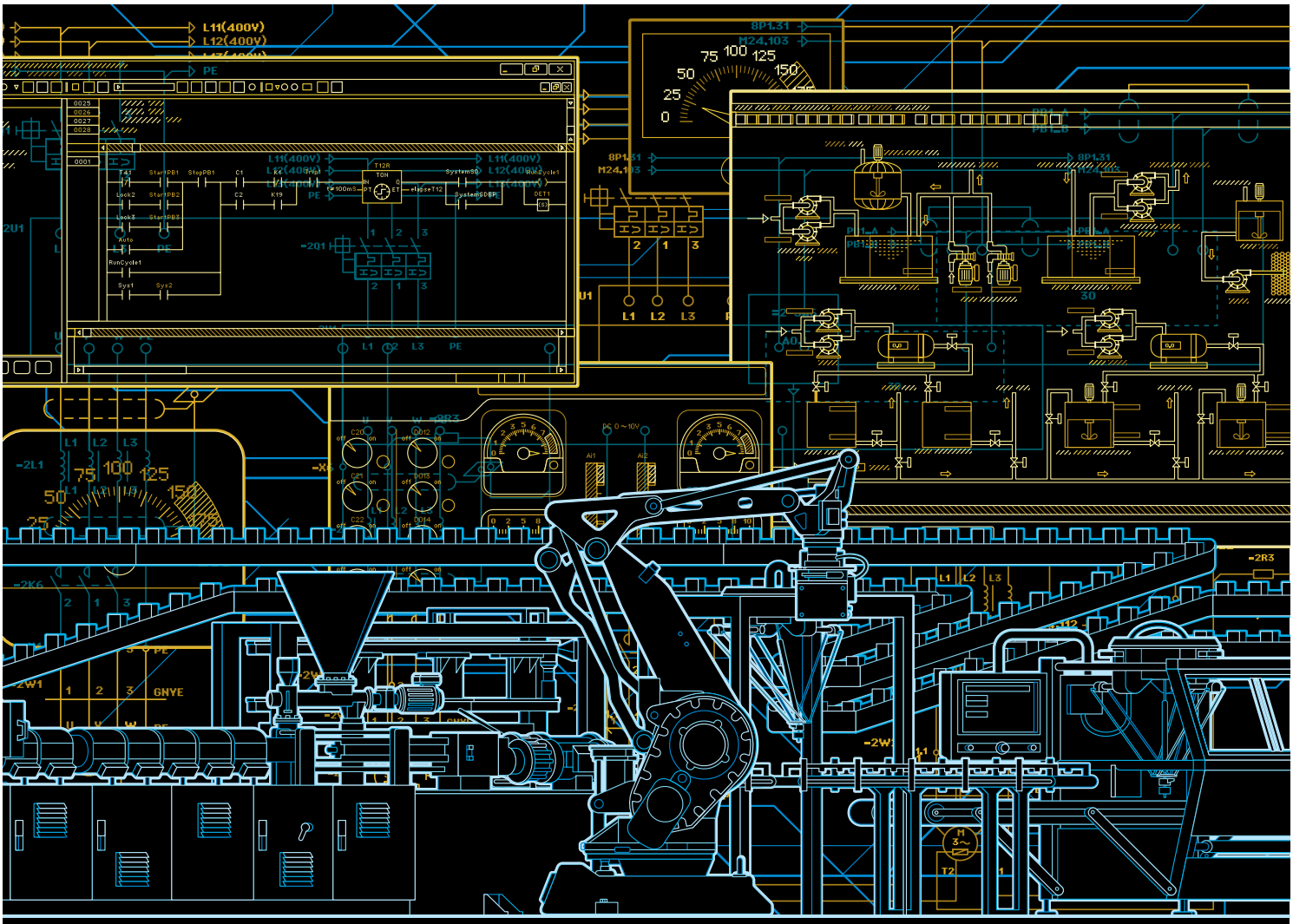

Manual

User Documentation: AC31 Adapter (Supplement to the Existing Documentation)

Power and productivity
for a better world™

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3ADR020105M0201, 1, en_US

Table of contents

1 AC31 adapter

1.1 Introduction

Innovative replacement devices for AC31 devices (90 series)

The modular product line of the AC31 adapter series includes modular exchange components for control systems of the Advant Controller 31 (90 series). The simple exchange of individual components allows existing customers to maintain their PLCs in a quick and cost-effective manner. Extensive software modifications are not required.

Each replacement device is based on trend setting technologies of the AC500 series. Therefore, by exchanging components it is not only possible to replace the existing device, but also to profit from new functions and improved product quality.

Note regarding product documentation

During the development of the AC31 adapter series, care was taken to keep the device configuration identical to the configuration of the AC31 devices. Consequently, the technical documents for the AC31 devices are still valid and serve as reference:

- Software description (only available in English): *http://www05.abb.com/global/scot/scot397.nsf/veritydisplay/cbda718e221a03b0c1257c2100539a53/$file/2CDC120064M0202.PDF*.
- System description Advant Controller 31: *http://www.abb.de/search.aspx?abbcontext=products&q=2cdc120009M0**

Only unavoidable deviations, for example due to technical limitations, are described in this document.

CAUTION!

Installation and maintenance work on the device must be performed by a qualified electrician in line with the recognized technical rules, regulations and relevant standards such as EN 60204-1.

For safety instructions, please refer to "Regulations for the erection of installations" http://search-ext.abb.com/library/Download.aspx?DocumentID=3ADR025003&Action=Launch.*

1.2 Overview of AC31 adapters (replacement devices)

An AC31 adapter (replacement device) is available for the following AC31 devices of the 90 series (existing devices):

Existing devices: AC31 (90 series)	Replacement devices: AC31 adapter	Replacement device is based on the following AC500 device
CPU devices:		
07KT94-ARC 07KT98-ARC 07KT98-ARC-DP 07KT98-ARC-ETH 07KT98-ETH-DP	07KT94-ARC-AD 07KT98-ARC-AD 07KT98-ARC-DP-AD ([1]) 07KT98-ARC-ETH-AD ([1]) 07KT98-ETH-DP-AD ([1])	PM590, DA501 and DA502
I/O modules:		
07DC91	07DC91-AD	DC532
07AC91	07AC91-AD (8-Bit)	AO523
07AC91	07AC91-AD2 (12-Bit)	AX522
07AI91	07AI91-AD	AI523
DC501-CS31	DC501-CS31-AD	DC532

([1]): planned, but not yet available

1.3 System data and CS31 bus system data

The system data described in this chapter are valid for the following replacement devices:

- 07KT94-ARC-AD
- 07KT98-ARC-AD
- 07KT98-ARC-DP-AD ([1])
- 07KT98-ARC-ETH-AD ([1])
- 07KT98-ETH-DP-AD ([1])
- 07AC91-AD
- 07AC91-AD2
- 07AI91-AD
- 07DC91-AD
- DC501-CS31-AD

([1]): planned, but not yet available

Please also observe the CS31 bus system data *Chapter 1.3.2 “CS31 bus system data” on page 12*.

