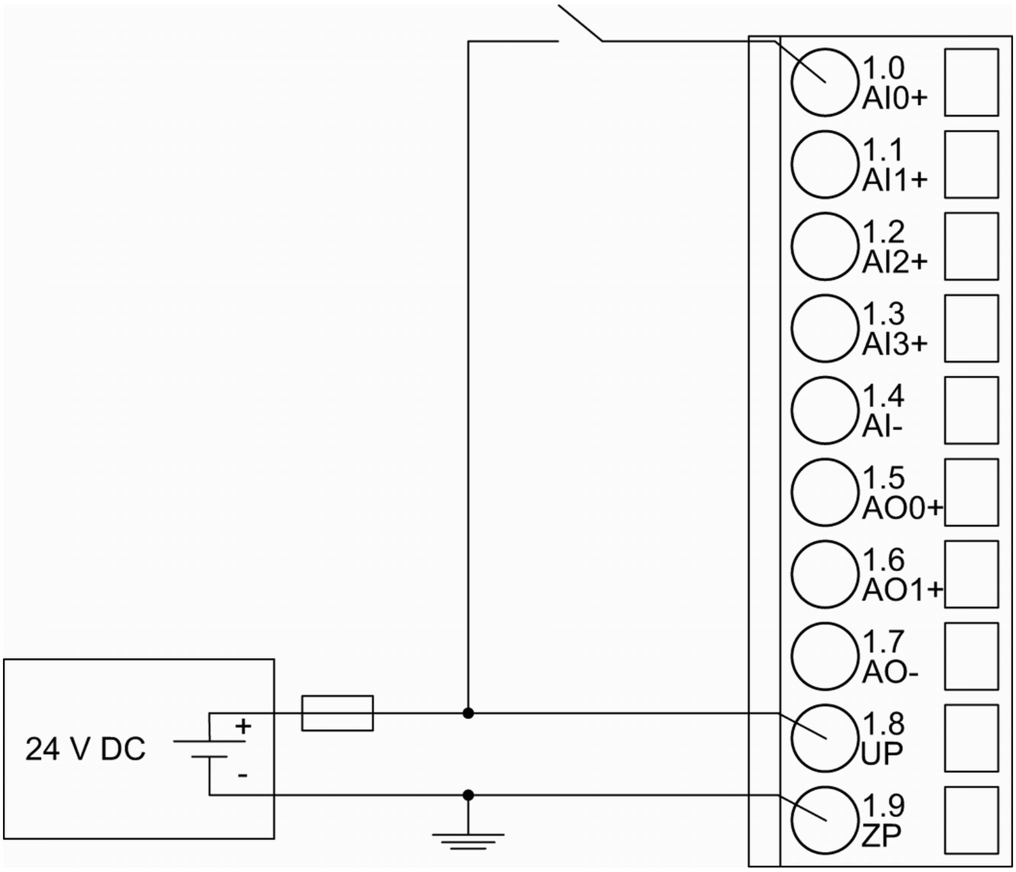


Fig. 190: Use of analog inputs as digital inputs

The following measuring ranges can be configured ⇘ *Chapter 1.7.6.2.7 “Parameterization” on page 1026* ⇘ *Chapter 1.7.6.2.9.1 “Input Ranges Voltage, Current and Digital Input” on page 1039* :

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.6.2.8 “Diagnosis and State LEDs” on page 1032.*

Connection of Analog Output Loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

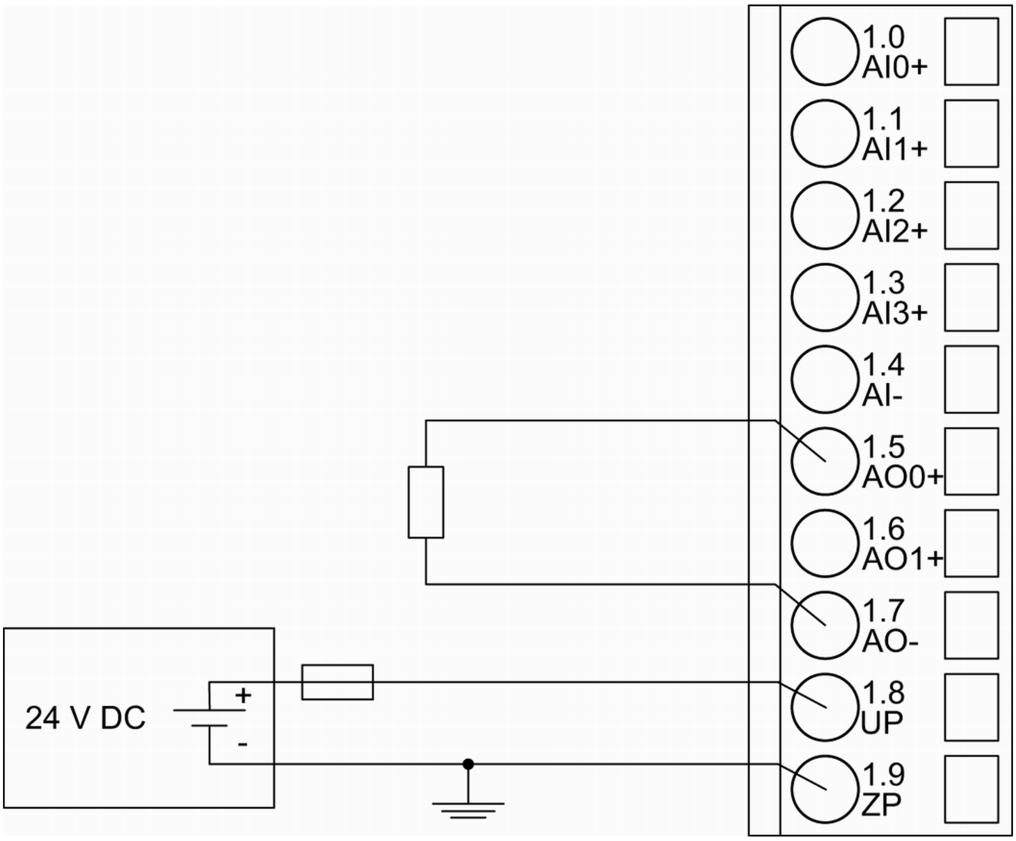


Fig. 191: Connection of analog output loads (voltage)

The following measuring ranges can be configured ↳ *Chapter 1.7.6.2.7 "Parameterization" on page 1026* ↳ *Chapter 1.7.6.2.9.1 "Input Ranges Voltage, Current and Digital Input" on page 1039*

Voltage	-10 V...+10 V	Load ±10 mA max.	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 1.7.6.2.8 "Diagnosis and State LEDs" on page 1032.*

Unused analog outputs can be left open-circuited.

Connection of Analog Output Loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

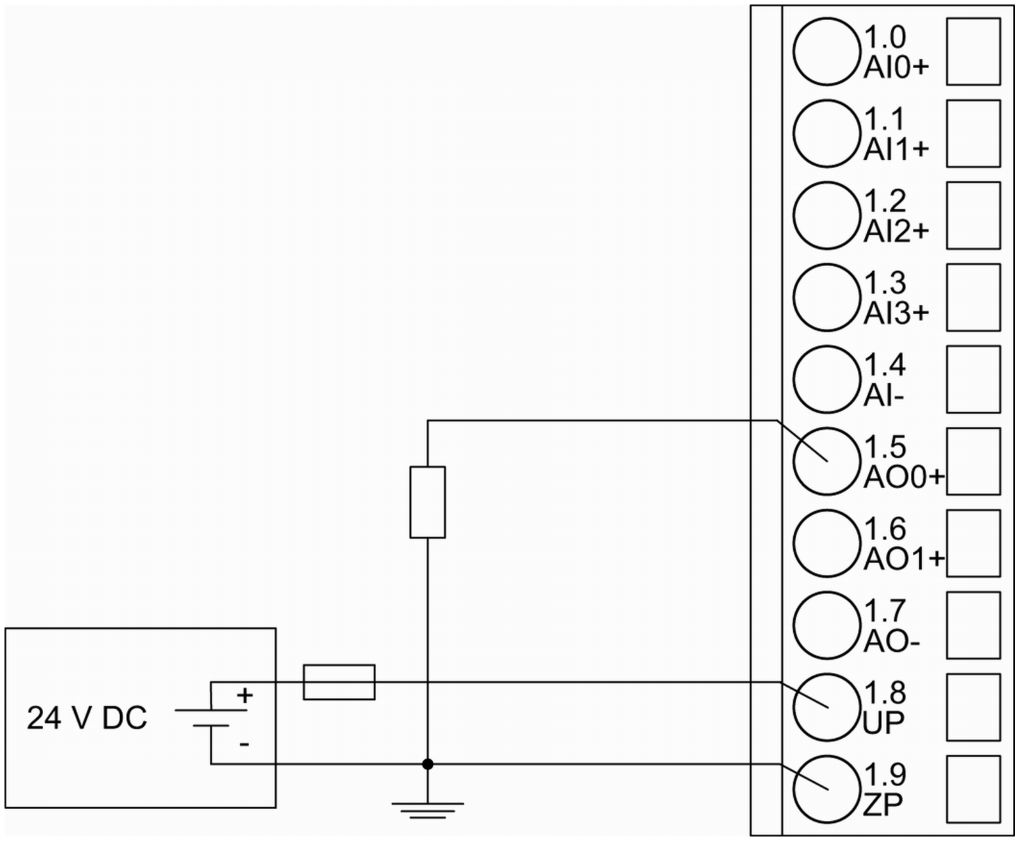


Fig. 192: Connection of analog output loads (current)

The following measuring ranges can be configured ⇘ *Chapter 1.7.6.2.7 “Parameterization” on page 1026* ⇘ *Chapter 1.7.6.2.9.1 “Input Ranges Voltage, Current and Digital Input” on page 1039*:

Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

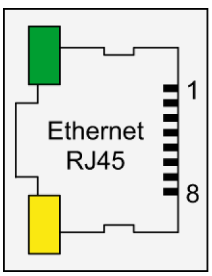
The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.6.2.8 “Diagnosis and State LEDs” on page 1032*.

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet Ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Table 165: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -

Interface	Pin	Signal	Description
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet *➪ Chapter 2.6.4.10 "Ethernet Connection Details" on page 1292.*

1.7.6.2.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

1.7.6.2.5 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

1.7.6.2.6 I/O Configuration

The CI501-PNIO stores some PROFINET configuration parameters (I/O device identifier, I/O device type and IP address configuration). No more configuration data is stored.

The analog/digital I/O channels are configured via software.

Details about configuration are described in Parameterization *➪ Chapter 1.7.6.2.7 "Parameterization" on page 1026*.

1.7.6.2.7 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7000	WORD	7000
Parameter length	Internal	25	BYTE	25
Error LED / Fail-safe function see	On	0	BYTE	0

Name	Value	Internal value	Internal value, type	Default
table Error LED / Failsafe function ↳ *Table 166 “Error LED / Failsafe function” on page 1028*	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Process cycle time [2])	1 ms process cycle time	1	BYTE	1 ms
	2 ms process cycle time	2		
	3 ms process cycle time	3		
	4 ms process cycle time	4		
	5 ms process cycle time	5		
	6 ms process cycle time	6		
	7 ms process cycle time	7		
	8 ms process cycle time	8		
	9 ms process cycle time	9		
	10 ms process cycle time	10		
	11 ms process cycle time	11		
	12 ms process cycle time	12		
	13 ms process cycle time	13		
	14 ms process cycle time	14		
	15 ms process cycle time	15		
	16 ms process cycle time	16		
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [3])	0 : 10	BYTE	0

Remarks:

[1])	With a faulty ID, the modules reports a "parameter error" and does not perform cyclic process data transmission.
[2])	As for device index C0 the parameter is no longer evaluated.
[3])	Counter operating modes, see description of the Fast counter *Chapter 1.5.1.2.10 “Fast Counter” on page 396*.

Table 166: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameters Behaviour AO at comm. error and Behaviour DO at comm. error are only analyzed if the Failsafe-mode is ON.	

Group Parameters for the Analog Part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.				

Channel Parameters for the Analog Inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Table Operating modes of the analog inputs *Table 167 "Channel Configuration" on page 1029*	Table Operating modes of the analog inputs *Table 167 "Channel Configuration" on page 1029*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 168 "Channel Monitoring" on page 1030*	Table Channel montoring *Table 168 "Channel Monitoring" on page 1030*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 167 "Channel Configuration" on page 1029*	Table Operating modes of the analog inputs *Table 167 "Channel Configuration" on page 1029*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 168 "Channel Monitoring" on page 1030*	Table Channel montoring *Table 168 "Channel Monitoring" on page 1030*	BYTE	0

Table 167: Channel Configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V...10 V
2	Digital input
3	0 mA...20 mA
4	4 mA...20 mA
5	-10 V...+10 V
8	2-wire Pt100 -50 °C...+400 °C
9	3-wire Pt100 -50 °C...+400 °C *)
10	0 V...10 V (voltage diff.) *)
11	-10 V...+10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C...+70 °C
15	3-wire Pt100 -50 °C...+70 °C *)
16	2-wire Pt1000 -50 °C...+400 °C
17	3-wire Pt1000 -50 °C...+400 °C *)
18	2-wire Ni1000 -50 °C...+150 °C

Internal value	Operating modes of the analog inputs, individually configurable
19	3-wire Ni1000 -50 °C...+150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 168: Channel Monitoring

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel Parameters for the Analog Outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Table Operating modes of the analog outputs *Further information on page 1031*	Table Operating modes of the analog outputs *Further information on page 1031*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 170 “Channel Monitoring” on page 1031*	Table Channel monitoring *Table 170 “Channel Monitoring” on page 1031*	BYTE	0
Output 0, Substitute value	Table Substitute value *Table 171 “Substitute Value” on page 1031*	Table Substitute value *Table 171 “Substitute Value” on page 1031*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs *Further information on page 1031*	Table Operating modes of the analog outputs *Further information on page 1031*	BYTE	0
Output 1, Check channel	Table Channel monitoring *Table 170 “Channel Monitoring” on page 1031*	Table Channel monitoring *Table 170 “Channel Monitoring” on page 1031*	BYTE	0
Output 1, Substitute value	Table Substitute value *Table 171 “Substitute Value” on page 1031*	Table Substitute value *Table 171 “Substitute Value” on page 1031*	WORD	0

Table 169: Channel Configuration

Internal value	Operating modes of the analog outputs, individually configu-rable
0 (default)	Not used
128	-10 V...+10 V
129	0 mA...20 mA
130	4 mA...20 mA

Table 170: Channel Monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 171: Substitute Value

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behav-iour of outputs in case of a communication error"	Required setting of the channel parameter "Substi-tute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short cir-cuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0...255	00h...FFh	BYTE	0 0x0000
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	On 0x01
[1]) The parameters Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON. [2]) The state "externally voltage detected" appears, if the output of a channel DC0...DC7 should be switched on while an externally voltage is connected ➮ *Chapter 1.7.6.2.3 “Electrical Connection” on page 1010*. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".				

1.7.6.2.8 Diagnosis and State LEDs

Structure of the Diagnosis Block via PNIO_DEV_ALARM Function Block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI501-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6...7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 4 Bit 6...7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0...5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error-Identi-fier	Error message	Remedy
	1)	2)	3)				
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	No process voltage UP	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O device type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot-swap terminal unit or defective module on hot-swap ter-minal unit 9)	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot-swap terminal unit 9)	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot-swap terminal unit 9)	Replace I/O module

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6...7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	1...10	31	5	54	I/O module does not support hot swap 8) 9)	Power off system and replace I/O module
4	-	1...10	31	6	42	No communication with hot-swap ter-minal unit 9)	Restart, if error persists replace terminal unit
4	-	31	31	31	46	Voltage feedback on activated digital outputs DO0...DO7 on UP3 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work	Check cabeling
4	-	31	31	31	45	No process voltage UP3	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) 5)	Check termi-nals/ check process supply voltage
Channel error digital							

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6...7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-** **Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	31	2	0...7	46	Externally voltage detected at digital output DO0...DO7 6)	Check terminals
4	-	31	2	0...7	47	Short circuit at digital output 7)	Check terminals
Channel error analog							
4	-	31	1	0...3	48	Analog value overflow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0...3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0...3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0...1	4	Analog value overflow at an analog output	Check output value
4	-	31	3	0...1	7	Analog value underflow at an analog output	Check output value

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0...4 or 10 = Position of the communication module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI501-PNIO diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself; 1...10 = Expansion module
3)	With "Module" the following allocation applies: 31 = Module itself Module type (1 = AI, 2 = DO, 3 = AO)

[4])	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage ↬ *Chapter 1.7.6.2.3 “Electrical Connection” on page 1010*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage on digital outputs DO0...DO7 has overrun the process supply voltage UP3 ↬ *Chapter 1.7.6.2.3 “Electrical Connection” on page 1010*. Diagnosis message appears for the whole module.
[6])	This message appears, if the output of a channel DO0...DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 100 ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot-swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 172: States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--

LED	Color	OFF	ON	Flashing
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 173: States of the 27 Process LEDs

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.6.2.9 Measuring Ranges

Input Ranges Voltage, Current and Digital Input

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Overflow	>11.7589	>11.7589	>23.5178	>22.8142	
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006	
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On
	0.0000	0.0000	0	4	Off
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994 : 0	
Measured value too low		-10.0004 : -11.7589			
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000	

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	27648 : 1	6C00 : 0001
	0	0000
	-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	-32768	8000

The represented resolution corresponds to 16 bits.

Input Range Resistor

Range	Pt100 / Pt1000 -50...+70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C
Overflow	> 80.0 °C	> 450.0 °C	> 160.0 °C
Measured value too high	80.0 °C	450.0 °C : 400.1 °C	
			160.0 °C : 150.1 °C
Normal range		400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C
		0.0 °C	0.0 °C
		-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low	< -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001

Range	Digital value	
	Decimal	Hex.
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output Ranges Voltage and Current

Range	-10...+10 V	0...20 mA	4...20 mA
Overflow	> 11.7589 V	> 23.5178 mA	> 22.8142 mA
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	< -11.7589 V	0 mA	0 mA

Range	Digital value	
	Decimal	Hex.
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000

Range	Digital value	
	Decimal	Hex.
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.7.6.2.10 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Input data length		2 bytes

Parameter	Value
Output data length	2 bytes
Reference potential for all digital inputs and outputs	Minus pole of the supply voltage, signal name ZP
Setting of the IO device identifier	With 2 rotary switches at the front side of the module
Diagnose	See Diagnosis and Displays *Chapter 1.7.6.2.8 “Diagnosis and State LEDs” on page 1032*
Operation and error displays	32 LEDs (totally)
Weight (without terminal unit)	Ca. 125 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Extended ambient temperature (XC version)	>60 °C on request
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name

Parameter	Value
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Electrical isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical Data of the Digital Inputs

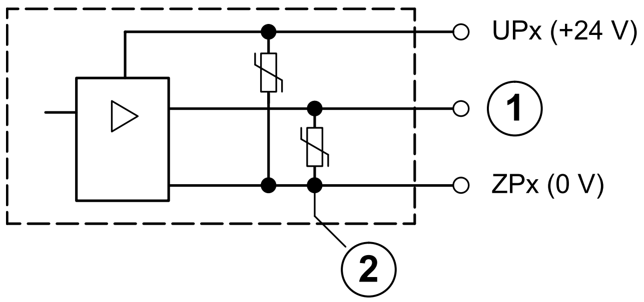
Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 to DI7		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA

Parameter		Value
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 to DO7		Terminals 3.0 to 3.7
Reference potential for all outputs		Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical Data of the Analog Inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group with 4 channels
Connection if channels AI0+ to AI3+	Terminals 1.0 to1.3
Reference potential for AI0+ to AI3+	Terminal 1.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9 and 3.9 for current measurement
Input type	
Unipolar	Voltage 0 V... 10 V, current or Pt100/Pt1000/ Ni1000
Bipolar	Voltage -10 V... +10 V
Electrical isolation	Against Ethernet network
Configurability	0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution	Range 0 V...10 V: 12 bits Range -10 V...+10 V: 12 bits + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	Tables Input ranges voltage, current and digital input and Input range resistor ⇨ *Chapter 1.7.6.2.9.1 "Input Ranges Voltage, Current and Digital Input" on page 1039*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical Data of the Analog Inputs, if used as Digital Inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 1.0 to 1.3
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical Data of the Analog Outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 1.5...1.6
Reference potential for AO0+ to AO1+		Terminal 1.7 (AO-) for voltage output terminal 1.9, 2.9 and 3.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Electrical isolation		Against internal supply and other modules
Configurability		-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω...500 Ω
Output loadability, as voltage output		±10 mA max.

Parameter	Value
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Table Output ranges voltage and current *Chapter 1.7.6.2.9.3 "Output Ranges Voltage and Current" on page 1041*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 2.0 (DI0), 2.1 (DI1)
Used outputs	Terminal 3.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	See Fast Counter
Operating modes	See Operating Modes

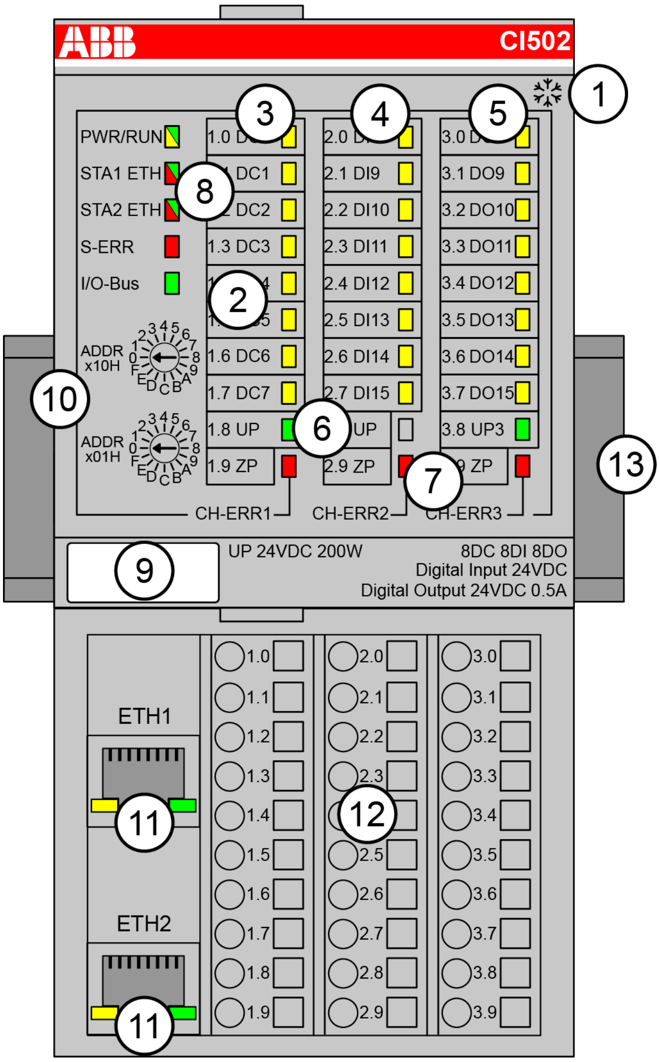
1.7.6.2.11 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 220 600 R0001	CI501-PNIO (V3), PROFINET bus module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 420 600 R0001	CI501-PNIO-XC (V3), PROFINET bus module, 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.6.3 CI502-PNIO (-XC)

- 8 digital inputs 24 VDC
- 8 digital outputs 24 VDC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 VDC, 0.5 A max.
- Module-wise electrically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 - DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 - DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 - DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the IO device identifier
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.6.3.1 Intended Purpose

The PROFINET bus module CI502-PNIO is used as communication interface module in PROFINET networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.7.6.3.2 Functionality

The CI502 Bus Module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs
- 8 digital inputs: 24 VDC
- 8 digital outputs: 24 VDC, 0.5 A max.

The inputs/outputs are electrically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

Parameter	**Value**
Interface	Ethernet
Protocol	PROFINET IO RT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	For setting the IO device identifier for configuration purposes (00h to FFh)
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 VDC; delay time configurable via software)
Digital outputs	8 (24 VDC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507-ETH or TU508-ETH *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*

1.7.6.3.3 Electrical Connection

The Ethernet bus module CI502-PNIO is plugged on the I/O terminal unit TU507-ETH *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144* or TU508-ETH *Chapter 1.4.1 “TU507-ETH and TU508-ETH for Ethernet Communication Interface Modules” on page 144*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 VDC

Terminal 3.8: Process supply voltage UP3 = +24 VDC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V.

The assignment of the other terminals:

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0..DC7 or DO0..DO7 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

This limitation does not apply for the input channels DI0..DI7.

CAUTION!
Risk of malfunction by not intended usage!
If the function cut off of the digital outputs should be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0...DO7 and DC0...DC7.

The assignment of the other terminals:

Terminal	Signal	Description
1.0	DC0	Signal of the configurable digital input/output DC0
1.1	DC1	Signal of the configurable digital input/output DC1
1.2	DC2	Signal of the configurable digital input/output DC2
1.3	DC3	Signal of the configurable digital input/output DC3
1.4	DC4	Signal of the configurable digital input/output DC4
1.5	DC5	Signal of the configurable digital input/output DC5

Terminal	Signal	Description
1.6	DC6	Signal of the configurable digital input/output DC6
1.7	DC7	Signal of the configurable digital input/output DC7
1.8	UP	Process voltage UP (24 VDC)
1.9	ZP	Process voltage ZP (0 VDC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 VDC)
2.9	ZP	Process voltage ZP (0 VDC)
3.0	DO8	Signal of the digital output DO8
3.1	DO9	Signal of the digital output DO9
3.2	DO10	Signal of the digital output DO10
3.3	DO11	Signal of the digital output DO11
3.4	DO12	Signal of the digital output DO12
3.5	DO13	Signal of the digital output DO13
3.6	DO14	Signal of the digital output DO14
3.7	DO15	Signal of the digital output DO15
3.8	UP3	Process voltage UP3 (24 VDC)
3.9	ZP	Process voltage ZP (0 VDC)

WARNING!
Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

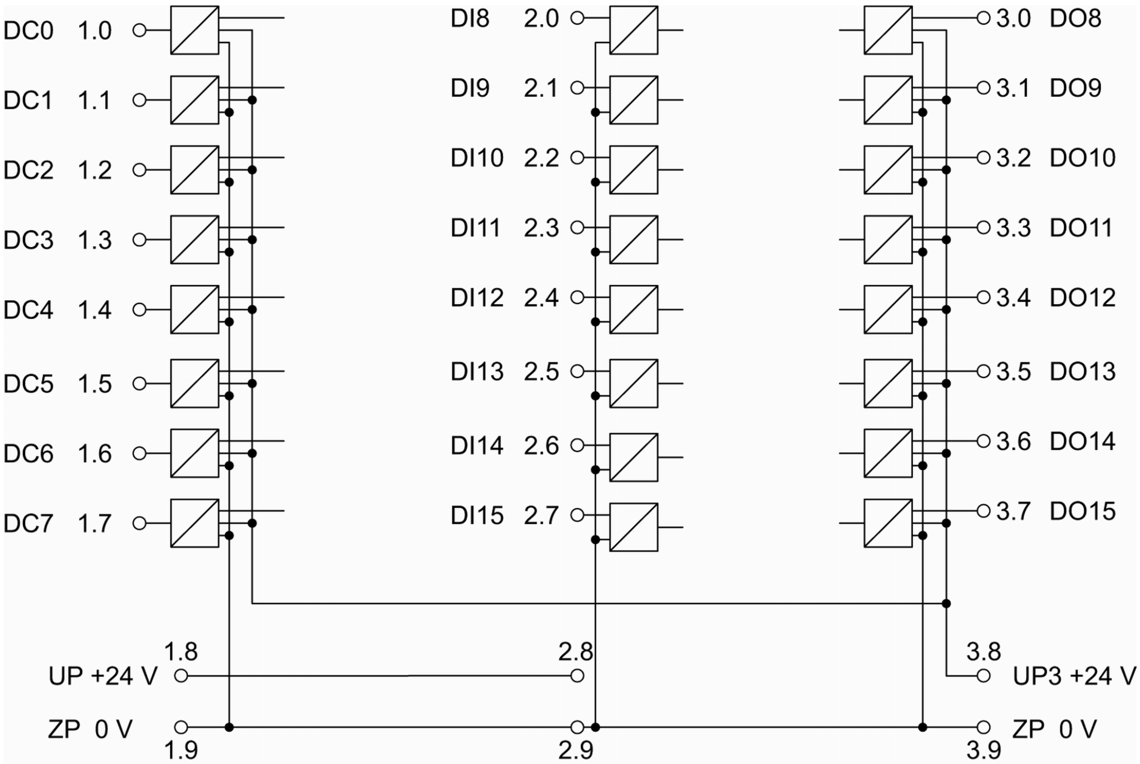
Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

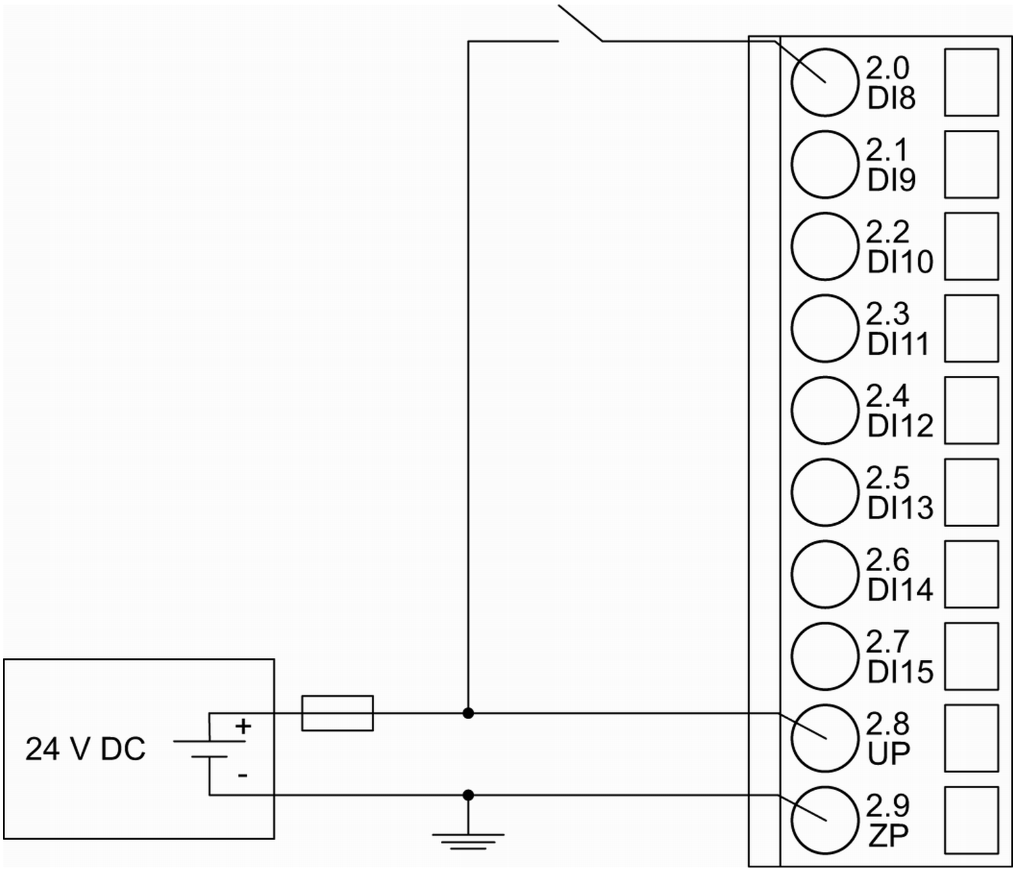
The following figure shows the electrical connection of the Ethernet bus module CI502-PNIO.



Further information is provided in the System Technology chapter *PROFINET*.

Connection of the Digital Inputs

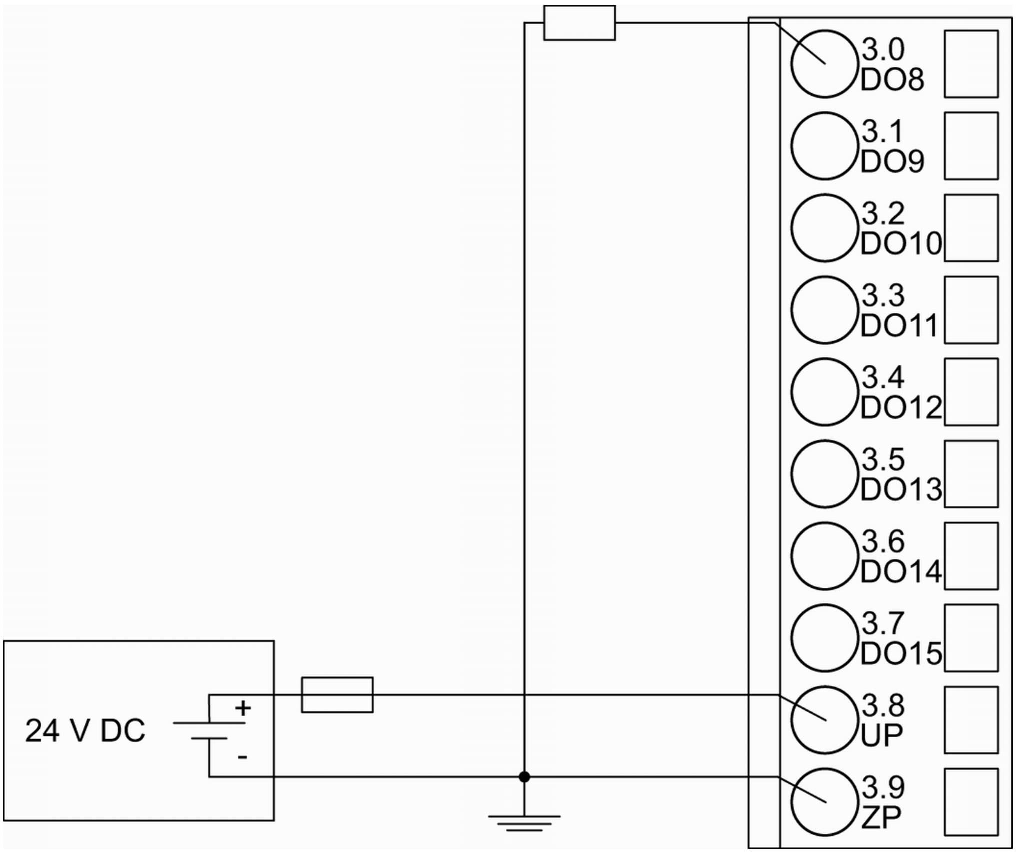
The following figure shows the electrical connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.



The meaning of the LEDs is described in Displays ↳ *Chapter 1.7.6.3.8.1 “State LEDs” on page 1064*.

Connection of the Digital Outputs

The following figure shows the electrical connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.

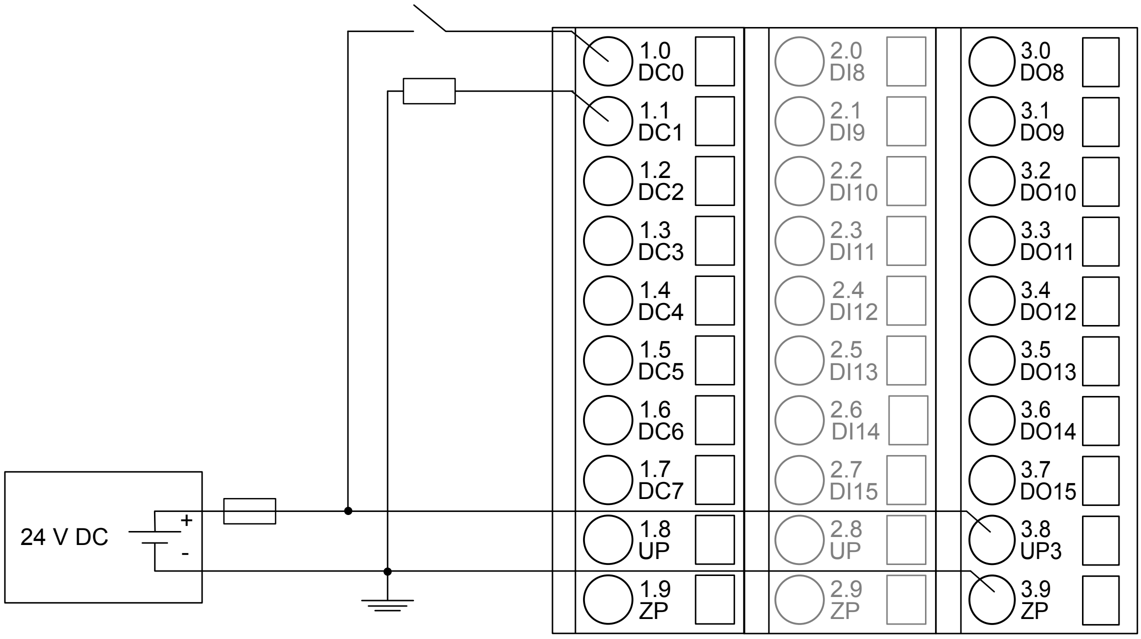


The meaning of the LEDs is described in Displays *Chapter 1.7.6.3.8.1 “State LEDs” on page 1064*.

Connection of the Configurable Digital Inputs/Outputs

The following figure shows the electrical connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 to DC7 in the same way.

> **CAUTION!**
> If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device *Chapter 1.7.6.3.3 "Electrical Connection" on page 1050*.

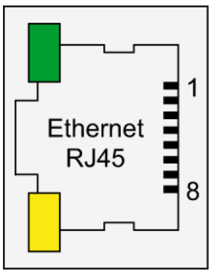


The meaning of the LEDs is described in Displays *Chapter 1.7.6.3.8.1 "State LEDs" on page 1064*.

Assignment of the Ethernet Ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Table 174: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet ⇨ Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.

1.7.6.3.4 Internal Data Exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.7.6.3.5 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

1.7.6.3.6 I/O Configuration

The CI502-PNIO stores some PROFINET configuration parameters (I/O device identifier, I/O device type and IP address configuration). No more configuration data is stored.

The digital I/O channels are configured via software.

Details about configuration are described in Parameterization ⇨ *Chapter 1.7.6.3.7 “Parameterization” on page 1057*.

1.7.6.3.7 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7005	WORD	7005
Parameter length	Internal	8	BYTE	8
Error LED / Failsafe function (Table Error LED / Failsafe function ⇨ *Further information on page 1057*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	19		

Name	Value	Internal value	Internal value, type	Default
Process cycle time	1 ms process cycle time	1	BYTE	1 ms
	2 ms process cycle time	2		
	3 ms process cycle time	3		
	4 ms process cycle time	4		
	5 ms process cycle time	5		
	6 ms process cycle time	6		
	7 ms process cycle time	7		
	8 ms process cycle time	8		
	9 ms process cycle time	9		
	10 ms process cycle time	10		
	11 ms process cycle time	11		
	12 ms process cycle time	12		
	13 ms process cycle time	13		
	14 ms process cycle time	14		
	15 ms process cycle time	15		
	16 ms process cycle time	16		
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [2])	0 : 10	BYTE	0
[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission. [2]) Counter operating modes ➡ *Chapter 1.5.1.2.10 “Fast Counter” on page 396*				

Table 175: Table Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.	

Group Parameters for the Digital Part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0...65535	0000h...FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0..DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

1)	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
2)	The state "externally voltage detected" appears, if the output of a channel DC0...DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
3)	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0...DC7 and accordingly DO0...DO7 has exceeded the process supply voltage UP3 *Chapter 1.7.6.3.3 "Electrical Connection" on page 1050* (see description in section). The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage.

1.7.6.3.8 Diagnosis

Structure of the Diagnosis Block via *PNIO_DEV_ALARM* Function Block.

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI502-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6...7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O device type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6...7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	1...10	31	5	8	I/O module removed from hot-swap terminal unit or defective module on hot-swap ter-minal unit [9])	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot-swap terminal unit [9])	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot-swap terminal unit [9])	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])	Power off system and replace I/O module
4	-	1...10	31	6	42	No communication with hot-swap ter-minal unit [9])	Restart, if error persists replace terminal unit
4	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work	Check cabeling
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6...7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
4	-	31	31	31	46	Reverse voltage from digital outputs DO0..DO7 to UP3 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) 5)	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0..DO7 6)	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0..DC7 6)	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output 7)	Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0...4 or 10 = Position of the Communication Module;14 = I/O-Bus; 31 = Module itself The identifier is not contained in the CI502-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1..10 = Expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DC0...DC7 oder DO0...DO7 cause that other digital outputs are supplied through that voltage (voltage feedback, see description in Electrical Connection *Chapter 1.7.6.3.3 "Electrical Connection" on page 1050*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0...DC7 and accordingly DO0...DO7 has exceeded the process supply voltage UP3 *Chapter 1.7.6.3.3 "Electrical Connection" on page 1050*. Diagnosis message appears for the whole module.
[6])	This message appears, if the output of a channel DC0...DC7 or DO0...DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 2000 ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn't support hot swapping, do not perform any hot-swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 176: States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System-LED "BF")	Green	---	Device configured, cyclic data exchange running	---

LED	Color	OFF	ON	Flashing
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 177: States of the 29 Process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.6.3.9 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 VDC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Electrical isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Input data length		12 bytes
Output data length		20 bytes
Reference potential for all digital inputs and outputs		Minus pole of the supply voltage, signal name ZP
Setting of the IO Device identifier		With 2 rotary switches at the front side of the module
Diagnosis		See Diagnosis and Displays *Chapter 1.7.6.3.8 “Diagnosis” on page 1060*
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Extended ambient temperature (XC version)		> 60 °C on request
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

> **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Electrical isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical Data of the Digital Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 to DI7	Terminals 2.0 to 2.7

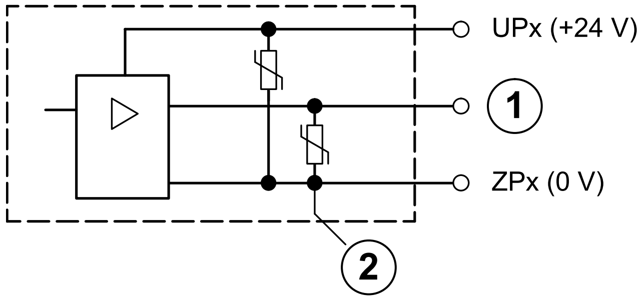
Parameter		Value
Reference potential for all inputs		Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 VDC
	Signal 0	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical Data of the Digital Outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 to DO7		Terminals 3.0 to 3.7
Reference potential for all outputs		Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request

Parameter		Value
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical Data of the Configurable Digital Inputs/Outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0...DC07	Terminals 1.0...1.7
If the channels are used as outputs		
	Channels DC0...DC07	Terminals 1.0...1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Electrical isolation		From the Ethernet network

Technical Data of the Digital Inputs/Outputs if used as Inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 1.0 to 1.7
Reference potential for all inputs	Terminals 1.9...3.9 (Minus pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 VDC
Signal 0	-3 V...+5 V
Undefined Signal	> +5 V...< +15 V
Signal 1	+15 V...+30 V
Ripple with signal 0	Within -3 V...+5 V
Ripple with signal 1	Within +15 V...+30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

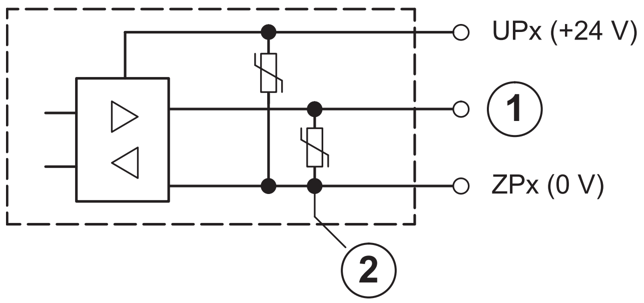
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical Data of the Digital Inputs/Outputs if used as Outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 1.0 to 1.7
Reference potential for all outputs	Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 3.8 (plus pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	

Parameter	Value
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/ overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	
Shielded	1000 m
Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical Data of the Fast Counter

Parameter	Value
Used inputs	Terminal 2.0 (DI8),Terminal 2.1 (DI9)
Used outputs	Terminal 3.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	See *Fast Counter*
Operating modes	See *Operating modes*

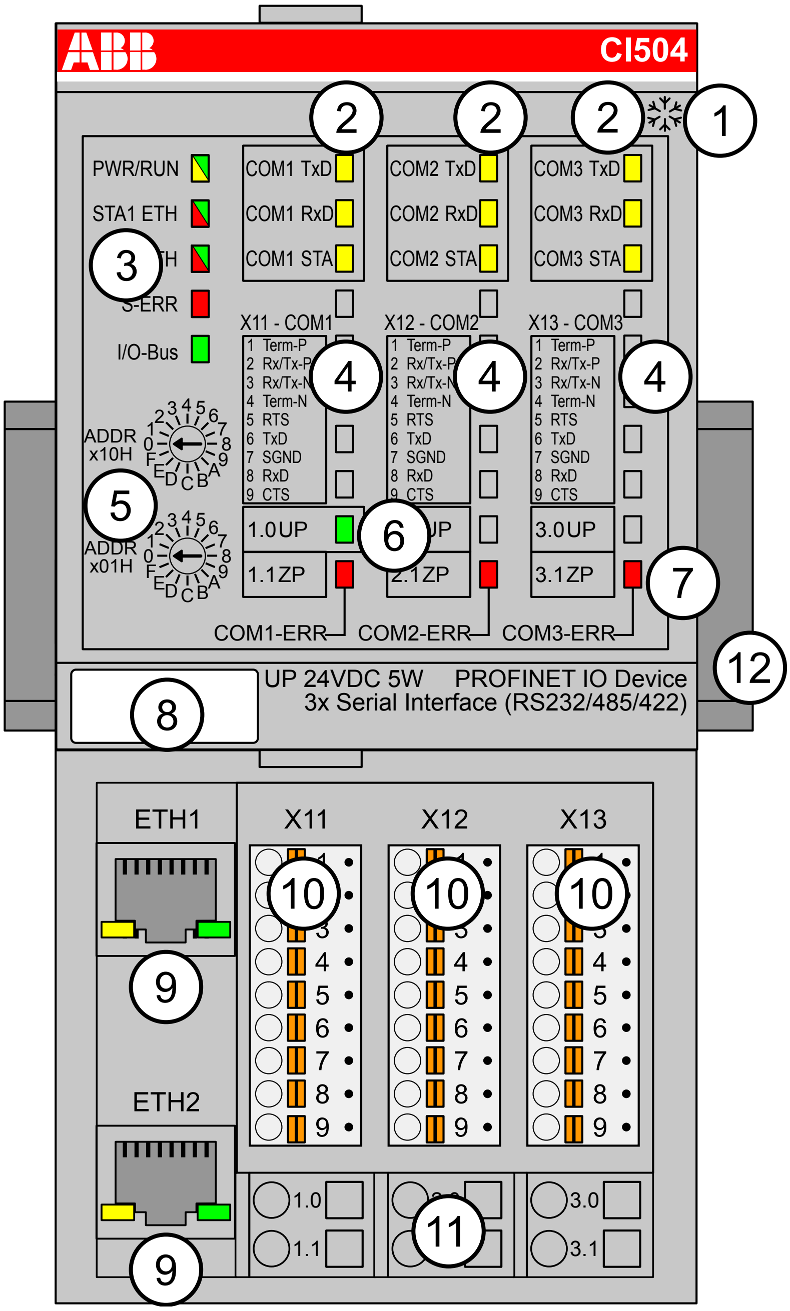
1.7.6.3.10 Ordering Data

Active	Active	Product Life Cycle Phase *)
1SAP 220 700 R0001	CI502-PNIO (V3), PROFINET bus module, 8 DI, 8 DO and 8 DC	Active
1SAP 420 700 R0001	CI502-PNIO-XC (V3), PROFINET bus module, 8 DI, 8 DO and 8 DC, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.6.4 CI504-PNIO

- 3 serial UART interfaces (RS-232, RS-422 or RS-485)
- Module-wise electrically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 3 x 3 yellow LEDs to display the signal states of the serial interfaces COM1, COM2 and COM3
3 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
4 Allocation between terminal number and signal name of the serial interfaces
5 2 rotary switches for setting the IO device identifier
6 1 green LED to display the process voltage UP
7 3 red LEDs to display errors (COM1-ERR, COM2-ERR, COM3-ERR) of the serial interfaces
8 Label
9 Ethernet Interfaces (ETH1, ETH2) on the terminal unit
10 3 removable connectors to connect the interfaces
11 6 spring terminals for power supply voltage (UP)
12 DIN rail
❄ Sign for XC version

1.7.6.4.1 Intended Purpose

The PROFINET I/O bus module CI504-PNIO provides 3 onboard serial interfaces. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

The bus interfaces are electrically isolated from the Ethernet network.

For usage in extreme ambient conditions (e. g. wider temperature and humidity range), a special XC version of the device is available.

1.7.6.4.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	PROFINET IO RT
Serial Interfaces	3 Serial UART interfaces RS-232, RS-422 and RS-485 available as physical layer
Serial protocol	ASCII
I/O bus interface	For up to 10 AC500 I/O Modules
Rotary switches	For setting the IO Device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, field bus indication, errors and power supply
Power supply	Via terminals UP and ZP (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU520 *Chapter 1.4.5 “TU520-ETH for PROFINET Communication Interface Modules” on page 160*

1.7.6.4.3 Electrical Connection

The PROFINET Bus Module CI504-PNIO is plugged on the terminal unit TU520-ETH *Chapter 1.4.5 “TU520-ETH for PROFINET Communication Interface Modules” on page 160*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 “TA526 - Wall Mounting Accessory” on page 1154*).

The electrical connection of the power supply voltage is carried out using the 6 terminals and the 3 removable connectors of the terminal unit. The CI504-PNIO can be replaced without re-wiring the terminal units.

> *For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter Chapter 2.6 “AC500 (Standard)” on page 1252.*

The terminals 1.0, 2.0 and 3.0 as well as 1.1, 2.1 and 3.1 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Table 178: Assignment of the terminals

Terminal	Signal	Description
1.0	UP	Process voltage UP (+24 VDC)
1.1	ZP	Process voltage ZP (0 VDC)
2.0	UP	Process voltage UP (+24 VDC)
2.1	ZP	Process voltage ZP (0 VDC)
3.0	UP	Process voltage UP (+24 VDC)
3.1	ZP	Process voltage ZP (0 VDC)

Table 179: Assignment of the terminals of removable connectors X11, X12 and X13 (Serial interfaces)

Terminal	Signal	Description	
1	Term-P	RS-485	Internal line terminating resistor for non-inverted signal (Rx/Tx-P)
		RS-422	Non-inverted receive signal terminal (RxD+)
2	Rx/Tx-P	RS-485	Non-inverted I/O signal terminal for each channel
		RS-422	Non-inverted transmit signal terminal (TxD+)
3	Rx/Tx-N	RS-485	Inverted I/O signal terminal for each channel
		RS-422	Inverted transmit signal terminal (TxD-)
4	Term-N	RS-485	Internal line-terminating-resistor for inverted signal (Rx/Tx-N) terminal
		RS-422	Inverted receive signal terminal (RxD-)
5	RTS	RS-232	Request To Send signal terminal for each channel
6	TxD	RS-232	Transmit signal terminal for each channel
7	SGND	RS-232	Signal ground for each channel
8	RxD	RS-232	Receive signal terminal for each channel
9	CTS	RS-232	Clear To Send signal terminal for each channel

The connection of SGND (ground) is optional for RS-485/RS-422.

For RS-422, no external line-terminating resistors have to connected. They are already connected inside the module.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

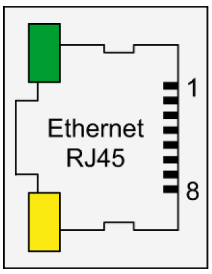
The module provide several diagnosis functions *Chapter 1.7.6.4.7 "Diagnosis" on page 1080*.

Further information is provided in the System Technology chapter *PROFINET*.

1.7.6.4.4 Assignment of the Ethernet Ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Table 180: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet *↳ Chapter 2.6.4.10 "Ethernet Connection Details" on page 1292.*

1.7.6.4.5 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

1.7.6.4.6 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7010	WORD	7010
Parameter length	Internal	33	BYTE	33
Error LED / Fail-safe function see table [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		

Remarks:

[1]) With a faulty module ID, the module reports a "parameter error" and does not perform cyclic process data transmission

Table 181: Error LED / Failsafe function [2])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Fail-safe-mode off
On + Failsafe	Error LED lights up at errors of all error classes, Failsafe-mode on
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode on
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Fail-safe-mode on

All values are validated during the parameterization of the CI504-PNIO according to the appended expansion modules. In the case of error, a diagnostic message "parameter errors" is generated and the cyclic process data transfer is terminated.

Parameters of the 3 Serial Channels

Name	Value	Internal value	Internal value, type	Default
Behavior for serial channel communication during PROFINET communication fault	Stop communi-cation and reset FIFO	0	BYTE	0
	Continue serial communication	1		
Number of frames/data blocks in reception FIFO	1...40	1...40	BYTE	1
Number of frames/Data blocks in transmission FIFO	1...40	1...40	BYTE	1
Behavior during reception FIFO overflow	Discard new received frames	1	BYTE	2
	Overwrite oldest frame in FIFO	2		
	Discard new received frames and send PROFINET alarm	3		
	Overwrite oldest frame in FIFO and send PROFINET alarm	4		
Physical layer	RS232	1	BYTE	1
	RS485	2		
	RS422	3		
RTS control	None	0	BYTE	1
	Telegram	1		
	RTS/CTS (DTE <-> DTE)	2		
	RTS/CTS (DTE -> DCE)	3		
	RTS/CTS (DCE <- DTE)	4		
TLS (RTS leading cycle)	0...850 ms	0...850	WORD	0
CDLY (RTS trailing cycle)	0...850 ms	0...850	WORD	0
Character timeout	0/32 bits	0/32	WORD	0
Telegram ending selection	None	0	BYTE	None

Name	Value	Internal value	Internal value, type	Default
	String (check reception)	1		
	Telegram length	2		
	Character timeout	4		
Telegram ending character	0...255	0...255	BYTE	0
Telegram ending value	0...65535	0...65535	WORD	0
Checksum	None	0	BYTE	0
	CRC8	1		
	CRC16	2		
	LRC	3		
	ADD	4		
	CS31	5		
	CRC8-FBP	6		
	XOR	7		
	CRC16 (Intel)	8		
Handshake mode	None	0	BYTE	0
	XON/XOFF	2		
Baudrate	Channel inactive	0	DWORD	19200
	300 bit/s	300		
	1200 bit/s	1200		
	4800 bit/s	4800		
	9600 bit/s	9600		
	14400 bit/s	14400		
	19200 bit/s	19200		
	38400 bit/s	38400		
	38400 bit/s	57600		
	57600 bit/s	57600		
	115200 bit/s	115200		
Parity	No parity	0	BYTE	No parity
	Odd parity	1		
	Even parity	2		
Data bits	5 bits	0	BYTE	8
	6 bits	1		
	7 bits	2		
	8 bits	3		
Stop bits	1 bit	0	BYTE	1
	2 bits	1		

> ***Configuration with Automation Builder***
> *The physical layers are selectable as submodules in PROFINET configuration (parameter Physical Layer not visible and fixed with the correct value). Certain parameters are not visible if a certain physical layer is selected. This concept of parameterization provides a better usability than configuring via GSDML (see below).*

> ***Configuration via GSDML (use by non-ABB PROFINET configuration tool)***
> *All parameters are visible independent of the configured physical layer (via parameter "Physical Layer"). The user must take precautions for each parameter since certain parameter values are invalid for certain physical layers. Nevertheless, the CI5xx-PNIO module performs a parameter check depending on the configured physical layer and generates a diagnosis message (parameter error) in the case of error.*

General Precautions

- If parameter telegram ending selection is set to value Character Timeout, the value in the parameter Character Timeout must be set to 0. The parameter End Value must be set to 32 (equivalent to 32-bits character timeout). Only 32-bits character timeout is supported.
- Checksum is only supported if a telegram ending selection is active.
- Please refer to AC500 serial channel documentation for additional precautions.

Precautions for RS-485/RS-422

DTE/DCE is not supported. The parameter RTS Control must be set to value Telegram or to None.

1.7.6.4.7 Diagnosis

Structure of the Diagnosis Block via *PNIO_DEV_ALARM* Function Block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI504-PNIO (e. g. error at integrated Serial Interface) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
2	Diagnosis Byte, module number	According to the I/O Bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O Bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis Byte, error code	According to the I/O Bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O-Bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6...7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
Module error							
3	-	31	31	31	43	Internal error in the module	Replace module
3	-	31	31	31	9	Overflow diagnosis buffer	New start
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage too low	Check process voltage
3	-	31	31	31	45	Process voltage gone	Check process voltage
3	-	1...10	31	31	17	No communication with I/O module	Replace I/O module
4	-	1...10	31	31	31	At least 1 I/O Module does not support failsafe mode	Check I/O mod-ules and parame-terization

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6...7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	1...10	31	31	32	Wrong I/O Module type on socket	Replace I/O module Check configu-ration
4	-	1...10	31	31	34	No response during initialization of the I/O Module	Replace I/O module
Serial Channel error							
4	-	31	31	1...3	12	Reception SW FIFO overrun	Check modules and parame-terization
4	-	31	31	1...3	26	Parameter error	Check modules and parame-terization

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific Function Blocks; 0...4 or 10 = Position of the Communication Module;14 = I/O-Bus; 31 = Module itself The identifier is not contained in the CI504-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself
[3])	With "Module" the following allocation applies dependent of the master: 31 = Module itself or 1...10 expansion module

1.7.6.4.8 State LEDs

The LEDs are located at the front of module. There are 4 different groups:

- 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- 4 Ethernet state LEDs located at the terminal unit TU520-ETH
- 12 state LEDs for the serial interfaces
- 1 LED to display the presence of the process supply voltage UP

Table 182: States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---

Table 183: States of the 4 Ethernet State LEDs

LED	Color	OFF	ON	Flashing
ETH1-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
ETH1-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
Eth2-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 184: States of the 12 State LEDs (4 per channel) of the Serial Interfaces

LED	Color	OFF	ON	Flashing
COMx TxD	Yellow	No data transmission over serial network	--	Channel is transmitting data via the serial interface (flashing rate depending on the telegram transmission frequency)
COMx RxD	Yellow	No data reception from serial network	--	Channel is receiving data from the serial interface (flashing rate depending on the telegram reception frequency)
COMx STA	Yellow	RS-232: RTS signal not active RS-485: Channel is in reception mode RS-422:Channel is not enabled	RS-232: RTS signal is active RS-485: Channel is transmitting RS-422: Channel is enabled (able to receive and transmit)	--
COMx-ERR	Red	Channel enabled, no error OR Channel deactivated	Channel boot up	Channel error (receive buffer overflow)

Table 185: State of the Power Supply LED

LED	Color	OFF	ON	Flashing
UP	Green	No process voltage available	Process voltage available	--

1.7.6.4.9 Technical Data

The System Data of AC500 and S500 ⇘ *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC ⇘ *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP		
	Rated value	24 VDC
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Connections	Terminals 1.0, 2.0 and 3.0 for +24 V (UP) Terminals 1.1, 2.1 and 3.1 for 0 V (ZP)
Input data length		0...36 bytes
Output data length		0...36 bytes
Max. power dissipation within the module		5 W
Setting of the I/O device identifier		With 2 rotary switches at the front side of the module
Operation and error displays		18 LEDs (total)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

Electrical isolation	Ethernet interface against the rest of the module, each serial port against each other and the rest of the module
Diagnosis	See Diagnosis *Chapter 1.7.6.4.7 “Diagnosis” on page 1080*

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated

Parameter	Value
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Electrical isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical Data of the Serial Interfaces

Parameter	Value
Number of serial interfaces	3
Connectors for serial interfaces	X11 for COM1 X12 for COM2 X13 for COM3
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Baudrate	Configurable from 300 bit/s to 115.200 bit/s

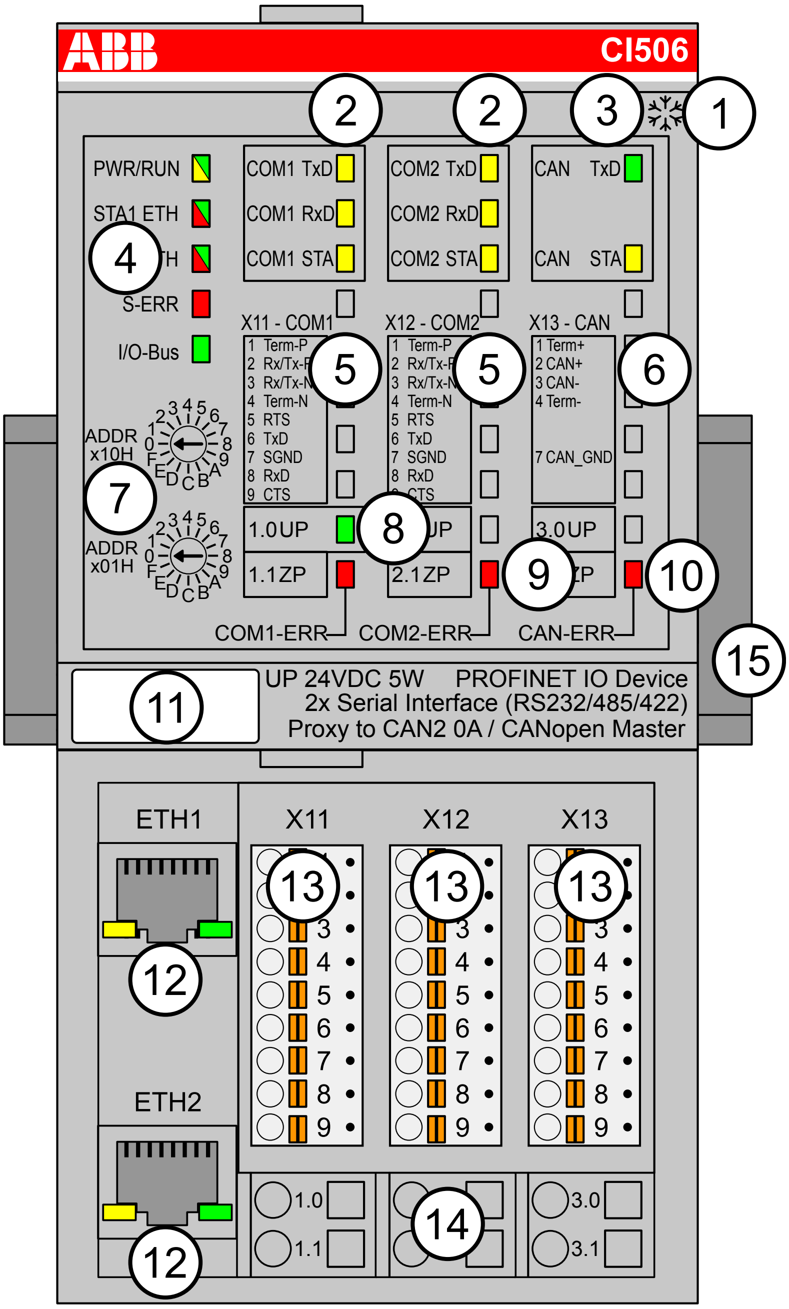
1.7.6.4.10 Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 221 300 R0001	CI504-PNIO, PROFINET bus module with 3 serial interfaces	Active
1SAP 421 300 R0001	CI504-PNIO-XC, PROFINET bus module with 3 serial interfaces, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.7.6.5 CI506-PNIO

- 2 serial UART interfaces (RS-232, RS-422 or RS-485)
- 1 CANopen master interface
- Module-wise electrically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 2 x 3 yellow LEDs to display the signal states of the serial interfaces COM1 and COM2
3 1 green and 1 yellow LEDs to display the signal states of the CANopen interface
4 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
5 Allocation between terminal number and signal name of the serial interfaces
6 Allocation between terminal number and signal name of the CANopen interface
7 2 rotary switches for setting the IO device identifier
8 1 green LED to display the process voltage UP
9 2 red LEDs to display errors (COM1-ERR, COM2-ERR) of the serial interfaces
10 1 red LED to display errors (CAN-ERR) of the CANopen interface
11 Label
12 Ethernet Interfaces (ETH1, ETH2) on the terminal unit
13 3 removable connectors to connect the subordinated interfaces
14 6 spring terminals for power supply voltage (UP)
15 DIN rail
Sign for XC version

1.7.6.5.1 Intended Purpose

The PROFINET I/O bus module CI506-PNIO provides 2 onboard serial interfaces and 1 CANopen master interface. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

The bus interfaces are electrically isolated from the Ethernet network.

For usage in extreme ambient conditions (e. g. wider temperature and humidity range), a special XC version of the device is available.

1.7.6.5.2 Functionality

Parameter	Value
Primary interface	Ethernet
Protocol (1st interface)	PROFINET IO RT
Secondary interface	CAN
Protocol (2nd interface)	CANopen
CANopen master	Baudrate up to 1 Mbit/s Support for up to 126 CANopen slaves
Serial Interfaces	2 Serial UART interfaces RS-232, RS-422 and RS-485 available as physical layer
Serial protocol	ASCII
I/O bus interface	For up to 10 AC500 I/O modules
Supply of the electronic circuitry of the I/O expansion modules attached	Through the expansion bus interface (I/O bus)
Rotary switches	For setting the IO Device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, field bus indication, errors and power supply
Power supply	Via terminals UP and ZP (process supply voltage 24 VDC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU520 *Chapter 1.4.5 "TU520-ETH for PROFINET Communication Interface Modules" on page 160*

1.7.6.5.3 Electrical Connection

The Ethernet Bus Module CI506-PNIO is plugged on the terminal unit TU520-ETH *Chapter 1.4.5 "TU520-ETH for PROFINET Communication Interface Modules" on page 160*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.8.2.4 "TA526 - Wall Mounting Accessory" on page 1154*).

The electrical connection of the power supply voltage is carried out using the 6 terminals and the 3 removable connectors of the terminal unit. The CI506-PNIO can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 1252.*

The terminals 1.0, 2.0 and 3.0 as well as 1.1, 2.1 and 3.1 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Table 186: Assignment of the terminals

Terminal	Signal	Description
1.0	UP	Process voltage UP (+24 VDC)
1.1	ZP	Process voltage ZP (0 VDC)
2.0	UP	Process voltage UP (+24 VDC)
2.1	ZP	Process voltage ZP (0 VDC)
3.0	UP	Process voltage UP (+24 VDC)
3.1	ZP	Process voltage ZP (0 VDC)

Table 187: Assignment of the terminals of removable connectors X11 and X12 (Serial interfaces)

Terminal	Signal	Description	
1	Term-P	RS-485	Internal line terminating resistor for non-inverted signal (Rx/Tx-P)
		RS-422	Non-inverted receive signal terminal (RxD+)
2	Rx/Tx-P	RS-485	Non-inverted I/O signal terminal for each channel
		RS-422	Non-inverted transmit signal terminal (TxD+)
3	Rx/Tx-N	RS-485	Inverted I/O signal terminal for each channel
		RS-422	Inverted transmit signal terminal (TxD-)
4	Term-N	RS-485	Internal line-terminating-resistor for inverted signal (Rx/Tx-N) terminal
		RS-422	Inverted receive signal terminal (RxD-)
5	RTS	RS-232	Request To Send signal terminal for each channel
6	TxD	RS-232	Transmit signal terminal for each channel
7	SGND	RS-232	Signal ground for each channel
8	RxD	RS-232	Receive signal terminal for each channel
9	CTS	RS-232	Clear To Send signal terminal for each channel

The connection of SGND (ground) is optional for RS-485/RS-422.

For RS-422, no external line-terminating resistors have to connected. They are already connected inside the module.

Table 188: Assignment of the terminals of removable connector X13 (CANopen interface)

Terminal	Signal	Description
1	TERM+	Internal line-terminating-resistor for CAN Bus. Bridging to CAN HIGH terminal if bus termination is required
2	CAN+	Non-inverted CAN data terminal
3	CAN-	Inverted CAN data terminal
4	TERM-	Internal line-terminating-resistor for CAN Bus. Bridging to CAN LOW terminal if bus termination is required
5	Not used	Not used
6	Not used	Not used
7	CAN_GND	CAN ground terminal
8	Not used	Not used
9	Not used	Not used

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

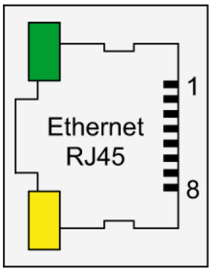
The module provide several diagnosis functions *Chapter 1.7.6.5.8 “Diagnosis” on page 1098*.

Further information is provided in the System Technology chapter PROFINET.

1.7.6.5.4 Assignment of the Ethernet Ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Table 189: Pin assignment RJ45 jack:

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	not used
	5	NC	not used
	6	RxD-	Receive data -
	7	NC	not used
	8	NC	not used
	Shield	Cable shield	Functional earth

For further information regarding wiring and cable types see chapter Ethernet *↳ Chapter 2.6.4.10 “Ethernet Connection Details” on page 1292.*

1.7.6.5.5 Addressing

The module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

1.7.6.5.6 I/O Configuration

The CI506-PNIO stores some PROFINET configuration parameters:

- Slave station name
- Slave station type
- IP address configuration
- MAC address
- Production data

No more configuration data is stored. The serial interfaces and the CANopen interface is configured via software. For details, refer to Parameterization *↳ Chapter 1.7.6.5.7 “Parameterization” on page 1093*.

1.7.6.5.7 Parameterization

Parameters of the Module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7015	WORD	7015
Parameter length	Internal	33	BYTE	33
Error LED / Fail-safe function see table [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		

Remarks:

[1]) With a faulty module ID, the module reports a "parameter error" and does not perform cyclic process data transmission

Table 190: Error LED / Failsafe function [2])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Fail-safe-mode off
On + Failsafe	Error LED lights up at errors of all error classes, Failsafe-mode on
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode on
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Fail-safe-mode on

All values are validated during the parameterization of the CI506-PNIO according to the appended expansion modules. In the case of error, a diagnostic message "parameter error" is generated and the cyclic process data transfer is terminated.

Parameters of the 2 Serial Channels

Name	Value	Internal value	Internal value, type	Default
Behavior for serial channel communication during PROFINET communica-tion fault	Stop communica-tion and reset FIFO	0	BYTE	0
	Continue serial communication	1		
Number of frames/data blocks in reception FIFO	1...40	1...40	BYTE	1

Name	Value	Internal value	Internal value, type	Default
Number of frames/Data blocks in transmission FIFO	1...40	1...40	BYTE	1
Behavior during reception FIFO overflow	Discard new received frames	1	BYTE	2
	Overwrite oldest frame in FIFO	2		
	Discard new received frames and send PROFINET alarm	3		
	Overwrite oldest frame in FIFO and send PROFINET alarm	4		
Physical layer	RS232	1	BYTE	1
	RS485	2		
	RS422	3		
RTS control	None	0	BYTE	1
	Telegram	1		
	RTS/CTS (DTE <-> DTE)	2		
	RTS/CTS (DTE -> DCE)	3		
	RTS/CTS (DCE <- DTE)	4		
TLS (RTS leading cycle)	0...850 ms	0...850	WORD	0
CDLY (RTS trailing cycle)	0...850 ms	0...850	WORD	0
Character timeout	0/32 bits	0/32	WORD	0
Telegram ending selection	None	0	BYTE	None
	String (check reception)	1		
	Telegram length	2		
	Character timeout	4		
Telegram ending character	0 - 255	0 - 255	BYTE	0
Telegram ending value	0 - 65535	0 - 65535	WORD	0
Checksum	None	0	BYTE	0
	CRC8	1		
	CRC16	2		
	LRC	3		
	ADD	4		
	CS31	5		
	CRC8-FBP	6		
	XOR	7		
	CRC16 (Intel)	8		

Name	Value	Internal value	Internal value, type	Default
Handshake mode	None	0	BYTE	0
	XON/XOFF	2		
Baudrate	Channel inactive	0	DWORD	19200
	300 bit/s	300		
	1200 bit/s	1200		
	4800 bit/s	4800		
	9600 bit/s	9600		
	14400 bit/s	14400		
	19200 bit/s	19200		
	38400 bit/s	38400		
	38400 bit/s	57600		
	57600 bit/s	57600		
	115200 bit/s	115200		
Parity	No parity	0	BYTE	No parity
	Odd parity	1		
	Even parity	2		
Data bits	5 bits	0	BYTE	8
	6 bits	1		
	7 bits	2		
	8 bits	3		
Stop bits	1 bit	0	BYTE	1
	2 bits	1		

Configuration with Automation Builder

The physical layers are selectable as submodules in PROFINET configuration (parameter Physical Layer not visible and fixed with the correct value). Certain parameters are not visible if a certain physical layer is selected. This concept of parameterization provides a better usability than configuring via GSDML (see below).

Configuration via GSDML (use by non-ABB PROFINET configuration tool)

All parameters are visible independent of the configured physical layer (via parameter “Physical Layer”). The user must take precautions for each parameter since certain parameter values are invalid for certain physical layers. Nevertheless, the CI5xx-PNIO module performs a parameter check depending on the configured physical layer and generates a diagnosis message (parameter error) in the case of error.

General Precautions

- If parameter telegram ending selection is set to value Character Timeout, the value in the parameter Character Timeout must be set to 0. The parameter End Value must be set to 32 (equivalent to 32-bits character timeout). Only 32-bits character timeout is supported.
- Checksum is only supported if a telegram ending selection is active.
- Please refer to AC500 serial channel documentation for additional precautions.

Precautions for RS-485/RS-422

DTE/DCE is not supported. The parameter RTS Control must be set to value Telegram or to None.

Parameters of the CANopen Master

Name	Value	Internal value	Internal value, type	Default
CANopen master baudrate	1000 kbit/s	0	DWORD	0
	800 kbit/s	1		
	500 kbit/s	2		
	250 kbit/s	3		
	125 kbit/s	4		
	100 kbit/s	5		
	50 kbit/s	6		
	20 kbit/s	7		
	10 kbit/s	8		
CANopen master SYNC object ID *)	0x01 to 0x7FFF	1 - 32767	DWORD	0x80
CANopen master SYNC cycle time *)	SYNC OFF	0	DWORD	0
	1 ms to 65535 ms	1 - 65535		
CANopen master heartbeat producer time *)	Heartbeat producer OFF	0	DWORD	10
	1 ms to 65535 ms	1 - 65535		
*) Parameter becomes irrelevant if the CANopen master function is not selected.				

The CANopen master functionality can only be activated when using ControlBuilderPlus/Automation Builder.

CAN2A / CAN2B Parameters

Name	Value	Internal value	Internal value, type	Default
CAN baudrate	1000 kbit/s	0	DWORD	0
	800 kbit/s	1		
	500 kbit/s	2		
	250 kbit/s	3		
	125 kbit/s	4		
	100 kbit/s	5		
	50 kbit/s	6		
	20 kbit/s	7		
	10 kbit/s	8		

Configuration via GSDML (use by non-ABB PROFINET configuration tool)
The parameter CAN Baud rate must be set twice for each CAN2A and CAN2B interfaces, and they must be set with identical values.

Buffer Parameters (to be configured for each used Buffer)

Name	Value	Internal value	Internal value, type	Default
Identifier	0..2047 (CAN2A)	0..2047 (CAN2A)	WORD (CAN2A)	0
	0..536870911 (CAN2B)	0..536870911 (CAN2B)	DWORD (CAN2B)	
Receive buffer size (size in numbers of telegrams)	1...32	1...32	BYTE	1
Behaviour on receive buffer overflow *)	Overwrite	0	BYTE	0
	Discard	1		
	Overwrite and send diagnostics (PROFINET alarm)	3		
	Discard and send diagnostics (PROFINET alarm)	4		
*) The following table describes the values in detail.				

Setting	Description
Overwrite	The oldest buffer entry which is stored in the buffer is overwritten with the new incoming telegram.
Discard	The new incoming telegram is discarded.

Setting	Description
Overwrite and send diagnostics (PROFINET alarm)	The oldest buffer entry which is stored in the buffer is over-written with the new incoming telegram. Additionally, a PROFINET alarm (diagnostic) will be sent to inform the user of the overflow occurrence.
Discard and send diagnostics (PROFINET alarm)	The new incoming telegram is discarded. Additionally a PROFINET alarm (diagnostic) will be sent to inform the user of the overflow occurrence.

Up to 64 buffers are allowed to be configured for each CAN2A and CAN2B type, each buffer containing the parameters described above.

1.7.6.5.8 Diagnosis

Structure of the Diagnosis Block via *PNIO_DEV_ALARM* Function Block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI506-PNIO (e. g. error at integrated serial interface) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 4 Bit 6...7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0...5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error identi-fier	Error message	Remedy
	[1])	[2])	[3])				
Module error							
3	-	31	31	31	43	Internal error in the module	Replace module
3	-	31	31	31	9	Overflow diagnosis buffer	New start
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage too low	Check process voltage
3	-	1..10	31	31	17	No communication with I/O Module	Replace I/O module
4	-	1..10	31	31	31	At least 1 I/O Module does not support failsafe mode	Check I/O mod-ules and parame-terization
4	-	1..10	31	31	32	Wrong I/O Module type on socket	Replace I/O module Check configu-ration
4	-	1..10	31	31	34	No response during initialization of the I/O Module	Replace I/O Module
Serial Channel error							
4	-	31	31	1...2	12	Reception SW FIFO overrun	Check modules and parame-terization
4	-	31	31	1...2	26	Parameter error	Check modules and parame-terization

E1...E4	d1	d2	d3	d4	Identi-fier 000...063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 4 Bit 6...7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0...5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error identi-fier	Error message	Remedy
	1)	2)	3)				
CANopen Channel error 4)							
4	-	31	31	12...75	12	Reception SW FIFO (CAN2.0A) overrun (Buffer number 1...64) 5)	Check modules and parame-terization
4	-	31	31	112...175	12	Reception SW FIFO (CAN2.0B) overrun (Buffer number 1...64) 5)	Check modules and parame-terization

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific Function Blocks; 0...4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI506-PNIO diagnosis block.
2)	With "Device" the following allocation applies: ADR = Hardware address (e.g. of the CI506-PNIO)
3)	With "Module" the following allocation applies dependent of the master: 31 = Module itself
4)	All CANopen master and slave diagnostics are not available as PROFINET alarms; instead they can be read via PROFINET acyclic service. In AC500 PLC these are available in form of Function Blocks.
5)	CAN2A Buffers 1...64 are mapped to the channel values 12...75, so the correlation value 11 has to be subtracted from the channel value to get the correct buffer number. CAN2B Buffers 1...64 are mapped to the channel values 112...175, so the correlation value 111 has to be subtracted from the channel value to get the correct buffer number

1.7.6.5.9 State LEDs

The LEDs are located at the front of module. There are 4 different groups:

- 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- 4 Ethernet state LEDs located at the terminal unit TU520-ETH
- 11 state LEDs for the serial interfaces an the CANopen Interface
- 1 LED to display the presence of the process supply voltage UP

Table 191: States of the 5 System LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System-LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System-LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---

Table 192: States of the 4 Ethernet State LEDs

LED	Color	OFF	ON	Flashing
ETH1-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
ETH1-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
Eth2-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 193: States of the 8 State LEDs (4 per channel) of the Serial Interfaces

LED	Color	OFF	ON	Flashing
COMx TxD	Yellow	No data transmission over serial network	--	Channel is transmitting data via the serial interface (flashing rate depending on the telegram transmission frequency)
COMx RxD	Yellow	No data reception from serial network	--	Channel is receiving data from the serial interface (flashing rate depending on the telegram reception frequency)
COMx STA	Yellow	RS-232: RTS signal not active RS-485: Channel is in reception mode RS-422:Channel is not enabled	RS-232: RTS signal is active RS-485: Channel is transmitting RS-422: Channel is enabled (able to receive and transmit)	--
COMx-ERR	Red	Channel enabled, no error or Channel deactivated	Channel boot up	Channel error (receive buffer overflow)

Table 194: States of the 3 State LEDs of the CANopen Interfaces

LED	Color	OFF	ON	Flashing
CAN-RUN	Yellow	--	Device configured, CANopen Bus in OPERATIONAL state and cyclic data exchange running	Flashing cyclically: CANopen Bus in Pre-operational state and slave is being configured Single flash: CANopen Bus in Stopped state.
CAN-STA	Yellow	No data transmission	Channel is transmitting data	--
CAN-ERR	Red	No error	CANopen bus is OFF	Flashing cyclically: Configuration error Single flash: Error counter overflow due to too many error frames Double flash: A Node-Guard or a Heartbeat event occurred

Table 195: State of the Power Supply LED

LED	Color	OFF	ON	Flashing
UP	Green	No process voltage available	Process voltage available	--

1.7.6.5.10 Technical Data

The System Data of AC500 and S500 *Chapter 2.6.1 “System Data AC500” on page 1252* are valid for standard version.

The System Data of AC500-XC *Chapter 2.7.1 “System Data AC500-XC” on page 1313* are valid for the XC version.

Only additional details are therefore documented below.

The technical data are also valid for the XC version.

Technical Data of the Module

Parameter		Value
Process supply voltages UP		
	Rated value	24 VDC
	Max. load for the terminals	10 A

Parameter		Value
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Connections	Terminals 1.0, 2.0 and 3.0 for +24 V (UP) Terminals 1.1, 2.1 and 3.1 for 0 V (ZP)
Input data length		0...36 bytes
Output data length		0...36 bytes
Max. power dissipation within the module		5 W
Setting of the I/O device identifier		With 2 rotary switches at the front side of the module
Operation and error displays		18 LEDs (total)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switch-gear cabinet.

Electrical isolation	Ethernet interface against the rest of the module, each serial and CAN port against each other and the rest of the module
Diagnosis	See Diagnosis ➪ *Chapter 1.7.6.5.8 “Diagnosis” on page 1098*

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher netX100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket

Parameter	Value
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Electrical isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical Data of the Serial Interfaces

Parameter	Value
Number of serial interfaces	2
Connectors for serial interfaces	X11 for COM1 X12 for COM2
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Baudrate	Configurable from 300 bit/s to 115.200 bit/s

Technical Data of the CANopen Interface

Parameter	Value
Number of CANopen interfaces	1
Connector for CANopen Interface	X13
Baudrate	Up to 1 Mbit/s

1.7.6.5.11 Ordering Data

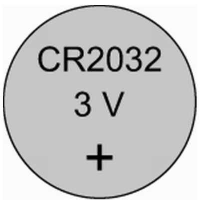
Part no.	Description	Product Life Cycle Phase *)
1SAP 221 500 R0001	CI506-PNIO, PROFINET bus module with 2 serial interfaces and 1 CANopen master interface	Active
1SAP 421 500 R0001	CI506-PNIO-XC, PROFINET bus module with 2 serial interfaces and 1 CANopen master interface, XC version	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8 Accessories

1.8.1 AC500-eCo

1.8.1.1 CR2032 - Battery for Real-Time Clock



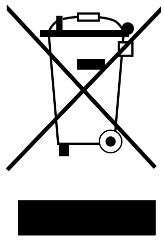
Intended Purpose

A standard lithium battery (type CR2032) is used to backup the real-time clock (RTC) in the adaptors TA561-RTC ↳ *Chapter 1.8.1.3 “TA561-RTC - Real-time Clock Adaptor ” on page 1109* and TA562-RS-RTC ↳ *Chapter 1.8.1.6 “TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock ” on page 1117* during power failures.

The CPU monitors the discharge degree of the battery. An diagnoses message is output before the battery condition becomes critical (about 2 weeks before). After the diagnosis message has appeared, the battery should be replaced as soon as possible.

Handling Instruction

- The handling instructions of the battery manufacturer must be observed.
- The Material Safety Data Sheet (MSDS) of the battery manufacturer must be observed.
- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.
- Recycle exhausted batteries meeting the environmental standards.



Transport

Transport of lithium batteries or equipment with installed lithium batteries:

- The transport and handling instructions of the battery producer must be observed.
- The transport regulations for transport of lithium batteries must be observed e.g. for transport by road or air.
- The forwarder must be informed if batteries are contained in the shipment.

Electrical Connection

Assembling and electrical connection of the battery is described in chapters TA561-RTC real-time clock adaptor *Chapter 1.8.1.3 “TA561-RTC - Real-time Clock Adaptor ” on page 1109* and TA562-RS-RTC serial RS-485 and real-time clock adaptor *Chapter 1.8.1.6 “TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock ” on page 1117*.

Battery Lifetime

The battery lifetime is the time the battery can operate the RTC while the CPU is not powered. The typical lifetime is 300 days (at 25 °C).

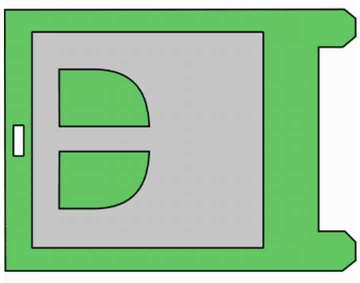
As long as the CPU is powered, the battery will only be discharged by its own leakage current.

Technical Data

The battery must meet die following technical data:

Parameter	Value
Battery designation	CR2032
Description	Manganese dioxide button cell, primary cell, not rechargeable
Nominal voltage	3 VDC
Capacity	230 mAh (measured with 5.6 kΩ load at 20 °C, discharging down to 2.0 V)
Typical lifetime (at 25 °C, CPU not powered)	300 days
Temperature range	≥ 0 °C ...+70 °C
Diameter	20 mm
Height	3.2 mm

1.8.1.2 MC503 - SD Memory Card Adaptor



Intended Purpose

The MC503 SD memory card adaptor is used for expanding processor modules PM55x-xP or PM56x-xP with a SD memory card slot. A SD memory card (MC502) is not included in the scope of delivery and must be ordered separately.

The SD memory card can be used for:

- saving process data,
- saving user programs,
- upgrading the firmware.

Insertion of the Adaptor

1. Make sure, that the power supply of the processor module is turned off.

> **WARNING!**
> **Risk of electric shock!**
> With an opened option cover, energized parts of the processor module could be touched.
> – Always turn off and disconnect the power supply for the processor module before you open the option cover.
> – Make sure that the option cover is closed before reconnecting the processor module to the power supply.

2. Remove the option cover of the processor module totally by pushing it to the left side.
3. Plug the SD memory card adaptor to the left expansion slot of the processor module. Make sure that the 2 noses of the expansion module fit to the holes of the processor module PCB.
4. Remove the bar located in the middle of the option cover slot.
5. Refit the option cover.
6. To insert the SD memory card, see MC502 *Chapter 1.8.2.1 “MC502 - SD Memory Card” on page 1147*.

Removal of the Adaptor

1. Make sure that the power supply of the processor module is turned off.

> **WARNING!**
> **Risk of electric shock!**
> With an opened option cover, energized parts of the processor module could be touched.
> – Always turn off and disconnect the power supply for the processor module before you open the option cover.
> – Make sure that the option cover is closed before reconnecting the processor module to the power supply.

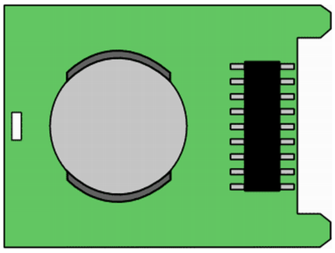
2. Remove the option cover of the processor module totally by pushing it to the left side.
3. Remove the adaptor out of the processor Module by lifting it up with a screwdriver.
4. Refit the option cover. The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules). *Chapter 1.8.1.7 “TA570 - Spare Part Set” on page 1124*

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R0100	MC503, SD memory card expansion module for PM55x-xP or PM56x-xP	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.1.3 TA561-RTC - Real-time Clock Adaptor



Intended Purpose

The TA561-RTC real time clock adaptor is used for equipping AC500-eCo processor modules with a real-time clock.

The real time clock can be buffered via an optional standard lithium battery (CR2032) during power supply failures (see lithium battery for real-time clock of AC500-eCo processor modules ↳ *Chapter 1.8.1.1 “CR2032 - Battery for Real-Time Clock” on page 1106*).

Insertion and Replacement of the Adaptor

WARNING!

Risk of electric shock!

With an opened option cover, energized parts of the processor module could be touched.

– Always turn off and disconnect the power supply for the processor module before you open the option cover.
– Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/ removal of the adaptor and replacement of the battery is also described in the installation instruction for TA561-RTC. See *https://new.abb.com/products/ABB1SAP181400R0001* or use the QR code.

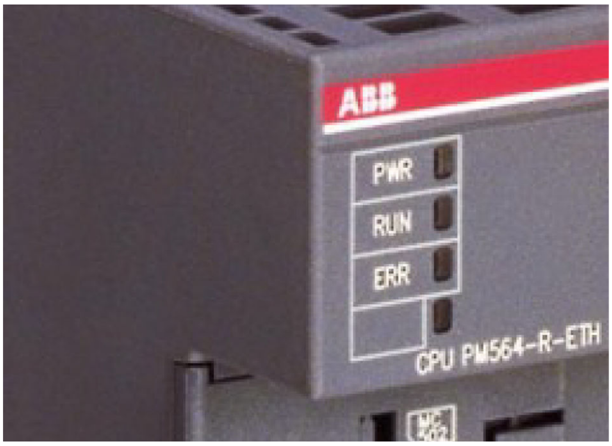
Click tab *“Documentation”* and select *“Operating Instruction”*.

The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules ↳ *Chapter 1.8.1.7 “TA570 - Spare Part Set” on page 1124*).

Replacement of the Battery

> **WARNING!**
> **Risk of death by electric shock!**
> Hazardous voltages can be present at the terminals of the module.
>
> Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

1. Switch off power supply of the system and verify that the CPU is powerless.



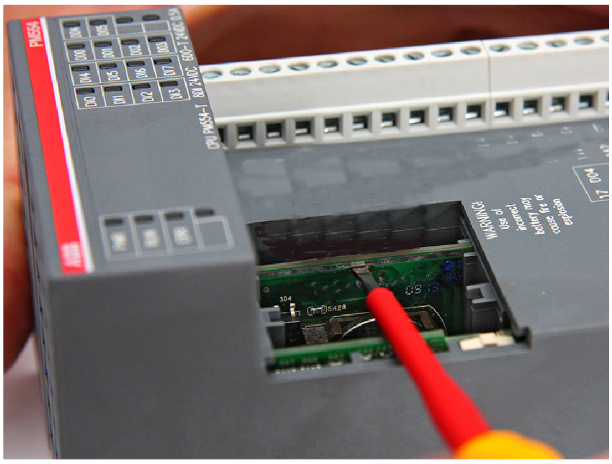
⇨ LEDs (PWR, RUN, ERR) must be off.

2. Remove the option cover.

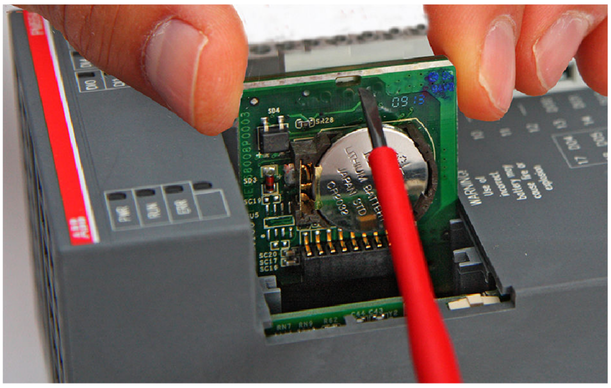
⇨ Remove the option cover of the CPU totally by pushing it to the outer side.

> **NOTICE!**
> **Avoidance of electrostatic charging**
> PLC devices and equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Observe the following rules when handling the system:
>
> – Touch a grounded object to discharge potential static.
> – Wear an approved grounding wrist strap.
> – Do not touch connectors or pins on component boards.
> – Do not touch circuit components inside the equipment.
> – If available, use a static-safe workstation.
> – When not in use, store the equipment in appropriate static-safe packaging.

3. Remove the option board.

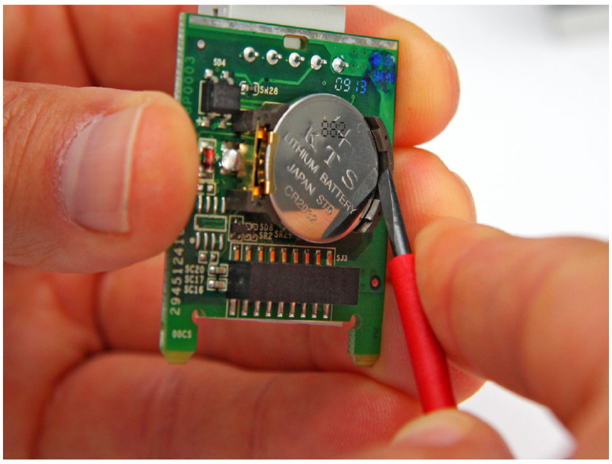


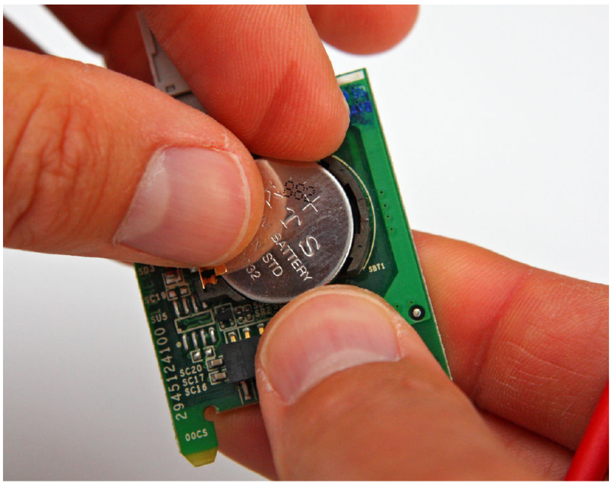
⇨ *Remove SD memory card (if installed) / terminal block (COM2).*



Remove the option board from the CPU by lifting it up with a screwdriver.

4. Remove the battery.





⇨

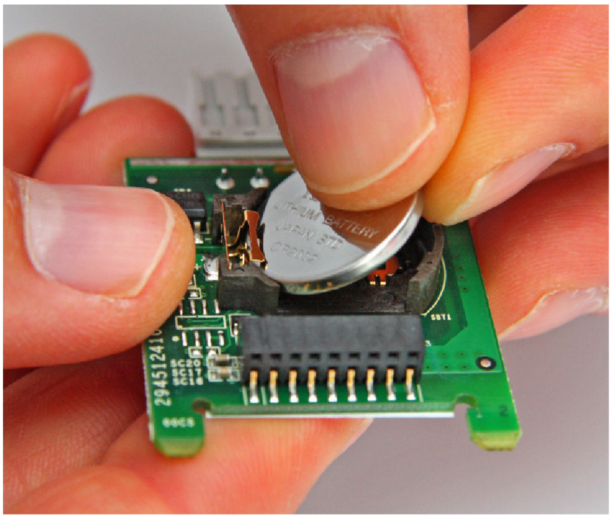
ATTENTION!

Lithium batteries must not be recharged, not be disassembled and not be disposed of in fire.

Exhausted batteries must be recycled to respect the environment.

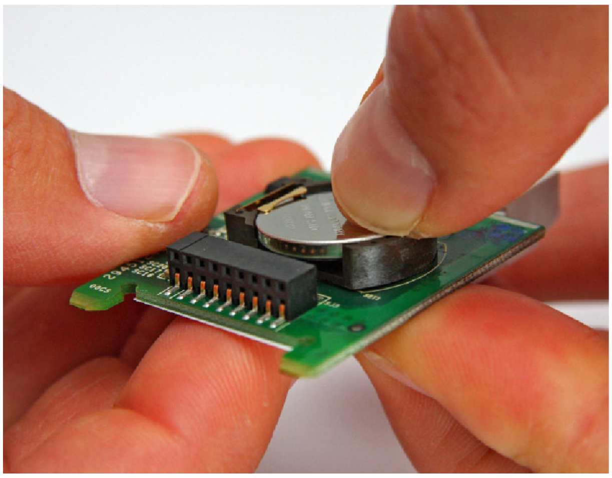
Dispose of battery properly according to disposal procedures for lithium batteries.

5. Insert replacement battery.

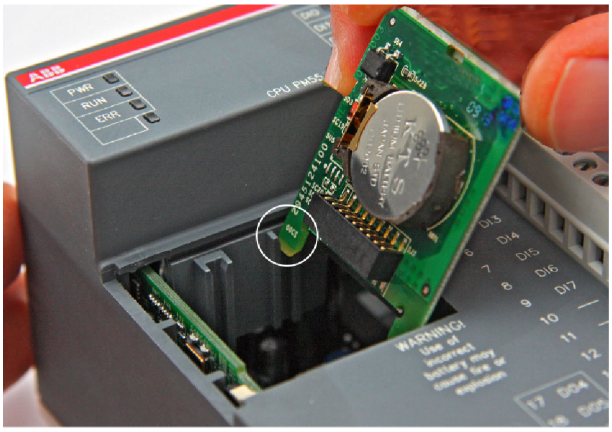


⇨

> ***ATTENTION!***
>
> *A standard batterie CR2032 can be used for **TA561-RTC** and **TA562-RS-RTC**.*
>
> *Nominal voltage: **3 VDC**.*
>
> *Required capacity: **230 mAh**.*
>
> *Required temperature range for discharge: **0 °C...+70 °C**.*
>
> *After replacement of the battery, the real-time clock (RTC) date and time must be set again by the user.*
>
> *Don't use a battery older than 3 years for replacement (e.g. battery kept too long in stock).*
>
> *Batteries must be stored in a dry place.*



6. Insert option board into the CPU.



⇨ Insert the adaptor TA56x-RTC into the slot on the right of the CPU.

> *Make sure that the 2 noses of the expansion module fit to the holes of the CPU PCB.*
>
> *See white circle in figure above.*

7. Refit the option cover of the CPU.

⇨

> *Remember to re-insert a SD memory card first if it has been removed previously.*

8. Only now the CPU can connected to power.

> *Set the time of the real-time clock.*

Technical Data

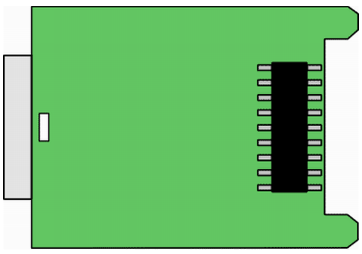
Parameter	Value
RTC accuracy (at 25 °C)	Typ. ±2 s / 24 h

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 181 400 R0001	TA561-RTC, serial RTC adaptor for PM55x-xP and PM56x-xP	Active
1TNE 968 901 R3200	TA561-RTC, serial RTC adaptor for PM55x-xP and PM56x-xP, lithium battery included (available in China only)	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

1.8.1.4 TA562-RS - Serial RS-485 Adaptor



Intended Purpose

The TA562-RS serial RS-485 adaptor is used for equipping AC500-eCo processor modules with a second serial interface COM2. The COM2 interface can be used for:

- online access
- free protocol communication
- Modbus RTU, client and server

> **CAUTION!**
> The serial RS-485 Interface is not electrically isolated.

Insertion/ Removal of the Adapter

WARNING!

Risk of electric shock!

With an opened option cover, energized parts of the processor module could be touched.

– Always turn off and disconnect the power supply for the processor module before you open the option cover.
– Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/removal of the adaptor is also described in the installation instruction for TA561-RTC. See

https://new.abb.com/products/ABB1SAP181400R0001 or use the QR code.

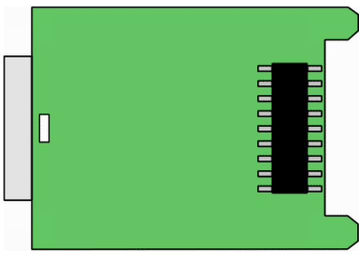
The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules *Chapter 1.8.1.7 "TA570 - Spare Part Set" on page 1124*).

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R4300	TA562-RS, serial RS-485 adaptor for PM55x/PM56x	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.1.5 TA569-RS-ISO - Serial RS-485 Isolated Adaptor



Intended Purpose

The TA569-RS-ISO serial RS-485 isolated adaptor is used for equipping AC500-eCo processor modules with a second serial interface COM2. The COM2 interface can be used for:

- online access
- free protocol communication
- Modbus RTU, client and server

The serial interface is isolated.

Insertion/ Removal of the Adapter

> **WARNING!**
> **Risk of electric shock!**
> With an opened option cover, energized parts of the processor module could be touched.
> – Always turn off and disconnect the power supply for the processor module before you open the option cover.
> – Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/removal of the adaptor is also described in the installation instruction for TA561-RTC. See

https://new.abb.com/products/ABB1SAP181400R0001 or use the QR code.

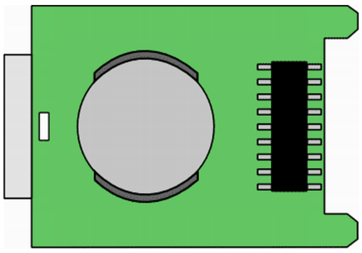
The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules *Chapter 1.8.1.7 “TA570 - Spare Part Set” on page 1124*).

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 186 400 R0001	TA569-RS-ISO, serial RS-485 isolated adaptor for PM55x/ PM56x	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

1.8.1.6 TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock



Intended Purpose

The TA562-RS-RTC serial RS-485 and real-time clock adaptor is used for equipping AC500-eCo processor modules with a real-time clock and a second serial RS-485 interface COM2.

The real time clock can be buffered via an optional standard lithium battery (CR2032) during power supply failures (see lithium battery for real-time clock of AC500-eCo processor modules *Chapter 1.8.1.1 “CR2032 - Battery for Real-Time Clock” on page 1106*).

Insertion/ Removal of the Adaptor

WARNING!
Risk of electric shock!
With an opened option cover, energized parts of the processor module could be touched.

- Always turn off and disconnect the power supply for the processor module before you open the option cover.
- Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/ removal of the adaptor and replacement of the battery is also described in the installation instruction for TA561-RTC. See *https://new.abb.com/products/ABB1SAP181400R0001* or use the QR code.

Click tab *"Documentation"* and select *"Operating Instruction"*.

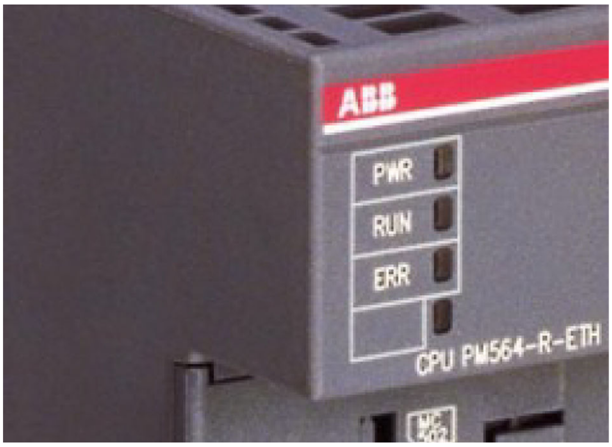
The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules ⇘ *Chapter 1.8.1.7 "TA570 - Spare Part Set" on page 1124*).

Replacement of the Battery

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

1. Switch off power supply of the system and verify that the CPU is powerless.



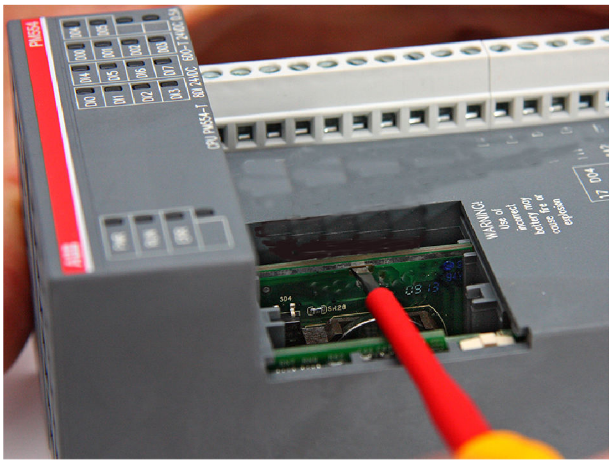
⇨ LEDs (PWR, RUN, ERR) must be off.

2. Remove the option cover.

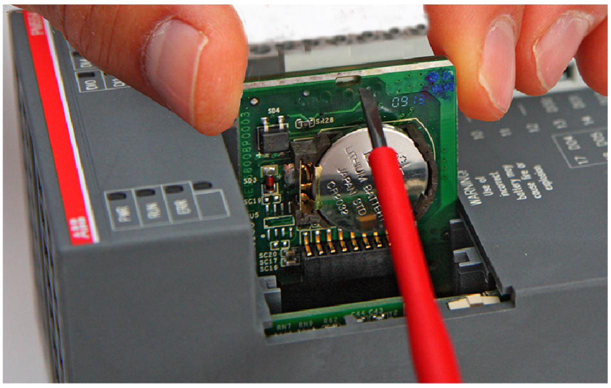
⇨ Remove the option cover of the CPU totally by pushing it to the outer side.

> **NOTICE!**
>
> **Avoidance of electrostatic charging**
>
> PLC devices and equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Observe the following rules when handling the system:
>
> – Touch a grounded object to discharge potential static.
> – Wear an approved grounding wrist strap.
> – Do not touch connectors or pins on component boards.
> – Do not touch circuit components inside the equipment.
> – If available, use a static-safe workstation.
> – When not in use, store the equipment in appropriate static-safe packaging.

3. Remove the option board.

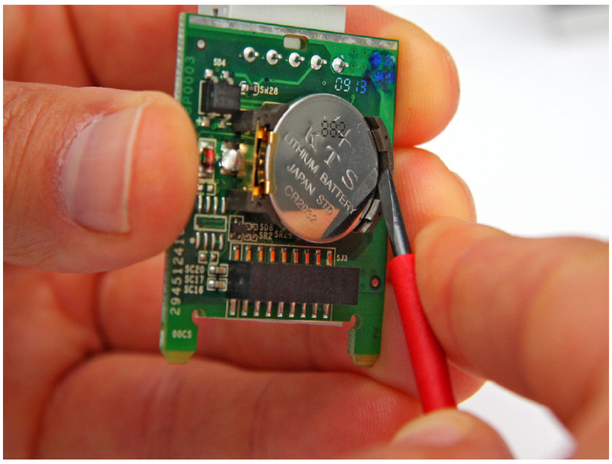


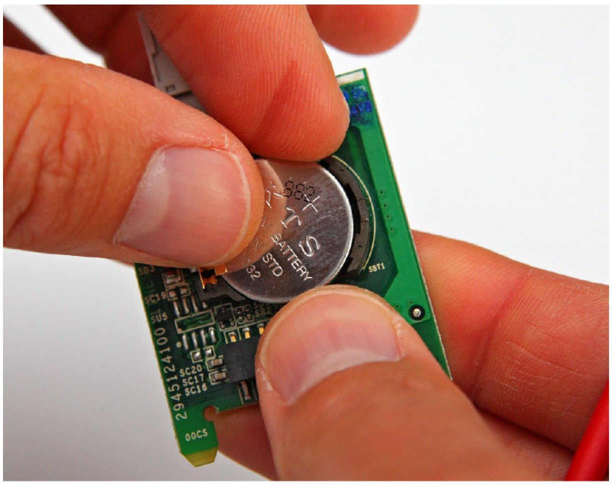
⇨ *Remove SD memory card (if installed) / terminal block (COM2).*



Remove the option board from the CPU by lifting it up with a screwdriver.

4. Remove the battery.

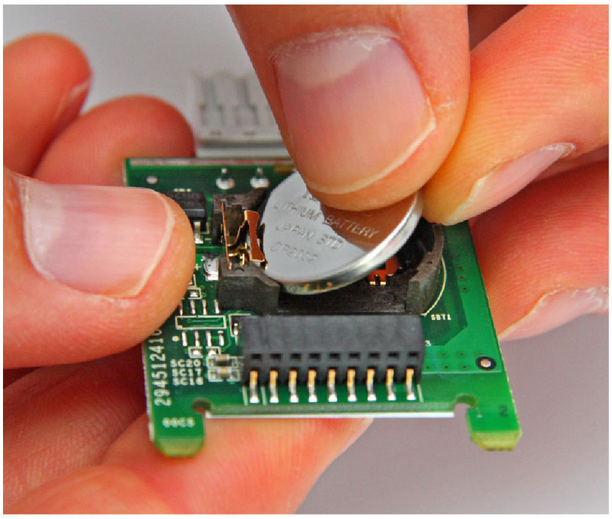




⇨

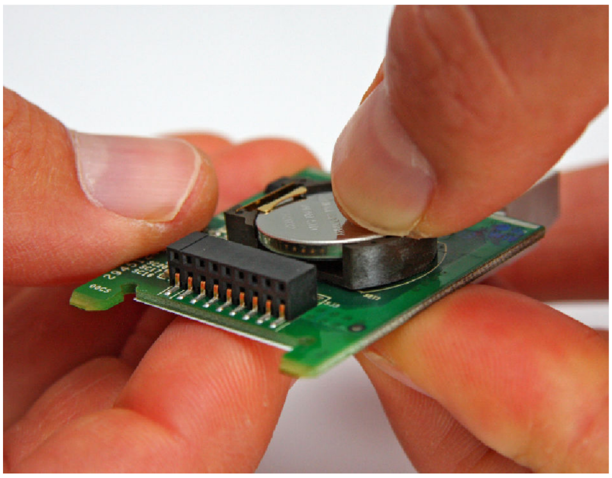
> ***ATTENTION!***
>
> *Lithium batteries must not be recharged, not be disassembled and not be disposed of in fire.*
>
> *Exhausted batteries must be recycled to respect the environment.*
>
> *Dispose of battery properly according to disposal procedures for lithium batteries.*

5. Insert replacement battery.

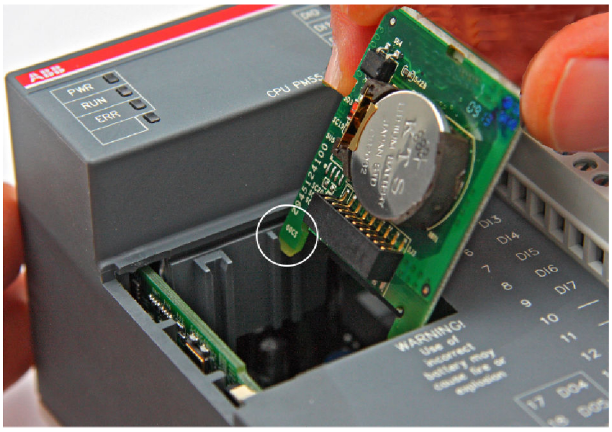


⇨

> ***ATTENTION!***
>
> *A standard batterie CR2032 can be used for **TA561-RTC** and **TA562-RS-RTC**.*
>
> *Nominal voltage: **3 VDC**.*
>
> *Required capacity: **230 mAh**.*
>
> *Required temperature range for discharge: **0 °C...+70 °C**.*
>
> *After replacement of the battery, the real-time clock (RTC) date and time must be set again by the user.*
>
> *Don’t use a battery older than 3 years for replacement (e.g. battery kept too long in stock).*
>
> *Batteries must be stored in a dry place.*



6. Insert option board into the CPU.



⇨ Insert the adaptor TA56x-RTC into the slot on the right of the CPU.

> *Make sure that the 2 noses of the expansion module fit to the holes of the CPU PCB.*
>
> *See white circle in figure above.*

7. Refit the option cover of the CPU.

⇨

> *Remember to re-insert a SD memory card first if it has been removed previously.*

8. Only now the CPU can connected to power.

Set the time of the real-time clock.

Technical Data

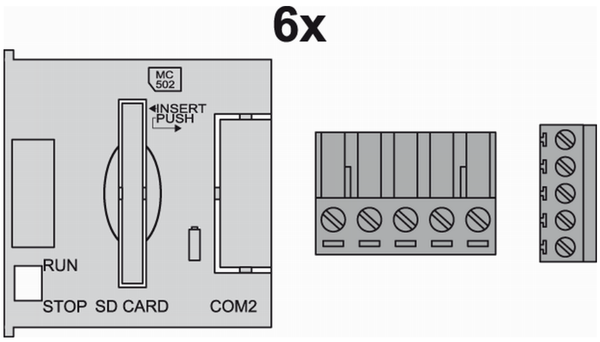
Parameter	Value
RTC accuracy (at 25 °C)	Typ. ±2 s / 24 h

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 181 500 R0001	TA562-RS-RTC, serial RS-485 and real-time clock adaptor for PM55x-xP and PM56x-xP	Active
1TNE 968 901 R5210	TA562-RS-RTC, serial RS-485 and real-time clock adaptor for PM55x-xP and PM56x-xP, lithium battery included (available in China only)	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.1.7 TA570 - Spare Part Set



Intended Purpose

The TA570 spare part set is used to replace lost or damaged parts of AC500-eCo processor modules. It contains the following parts:

- Option Cover
- Terminal block for power supply
- Terminal block for serial RS-485 adaptor

Every spare is included 6x inside TA570.

Technical Data

Table 196: Option Cover

Parameter	Value
Weight	5 g
Dimensions	40 mm x 40 mm x 3 mm

Table 197: Terminal Block for Power Supply

Parameter		Value
Type		Screw clamp plug, wire connection from front
Usage		For AC500-eCo processor modules
Conductor cross section		
	Solid	0.2 mm²...2.5 mm²
	Flexible (with wire-end ferrule only)	0.2 mm²...2.5 mm²
Stripped conductor end		7 mm...8 mm
Fastening torque		0.5 Nm
Degree of protection		IP20
Dimensions		25.4 mm x 17.4 mm x 15.1 mm
Weight		5 g

Table 198: Terminal Block for Serial RS-485 Adaptor

Parameter		Value
Type		Screw clamp plug, wire connection from side
Usage for		*Chapter 1.8.1.4 "TA562-RS - Serial RS-485 Adaptor" on page 1115* *Chapter 1.8.1.5 "TA569-RS-ISO - Serial RS-485 Isolated Adaptor" on page 1116* *Chapter 1.8.1.6 "TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock " on page 1117*
Conductor cross section		
	Solid	0.14 mm²...1.5 mm²
	Flexible (with wire-end ferrule only)	0.14 mm²...1.5 mm²
Stripped conductor end		7 mm
Fastening torque		0.4 Nm
Degree of protection		IP20
Dimensions		19.05 mm x 8.7 mm x 19.1 mm
Weight		5 g

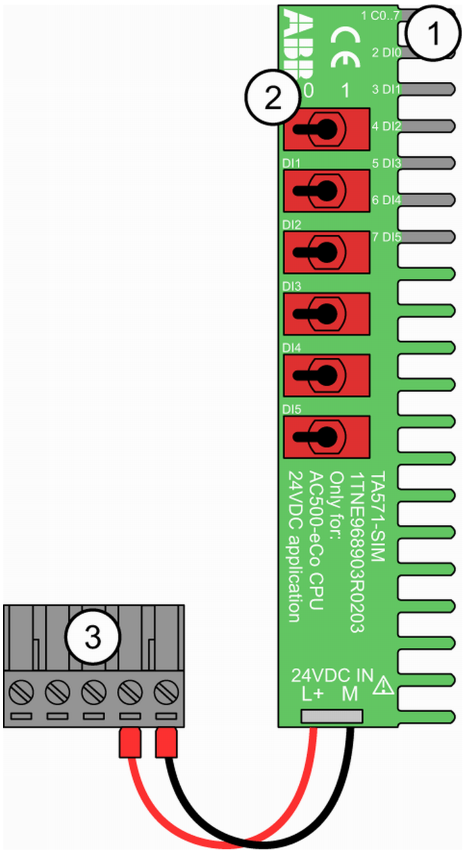
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3203	TA570, spare part set for AC500-eCo processor modules, 3x6 pieces	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

1.8.1.8 TA571-SIM - Input Simulator

- Input Simulator for 6 digital inputs 24 VDC
- For usage with AC500-eCo processor modules



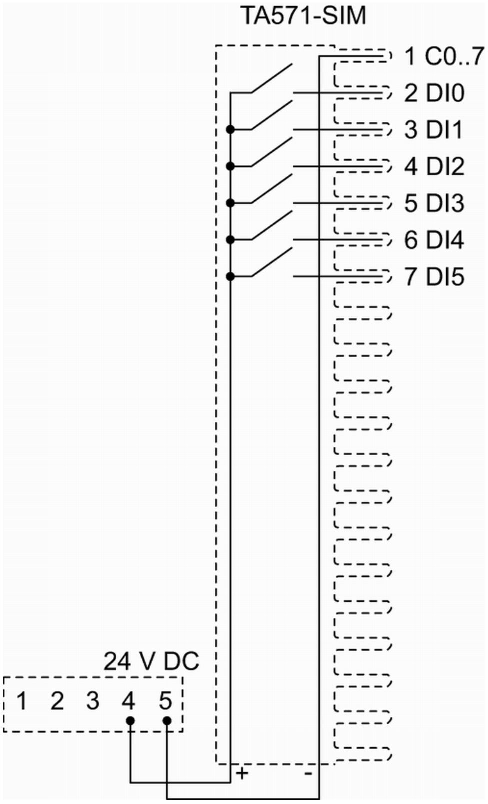
1 Contacts to connect to clamps of onboard I/Os
2 6 switches for the digital inputs DI0 ... DI5 (0 means opened switch, 1 means closed switch)
3 Terminal block for power supply connector of processor module PM55x/PM56x

Intended Purpose

The input simulator TA571-SIM is used for test and training purposes with AC500-eCo processor modules PM55x and PM56x. It can simulate 6 digital 24 VDC input signals to the digital inputs DI0...DI5 of onboard I/Os.

Electrical Diagram

The diagram below shows the electrical connection of the input simulator.



Mounting

To insert the input simulator follow the procedure shown below.

1. Make sure, that the power supply of the processor module is turned off.

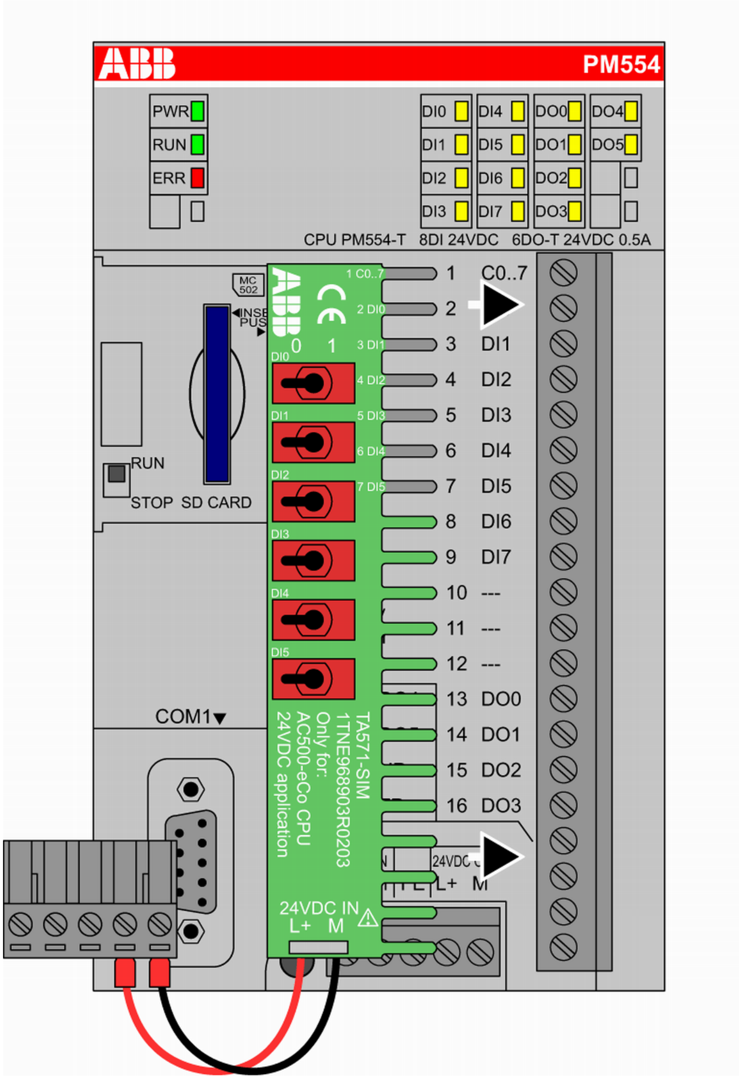
> **CAUTION!**
> **Risk of damaging the PLC modules!**
> The PLC modules can be damaged by overvoltages and short circuits. Make sure, that all voltage sources (supply and process voltage) are switched off before you are beginning with operations at the system. Never connect any voltages > 24 VDC to clamp 4/5 of the terminal block of input simulator TA571-SIM.

> **CAUTION!**
> **Risk of damaging the Input Simulator or PLC modules!**
> The input simulator must only be used with AC500-eCo processor modules PM55x and PM56x. Never use the input simulator with other devices.

> *The input simulator must only be used for test and training purposes. Never use it within productive plants.*

2. Remove the terminal block for power supply from the processor module by a flat-blade screwdriver.
3. Make sure, that all clamps of the onboard I/Os are totally open.
4. Use a flat-blade screwdriver to unplug the terminal block for power supply of the processor module.

5. Insert the input simulator as shown in the picture.



6. Tighten all screws of the onboard I/O clamps (max. torque 1.2 Nm).
7. Plug the terminal block for power supply of the TA571-SIM to the connector of the processor module.
8. Connect the processor module power supply wires (24 VDC or 100-240 VAC). See PM55x/PM56x *Chapter 1.2.1.1.4 “Power Supply” on page 26*

Usage

With input simulator TA571-SIM, the digital 24 VDC inputs DI0...DI5 of can be turned OFF and ON separately:

- If the lever of the switch is on the right side, the input is ON.
- If the lever of the switch is on the left side, the input is OFF.

Removal

To remove the input simulator follow the procedure shown below.

1. Make sure, that the power supply of the processor module is turned off.

> **CAUTION!**
> **Risk of damaging the PLC modules!**
> The PLC modules can be damaged by overvoltages and short circuits.
> Make sure, that all voltage sources (supply and process voltage) are switched off before you are beginning with operations at the system.

2. Disconnect the processor module power supply wires (24 VDC or 100-240 VAC) from the terminal block for power supply.
3. Unplug the terminal block for power supply with a flat-blade screwdriver of the power connector.
4. Loosen all screws of the onboard I/Os.
5. Remove the input simulator by pulling it to the left side.

Technical Data

Table 199: Technical Data of the Module

Parameter	Value
Process Supply Voltage	
Connections	Terminal 4 (L+) for +24 VDC and terminal 5 (M) for 0 VDC
Rated value	24 VDC
Max. ripple	5 %
Protection against reversed voltage	Yes
Electrical isolation	Yes, per module
Isolated Groups	1 (6 channels per group)
Weight	On request
Mounting position	Horizontal or vertical

Table 200: Technical Data of the Inputs

Parameter	Value
Number of channels per module	6 digital input channels (+24 VDC)
Distribution of the channels into groups	1 (6 channels per group)
Connections of channels DI0 to DI5	Terminals 2...7
Reference potential for the channels DI0 to DI5	Terminal 1 (minus pole of the process supply voltage, signal name C0...7)
Input current per active channel (at input voltage +24 VDC) The current is given through the used processor module.	Typ. 5 mA
Inrush current per active channel The current is given through the used processor module.	Typ. 5 mA

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 903 R0203	TA571-SIM, input simulator for PM55x and PM56x	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.1.9 TK504 - Programming Cable

- PC-side: USB connector type A
- AC500-side: 5-pole terminal block
- Length 3 m

Intended Purpose

TK504 programming cable connects the USB interface of a PC with the serial interface of processor module PM55x and PM56x. It is used for programming purposes.

CAUTION!
Risk of communication faults!
The mechanical connection of TK504 may get lost due to mechanical vibration.

Use TK504 only for programming and debugging. A permanent usage is not foreseen.

With AC500/AC500-eCo processor modules, only the ABB programming cables TK50x can be used. Other cables may cause communication faults and must not be used.

Electrical Connection

1. Install the device driver for the programming cable (see *“Installation of Cable Driver” on page 1131*).

   Once you have installed the device driver of the cable in your Windows system, make sure that you use always the same USB port of your computer. Otherwise, Windows will ask you to install the driver a second time if you connect the cable to a different USB port of your computer.

2. Connect the 5-pole terminal block of the TK504 to the processor module *Chapter 2.5.4.3 “Serial Interface COM2” on page 1214*.
3. Plug the USB connector to an USB interface at your PC.

Technical Data

Parameter	Value
Connector at the PC (USB interface)	USB connector type A
Connector at the Processor Module	Single conductors
Length	3 m

Parameter	Value
Cable type	Programming cable
Weight	0.4 kg

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R2100	TK504, programming cable USB -> single conductors, length 3 m	Active

**) For planning and commissioning of new installations use modules in Active status only.*

Installation of Cable Driver

Contents

1 Introduction and Basics

1.1 Intended Use

The TK503/TK504 programming cable can be used to operate and to configure the PLC via a PC or laptop. For this, CODESYS software, driver and utility programs must be installed and a TK503 or TK504 programming cable must be connected.

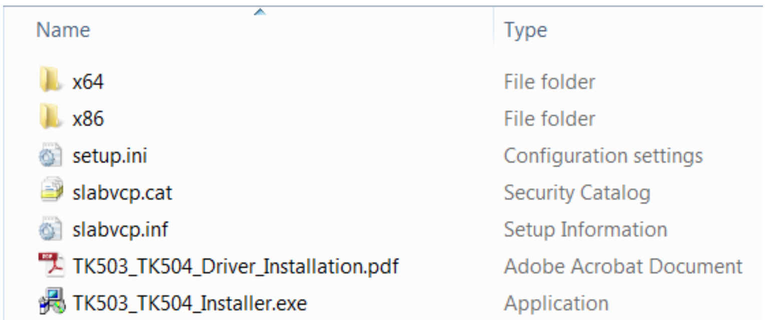
> **NOTICE!**
>
> The TK503/TK504 programming cable cannot be used for AC500 V3 Processor Modules.

1.2 PC System Requirements

– Platform: Microsoft Windows Vista, Windows 7, Windows 10
– CD-ROM drive
– USB port available for connecting the TK503/TK504 programming cable

> **NOTICE!**
>
> Microsoft, Windows and the Windows logo are trademarks of Microsoft Corporation in the USA and/or other countries. All other product and company names are trademarks of their respective owners.

1.3 Content of the Installation Package



Name	Type
x64	File folder
x86	File folder
setup.ini	Configuration settings
slabvcp.cat	Security Catalog
slabvcp.inf	Setup Information
TK503_TK504_Driver_Installation.pdf	Adobe Acrobat Document
TK503_TK504_Installer.exe	Application

2 Installation

2.1 Installation Steps

Before you can use the TK503/TK504 programming cable, the appropriate USB driver must be installed on your PC or laptop.

The driver for the TK503/TK504 programming cable is installed in two steps:

– Pre-installation of the driver on your PC using the program *TK503_TK504_Installer.exe*.

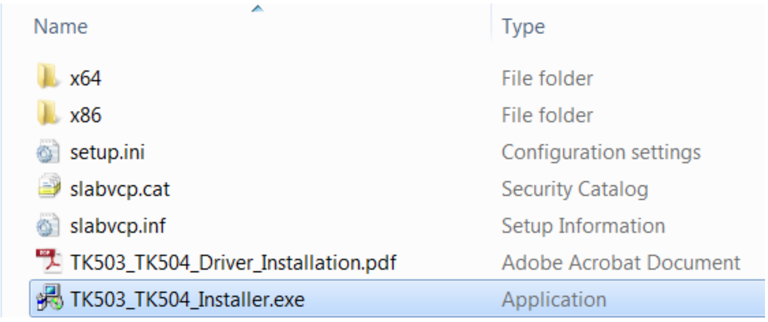
– Installation of the new hardware in Windows after the TK503 programming cable or TK504 programming cable is plugged in for the first time.

NOTICE!

Before you connect the TK503/TK504 programming cable with the PC, install the USB driver first.

2.2 Pre-Installation Routine

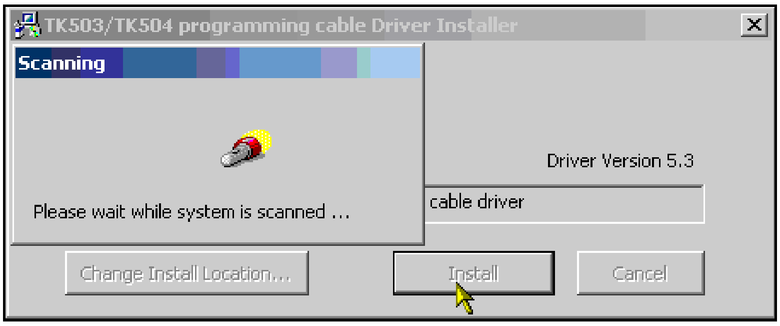
1. Uninstall all existing versions of the driver software.
2. Start the pre-installation of the driver by calling *TK503_TK504_Installer.exe.*



NOTICE!

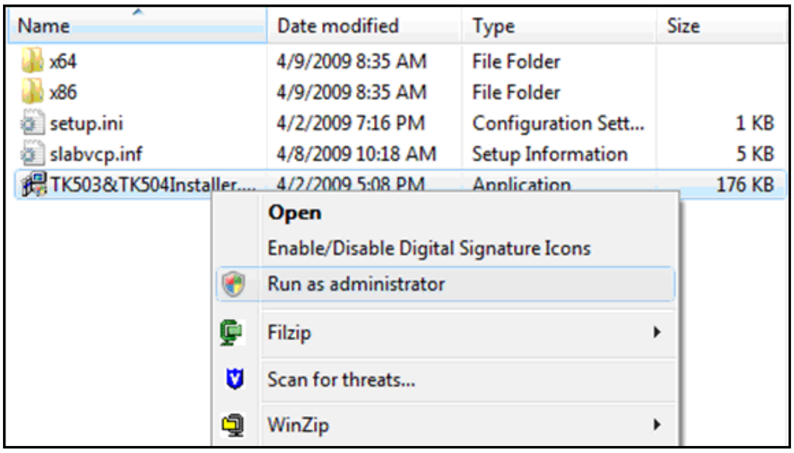
You must have administrator rights to run the installation.