The devices of the AC31 adapter series do not have marine approval.

1.3.1 System data of the AC31 adapters

1.3.1.1 Operating and environmental conditions

Supply voltages:

Voltages according to IEC 61131-2:		
24 V DC	Process and supply voltage	24 V DC (-15 %, +20 % without residual ripple)
	Absolute limits	19.2 V ... 30 V incl. residual ripple
	Residual ripple	≤ 5 %
	Polarity reversal protection	10 s (test duration), permanently present on AC31 adapters
Bridging time for power interruptions according to IEC 61131-2:		
	DC supply	Interruption < 10 ms Time between 2 interruptions > 1 s

CAUTION!

System damage caused by voltage!

Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Operating and environmental conditions:

Temperature:	
-> Operation	0 °C ... +60 °C (vertical mounting position, terminals upward and downward)
-> Storage	-40 °C ... +70 °C
-> Transport	-40 °C ... +70 °C
Humidity	max. 95 %, without condensation
Air pressure:	
-> Operation	> 800 hPa / < 2000 m
-> Storage	> 660 hPa / < 3500 m

1.3.1.2 Creepage distances and clearances

The creepage distances and clearances correspond to overvoltage category II, pollution degree 2.

1.3.1.3 Test voltages for type test

Test voltages for type test according to IEC 61131-2:

Impulse testing:

Data	Voltage	Duration
24 V circuits (supply, 24 V inputs/outputs), when electrically isolated from other circuitry	500 V	1.2 / 50 µs
CS31 interface from other circuitry	500 V	1.2 / 50 µs
Ethernet	500 V	1.2 / 50 µs
ARCNET	500 V	1.2 / 50 µs
COM interfaces, electrically isolated	500 V	1.2 / 50 µs
Enabling input, electrically isolated	500 V	1.2 / 50 µs

AC voltage tests:

Data	Voltage	Duration
24 V circuits (supply, 24 V inputs/outputs), when electrically isolated from other circuitry	350 VAC	60 s
CS31 interface from other circuitry	350 VAC	60 s
Ethernet	350 VAC	60 s
ARCNET	350 VAC	60 s
COM interfaces, electrically isolated	350 VAC	60 s
Enabling input, electrically isolated	350 VAC	60 s

1.3.1.4 Power Supply Units

For the supply of devices, use power supply units according to PELV specification.

1.3.1.5 Electromagnetic compatibility

Immunity:

Data	Value
Immunity against electrostatic discharge (ESD)	According to EN 61000-4-2, zone B, criterion B
-> Interference voltage with air discharge	8 kV
-> Interference voltage with contact discharge	4 kV
ESD with communication connectors	Ensure that any electrostatic charge is discharged prior to contact with the communication connectors (e.g. by touching an earthed metal object). Otherwise malfunctions may occur.
ESD plug-in base connections	Do not touch the connectors to the plug-in base located at the bottom of the device.
ESD external coupler interface	Do not touch the plug to the flat ribbon cable.

Data	Value
Immunity against the influence of radiated interference (CW radiated)	According to EN 61000-4-3, zone B, criterion A
-> Test field strength	10 V/m (except ITU transmission bands 87…108 MHz, 174…230 MHz and 470…790 MHz -> 3 V/m)
-> Maximum temporary deviation during irradiation	Analog current output signals max. 1.5 %. Devices affected: 07AC91-AD, 07AC91-AD2, 07KT94-ARC-AD, 07KT98-ARC-AD, 07KT98-ARC-DP-AD ([1]), 07KT98-ARC-ETH-AD ([1]), 07KT98-ETH-DP-AD ([1])
Immunity against transient interference voltages (burst)	According to EN 61000-4-4, zone B, criterion B
-> Voltage supply	2 kV
-> Enabling input	2 kV
-> Digital inputs/outputs	1 kV
-> Analog inputs/outputs	1 kV
-> CS31 system bus	1 kV
-> Serial RS-232 interfaces (COM)	1 kV
-> ARCNET	1 kV
-> Ethernet	1 kV
-> I/O supply, DC out	1 kV
Immunity against the influence of line-conducted interference (CW conducted):	According to EN 61000-4-6, zone B, criterion A
-> Test voltage	Zone B, also according to 10 V
Immunity against transient interference voltages with high energy (surge)	According to EN 61000-4-5, zone B, criterion B
-> Voltage supply DC, enabling input	0.5 kV CM / 0.5 kV DM ([2])
-> I/O supply, DC out	0.5 kV CM / 0.5 kV DM ([2])
-> Shielded buses	1 kV CM ([2])
-> I/O analog, I/O DC unshielded	1 kV CM / 0.5 kV DM ([2])
Emitted interference (radiation):	-
-> From radiated interferences	According to EN 55011, group 1, class A

([1]): planned, but not yet available

([2]): CM = Common Mode, DM = Differential Mode

The devices of the AC31 adapter series do not have marine approval.

1.3.1.6 Mechanical data

Data	Value
Degree of protection	IP20
Housing	According to UL 94
Vibration resistance according to EN 61131-2	All three axes 2 Hz ... 15 Hz, continuous 3.5 mm 15 Hz ... 150 Hz, continuous 1 g
Vibration resistance with SD card plugged	15 Hz ... 150 Hz, continuous 1 g
Shock resistance	All three axes 15 g, 11 ms, half-sinusoidal

1.3.1.7 Earthing

The AC31 adapter devices can be earthed as follows:

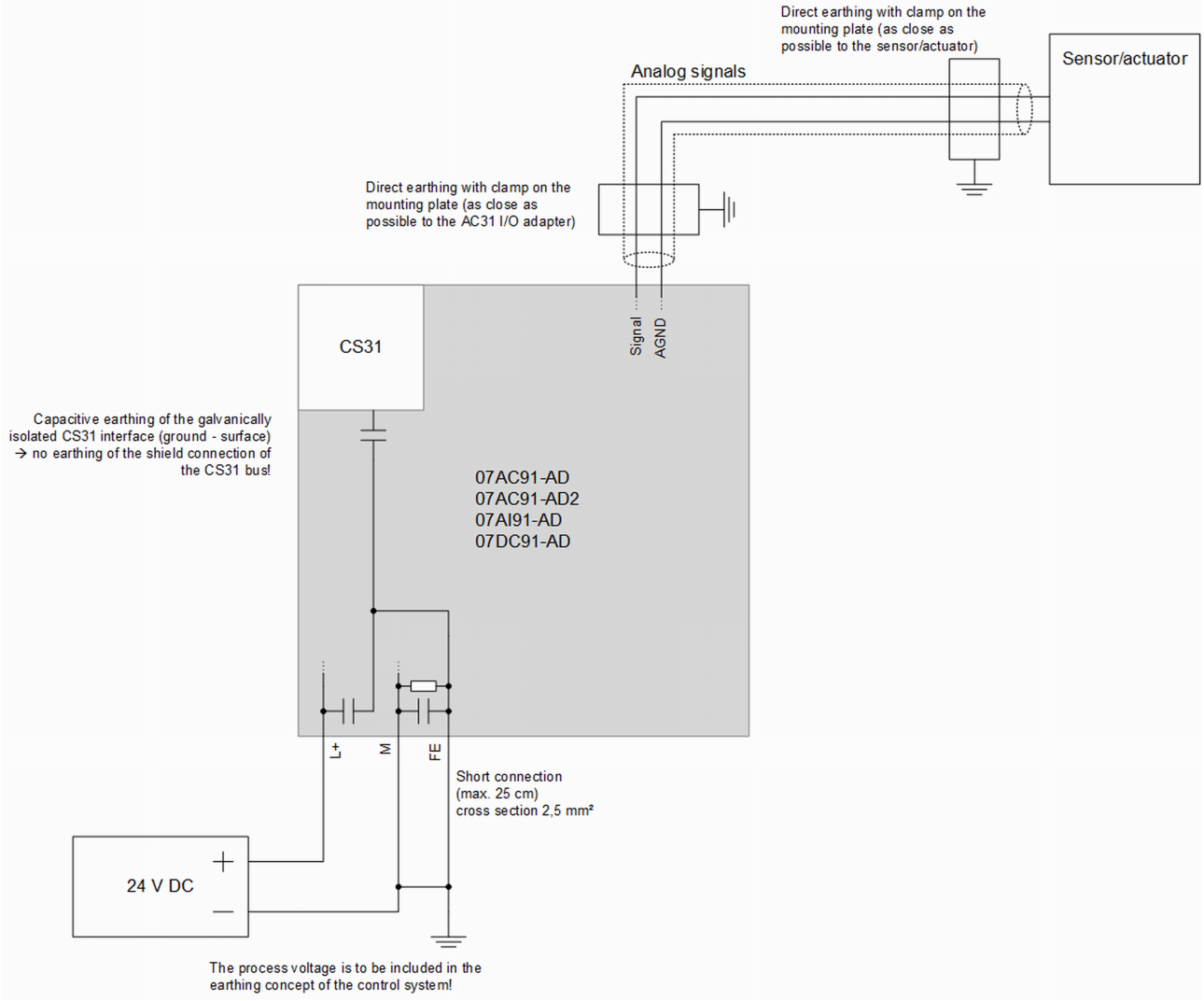


Fig. 1: Earthing of devices 07AC91-AD, 07AC91-AD2, 07AI91-AD and 07DC91-AD

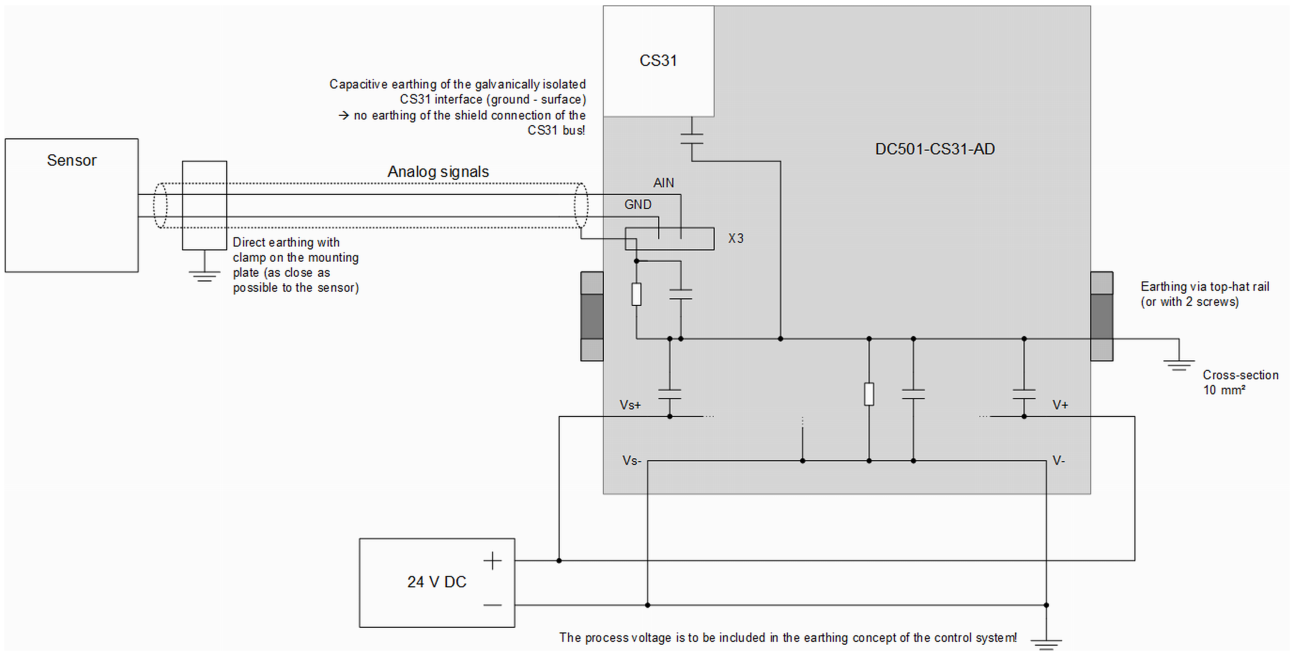


Fig. 2: Earthing of device DC501-CS31-AD

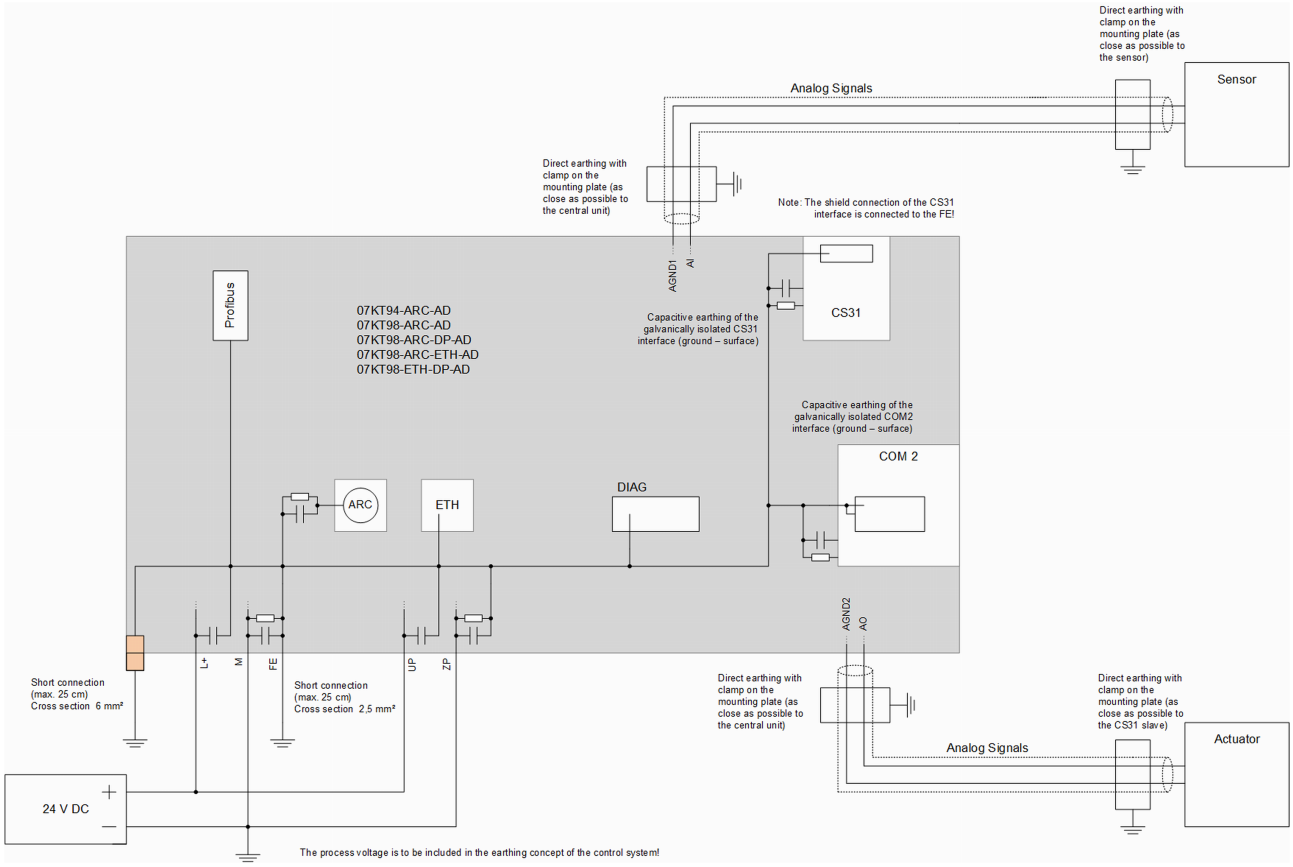


Fig. 3: CPU earthing

When earthing the replacement devices, observe the following:

- Install the AC31 adapter devices onto an earthed mounting plate to ensure a uniform reference potential of all equipment.
- Implement the connections between switchgear cabinet, mounting plate, PE rail and shield rail with low impedance.
- Install the lines in groups (power lines, power supply lines, signal lines, data lines).
- Use lines with braided cable shield for analog signals. Earth the shield on both sides and make sure that no compensation currents flow through the cable shield. For this purpose, use a potential equalization line with current carrying capacity, for instance on systems consisting of several switchgear cabinets.

Further information concerning CS31 bus earthing: ↳ *Chapter 1.3.2.3 “Earthing” on page 14*

1.3.2 CS31 bus system data

1.3.2.1 Wiring

Bus line:

Data	Value
Configuration	2 cores, twisted, with common shield
Cross section	> 0.22 mm² (24 AWG) Recommendation: 0.5 mm² corresponds to Ø 0.8 mm
Twisting rate	> 10/m (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	approx. 120 Ω (100 ... 150 Ω)