3. Define the installation directory and click **Install**.



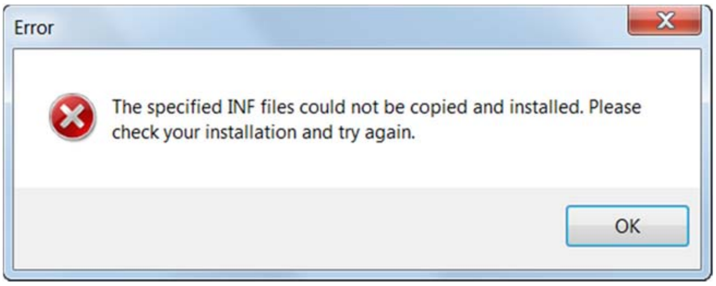
Windows Vista users only:

Start the *TK503&TK504Installer.exe* with the **Run as administrator** option, even if you have administrator rights. Acknowledge the following dialog with **Allow**.

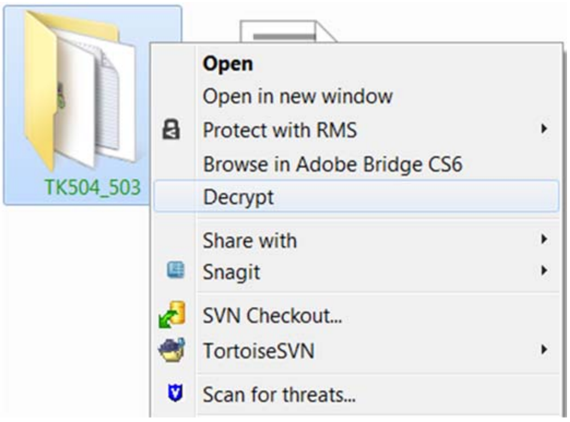


Windows 7 users only:

Windows will display an error message after clicking **Install**.



On this condition, decrypt the installation folder:



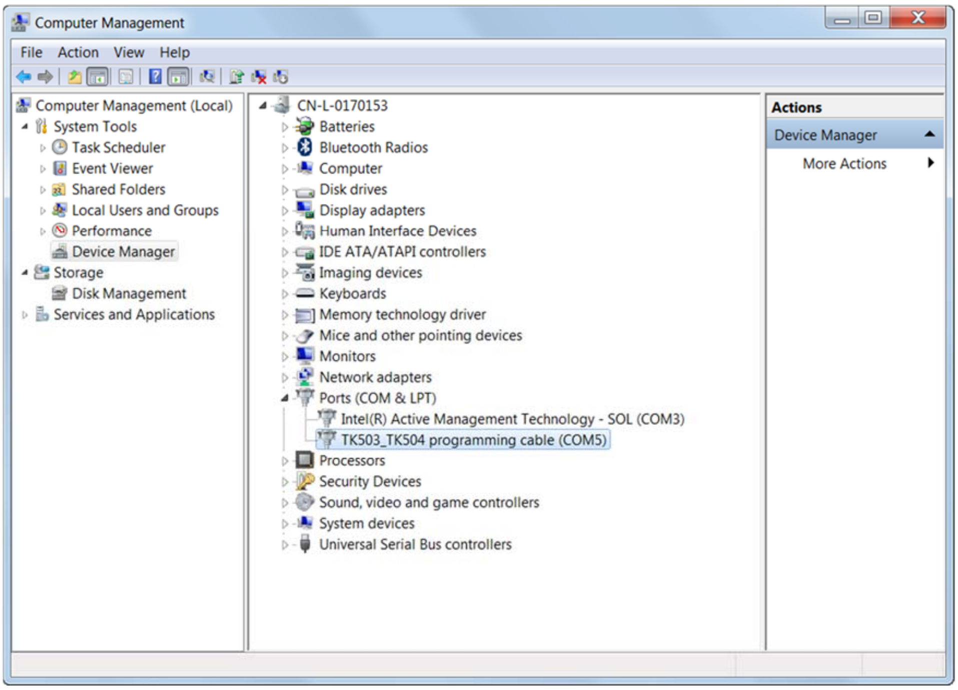
Then, start *TK503_TK504_Installer.exe* with the **Run as administrator** option again.

3 Communication

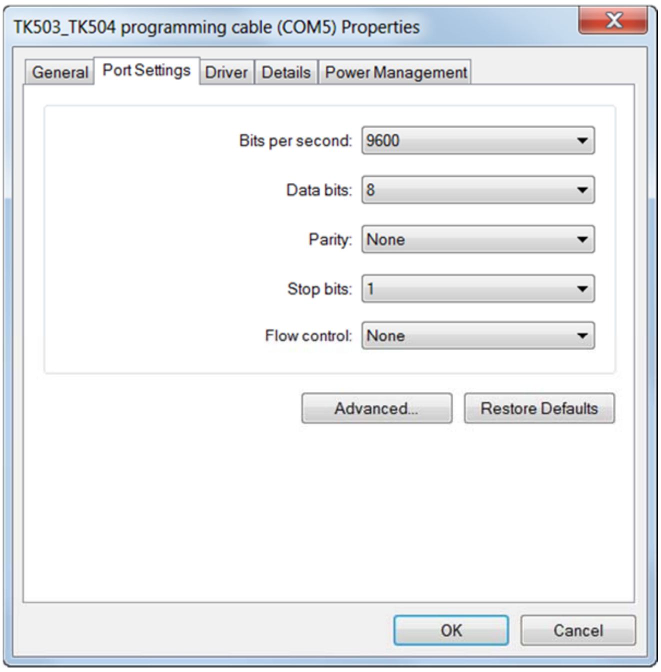
3.1 Virtual Communication Port Configuration

If the TK503/TK504 programming cable is plugged in a USB interface, Windows creates a virtual communication port (COM port).

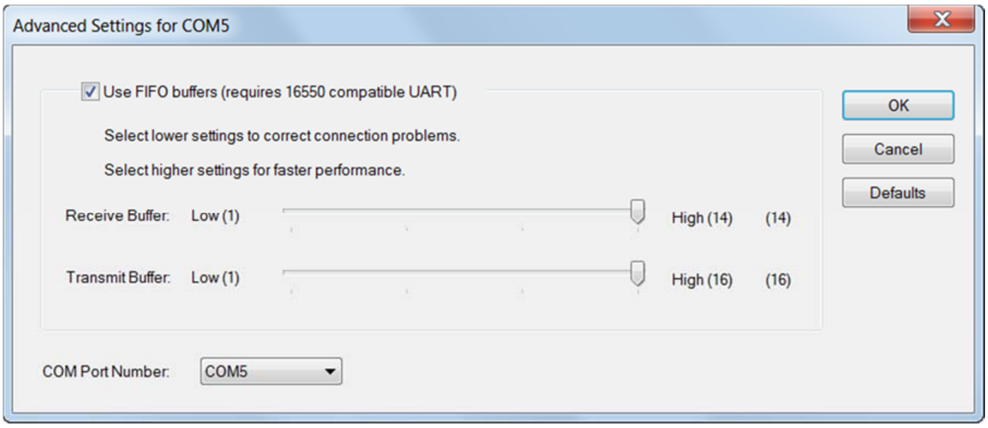
All communication ports can be viewed in the Windows Control Panel under Device Manager.



4. In the Ports settings click **Properties** to set the baud rate.



5. Set the COM port number under **Advanced** (up to COM32).

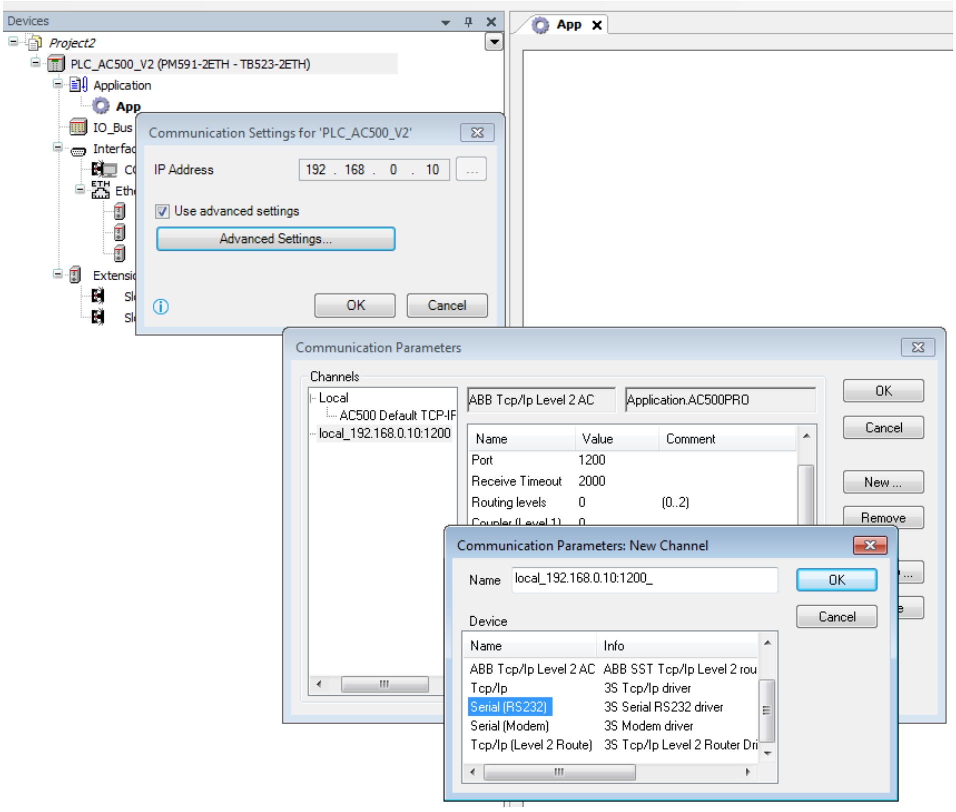


NOTICE!

When configuring the communication connection in CODESYS, the baud rate can also be set separately for each COM connection.

4 Automation Builder Communication

1. Install TK503/TK504 programming cable driver.
2. Connect the TK503 or TK504 programming cable to a PC or laptop. Windows detects the new hardware – complete the installation.
3. Start Automation Builder and open the project.
4. Right-click the PLC root node and select **Communication Parameters.**
5. Select the new virtual COM port.

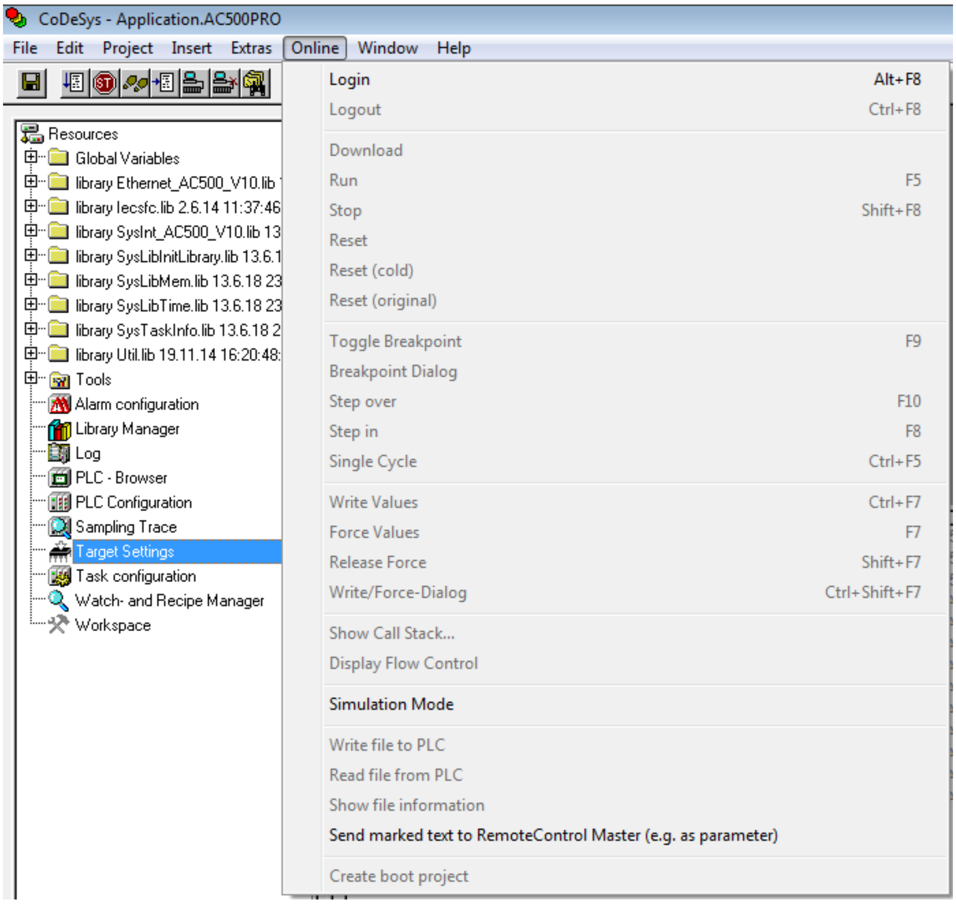


NOTICE!

The port number must be the same as the port number in the Device manager – Port – TK503/TK504 programming cable (COMx). Otherwise the communication cannot be built up.

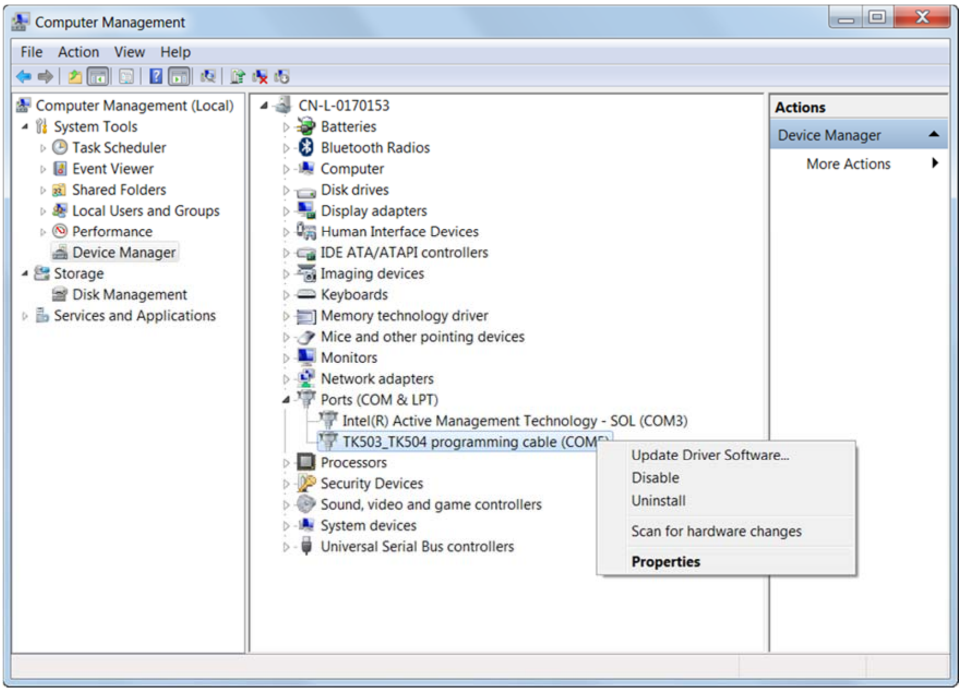
The number of COM ports depends on the availability on your computer.
The baud rate can be selected between 19200 and 115200 bps.

6. In CODESYS, create the communication between Automation Builder and the PLC.


CoDeSys - Application.AC500PRO
File Edit Project Insert Extras Online Window Help
Resources
Global Variables
library Ethernet_AC500_V10.lib
library Iecsfc.lib 2.6.14 11:37:46
library SysInt_AC500_V10.lib 13
library SysLibInitLibrary.lib 13.6.1
library SysLibMem.lib 13.6.18 23
library SysLibTime.lib 13.6.18 23
library SysTaskInfo.lib 13.6.18 2
library Util.lib 19.11.14 16:20:48
Tools
Alarm configuration
Library Manager
Log
PLC - Browser
PLC Configuration
Sampling Trace
Target Settings
Task configuration
Watch- and Recipe Manager
Workspace
Login Alt+F8
Logout Ctrl+F8
Download
Run F5
Stop Shift+F8
Reset
Reset (cold)
Reset (original)
Toggle Breakpoint F9
Breakpoint Dialog
Step over F10
Step in F8
Single Cycle Ctrl+F5
Write Values Ctrl+F7
Force Values F7
Release Force Shift+F7
Write/Force-Dialog Ctrl+Shift+F7
Show Call Stack...
Display Flow Control
Simulation Mode
Write file to PLC
Read file from PLC
Show file information
Send marked text to RemoteControl Master (e.g. as parameter)
Create boot project

5 Uninstallation / Update

1. In the Windows Control Panel open the Device Manger.
2. Right-click on the entry**TK503/TK504 programming cable** and select **Uninstall** or **Update Driver**.



Document Number: 3ADR020159M0201, 1, en_US

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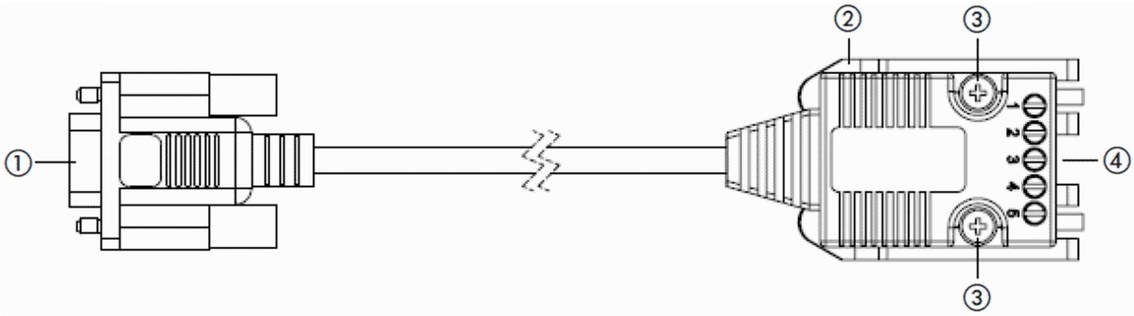
—

1.8.1.10 TK506 - RS-485 Isolator for COM1

1.8.1.10.1 Composition

- Isolated side: 5-pin terminal
- AC500-eCo-side: D-sub 9, male
- Length 0.6 m



1 D-sub 9 terminal, male, RS-485
2 DIN rail mounting spring
3 Holes for mounting with 2x M4 screws
4 5-pin terminal, screw-type, RS-485

1.8.1.10.2 Intended Purpose

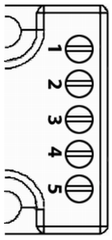
The RS485 isolator TK506 for COM1 of processor modules PM55x and PM56x allows longer cable length for serial communication. The product can be used for the communication protocols Modbus RTU or CS31 system bus.

> *The RS-485 isolator TK506 supports the processor modules PM55x and PM56x with the following ordering numbers and version indices:*
>
> – *1TNE968900Rxxxx with version index ≥ A3 (see image below)*
>
> – *1SAP12xx00Rxxxx independent of the version index ⇘ Table 7 “Processor Modules for AC500-eCo” on page 35*

The isolator provides galvanic isolation of the RS-485 communication signals. It is supplied via the 3.3 V output of the COM1 interface of the Processor Module. The isolator automatically detects and follows serial data flow direction changes. It is adapted to communication speeds up to 187.5 kBaud.

1.8.1.10.3 Connections

Connection: Interface



Pin No.	Signal	Description
1	Terminator P	Terminator positive
2	RxD/TxD-P	Receive/transmit positive
3	RxD/TxD-N	Receive/transmit negative
4	Terminator N	Terminator negative
5	FE	Functional earth (internally connected to DIN rail spring)

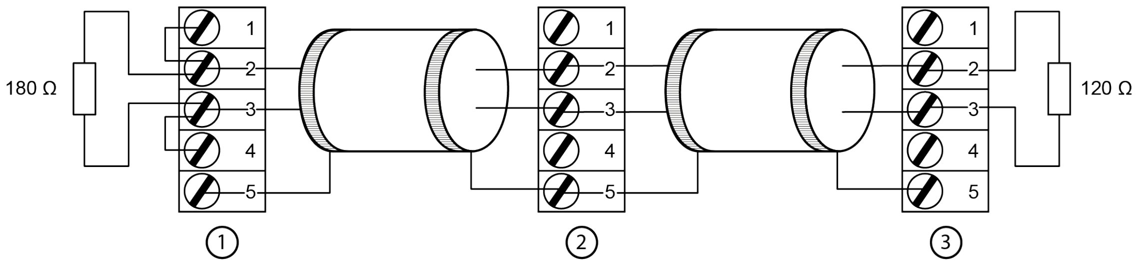
RS-485 communication requires an electrical termination of the communication line. The following is necessary:

- 2 suitable resistors at both line ends (to avoid signal reflections)
- a pull-up resistor at RxD/TxD-P and a pull-down resistor at RxD/TxD-N. These 2 resistors care for a defined high level on the bus, while there is no data exchange.

In every RS-485 network 1 pull-up and pull-down resistors must be activated. It is recommended to activate the pull-up and the pull-down resistors at the bus master. These 2 resistors are integrated inside the TK506 RS-485 isolator. They can be activated by connecting the terminals 1-2 and 3-4 of the terminal block with cable bridges.

Master at the Bus Line End

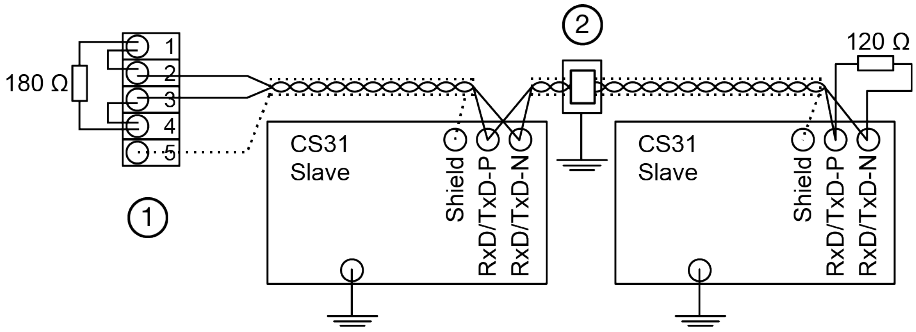
The following picture shows a RS-485 bus with the master at the end of bus line.



1 Master at the end of bus line, pull-up and pull-down resistors are activated, bus termination with 180 Ω resistor
2 Slave within the bus line
3 Slave at the end of bus line, bus termination with 120 Ω resistor

Connection: CS31 Protocol

The following figure shows an CS31 bus with the master at the end of bus line.



1 Master at the end of bus line, pull-up and pull-down activated, bus termination with 180 Ω resistor
2 Direct grounding clip or steel plate

> **NOTICE!**
> **Risk of EMC disturbances!**
> Unshielded cables may cause EMC disturbances.
>
> Always use shielded cables and connect the shield at every device.

1.8.1.10.4 Technical Data

Parameter		Value
Physical link		RS-485
Electrical Isolation		Yes
Usage / Supported protocols		Modbus (Master and Slave) CS31 (Master only)
Supported baudrates [baud]		
	Modbus	9.6 k, 14.4 k, 19.2 k, 38.4 k and 187.5 k
	CS31 system bus	187.5 k
Connector at the communication line		5-pin screw terminal block
Connector at PM554 or PM564		D-sub 9, male
Cable type and specification		Twisting rate minimum 10 per meter, with common shield Capacitance between the cores: < 55 nF/km Characteristic impedance: 120 Ω
	Recommended cable cross section	Conductor cross section 0.5 mm^2 Resistance per core: < 40 Ω/km
	Thinnest cable cross section	Conductor cross section 0.22 mm^2 Resistance per core: < 100 Ω/km
Max. cable length for Modbus		
	at 19.2 kBaud	500 m with cable cross section 0.5 mm^2 or 400 m with cable cross section 0.22 mm^2
Max. cable length for CS31 system bus		500 m with cable cross section 0.5 mm^2 or 400 m with cable cross section 0.22 mm^2

Parameter	Value
Specification for external termination resistor	120 Ω, 1 %, ≥ 0.25 W or 180 Ω, 1 %, ≥ 0.25 W
Length	0.6 m
Weight	80 g
Isolation voltage	500 VDC (type test)
Surge voltage (common mode)	1000 V (type test)

1.8.1.10.5 Ordering Data

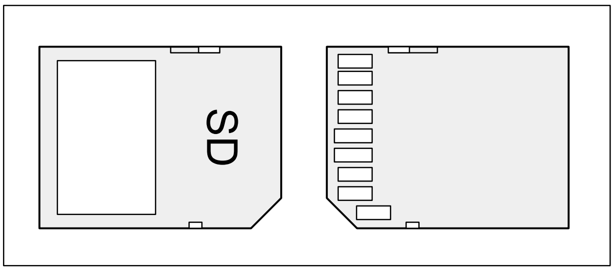
Part no.	Description	Product Life Cycle Phase *)
1SAP 186 100 R0001	TK506, RS-485 isolator D-sub 5 terminal	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2 AC500 (Standard)

1.8.2.1 MC502 - SD Memory Card

- Secure digital card
- Solid state flash memory storage



Purpose

The SD memory card is used to back-up user data and store user programs or project source codes as well as to update the internal CPU firmware. The processor modules can be operated with and without SD memory card.

AC500/AC500-eCo processor modules are supplied without SD memory card. It therefore must be ordered separately.

The MC memory card can be read on a PC with a standard memory card reader. AC500 processor modules are equipped with an MC memory card reader.

For AC500-eCo processor modules the device must be equipped with a MC503 SD memory card adaptor *Chapter 1.8.1.2 “MC503 - SD Memory Card Adaptor” on page 1107*.

The SD memory card has a write protect switch. In the position "LOCK", the card can only be read.

The use of memory cards other than the MC502 SD memory card is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Insertion of the SD Memory Card

NOTICE!

Removal of the SD memory card

Do not remove the SD memory card during access. Remove only when the RUN LED does not blink. Otherwise the SD memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

Unpack the SD memory card and insert it into the opening of the front face of the processor module until locked:

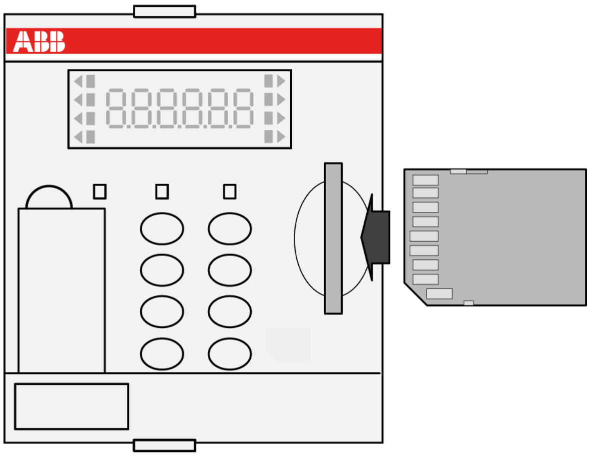


Fig. 193: Insertion: PM57x, PM58x, PM59x and PM56xx

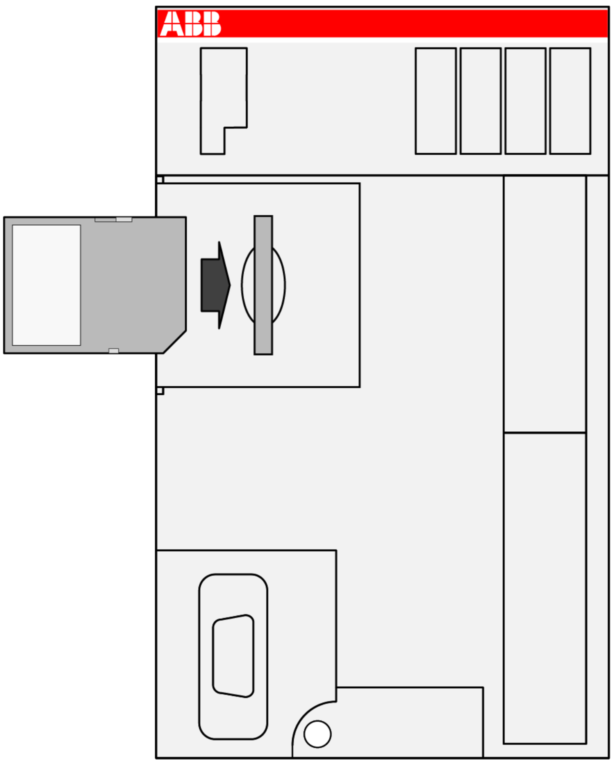


Fig. 194: Insertion: PM55x-xP and PM56x-xP

To remove the SD memory card, push on the card until it moves forward. By this, the card is unlocked and can be removed.

Technical Data

Parameter	Value
Memory capacity	Up to 2 GB, for exactly size see type plate
Temperature range	-20 °C...+85 °C
No. of writing cycles	> 100 000
No. of reading cycles	No limitation
Data safety	> 10 years
Write Protect Switch	Yes, at the edge of the SD memory card
Weight	2 g
Dimensions	24 mm x 32 mm x 2.1 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

Further information on using the SD memory card in AC500 PLCs is provided in the chapter *Storage Devices*.

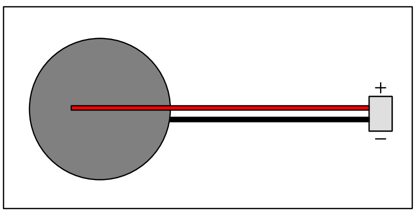
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 100 R0001	MC502, SD memory card	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.2 TA521 - Lithium Battery

- Manganese dioxide lithium battery, 3 V, 560 mAh
- Non-rechargeable



Purpose

The TA521 lithium battery is the only applicable battery for the AC500 processor modules *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64* and *PM56xx*. It cannot be recharged.

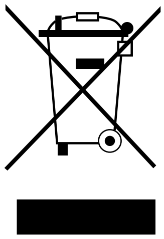
The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

See *AC500 Battery*.

The CPU monitors the discharge degree of the battery. A warning is issued before the battery condition becomes critical (about 2 weeks before). Once the warning message appears, the battery should be replaced as soon as possible.

Handling Instructions

- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.
- Replace the battery with supply voltage ON in order not to risk data being lost.
- Recycle exhausted batteries meeting the environmental standards.



Battery Lifetime

The battery lifetime is the time, the battery can store data while the processor module is not powered. As long as the processor module is powered, the battery will only be discharged by its own leakage current.

> *To avoid a short battery discharge, the battery should always be inserted or replaced while the process module is under power, then the battery is correctly recognized and will not shortly discharged.*

Technical Data

Parameter	Value
Nominal voltage	3 V
Nominal capacity	560 mAh
Temperature range (index below C0)	Operating: 0 °C...+60 °C Storage: -20 °C...+60 °C Transport: -20 °C...+60 °C
Temperature range (index C0 and above)	Operating: -40 °C...+70 °C Storage: -40 °C...+85 °C Transport: -40 °C...+85 °C
Battery lifetime	Typ. 3 years at 25 °C
Self-discharge	2 % per year at 25 °C 5 % per year at 40 °C 20 % per year at 60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug.
Insulation	The battery is completely insulated.
Connection	Red = plus pole = above at plug, black = minus pole,
Weight	7 g
Dimensions	Diameter of the button cell: 24.5 mm Thickness of the button cell: 5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 300 R0001	TA521, lithium battery	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.2.1 Insertion

Insertion

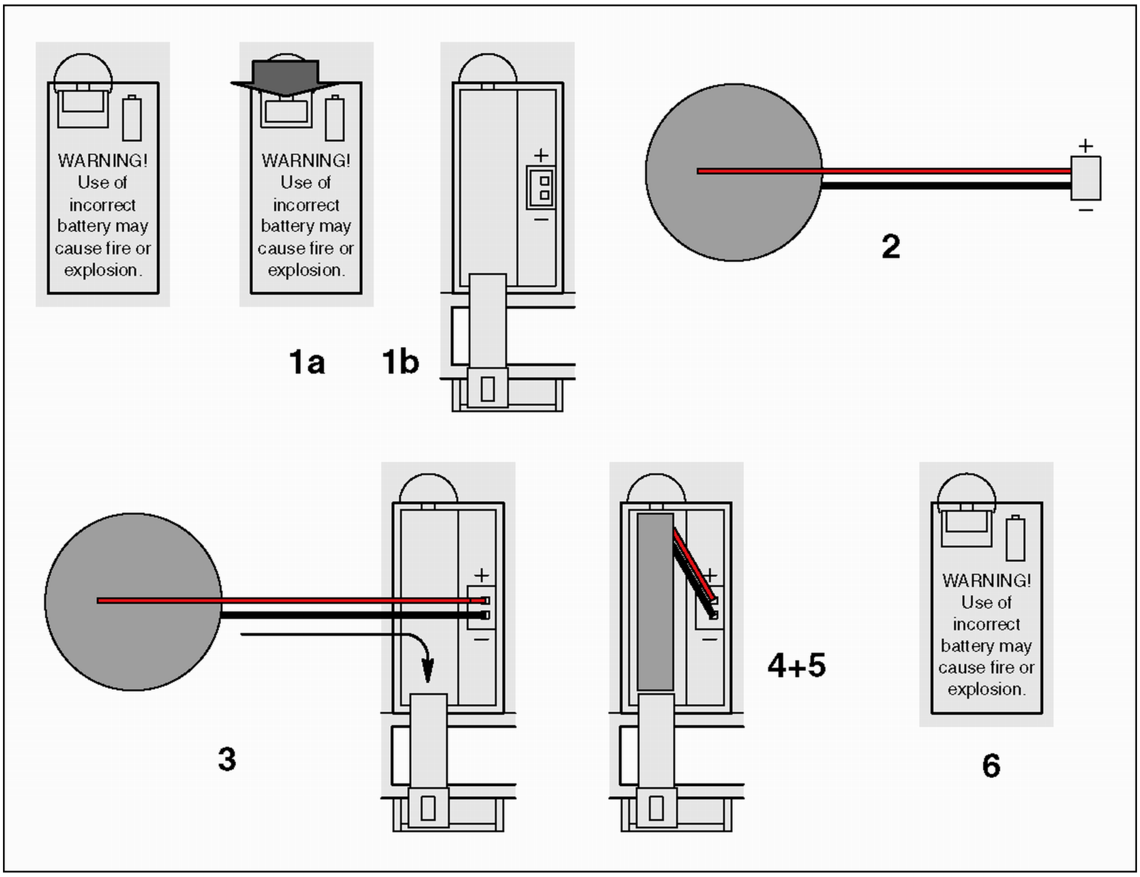


Fig. 195: Insertion of the Lithium battery

To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.

1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front face of the processor module and cannot be removed.
2. Remove the TA521 battery from its package and hold it by the small cable.
3. Insert the battery connector into the small connector port of the compartment. The connector is keyed to find the correct polarity (red = plus-pole = above).
4. Insert first the cable and then the battery into the compartment, push it until it reaches the bottom of the compartment.
5. Arrange the cable in order not to inhibit the door to close.
6. Pull-up the door and press until the locking mechanism snaps.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

1.8.2.2.2 Replacement

Replacement of the Battery

To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.

1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front face of the processor module and cannot be removed.
2. Remove the old TA521 battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

3. Follow the previous instructions to insert a new battery.

CAUTION!

Risk of explosion!

Do not open, re-charge or disassemble a lithium battery. Attempts to charge lithium batteries lead to overheating and possible explosions.

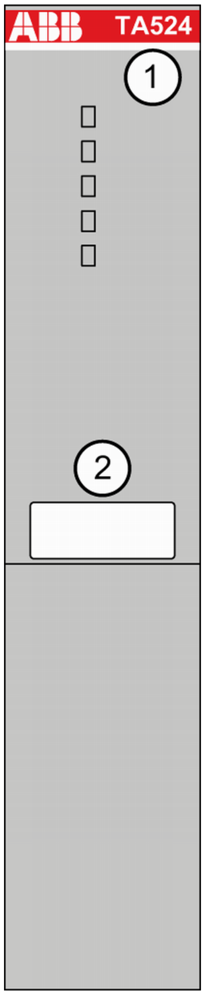
Prevent them from heat and fire and store them in a dry place.

Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid chance short circuiting and therefore do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

1.8.2.3 TA524 - Dummy Communication Module



1 Type
2 Label

Purpose

TA524 is used to cover an unused communication module slot of a terminal base *Chapter 1.1.1 “TB51x-TB54x” on page 4* and TB56xx. It protects the terminal base from dust and inadvertent touch.

Handling Instructions

TA524 is mounted in the same way as a common communication module *Chapter 2.6.3.6 “Mounting and Demounting the Communication Modules” on page 1275.*

Technical Data

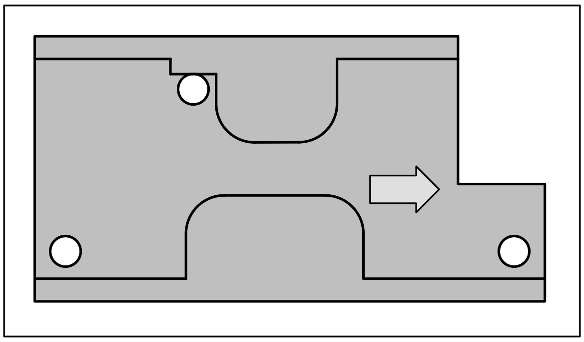
Parameter	Value
Weight	50 g
Dimensions	135 mm x 28 mm x 62 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 600 R0001	TA524, dummy communication module	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.4 TA526 - Wall Mounting Accessory



Purpose

If a terminal base TB5xx or a terminal unit TU5xx should be mounted with screws, the wall mounting accessories TA526 must be inserted at the rear side first. This plastic parts prevent bending of terminal bases and terminal units while screwing up.

Handling Instructions

Handling of the wall mounting accessory is described in detail in the section *Mounting and Disassembling the Terminal Unit* *“Mounting with Screws” on page 1268* and *Mounting/Disassembling Terminal Bases and Function Module Terminal Bases* *“Mounting with Screws” on page 1266*.

Technical Data

Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.5 TA541 - Lithium Battery

- Manganese dioxide lithium battery, 3 V
- Non-rechargeable

Purpose

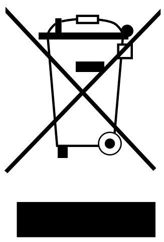
The TA541 lithium battery is the only applicable battery for PM595 *Chapter 1.2.2.2 "PM595" on page 79*. It is used to save RAM content of the processor module (PM595-4ETH-F only) and to back-up the real-time clock (all PM595 variants). It cannot be recharged.

The processor modules are supplied without a lithium battery. It therefore must be ordered separately. The TA521 Lithium Battery is used to save RAM contents of AC500 processor modules and back-up the real-time clock. Although the processor modules can work without a battery, its use is still recommended in order to avoid process data being lost.

The CPU monitors the discharge degree of the battery. A warning is output, before the battery condition becomes critical (about 2 weeks before). After the warning message has appeared, the battery should be replaced as soon as possible.

Handling Instructions

- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.
- Replace the battery with supply voltage ON in order not to risk data being lost.
- Recycle exhausted batteries meeting the environmental standards.



Battery Lifetime

The battery lifetime is the time the battery can store data while the CPU is not powered. As long as the CPU is powered, the battery will only be discharged by its own leakage current.

Technical Data

Parameter	Value
Nominal voltage	3 V
Nominal capacity	1800 mAh
Temperature range	Operating: -40 °C...+70 °C Storage: -40 °C...+85 °C Transport: -40 °C...+85 °C

Parameter	Value
Battery lifetime	Typ. 3 years at 25 °C
Self-discharge	1 % per year at 25 °C 5 % per year at 40 °C 20 % per year at 60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug
Insulation	The battery is completely insulated.
Connection	Red = plus pole = above at plug Black = minus pole
Weight	17 g
Dimensions	Diameter of the battery: ca. 18 mm Height of the battery: ca. 35 mm

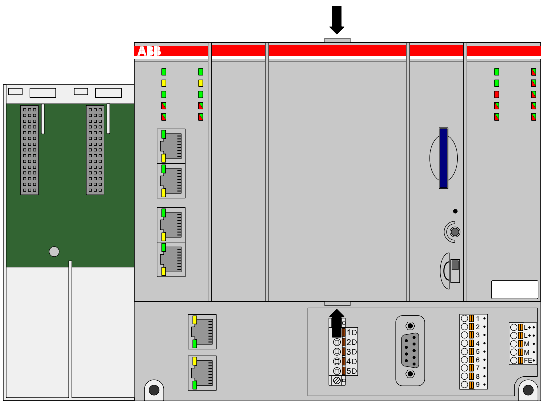
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 182 700 R0001	TA541, lithium battery	Active

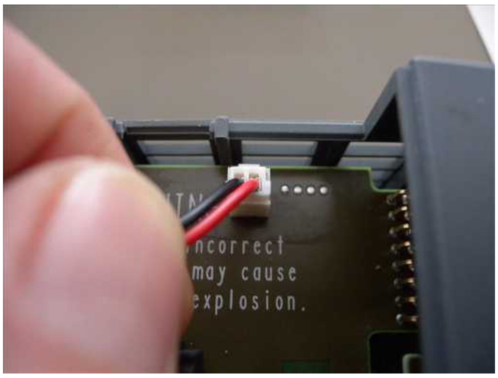
**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.5.1 Insertion

The TA541 lithium battery is the only applicable battery for Processor Modules PM595.

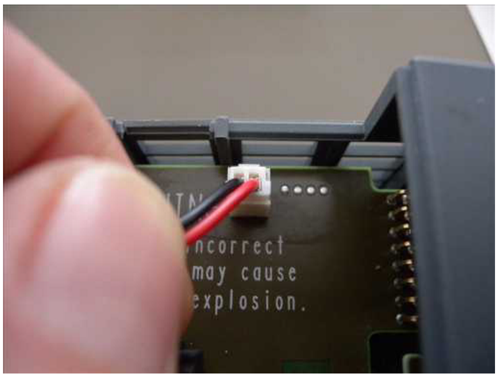


1. Remove the front cover / display by pressing the marked areas and pull it to the front.



2. Remove the old battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

3. Remove the battery from its package and hold it by the small cable.



4. Insert the battery connector into the small connector port of the compartment. The connector is keyed to find the correct polarity (red = plus-pole = right side).

5. Insert the battery into the battery compartment on the left side as shown in the picture.

6. Re-assemble the front cover / display by pressing it straight from the front until it snaps in.

> *In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.*
>
> *Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.*

1.8.2.5.2 Replacement

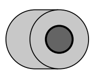
> *For PM595-4ETH-F only: battery replacement should be done with the system under power. Without battery and power supply there is no data buffering possible.*
>
> *For PM595-4ETH-M-XC only: battery only back-ups the real-time clock.*

1. Remove the front cover / display by pressing the marked areas and pull it to the front.
2. Remove the old battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

   Follow the previous instructions to insert a new battery.

> **CAUTION!**
> **Risk of explosion!**
> Do not open, re-charge or disassemble a lithium battery. Attempts to charge lithium batteries lead to overheating and possible explosions.
>
> Prevent them from heat and fire and store them in a dry place.
>
> Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid chance short circuiting and therefore do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

1.8.2.6 TA543 - Screw Mounting Accessory



Intended Purpose The TA543 screw mounting accessory is used for mounting the processor module PM595 *Chapter 1.2.1.2 “Onboard I/Os in Processor Module PM55x” on page 36* without DIN rail.

Handling Instruction 3x TA543 must be snapped on the backside of PM595 *Chapter 2.6.3.3 “Mounting and Demounting the Processor Module PM595” on page 1270*.

Technical Data

Parameter	Value
Weight	5 g
Dimensions	12 mm x 8.5 mm x 10 mm

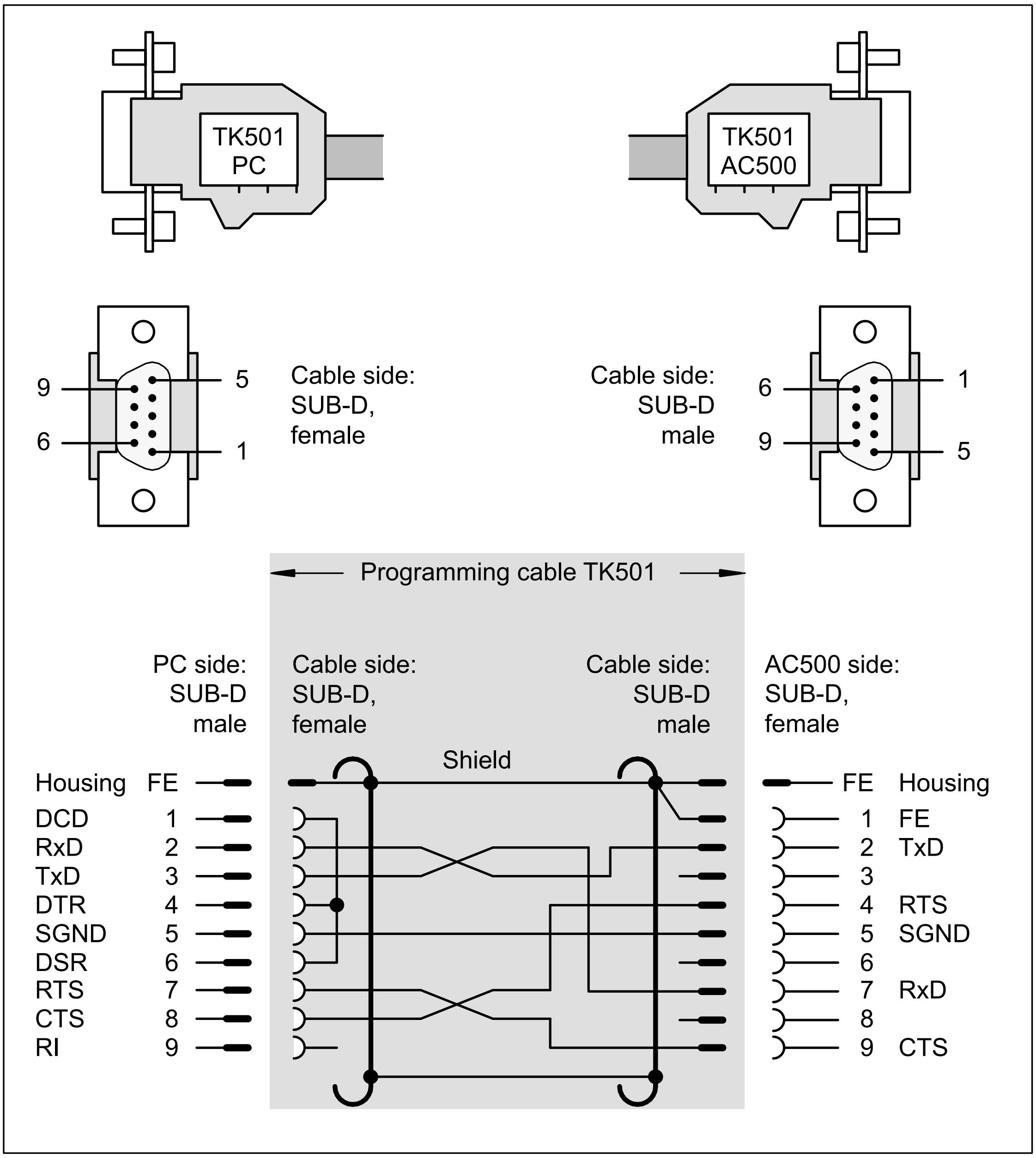
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 182 800 R0001	TA543, screw mounting accessory for PM595	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.7 TK501 - Programming Cable

- Cable on PC side: D-sub, 9-pole, female, RS-232, for COM interface
- Cable on AC500 side: D-sub, 9-pole, male, RS-232, for COM2 interface
- Cable length: 5 m


TK501
PC
TK501
AC500
9
6
5
1
Cable side:
SUB-D,
female
Cable side:
SUB-D
male
6
9
1
5
Programming cable TK501
PC side:
SUB-D
male
Cable side:
SUB-D,
female
Cable side:
SUB-D
male
AC500 side:
SUB-D,
female
Shield
Housing FE
DCD 1
RxD 2
TxD 3
DTR 4
SGND 5
DSR 6
RTS 7
CTS 8
RI 9
FE Housing
1 FE
2 TxD
3
4 RTS
5 SGND
6
7 RxD
8
9 CTS

CTS	Clear To Send
DCD	Data Carrier Detect
DTR	Data Terminal Ready
DSR	Data Set Ready
FE	Functional Earth
RI	Ring Indicator
RTS	Request To Send
RxD	Receive Data
SGND	Signal Ground
TxD	Transmit Data

Purpose

The TK501 cable connects a 9-pole serial COM interface of a PC with the serial COM2 interface of PM57x, PM58x and PM59x. It is used for programming purposes.

With AC500/AC500-eCo processor modules, only the ABB programming cables TK50x can be used. Other cables may cause communication faults and must not be used.

Electrical Connection

The 2 plugs are put on the 2 COM interfaces and tightened there.

Technical Data

Parameter	Value
Connector at the PC (COM interface)	D-sub, 9-pole, female
Connector at the Processor Module (COM2)	D-sub, 9-pole, male
Cable length	5 m
Cable type	LiYCY 5 x 0.14 mm², shielded
Weight	220 g

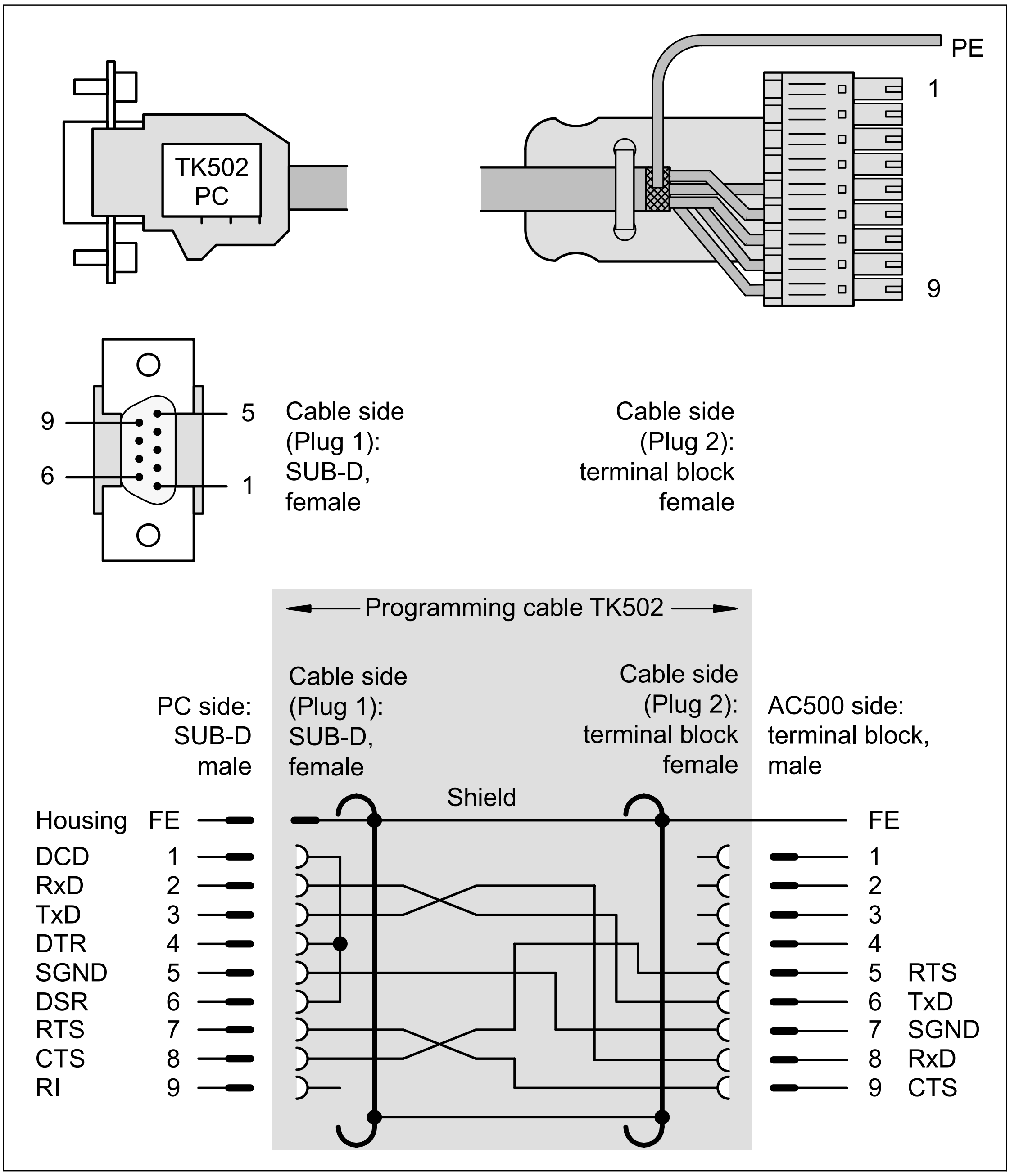
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 200 R0001	TK501, programming cable D-sub / D-sub, length: 5 m	Classic

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.8 TK502 - Programming Cable

- Cablel on PC side: D-sub, 9-pole, female, RS-232, for COM interface
- Cable on AC500 side: terminal block, 9-pole, female, RS-232, for COM1 interface
- Cable length: 5 m


TK502
PC
PE
1
9
9
5
6
1
Cable side
(Plug 1):
SUB-D,
female
Cable side
(Plug 2):
terminal block
female
Programming cable TK502
PC side:
SUB-D
male
Cable side
(Plug 1):
SUB-D,
female
Cable side
(Plug 2):
terminal block
female
AC500 side:
terminal block,
male
Shield
Housing FE
DCD 1
RxD 2
TxD 3
DTR 4
SGND 5
DSR 6
RTS 7
CTS 8
RI 9
FE
1
2
3
4
5 RTS
6 TxD
7 SGND
8 RxD
9 CTS

CTS	Clear To Send
DCD	Data Carrier Detect
DTR	Data Terminal Ready
DSR	Data Set Ready
FE	Functional Earth
RI	Ring Indicator
RTS	Request To Send
RxD	Receive Data
SGND	Signal Ground
TxD	Transmit Data

Purpose

The TK502 cable connects a 9-pole serial COM interface of a PC with the serial COM1 interface of PM57x, PM58x and PM59x. It is used for programming purposes.

With AC500/AC500-eCo processor modules, only the ABB programming cables TK50x can be used. Other cables may cause communication faults and must not be used.

Electrical Connection

The 2 plugs are put on the two COM interfaces and the plug at the PC side is tightened then.

Technical Data

Parameter	Value
Connector at the PC (COM interface)	D-sub, 9-pole, female
Connector at the AC500 CPU (COM1)	terminal block, 9-pole, female
Cable length	5 m
Cable type	LiYCY 5 x 0.14 mm^2, shielded
Weight	220 g

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 200 R0101	TK502, programming cable terminal block / D-sub, length: 5 m	Classic

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.2.9 TK503 - Programming Cable

- PC-side: USB connector type A
- AC500-side: D-sub, 9-pin, male
- Length 3 m

Intended Purpose

TK503 programming cable connects the USB interface of a PC with the serial interface of a processor module. It is used for programming purposes. TK503 can be used with all AC500 processor modules.

> *With AC500/AC500-eCo processor modules, only the ABB programming cables TK50x can be used. Other cables may cause communication faults and must not be used.*

Electrical Connection

1. Install the device driver for the programming cable (see *“Installation of Cable Driver” on page 1164*).

   > *Once you have installed the device driver of the cable in your Windows system, make sure that you use always the same USB port of your computer. Otherwise, Windows will ask you to install the driver a second time if you connect the cable to a different USB port of your computer.*

2. Plug the 9-pin D-sub male connector to the connector at the processor module and tighten it there.
3. Plug the USB connector to an USB interface at your PC.

Technical Data

Parameter	**Value**
Connector at the PC (USB interface)	USB connector type A
Connector at the Processor Module	D-sub, 9-pin, male
Length	3 m
Cable type	Programming cable
Weight	0.4 kg

Ordering Data

Part no.	**Description**	**Product Life Cycle Phase *)**
1TNE 968 901 R1100	TK503, programming cable USB -> D-sub (RS485), length 3 m	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

Installation of Cable Driver

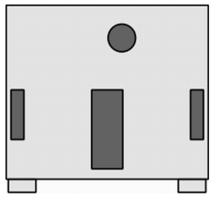
OPERATION INSTRUCTION

PROGRAMMING CABLE TK503 / TK504

USB DRIVER INSTALLATION

1.8.3 S500-eCo

1.8.3.1 TA566 - Wall Mounting Accessory



Intended Purpose

The TA566 wall mounting accessory is used for mounting S500-eCo I/O modules and AC500-eCo processor modules without DIN rail.

Handling Instruction

The TA566 is snapped into the back side of the device's housing ↪ *Chapter 2.5.3.2 “Mounting and Demounting of S500-eCo I/O Modules” on page 1205*.

Technical Data

Parameter	Value
Weight	5 g
Dimensions	29 mm x 28 mm x 5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3107	TA566, wall mounting accessory, 100 pieces	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.3.2 TA563-TA565 - Terminal Blocks

These terminal blocks must only be used with AC500-eCo I/O Modules and AC500-eCo processor modules.

Intended Purpose

The TA563-TA565 terminal blocks are used to connect process signals and process voltages to AC500-eCo I/O modules and AC500-eCo processor modules (with -P extension inside their type designator only). 3 different kind of terminal blocks are available:

- Screw terminals with cable insertion on the side
- Screw terminals with cable insertion on the front
- Spring terminals with cable insertion on the front

Of each kind, 2 sizes are available:

- Terminals with 9 poles
- Terminals with 11 poles.

There are 2 compatible variants of each kind and size.

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

Technical Data

Table 201: Screw-type Terminals (TA563/TA564)

Parameter		Value
Type		Front terminal or side terminal (depending on model)
Conductor cross section		
	Solid	0.5 mm^2 to 2.5 mm^2
	Flexible	0.5 mm^2 to 2.5 mm^2
Stripped conductor end		
	TA563	8 mm
	TA564	10 mm
Width of the screwdriver		3.5 mm
Fastening torque		0.4 Nm - 0.5 Nm
Degree of protection		IP 20 (if all terminal screws are tightened)
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Table 202: Spring Terminals (TA565)

Parameter		Value
Type		Front terminal
Conductor cross section		
	Solid	0.5 mm^2 to 2.5 mm^2
	Flexible	0.5 mm^2 to 2.5 mm^2
Stripped conductor end		10 mm
Degree of protection		IP 20
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3101	Terminal Block TA563-9, 9-pole, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal Block TA563-11, 11-pole, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3103	Terminal Block TA564-9, 9-pole, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal Block TA564-11, 11-pole, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal Block TA565-9, 9-pole, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal Block TA565-11, 11-pole, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.4 S500

1.8.4.1 CP-E - Economic Range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

- Wide-range input voltage
- Mounting on DIN rail
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Wide ambient temperature range from -40 °C...+70 °C
- No-load-proof, overload-proof, continuous short-circuit-proof
- Power factor correction (depending on the type)
- Approved in accordance with all relevant international standards

Table 203: Ordering Data

Order No.	**Type**	**Input**	**Output**	**Overload capacity**	**Module width [mm]**
1SVR427030R0000	CP-E 24/0.75	100-240 VAC or 120-370 VDC	24 VDC, 0.75 A	-	22.5
1SVR427031R0000	CP-E 24/1.25	100-240 VAC or 90-375 VDC	24 VDC, 1.25 A	-	40.5
1SVR427032R0000	CP-E 24/2.5	100-240 VAC or 90-375 VDC	24 VDC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 VAC auto select or 210-370 VDC	24 VDC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 VAC auto select or 210-370 VDC	24 VDC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115-230 VAC or 120-370 VDC	24 VDC, 20 A	-	175

1.8.4.2 CP-C.1 - High Performance Range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

The CP-C.1 power supplies are ABB’s high performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combinded with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications.

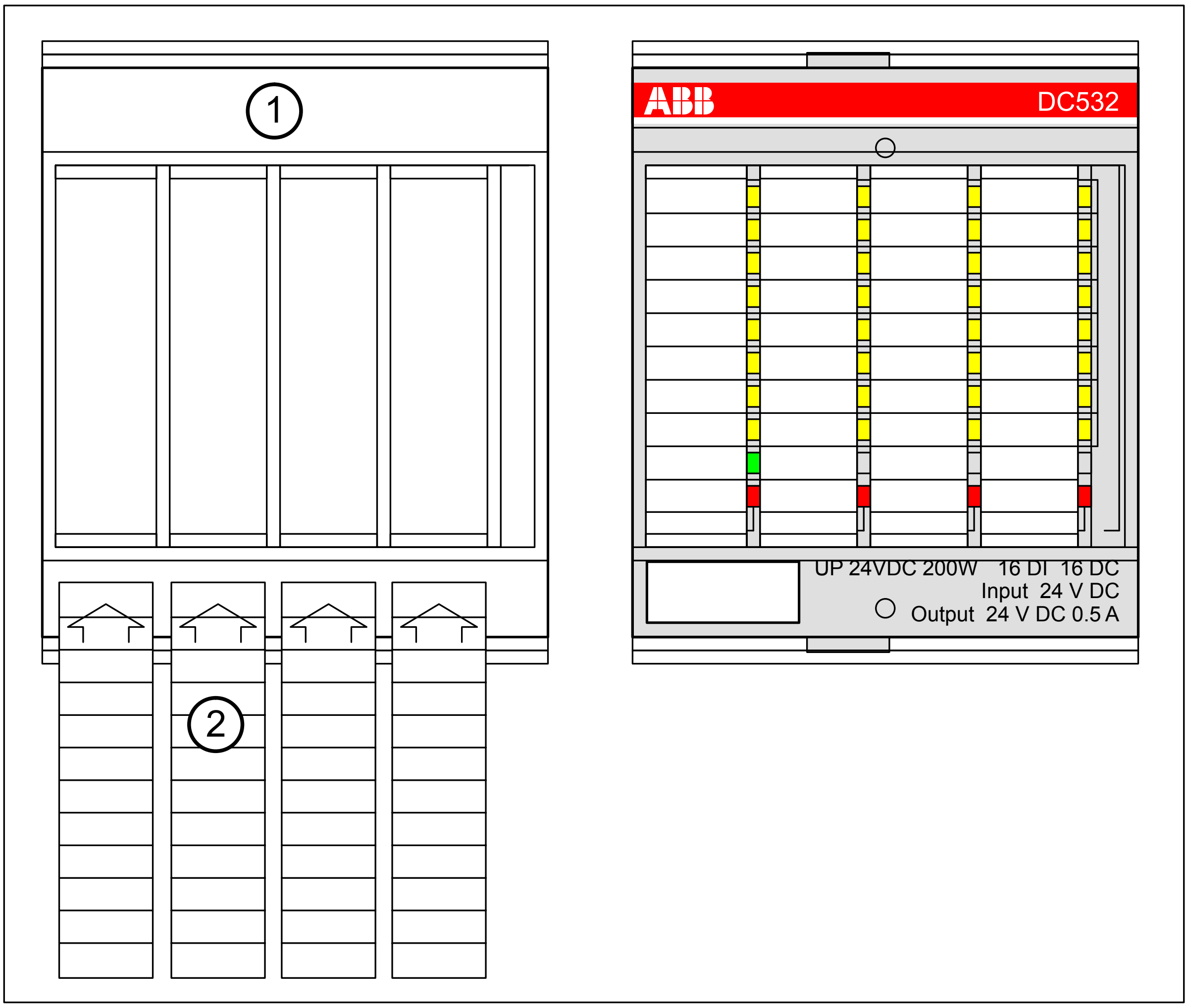
- Typical efficiency of up to 94 %
- Power reserve design delivers up to 150 % of the nominal output current
- Signaling outputs for DC OK and power reserve mode
- High power density leads to very compact and small devices
- No-load-proof, overload-proof, continuous short-circuit-proof
- Active power factor correction (PFC)

Table 204: Ordering Data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110-240 VAC or 90-300 VDC	24 VDC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110-240 VAC or 90-300 VDC	24 VDC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110-240 VAC or 90-300 VDC	24 VDC, 20 A	+30 %	82

1.8.4.3 TA523 - Pluggable Marker Holder

For labelling the channels of S500 I/O modules.



1 Pluggable Marker Holder TA523
2 Marking stripes to be inserted into the holder
3 Pluggable Marker Holder, snapped on an I/O module

Purpose

The Pluggable Marker Holder is used to hold 4 marking stripes, on which the meaning of the I/O channels of I/O modules can be written down. The holder is transparent so that after snapping it onto the module the LEDs shine through.

Handling Instructions

The marking stripes can be printed out from TA563.doc *http://new.abb.com/products/ABB1SAP180500R0001*.

Technical Data

Parameter	Value
Use	For labelling channels of I/O modules
Mounting	Snap-on to the module
Weight	20 g
Dimensions	82 mm x 67 mm x 13 mm

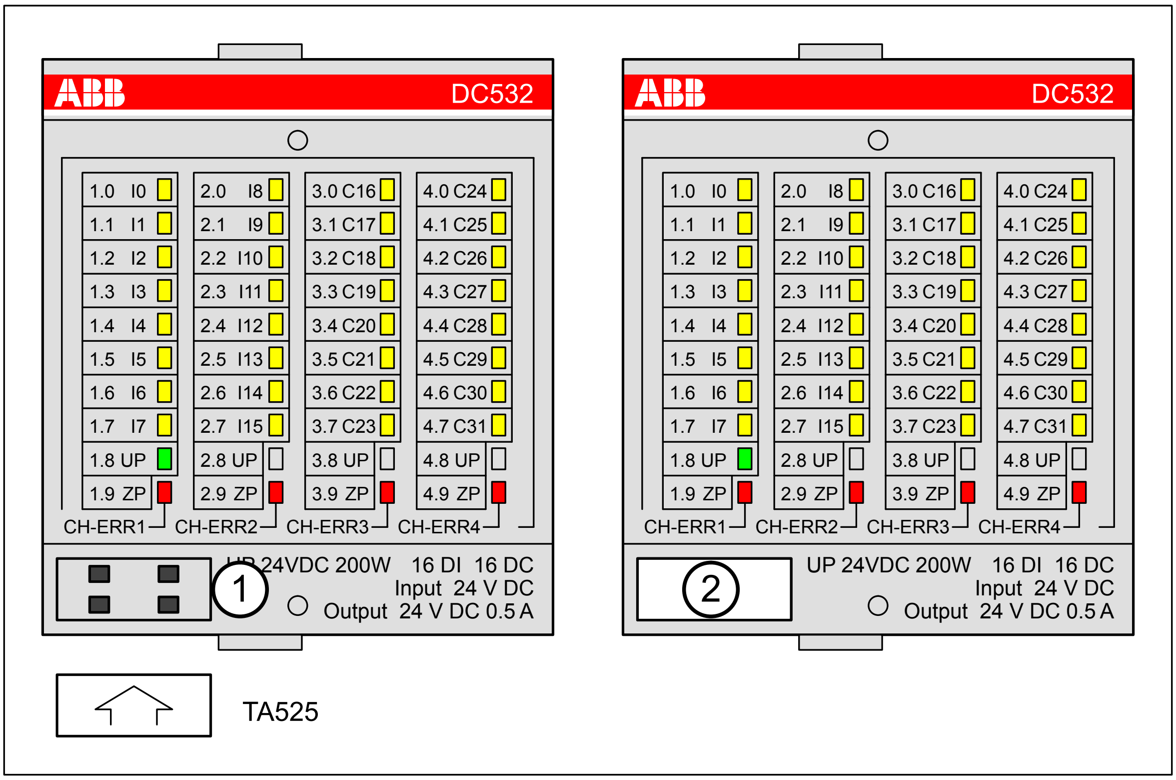
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 500 R0001	TA523, Pluggable Marker Holder (10 pieces)	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.4.4 TA525 - Plastic Markers

Accessory to label AC500 and S500 modules.



1 Module without Plastic Marker TA525
2 Module with Plastic Marker TA525

Purpose

The Plastic Markers are suitable for labelling AC500 and S500 modules (CPUs, communication modules and I/O modules). The small plastic parts can be written with a standard waterproof pen.

Handling Instructions

The Plastic Markers are inserted under a slight pressure. For disassembly, a small screwdriver is inserted at the lower edge of the module.

Technical Data

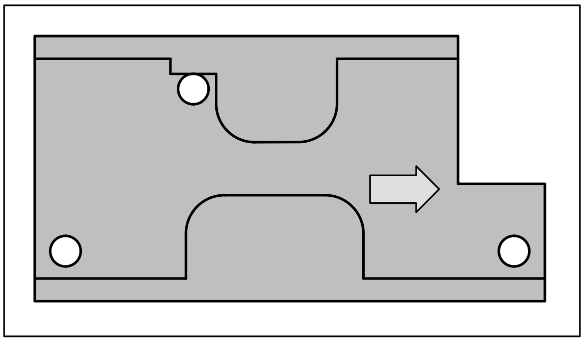
Parameter	Value
Use	For labelling AC500 and S500 modules
Mounting	Insertion under a slight pressure
Disassembly	With a small screwdriver
Scope of delivery	10 pieces
Weight	1 g per piece
Dimensions	8 mm x 20 mm x 5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 700 R0001	TA525, Set of 10 white Plastic Markers	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.4.5 TA526 - Wall Mounting Accessory



Purpose

If a terminal base TB5xx or a terminal unit TU5xx should be mounted with screws, the wall mounting accessories TA526 must be inserted at the rear side first. This plastic parts prevent bending of terminal bases and terminal units while screwing up.

Handling Instructions

Handling of the wall mounting accessory is described in detail in the section *Mounting and Disassembling the Terminal Unit* *➪ "Mounting with Screws" on page 1268* and *Mounting/Disassembling Terminal Bases and Function Module Terminal Bases* *➪ "Mounting with Screws" on page 1266*.

Technical Data

Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

**) For planning and commissioning of new installations use modules in Active status only.*

1.8.4.6 TA535 - Protective Caps for XC Devices

Purpose

Accessory to cover unused connectors of XC devices in salt mist environments.

One TA535 package includes different cap types for the following connectors:

- RJ45 connectors
- 9-pole D-sub connector
- FieldBusPlug connector

Protection should be done for all unused slots of -XC devices.

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 182 300 R0001	TA535, Protective Caps for XC devices	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2 System Assembly, Construction and Connection

2.1 Introduction

This chapter provides information on assembly, construction and connection of control systems of the product family AC500.

The AC500 product family consists of the sub-families:

- AC500 (standard): standard PLC that offers a wide range of performance levels and scalability.
- AC500-eCo: cost-effective PLC that offers total inter-operability with the core AC500 range.
- AC500-S: PLC for special safety requirements in all functional safety applications.

AC500 (standard) and AC500-S provide devices with -XC extension as a product variant. Those devices operate mainly identical to the appropriate AC500 product family, however, can be operated under extreme conditions *Chapter 2.7.1 “System Data AC500-XC” on page 1313*.

AC500 product family is characterized by functional modularity, i.e. the devices of all AC500 sub-families can be combined flexible.

As assembly, construction and connection for the devices of the AC500 product family is similar, information that is valid for all sub-families is provided within an overall section. Details that are only valid for a specific AC500 sub-family are described in separate sections.

As assembly, construction and connection for the devices of the AC500 product family is similar, information that is valid for all sub-families is provided within an overall section *Chapter 2.4 “Overall Information (valid for complete AC500 Product Family)” on page 1180*. Details that are only valid for a specific AC500 sub-family are described in separate sections.

> ***Consider the Safety Instructions***
> *In the description, special attention must be paid to designs using electrical isolation, earthing and EMC measures for the reasons stated. Consider the safety instructions for AC500 product family Chapter 2.3 “Safety Instructions” on page 1177.*

2.2 Regulations

Appropriate system setup

The following regulations have to be taken into due consideration:

- DIN VDE 0100: "Regulations for the Setting up of Power Installations"
- DIN VDE 0110 Part 1 and Part 2: "The Rating of Creepage Distances and Clearances"
- DIN VDE 0160 and DIN VDE 0660 Part 500: "The Equipment of Power Installations with Electrical Components"

To ensure project success and proper installation of all systems, customers must be familiar and proficient with the following standards and must comply with their directives:

- DIN VDE 0113 Part 1 & Part 200: "Working & Process Machinery"
- DIN VDE 0106 Part 100: "Close proximity to dangerous voltages"
- DIN VDE 0160, DIN VDE 0110 Part 1: "Protection against direct contact"

The user has to guarantee that the devices and the components are mounted following these regulations. For operating the machines and installations, other national and international relevant regulations, concerning prevention of accidents and using technical working means, also have to be met.

AC500 devices are designed according to IEC 1131 Part 2 under overvoltage category II per DIN VDE 0110 Part 2.

For direct connection of AC Category III overvoltages provide protection measures for overvoltage category II according to IEC-Report 664/1980 and DIN VDE 0110 Part 1.

Equivalent standards:

- DIN VDE 0110 Part 1 ↔ IEC 664
- DIN VDE 0113 Part 1 ↔ EN 60204 Part 1
- DIN VDE 0660 Part 500 ↔ EN 60439-1 ↔ IEC 439-1

All rights reserved to change design, size, weight, etc.

Qualified Personnel

Both the control system AC500 and other components in the vicinity are operated with dangerous contact voltages. Touching parts, which are under such voltages, can cause grave damage to health.

In order to avoid such risks and the occurrence of material damage, persons involved with the assembly, starting up and servicing must possess pertinent knowledge of the following:

- Automation technology sector
- Dealing with dangerous voltages
- Using standards and regulations, in particular VDE, accident prevention regulations and regulations concerning special ambient conditions (e.g. areas potentially endangered by explosive materials, heavy pollution or corrosive influences).

2.3 Safety Instructions

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variants and requirements associated with any particular installation, ABB cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by ABB with respect to use of information, circuits, equipment or software described in this manual. No liability is assumed for the direct or indirect consequences of the improper use, improper application or inadequate maintenance of these devices. In no event will ABB be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

PLC specific Safety Notices

The product family AC500 control system is designed according to EN 61131-2 IEC 61131-2 standards. Data, different from IEC 61131, are caused by the higher requirements of Maritime Services. Other differences are described in the technical data description of the devices.

NOTICE!

Avoidance of electrostatic charging

PLC devices and equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Observe the following rules when handling the system:

– Touch a grounded object to discharge potential static.
– Wear an approved grounding wrist strap.
– Do not touch connectors or pins on component boards.
– Do not touch circuit components inside the equipment.
– If available, use a static-safe workstation.
– When not in use, store the equipment in appropriate static-safe packaging.

NOTICE!
PLC damage due to operation conditions
Protect the devices from dampness, dirt and damage during transport, storage and operation!

NOTICE!
PLC damage due to wrong enclosures
Due to their construction (degree of protection IP 20 according to EN 60529) and their connection technology, the devices are suitable only for operation in enclosed switchgear cabinets.

Cleaning instruction
Do not use cleaning agent for cleaning the device.

Use a damp cloth instead.

Connection plans and user software must be created so that all technical safety aspects, legal regulations and standards are observed. In practice, possible shortcircuits and breakages must not be able to lead to dangerous situations. The extent of resulting errors must be kept to a minimum.

Do not operate devices outside of the specified, technical data!

Trouble-free functioning cannot be guaranteed outside of the specified data.

NOTICE!
PLC Damage due to missing Earthing
– Ensure to earth the devices.
– The earthing (switch cabinet earthing, PE) is supplied both by the mains connection (or 24 V supply voltage) and via DIN rail. The DIN rail must be connected to the earth before the device is subjected to any power. The earthing may be removed only if it is certain that no more power is being supplied to the control system.

In the description for the devices (operating manual or AC500 system description), reference is made at several points to earthing, electrical isolation and EMC measures. One of the EMC measures consists of discharging interference voltages into the earthing via Y-type capacitors. Capacitor discharge currents must basically be able to flow off to the earthing (in this respect, see also VBG 4 and the relevant VDE regulations).

CAUTION!
Do not obstruct the ventilation for cooling!
The ventilation slots on the upper and lower side of the devices must not be covered.

CAUTION!

Run signal and power wiring separately!

Signal and supply lines (power cables) must be laid out so that no malfunctions due to capacitive and inductive interference can occur (EMC).

WARNING!

Labels on or inside the device alert people that dangerous voltage may be present or that surfaces may have dangerous temperatures.

WARNING!

Splaying of strands can cause hazards!

During wiring of terminals with stranded conductors, splaying of strands shall be avoided.

– Ferrules can be used to prevent splaying.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

Information on Batteries

CAUTION!

Use only ABB approved lithium battery modules!

At the end of the battery's lifetime, always replace it only with a genuine battery module.

CAUTION!
Risk of explosion!
Do not open, re-charge or disassemble a lithium battery. Attempts to charge lithium batteries lead to overheating and possible explosions.

Prevent them from heat and fire and store them in a dry place.

Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid chance short circuiting and therefore do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

Environment Considerations
Recycle exhausted batteries. Dispose batteries in an environmentally conscious manner, in accordance to local-authority regulations.

Environment and Enclosure Information

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2.000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as "open type" equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

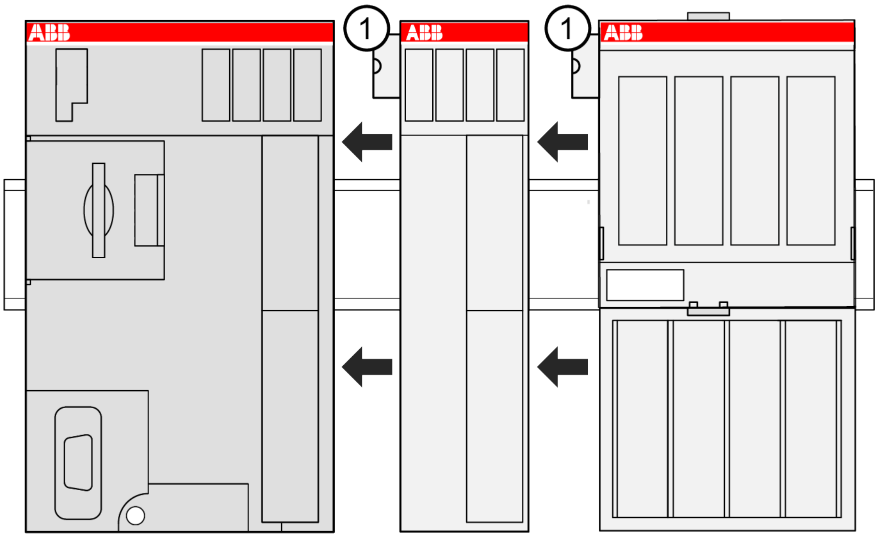
Refer to NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also see the appropriate sections in this manual.

2.4 Overall Information (valid for complete AC500 Product Family)

2.4.1 Serial I/O Bus

The synchronized serial I/O bus is the I/O data bus for the I/O modules connected with the Processor Modules or Communication Interface Modules. Through this bus, I/O and diagnosis data are transferred.

Up to 10 I/O Terminal Units (for 1 I/O module each) can be added to one Terminal Base or to one AC500-eCo processor module. The I/O Terminal Units and the AC500--eCo I/O modules, have a bus input at the left side and a bus output at the right side. Thus the length of the I/O bus increases with the number of attached I/O modules.



1 I/O bus connection

The electrical connection of the I/O bus is performed automatically by telescoping the modules on the DIN rail. The I/O bus provides the following signals:

- Supply voltage of 3.3 VDC for feeding the electronic interface components
- 3 data lines for the synchronized serial data exchange
- several control signals

NOTICE!
The I/O bus is not designed for plugging and unplugging modules while in operation. If a module is plugged or replaced while the bus is in operation, the following consequences are possible

– reset of the station or of the CPU
– system lockup
– damage of the module

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

With its fast data transmission, the I/O bus obtains very low reaction times. Depending on the device and on the version of firmware and Automation Builder, the following numbers of I/O devices can be connected to the I/O bus.

Device	Version Control Builder/Automation Builder	Version Firmware	Max. Number of I/O Devices
AC500-eCo PM55x and PM56x (-ETH variants only)	As of V2.0.0	As of V2.0.0	7
AC500-eCo PM55x and PM56x	As of V2.1.0	As of V2.0.6	10
CS31 bus Modules DC551-CS31 and CI592-CS31-HA	All	All	7
CANopen Bus Modules CI581-CN and CI582-CN	As of V2.1.0	All	10
PROFIBUS Bus Modules CI541-DP and CI542-DP	As of V2.1.0	all	10
PROFINET Bus Modules CI504-PNIO and CI506-PNIO	As of V2.1.0	all	10
EtherCAT Communication interface module CI511-ETHCAT and CI512-ETHCAT	As of AB V1.1	As of FW Version V2.0.x	10

Table 205: General data

Supply voltage, signal level	3.3 V DC ± 10 %
Max. supply current	On request
Type of the data interface	Synchronized serial data exchange
Bus data transmission speed	1.8 Mb/s
Minimum bus cycle time	500 µs [1])
Galvanic isolation	I/O-Bus is galvanic connected to CPU and communication interface logic ciruits. Galvanic isolation of I/O-Bus is I/O module specific. See each module specification for details.
Protection against electrostatic discharge (ESD)	TB5xx, TB56xx: with protection diodes, no ESD discharge allowed on the port.
Max. bus length	1 m
[1]) Minimum bus cycle time: This value is valid for all module combinations (from 1 to 10 I/O modules)	

Table 206: Wiring (bus connection)

Bus connection	Left-side and right-side connection from module to module via a 10-pole HE plug (male at the left side, female at the right side)
Mechanical connection	Established by the Terminal Units
Max. bus length	1 m

2.4.2 Mechanical Encoding

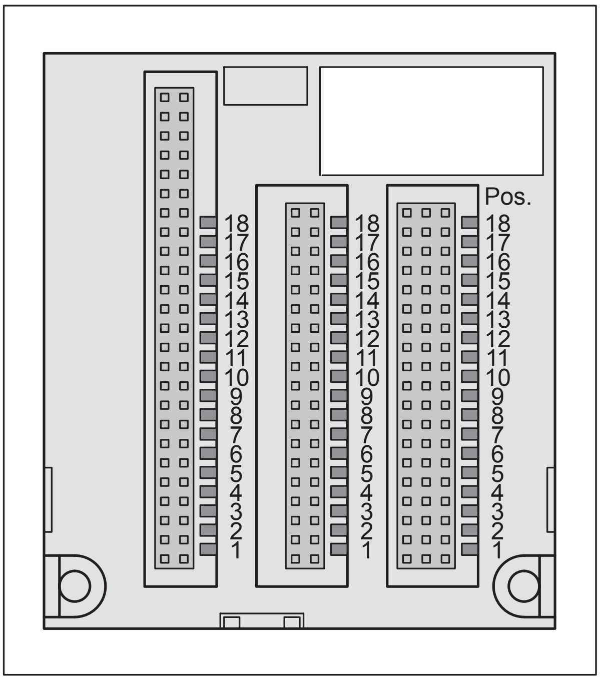


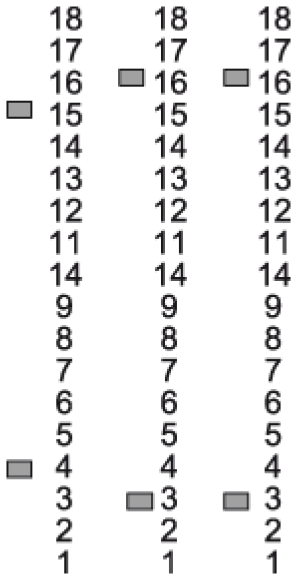
Fig. 196: Possible positions for mechanical encoding (1 to 18)

> **NOTICE!**
> Terminal units and terminal bases have a mechanical coding which prevents that modules are inserted to wrong places for cases that might result in dangerous parasitic voltages or if modules could be destroyed.

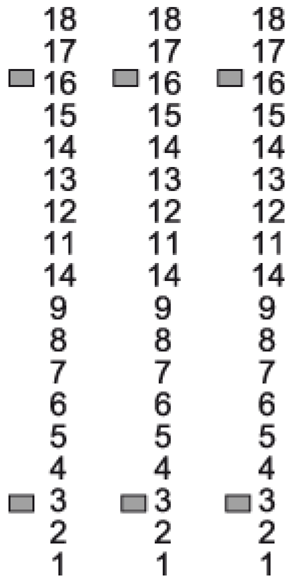
The coding either makes it impossible to insert the module to the wrong place or blocks its electrical function (outputs are not activated).

The following figures show the possible encodings.

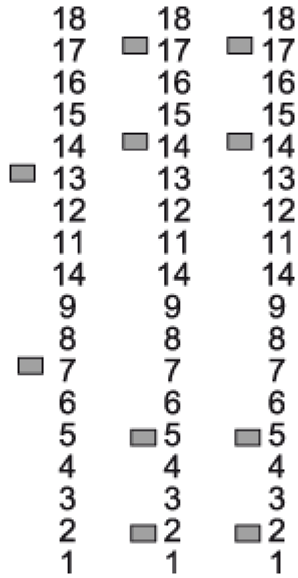
For processor modules with Ethernet interface:



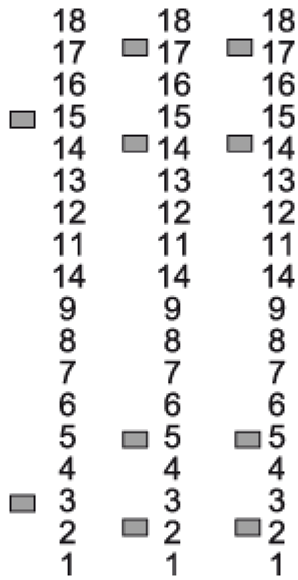
For processor modules with ARCNET interface:



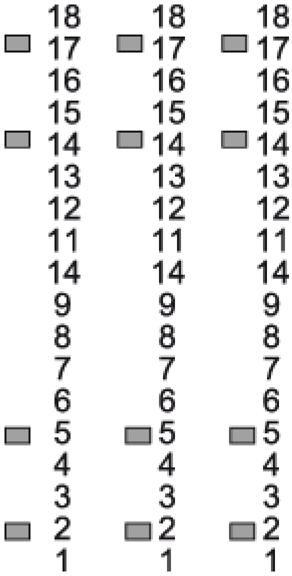
For real-time Ethernet modules:



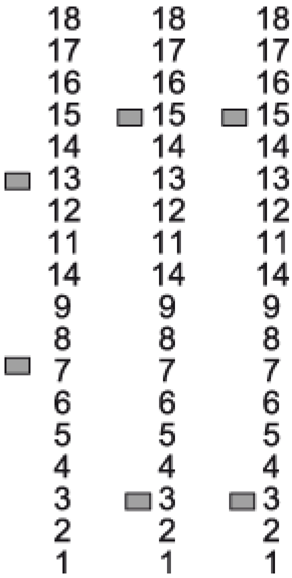
For communication interface modules:



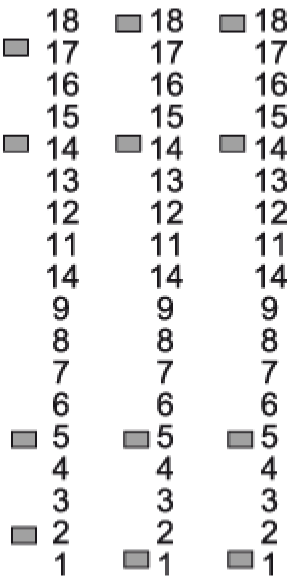
For I/O modules (24 VDC):



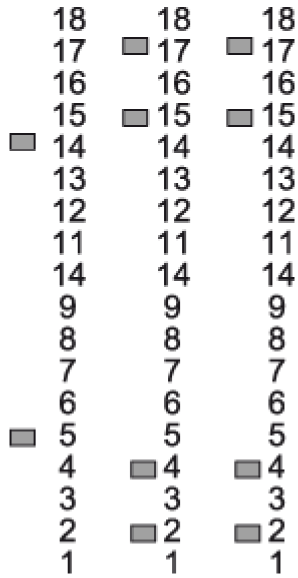
For communication interface modules with PROFINET interface:



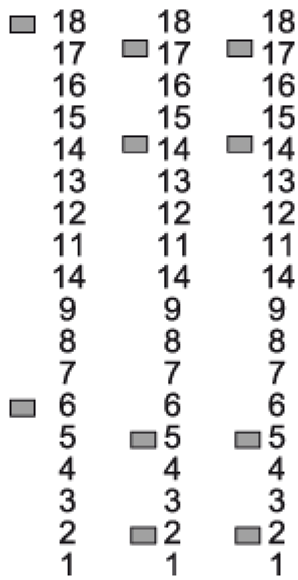
For I/O modules (120 VAC / 230 VAC):



For positioning modules:



For CS31 fieldbus modules:



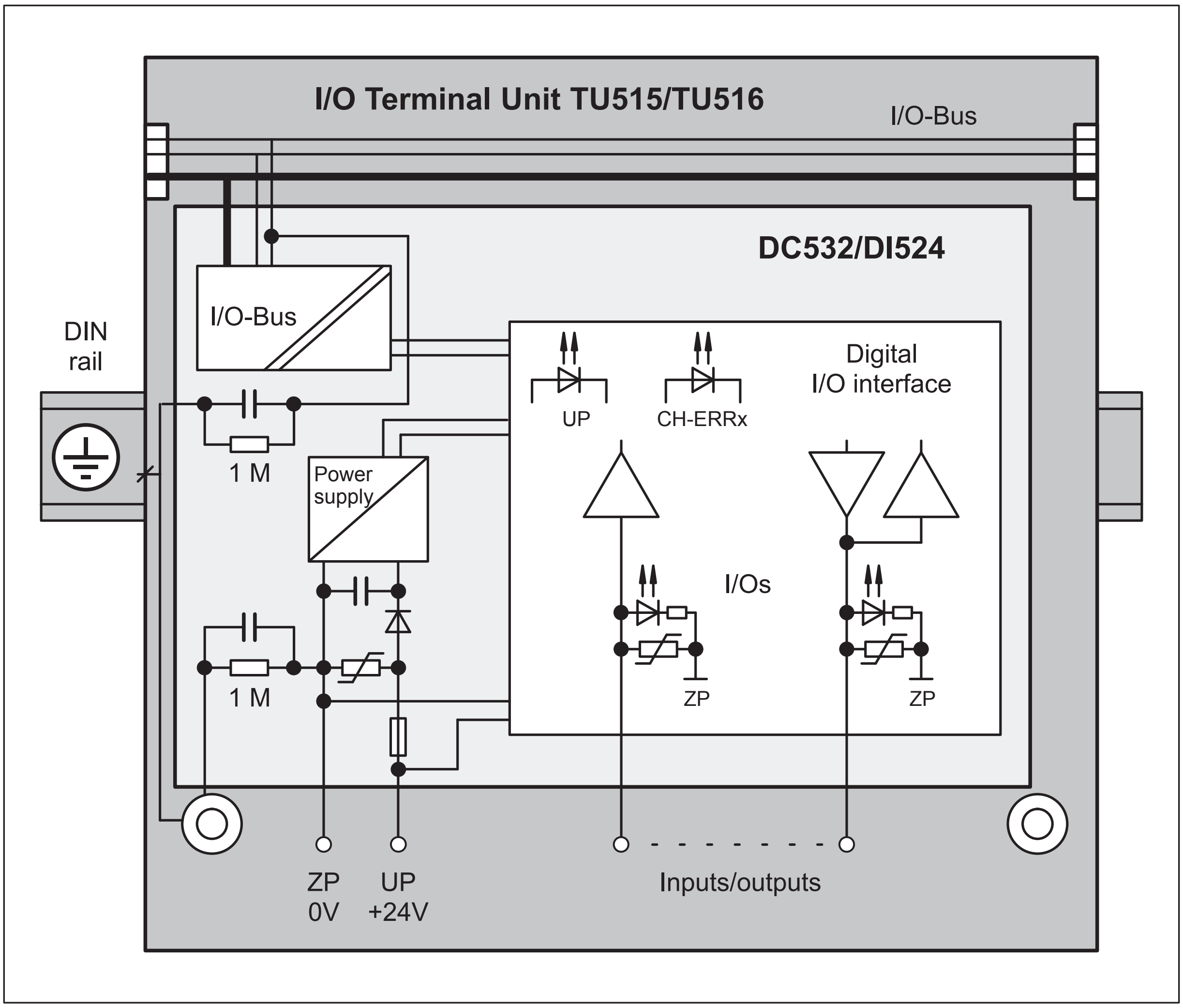
2.4.3 Earthing Concept (Block Diagrams)

NOTICE!

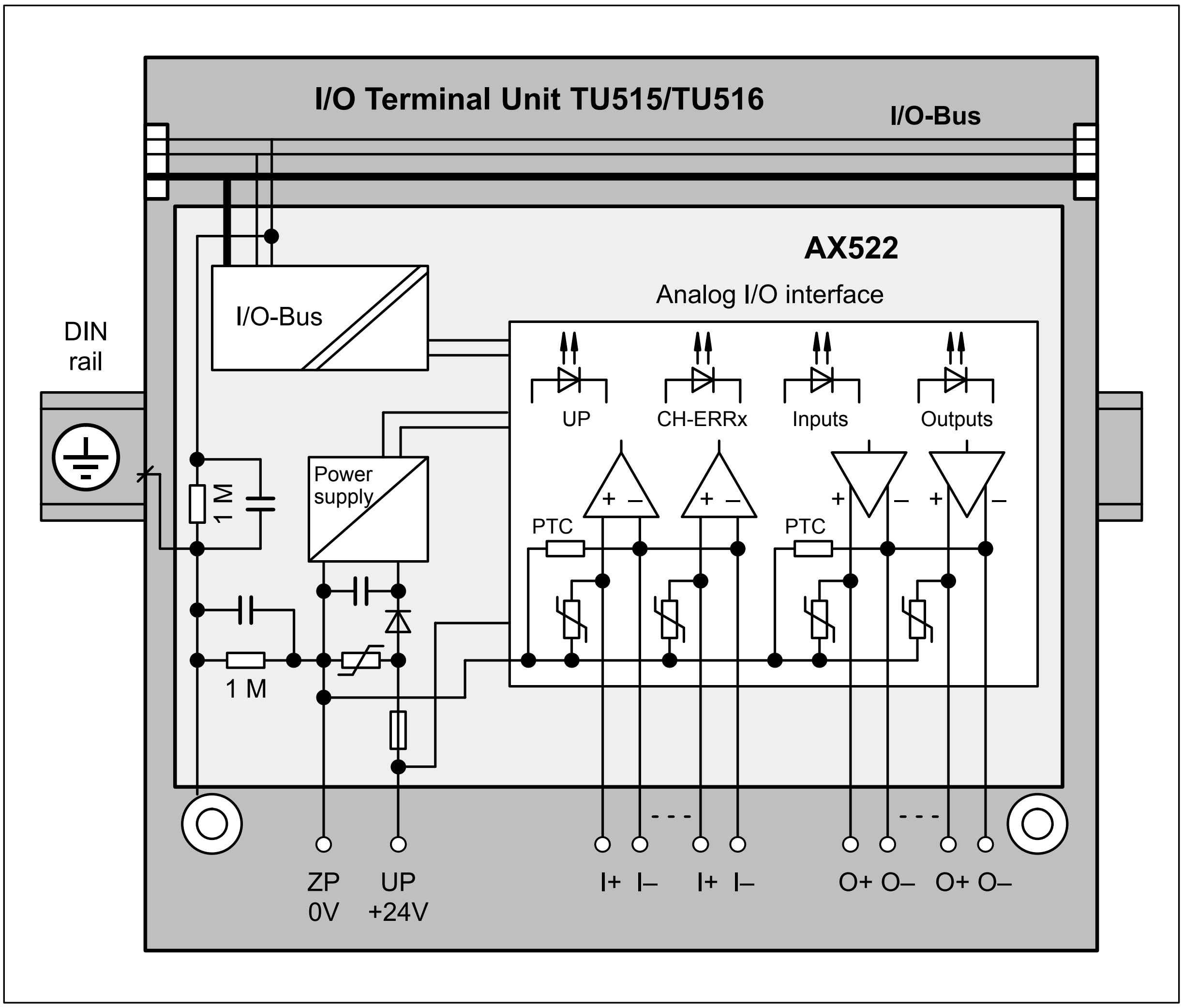
PLC Damage due to missing Earthing

– Ensure to earth the devices.
– The earthing (switch cabinet earthing, PE) is supplied both by the mains connection (or 24 V supply voltage) and via DIN rail. The DIN rail must be connected to the earth before the device is subjected to any power. The earthing may be removed only if it is certain that no more power is being supplied to the control system.

Block Diagram: Digital I/O Modules



Block Diagram: Analog I/O Modules



2.4.4 EMC-Conforming Assembly and Construction

2.4.4.1 General Principles

General Considerations

Electric and electronical devices have to work correctly on site. This is also valid when electro-magnetic influences affect them in defined and/or expected strength. The devices themselves must not emit electro-magnetic noises.

Advant Controller components have a very high noise immunity.

When the wiring and earthing instructions are met, an error-free operation is given.

High electro-magnetic noises of nearby mounted applications must be taken in consideration during the planning phase.

An EMC compatible earthing concept will also guarantee an error-free operation here.

There are three important principles to be especially considered:

- *Keep all connections as short as possible (in particular the earthing conductors)*
- *Use large conductor cross sections (in particular for the earthing conductors)*
- *Create low-impedance, i.e. good and large-sized contacts (in particular for the earthing conductors)*

Pay attention to the following:

- *Use vibration-resistant connections*
- *Clean metallic contact areas*
- *Use solid plug and screw-type connections*
- *Use earth cable shields with clips on a well-grounded metallic surface*
- *Do not use aluminium parts*
- *Do not use sheath wires*
- *Do not use toothed lock washers under screw connections*

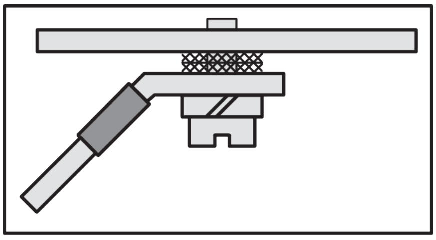


Fig. 197: Assembly: wrong

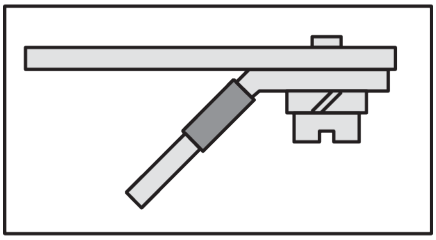


Fig. 198: Assembly: correct

Make a connection between the DIN rails and PE (Protective Earth). For this, use an earthing wire with a minimum conductor cross section of 10 mm².

The wire is connected to the DIN rail with an M6 screw.

A large-area contact of the DIN rail with the metallic mounting plate improves the EMC behaviour significantly, as the disturbances can be discharged more effective.

2.4.4.2 Cable Routing

- Route cables meeting the standards.
- Sort the cables into cable groups:
  - Power current cables
  - Power supply cables
  - Signal cables
  - Data cables

- Rout signal cables and data cables separately from the power cables.
  - Separate cable ducts or cable bundles.
  - The distance should be 20 cm or greater.
- Lay signal and data cables close to earthed surfaces.

2.4.4.3 Cable Shields

- Use only shielded data cables. The shield should be earthed at both ends.
  A cable shield only earthed at one end can only protect from capacitively coupled interference and low-frequency disturbances (50 Hz hum).
- Avoid parasitic currents flowing through the cable shields.
  This can be done by installing current-carrying equipotential bondings.
- Use only cables with braided shields.
  Foil shields are not robust enough, cannot be contacted well and have poor HF properties.
- Use only metallic or metal-plated plugs for shielded data cables.
- Use only shielded cables for analog signals.
  For small signals earth the shield only at one end.
- Earth the cable shield directly with a clip when entering the switch-gear cabinet.
  Do not cut the shield until the cable reaches the module connected.

> *The connection between the PE bar and the shield bar must have a low impedance.*

2.4.4.4 Switch-Gear Cabinet

Connections The connections between the switch-gear cabinet, the mounting plates, the PE bar and the shield bar must have a low impedance.

Earthing Earth the switch-gear cabinet doors with short and highly flexible conductors.

Illumination Only use filament lamps (bulbs) or fluorescent tubes with interference suppression.

For supplying the PC Use the mains socket which is located inside the switch-gear cabinet.

Chapter 2.5.2.1 “Switchgear Cabinet Assembly” on page 1198

2.4.4.5 Reference Potential

- Provide a uniform reference potential in the entire installation and earth all electrical appliances if possible.
- Route your earthing conductors in a star configuration so that no earth loops can occur.

2.4.4.6 Equipotential Bonding

The Installation of equipotential bondings are necessary if there are present or expected potential differences between parts of your application.

- *The impedance of equipotential bonding must be equal or lower than 10 % of the shield impedance of the shielded signal cables between the same points.*
- *The conductor cross section of a equipotential bonding must be 16 mm² to withstand the maximum possible compensating current.*
- *Equipotential bondings and shielded signal cables should be laid close to each other.*
- *Equipotential bondings must be connected to PE with low impedance.*

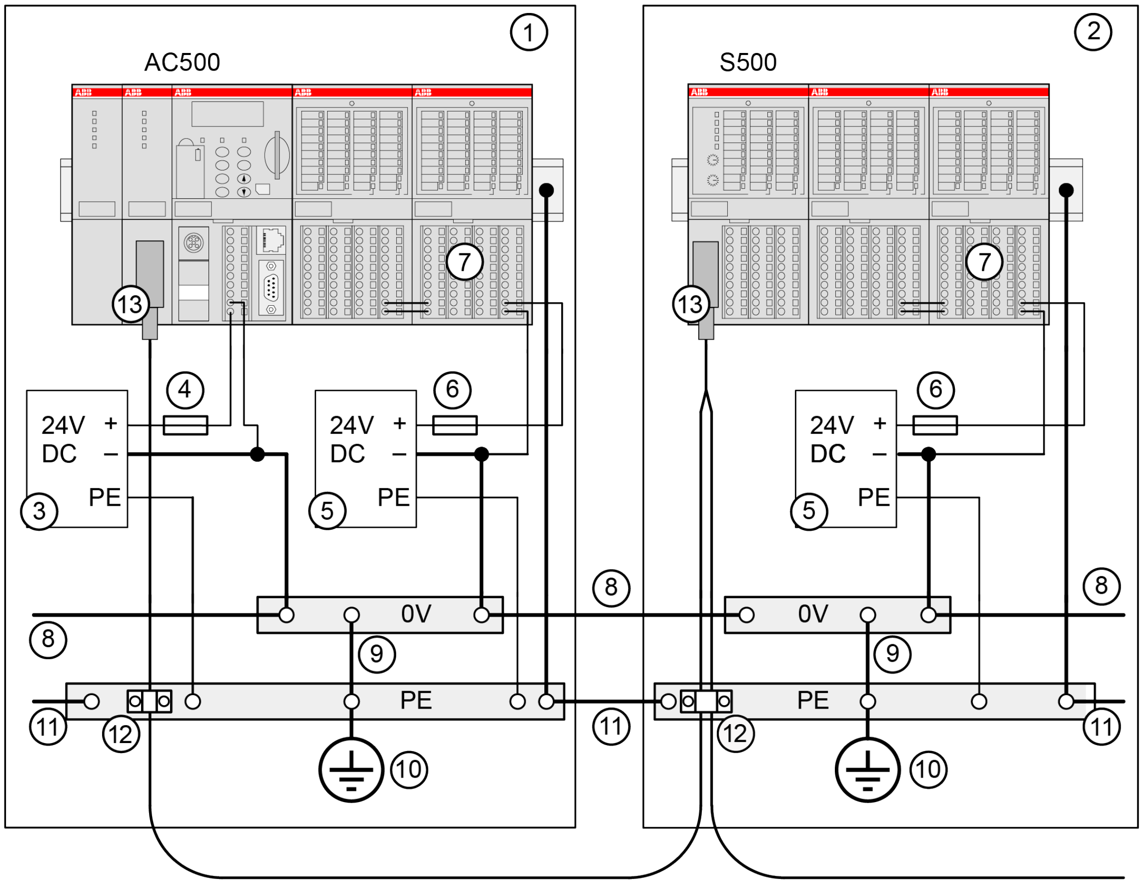


Fig. 199: AC500, equipotential bonding

1 Cabinet 1
2 Cabinet 2
3 Power supply for the CPU
4 Fuse for the CPU power
5 Power supply for the I/Os
6 Fuse for the I/O power
7 For fuses for the contacts of the relay outputs
8 0V rail
9 Earthing of the 0V rail
10 Cabinet earthing
11 Equipotential bonding between the cabinets min. 16 mm^2
12 Cable shields earthing
13 Fieldbus connection (e.g. Ethernet)

2.4.5 Power Consumption of an Entire Station

The power consumption of a complete station consists of the sum of all individual consumptions.

- Consumers over terminals L+ and M on the AC500 terminal base/AC500-eCo CPU:
  – CPU itself
  – I/O modules attached on the I/O bus
  – Communication modules attached (AC500 terminal base)
- Consumers over the process supply voltage terminals ZP and UP of the AC500 Terminal Units / the L+/M or UP/ZP terminals of the AC500-eCo I/O modules:
  – Digital I/O modules
  – Analog I/O modules

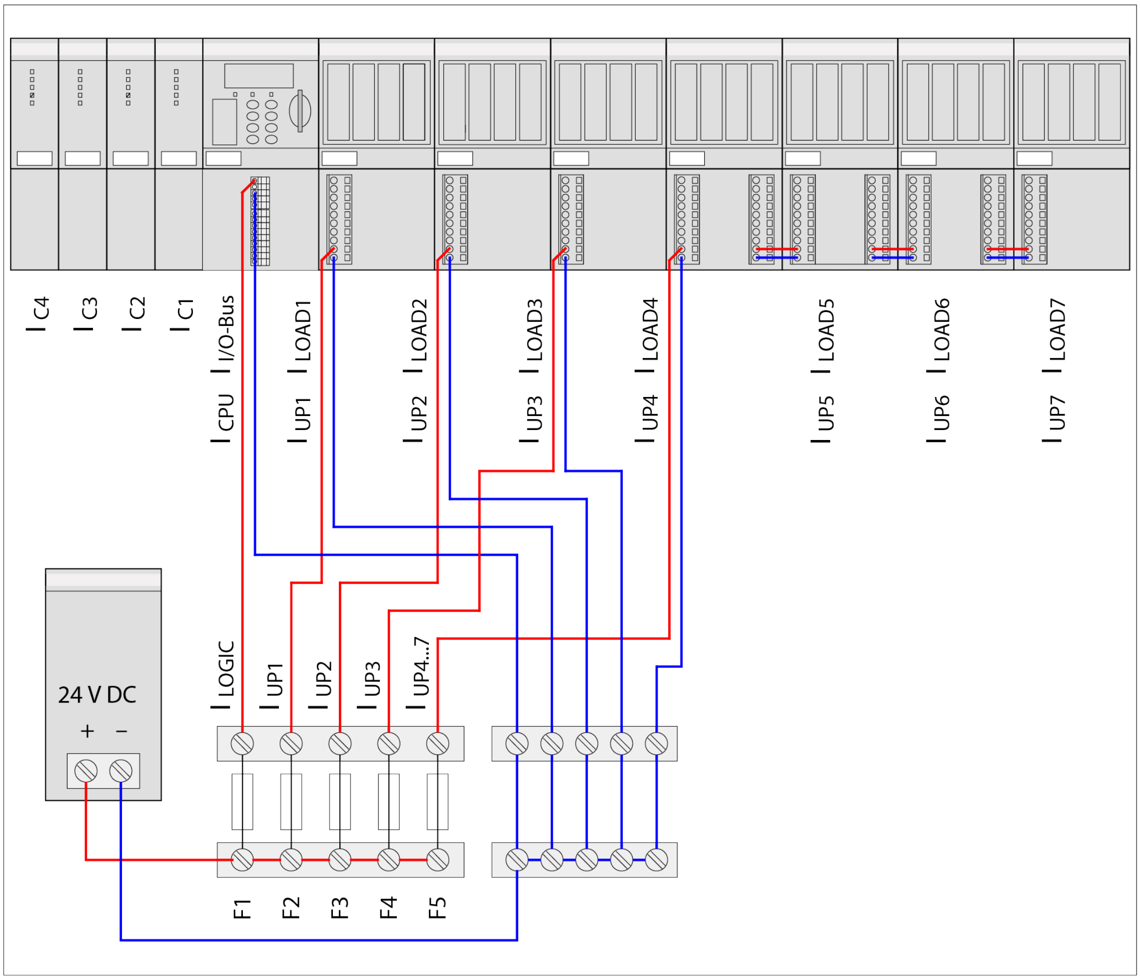
The two supply voltages can be provided by the same power supply unit. The CPU and the I/O modules should, however, be fused separately. Of course also separate power supplies are possible.

2.4.5.1 Calculation of the total Current Consumption

Example

In the example, the AC500 control system consists of the following devices:

- CPU PM5xx-ETH
- 4 communication modules
- 7 I/O modules (digital and analog)
- As well as the required terminal bases and terminal units



Because of the high total current consumption of the digital I/O modules (from UP = 24 VDC), the supply is divided up into several electric circuits fused separately.

The maximum permitted total current over the supply terminals of the I/O terminal units is 8 A.

The total current can be calculated as follows:

$I_{Total} = I_{LOGIC} + I_{UP}$

with the assumptions

$I_{LOGIC} = I_{CPU} + I_{I/O\ bus} + I_{C1} + I_{C2} + I_{C3} + I_{C4}$ (CPU + communication modules + I/O bus)

$I_{I/O\ bus}$ = Number of expansion modules × Current consumption through the I/O bus per module

and

$I_{UP} = I_{UP1} + I_{LOAD1} + I_{UP2} + I_{LOAD2} + I_{UP3} + I_{LOAD3} + I_{UP4} + I_{LOAD4} + I_{UP5} + I_{LOAD5} + I_{UP6} + I_{LOAD6} + I_{UP7} + I_{LOAD7}$

If one assumes that all outputs are switched on and are operated with their maximum permitted load currents (under compliance with the maximum permitted currents at the supply terminals), then the following values are the result for an example shown above:

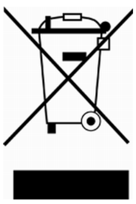
	I_{CPU} *)	**I_{Cx} *)**	**$I_{I/O\ bus}$ *)**	**I_{UPx} *)**	**I_{LOADx} *)**
CPU / communication module part					
CPU	0.110 A	-	-	-	-
C1	-	0.050 A	-	-	-
C2	-	0.085 A	-	-	-
C3	-	0.050 A	-	-	-
C4	-	0.050 A	-	-	-
I/O module part					
Analog1	-	-	0.002 A	0.150 A	-
Analog2	-	-	0.002 A	0.150 A	0.160 A
Analog3	-	-	0.002 A	0.100 A	0.080 A
Analog4	-	-	0.002 A	0.100 A	0.080 A
Digital1	-	-	0.002 A	0.050 A	8.000 A
Digital2	-	-	0.002 A	0.050 A	8.000 A
Digital3	-	-	0.002 A	0.050 A	8.000 A
Σ columns	0.110 A	0.235 A	0.014 A	0.650 A	24.320 A
	$\Sigma\ I_{LOGIC} \approx 0.4$ A			$\Sigma\ I_{UP} \approx 25$ A	
	$I_{Total} \approx 25.4$ A				
*) All values in this column are exemplary values					

2.4.5.2 Dimensioning of the Fuses

To be able to select the fuses for the station correctly, both the current consumption and the inrush currents (melting integral for the series-connected fuse) must be taken into consideration.

Fuse	for	Σ of the melting integrals in A²s	$I_{Logic\ A}$	$I_{UPx\ A}$	Recommended fuse	
					Type	Value
F1	CPU logic	1.000	≈ 0.4	-	Quick	10 A
F2	Module Digital1	0.005	-	8.050	Quick	10 A
F3	Module Digital2	0.008	-	8.050	Quick	10 A
F4	Module Digital3	0.007	-	8.050	Quick	10 A
F5	Modules Analog1 + Analog2 + Analog3 + Analog4	0.130	-	0.820	Quick	10 A

2.4.6 Recycling and Disposal



Devices of AC500 product family must not be disposed as unsorted domestic waste. The devices contain valuable raw material which can be recycled. Remove the battery - if existing. Dispose the products according to the local regulations.

Devices of AC500 product family are free from pollutants and are no danger for the environment.

2.5 AC500-eCo

2.5.1 System Data AC500-eCo

2.5.1.1 Environmental Conditions

Table 207: Process and Supply Voltages

Parameter		Value
24 VDC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
100 VAC		
	Voltage	100 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
230 VAC		
	Voltage	230 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
100...240 VAC wide range supply		
	Voltage	100 V...240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		

Parameter		Value
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s

NOTICE!
Exceeding the maximum power supply voltage (> 30 VDC) for process or supply voltages could lead to unrecoverable damage of the system. The system could be destroyed.

Parameter		Value
Temperature		
	Operating	0 °C...+60 °C (horizontal mounting of modules) 0 °C...+40 °C (vertical mounting of modules and output load reduced to 50 % per group)
	Storage	-40 °C...+70 °C
	Transport	-40 °C...+70 °C
Humidity		Max. 95 %, without condensation
Air pressure		
	Operating	> 800 hPa / < 2000 m
	Storage	> 660 hPa / < 3500 m

2.5.1.2 Creepage Distances and Clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

2.5.1.3 Insulation Test Voltages, Routine Test

According to EN 61131-2

Parameter	Value	
200 V...240 V circuits against other circuitry	2500 V	1.2/50 µs
100 V...127 V circuits against other circuitry	1500 V	1.2/50 µs
100 V...240 V circuits against other circuitry	2500 V	1.2/50 µs
24 V circuits (supply, 24 V inputs/outputs, analogue inputs/outputs), if they are electrically isolated against other circuitry	500 V	1.2/50 µs
COM interfaces, electrically isolated	500 V	1.2/50 µs

Parameter	Value	
COM interfaces, electrically not isolated	Not applicable	Not applicable
FBP interface	500 V	1.2/50 µs
Ethernet	500 V	1.2/50 µs
ARCNET	500 V	1.2/50 µs
200 V... 240 V circuits against other circuitry	1350 V	AC 2 s
100 V circuits against other circuitry	820 V	AC 2 s
100 V...240 V circuits against other circuitry	1350 V	AC 2 s
24 V circuits (supply, 24 V inputs/outputs, analogue inputs/outputs), if they are electrically isolated against other circuitry	350 V	AC 2 s
COM interfaces, electrically isolated	350 V	AC 2 s
COM interfaces, electrically not isolated	Not applicable	Not applicable
FBP interface	350 V	AC 2 s
Ethernet	350 V	AC 2 s
ARCNET	350 V	AC 2 s

2.5.1.4 Power Supply Units

For the supply of the modules, power supply units according to PELV specifications must be used.

2.5.1.5 Electromagnetic Compatibility

Electromagnetic Compatibility		
Device suitable for:		
	Industrial applications	Yes
	Domestic applications	No
Immunity against electrostatic discharge (ESD):		According to IEC 61000-4-2, zone B, criterion B
	Electrostatic voltage in case of air discharge	8 kV
	Electrostatic voltage in case of contact discharge	4 kV, in a closed switch-gear cabinet 6 kV [1])

Electromagnetic Compatibility		
	ESD with communication connectors	In order to prevent operating malfunctions, it is recommended, that the operating personnel discharge themselves prior to touching communication connectors or perform other suitable measures to reduce effects of electrostatic discharges.
Immunity against the influence of radiated (CW radiated):		According to IEC 61000-4-3, zone B, criterion A
	Test field strength	10 V/m
Immunity against transient interference voltages (burst):		According to IEC 61000-4-4, zone B, criterion B
	Supply voltage units (DC)	2 kV
	Supply voltage units (AC)	2 kV
	Digital inputs/outputs (24 VDC)	1 kV
	Digital inputs/outputs (120 VAC...2400 VAC)	2 kV
	Analog inputs/outputs	1 kV
	CS31 system bus	1 kV
	Serial RS-485 interfaces (COM)	1 kV
	Serial RS-232 interfaces (COM, not for PM55x and PM56x)	1 kV
	ARCNET	1 kV
	FBP	1 kV
	Ethernet	1 kV
	I/O supply, DC-out	1 kV
Immunity against the influence of line-conducted interferences (CW conducted):		According to IEC 61000-4-6, zone B, criterion A
	Test voltage	3 V zone B, 10 V is also met.
	High energy surges	According to IEC 61000-4-5, zone B, criterion B
	Power supply AC	2 kV CM / 1 kV DM [2])
	Power supply DC	1 kV CM / 0.5 kV DM [2])
	DC I/O supply, add. DC-supply-out	0.5 kV CM / 0.5 kV DM [2])
	Buses, shielded	1 kV CM [2])
	AC I/O unshielded	2 kV CM / 1 kV DM [2])
	I/O analog, I/O DC unshielded	1 kV CM / 0.5 kV DM [2])
	Radiation (radio disturbance)	According to IEC 55011, group 1, class A

[1]) High requirement for shipping classes are achieved with additional specific measures (see specific documentation).

[2]) CM = Common Mode, DM = Differential Mode

2.5.1.6 Mechanical Data

Parameter	Value
Mounting	Horizontal
Degree of protection	IP 20 (if all terminal screws are tightened)
Housing	Classification V-2 according to UL 94
Vibration resistance acc. to EN 61131-2	all three axes (DIN rail mounting) 5 Hz...8.4 Hz, continuous 3.5 mm 8.4 Hz...150 Hz, continuous 1 g
Shock test	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
DIN rail according to DIN EN 50022	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	Screws with a diameter of 4 mm
Fastening torque	1.2 Nm

2.5.1.7 Approvals and certifications

Information on approvals and certificates can be found in the corresponding chapter of the *Main catalog, PLC Automation*.

2.5.2 Mechanical Dimensions

2.5.2.1 Switchgear Cabinet Assembly

Information on EMC-conforming assembly and construction is provided within the overall functions section *Chapter 2.4.4 “EMC-Conforming Assembly and Construction” on page 1188.*

PLC enclosure

NOTICE!

PLC damage due to wrong enclosures

Due to their construction (degree of protection IP 20 according to EN 60529) and their connection technology, the devices are suitable only for operation in enclosed switchgear cabinets.

To protect PLCs against:

- unauthorized access,
- dusting and pollution,
- moisture and wetness and
- mechanical damage,

switchgear cabinet IP54 for common dry factory floor environment is suitable.

Maintain spacing from:

- enclosure walls
- wireways
- adjacent equipment

Allow a minimum of 20 mm clearance on all sides. This provides ventilation and electrical isolation.

It is recommended to mount the modules on an earthed mounting plate, or an earthed DIN rail, independent of the mounting location.

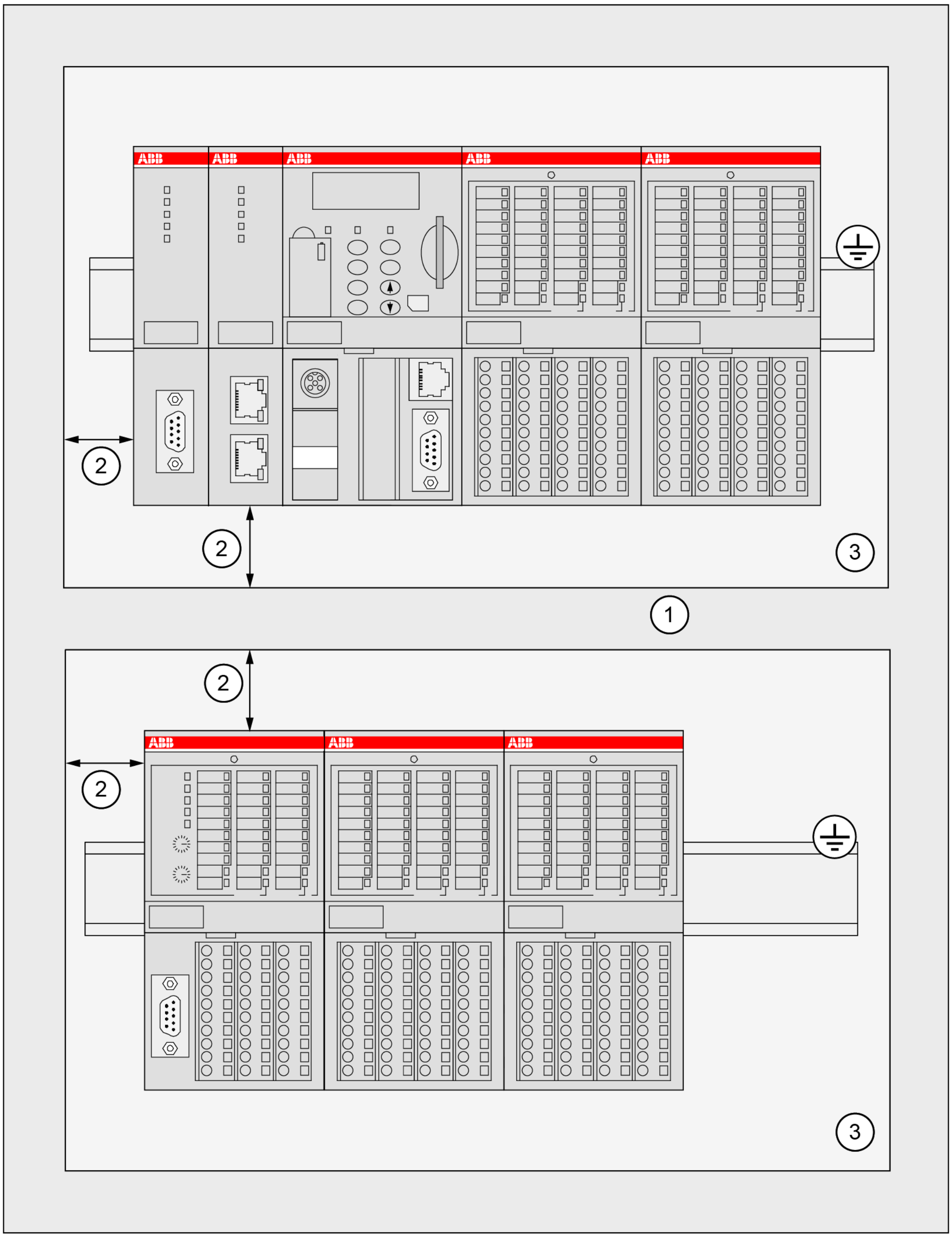


Fig. 200: Installation of AC500/S500 modules in a switch-gear cabinet

1 Cable duct
2 Distance from cable duct ≥20 mm
3 Mounting plate, earthed

NOTICE!
Horizontal mounting is highly recommended.

Vertical mounting is possible, however, derating consideration should be made to avoid problems with poor air circulation and overheating (see *Chapter 2.6.1.1 "Environmental Conditions" on page 1252*).

By vertical mounting, always place an end-stop terminal block (e.g. type BADL, P/N: 1SNA399903R0200) on the bottom and on the top of the modules to properly secure the modules.

By high vibration applications and horizontal mounting, we also recommend to place end-stop terminals at the right and left side of the device to properly secure the modules, e.g. type BADL, P/N: 1SNA399903R0200.

2.5.2.2 Mechanical Dimensions AC500-eCo

All mechanical dimensions are given in millimeters and inches. The value in brackets is the inch-value.

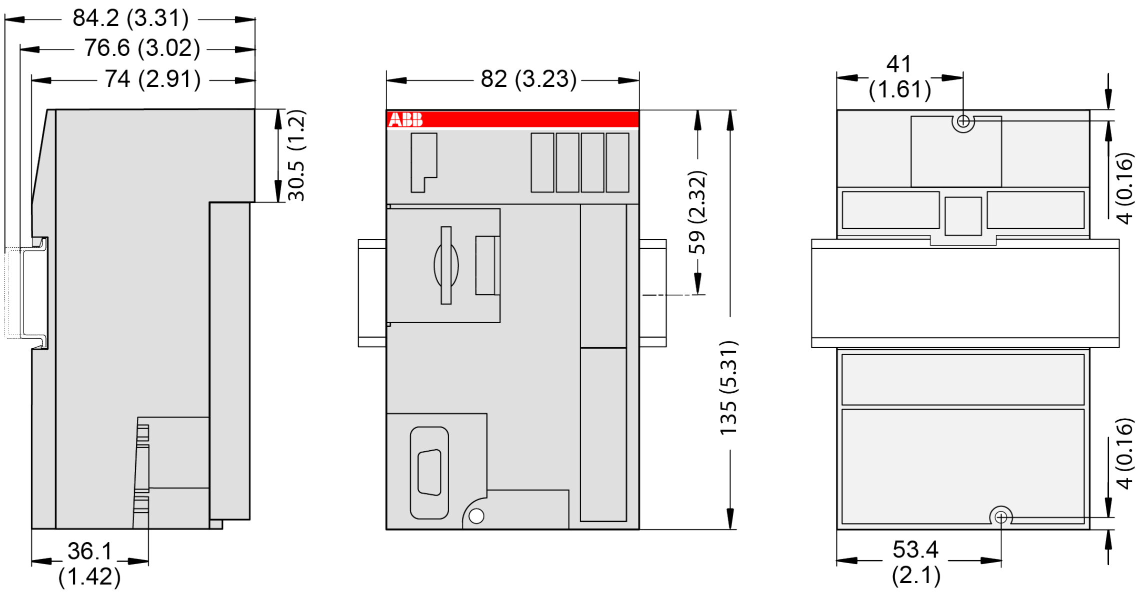


Fig. 201: Side, front and back view

2.5.2.3 Mechanical Dimensions S500-eCo

All mechanical dimensions are given in millimeters and inches. The value in brackets is the inch-value.

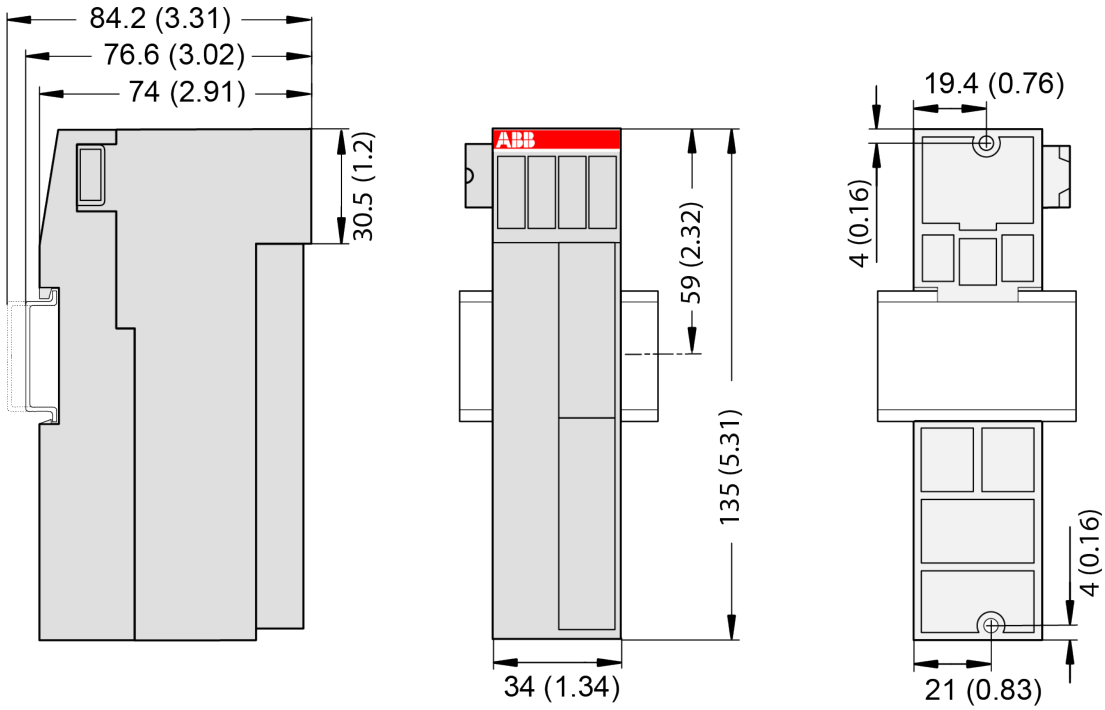


Fig. 202: Side, front and back view

2.5.3 Mounting and Demounting

The control system is designed to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded.

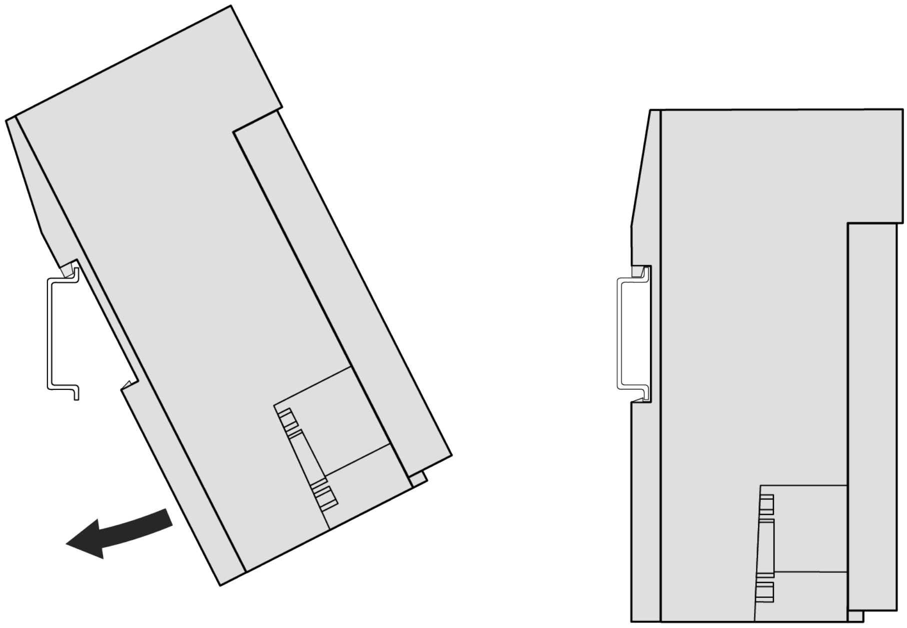
> *During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.*

> *All devices are grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate stell DIN rail to assure proper grounding. The use of other DIN rail materials (e.g. aluminium, plastic, etc.) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.*

2.5.3.1 Mounting and Demounting of the AC500-eCo CPUs

Mounting a Processor Module on a DIN Rail

> **NOTICE!**
> **Risk of function faults!**
> The processor module is earthed via DIN rail.
>
> The DIN rail must be included into the earthing conception of the plant.