Capacitance between the cores	< 55 nF/km (in case of higher capacitance values, the maximum possible bus length is reduced)
Terminating resistors	120 Ω ¼ W at both ends
Notes	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 terminating resistor is 100 Ω. Cables with PE core insulation can be used up to a length of approx. 500 m.

The baud rate used on the CS31 bus is 187.5 kBaud.

1.3.2.2 Bus topology

A CS31 system bus always contains only one CS31 bus master to control the bus. Up to 31 CS31 slaves can be controlled by one bus. The CS31 bus master has no address, whereas the CS31 slaves can accept addresses in the range from 0 - 61, depending on CS31 slave type.

Possible CS31 bus master:

- 07KT94-ARC-AD, 07KT94
- 07KT98-ARC-AD, 07KT98

- 07KT98-ARC-DP-AD ([1])
- 07KT98-ARC-ETH-AD ([1])
- 07KT98-ETH-DP-AD ([1])

([1]): planned, but not yet available

Possible CS31 slaves:

- 07AC91-AD, 07AC91
- 07AC91-AD2
- 07AI91-AD, 07AI91
- 07DC91-AD, 07DC91
- DC501-CS31-AD, DC501-CS31

The following diagram shows the bus topology without shielding and earthing treatment:

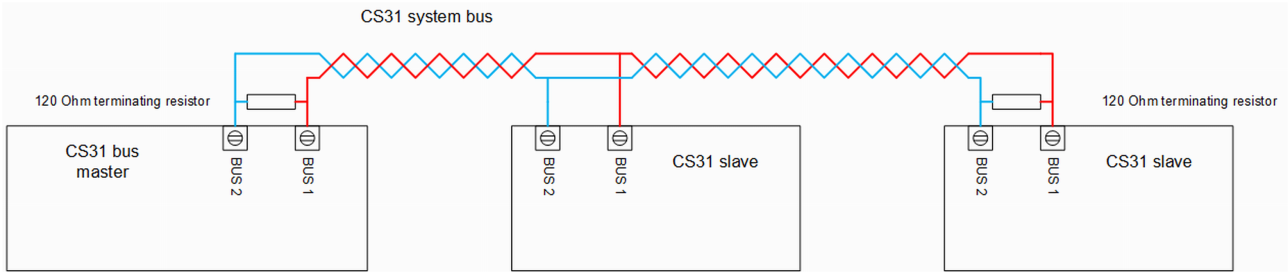


Fig. 4: Bus topology with CS31 bus master in the middle

The CS31 slave DC501-CS31-AD has an internal 120 Ω terminating resistor which can be connected by using a DIP switch. On the other CS31 slaves and the CS31 bus master, the terminating resistor must be installed externally by the user.