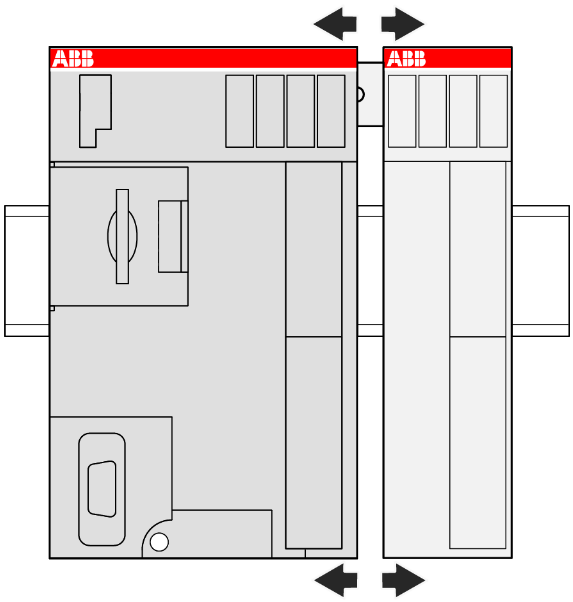


Mount the processor module at the top of the DIN rail, then snap it in below.

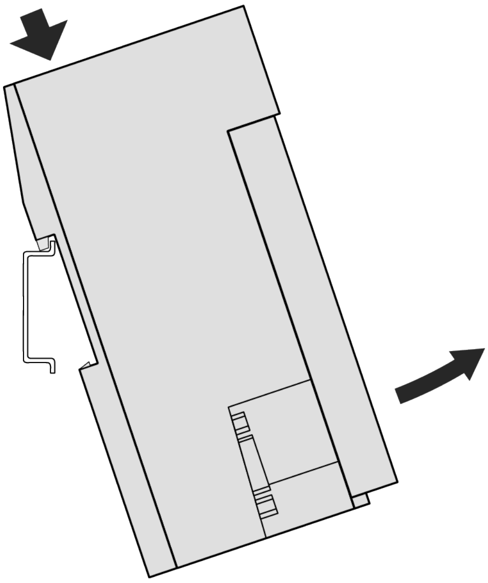
See Hardware description of PM55x-xP and PM56x-xP ⇨ Chapter 1.2.1.1 "PM55x-xP and PM56x-xP" on page 21 for electrical connection.

Demounting a Processor Module Mounted on a DIN Rail

1. Remove IO modules if connected.



2. While pressing down processor module pull it away from DIN rail.



Mounting a Processor Module on a Metal Plate

NOTICE!
Risk of function faults!
Missing electrical contact by isolating screws or washers!

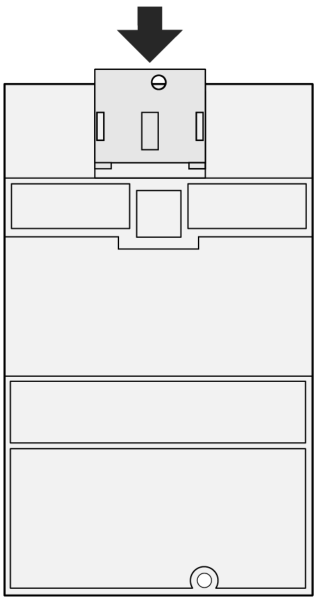
Use metal screws on the metal plate.

The metal plate must be included into the earthing concept of the plant.

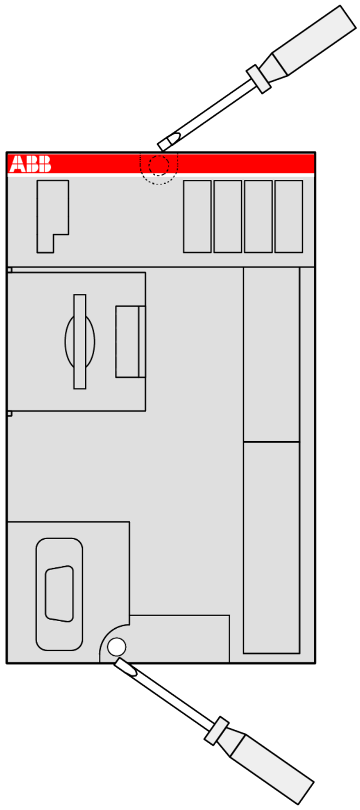
Do NOT use isolating washers!

One TA566 Wall Mounting Accessory *➪ Chapter 2.5.5.9 “ TA566 - Wall Mounting Accessory” on page 1247* *is needed per processor module.*

1. Snap in the TA566 at the back side of the processor module.



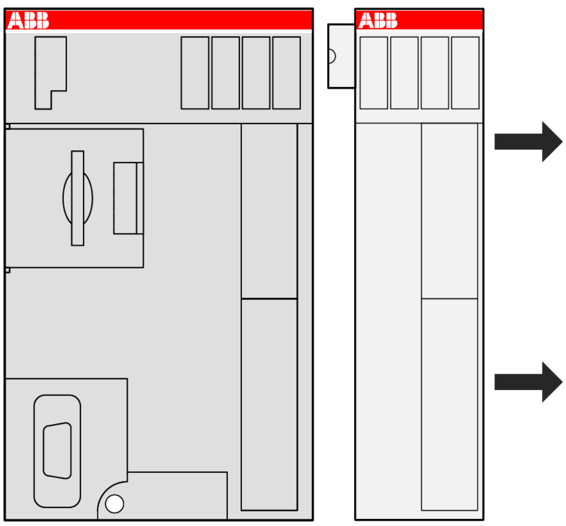
2. Fasten the processor module with two screws (max. diameter: 4 mm) to the metal plate.



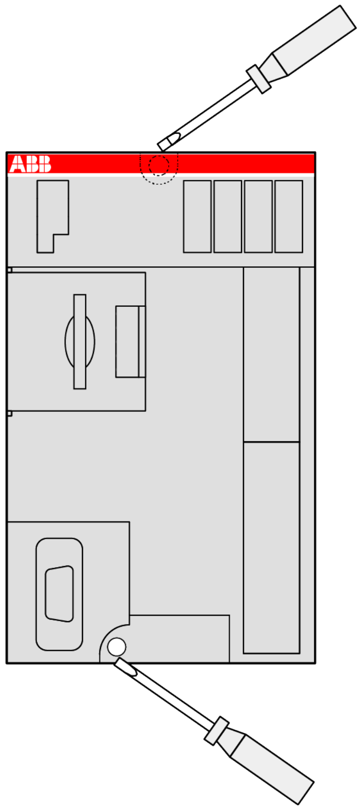
See Hardware description of PM55x-xP and PM56x-xP *✎ Chapter 1.2.1.1 "PM55x-xP and PM56x-xP" on page 21* *for electrical connection.*

Demounting a Processor Module Mounted on a Metal Plate

1. Remove IO modules if connected.



2. Remove the 2 screws.



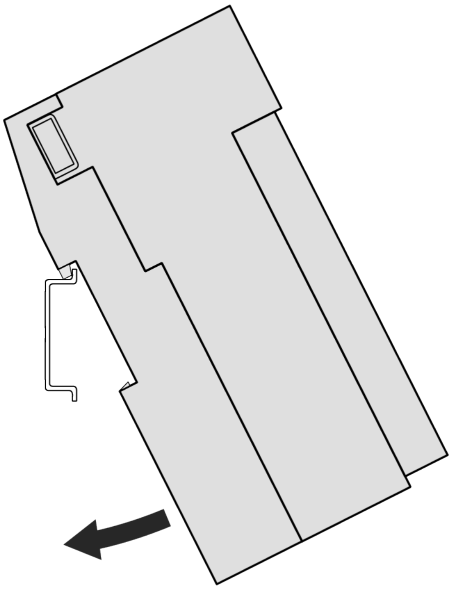
2.5.3.2 Mounting and Demounting of S500-eCo I/O Modules

S500-eCo I/O-modules can be mounted either on a DIN rail or with screws on a metal plate.

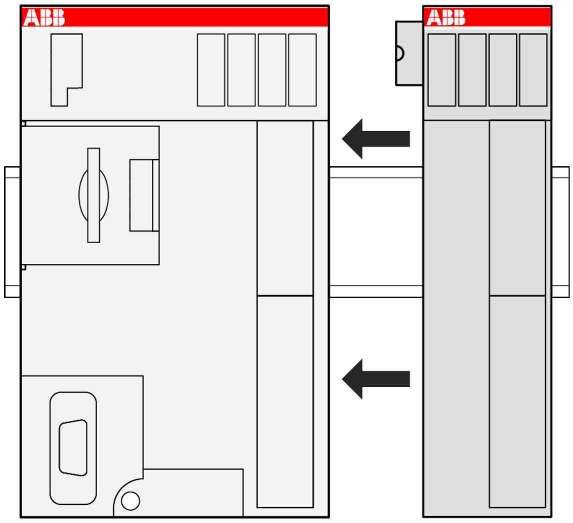
Mounting I/O Modules on a DIN Rail

> **NOTICE!**
> **Risk of function faults!**
> The S500-eCo I/O modules are earthed via the DIN rail.
>
> The DIN rail must be included into the earthing concept of the plant.
>
> Use only metal screws.

1. Mount I/O module at the top of the DIN rail, then snap it in below.

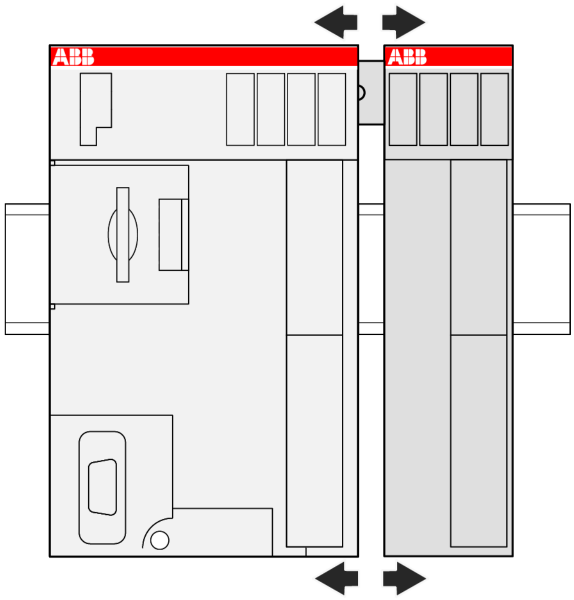


2. Attach I/O module by hand to an other module. The serial I/O bus is connected automatically.

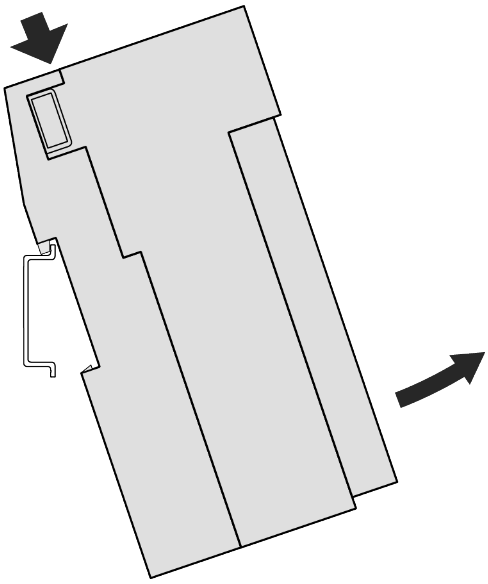


Demounting I/O Modules Mounted on a DIN Rail

1. Remove I/O module by hand if connected.



2. While pressing down I/O module pull it away from DIN rail.



Mounting I/O Modules on a Metal Plate

NOTICE!
Risk of function faults!
Missing electrical contact by isolating screws or washers!

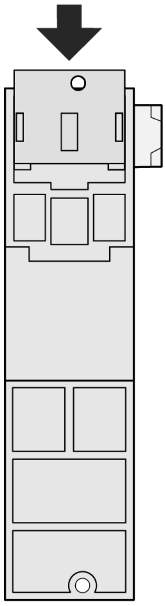
Use metal screws on the metal plate.

The metal plate must be included into the earthing concept of the plant.

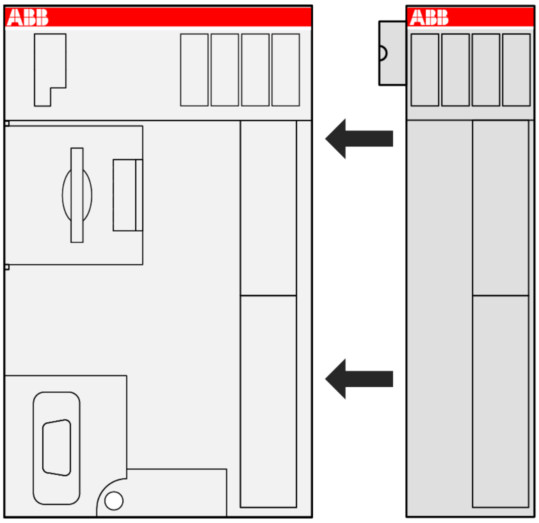
Do NOT use isolating washers!

One TA566 wall mounting accessory *Chapter 2.5.5.9 " TA566 - Wall Mounting Accessory" on page 1247* *is needed per S500-eCo I/O module.*

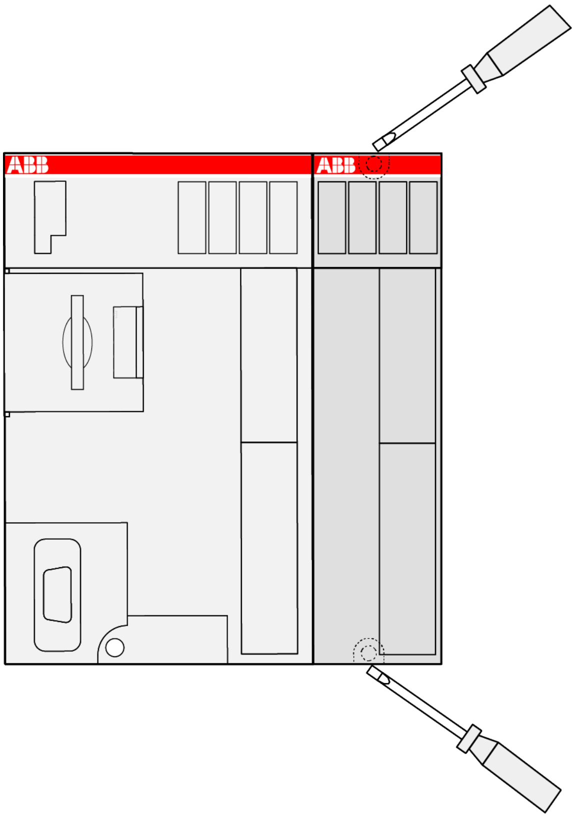
1. Snap in the TA566 at the back side of the I/O module.



2. Attach the I/O module by hand to an other module. The serial I/O bus is connected automatically.

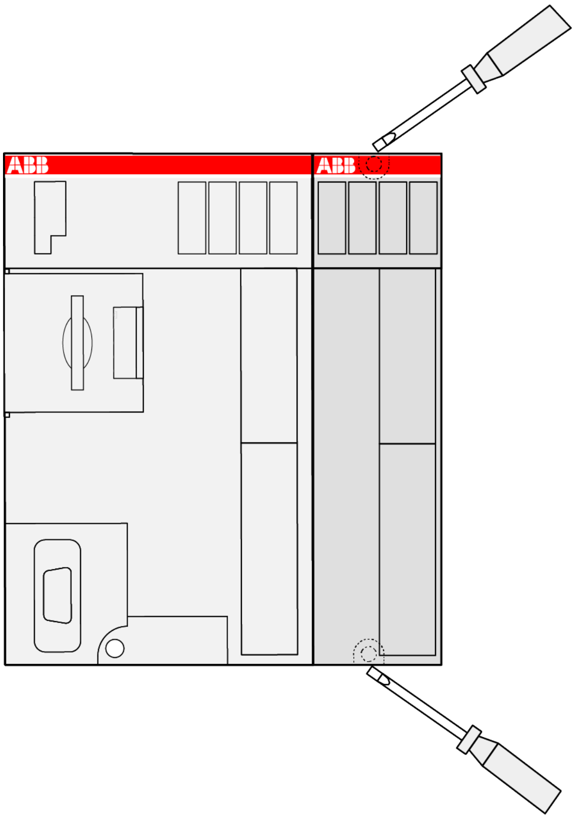


3. Fasten the I/O module with two screws (max. diameter: 4 mm) to the metal plate.

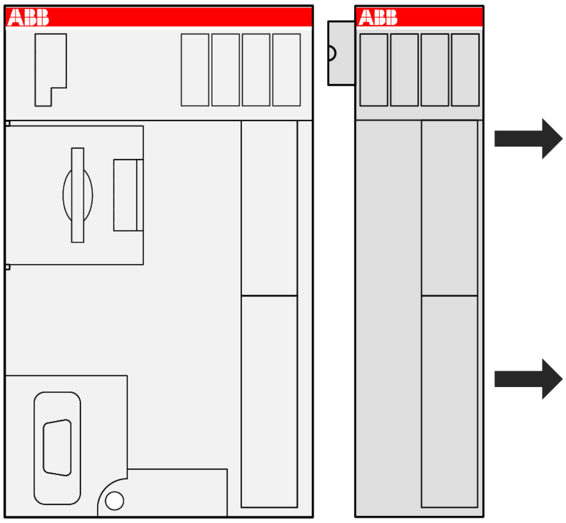


Demounting I/O Modules Mounted on a Metal Plate

1. Remove the 2 screws.



2. Remove the I/O module from the connected module by hand.



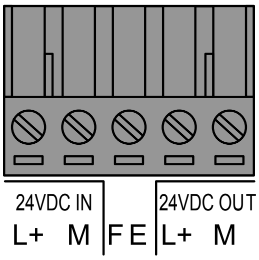
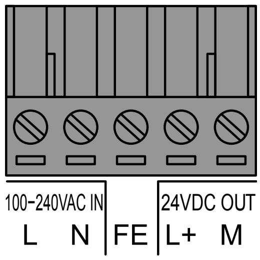
2.5.4 Connection and Wiring

For detailed information such as technical data of your mounted devices (AC500 product family) refer to the hardware device specification of the appropriate device.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

2.5.4.1 Power Supply

Power Supply Depending on the variant, the processor modules can be connected to the following supply voltages:

	
24 VDC	100 - 240 VAC

The electrical connection is established via a removable 5-pin terminal block. As the terminal block is also available as a spare part (inside TA570 Spare Part Set for AC500-eCo processor modules), further information on the terminal block for power supply and the terminal block for serial RS-485 adaptor is provided under *Chapter 2.5.5.12 “TA570 - Spare Part Set” on page 1251*.

The 24 VDC variant contains 2 L+ and M terminals. The L+ terminal on the left side is the input and the right side is the output. The M terminals are internally interconnected. The supply can be easily looped through to the onboard digital inputs.

CAUTION!
Risk of damaging the processor module and the connected modules!
Voltages > 35 VDC (DC variants only) or > 288 VAC (AC variants only) might damage the processor module and the connected modules.

Make sure that the supply voltage never exceeds 35 VDC / 288 VAC.

CAUTION!
Risk of damaging the processor module!
Excess currents at 24 VDC output (24 VDC processor module variant) will damage the processor module.

Use an appropriate fuse *Chapter 1.2.1.1.8 “Technical Data” on page 31*within 24 VDC input connection.

The 100-240 VAC variant contains an internal power supply with a wide-range input. It provides a 24 VDC output at the terminals L+ and M which can be used to supply the onboard digital inputs.

The voltage output at 100-240 VAC variants can provide 180 mA max. The output is protected against overload by a self-resetting fuse (PTC).

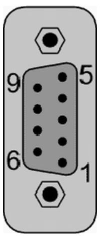
> *According to IEC 60204-1:2016, where control circuits are supplied from an AC source, transformers having separate windings shall be used to separate the power supply from the control supply.*

2.5.4.2 Serial Interface COM1

The serial interfaces COM1 and COM2 are designed according to the standard EIA RS-485. Both interfaces can be operated in RS-485 mode.

Parameter	Value
Standard of the serial interfaces	RS-485
Interface connectors	COM1: 9-pin D-sub connector (female) COM2: 5-pole connector with screw-type connection (optional)
Electrical isolation	none (with TA562) 500 VDC (with TA569-RS-ISO)
Serial interface parameters	Configurable by the software
Operating modes	Programming or data exchange
Supported protocols	Modbus or serial data exchange using special software function blocks

Table 208: Pin assignment

Serial Interface	Pin	Signal	Description
Serial Interface 	1	FE	Functional earth
	2	SGND	0 V power supply, internally connected to M terminal
	3	RxD/TxD-P	Receive/Transmit positive
	4	Reserved	Reserved, not connected
	5	SGND	0 V power supply, internally connected to M terminal
	6	+3.3 V	3.3 V power supply
	7	Reserved	Reserved, not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	Reserved	Reserved, not connected
	Shield	Cable shield	Functional earth

The serial non-isolated interface COM1 is connected to a 9-pole D-sub connector. It is configurable for RS-485 and can be used for:

- online access with Automation Builder (via RS-485 programming cable e. g. TK504 ⇨ *Chapter 1.8.1.9 “TK504 - Programming Cable” on page 1130*),
- as Modbus RTU, client and server

- for ASCII serial protocols
- a CS31 system bus (RS-485), as master only.

> *The serial RS-485 interface is not electrically isolated.*

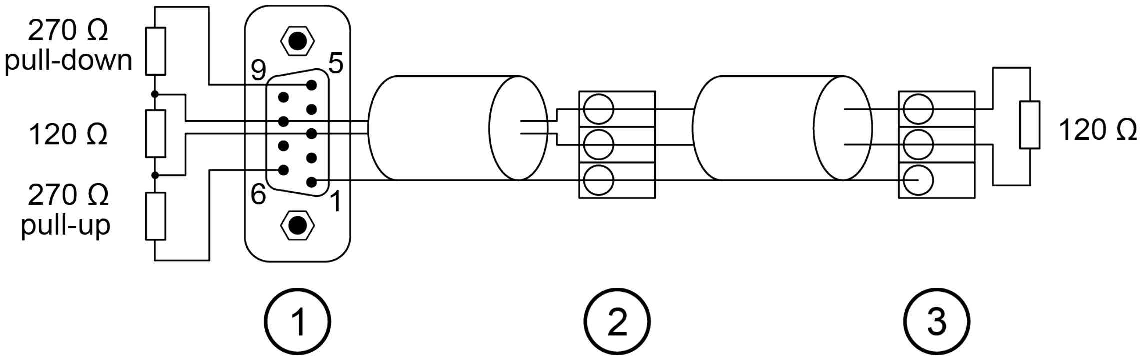
If the RS-485 bus is used, each interconnected bus line (each bus segment) must be electrically terminated. The following is necessary:

- 2 resistors of 120 Ω each at both line ends (to avoid signal reflections)
- In addition, a pull-up resistor at RxD/TxD-P and a pull-down resistor at RxD/TxD-N. These 2 resistors care for a defined high level on the bus, while there is no data exchange.

> *The pull-up, pull-down and termination resistors are not included inside the processor module and must be connected externally.*

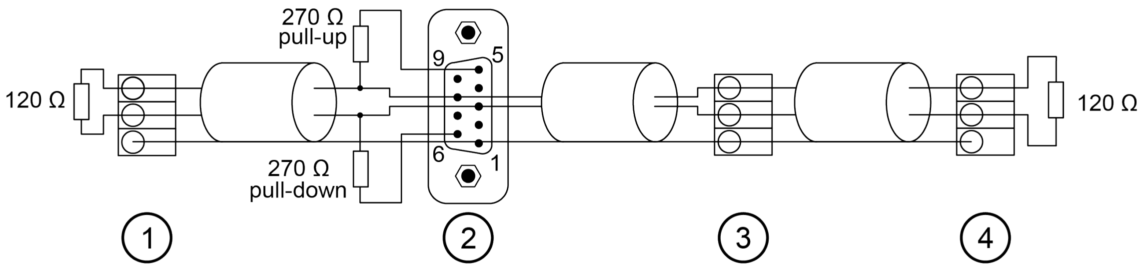
It is useful to add both the pull-up and the pull-down resistors, which only are necessary once on every bus line, at the bus master.

The following figure shows an RS-485 bus with the bus master at one line end.



1 Master at the bus line end, pull-up and pull-down activated, bus termination with 120 Ω resistors
2 Slave within the bus line
3 Slave at the bus line end, bus termination with 120 Ω resistors

If the master is located within the bus line, it does not need a terminating resistor. The pull-up and the pull-down resistors, however, are necessary:



1 Slave at the bus line end, bus termination with 120 Ω resistors
2 Master within the bus line, pull-up and pull-down activated
3 Slave within the bus line
4 Slave at the bus line end, bus termination with 120 Ω resistors

> **NOTICE!**
> **Risk of EMC disturbances!**
> Unshielded cables may cause EMC disturbances.
>
> Always use shielded cables and connect the shield at every device.

> **NOTICE!**
> **Risk of malfunctions!**
> The pull-up/pull-down resistors must be used only one time within a bus line.
>
> Use the pull-up/pull-down resistors only at 1 master.

The cable shields must be earthed. See CS31 system bus *Chapter 2.5.4.4 “CS31 bus” on page 1217*.

2.5.4.3 Serial Interface COM2

The serial interfaces COM1 and COM2 are designed according to the standard EIA RS-485. Both interfaces can be operated in RS-485 mode.

Parameter	Value
Standard of the serial interfaces	RS-485
Interface connectors	COM1: 9-pin D-sub connector (female) COM2: 5-pole connector with screw-type connection (optional)
Electrical isolation	none (with TA562) 500 VDC (with TA569-RS-ISO)
Serial interface parameters	Configurable by the software
Operating modes	Programming or data exchange
Supported protocols	Modbus or serial data exchange using special software function blocks

The serial interface COM2 is connected via a 5-pole terminal block and can be used for

- online access
- free protocol communication
- Modbus RTU, client and server

> *The serial RS-485 interface is not electrically isolated using TA562-RS or TA562-RS-RTC.*
>
> *Using TA569-RS-ISO the serial RS-485 interface has galvanic isolation.*

> *It is not intended to use COM2 to establish a CS31 system bus.*

If the RS-485 bus is used, each interconnected bus line (each bus segment) must be electrically terminated. The following is necessary:

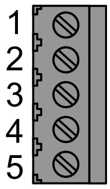
- 2 suitable resistors at both line ends (to avoid signal reflections)
- A pull-up resistor at RxD/TxD-P and a pull-down resistor at RxD/TxD-N. These 2 resistors care for a defined high level on the bus, while there is no data exchange.

The pull-up and the pull-down resistors are included inside the processor module's serial RS-485 adaptor. The termination resistor is not included inside the processor module and must be connected externally.

It is useful to activate both the pull-up and the pull-down resistors, which are only necessary once on every bus line, at the bus master. For this reason, these 2 resistors are already integrated within the COM2 interface of the processor module. They can be activated by connecting the terminals 1-2 and 3-4 of COM2.

For equipping AC500-eCo processor modules with a real-time clock and a second serial RS-485 interface COM2, use TA562-RS-RTC serial RS-485 and real-time clock adaptor *✎ Chapter 2.5.5.6 “TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock ” on page 1237.*

Table 209: Pin assignment

Serial Interface	Pin	Description
	1	Terminator P
	2	TxD/RxD-P
	3	TxD/RxD-N
	4	Terminator N
	5	Functional earth

NOTICE!
Risk of EMC disturbances!
Unshielded cables may cause EMC disturbances.

Always use shielded cables and connect the shield at every device.

NOTICE!
Risk of malfunctions!
The pull-up/pull-down resistors must be used only one time within a bus line.

Use the pull-up/pull-down resistors only at 1 master.

The ground potential of the interface COM2 is internally connected to the M terminal of the CPU power supply connector (not for TA569-RS-ISO).

The cable shields must be earthed. See CS31 system bus ✎ *Chapter 2.5.4.4 “CS31 bus” on page 1217*.

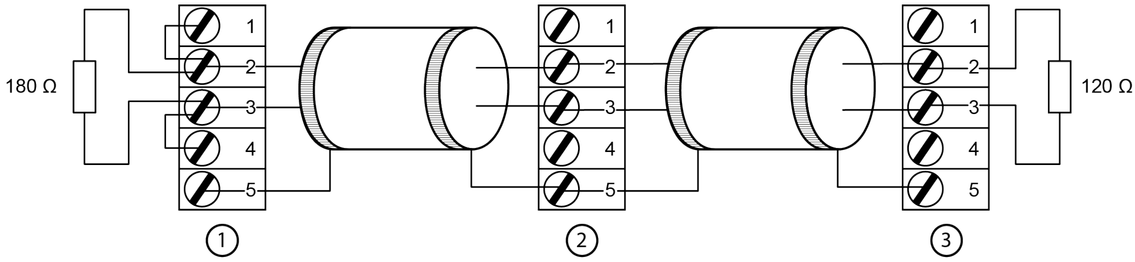
2.5.4.3.1 COM2 as Master of RS-485 Communication System

When COM2 is configured as a master in serial communication application, internal pull-up/pull-down resistors have to be activated to comply minimum 200 mV input voltage on A/B line during idle state.

COM2 as Master at the Bus Line End

It is recommended to apply COM2 at the line end if RS-485 master is configured.

When COM2 is applied to the bus line end as a master it needs a 180 Ω terminator and pull-up/pull-downdown resistors wiring to comply with signal integrity and impedance matching. Terminator wiring and pull-up/pull-down resistors activating can be as:



1 COM2 as master at the end of bus line, pull-up and pull-down resistors are activated, bus termination with 180 Ω resistor
2 Slave within the bus line
3 Slave at the end of bus line, bus termination with 120 Ω resistor

AC500-eCo as master must always be located at the end of the bus line.

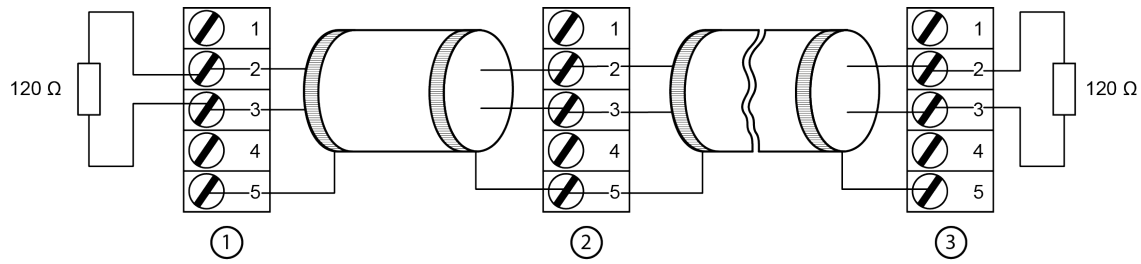
2.5.4.3.2 COM2 as Slave of RS-485 Communication System

When COM2 is configured as a slave in serial communication application, pull-up/pull-down resistors must be inactivated. Terminator wiring complies with the node position.

It does not matter wherever the master is located when COM2 is configured as slave in the line.

COM2 as Slave at the Bus Line End

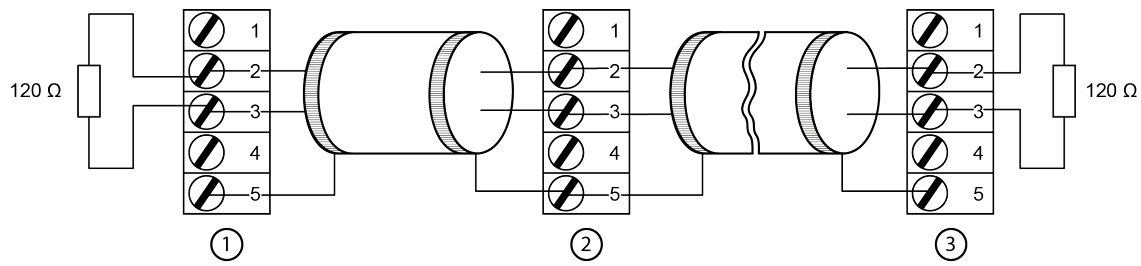
A 120 Ω 1/2 W resistor is a typical terminator to match the impedance of most of cable applied when COM2 is located at the end of bus line.



1 COM2 as slave at the end of bus line, bus termination with 120 Ω resistor, but the pull-up and pull-down termination must be inactivated
2 Slave within the bus line
3 Slave at the end of bus line, bus termination with 120 Ω resistor

COM2 as Slave located within the Bus Line

If COM2 is configured as a slave node within the bus line, it does not need a terminator. Pull-up and pull-down resistors are not required by a slave node.



1 Slave at the end of bus line, bus termination with 120 Ω resistor
2 COM2 as slave within the bus line, pull-up and pull-down termination must be inactivated
3 Slave at the end of bus line, bus termination with 120 Ω resistor

2.5.4.4 CS31 bus

Connection

The AC500-eCo Processor Modules can be used as a CS31 bus master. They cannot be used as a CS31 bus slave. The connection is performed via the serial interface COM1 used as a CS31 bus (see chapter Serial Interface COM1 *Chapter 1.2.1.1.3 “Connections” on page 24*). Connection of the bus signals: pin 3 and pin 8.

Wiring

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm² (24 AWG)
Recommendation	0.5 mm² corresponds to 0.8 mm
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω...150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends
Remarks	Shielded cables with PVC core insulation and a core diameter of 0.8 mm can be used up to a length of ca. 50 m. In this case, the bus terminating resistor is ca. 100 Ω.

Wiring Remarks Shielded cables with PVC core insulation and a core diameter of 0.8 mm can be used up to a length of ca. 50 m. In this case, the bus terminating resistor is ca. 100 Ω.

Bus Topology A CS31 bus always contains only one bus master (CPU or Communication Module) which controls all actions on the bus. Up to 31 slaves can be connected to the bus, e. g. remote modules or slave-configured CPUs. Besides the wiring instructions shown below, the wiring and earthing instructions provided with the descriptions of the modules are valid additionally.

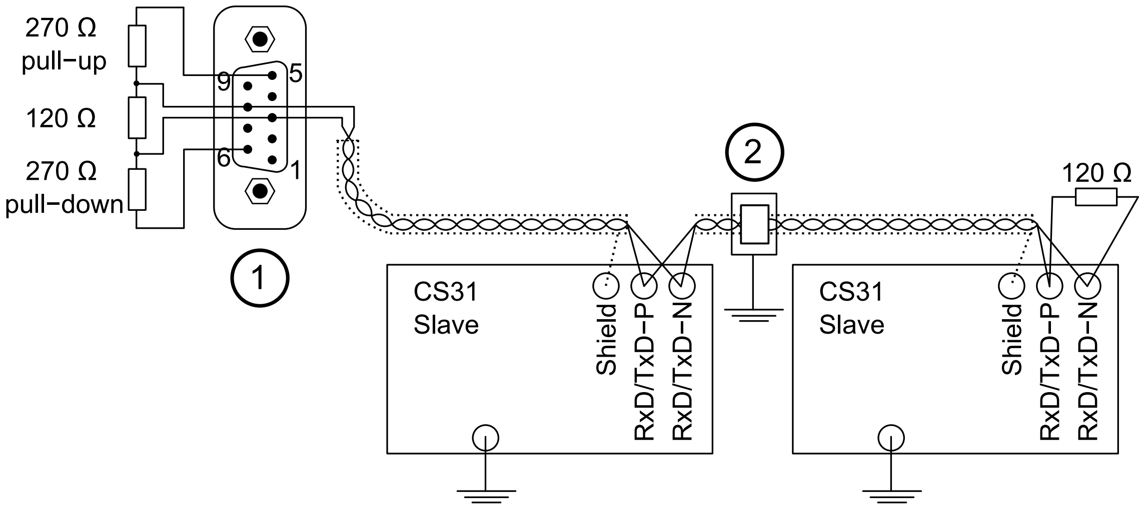


Fig. 203: Bus topology for a CS31 bus at COM1 (Master is at the end of the bus line)

1 Master at the bus line end, pull-up and pull-down activated, bus termination with 120 Ω resistors
2 Direct earthing with clip or steel plate

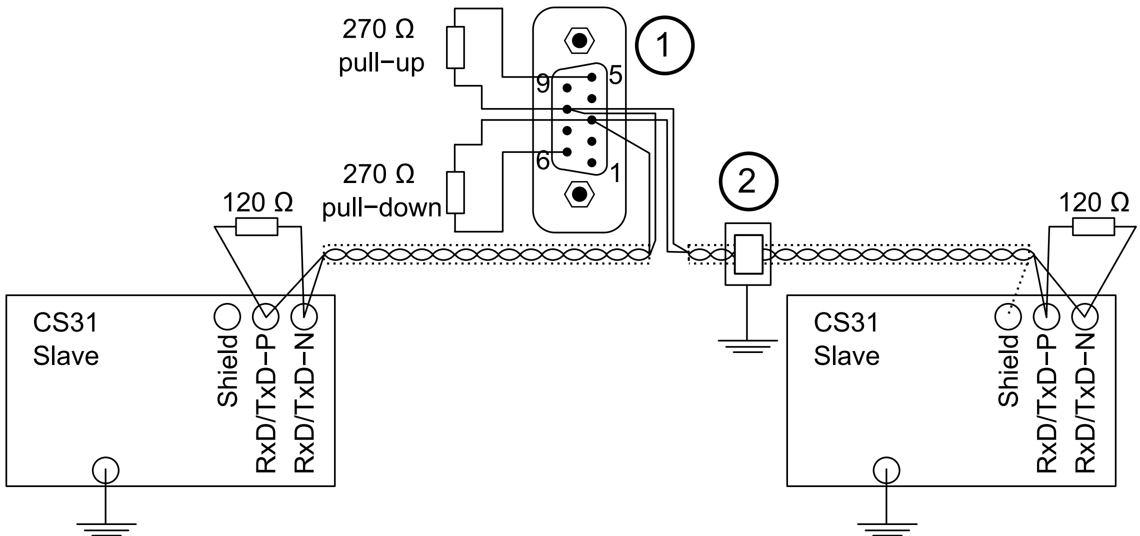


Fig. 204: Bus topology for a CS31 bus at COM1 (Master is within the bus line)

1 Master within the bus line, pull-up and pull-down activated
2 Direct earthing with clip or steel plate

> **NOTICE!**
> **Risk of malfunctions!**
> Spur lines are not allowed within the CS31 bus.
>
> Loop the bus line from module to module.

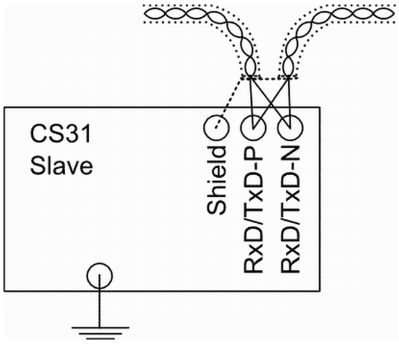


Fig. 205: Correct

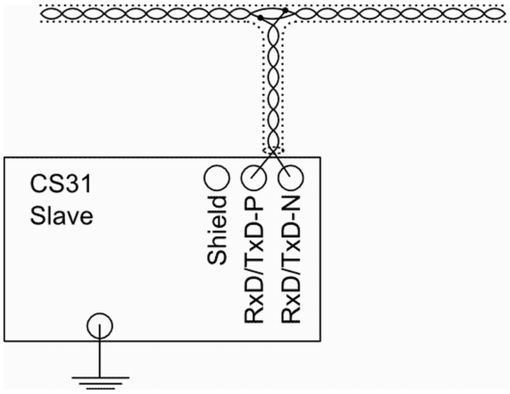


Fig. 206: Wrong

Earthing In order to avoid disturbance, the cable shields must be earthed directly.

Case A Multiple switch-gear cabinets: If it can be guaranteed that no potential differences can occur between the switch-gear cabinets by means of current-carrying metal connections (earthing bars, steel constructions etc.), the direct earthing is chosen.

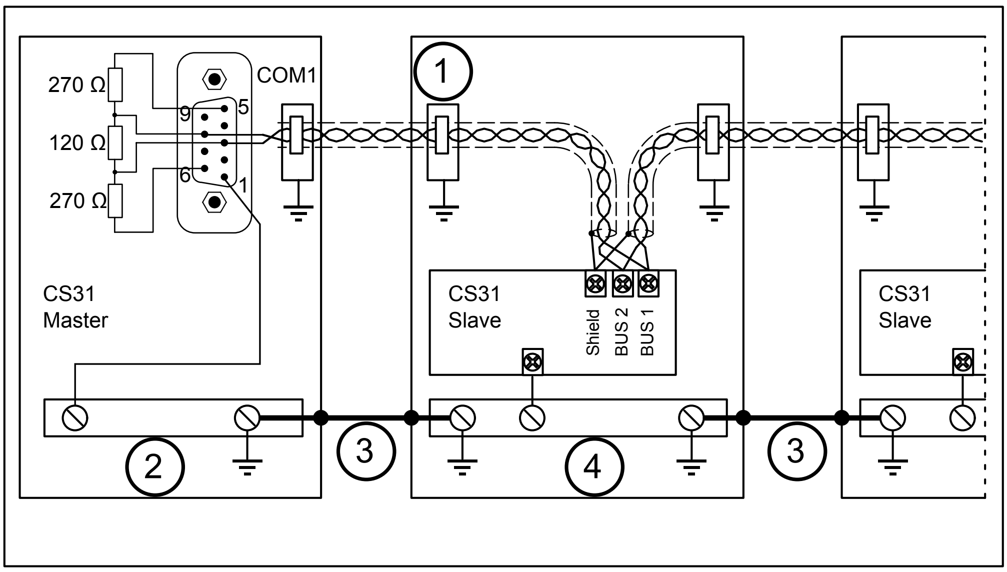


Fig. 207: Direct earthing

1 Direct earthing with clip or steel plate
2 Earth of Cabinet 1
3 Current-carrying connection
4 Earth of Cabinet 2

Case B

Multiple switch-gear cabinets: If potential differences can occur between the switch-gear cabinets, the capacitive earthing method is chose0n in order to avoid circulating currents on the cable shields.

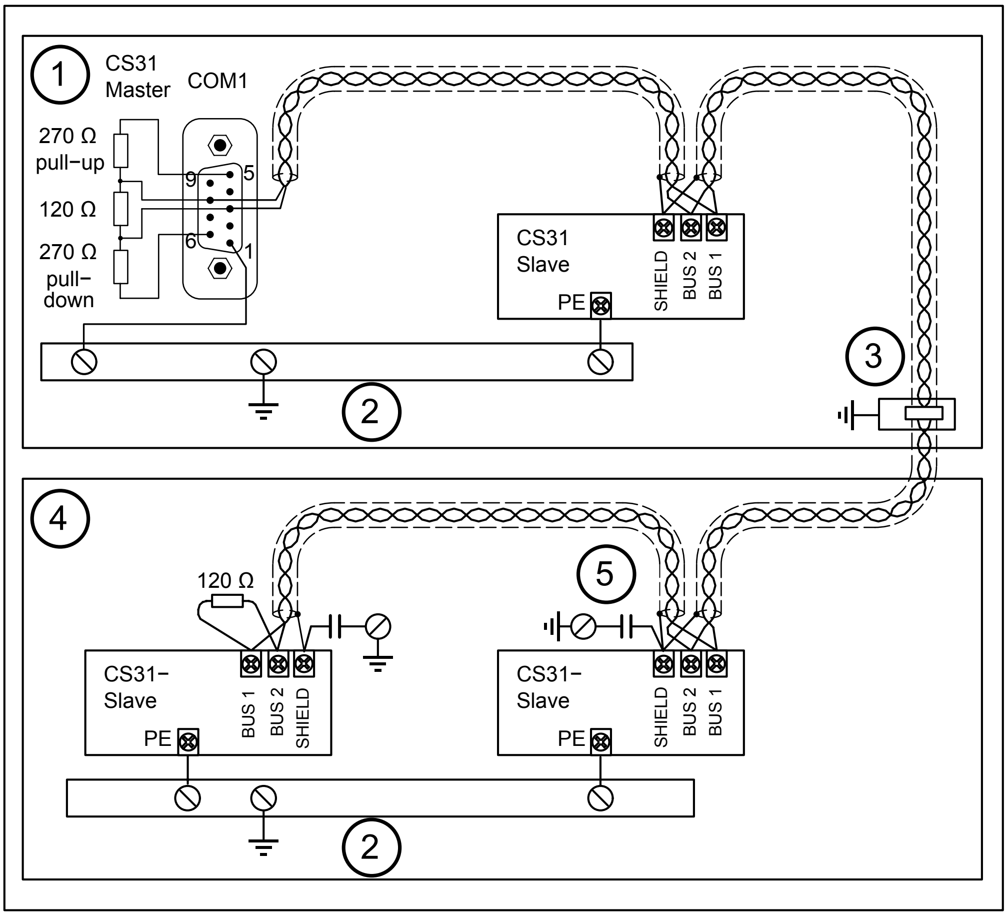


Fig. 208: Earthing concept with several switch-gear cabinets: direct earthing of cable shields when cables enter the first switch-gear cabinet (containing the master), and capacitive earthing at the modules

1 Cabinet 1
2 Cabinet earthing
3 Direct earthing with clip or steel plate
4 Cabinet 2
5 Capacitive earthing with 0.1 µF X-type capacitor directly on the cabinet steel plate

Everywhere is valid: The total length of the earthing connections between the shield of the Terminal Base and the earthing bar must be as short as possible (max. 25 cm). The conductor cross section must be at least 2.5 mm².

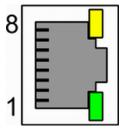
VDE 0160 requires, that the shield must be earthed directly at least once per system.

2.5.4.5 Ethernet

Ethernet is also used for PROFINET, EtherCAT and Modbus TCP connection.

2.5.4.5.1 Ethernet Interface

The Ethernet interface is carried out via a RJ45 jack. The pin assignment of the Ethernet interface:

Interface	Pin	Description	
	1	Tx+	Transmit Data +
	2	Tx-	Transmit Data -
	3	Rx+	Receive Data +
	4	NC	Not connected
	5	NC	Not connected
	6	Rx-	Receive Data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

The supported protocols and used Ethernet ports can be found in a separate *chapter*.

Communication via Modbus TCP/IP is described in detail in a separate *chapter*.

2.5.4.5.2 Wiring

Cable Length Restrictions

For the maximum possible cable lengths within an Ethernet network, various factors have to be taken into account. Twisted pair cables (TP cables) are used as transmission medium for 10 Mbit/s Ethernet (10Base-T) as well as for 100 Mbit/s (Fast) Ethernet (100Base-TX). For a transmission rate of 10 Mbit/s, cables of at least category 3 (IEA/TIA 568-A-5 Cat3) or class C (according to European standards) are allowed. For fast Ethernet with a transmission rate of 100 Mbit/s, cables of category 5 (Cat5) or class D or higher have to be used. The maximum length of a segment, which is the maximum distance between two network components, is restricted to 100 m due to the electric properties of the cable.

Furthermore, the length restriction for one collision domain has to be observed. A collision domain is the area within a network which can be affected by a possibly occurring collision (i.e. the area the collision can propagate over). This, however, only applies if the components operate in half-duplex mode since the CSMA/CD access method is only used in this mode. If the components operate in full-duplex mode, no collisions can occur. Reliable operation of the collision detection method is important, which means that it has to be able to detect possible collisions even for the smallest possible frame size of 64 bytes (512 bits). But this is only guaranteed if the first bit of the frame arrives at the most distant subscriber within the collision domain before the last bit has left the transmitting station. Furthermore, the collision must be able to propagate to both directions at the same time. Therefore, the maximum distance between two ends must not be longer than the distance corresponding to the half signal propagation time of 512 bits. Thus, the resulting maximum possible length of the collision domain is 2000 m for a transmission rate of 10 Mbit/s and 200 m for 100 Mbit/s. In addition, the bit delay times caused by the passed network components also have to be considered.

The following table shows the specified properties of the respective cable types per 100 m.

Table 210: Specified cable properties:

Parameter	10Base-T [10 MHz]	100Base-TX [100 MHz]
Attenuation [dB / 100m]	10.7	23.2
NEXT [dB / 100m]	23	24
ACR [dB / 100m]	N/A	4
Return loss [dB / 100m]	18	10

Parameter	**10Base-T [10 MHz]**	**100Base-TX [100 MHz]**
Wave impedance [Ohms]	100	100
Category	3 or higher	5
Class	C or higher	D or higher

TP Cable

The TP cable has eight wires arranged in four pairs of twisted wires. Different color codes exist for the coding of the wires, the coding according to EIA/TIA 568, version 1, being the one most commonly used. In this code, the individual pairs are coded with blue, orange, green and brown color. One wire of a pair is unicolored and the corresponding second wire is striped, the respective color alternating with white. For shielded cables, a distinction is made between cables that have one single shield around all pairs of wires and cables that have an additional individual shield for each pair of wires. The following table shows the different color coding systems for TP cables:

Table 211: Color coding of TP cables:

Pairs	**EIA/TIA 568 Version 1**		**EIA/TIA 568 Version 2**		**DIN 47100**		**IEC 189.2**	
Pair 1	white/ blue	blue	green	red	white	brown	white	blue
Pair 2	white/ orange	orange	black	yellow	green	yellow	white	orange
Pair 3	white/ green	green	blue	orange	grey	pink	white	green
Pair 4	white/ brown	brown	brown	slate	blue	red	white	brown

Two general variants are distinguished for the pin assignment of the normally used RJ45 connectors: EIA/TIA 568 version A and version B. The wiring according to EIA/TIA 568 version B is the one most commonly used.

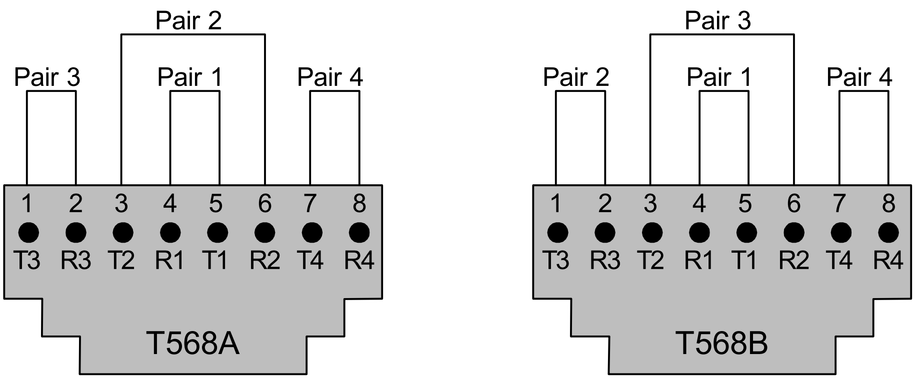


Fig. 209: Pin assignment of RJ45 sockets

2.5.4.5.3 Cable Types

Straight-through cable

For networks with more than two subscribers, hubs or switches have to be used additionally for distribution. These active devices already have the crossover functionality implemented which allows a direct connection of the terminal devices using straight-through cables.

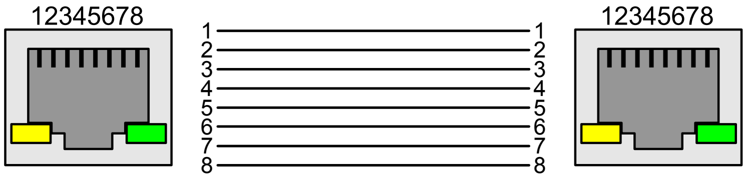


Fig. 210: Wiring of a straight-through cable

CAUTION!
Risk of communication faults!
When using inappropriate cables, malfunctions in communication may occur.

Only use network cables of the categories 5 (Cat 5, Cat 5e, Cat 6 or Cat 7) or higher within PROFINET networks.

2.5.4.6 Modbus RTU Connection Details

The Modbus RTU protocol is implemented in the AC500 Processor Modules.

Modbus is a master-slave (client-server) protocol. The client sends a request to the server(s) and receives the response(s).

Available serial interfaces can work as Modbus interfaces simultaneously.

The Modbus client operating mode of an interface is set with the Function Block *COM_MOD_MAST*.

Technical data

The Modbus operating mode and the interface parameters are set in the *PLC configuration*.

Description of the Modbus protocol:

Supported standard	PM55x and PM56x: EIA RS-485 PM57x, PM58x and PM59x: EIA RS-232 / RS-485
Number of connection points	1 client Max. 1 server with RS-232 interface Max. 31 servers with RS-485
Protocol	Modbus
Operating mode	Client/server
Address	Server only
Data transmission control	CRC16
Data transmission speed	Up to 187.500 baud
Encoding	1 start bit 8 data bits 1 parity bit, (optional) even, odd, mark or space 1 or 2 stop bits
Max. cable length for RS-485 on COM1 / COM2 for AC500 CPU	1.200 m at 19.200 baud

Max. cable length for RS-485 on COM1 / COM2 for AC500-eCo CPU			
	COM1:		
		Non-isolated:	Max. 50 m (with shielded cable)
		Isolated with TK506:	Max. 500 m @ 19200 (with shielded cable)*)
	COM2:		
		Non-isolated with TA562:	Max. 50 m (with shielded cable)
		Isolated with TA569:	Max. 500 m @ 19200 (with shielded cable)*)

*) 500 m Cable type STP-120 Ω/AWG-20

If a Processor Module provides more than one serial interface, both interfaces (COM1/COM2) can be operated simultaneously as Modbus interfaces and can operate as Modbus server as well as Modbus client.

Bus topology

Point-to-point with RS-232 or bus topology with RS-485. Modbus is a master-slave protocol.

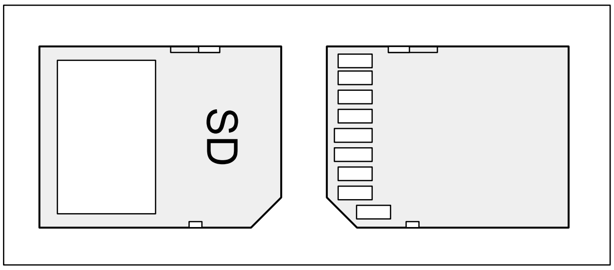
For further information on Modbus see chapter *Communication with Modbus RTU*.

2.5.5 Handling of Accessories

This section only describes accessories that are frequently used for system assembly, connection and construction. A description of all additional accessories that can be used to supplement AC500 system can be found in the Hardware PLC device description.

2.5.5.1 MC502 - SD Memory Card

- Secure digital card
- Solid state flash memory storage



Purpose

The SD memory card is used to back-up user data and store user programs or project source codes as well as to update the internal CPU firmware. The processor modules can be operated with and without SD memory card.

AC500/AC500-eCo processor modules are supplied without SD memory card. It therefore must be ordered separately.

The MC memory card can be read on a PC with a standard memory card reader. AC500 processor modules are equipped with an MC memory card reader.

For AC500-eCo processor modules the device must be equipped with a MC503 SD memory card adaptor ↬ *Chapter 2.5.5.2 “MC503 - SD Memory Card Adaptor” on page 1227*.

The SD memory card has a write protect switch. In the position "LOCK", the card can only be read.

The use of memory cards other than the MC502 SD memory card is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Insertion of the SD Memory Card

NOTICE!

Removal of the SD memory card

Do not remove the SD memory card during access. Remove only when the RUN LED does not blink. Otherwise the SD memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

Unpack the SD memory card and insert it into the opening of the front face of the processor module until locked:

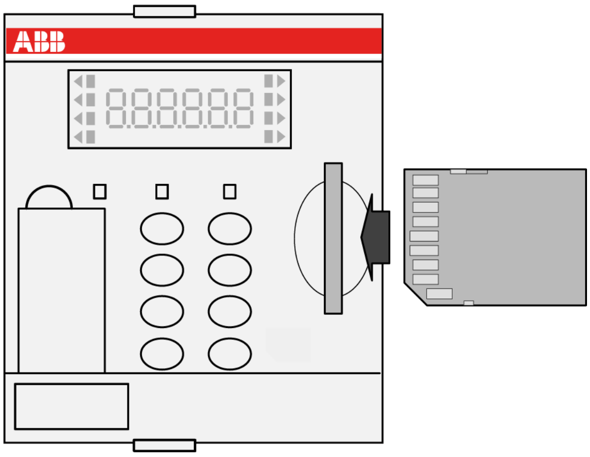


Fig. 211: Insertion: PM57x, PM58x, PM59x and PM56xx

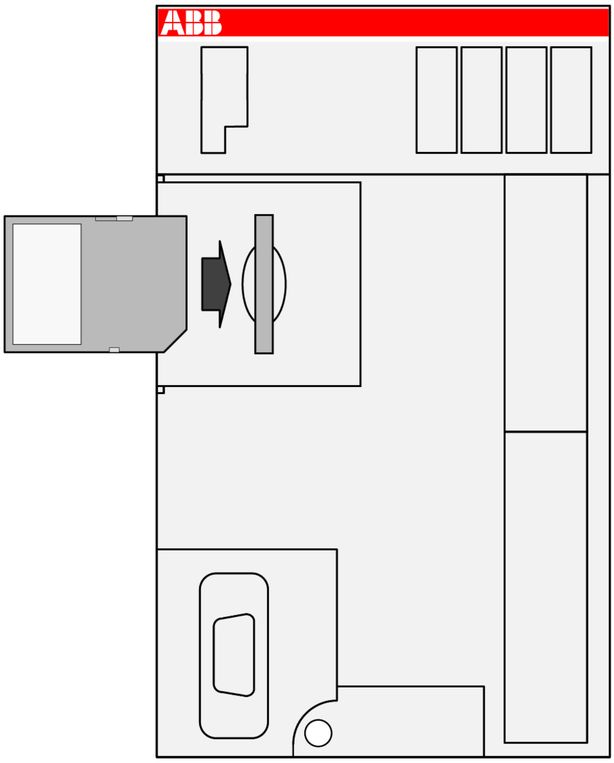


Fig. 212: Insertion: PM55x-xP and PM56x-xP

To remove the SD memory card, push on the card until it moves forward. By this, the card is unlocked and can be removed.

Technical Data

Parameter	Value
Memory capacity	Up to 2 GB, for exactly size see type plate
Temperature range	-20 °C...+85 °C
No. of writing cycles	> 100 000
No. of reading cycles	No limitation
Data safety	> 10 years
Write Protect Switch	Yes, at the edge of the SD memory card
Weight	2 g
Dimensions	24 mm x 32 mm x 2.1 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

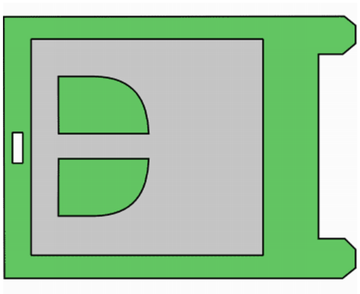
Further information on using the SD memory card in AC500 PLCs is provided in the chapter *Storage Devices*.

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 100 R0001	MC502, SD memory card	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.5.5.2 MC503 - SD Memory Card Adaptor



Intended Purpose

The MC503 SD memory card adaptor is used for expanding processor modules PM55x-xP or PM56x-xP with a SD memory card slot. A SD memory card (MC502) is not included in the scope of delivery and must be ordered separately.

The SD memory card can be used for:

- saving process data,
- saving user programs,
- upgrading the firmware.

Insertion of the Adaptor

1. Make sure, that the power supply of the processor module is turned off.

   WARNING!
   Risk of electric shock!
   With an opened option cover, energized parts of the processor module could be touched.
   – Always turn off and disconnect the power supply for the processor module before you open the option cover.
   – Make sure that the option cover is closed before reconnecting the processor module to the power supply.

2. Remove the option cover of the processor module totally by pushing it to the left side.
3. Plug the SD memory card adaptor to the left expansion slot of the processor module. Make sure that the 2 noses of the expansion module fit to the holes of the processor module PCB.
4. Remove the bar located in the middle of the option cover slot.
5. Refit the option cover.
6. To insert the SD memory card, see MC502 *Chapter 2.5.5.1 “MC502 - SD Memory Card” on page 1224*.

Removal of the Adaptor

1. Make sure that the power supply of the processor module is turned off.

> **WARNING!**
> **Risk of electric shock!**
> With an opened option cover, energized parts of the processor module could be touched.
> – Always turn off and disconnect the power supply for the processor module before you open the option cover.
> – Make sure that the option cover is closed before reconnecting the processor module to the power supply.

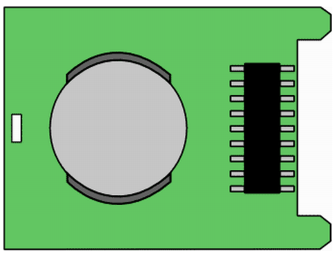
2. Remove the option cover of the processor module totally by pushing it to the left side.
3. Remove the adaptor out of the processor Module by lifting it up with a screwdriver.
4. Refit the option cover. The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules). *Chapter 2.5.5.12 “TA570 - Spare Part Set” on page 1251*

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R0100	MC503, SD memory card expansion module for PM55x-xP or PM56x-xP	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

2.5.5.3 TA561-RTC - Real-time Clock Adaptor



Intended Purpose

The TA561-RTC real time clock adaptor is used for equipping AC500-eCo processor modules with a real-time clock.

The real time clock can be buffered via an optional standard lithium battery (CR2032) during power supply failures (see lithium battery for real-time clock of AC500-eCo processor modules *Chapter 2.5.5.7 “CR2032 - Battery for Real-Time Clock” on page 1244*).

Insertion and Replacement of the Adaptor

> **WARNING!**
> **Risk of electric shock!**
> With an opened option cover, energized parts of the processor module could be touched.
> – Always turn off and disconnect the power supply for the processor module before you open the option cover.
> – Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/ removal of the adaptor and replacement of the battery is also described in the installation instruction for TA561-RTC. See https://new.abb.com/products/ABB1SAP181400R0001 or use the QR code.

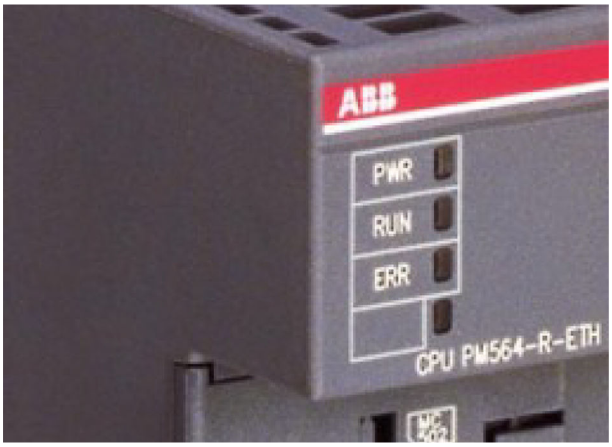
Click tab *"Documentation"* and select *"Operating Instruction"*.

The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules *Chapter 2.5.5.12 "TA570 - Spare Part Set" on page 1251*).

Replacement of the Battery

> **WARNING!**
> **Risk of death by electric shock!**
> Hazardous voltages can be present at the terminals of the module.
>
> Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

1. Switch off power supply of the system and verify that the CPU is powerless.



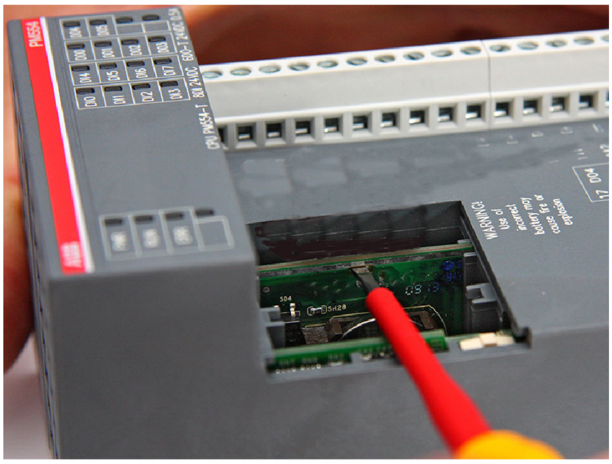
⇨ LEDs (PWR, RUN, ERR) must be off.

2. Remove the option cover.

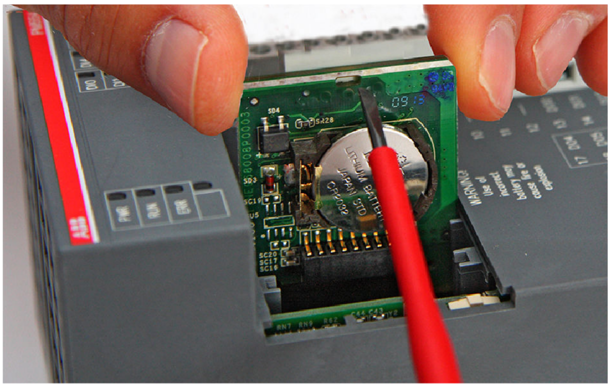
⇨ Remove the option cover of the CPU totally by pushing it to the outer side.