The following diagram shows the bus topology without shielding and earthing treatment:

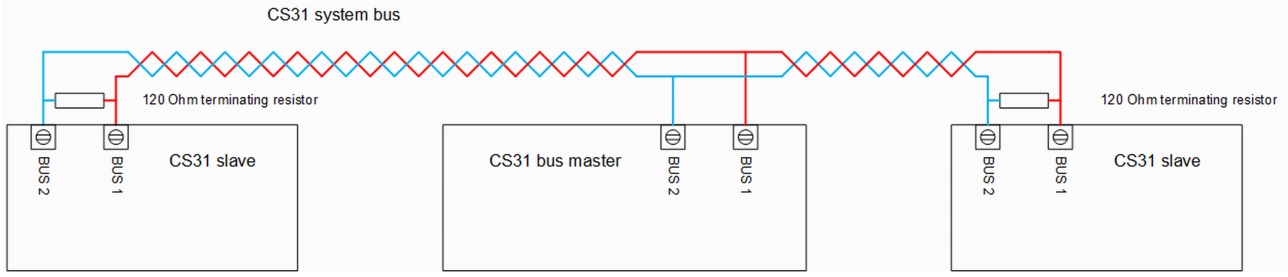


Fig. 5: Bus topology with CS31 bus master in the middle

CAUTION!

Risk of malfunctions!

Spur lines are not allowed within the CS31 bus. Loop the bus line from module to module.

CS31 cable laying without spur lines:

Correct cable laying:

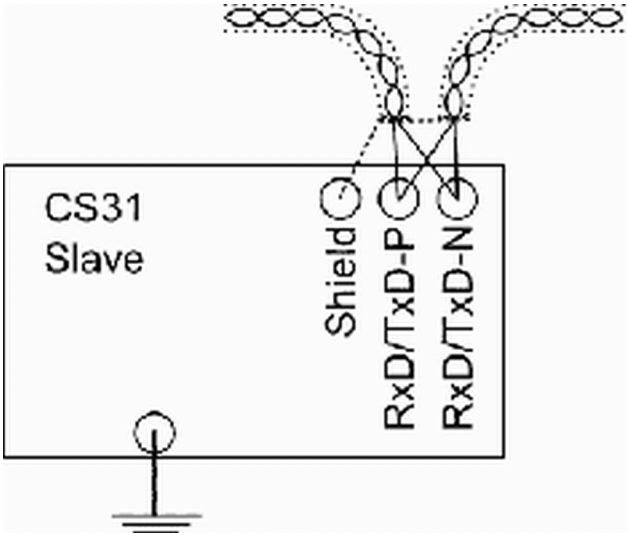


Fig. 6: CS31_PM554_PM564-03

Incorrect cable laying:

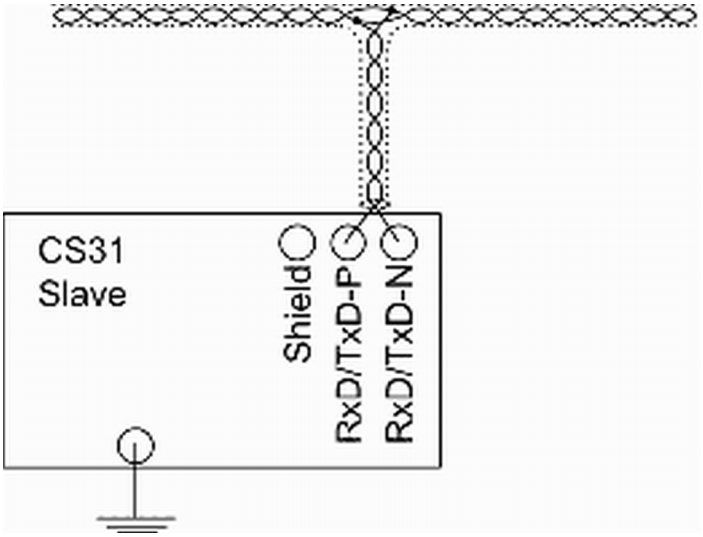


Fig. 7: CS31_PM554_PM564-04

1.3.2.3 Earthing

In order to avoid disturbances, earth the cable shields directly.

Case a: Several switchgear cabinets (current carrying capacity):

Choose direct earthing if it can be ensured by means of current carrying metal connections (steel constructions, earth bars, etc.) that no potential differences can occur.

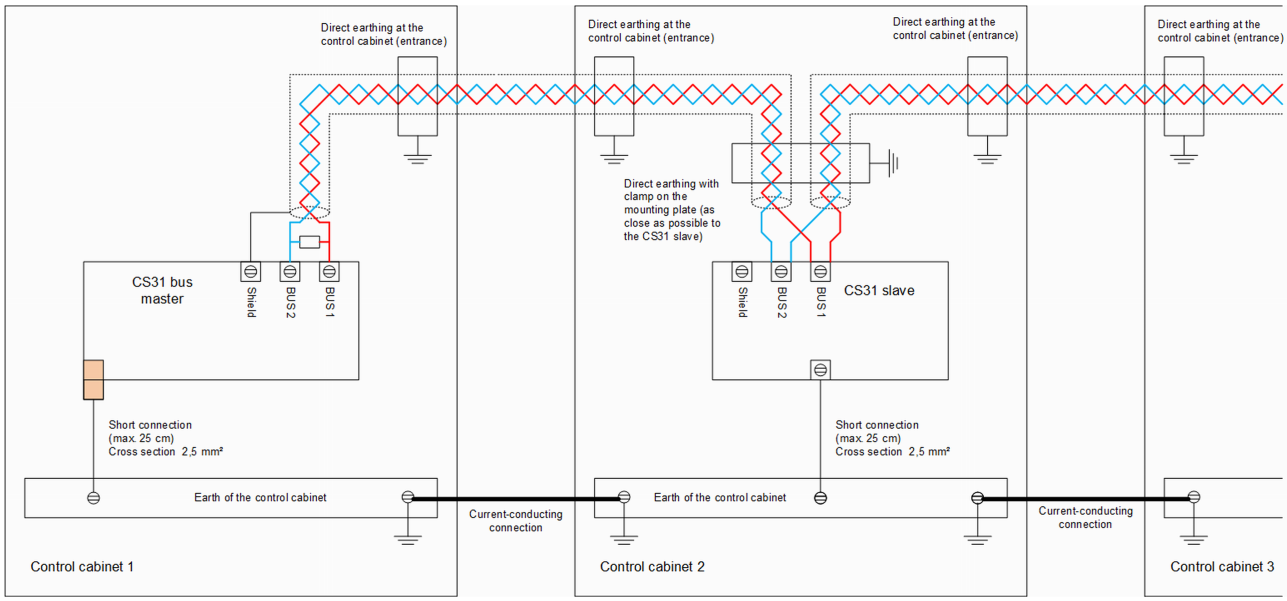


Fig. 8: Direct earthing of CS31 bus master and CS31 slave

The shield connection of the CS31 bus master is internally connected to the earth terminal.

Case b: Several switchgear cabinets (without current carrying capacity):

Use capacitive earthing if the connection between equipment parts is non-current carrying conductive. This prevents the flow of compensation currents through the cable shields.

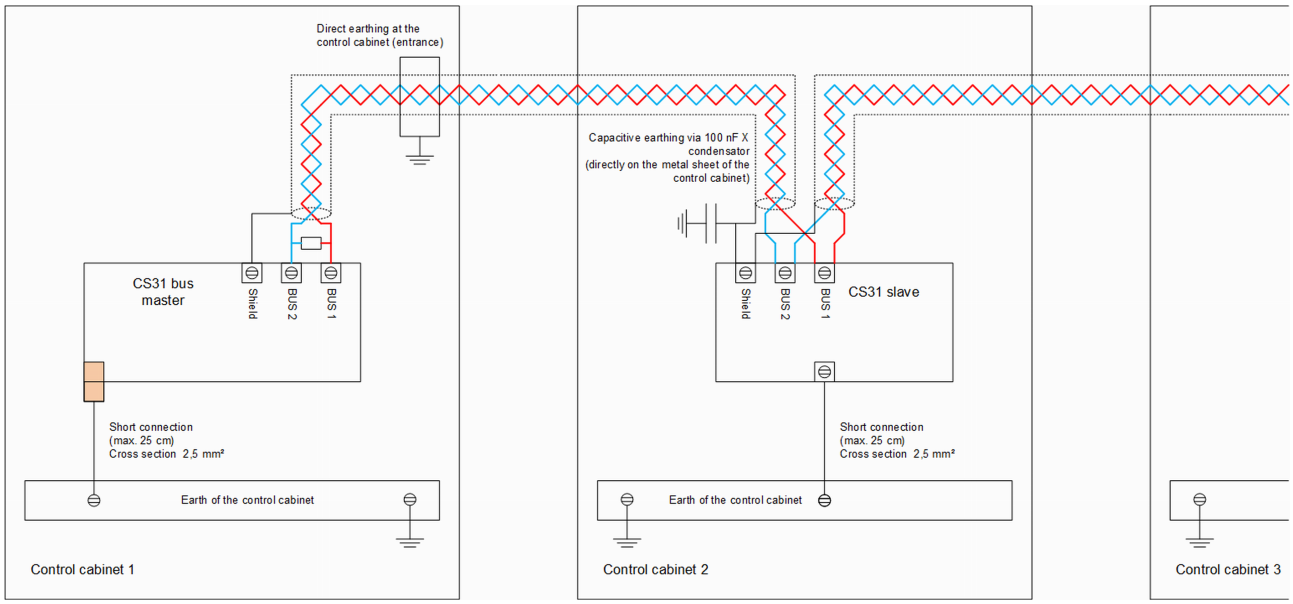


Fig. 9: Direct earthing of CS31 bus master and capacitative CS31 slave

On the CS31 slave, the shield connection is not connected internally and thus not earthed. The shield connection can be used to connect the shields of two cables.

VDE 0160 requires that the system's shield is earthed directly at least once.

1.3.2.4 Bus cycle time and data security

The communication via the CS31 bus is cyclic and controlled by the CS31 bus master.

Fig. 10: Format of request telegram of a CS31 bus master

In each cycle, the CS31 bus master successively polls all existing CS31 slaves at regular intervals, performs a diagnosis on one of the existing CS31 slaves and sends a request to search for added CS31 slaves. Thus, on one hand it is possible to maintain a continuous diagnosis of the proper network function and on the other hand to take all the newly added CS31 slaves into account.

Fig. 11: Format of response telegram of a CS31 slave

The CS31 slaves respond to the telegrams of the CS31 bus master with a response telegram (see diagram above). The data are indicated in the documentation of the individual devices (e.g. 07AC91-AD2). The telegram is ignored when a CS31 slave or a CS31 bus master detects a deviation between the received CRC and the self-calculated CRC. A CS31 bus error exists when 10 faulty telegrams are issued successively.

The bus cycle time is composed of a base time, the bus transmission times of the data of the individual CS31 slaves and the bus idle times between the individual telegrams.

During the base time, the CS31 bus master performs a diagnosis and searches for newly added CS31 slaves. This time depends on the control system (PLC / central unit) and is partially configurable:

- Devices 07KT94 and 07KT98: base time 2 ms
- Device 07KT94-ARC-AD: base time 10 ms ([2])
- Devices 07KT98-ARC-AD, 07KT98-ARC-DP-AD ([1]), 07KT98-ARC-ETH-AD ([1]), 07KT98-ETH-DP-AD ([1]): base time 5 ms to 100 ms (configurable in Automation Builder, parameter "Min update time")

([1]): planned, but not yet available

([2]): The base time of device 07KT94-ARC-AD cannot be configured since the old programming environment (907 PC 331) must be used.

The bus transmission times of the data of the individual CS31 slaves can be determined as follows:

- Duration for the transmission of 1 byte = (1/187.5 kBaud) x 8 = 43 µs
- Determine number of data bytes (sending + receiving) from existing documentation
- Add 3 bytes for the transmission of the address and CRCs

Per CS31 slave, approx. 0.5 ms can be assumed as bus idle time. The CS31 bus master needs this time to process the data. This time depends on the computing power and on the implementation of the CS31 bus master. This time can vary between various firmware versions.

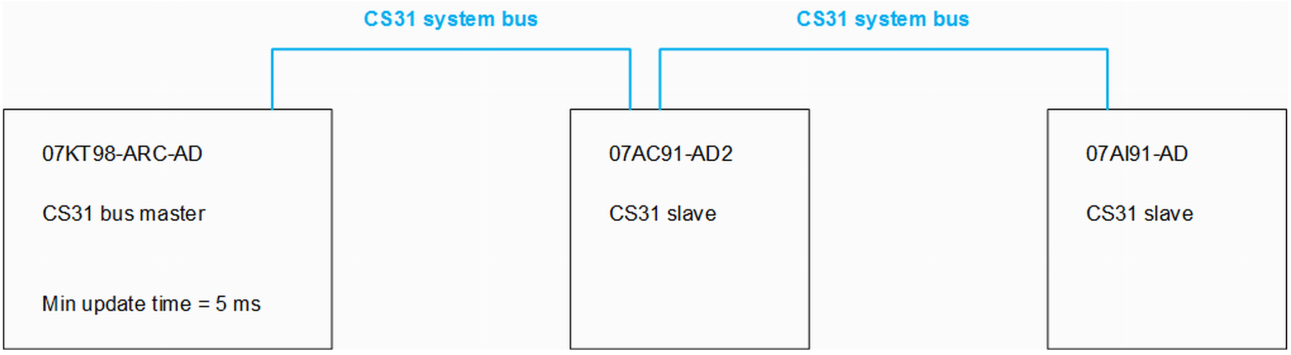


Fig. 12: Example bus cycle time

Example: Bus cycle time:

Base time	Min. update time = 5 ms		5000 µs
Bus transmission time 07AC91-AD2	Receiving 16 byte data	16 x 43 µs	688 µs
	Sending 16 byte data	16 x 43 µs	688 µs
	3 byte address + CRCs	3 x 43 µs	129 µs
Bus idle time	-	-	500 µs
Bus transmission time 07AI91-AD	Sending 16 byte data	16 x 43 µs	688 µs
	3 byte address + CRCs	3 x 43 µs	129 µs
Bus idle time	-	-	500 µs
Bus cycle time (sum)	-	-	8322 µs ≈ 8500 µs

1.3.2.5 Configuration

Below is a description of the configuration of the devices 07KT98-ARC-AD, 07KT98-ARC-DP-AD ([1]), 07KT98-ARC-ETH-AD ([1]) and 07KT98-ETH-DP-AD ([1]) in the Automation Builder software. For further information on Automation Builder, please refer to the AC500 documentation.