> **NOTICE!**
>
> **Avoidance of electrostatic charging**
>
> PLC devices and equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Observe the following rules when handling the system:
>
> – Touch a grounded object to discharge potential static.
> – Wear an approved grounding wrist strap.
> – Do not touch connectors or pins on component boards.
> – Do not touch circuit components inside the equipment.
> – If available, use a static-safe workstation.
> – When not in use, store the equipment in appropriate static-safe packaging.

3. Remove the option board.

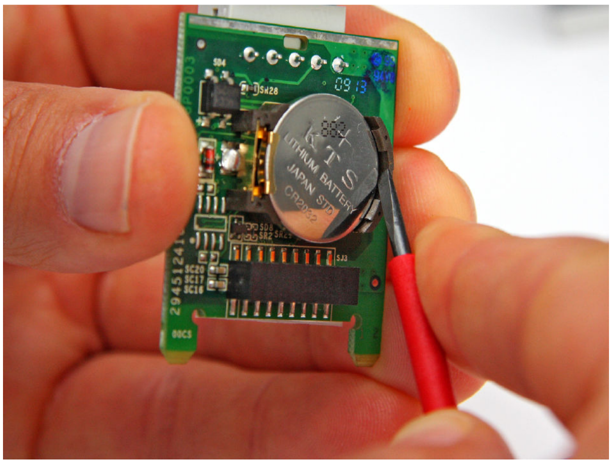


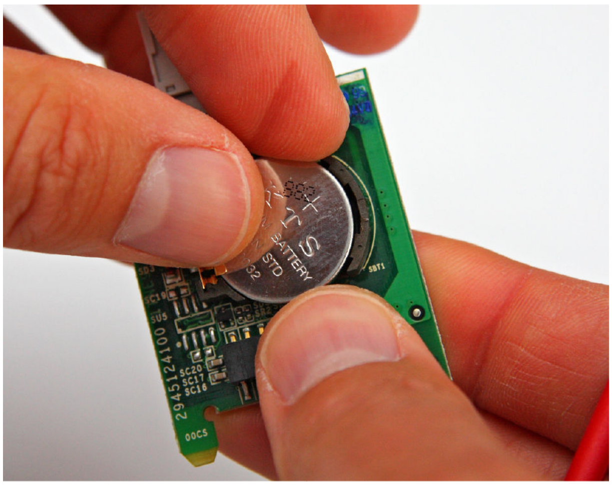
⇨ *Remove SD memory card (if installed) / terminal block (COM2).*



Remove the option board from the CPU by lifting it up with a screwdriver.

4. Remove the battery.

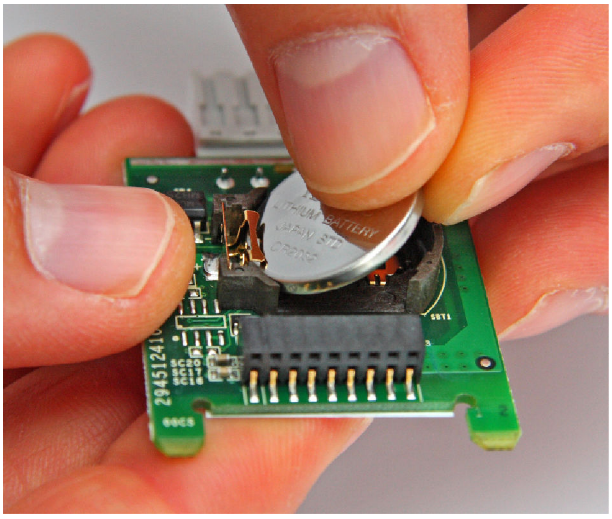




⇨

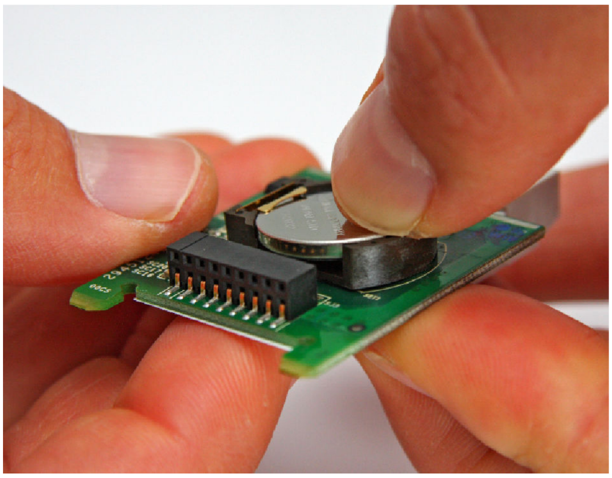
> **_ATTENTION!_**
>
> *Lithium batteries must not be recharged, not be disassembled and not be disposed of in fire.*
>
> *Exhausted batteries must be recycled to respect the environment.*
>
> *Dispose of battery properly according to disposal procedures for lithium batteries.*

5. Insert replacement battery.

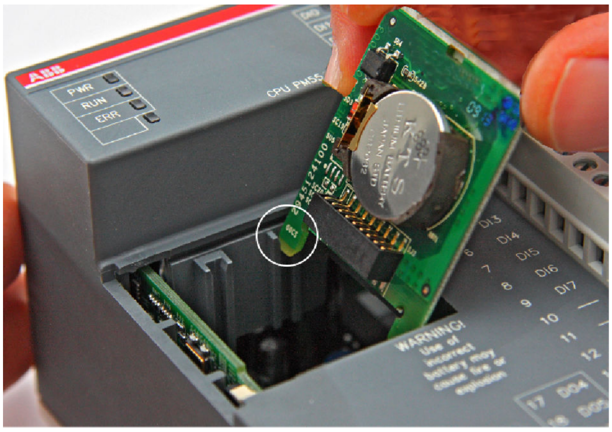


⇨

> ***ATTENTION!***
>
> *A standard batterie CR2032 can be used for **TA561-RTC** and **TA562-RS-RTC**.*
>
> *Nominal voltage: **3 VDC**.*
>
> *Required capacity: **230 mAh**.*
>
> *Required temperature range for discharge: **0 °C...+70 °C**.*
>
> *After replacement of the battery, the real-time clock (RTC) date and time must be set again by the user.*
>
> *Don't use a battery older than 3 years for replacement (e.g. battery kept too long in stock).*
>
> *Batteries must be stored in a dry place.*



6. Insert option board into the CPU.



⇨ Insert the adaptor TA56x-RTC into the slot on the right of the CPU.

> *Make sure that the 2 noses of the expansion module fit to the holes of the CPU PCB.*
>
> *See white circle in figure above.*

7. Refit the option cover of the CPU.

⇨

> *Remember to re-insert a SD memory card first if it has been removed previously.*

8. Only now the CPU can connected to power.

Set the time of the real-time clock.

Technical Data

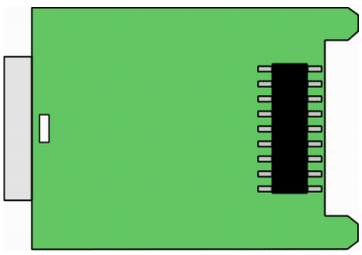
Parameter	Value
RTC accuracy (at 25 °C)	Typ. ±2 s / 24 h

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 181 400 R0001	TA561-RTC, serial RTC adaptor for PM55x-xP and PM56x-xP	Active
1TNE 968 901 R3200	TA561-RTC, serial RTC adaptor for PM55x-xP and PM56x-xP, lithium battery included (available in China only)	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.5.5.4 TA562-RS - Serial RS-485 Adaptor



Intended Purpose

The TA562-RS serial RS-485 adaptor is used for equipping AC500-eCo processor modules with a second serial interface COM2. The COM2 interface can be used for:

- online access
- free protocol communication
- Modbus RTU, client and server

CAUTION!
The serial RS-485 Interface is not electrically isolated.

Insertion/ Removal of the Adapter

WARNING!
Risk of electric shock!
With an opened option cover, energized parts of the processor module could be touched.

– Always turn off and disconnect the power supply for the processor module before you open the option cover.
– Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/removal of the adaptor is also described in the installation instruction for TA561-RTC. See

https://new.abb.com/products/ABB1SAP181400R0001 or use the QR code.

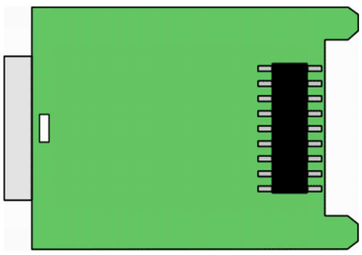
The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules *Chapter 2.5.5.12 “TA570 - Spare Part Set” on page 1251*).

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R4300	TA562-RS, serial RS-485 adaptor for PM55x/PM56x	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.5.5.5 TA569-RS-ISO - Serial RS-485 Isolated Adaptor



Intended Purpose

The TA569-RS-ISO serial RS-485 isolated adaptor is used for equipping AC500-eCo processor modules with a second serial interface COM2. The COM2 interface can be used for:

- online access
- free protocol communication
- Modbus RTU, client and server

The serial interface is isolated.

Insertion/ Removal of the Adapter

WARNING!

Risk of electric shock!

With an opened option cover, energized parts of the processor module could be touched.

– Always turn off and disconnect the power supply for the processor module before you open the option cover.
– Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/removal of the adaptor is also described in the installation instruction for TA561-RTC. See

https://new.abb.com/products/ABB1SAP181400R0001 or use the QR code.

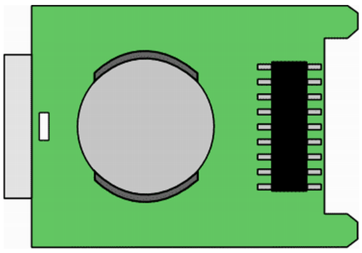
The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules *Chapter 2.5.5.12 "TA570 - Spare Part Set" on page 1251*).

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 186 400 R0001	TA569-RS-ISO, serial RS-485 isolated adaptor for PM55x/ PM56x	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.5.5.6 TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock



Intended Purpose

The TA562-RS-RTC serial RS-485 and real-time clock adaptor is used for equipping AC500-eCo processor modules with a real-time clock and a second serial RS-485 interface COM2.

The real time clock can be buffered via an optional standard lithium battery (CR2032) during power supply failures (see lithium battery for real-time clock of AC500-eCo processor modules *Chapter 2.5.5.7 "CR2032 - Battery for Real-Time Clock" on page 1244*).

Insertion/ Removal of the Adaptor

> **WARNING!**
> **Risk of electric shock!**
> With an opened option cover, energized parts of the processor module could be touched.
>
> – Always turn off and disconnect the power supply for the processor module before you open the option cover.
> – Make sure that the option cover is closed before reconnecting the processor module to the power supply.

Insertion/ removal of the adaptor and replacement of the battery is also described in the installation instruction for TA561-RTC. See https://new.abb.com/products/ABB1SAP181400R0001 or use the QR code.

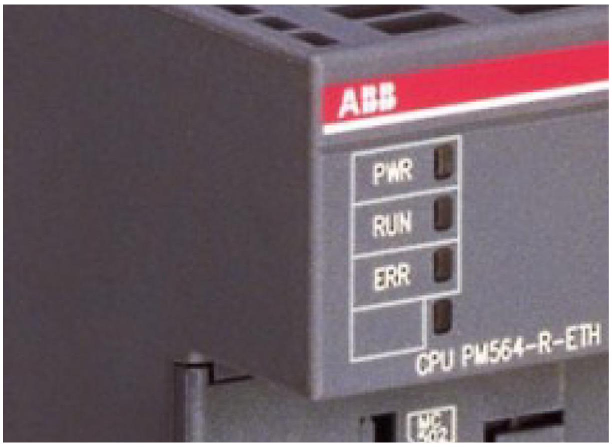
Click tab *"Documentation"* and select *"Operating Instruction"*.

The option cover is available as a spare part (see TA570 spare part set for AC500-eCo processor modules *Chapter 2.5.5.12 "TA570 - Spare Part Set" on page 1251*).

Replacement of the Battery

> **WARNING!**
> **Risk of death by electric shock!**
> Hazardous voltages can be present at the terminals of the module.
>
> Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.

1. Switch off power supply of the system and verify that the CPU is powerless.



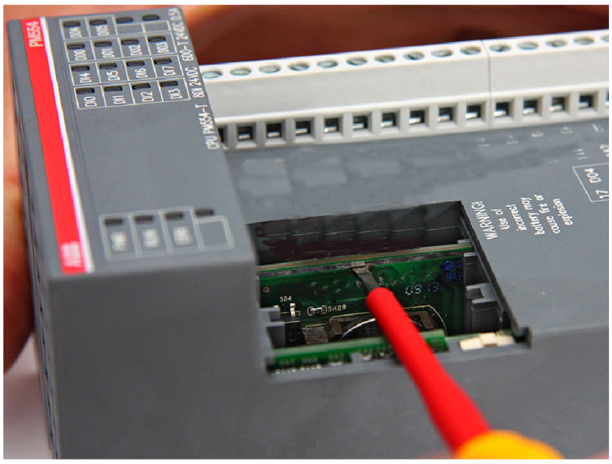
⇨ LEDs (PWR, RUN, ERR) must be off.

2. Remove the option cover.

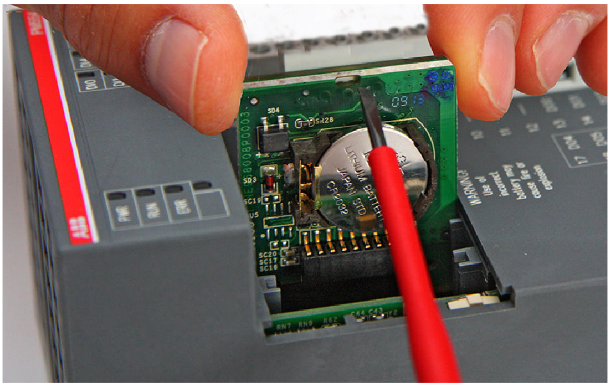
⇨ Remove the option cover of the CPU totally by pushing it to the outer side.

> **NOTICE!**
> **Avoidance of electrostatic charging**
> PLC devices and equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Observe the following rules when handling the system:
>
> – Touch a grounded object to discharge potential static.
> – Wear an approved grounding wrist strap.
> – Do not touch connectors or pins on component boards.
> – Do not touch circuit components inside the equipment.
> – If available, use a static-safe workstation.
> – When not in use, store the equipment in appropriate static-safe packaging.

3. Remove the option board.

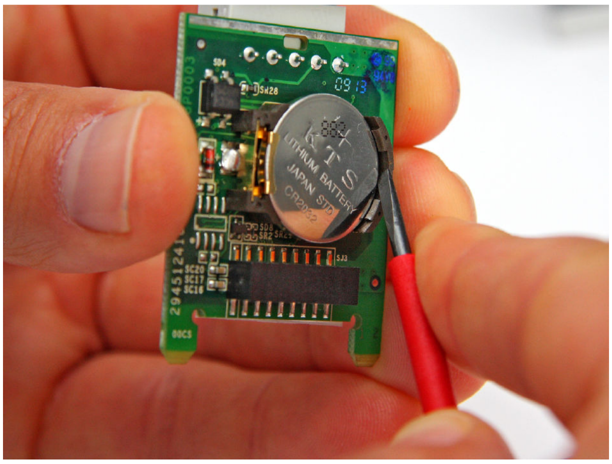


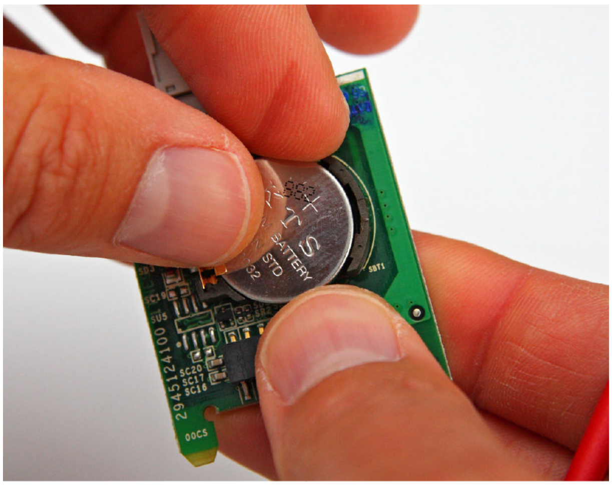
⇨ *Remove SD memory card (if installed) / terminal block (COM2).*



Remove the option board from the CPU by lifting it up with a screwdriver.

4. Remove the battery.

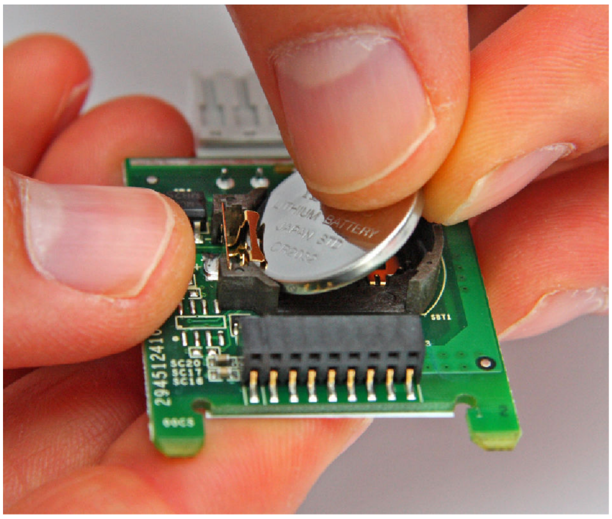




⇨

> **ATTENTION!**
>
> *Lithium batteries must not be recharged, not be disassembled and not be disposed of in fire.*
>
> *Exhausted batteries must be recycled to respect the environment.*
>
> *Dispose of battery properly according to disposal procedures for lithium batteries.*

5. Insert replacement battery.



⇨

__ATTENTION!__

*A standard batterie CR2032 can be used for **TA561-RTC** and **TA562-RS-RTC**.*

*Nominal voltage: **3 VDC**.*

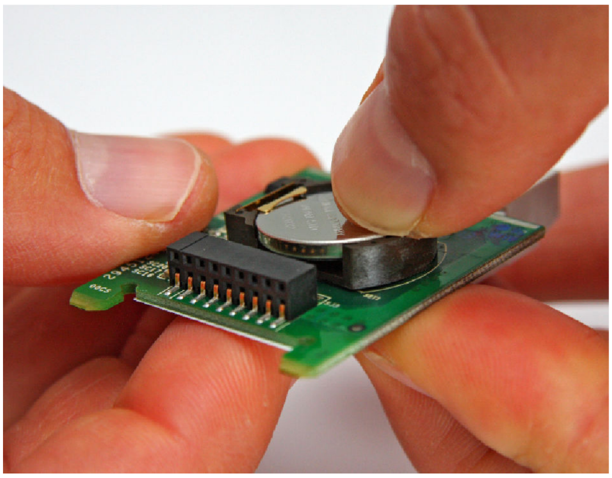
*Required capacity: **230 mAh**.*

*Required temperature range for discharge: **0 °C...+70 °C**.*

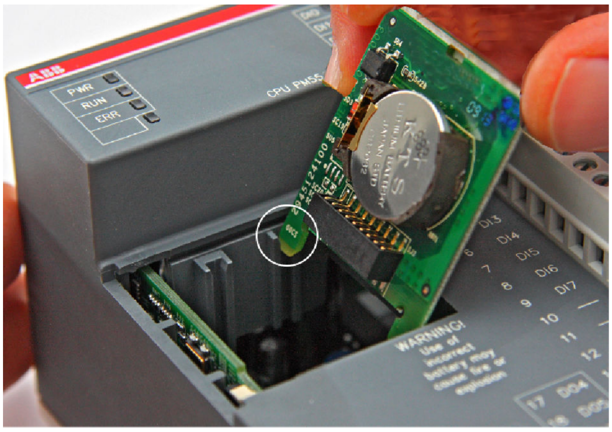
After replacement of the battery, the real-time clock (RTC) date and time must be set again by the user.

Don't use a battery older than 3 years for replacement (e.g. battery kept too long in stock).

Batteries must be stored in a dry place.



6. Insert option board into the CPU.



⇨ Insert the adaptor TA56x-RTC into the slot on the right of the CPU.

> *Make sure that the 2 noses of the expansion module fit to the holes of the CPU PCB.*
>
> *See white circle in figure above.*

7. Refit the option cover of the CPU.

⇨

> *Remember to re-insert a SD memory card first if it has been removed previously.*

8. Only now the CPU can connected to power.

Set the time of the real-time clock.

Technical Data

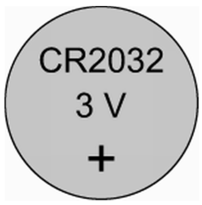
Parameter	Value
RTC accuracy (at 25 °C)	Typ. ±2 s / 24 h

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 181 500 R0001	TA562-RS-RTC, serial RS-485 and real-time clock adaptor for PM55x-xP and PM56x-xP	Active
1TNE 968 901 R5210	TA562-RS-RTC, serial RS-485 and real-time clock adaptor for PM55x-xP and PM56x-xP, lithium battery included (available in China only)	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.5.5.7 CR2032 - Battery for Real-Time Clock



Intended Purpose

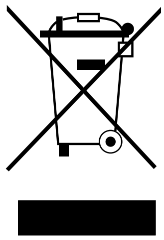
A standard lithium battery (type CR2032) is used to backup the real-time clock (RTC) in the adaptors TA561-RTC ➪ *Chapter 2.5.5.3 “TA561-RTC - Real-time Clock Adaptor ” on page 1228* and TA562-RS-RTC ➪ *Chapter 2.5.5.6 “TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock ” on page 1237* during power failures.

The CPU monitors the discharge degree of the battery. An diagnoses message is output before the battery condition becomes critical (about 2 weeks before). After the diagnosis message has appeared, the battery should be replaced as soon as possible.

Handling Instruction

- The handling instructions of the battery manufacturer must be observed.
- The Material Safety Data Sheet (MSDS) of the battery manufacturer must be observed.
- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.

- Store the battery in a dry place.
- Recycle exhausted batteries meeting the environmental standards.



Transport

Transport of lithium batteries or equipment with installed lithium batteries:

- The transport and handling instructions of the battery producer must be observed.
- The transport regulations for transport of lithium batteries must be observed e.g. for transport by road or air.
- The forwarder must be informed if batteries are contained in the shipment.

Electrical Connection

Assembling and electrical connection of the battery is described in chapters TA561-RTC real-time clock adaptor *Chapter 2.5.5.3 “TA561-RTC - Real-time Clock Adaptor ” on page 1228* and TA562-RS-RTC serial RS-485 and real-time clock adaptor *Chapter 2.5.5.6 “TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock ” on page 1237*.

Battery Lifetime

The battery lifetime is the time the battery can operate the RTC while the CPU is not powered. The typical lifetime is 300 days (at 25 °C).

As long as the CPU is powered, the battery will only be discharged by its own leakage current.

Technical Data

The battery must meet die following technical data:

Parameter	Value
Battery designation	CR2032
Description	Manganese dioxide button cell, primary cell, not rechargeable
Nominal voltage	3 VDC
Capacity	230 mAh (measured with 5.6 kΩ load at 20 °C, discharging down to 2.0 V)
Typical lifetime (at 25 °C, CPU not powered)	300 days
Temperature range	≥ 0 °C ...+70 °C
Diameter	20 mm
Height	3.2 mm

2.5.5.8 TA563-TA565 - Terminal Blocks

These terminal blocks must only be used with AC500-eCo I/O Modules and AC500-eCo processor modules.

Intended Purpose

The TA563-TA565 terminal blocks are used to connect process signals and process voltages to AC500-eCo I/O modules and AC500-eCo processor modules (with -P extension inside their type designator only). 3 different kind of terminal blocks are available:

- Screw terminals with cable insertion on the side
- Screw terminals with cable insertion on the front
- Spring terminals with cable insertion on the front

Of each kind, 2 sizes are available:

- Terminals with 9 poles
- Terminals with 11 poles.

There are 2 compatible variants of each kind and size.

> **WARNING!**
> **For screw terminals only: Danger of death by electric shock!**
> The IP 20 protection degree is only provided if all terminal screws are tightened.
>
> Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

Technical Data

Table 212: Screw-type Terminals (TA563/TA564)

Parameter		Value
Type		Front terminal or side terminal (depending on model)
Conductor cross section		
	Solid	0.5 mm^2 to 2.5 mm^2
	Flexible	0.5 mm^2 to 2.5 mm^2
Stripped conductor end		
	TA563	8 mm
	TA564	10 mm
Width of the screwdriver		3.5 mm
Fastening torque		0.4 Nm - 0.5 Nm
Degree of protection		IP 20 (if all terminal screws are tightened)
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Table 213: Spring Terminals (TA565)

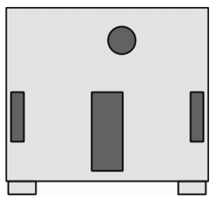
Parameter		Value
Type		Front terminal
Conductor cross section		
	Solid	0.5 mm^2 to 2.5 mm^2
	Flexible	0.5 mm^2 to 2.5 mm^2
Stripped conductor end		10 mm
Degree of protection		IP 20
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3101	Terminal Block TA563-9, 9-pole, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal Block TA563-11, 11-pole, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal Block TA564-9, 9-pole, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal Block TA564-11, 11-pole, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal Block TA565-9, 9-pole, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal Block TA565-11, 11-pole, spring front, cable front, 6 pieces per unit	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.5.5.9 TA566 - Wall Mounting Accessory



Intended Purpose

The TA566 wall mounting accessory is used for mounting S500-eCo I/O modules and AC500-eCo processor modules without DIN rail.

Handling Instruction

The TA566 is snapped into the back side of the device's housing *Chapter 2.5.3.2 “Mounting and Demounting of S500-eCo I/O Modules” on page 1205*.

Technical Data

Parameter	Value
Weight	5 g
Dimensions	29 mm x 28 mm x 5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3107	TA566, wall mounting accessory, 100 pieces	Active

*) For planning and commissioning of new installations use modules in Active status only.

2.5.5.10 CP-E - Economic Range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

- Wide-range input voltage
- Mounting on DIN rail
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Wide ambient temperature range from -40 °C...+70 °C
- No-load-proof, overload-proof, continuous short-circuit-proof
- Power factor correction (depending on the type)
- Approved in accordance with all relevant international standards

Table 214: Ordering Data

Order No.	**Type**	**Input**	**Output**	**Overload capacity**	**Module width [mm]**
1SVR427030R0000	CP-E 24/0.75	100-240 VAC or 120-370 VDC	24 VDC, 0.75 A	-	22.5
1SVR427031R0000	CP-E 24/1.25	100-240 VAC or 90-375 VDC	24 VDC, 1.25 A	-	40.5
1SVR427032R0000	CP-E 24/2.5	100-240 VAC or 90-375 VDC	24 VDC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 VAC auto select or 210-370 VDC	24 VDC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 VAC auto select or 210-370 VDC	24 VDC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115-230 VAC or 120-370 VDC	24 VDC, 20 A	-	175

2.5.5.11 CP-C.1 - High Performance Range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

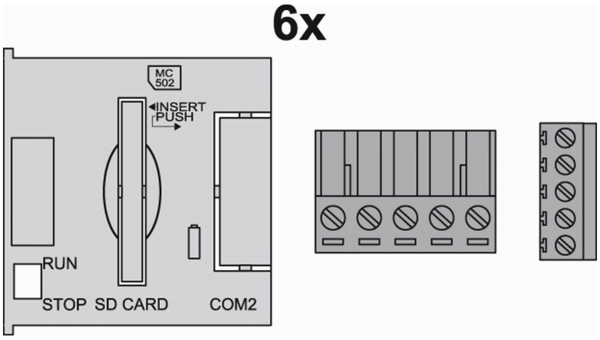
The CP-C.1 power supplies are ABB’s high performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combinded with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications.

- Typical efficiency of up to 94 %
- Power reserve design delivers up to 150 % of the nominal output current
- Signaling outputs for DC OK and power reserve mode
- High power density leads to very compact and small devices
- No-load-proof, overload-proof, continuous short-circuit-proof
- Active power factor correction (PFC)

Table 215: Ordering Data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110-240 VAC or 90-300 VDC	24 VDC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110-240 VAC or 90-300 VDC	24 VDC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110-240 VAC or 90-300 VDC	24 VDC, 20 A	+30 %	82

2.5.5.12 TA570 - Spare Part Set



Intended Purpose

The TA570 spare part set is used to replace lost or damaged parts of AC500-eCo processor modules. It contains the following parts:

- Option Cover
- Terminal block for power supply
- Terminal block for serial RS-485 adaptor

Every spare is included 6x inside TA570.

Technical Data

Table 216: Option Cover

Parameter	Value
Weight	5 g
Dimensions	40 mm x 40 mm x 3 mm

Table 217: Terminal Block for Power Supply

Parameter		Value
Type		Screw clamp plug, wire connection from front
Usage		For AC500-eCo processor modules
Conductor cross section		
	Solid	0.2 mm²...2.5 mm²
	Flexible (with wire-end ferrule only)	0.2 mm²...2.5 mm²
Stripped conductor end		7 mm...8 mm
Fastening torque		0.5 Nm

Parameter	Value
Degree of protection	IP20
Dimensions	25.4 mm x 17.4 mm x 15.1 mm
Weight	5 g

Table 218: Terminal Block for Serial RS-485 Adaptor

Parameter		Value
Type		Screw clamp plug, wire connection from side
Usage for		*Chapter 2.5.5.4 "TA562-RS - Serial RS-485 Adaptor" on page 1235* *Chapter 2.5.5.5 "TA569-RS-ISO - Serial RS-485 Isolated Adaptor" on page 1236* *Chapter 2.5.5.6 "TA562-RS-RTC - Adaptor with Serial RS-485 (COM2) and Real-time Clock " on page 1237*
Conductor cross section		
	Solid	0.14 mm^2...1.5 mm^2
	Flexible (with wire-end ferrule only)	0.14 mm^2...1.5 mm^2
Stripped conductor end		7 mm
Fastening torque		0.4 Nm
Degree of protection		IP20
Dimensions		19.05 mm x 8.7 mm x 19.1 mm
Weight		5 g

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1TNE 968 901 R3203	TA570, spare part set for AC500-eCo processor modules, 3x6 pieces	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.6 AC500 (Standard)

2.6.1 System Data AC500

2.6.1.1 Environmental Conditions

Table 219: Process and supply voltages

Parameter		Value
24 VDC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
120 VAC		

Parameter		Value
	Voltage	120 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
230 VAC		
	Voltage	230 VAC (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
120 VAC...240 VAC wide range supply		
	Voltage	120 V...240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s

NOTICE!
Exceeding the maximum power supply voltage for process or supply voltages could lead to unrecoverable damage of the system. The system could be destroyed.

NOTICE!
Improper voltage level or frequency range which cause damage of AC inputs:

– AC voltage above 264 V
– Frenquency below 47 Hz or above 62.4 Hz

NOTICE!
Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		Value
Temperature		
	Operating	0 °C...+60 °C: Horizontal mounting of modules. 0 °C...+40 °C: Vertical mounting of modules. Output load reduced to 50 % per group.
	Storage	-40 °C...+70 °C
	Transport	-40 °C...+70 °C
Humidity		Max. 95 %, without condensation
Air pressure		
	Operating	> 800 hPa / < 2000 m
	Storage	> 660 hPa / < 3500 m
Ingress protection		IP20

2.6.1.2 Creepage Distances and Clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

2.6.1.3 Insulation Test Voltages, Routine Test

According to EN 61131-2

Parameter	Value	
230 V circuits against other circuitry	2500 V	1.2/50 µs
120 V circuits against other circuitry	1500 V	1.2/50 µs
120 V...240 V circuits against other circuitry	2500 V	1.2/50 µs
24 V circuits (supply, 24 V inputs/outputs, analogue inputs/outputs), if they are electrically isolated against other circuitry	500 V	1.2/50 µs
COM interfaces, electrically isolated	500 V	1.2/50 µs
COM interfaces, electrically not isolated	Not applicable	Not applicable
FBP interface	500 V	1.2/50 µs
Ethernet	500 V	1.2/50 µs
ARCNET	500 V	1.2/50 µs
230 V circuits against other circuitry	1350 V	AC 2 s
120 V circuits against other circuitry	820 V	AC 2 s
120 V...240 V circuits against other circuitry	1350 V	AC 2 s
24 V circuits (supply, 24 V inputs/outputs, analogue inputs/outputs), if they are electrically isolated against other circuitry	350 V	AC 2 s
COM interfaces, electrically isolated	350 V	AC 2 s
COM interfaces, electrically not isolated	Not applicable	Not applicable
FBP interface	350 V	AC 2 s
Ethernet	350 V	AC 2 s
ARCNET	350 V	AC 2 s

2.6.1.4 Power Supply Units

For the supply of the modules, power supply units according to PELV specifications must be used.

2.6.1.5 Electromagnetic Compatibility

Electromagnetic Compatibility		
Device suitable for:		
	Industrial applications	Yes
	Domestic applications	No
Immunity against electrostatic discharge (ESD):		According to IEC 61000-4-2, zone B, criterion B
	Electrostatic voltage in case of air discharge	8 kV
	Electrostatic voltage in case of contact discharge	4 kV, in a closed switch-gear cabinet 6 kV [1])
	ESD with communication connectors	In order to prevent operating malfunctions, it is recommended, that the operating personnel discharge themselves prior to touching communication connectors or perform other suitable measures to reduce effects of electrostatic discharges.
	ESD with connectors of Terminal Bases	The connectors between the Terminal Bases and Processor Modules or Communication Modules must not be touched during operation. The same is valid for the I/O-Bus with all modules involved.
Immunity against the influence of radiated (CW radiated):		According to IEC 61000-4-3, zone B, criterion A
	Test field strength	10 V/m
Immunity against fast transient interference voltages (burst):		According to IEC 61000-4-4, zone B, criterion B
	Supply voltage units (DC)	2 kV
	Supply voltage units (AC)	2 kV
	Digital inputs/outputs (24 VDC)	1 kV
	Digital inputs/outputs (120 VAC...240 VAC)	2 kV
	Analog inputs/outputs	1 kV
	CS31 system bus	1 kV
	Serial RS-485 interfaces (COM)	1 kV
	Serial RS-232 interfaces (COM, not for PM55x and PM56x)	1 kV
	ARCNET	1 kV
	FBP	1 kV
	Ethernet	1 kV
	I/O supply (DC-out)	1 kV
Immunity against the influence of line-conducted interferences (CW conducted):		According to IEC 61000-4-6, zone B, criterion A

Electromagnetic Compatibility		
	Test voltage	3V zone B, 10 V is also met.
High energy surges		According to IEC 61000-4-5, zone B, criterion B
	Power supply DC	1 kV CM / 0.5 kV DM [2])
	DC I/O supply	0.5 kV CM / 0.5 kV DM [2])
	Communication Lines, shielded	1 kV CM [2])
	AC I/O unshielded	2 kV CM / 1 kV DM [2])
	I/O analog, I/O DC unshielded	1 kV CM / 0.5 kV DM [2])
Radiation (radio disturbance)		According to IEC 55011, group 1, class A

[1]) High requirement for shipping classes are achieved with additional specific measures (see specific documentation).

[2]) CM = Common Mode, DM = Differential Mode

2.6.1.6 Mechanical Data

Parameter	**Value**
Mounting	Horizontal
Degree of protection	IP 20
Housing	Classification V-2 according to UL 94
Vibration resistance acc. to EN 61131-2	all three axes 2 Hz...8.4 Hz, continuous 3.5 mm 8.4 Hz...150 Hz, continuous 1 g (higher values on request)
Shock test	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
DIN rail according to DIN EN 50022	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	Screws with a diameter of 4 mm
Fastening torque	1.2 Nm

2.6.1.7 Approvals and certifications

Information on approvals and certificates can be found in the corresponding chapter of the *Main catalog, PLC Automation*.

2.6.2 Mechanical Dimensions

2.6.2.1 Switchgear Cabinet Assembly

Information on EMC-conforming assembly and construction is provided within the overall functions section *Chapter 2.4.4 “EMC-Conforming Assembly and Construction” on page 1188.*

PLC enclosure

> **NOTICE!**
> **PLC damage due to wrong enclosures**
> Due to their construction (degree of protection IP 20 according to EN 60529) and their connection technology, the devices are suitable only for operation in enclosed switchgear cabinets.

To protect PLCs against:

- unauthorized access,
- dusting and pollution,
- moisture and wetness and
- mechanical damage,

switchgear cabinet IP54 for common dry factory floor environment is suitable.

Maintain spacing from:

- enclosure walls
- wireways
- adjacent equipment

Allow a minimum of 20 mm clearance on all sides. This provides ventilation and electrical isolation.

It is recommended to mount the modules on an earthed mounting plate, or an earthed DIN rail, independent of the mounting location.

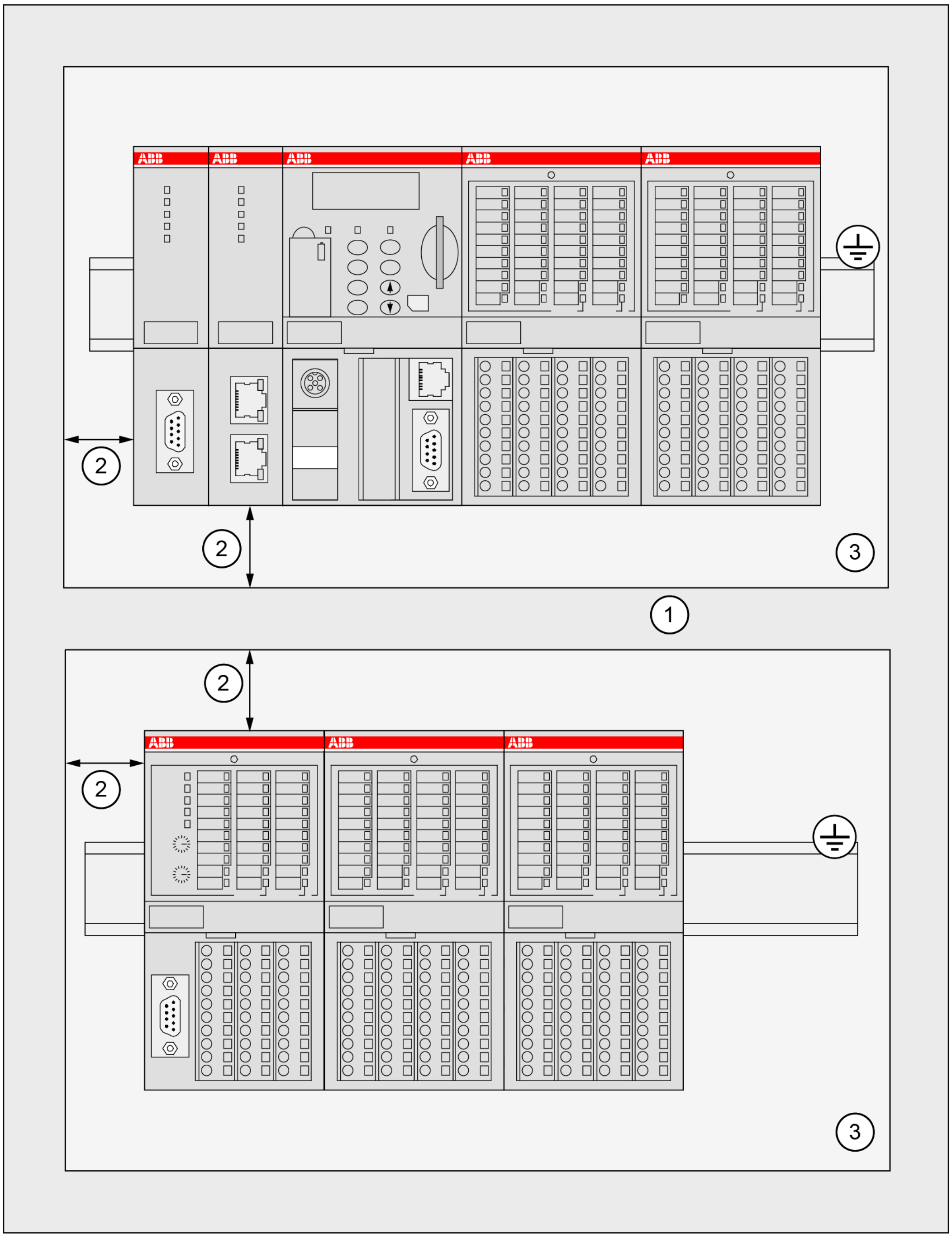


Fig. 213: Installation of AC500/S500 modules in a switch-gear cabinet

1 Cable duct
2 Distance from cable duct ≥20 mm
3 Mounting plate, earthed

> **NOTICE!**
>
> Horizontal mounting is highly recommended.
>
> Vertical mounting is possible, however, derating consideration should be made to avoid problems with poor air circulation and overheating (see *Chapter 2.6.1.1 “Environmental Conditions” on page 1252*).

By vertical mounting, always place an end-stop terminal block (e.g. type BADL, P/N: 1SNA399903R0200) on the bottom and on the top of the modules to properly secure the modules.

By high vibration applications and horizontal mounting, we also recommend to place end-stop terminals at the right and left side of the device to properly secure the modules, e.g. type BADL, P/N: 1SNA399903R0200.

2.6.2.2 Mechanical Dimensions AC500

Dimensions:
Terminal Bases

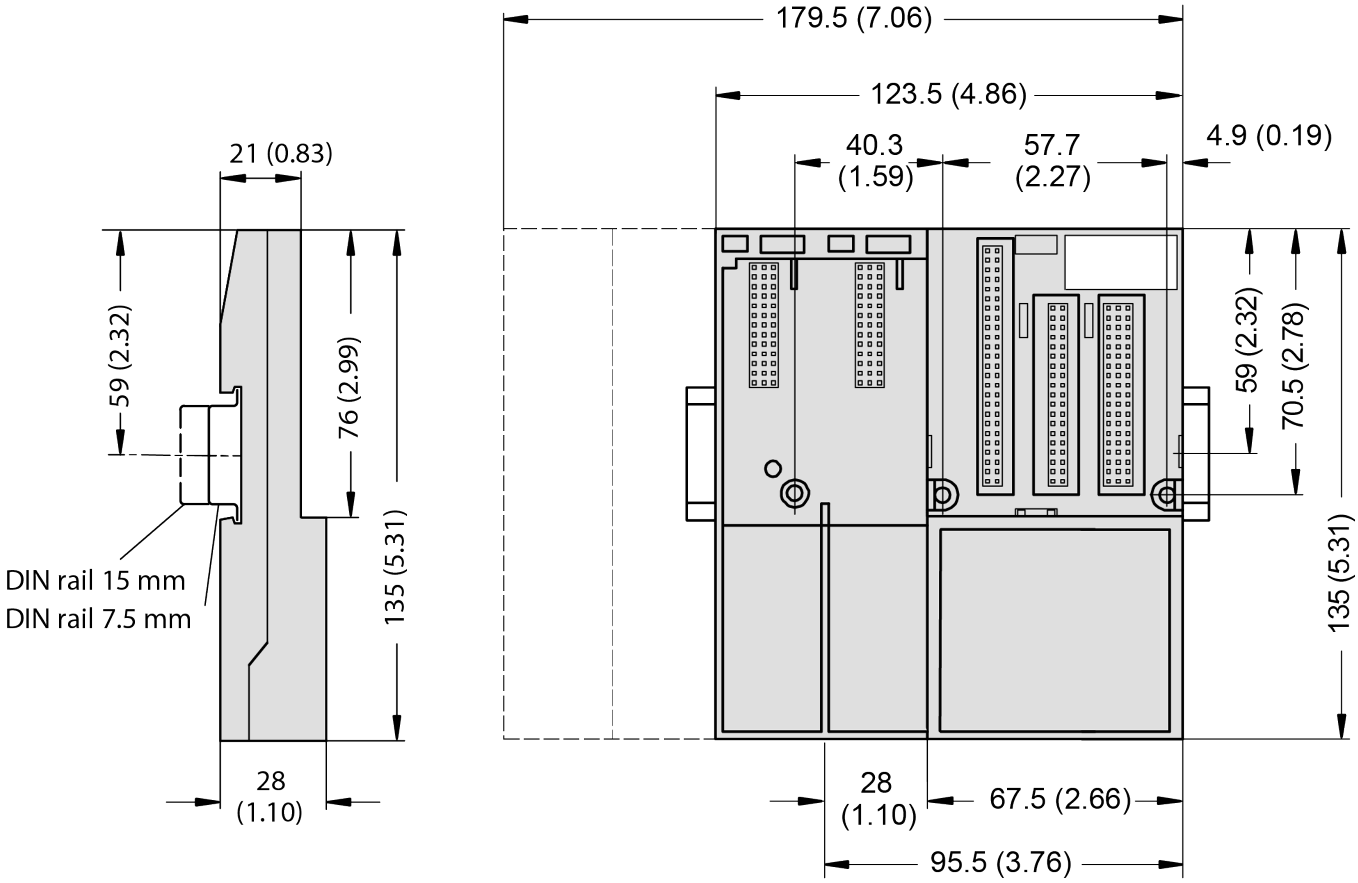


Fig. 214: Terminal Bases, side view and front view

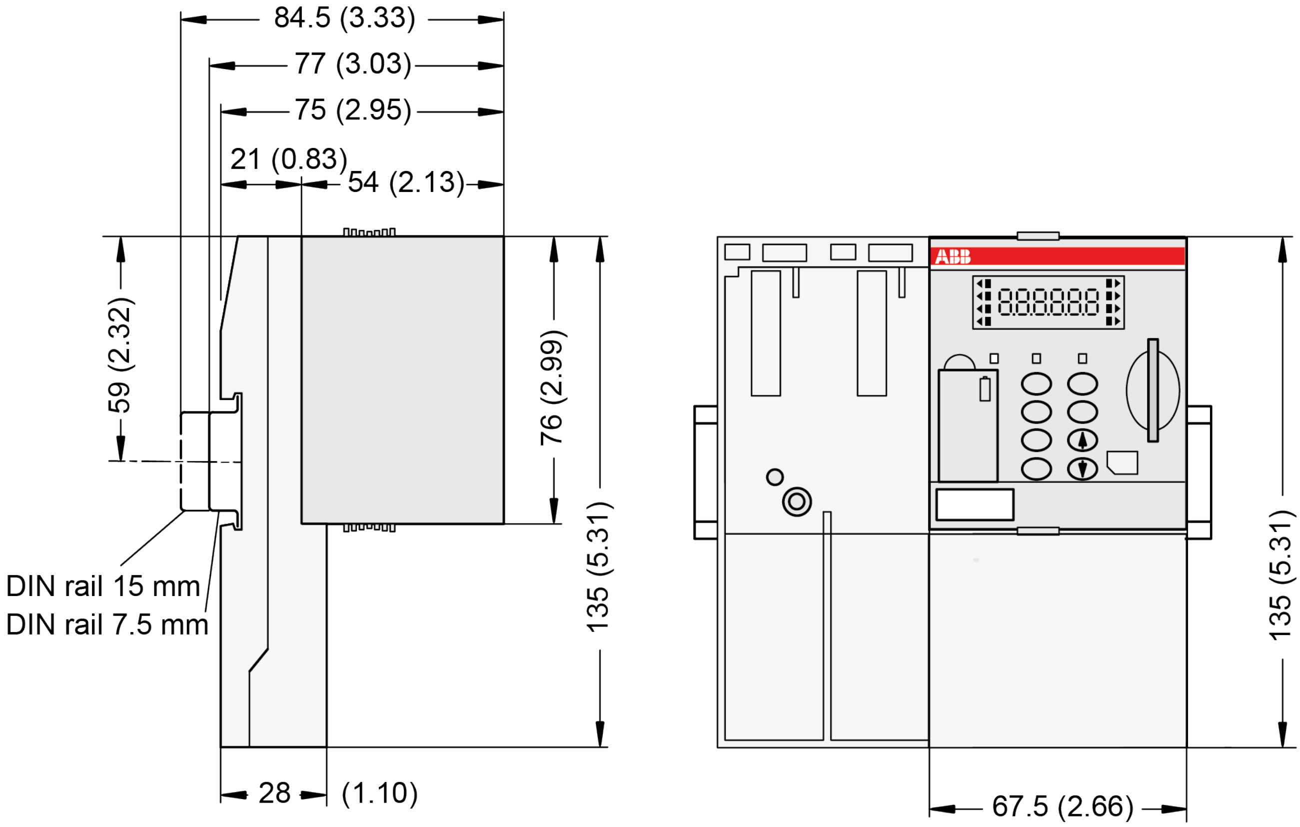


Fig. 215: Terminal Bases with Processor Modules, side view and front view

Dimensions: Function Module Terminal Bases

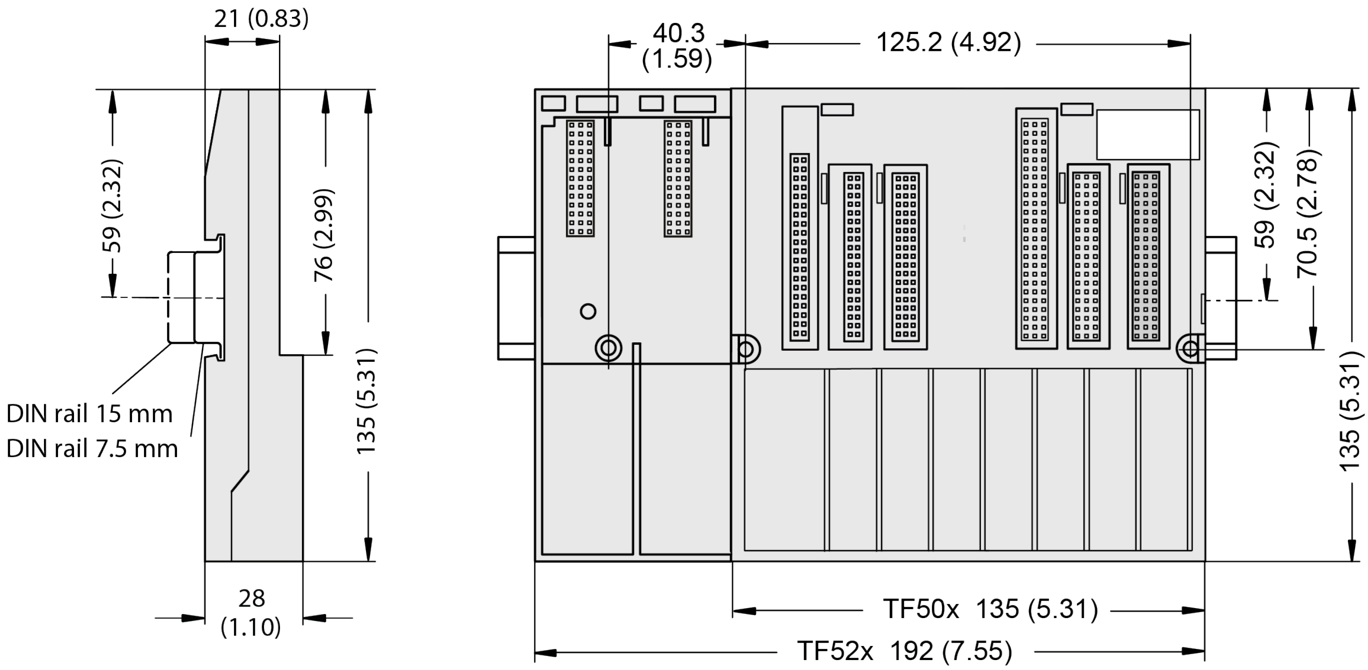


Fig. 216: Function Module Terminal Bases, side view and front view

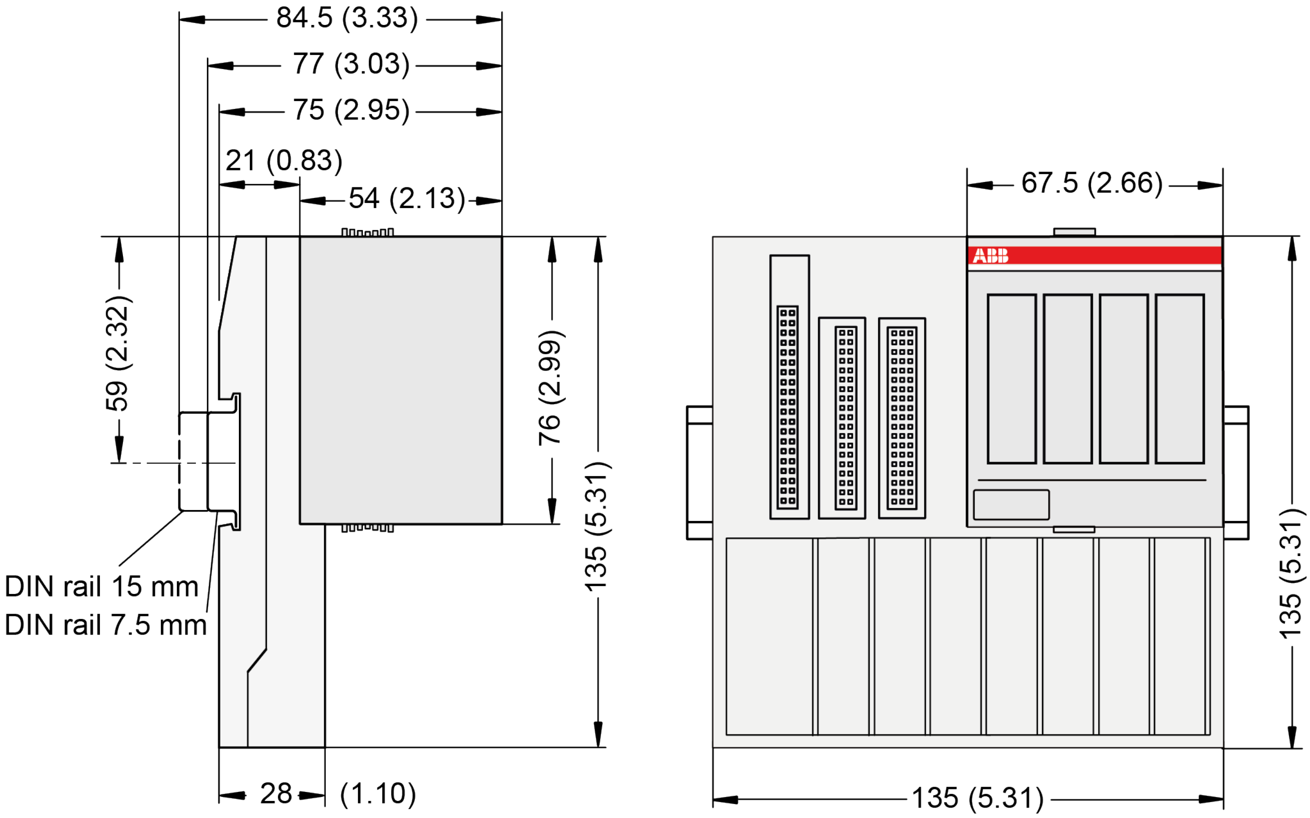


Fig. 217: Function Module Terminal Bases with Function Modules for CMS, side view and front view

Dimensions:
PM595

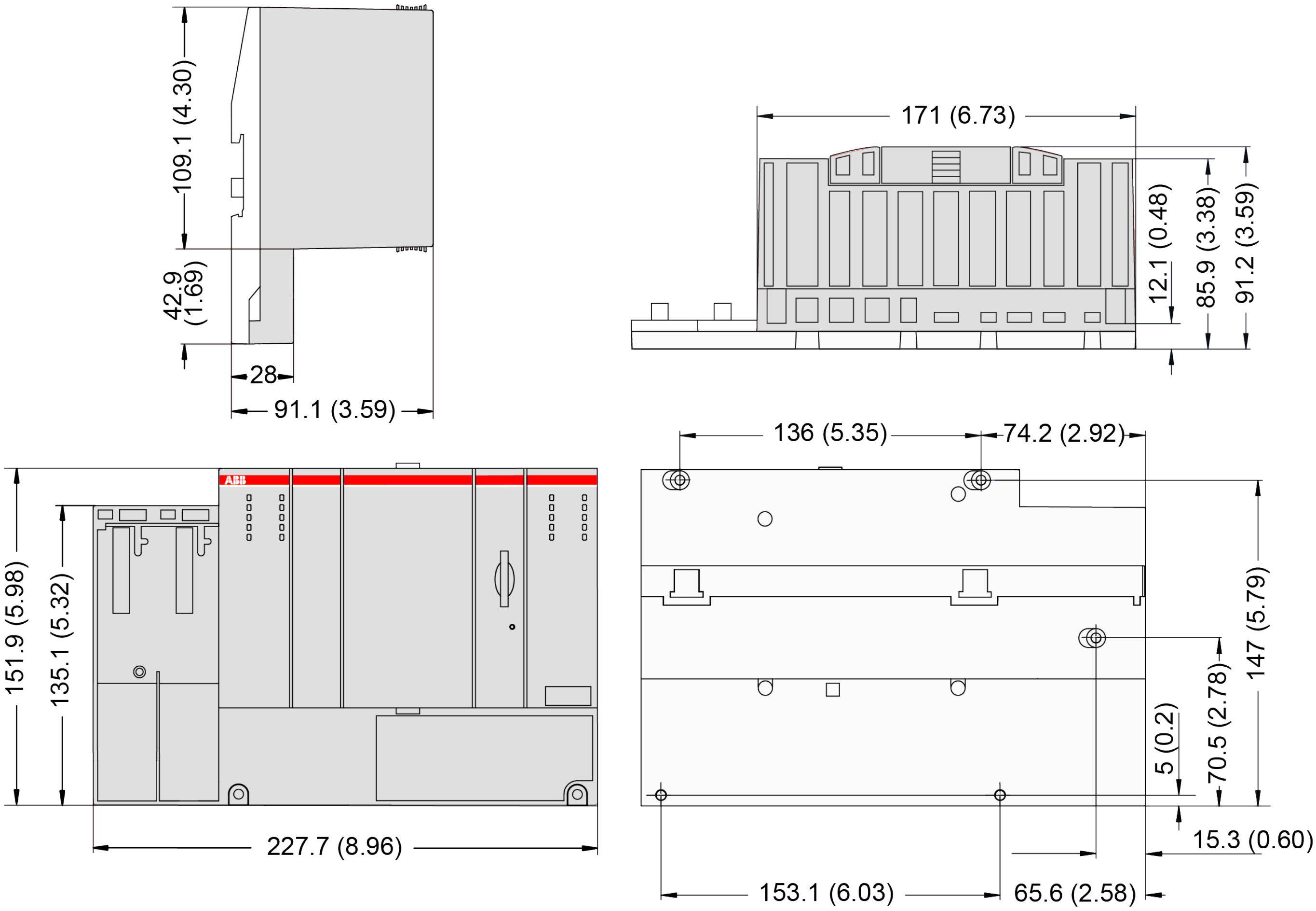


Fig. 218: Processor Module PM595, side view, top view, front view, back view

2.6.2.3 Mechanical Dimensions S500

Dimensions:
Terminal Units

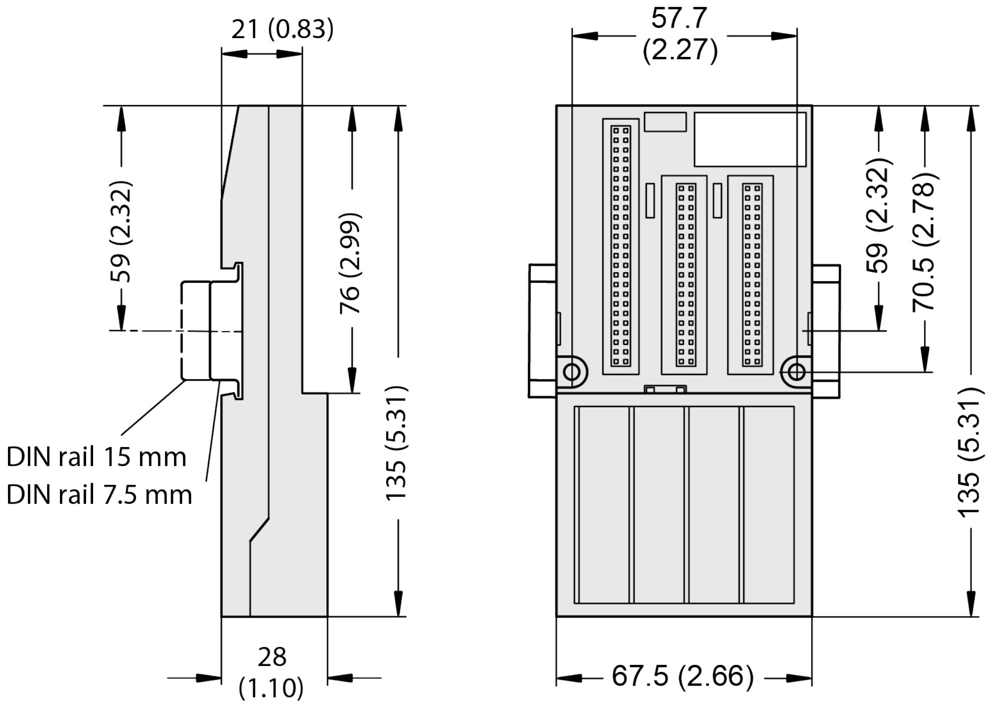


Fig. 219: Terminal Units, side view and front view

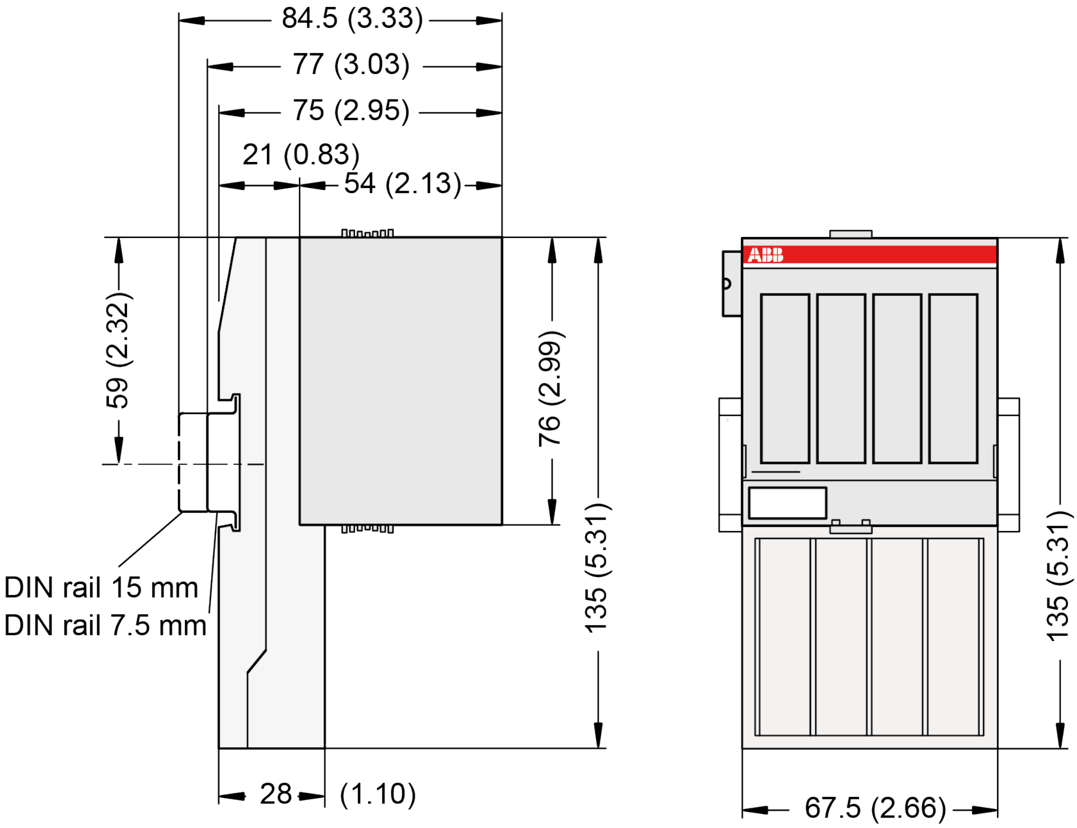


Fig. 220: Terminal Units and S500 modules, side view and front view

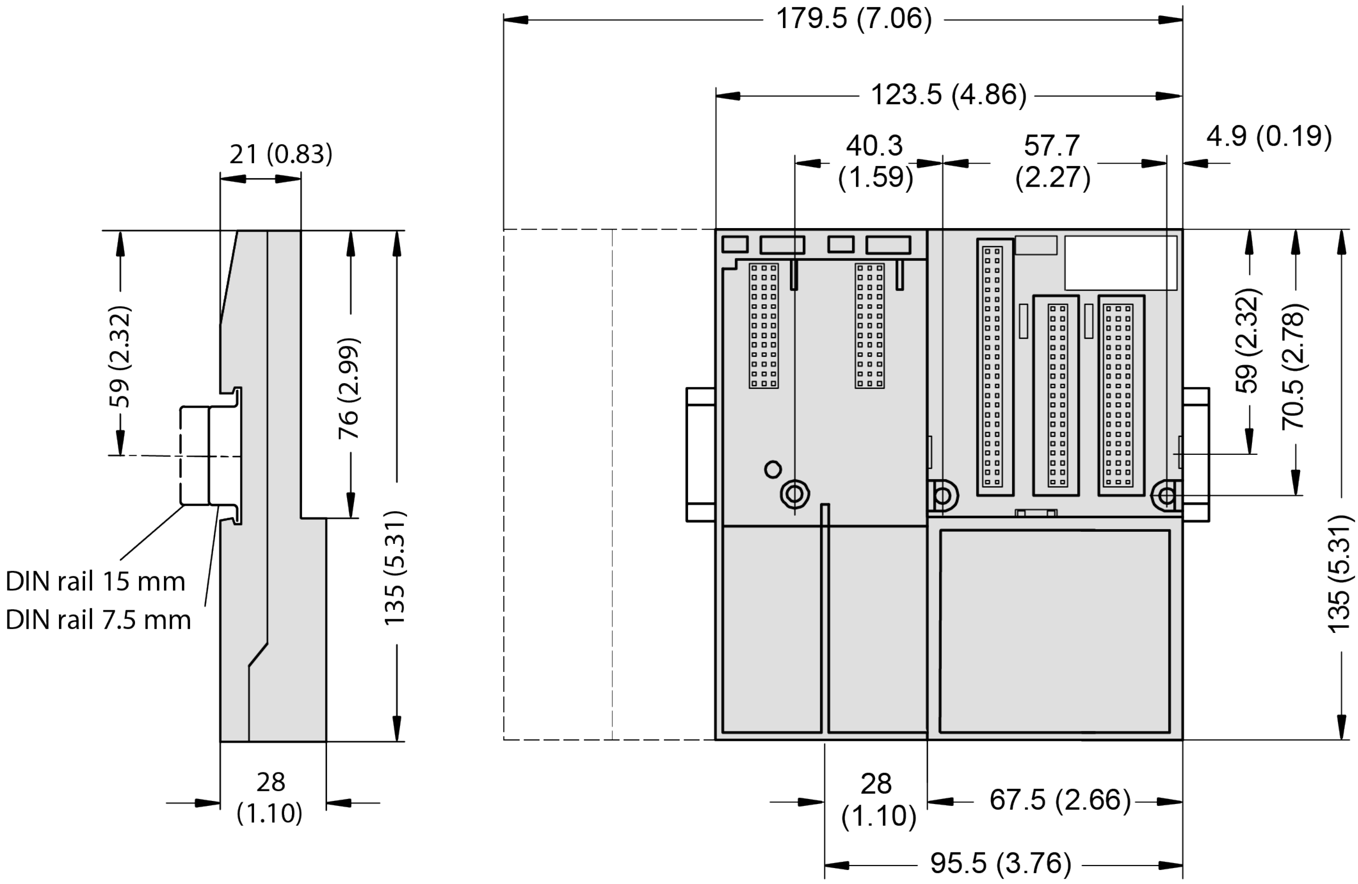


Fig. 221: Terminal Base (for comparison)

> *All dimensions are in mm (in.). Hole spacing tolerance: ±0.4 mm (0.016 in.)*

Dimensions:
FM502-CMS

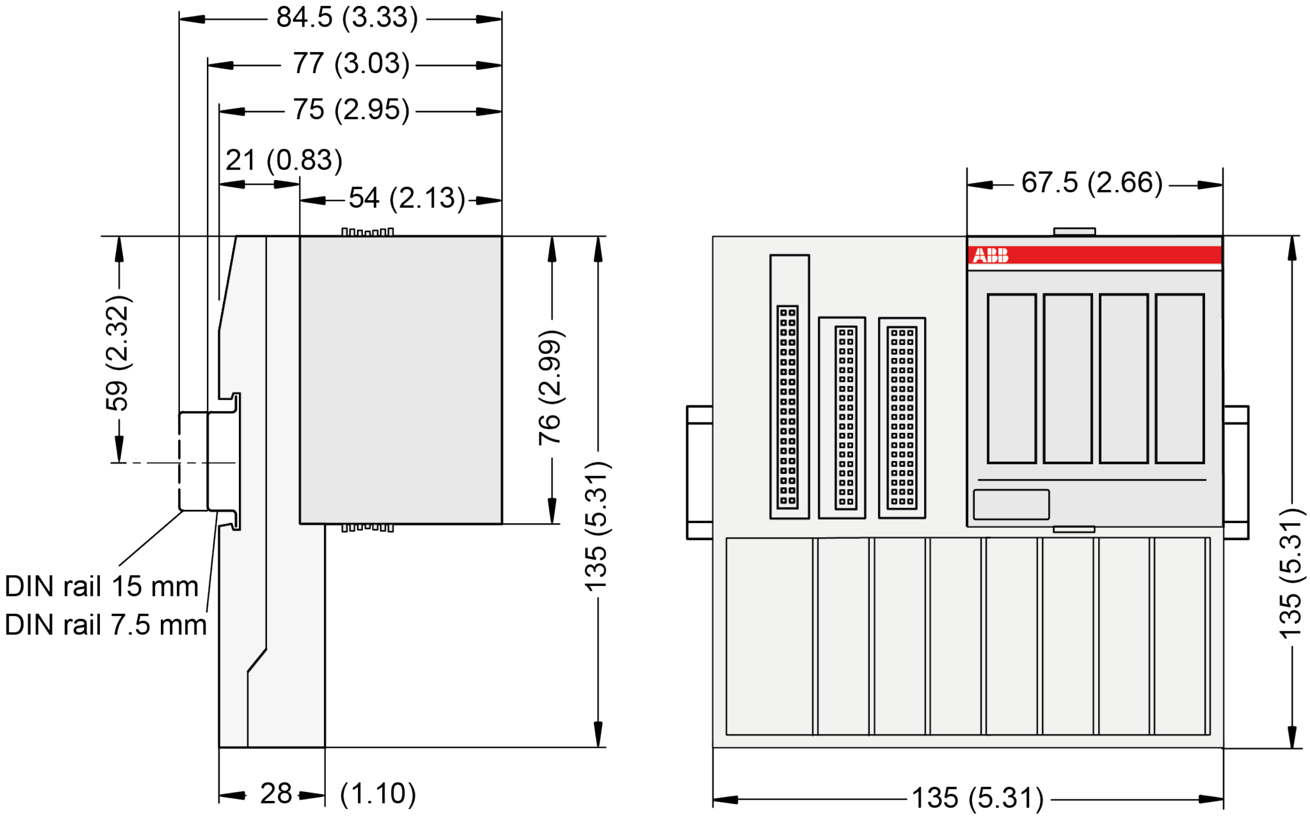


Fig. 222: Function Module Terminal Bases and Function Modules for CMS, side view and front view

2.6.3 Mounting and Demounting

The control system is designed to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded.