([1]): planned, but not yet available

The configuration of the CS31 slaves takes place only by means of DIP switches (see existing documentation), whereby the configuration of the CS31 bus topology is carried out in the CS31 bus master.

The configuration of the devices 07KT94 and 07KT94-ARC-AD is carried out with the DOS program "907 PC 331". Further information on configuration is available in the existing documentation.

Configure the COM1 interface as CS31 bus master:

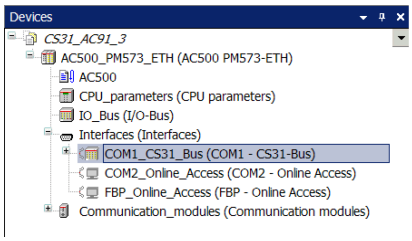


Fig. 13: CS31 bus master

The "Min update time" parameter can also be set on the CS31 bus master:

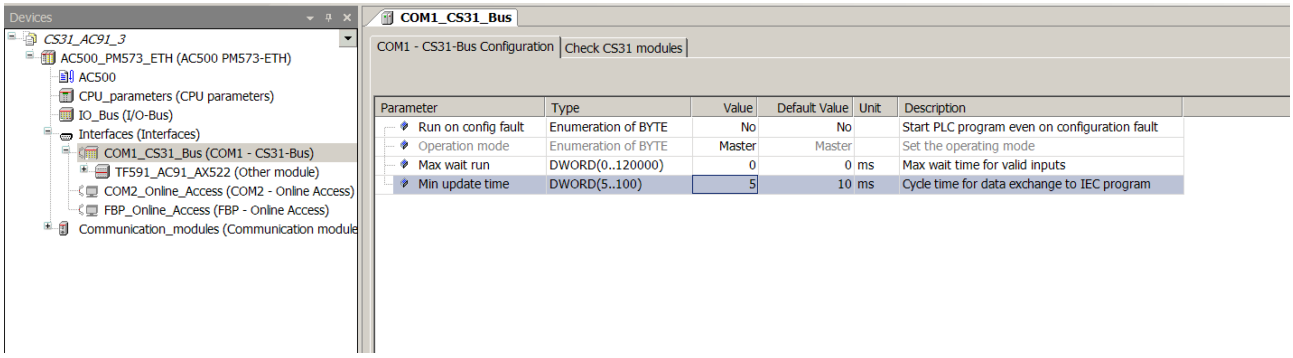


Fig. 14: Parameter configuration

The individual CS31 slaves must be configured in the tree structure under the CS31 bus master:

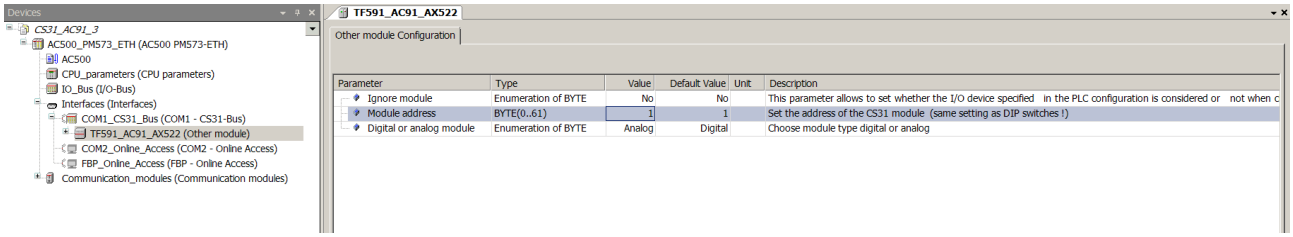


Fig. 15: CS31 slave

The module address must be set on each CS31 slave. Specify the same module address that has been selected with the DIP switches.

Set the CS31 slave type (analog/digital):

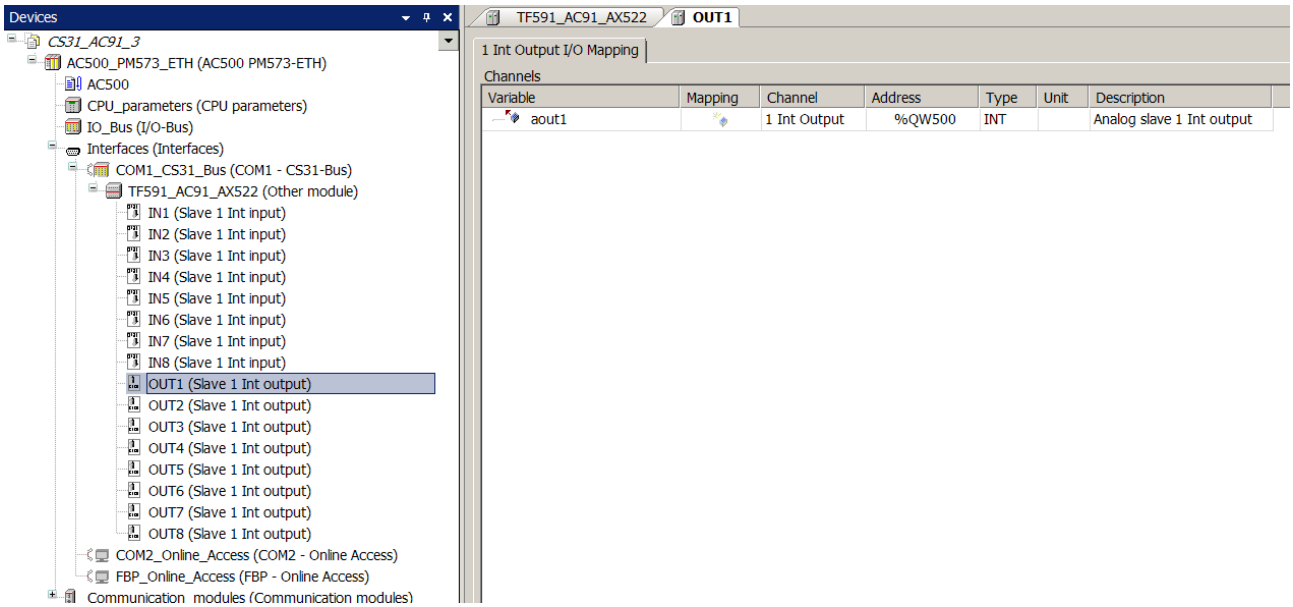


Fig. 16: CS31 slave configuration

The data must be configured in the tree structure under the CS31 slave. Information about the number of input and output data can be obtained from the respective documentation of the CS31 slaves.