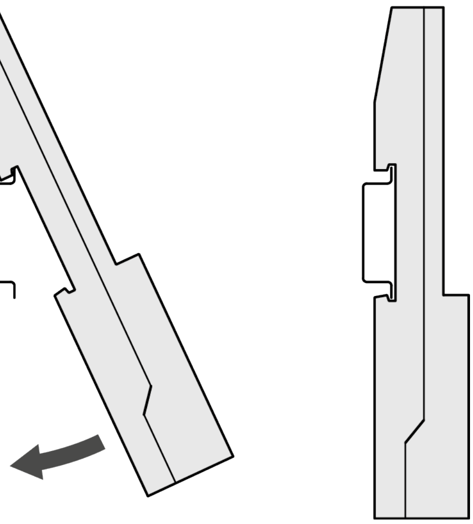
During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.

All devices are grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate stell DIN rail to assure proper grounding. The use of other DIN rail materials (e.g. aluminium, plastic, etc.) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

2.6.3.1 Mounting/Demounting Terminal Bases and Function Module Terminal Bases

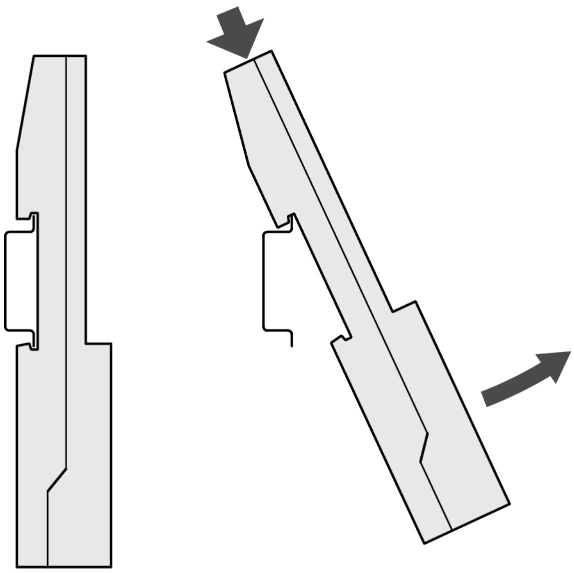
Demounting on DIN rail

1. Mount DIN rail 7.5 mm or 15 mm.
2. Mount the Terminal Base/Function Module Terminal Base:



⇨ The Terminal Base is put on the DIN rail above and then snapped-in below.

3. The demounting is carried out in a reversed order.



Mounting with Screws

If the Terminal Base should be mounted with screws, Wall Mounting Accessories TA526 ↬ *Chapter 2.6.5.7 “TA526 - Wall Mounting Accessory” on page 1312* must be inserted at the rear side first. These plastic parts prevent bending of the Terminal Base while screwing on. TB51x needs one TA526, TB52x and TB54x need two TA526.

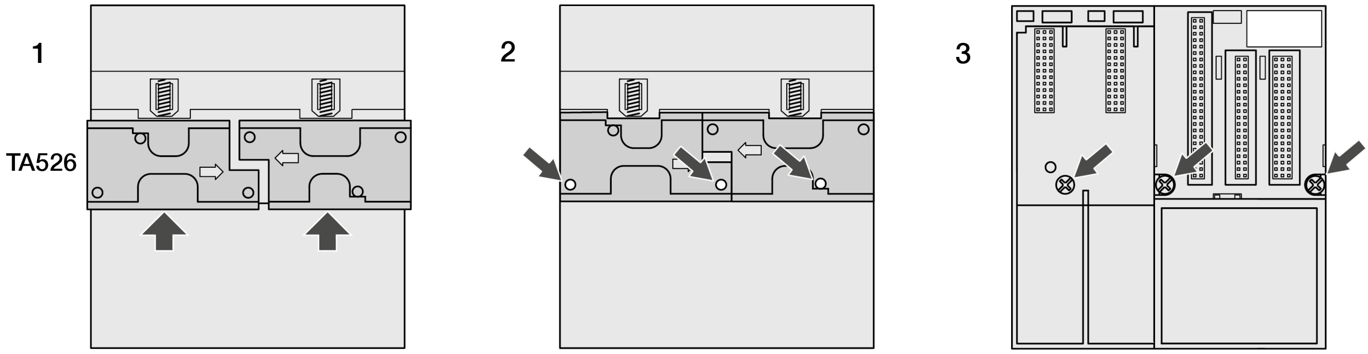


Fig. 223: Terminal Bases, Fastening with screws

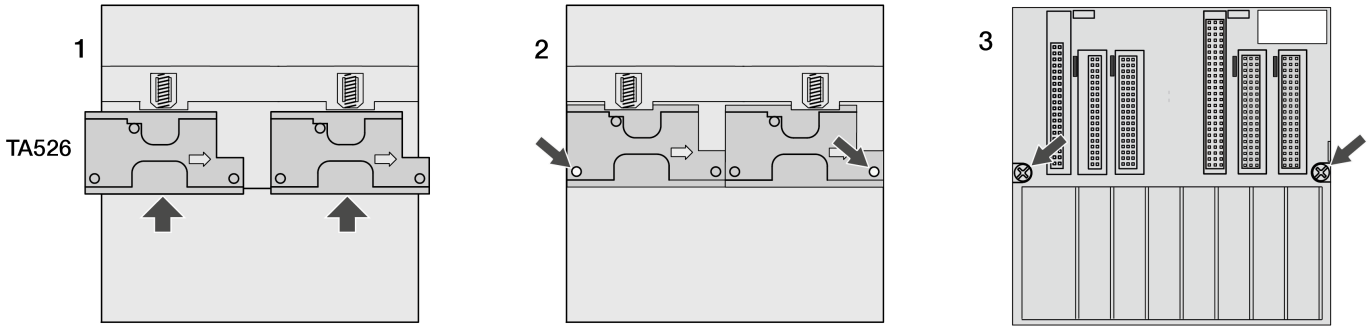


Fig. 224: Function Module Terminal Bases, Fastening with screws

By wall mounting, the Terminal Base is earthed through the screws. It is necessary that

- *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
- *the mounting plate is earthed*
- *the screws have a good electrical contact to the mounting plate*

Practical Tip

The following procedure allows you to use the mounted modules as a template for drilling holes in the panel. Due to module mounting hole tolerance, it is important to follow these procedures:

1. On a clean work surface, mount no more than 3 modules (e.g. one Terminal Base and two Terminal Units).
2. Using the mounted modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the mounted modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the screws (M4 or #8 recommended).
5. Place the modules back on the panel and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.

7. Repeat the steps for all remaining modules.

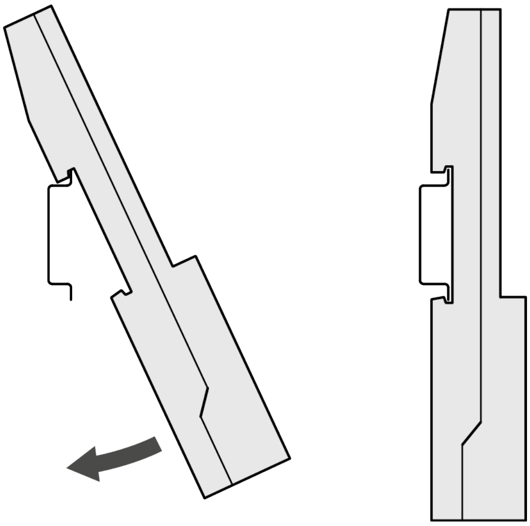
2.6.3.2 Mounting and Demounting the Terminal Unit

Mounting on DIN rail

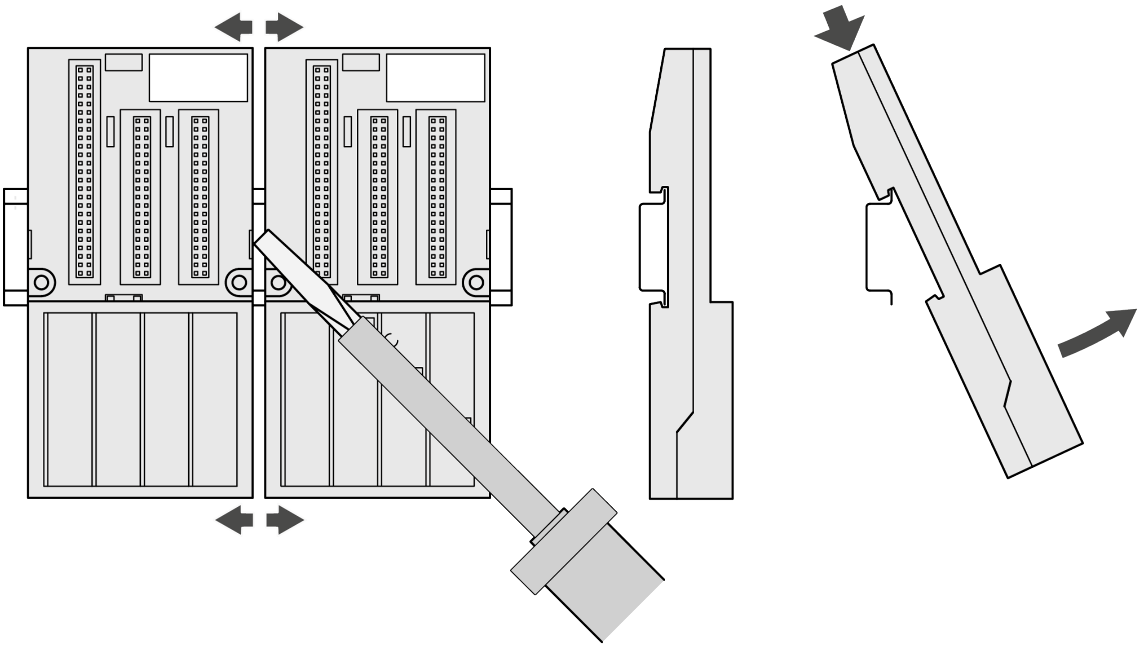
1. Mount DIN rail 7.5 mm or 15 mm.
2. Mount the Terminal Unit.

   The Terminal Unit is snapped into the DIN rail in the same way as the Terminal Base. Once secured to the DIN rail, slide the Terminal Unit to the left until it fully locks into place creating a solid mechanical and electrical connection.

   > *When attaching the devices, make sure the bus connectors are securely locked together to ensure proper electrical connection. Max. 10 Terminal Units can be attached.*



3. Demounting: A screwdriver is inserted in the indicated place to separate the Terminal Units.



Mounting with Screws

If the Terminal Unit should be mounted with screws, Wall Mounting Accessories TA526 🗲 *Chapter 2.6.5.7 “TA526 - Wall Mounting Accessory” on page 1312* must be inserted at the rear side first. These plastic parts prevent bending of the Terminal Base while screwing on.

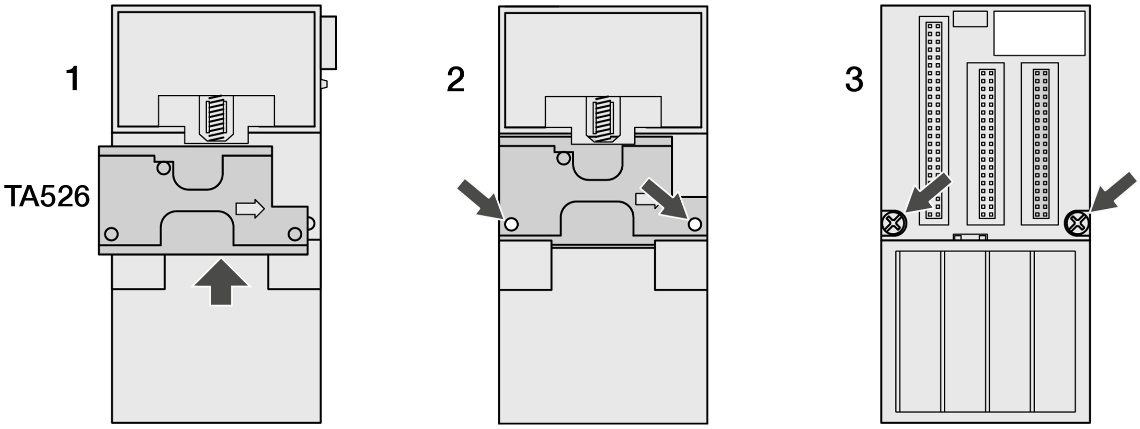


Fig. 225: Fastening with screws

> *By wall mounting, the Terminal Unit is earthed through the screws. It is necessary that*
>
> – *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
> – *the mounting plate is earthed*
> – *the screws have a good electrical contact to the mounting plate*

Practical Tip

The following procedure allows you to use the mounted modules as a template for drilling holes in the panel. Due to module mounting hole tolerance, it is important to follow these procedures:

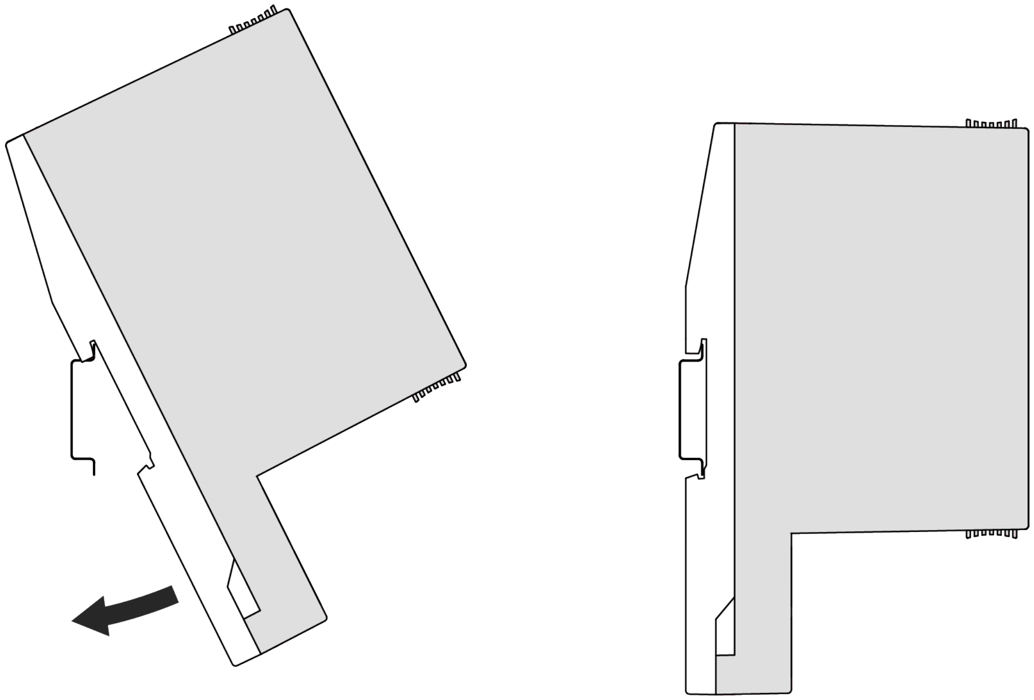
1. On a clean work surface, mount no more than 3 modules (e.g. one Terminal Base and two Terminal Units).
2. Using the mounted modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the mounted modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the screws (M4 or #8 recommended).
5. Place the modules back on the panel and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

> *If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.*

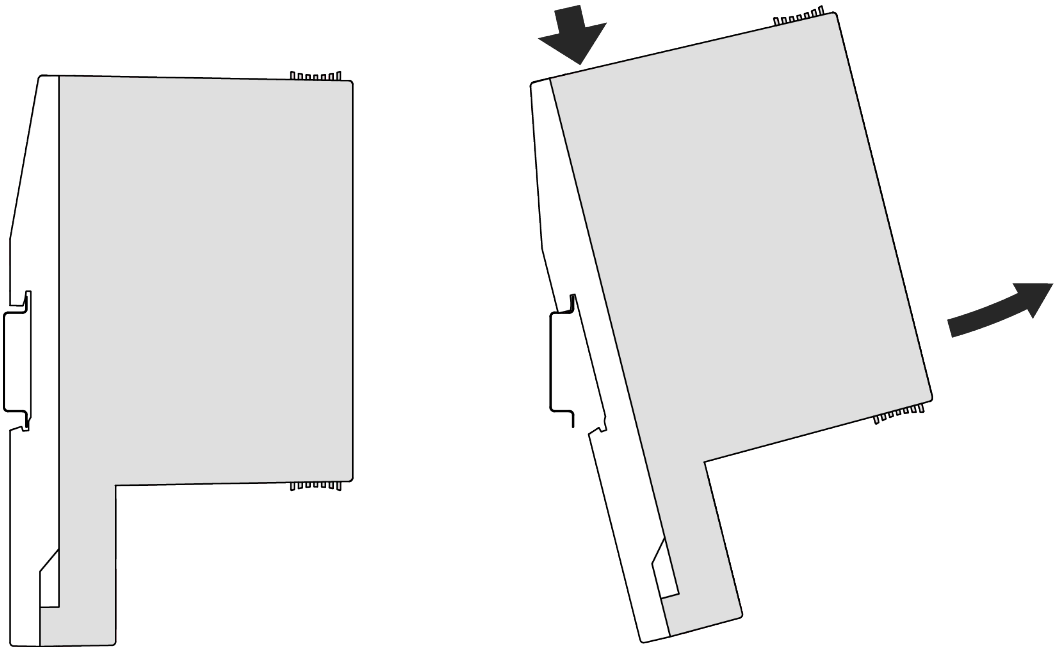
7. Repeat the steps for all remaining modules.

2.6.3.3 Mounting and Demounting the Processor Module PM595

Mounting on DIN rail



▷ Put the Processor Module on the DIN rail above and then snapped-in below. The demounting is carried out in a reversed order.



1. Pull Down the Processor Module.
2. Remove it.

NOTICE!

Risk of malfunctions!

Unused slots for communication modules are not protected against accidental physical contact.

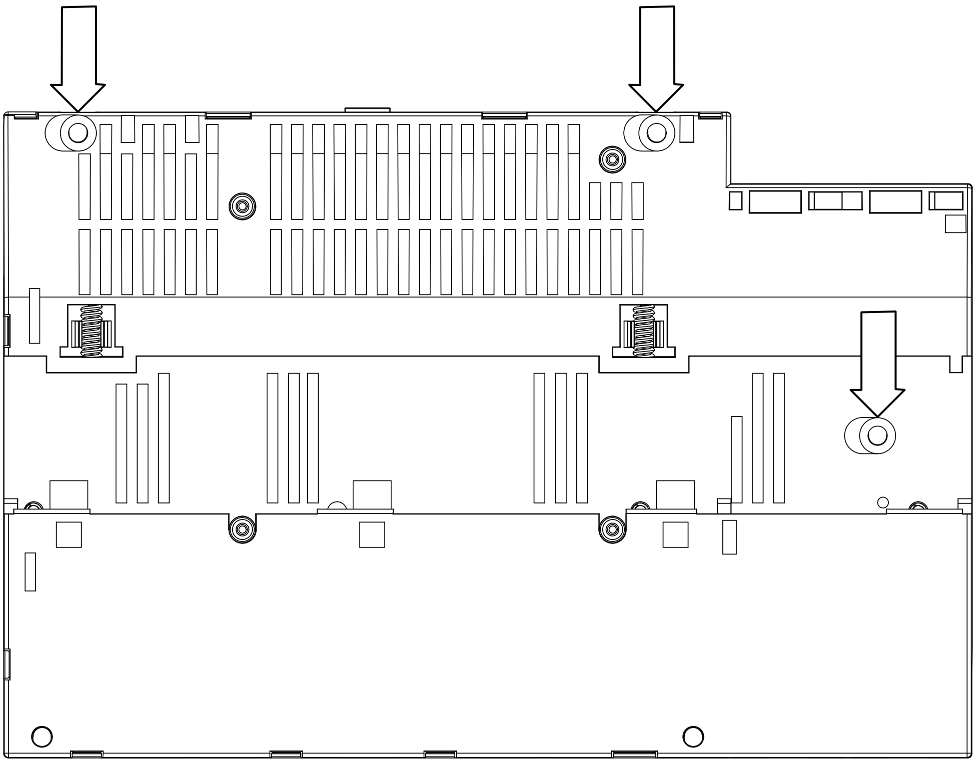
– Unused slots for communication modules must be covered with dummy communication modules (TA524 ␖ *Chapter 2.6.5.4 “TA524 - Dummy Communication Module” on page 1308* to achieve IP20 rating.
– I/O bus connectors must not be touched during operation.

NOTICE!

Only use TA543 accessory when the PLC is to be screw mounted. With DIN rail mounting the PLC could not be removed from the rail without the risk of damaging the housing.

Mounting with Screws

If the Processor Module should be mounted with screws, Screw Mounting Accessories TA543 ␖ *Chapter 2.6.5.8 “TA543 - Screw Mounting Accessory” on page 1313* must be inserted at the rear side first. These plastic parts prevent bending of the Processor Module while screwing on. 3x TA543 Screw Mounting Accessories are needed per PM595. A dimension drawing for the position of screw's holes can be found in Mechanical Dimensions AC500 ␖ *Chapter 2.6.2.2 “Mechanical Dimensions AC500” on page 1259*.

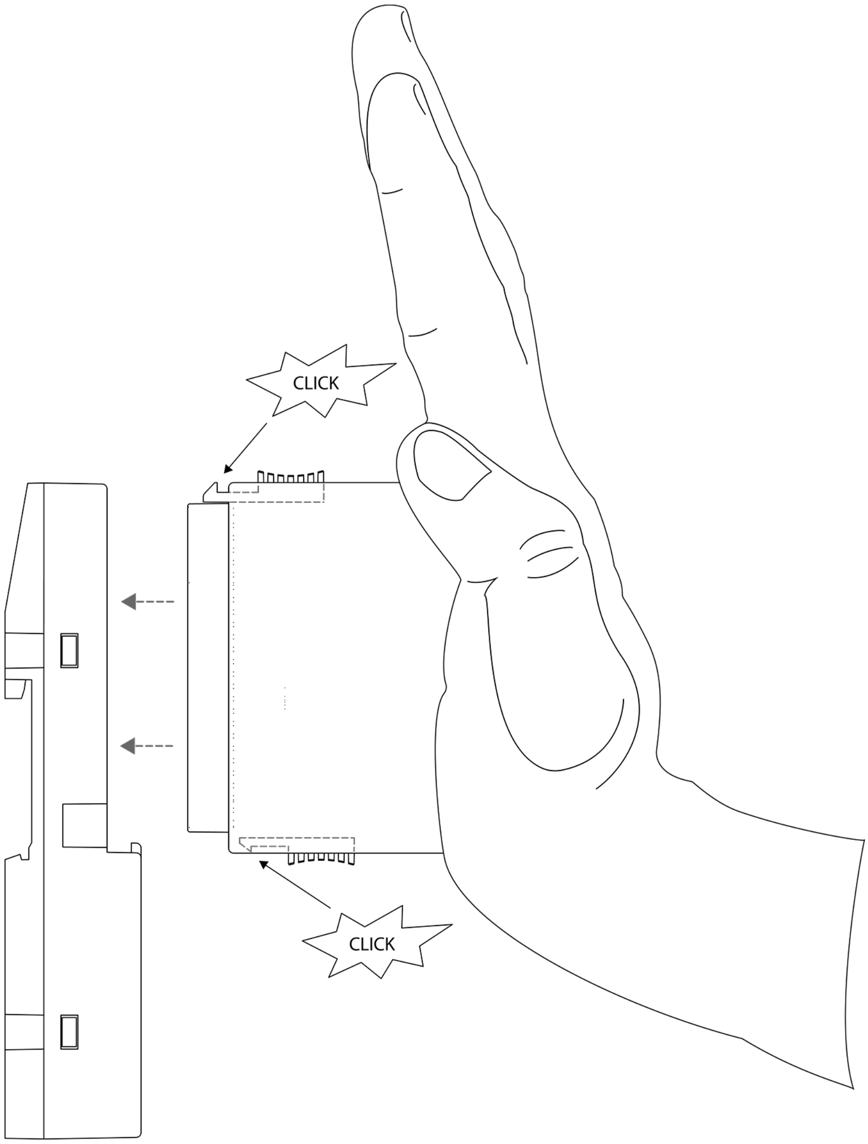


1. Snap 3x TA543 Screw Mounting Accessories to the positions marked in the picture.
2. Fasten the Processor Module with 4 screws (diameter 4 mm max.)

> *By wall mounting, the Processor Module PM595 is earthed through the screws. It is necessary that*
>
> – *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
> – *the mounting plate is earthed*
> – *the screws have a good electrical contact to the mounting plate*

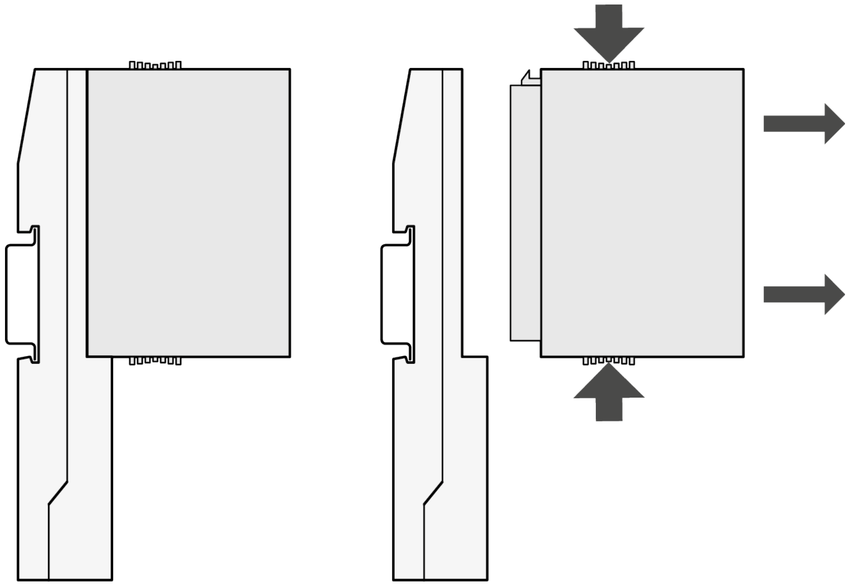
2.6.3.4 Mounting Processor Modules PM57x, PM58x, PM59x and PM56xx

1. After mounting the Terminal Base on the DIN rail, mount the Processor Module.



2. Press the Processor Module into the Terminal Base until it locks in place.

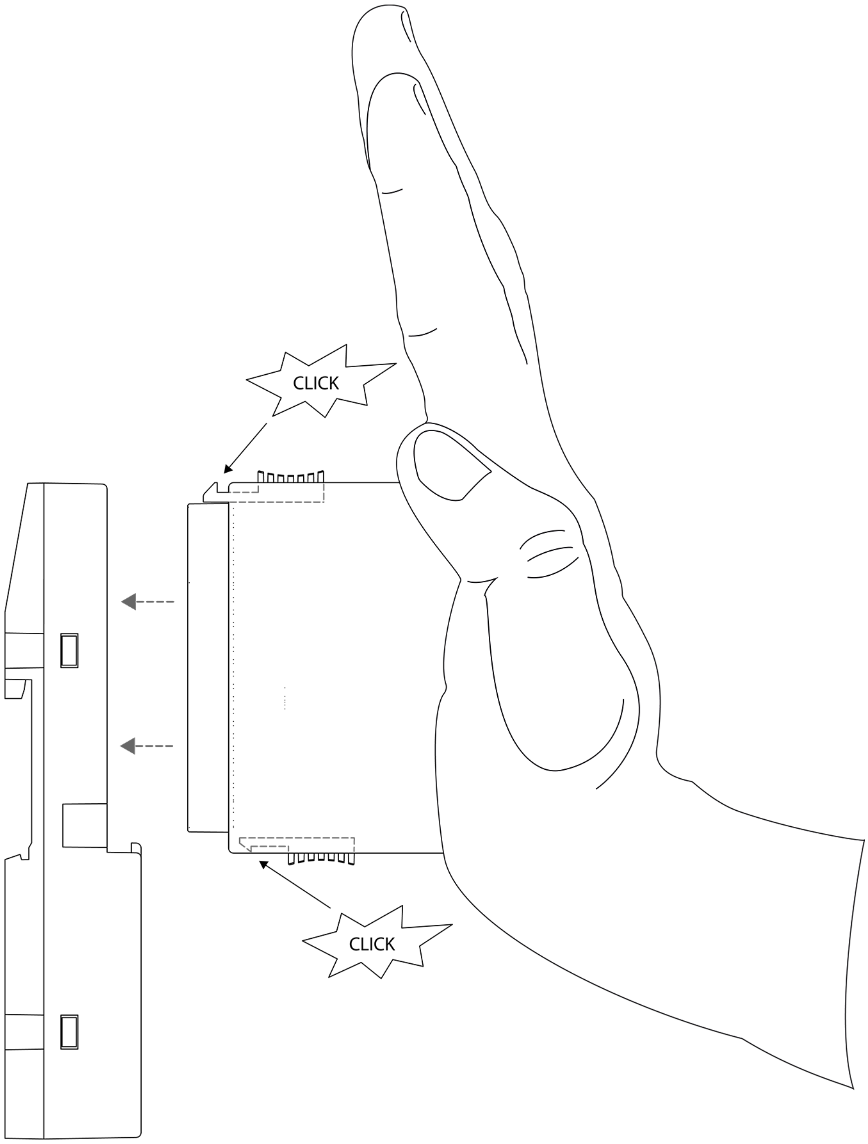
3. The demounting is carried out in a reversed order. Press above and below, then remove the Processor Module.



2.6.3.5 Mounting and Demounting the I/O Modules

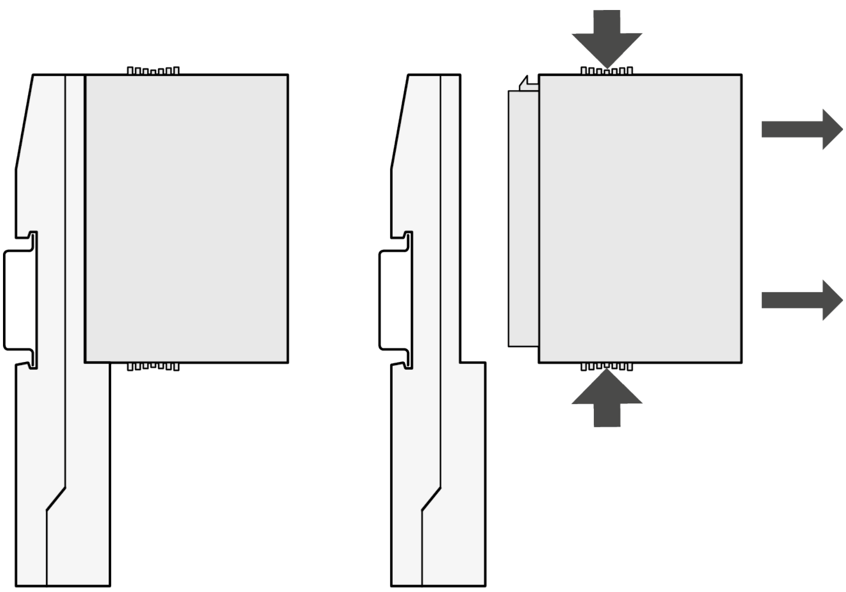
After mounting the Terminal Unit, mount the I/O Modules.

1. Press the I/O Module into the Terminal Unit until it locks in place.



2. The demounting is carried out in a reversed order.

   Press above and below, then remove the module.



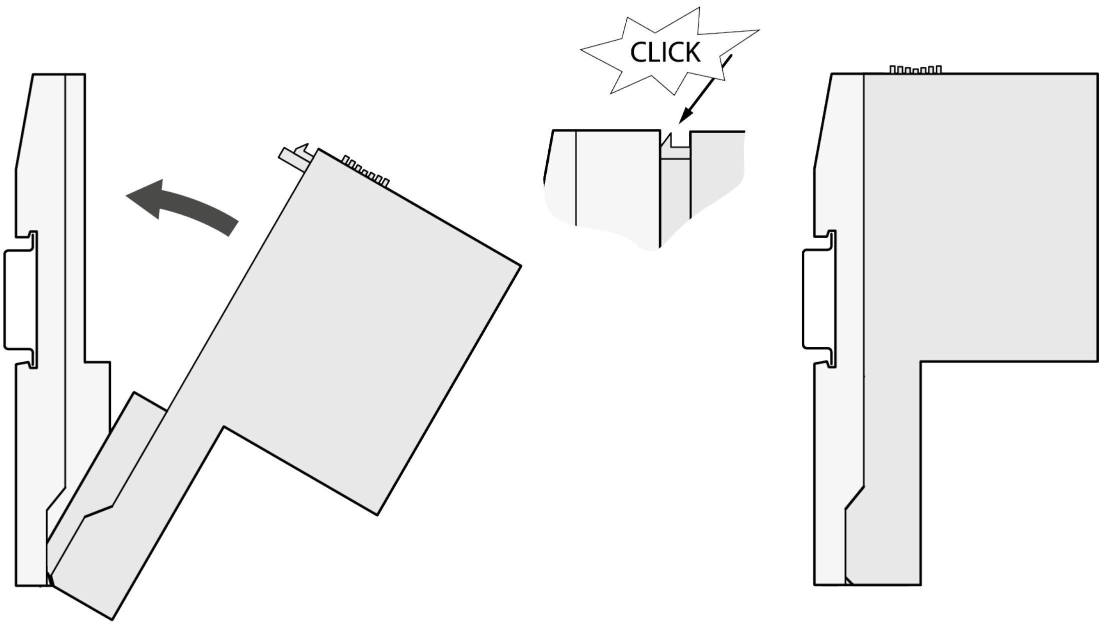
2.6.3.6 Mounting and Demounting the Communication Modules

Communication Modules are mounted on the left side of the Processor Module on the same Terminal Base. The electrical connection is established automatically when mounting the Communication Module.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations at the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

After mounting the Terminal Base, mount the Communication Modules.

1. First insert the bottom nose of the Communication Module into the dedicated holes of the Terminal Base. Then, rotate the Communication Module on the dedicated Terminal Base slot until it is locked in place.

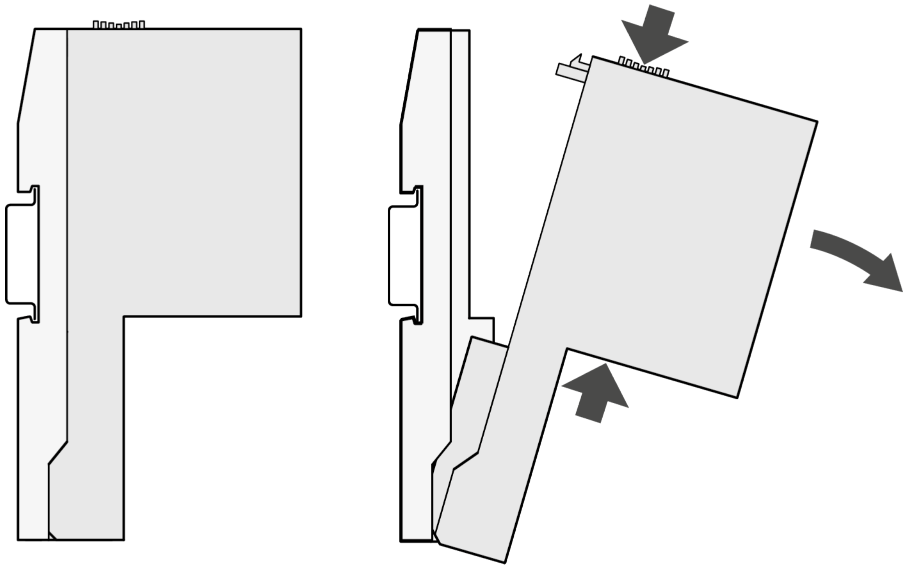


⇨

> **NOTICE!**
> **Risk of malfunctions!**
> Unused slots for communication modules are not protected against accidental physical contact.
> – Unused slots for communication modules must be covered with dummy communication modules (TA524 ↬ *Chapter 2.6.5.4 “TA524 - Dummy Communication Module” on page 1308* to achieve IP20 rating.
> – I/O bus connectors must not be touched during operation.

2. The demounting is carried out in a reversed order.

   Press above and below, then rotate the Communication Module and remove it.



2.6.4 Connection and Wiring

For detailed information such as technical data of your mounted devices (AC500 product family) refer to the hardware device description of the appropriate device.

> **NOTICE!**
> **Attention:**
> The devices should be installed by trained persons with knowledge of wiring electronic devices. In case of bad wiring, the following problems could occur:
>
> – On the Terminal Base, the terminals L+ and M are doubled. If the power supply is badly connected, a short circuit could happen and lead to a destruction of the power supply or its fuse. If no suitable fuse exists, the Terminal Base itself could be destroyed.
> – The Terminal Bases and all electronic modules and Terminal Units are protected against reverse polarity.
> – All necessary measures should be carried out to avoid damages to modules and wiring. Notice the wiring plans and connection examples.

> **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 VDC.

> **NOTICE!**
> **Attention:**
> Due to possible loss of communcation, the communication cables should be fixed with cable duct or bracket or clamp during application.

2.6.4.1 Power Supply

AC500 System Power Supply

As soon as the power supply of the Processor Module (CPU) is higher than the minimum Process and supply voltage (see *Chapter 2.6.1.1 “Environmental Conditions” on page 1252*), the power supply detection is activated and the Processor Module is started. Power supply of Processor Module and I/O modules should be powered on the same time, otherwise the Processor Module will not switch to run after startup.

When during operation the power supply is going down lower than the minimum Process and supply voltage (see *Chapter 2.6.1.1 “Environmental Conditions” on page 1252*) for more than 10 ms, the Processor Module is switched to safety mode (display shows “AC500”). A restart of the Processor Module only occurs by switching the power supply off and on again.

If an I/O module is disconnected during normal operation from power supply while Processor Module is still powered, the Processor Module will continue its normal operation on all other powered peripherals (I/O modules, communication modules and communication interfaces), but freezes the input image. After recovery of I/O Module power supply it will continue normal operation and inputs and outputs were updated.

Logic Controller Supply: AC500 logic controller power supply is provided through terminals L+ / M.

Process Power Supply: S500 process power supply is provided through terminals UP / ZP.

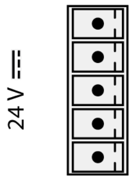
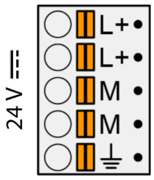
Logic Controller Supply is galvanic isolated from Process Power Supply.

As system power supply for AC500/S500, the ABB CP power supply series can be used.

2.6.4.1.1 Power Supply for Processor Modules

The supply voltage of 24 VDC is connected to a removable 5-pin terminal block. L+/M exist twice. It is therefore possible to feed e.g. external sensors (up to 8 A max. with 1.5 mm^2 conductor) via these terminals.

Pin Assignment

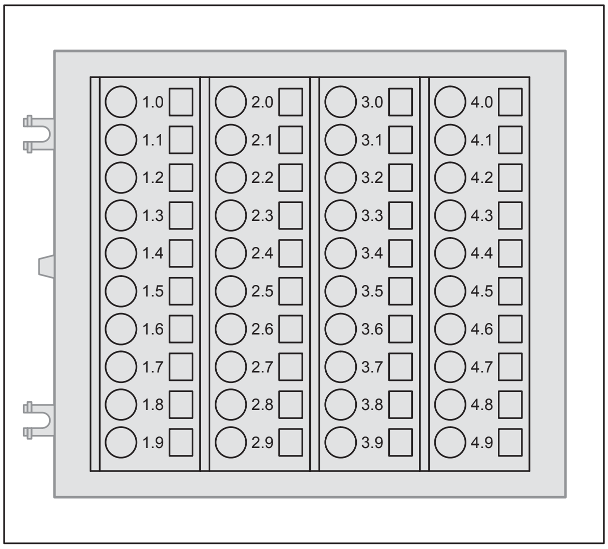
<table>
<tr><th colspan="2">Pin Assignment</th><th>Label</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="5">Terminal block removed</td><td rowspan="5">Terminal block inserted</td><td>L+</td><td>+24 VDC</td><td>Positive pin of the power supply voltage</td></tr>
<tr><td>L+</td><td>+24 VDC</td><td>Positive pin of the power supply voltage</td></tr>
<tr><td>M</td><td>0 V</td><td>Negative pin of the power supply voltage</td></tr>
<tr><td>M</td><td>0 V</td><td>Negative pin of the power supply voltage</td></tr>
<tr><td>⏚</td><td>FE</td><td>Functional earth</td></tr>
</table>

2.6.4.2 Terminals for Power Supply and the COM1 Interface

Terminal type: Spring Terminal

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm^2 to 1.5 mm^2
1	Flexible	0.08 mm^2 to 1.5 mm^2
1 with wire end ferrule (without plastic sleeve)	Flexible	0.25 mm^2 to 1.5 mm^2
1 with wire end ferrule (with plastic sleeve)	Flexible	0.25 mm^2 to 0.5 mm^2
1 (TWIN wire end ferrule)	Flexible	0.5 mm^2

2.6.4.3 Terminals at the Terminal Unit



Terminal type: Screw-type Terminal

Front terminal, conductor connection vertically with respect to the printed circuit board.

Parameter	Value
Type	Front terminal
Degree of protection	IP 20
Stripped conductor end	9 mm, min. 8 mm
Fastening torque	0.6 Nm
Needed tool	Slotted screwdriver
Dimensions	Blade diameter 3.5 mm

Terminal units with product index < C0 e. g. 1SAP 212 200 R0001 B0

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm² to 2.5 mm²
1	Flexible	0.08 mm² to 2.5 mm²
1 with wire end ferrule	Flexible	0.25 mm² to 1.5 mm²
2	Solid	Not intended
2	Flexible	Not intended
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.25 mm² or 2 x 0.5 mm² or 2 x 0.75 mm², with square cross-section of the wire-end ferrule also 2 x 1.0 mm²

Terminal Units with Product Index ≥ C0 , e. g. 1SAP 212 200 R0001 C0

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm² to 2.5 mm²
1	Flexible	0.08 mm² to 2.5 mm²

Number of cores per terminal	Conductor type	Cross section
1 with wire end ferrule without plastic sleeve	Flexible	0.08 mm² to 2.5 mm²
1 with wire end ferrule with plastic sleeve	Flexible	0.14 mm² to 1.5 mm²
2	Solid	0.08 mm² to 1.5 mm²
2	Flexible	0.08 mm² to 1.5 mm²
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.5 mm² to 2 x 1.0 mm²
2 with separate wire end ferrule without plastic sleeve	Flexible	0.08 mm² to 0.75 mm²

Terminal type: Spring Terminal Front terminal, conductor connection vertically with respect to the printed circuit board.

Parameter	Value
Type	Front terminal
Degree of protection	IP 20
Stripped conductor end	9 mm, min. 8 mm
Needed tool	Slotted screwdriver
Dimensions	2.5 x 0.4 to 3.5 x 0.5 mm, screwdriver must be at least 15 mm free of insulation at the tip

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm² to 2.5 mm²
1	Flexible	0.08 mm² to 2.5 mm²
1 with wire end ferrule	Flexible	0.25 mm² to 1.5 mm²
2	Solid	Not intended
2	Flexible	Not intended
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.25 mm² or 2 x 0.5 mm² or 2 x 0.75 mm², with square cross-section of the wire-end ferrule also 2 x 1.0 mm²

2.6.4.4 Connection of Wires at the Spring Terminals

Connection

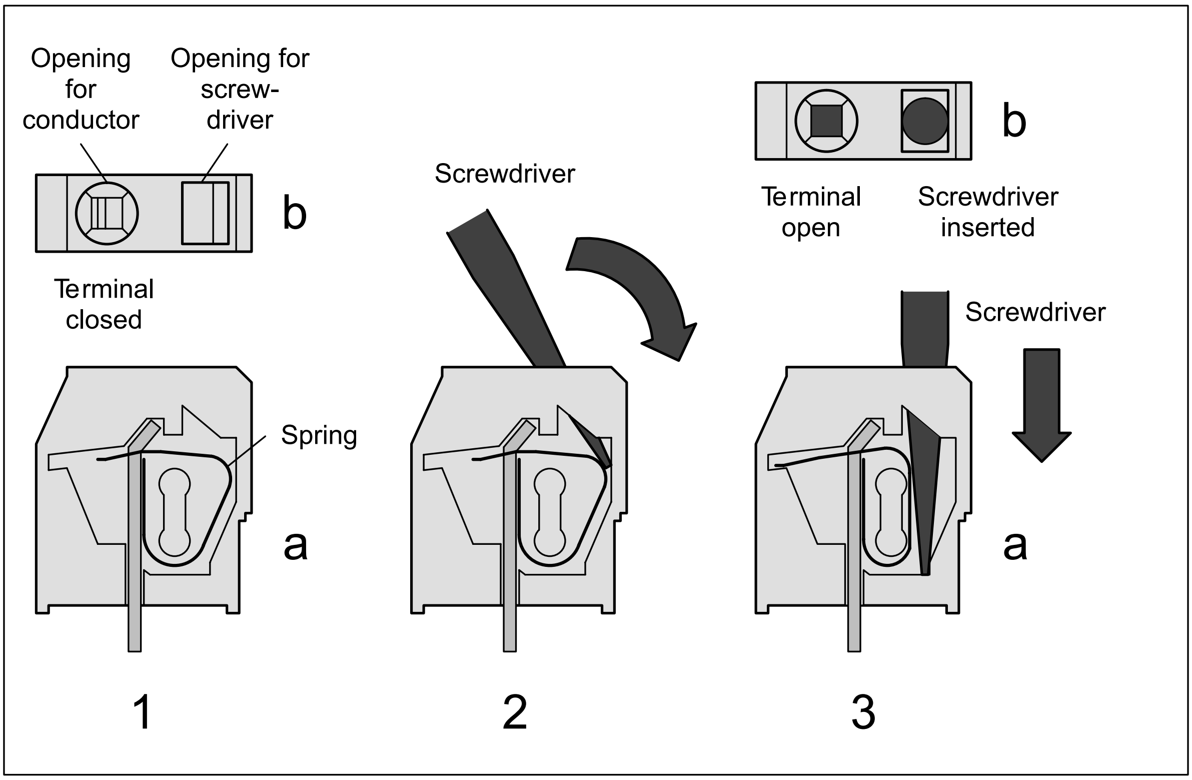


Fig. 226: Connect the wire to the spring terminal (steps 1 to 3)

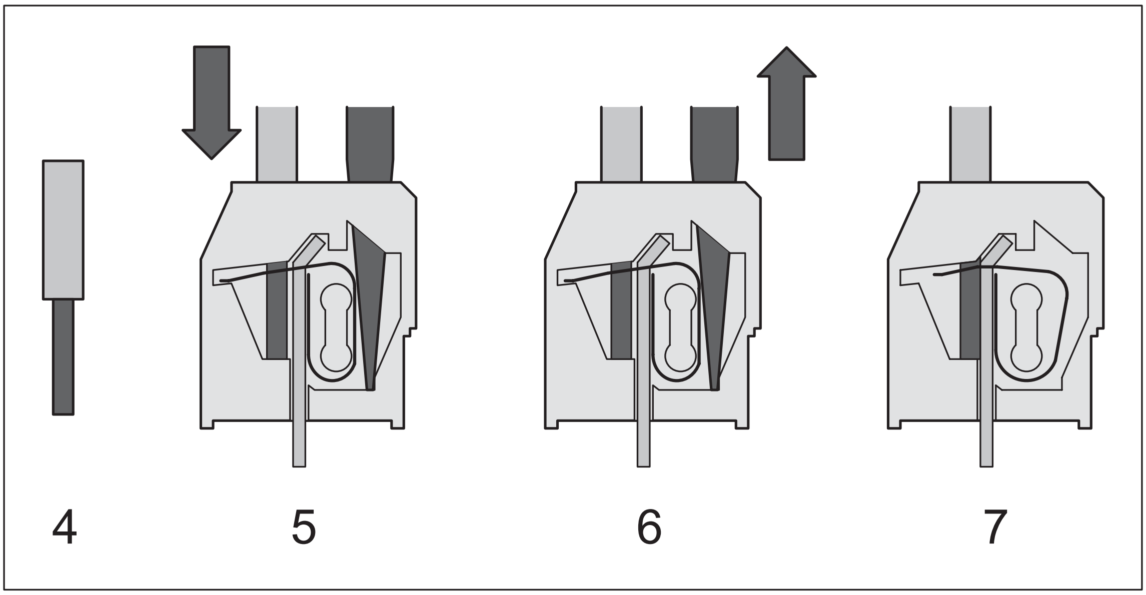


Fig. 227: Connect the wire to the spring terminal (steps 4 to 7)

1. Side view (open terminal drawn for illustration)
2. The top view shows the openings for wire and screwdriver
3. Insert screwdriver (2.5 x 0.4 to 3.5 x 0.5 mm) at an angle, screwdriver must be at least 15 mm free of insulation at the tip
4. While erecting the screwdriver, insert it until the stop (requires a little strength)
5. Screwdriver inserted - terminal open
6. Strip the wire for 7 mm (and put on wire end ferrule)

7. Insert wire into the open terminal
8. Done

Disconnection

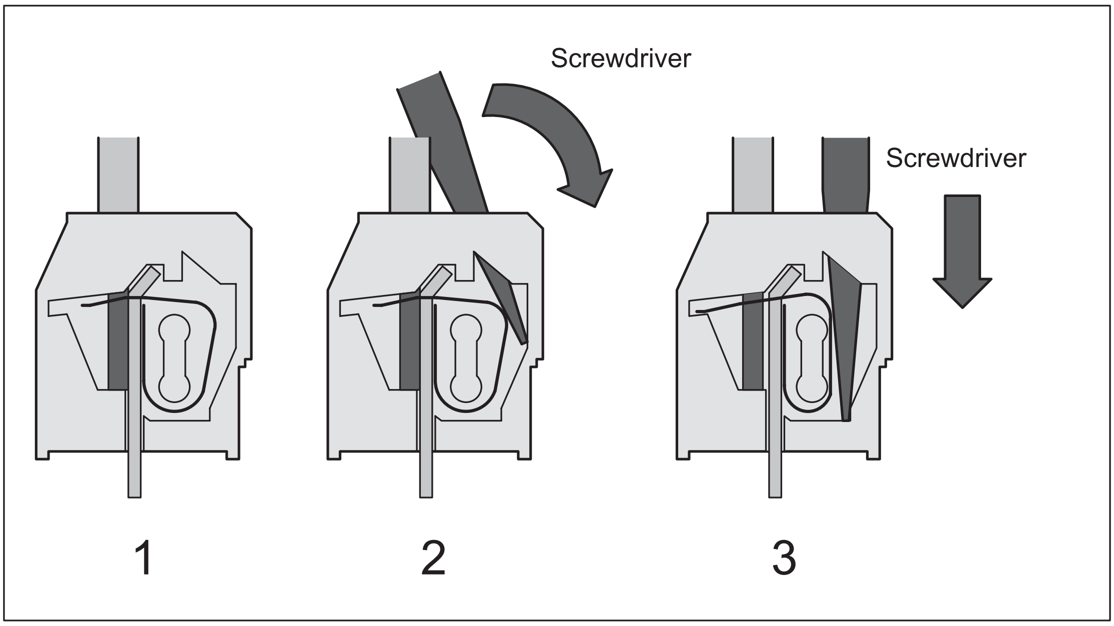


Fig. 228: Disconnect wire from the spring terminal (steps 1 to 3)

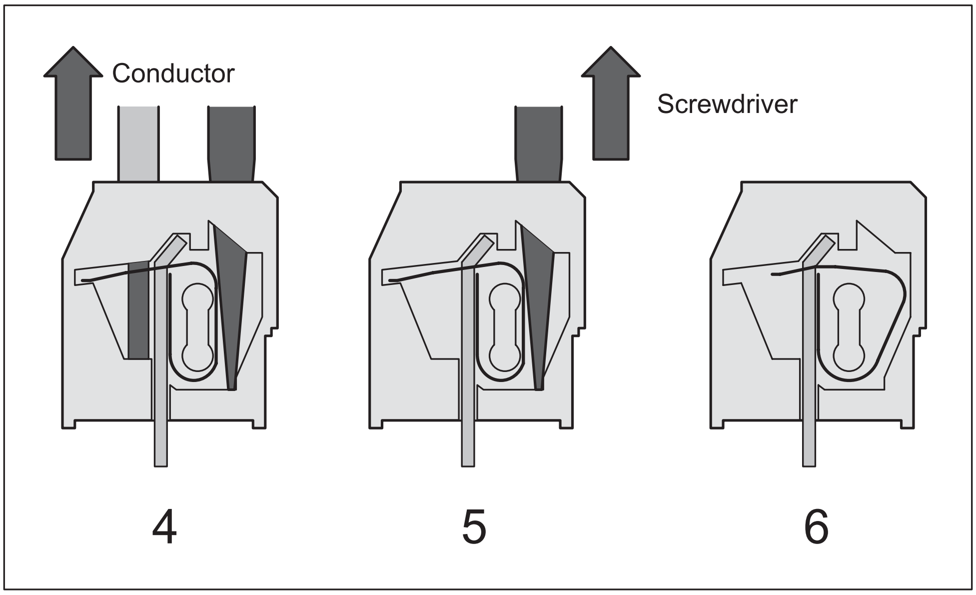


Fig. 229: Disconnect wire from the spring terminal (steps 4 to 6)

1. Terminal with wire connected
2. Insert screwdriver (2.5 x 0.4 to 3.5 x 0.5 mm) at an angle, screwdriver must be at least 15 mm free of insulation at the tip
3. While erecting the screwdriver, insert it until the stop (requires a little strength) - terminal is now open
4. Remove wire from the open terminal
5. Done

2.6.4.5 Terminals for CANopen/DeviceNet Communication Modules

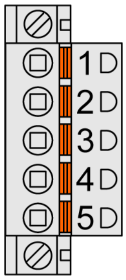


Fig. 230: Combicon, 5-pole, female, removable plug with spring terminals

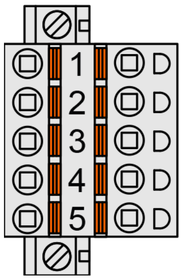


Fig. 231: Combicon, 5-pole, female, removable plug with spring terminals

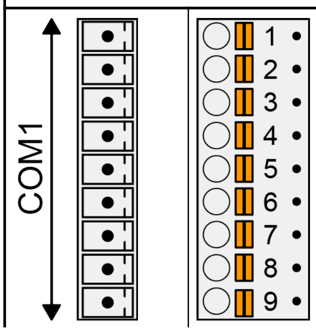
Terminal type: Spring terminal

Number of cores per terminal	Conductor type	Cross section	Stripped conductor end
1	solid	0.2 mm² to 2.5 mm²	10 mm
1	flexible	0.2 mm² to 2.5 mm²	10 mm
1 with wire end fer-rule (without plastic sleeve)	flexible	0.25 mm² to 2.5 mm²	10 mm
1 with wire end fer-rule (with plastic sleeve)	flexible	0.25 mm² to 2.5 mm²	10 mm

2.6.4.6 Serial Interface COM1 of the Terminal Bases

The serial interface COM1 is connected via a removable 9-pin terminal block. It is configurable for RS-232 or RS-485 and can be used for:

- Online access (not valid for PM56xx),
- A free protocol,
- Modbus RTU, client and server,
- CS31 system bus, as master only (not valid for PM56xx) ↳ *Chapter 2.6.4.8 “CS31 System Bus” on page 1286*.



Pin	Signal	Interface	Description
1	Terminator P	RS-485	Terminator P
2	RxD/TxD-P	RS-485	Receive/Transmit, positive
3	RxD/TxD-N	RS-485	Receive/Transmit, negative

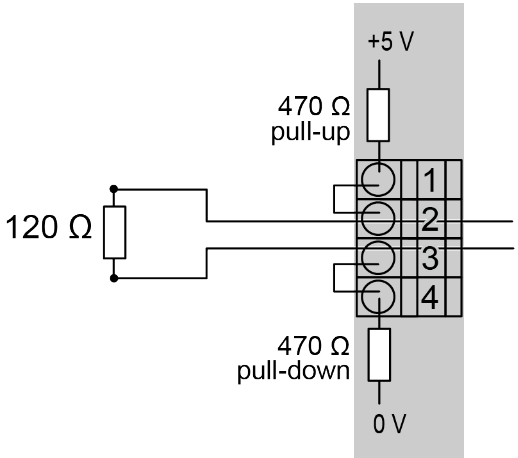
		Pin	Signal	Interface	Description
Terminal block removed	Terminal block inserted	4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

RS-485 bus

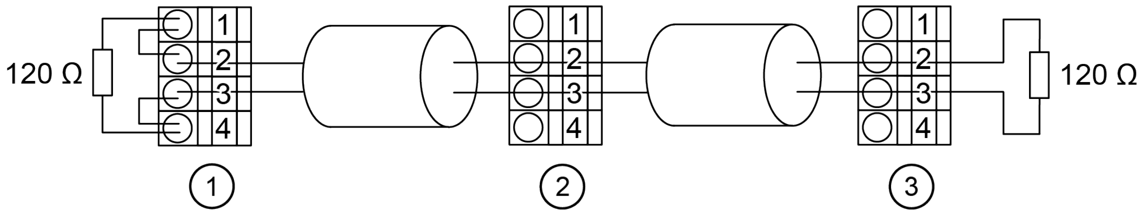
If the RS-485 bus is used, each interconnected bus line (each bus segment) must be electrically terminated. The following is necessary:

- 2 resistors of 120 Ω each at both line ends (to avoid signal reflections)
- Pull-up resistor at RxD/TxD-P and a pull-down resistor at RxD/TxD-N. These 2 resistors care for a defined high level on the bus, while there is no data exchange.

It is useful, to activate both the pull-up and the pull-down resistors, which only are necessary once on every bus line, at the bus master. For this reason, these two resistors are already integrated within the COM1 interface of the AC500 terminal bases. They can be activated by connecting the terminals 1-2 and 3-4 of COM1.

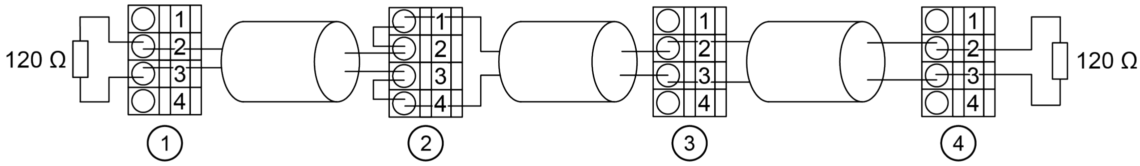


The following drawing shows an RS-485 bus with the bus master at the line end.



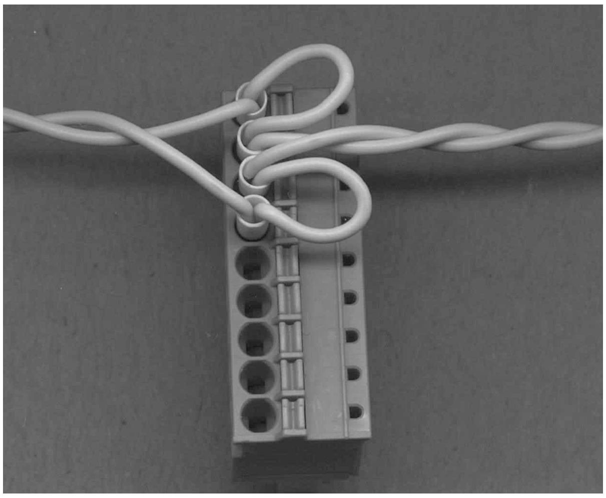
1 Master at the bus line end, pull-up and pull-down activated, bus termination with 120 Ω resistors
2 Slave within the bus line
3 Slave at the bus line end, bus termination with 120 Ω resistors

If the master is located within the bus line, it does not need a terminating resistor. The pull-up and the pull-down resistors, however, must be activated (see the following drawing).



1 Slave at the bus line end, bus termination with 120 Ω resistors
2 Master within the bus line, pull-up and pull-down activated
3 Slave within the bus line
4 Slave at the bus line end, bus termination with 120 Ω resistors

The following photo shows a wiring example "master within the bus line", wired at the COM1 bus connector of the terminal base:



If the bus is operated with several masters, the pull-up and pull-down resistors may only be activated at one master.

The earthing of the cable shields of the bus lines are described in the CS31 system bus (PM57x, PM58x and PM59x) *Chapter 2.6.4.8 "CS31 System Bus" on page 1286*.

2.6.4.7 Serial Interface COM2 of the Terminal Bases

The serial interface COM2 is not available at:

– *Processor modules with type designator -2ETH (e. g. PM591-2ETH)*
– *Processor modules PM56xx*

The serial interface COM2 is connected via a 9-pole D-sub connector. It is not intended to use COM2 to establish a CS31 system bus. It is configurable for RS-232 or RS-485 and can be used for

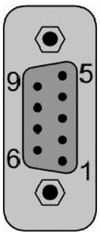
- online access
- a free protocol
- Modbus RTU, master and slave

If the RS-485 bus is used, each interconnected bus line (each bus segment) must be electrically terminated. The following is necessary:

- 2 resistors of 120 Ω each at both line ends (to avoid signal reflections)
- a pull-up resistor at RxD/TxD-P and a pull-down resistor at RxD/TxD-N. These 2 resistors care for a defined high level on the bus, while there is no data exchange.

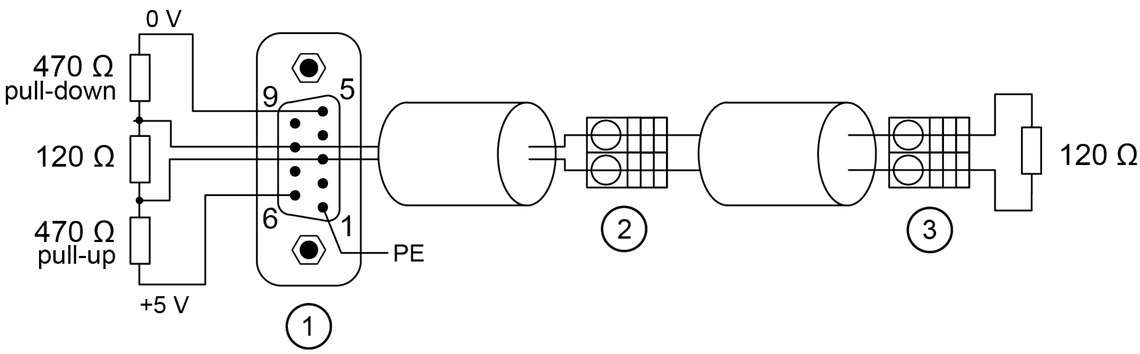
It is useful, to activate both the pull-up and the pull-down resistors, which only are necessary once on every bus line, at the bus master.

Pin Assignment

Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

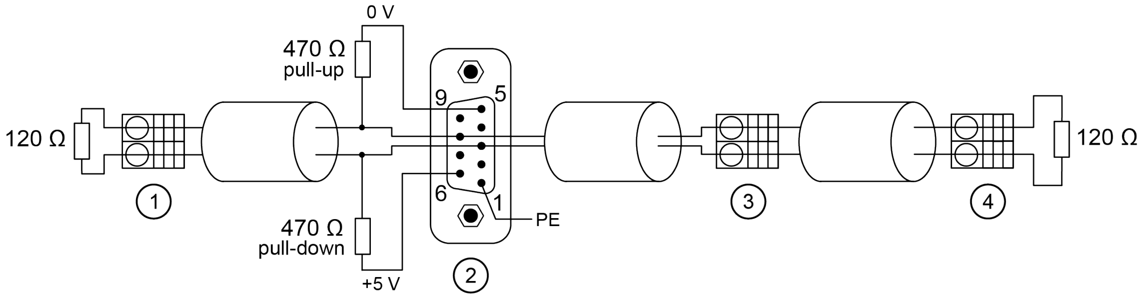
> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *TA535 ↳ Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

The following drawing shows an RS-485 bus with the bus master at the line end.



1 Master at the bus line end, pull-up and pull-down activated, bus termination with 120 Ω resistors
2 Slave within the bus line
3 Slave at the bus line end, bus termination with 120 Ω resistors

If the master is located within the bus line, it does not need a terminating resistor. The pull-up and the pull-down resistors, however, are necessary:



1 Slave at the bus line end, bus termination with 120 Ω resistors
2 Master within the bus line, pull-up and pull-down activated
3 Slave within the bus line
4 Slave at the bus line end, bus termination with 120 Ω resistors

NOTICE!
If the bus is operated with several masters, the pull-up and pull-down resistors may only be installed at one master.

The cable shields must be earthed. See CS31 system bus *Chapter 2.5.4.4 “CS31 bus” on page 1217*.

2.6.4.8 CS31 System Bus

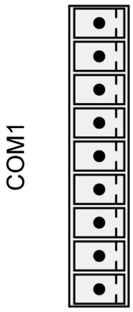
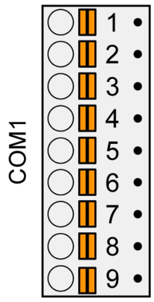
2.6.4.8.1 Connection of the Processor Module to the CS31 System Bus

*The PM56xx processor mModule does **not** support the CS31 system bus.*

COM1 of the Terminal Base

The processor module can be used as a CS31 bus master. The connection is performed via the serial interface COM1 used as a CS31 system bus.

Pin Assignment

		Pin	Signal	Interface	Description
 Terminal block removed	 Terminal block inserted	1	Terminator P	RS-485	Terminator P
		2	RxD/TxD-P	RS-485	Receive/Transmit, positive
		3	RxD/TxD-N	RS-485	Receive/Transmit, negative
		4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	Signal Ground
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

NOTICE!
Unused connector!
Make sure that the terminal block is always connected to the terminal base, even if you do not use the interface.

With connecting the terminals 1-2 and 3-4, a pull-up and a pull-down resistor can be activated (see chapter Serial Interface COM1 *Chapter 2.6.4.6 “Serial Interface COM1 of the Terminal Bases” on page 1282*.

2.6.4.8.2 Wiring

Wiring

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm² (24 AWG)
Recommendation	0.5 mm² corresponds to 0.8 mm
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω...150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends
Remarks	Shielded cables with PVC core insulation and a core diameter of 0.8 mm can be used up to a length of ca. 50 m. In this case, the bus terminating resistor is ca. 100 Ω.

Remarks:

Cables with PVC core insulation and a core diameter of 0.8 mm can be used up to a length of ca. 250 m. In this case, the bus terminating resistor is ca. 100 Ω.

Cables with PE core insulation can be used up to a length of ca. 500 m.

2.6.4.8.3 Bus Topology

A CS31 system bus always contains only one bus master (CPU or communication module) which controls all actions on the bus. Up to 31 slaves can be connected to the bus, e.g. remote modules or slave-configured CPUs. Besides the wiring instructions shown below, the wiring and earthing instructions provided with the descriptions of the modules are valid additionally.

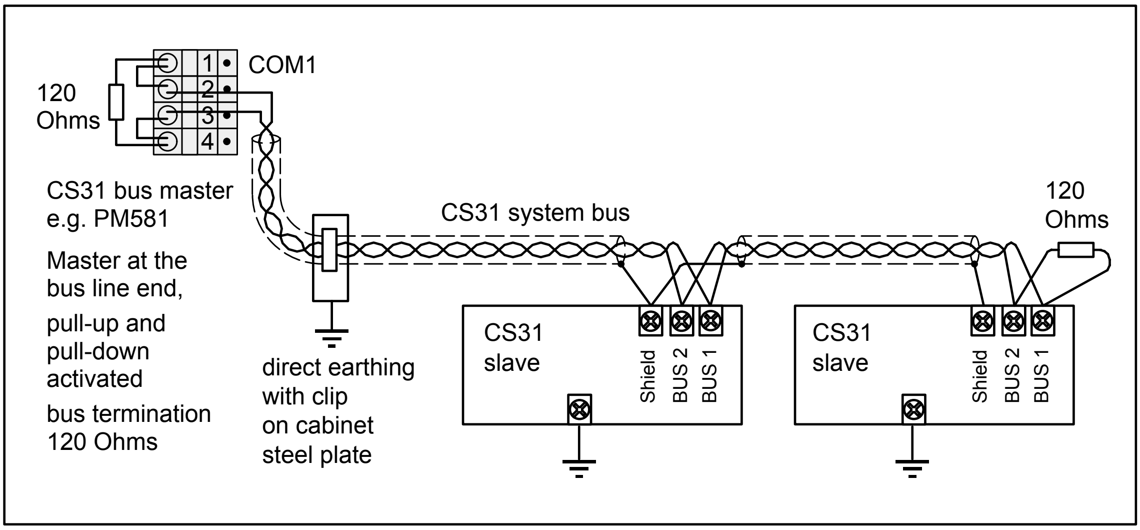


Fig. 232: Bus topology for a CS31 system bus at COM1 (bus master at one end of the bus line)

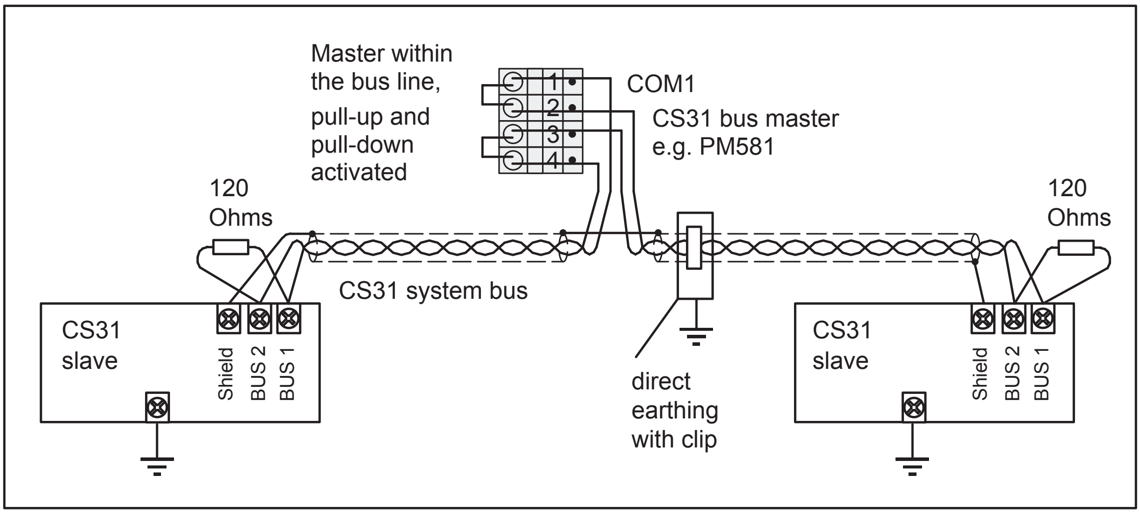


Fig. 233: Bus topology for a CS31 system bus at COM1 (bus master within the bus line)

> **NOTICE!**
> **Risk of malfunctions!**
> Spur lines are not allowed within the CS31 bus.
>
> Loop the bus line from module to module.

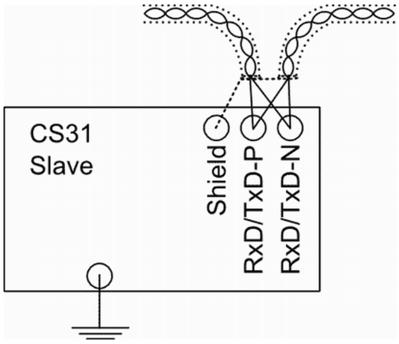


Fig. 234: Bus line: Correct

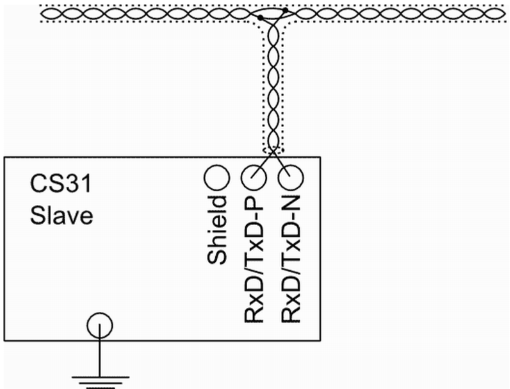


Fig. 235: Bus line: Wrong

2.6.4.8.4 Earthing

In order to avoid disturbance, the cable shields must be earthed directly.

Case a:

Multiple switch-gear cabinets: If it can be guaranteed that no potential differences can occur between the switch-gear cabinets by means of current-carrying metal connections (earthing bars, steel constructions etc.), the direct earthing is chosen.

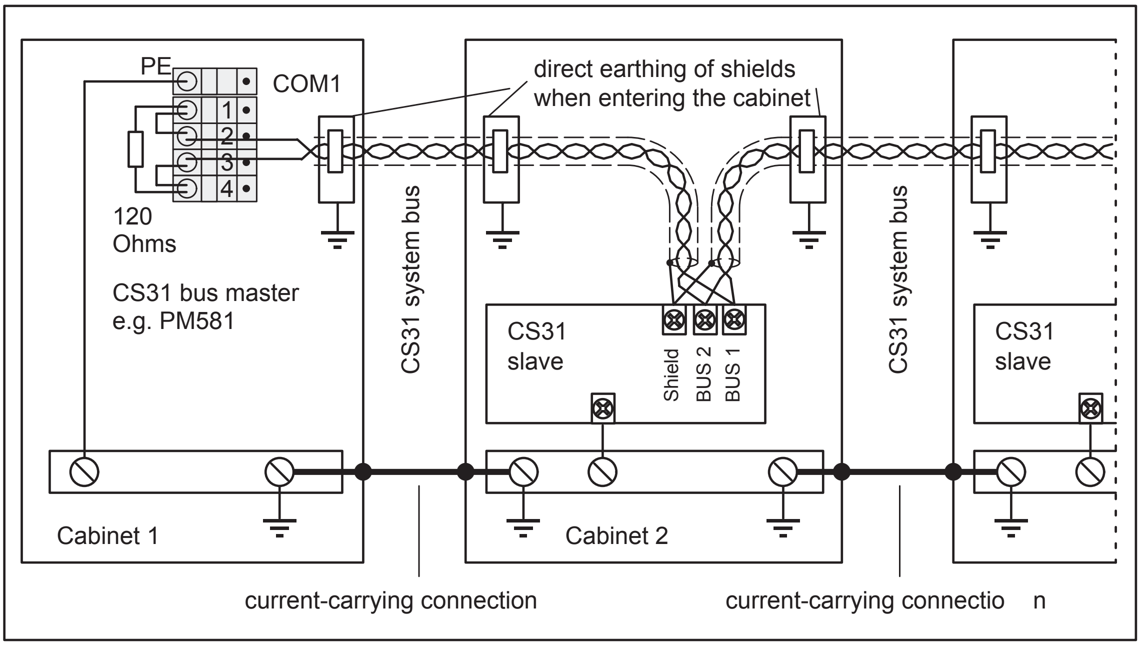


Fig. 236: Direct earthing

Case b:

Multiple switch-gear cabinets: If potential differences can occur between the switch-gear cabinets, the capacitive earthing method is chosen in order to avoid circulating currents on the cable shields.

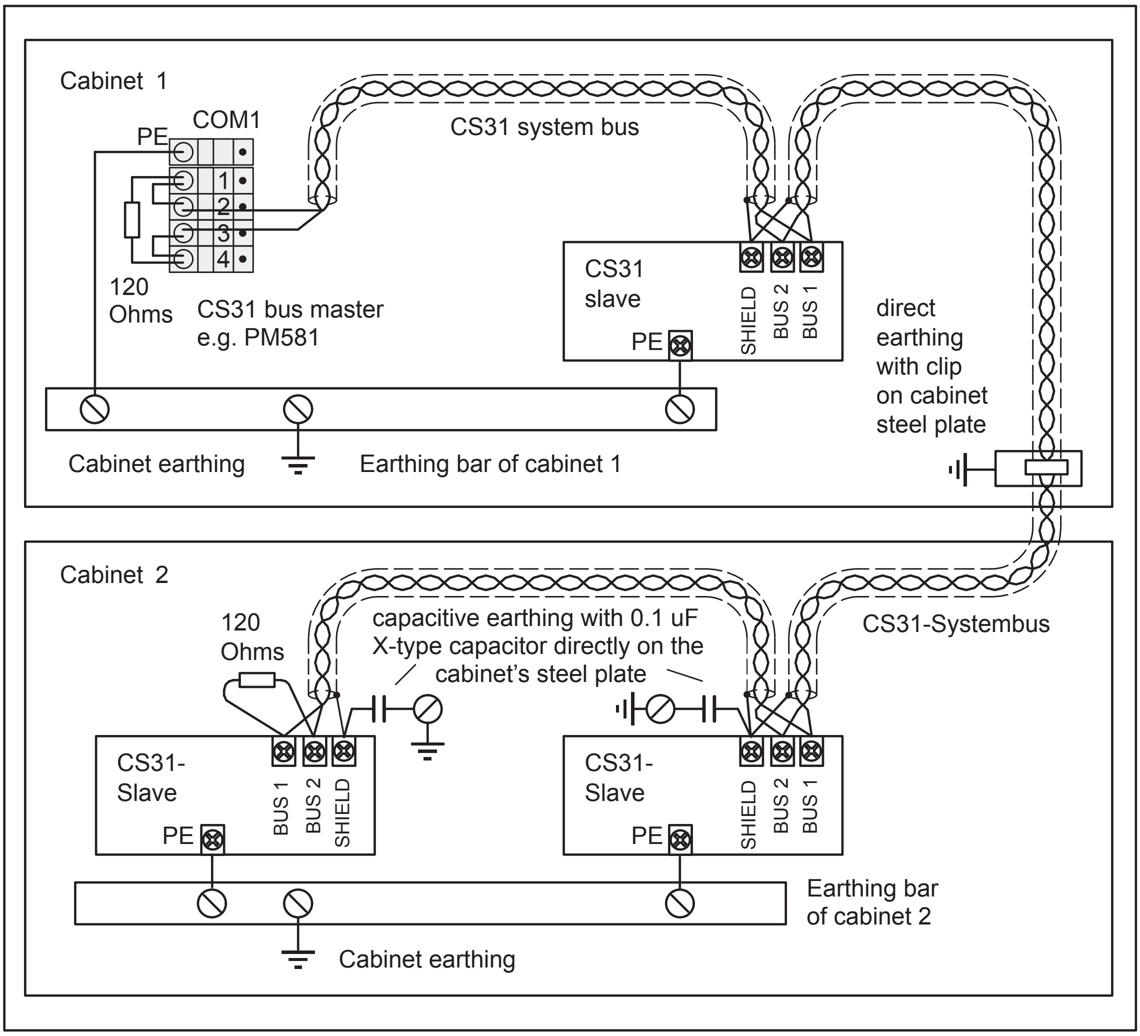


Fig. 237: Earthing concept with several switch-gear cabinets: direct earthing of cable shields when cables enter the first switch-gear cabinet (containing the master), and capacitive earthing at the modules

Everywhere is valid: The total length of the earthing connections between the shield of the Terminal Base and the earthing bar must be as short as possible (max. 25 cm). The conductor cross section must be at least 2.5 mm².

> *VDE 0160 requires, that the shield must be earthed directly at least once per system.*

2.6.4.9 CANopen Field Bus

Types of Bus Cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	Bus cable (shielded, twisted pair)			Max. baud rate [kbit/s]
	Conductor cross section [mm²]	Line resistance [Ω/km]	Wave impedance [Ω]	
0...40	0.25...0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34...0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50...0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75...0.80 / AWG18	< 26	120	< 50 at 1000 m

NOTICE!

Risk of telegram and data errors!

The use of wrong cable type and quality could lead to limitations in cable length, causing telegram and data errors.

NOTICE!

Risk of damaging the terminating resistor!

A bus-line short-circuit to the 24 VDC power supply can cause damage by exceeding the power rating of the terminating resistor.

NOTICE!

Risk of telegram and data errors!

Miss- or unterminated data lines can cause reflections on the bus, leading to telegram and data errors. For maximum cable length and transmission rate, the bus must always be terminated on both ends with the characteristic impedance of the cable type.

NOTICE!

Verification of termination (Make sure the power supply on all CAN nodes is turned off)!

To verify the termination, the DC resistance between CAN_H and CAN_L can be measured. The value should be between 50 Ω and 70 Ω.

Check for correct resistor values, short circuits and correct number of terminating resistors, if the measurement is showing deviations.

Installation Hint

Ensure that the termination and FE connection will not be removed when removing CAN modules from the bus.

Branches are not allowed in a CAN network. Stubs should be avoided or kept as short as possible (< 0.3 m).

When connecting the cable take care to use one dedicated twisted pair for the CAN signals (CAN_L and CAN_H) and another free wire for CAN_GND. CAN_GND must be connected as reference, to avoid common mode problems causing telegram errors.

Keep the CAN bus wiring away from electrical disturbance and close to earth potential to minimize interference.

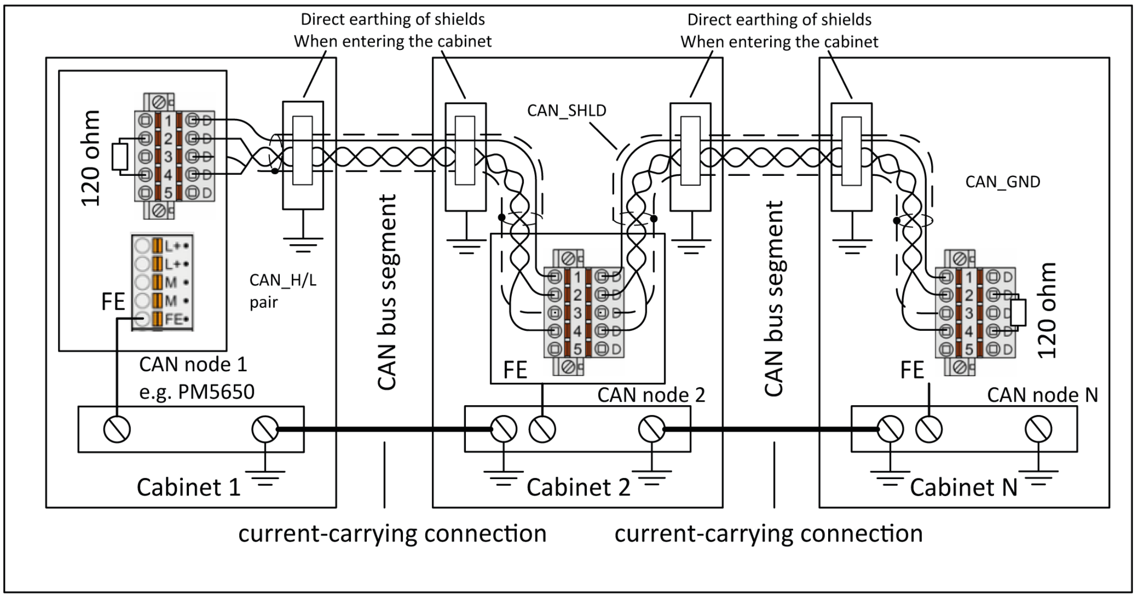


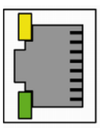
Fig. 238: CAN Bus, connection and wiring

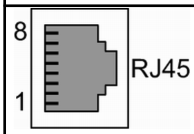
2.6.4.10 Ethernet Connection Details

Ethernet is also used for PROFINET, EtherCAT and Modbus TCP connection.

2.6.4.10.1 Ethernet Interface

Pin Assignment

Interface	Pin	Signal	Description
 1 8 or	1	TxD+	Transmit Data +
	2	TxD-	Transmit Data -
	3	RxD+	Receive Data +
	4	NU	Not used

Interface	Pin	Signal	Description
	5	NU	Not used
	6	RxD-	Receive Data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

See supported protocols and used Ethernet ports for AC500 V2 products:*Ethernet Protocols and Ports*.

See communication via Modbus for AC500 V2 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V2 products: *Modbus RTU*.

See supported protocols and used Ethernet ports for AC500 V3 products:*Ethernet Protocols and Ports*.

See communication via Modbus for AC500 V3 products: *Modbus TCP/IP*.

See communication via Modbus for AC500 V3 products: *Modbus RTU*.

2.6.4.10.2 Wiring

Cable Length Restrictions

For the maximum possible cable lengths within an Ethernet network, various factors have to be taken into account. Twisted pair cables (TP cables) are used as transmission medium for 10 Mbit/s Ethernet (10Base-T) as well as for 100 Mbit/s (Fast) Ethernet (100Base-TX). For a transmission rate of 10 Mbit/s, cables of at least category 3 (IEA/TIA 568-A-5 Cat3) or class C (according to European standards) are allowed. For fast Ethernet with a transmission rate of 100 Mbit/s, cables of category 5 (Cat5) or class D or higher have to be used. The maximum length of a segment, which is the maximum distance between two network components, is restricted to 100 m due to the electric properties of the cable.

Furthermore, the length restriction for one collision domain has to be observed. A collision domain is the area within a network which can be affected by a possibly occurring collision (i.e. the area the collision can propagate over). This, however, only applies if the components operate in half-duplex mode since the CSMA/CD access method is only used in this mode. If the components operate in full-duplex mode, no collisions can occur. Reliable operation of the collision detection method is important, which means that it has to be able to detect possible collisions even for the smallest possible frame size of 64 bytes (512 bits). But this is only guaranteed if the first bit of the frame arrives at the most distant subscriber within the collision domain before the last bit has left the transmitting station. Furthermore, the collision must be able to propagate to both directions at the same time. Therefore, the maximum distance between two ends must not be longer than the distance corresponding to the half signal propagation time of 512 bits. Thus, the resulting maximum possible length of the collision domain is 2000 m for a transmission rate of 10 Mbit/s and 200 m for 100 Mbit/s. In addition, the bit delay times caused by the passed network components also have to be considered.

The following table shows the specified properties of the respective cable types per 100 m.

Table 220: Specified cable properties:

Parameter	10Base-T [10 MHz]	100Base-TX [100 MHz]
Attenuation [dB / 100m]	10.7	23.2
NEXT [dB / 100m]	23	24
ACR [dB / 100m]	N/A	4
Return loss [dB / 100m]	18	10
Wave impedance [Ohms]	100	100

Parameter	10Base-T [10 MHz]	100Base-TX [100 MHz]
Category	3 or higher	5
Class	C or higher	D or higher

TP Cable

The TP cable has eight wires arranged in four pairs of twisted wires. Different color codes exist for the coding of the wires, the coding according to EIA/TIA 568, version 1, being the one most commonly used. In this code, the individual pairs are coded with blue, orange, green and brown color. One wire of a pair is unicolored and the corresponding second wire is striped, the respective color alternating with white. For shielded cables, a distinction is made between cables that have one single shield around all pairs of wires and cables that have an additional individual shield for each pair of wires. The following table shows the different color coding systems for TP cables:

Table 221: Color coding of TP cables:

Pairs	EIA/TIA 568 Version 1		EIA/TIA 568 Version 2		DIN 47100		IEC 189.2	
Pair 1	white/ blue	blue	green	red	white	brown	white	blue
Pair 2	white/ orange	orange	black	yellow	green	yellow	white	orange
Pair 3	white/ green	green	blue	orange	grey	pink	white	green
Pair 4	white/ brown	brown	brown	slate	blue	red	white	brown

Two general variants are distinguished for the pin assignment of the normally used RJ45 connectors: EIA/TIA 568 version A and version B. The wiring according to EIA/TIA 568 version B is the one most commonly used.

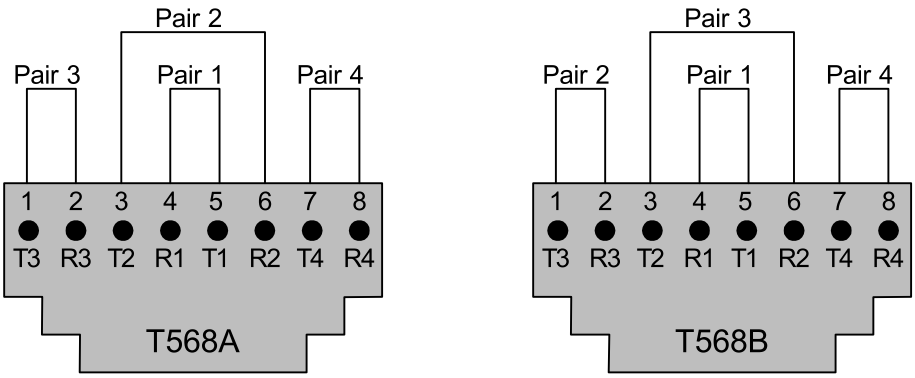


Fig. 239: Pin assignment of RJ45 sockets

2.6.4.10.3 Cable Types

Crossover cable

> ***Particular use***
>
> *Crossover cables are needed only for a direct Ethernet connection without crossover functionality. In particular for AC500 modules in product life cycle phase "Classic".*

Crossover cables are for a direct Ethernet connection of two terminal devices as the simplest variant of a network. From transmission lines of the first station to the reception lines of the second station.

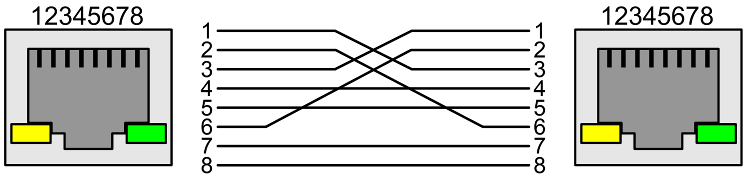


Fig. 240: Wiring of a crossover cable

Straight-through cable For networks with more than two subscribers, hubs or switches have to be used additionally for distribution. These active devices already have the crossover functionality implemented which allows a direct connection of the terminal devices using straight-through cables.

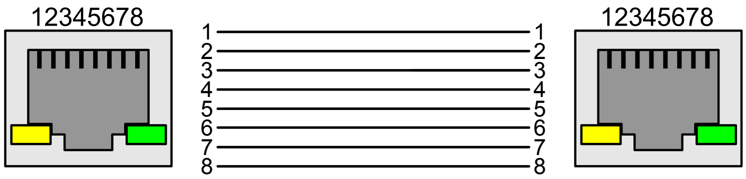


Fig. 241: Wiring of a straight-through cable

CAUTION!
Risk of communication faults!
When using inappropriate cables, malfunctions in communication may occur.

Only use network cables of the categories 5 (Cat 5, Cat 5e, Cat 6 or Cat 7) or higher within PROFINET networks.

2.6.4.11 PROFIBUS Connection Details

Attachment Plug for the Bus Cable 9-pin D-sub connector, male

Parameter	Value
Fastening torque	0.4 Nm

Assignment

Pin	Signal	Description
1	Shield	Shielding, protective earth
2	not used	-
3	RxD/TxD-P	Reception / transmission line, positive
4	CBTR-P	Control signal for repeater, positive (optional)
5	DGND	Reference potential for data lines and +5 V
6	VP	+5 V, supply voltage for bus terminating resistors
7	not used	-

Pin	Signal	Description
8	RxD/TxD-N	Reception / transmission line, negative
9	CNTR-N	Control signal for repeater, negative (optional)

Bus Cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω...165 Ω
Cable capacity	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable Lengths

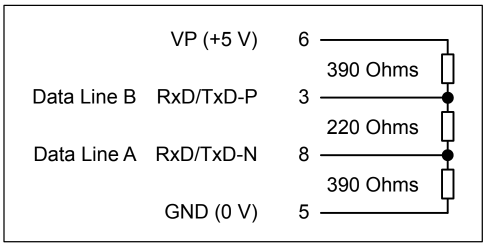
The maximum possible cable length of a PROFIBUS subnet within a segment depends on the baud rate (transmission rate).

Baud Rate	Maximum Cable Length
9.6 / 19.2 / 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

Branch lines are generally permissible for baud rates of up to 1500 kbit/s. But in fact they should be avoided for transmission rates higher than 500 kbit/s.

Bus Terminating Resistors

The line ends (of the bus segments) have to be terminated using bus terminating resistors according to the drawing below. The bus terminating resistors are usually placed inside the bus connector.



Repeaters

One bus segment can have up to 32 subscribers. Using repeaters a system can be expanded to up to 126 subscribers. Repeaters are also required for longer transfer lines. Please note that a repeater's load to the bus segment is the same as the load of a normal bus subscriber. The sum of normal bus subscribers and repeaters in one bus segment must not exceed 32.

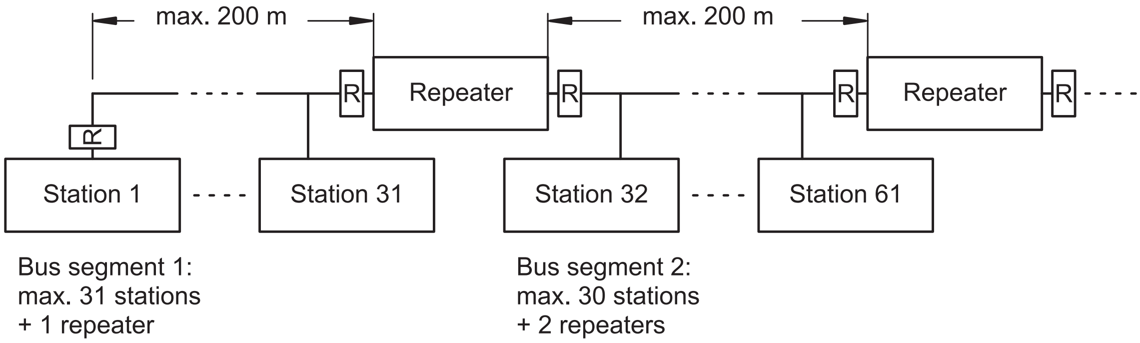


Fig. 242: Principle example for a PROFIBUS-DP system with repeaters (1500 kbit/s baud rate)

2.6.4.12 Modbus RTU Connection Details

The Modbus RTU protocol is implemented in the AC500 Processor Modules.

Modbus is a master-slave (client-server) protocol. The client sends a request to the server(s) and receives the response(s).

Available serial interfaces can work as Modbus interfaces simultaneously.

The Modbus client operating mode of an interface is set with the Function Block *COM_MOD_MAST*.

Technical data

The Modbus operating mode and the interface parameters are set in the *PLC configuration*.

Description of the Modbus protocol:

Supported standard	PM55x and PM56x: EIA RS-485 PM57x, PM58x and PM59x: EIA RS-232 / RS-485
Number of connection points	1 client Max. 1 server with RS-232 interface Max. 31 servers with RS-485
Protocol	Modbus
Operating mode	Client/server
Address	Server only
Data transmission control	CRC16
Data transmission speed	Up to 187.500 baud
Encoding	1 start bit 8 data bits 1 parity bit, (optional) even, odd, mark or space 1 or 2 stop bits
Max. cable length for RS-485 on COM1 / COM2 for AC500 CPU	1.200 m at 19.200 baud
Max. cable length for RS-485 on COM1 / COM2 for AC500-eCo CPU	

	COM1:		
		Non-isolated:	Max. 50 m (with shielded cable)
		Isolated with TK506:	Max. 500 m @ 19200 (with shielded cable)*)
	COM2:		
		Non-isolated with TA562:	Max. 50 m (with shielded cable)
		Isolated with TA569:	Max. 500 m @ 19200 (with shielded cable)*)

*) 500 m Cable type STP-120 Ω/AWG-20

If a Processor Module provides more than one serial interface, both interfaces (COM1/COM2) can be operated simultaneously as Modbus interfaces and can operate as Modbus server as well as Modbus client.

Bus topology

Point-to-point with RS-232 or bus topology with RS-485. Modbus is a master-slave protocol.

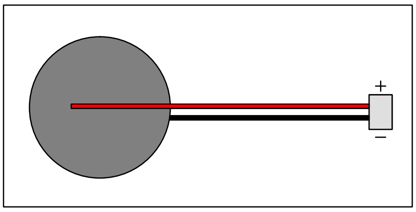
For further information on Modbus see chapter *Communication with Modbus RTU*.

2.6.5 Handling of Accessories

This section only describes accessories that are frequently used for system assembly, connection and construction. A description of all additional accessories that can be used to supplement AC500 system can be found in the Hardware PLC device description.

2.6.5.1 TA521 - Lithium Battery

- Manganese dioxide lithium battery, 3 V, 560 mAh
- Non-rechargeable



Purpose

The TA521 lithium battery is the only applicable battery for the AC500 processor modules *Chapter 1.2.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 64* and *PM56xx*. It cannot be recharged.

The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

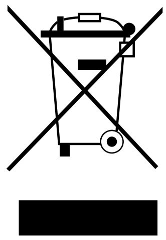
See *AC500 Battery*.

The CPU monitors the discharge degree of the battery. A warning is issued before the battery condition becomes critical (about 2 weeks before). Once the warning message appears, the battery should be replaced as soon as possible.

Handling Instructions

- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.

- Replace the battery with supply voltage ON in order not to risk data being lost.
- Recycle exhausted batteries meeting the environmental standards.



Battery Lifetime

The battery lifetime is the time, the battery can store data while the processor module is not powered. As long as the processor module is powered, the battery will only be discharged by its own leakage current.

> *To avoid a short battery discharge, the battery should always be inserted or replaced while the process module is under power, then the battery is correctly recognized and will not shortly discharged.*

Technical Data

Parameter	Value
Nominal voltage	3 V
Nominal capacity	560 mAh
Temperature range (index below C0)	Operating: 0 °C...+60 °C Storage: -20 °C...+60 °C Transport: -20 °C...+60 °C
Temperature range (index C0 and above)	Operating: -40 °C...+70 °C Storage: -40 °C...+85 °C Transport: -40 °C...+85 °C
Battery lifetime	Typ. 3 years at 25 °C
Self-discharge	2 % per year at 25 °C 5 % per year at 40 °C 20 % per year at 60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug.
Insulation	The battery is completely insulated.
Connection	Red = plus pole = above at plug, black = minus pole,
Weight	7 g
Dimensions	Diameter of the button cell: 24.5 mm Thickness of the button cell: 5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 300 R0001	TA521, lithium battery	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.6.5.1.1 Insertion

Insertion

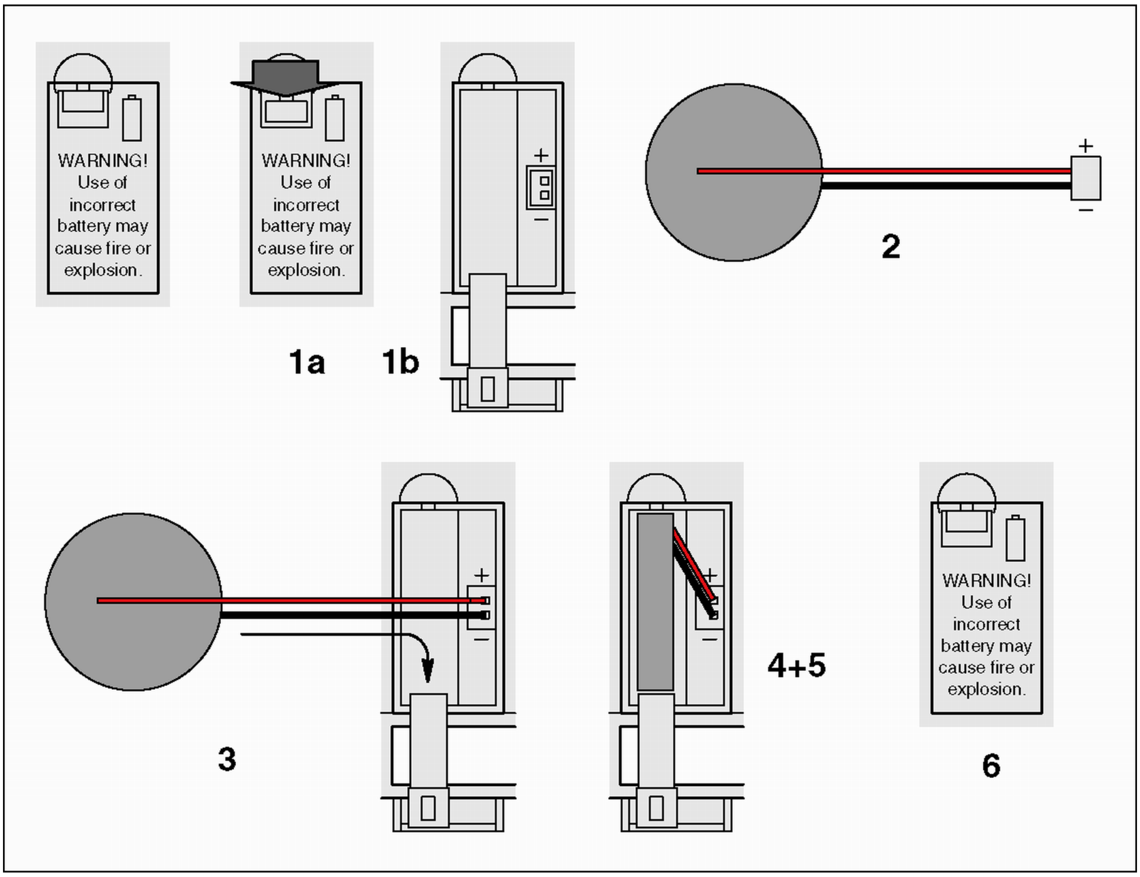


Fig. 243: Insertion of the Lithium battery

To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.

1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front face of the processor module and cannot be removed.
2. Remove the TA521 battery from its package and hold it by the small cable.
3. Insert the battery connector into the small connector port of the compartment. The connector is keyed to find the correct polarity (red = plus-pole = above).
4. Insert first the cable and then the battery into the compartment, push it until it reaches the bottom of the compartment.
5. Arrange the cable in order not to inhibit the door to close.
6. Pull-up the door and press until the locking mechanism snaps.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

2.6.5.1.2 Replacement

Replacement of the Battery

To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.

1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front face of the processor module and cannot be removed.
2. Remove the old TA521 battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

3. Follow the previous instructions to insert a new battery.

CAUTION!

Risk of explosion!

Do not open, re-charge or disassemble a lithium battery. Attempts to charge lithium batteries lead to overheating and possible explosions.

Prevent them from heat and fire and store them in a dry place.

Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid chance short circuiting and therefore do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

> *In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.*
>
> *Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.*

2.6.5.2 TA541 - Lithium Battery

- Manganese dioxide lithium battery, 3 V
- Non-rechargeable

Purpose

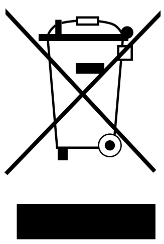
The TA541 lithium battery is the only applicable battery for PM595 ⇘ *Chapter 1.2.2.2 “PM595” on page 79*. It is used to save RAM content of the processor module (PM595-4ETH-F only) and to back-up the real-time clock (all PM595 variants). It cannot be recharged.

The processor modules are supplied without a lithium battery. It therefore must be ordered separately. The TA521 Lithium Battery is used to save RAM contents of AC500 processor modules and back-up the real-time clock. Although the processor modules can work without a battery, its use is still recommended in order to avoid process data being lost.

The CPU monitors the discharge degree of the battery. A warning is output, before the battery condition becomes critical (about 2 weeks before). After the warning message has appeared, the battery should be replaced as soon as possible.

Handling Instructions

- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.
- Replace the battery with supply voltage ON in order not to risk data being lost.
- Recycle exhausted batteries meeting the environmental standards.



Battery Lifetime

The battery lifetime is the time the battery can store data while the CPU is not powered. As long as the CPU is powered, the battery will only be discharged by its own leakage current.

Technical Data

Parameter	Value
Nominal voltage	3 V
Nominal capacity	1800 mAh
Temperature range	Operating: -40 °C...+70 °C Storage: -40 °C...+85 °C Transport: -40 °C...+85 °C
Battery lifetime	Typ. 3 years at 25 °C
Self-discharge	1 % per year at 25 °C 5 % per year at 40 °C 20 % per year at 60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug
Insulation	The battery is completely insulated.
Connection	Red = plus pole = above at plug Black = minus pole
Weight	17 g
Dimensions	Diameter of the battery: ca. 18 mm Height of the battery: ca. 35 mm

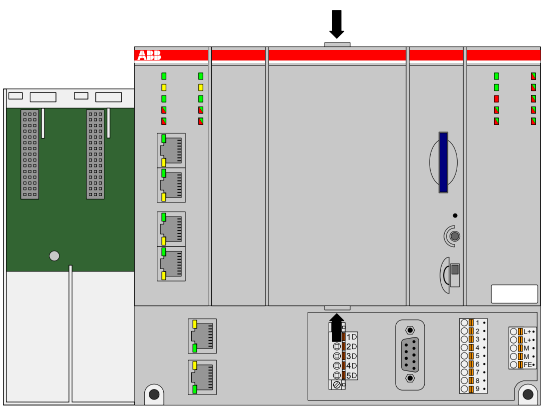
Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 182 700 R0001	TA541, lithium battery	Active

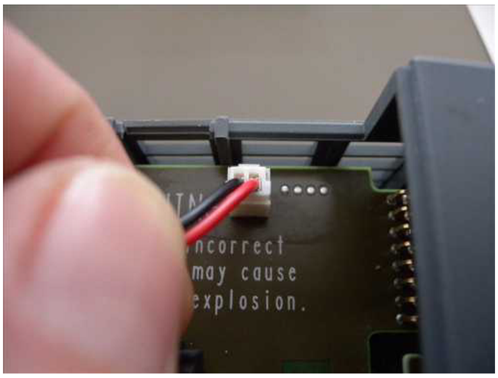
**) For planning and commissioning of new installations use modules in Active status only.*

2.6.5.2.1 Insertion

The TA541 lithium battery is the only applicable battery for Processor Modules PM595.

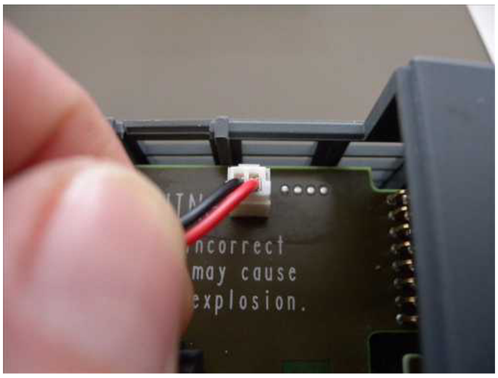


1. Remove the front cover / display by pressing the marked areas and pull it to the front.



2. Remove the old battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

3. Remove the battery from its package and hold it by the small cable.



4. Insert the battery connector into the small connector port of the compartment. The connector is keyed to find the correct polarity (red = plus-pole = right side).

5. Insert the battery into the battery compartment on the left side as shown in the picture.

6. Re-assemble the front cover / display by pressing it straight from the front until it snaps in.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

2.6.5.2.2 Replacement

For PM595-4ETH-F only: battery replacement should be done with the system under power. Without battery and power supply there is no data buffering possible.

For PM595-4ETH-M-XC only: battery only back-ups the real-time clock.

1. Remove the front cover / display by pressing the marked areas and pull it to the front.
2. Remove the old battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

   Follow the previous instructions to insert a new battery.

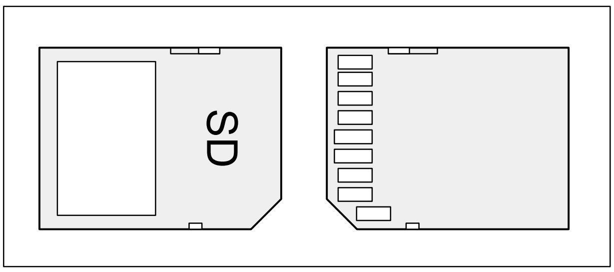
CAUTION!
Risk of explosion!
Do not open, re-charge or disassemble a lithium battery. Attempts to charge lithium batteries lead to overheating and possible explosions.

Prevent them from heat and fire and store them in a dry place.

Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid chance short circuiting and therefore do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

2.6.5.3 MC502 - SD Memory Card

- Secure digital card
- Solid state flash memory storage



Purpose

The SD memory card is used to back-up user data and store user programs or project source codes as well as to update the internal CPU firmware. The processor modules can be operated with and without SD memory card.

AC500/AC500-eCo processor modules are supplied without SD memory card. It therefore must be ordered separately.

The MC memory card can be read on a PC with a standard memory card reader. AC500 processor modules are equipped with an MC memory card reader.

For AC500-eCo processor modules the device must be equipped with a MC503 SD memory card adaptor *Chapter 2.5.5.2 “MC503 - SD Memory Card Adaptor” on page 1227*.

> *The SD memory card has a write protect switch. In the position "LOCK", the card can only be read.*

> *The use of memory cards other than the MC502 SD memory card is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.*

Insertion of the SD Memory Card

> **NOTICE!**
> **Removal of the SD memory card**
> Do not remove the SD memory card during access. Remove only when the RUN LED does not blink. Otherwise the SD memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

Unpack the SD memory card and insert it into the opening of the front face of the processor module until locked:

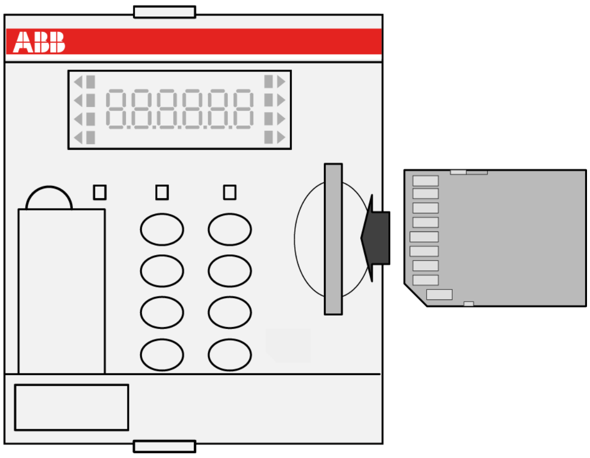


Fig. 244: Insertion: PM57x, PM58x, PM59x and PM56xx

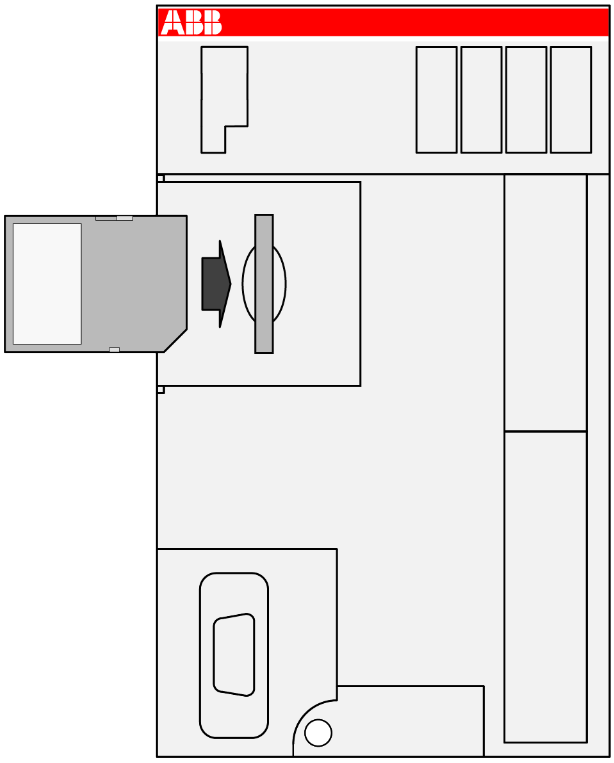


Fig. 245: Insertion: PM55x-xP and PM56x-xP

To remove the SD memory card, push on the card until it moves forward. By this, the card is unlocked and can be removed.

Technical Data

Parameter	Value
Memory capacity	Up to 2 GB, for exactly size see type plate
Temperature range	-20 °C...+85 °C
No. of writing cycles	> 100 000
No. of reading cycles	No limitation
Data safety	> 10 years
Write Protect Switch	Yes, at the edge of the SD memory card
Weight	2 g
Dimensions	24 mm x 32 mm x 2.1 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

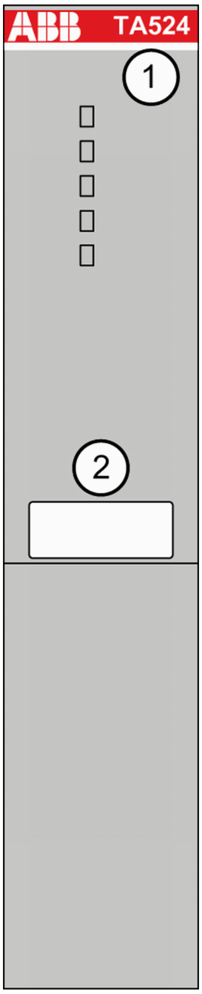
Further information on using the SD memory card in AC500 PLCs is provided in the chapter *Storage Devices*.

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 100 R0001	MC502, SD memory card	Active

> **) For planning and commissioning of new installations use modules in Active status only.*

2.6.5.4 TA524 - Dummy Communication Module



1 Type
2 Label

Purpose

TA524 is used to cover an unused communication module slot of a terminal base ␥ *Chapter 1.1.1 “TB51x-TB54x” on page 4* and TB56xx. It protects the terminal base from dust and inadvertent touch.

Handling Instructions

TA524 is mounted in the same way as a common communication module ␥ *Chapter 2.6.3.6 “Mounting and Demounting the Communication Modules” on page 1275*.

Technical Data

Parameter	Value
Weight	50 g
Dimensions	135 mm x 28 mm x 62 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 600 R0001	TA524, dummy communication module	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.6.5.5 CP-E - Economic Range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

- Wide-range input voltage
- Mounting on DIN rail
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Wide ambient temperature range from -40 °C...+70 °C
- No-load-proof, overload-proof, continuous short-circuit-proof
- Power factor correction (depending on the type)
- Approved in accordance with all relevant international standards

Table 222: Ordering Data

Order No.	**Type**	**Input**	**Output**	**Overload capacity**	**Module width [mm]**
1SVR427030R0000	CP-E 24/0.75	100-240 VAC or 120-370 VDC	24 VDC, 0.75 A	-	22.5
1SVR427031R0000	CP-E 24/1.25	100-240 VAC or 90-375 VDC	24 VDC, 1.25 A	-	40.5
1SVR427032R0000	CP-E 24/2.5	100-240 VAC or 90-375 VDC	24 VDC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 VAC auto select or 210-370 VDC	24 VDC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 VAC auto select or 210-370 VDC	24 VDC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115-230 VAC or 120-370 VDC	24 VDC, 20 A	-	175

2.6.5.6 CP-C.1 - High Performance Range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

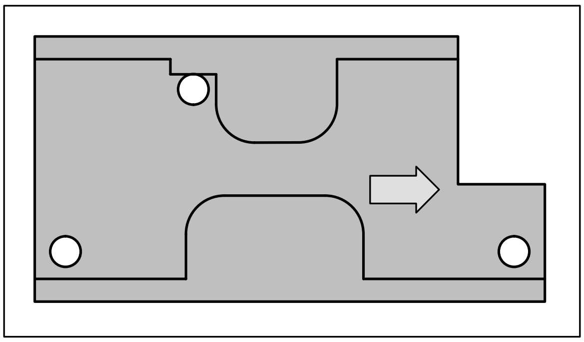
The CP-C.1 power supplies are ABB's high performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combinded with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications.

- Typical efficiency of up to 94 %
- Power reserve design delivers up to 150 % of the nominal output current
- Signaling outputs for DC OK and power reserve mode
- High power density leads to very compact and small devices
- No-load-proof, overload-proof, continuous short-circuit-proof
- Active power factor correction (PFC)

Table 223: Ordering Data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110-240 VAC or 90-300 VDC	24 VDC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110-240 VAC or 90-300 VDC	24 VDC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110-240 VAC or 90-300 VDC	24 VDC, 20 A	+30 %	82

2.6.5.7 TA526 - Wall Mounting Accessory



Purpose

If a terminal base TB5xx or a terminal unit TU5xx should be mounted with screws, the wall mounting accessories TA526 must be inserted at the rear side first. This plastic parts prevent bending of terminal bases and terminal units while screwing up.

Handling Instructions

Handling of the wall mounting accessory is described in detail in the section *Mounting and Disassembling the Terminal Unit* *➮ “Mounting with Screws” on page 1268* and *Mounting/Disassembling Terminal Bases and Function Module Terminal Bases* *➮ “Mounting with Screws” on page 1266*.

Technical Data

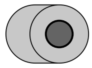
Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.6.5.8 TA543 - Screw Mounting Accessory



Intended Purpose

The TA543 screw mounting accessory is used for mounting the processor module PM595 *Chapter 1.2.1.2 “Onboard I/Os in Processor Module PM55x” on page 36* without DIN rail.

Handling Instruction

3x TA543 must be snapped on the backside of PM595 *Chapter 2.6.3.3 “Mounting and Demounting the Processor Module PM595” on page 1270*.

Technical Data

Parameter	Value
Weight	5 g
Dimensions	12 mm x 8.5 mm x 10 mm

Ordering Data

Part no.	Description	Product Life Cycle Phase *)
1SAP 182 800 R0001	TA543, screw mounting accessory for PM595	Active

**) For planning and commissioning of new installations use modules in Active status only.*

2.7 AC500-XC

2.7.1 System Data AC500-XC

Assembly, construction and connection of devices of the variant AC500-XC is identical to AC500 (standard) Chapter 2.6 “AC500 (Standard)” on page 1252. The following description provides information on general technical data of AC500-XC system.

2.7.1.1 Environmental Conditions

Table 224: Process and Supply Voltages

Parameter		Value
24 VDC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
120 VAC...240 VAC wide range supply		
	Voltage	120...240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)

Parameter		Value
Allowed interruptions of power supply		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2

NOTICE!
Exceeding the maximum power supply voltage for process or supply voltages could lead to unrecoverable damage of the system. The system could be destroyed.

NOTICE!
For the supply of the modules, power supply units according to PELV or SELV specifications must be used.

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

Parameter		Value
Temperature		
	Operating	-40 °C...+70 °C -40 °C...-30 °C: Proper start-up of system; technical data not guaranteed -40 °C...0 °C: Due to the LCD technology, the display might respond very slowly. -40 °C...+40 °C: Vertical mounting of modules possible, output load limited to 50 % per group +60 °C...+70 °C with the following deratings: ● System is limited to max. 2 communication modules per terminal base ● Applications certified for cULus up to +60 °C ● Digital inputs: maximum number of simultaneously switched on input channels limited to 75 % per group (e.g. 8 channels => 6 channels) ● Digital outputs: output current maximum value (all channels together) limited to 75 % per group (e.g. 8 A => 6 A) ● Analog outputs only if configured as voltage output: maximum total output current per group is limited to 75 % (e.g. 40 mA => 30 mA) ● Analog outputs only if configured as current output: maximum number of simultaneously used output channels limited to 75 % per group (e.g. 4 channels => 3 channels)
	Storage / Transport	-40 °C...+85 °C

Parameter	Value
Humidity	Operating / Storage: 100 % r. H. with condensation
Air pressure	Operating: -1000 m....4000 m (1080 hPa...620 hPa) > 2000 m (< 795 hPa): ● max. operating temperature must be reduced by 10 K (e.g. 70 °C to 60°C) ● I/O module relay contacts must be operated with 24 V nominal only
Immunity to corrosive gases	Operating: Yes, according to: ISA S71.04.1985 Harsh group A, G3/GX IEC 60721-3-3 3C2 / 3C3
Immunity to salt mist	Operating: Yes, horizontal mounting only, according to IEC 60068-2-52 severity level: 1

NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices *TA535* *Chapter 1.8.4.6 “TA535 - Protective Caps for XC Devices” on page 1174*.

Table 225: Electromagnetic Compatibility

Parameter		Value
Device suitable for:		
	Industrial applications	Yes
	Domestic applications	No
Radiated emission (radio disturbances)		Yes, according to: CISPR 16-2-3
Conducted emission (radio disturbances)		Yes, according to: CISPR 16-2-1, CISPR 16-1-2
Electrostatic discharge (ESD)		Yes, according to: IEC 61000-4-2, zone B, criterion B
Fast transient interference voltages (burst)		Yes, according to: IEC 61000-4-4, zone B, criterion B
High energy transient interference voltages (surge)		Yes, according to: IEC 61000-4-5, zone B, criterion B
Influence of radiated disturbances		Yes, according to: IEC 61000-4-3, zone B, criterion A

Parameter	Value
Influence of line-conducted interferences	Yes, according to: IEC 61000-4-6, zone B, criterion A
Influence of power frequency magnetic fields	Yes, according to: IEC 61000-4-8, zone B, criterion A

In order to prevent malfunctions, it is recommended, that the operating personnel discharge themselves prior to touching communication connectors or perform other suitable measures to reduce effects of electrostatic discharges.

NOTICE!
Risk of malfunctions!
Unused slots for communication modules are not protected against accidental physical contact.

– Unused slots for communication modules must be covered with dummy communication modules (TA524 *Chapter 2.6.5.4 “TA524 - Dummy Communication Module” on page 1308* to achieve IP20 rating.
– I/O bus connectors must not be touched during operation.

2.7.1.2 Mechanical Data

Parameter	Value
Wiring method	Spring terminals
Degree of protection	IP 20
Vibration resistance	Yes, according to: IEC 61131-2 IEC 60068-2-6 IEC 60068-2-64
Shock resistance	Yes, according to: IEC 60068-2-27
Assembly position	Horizontal Vertical (no application in salt mist environment)
Assembly on DIN rail	
DIN rail type	According to IEC 60715 35 mm, depth 7.5 mm or 15 mm
Assembly with screws	
Screw diameter	4 mm
Fastening torque	1.2 Nm

2.7.1.3 Environmental Tests

Parameter	Value
Storage	IEC 60068-2-1 Test Ab: cold withstand test -40 °C / 16 h IEC 60068-2-2 Test Bb: dry heat withstand test +85 °C / 16 h
Humidity	IEC 60068-2-30 Test Db: Cyclic (12 h / 12 h) damp-heat test 55 °C, 93 % r. H. / 25 °C, 95 % r. H., 6 cycles IEC 60068-2-78, stationary humidity test: 40 °C, 93 % r. H., 240 h
Insulation Test	IEC 61131-2
Vibration resistance	IEC 61131-2 / IEC 60068-26: 5 Hz...500 Hz, 2 g (with SD memory card inserted) IEC 60068-2-64: 5 Hz...500 Hz, 4 g rms
Shock resistance	IEC 60068-2-27: all 3 axes 15 g, 11 ms, half-sinusoidal

Table 226: EMC Immunity

Parameter	Value
Electrostatic discharge (ESD)	Electrostatic voltage in case of air discharge: 8 kV Electrostatic voltage in case of contact discharge: 6 kV
Fast transient interference voltages (burst)	Supply voltage units (DC): 4 kV Digital inputs/outputs (24 VDC): 2 kV Analog inputs/outputs: 2 kV Communication lines shielded: 2 kV I/O supply (DC-out): 2 kV
High energy transient interference voltages (surge)	Supply voltage units (DC): 1 kV CM *) / 0.5 kV DM *) Digital inputs/outputs (24 VDC): 1 kV CM *) / 0.5 kV DM *) Digital inputs/outputs (AC): 4 kV Analog inputs/outputs: 1 kV CM *) / 0.5 kV DM *) Communication lines shielded: 1 kV CM)* I/O supply (DC-out): 0,5 kV CM *) / 0.5 kV DM *)
Influence of radiated disturbances	Test field strength: 10 V/m
Influence of line-conducted interferences	Test voltage: 10 V
Power frequency magnetic fields	30 A/m 50 Hz 30 A/m 60 Hz

*) CM = Common Mode, * DM = Differential Mode

2.8 AC500-S

2.8.1 Information About AC500-S

The AC500-S Safety User Manual (refer to *http://www.ABB.com/PLC*) must be read and understood before using safety configuration and programming tools of PS501 Control Builder Plus / Automation Builder. Only qualified personnel shall be allowed to work with AC500-S Safety PLCs.

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