If the data represent bipolar values (e.g. voltage from -10 V…+10 V), the use of the data type 'Int' is appropriate. In case of unipolar values (e.g. current from 0 mA…20 mA), the data type 'Word' can be used.

1.3.2.6 Diagnosis

For the diagnosis of the CS31 system bus, various mechanisms are available in the CS31 bus master of the devices 07KT98-ARC-AD, 07KT98-ARC-DP-AD ([1]), 07KT98-ARC-ETH-AD ([1]) and 07KT98-ETH-DP-AD ([1]):

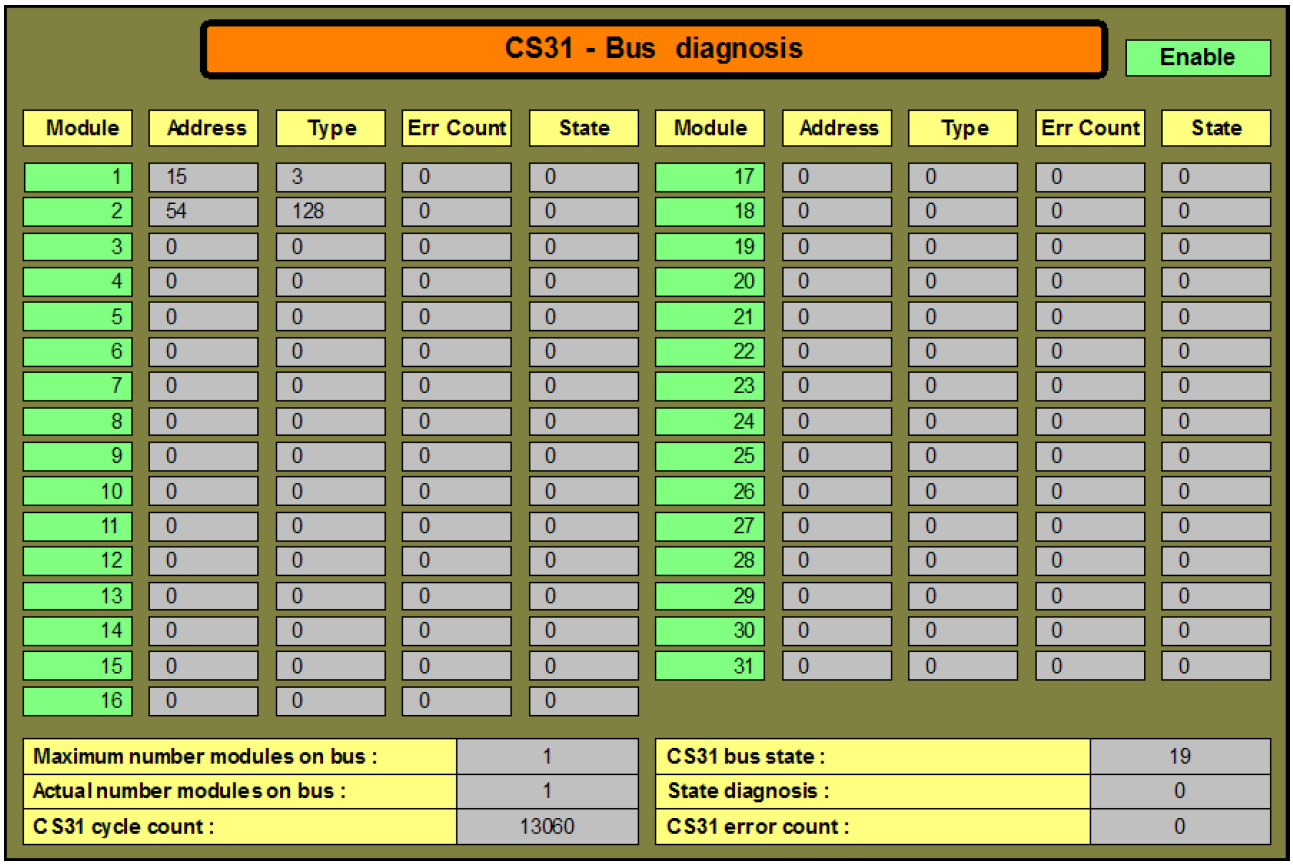
- Diagnosis via the function block `CS31_DIAG`
- Diagnosis system of the AC500 series

([1]): planned, but not yet available

For further information on both mechanisms, please refer to the AC500 documentation. Below, only a few special diagnosis functions of the AC31 adapter are addressed.

Function block `CS31_DIAG`:

In the 'State' column, the variable `byStateDiag` of the structure `strCS31_DiagOneModule` is indicated for every CS31 slave.



Module	Address	Type	Err Count	State	Module	Address	Type	Err Count	State
1	15	3	0	0	17	0	0	0	0
2	54	128	0	0	18	0	0	0	0
3	0	0	0	0	19	0	0	0	0
4	0	0	0	0	20	0	0	0	0
5	0	0	0	0	21	0	0	0	0
6	0	0	0	0	22	0	0	0	0
7	0	0	0	0	23	0	0	0	0
8	0	0	0	0	24	0	0	0	0
9	0	0	0	0	25	0	0	0	0
10	0	0	0	0	26	0	0	0	0
11	0	0	0	0	27	0	0	0	0
12	0	0	0	0	28	0	0	0	0
13	0	0	0	0	29	0	0	0	0
14	0	0	0	0	30	0	0	0	0
15	0	0	0	0	31	0	0	0	0
16	0	0	0	0					

Maximum number modules on bus :	1	CS31 bus state :	19
Actual number modules on bus :	1	State diagnosis :	0
CS31 cycle count :	13060	CS31 error count :	0

Fig. 17: Visualization: CS31 bus diagnosis

Interpretation of variable `byStateDiag`:

Bit	Value	Description
0	1	CS31 slave disconnected
1	2	Not used
2	4	CS31 slave on bus not configured
3	8	Difference in the number of data bytes between configuration and CS31 system bus
4	16	Internal device error
5	32	Channel error
6	64	Not used
7	128	Not used

All bits of `byStateDiag` equal 0 -> no error in CS31 slave.

The variables `byDiagChannel` and `byDiagErr` in the structure `strCS31_DiagOneModule` contain the channel of the error and an error code. The possible values of these variables are indicated in the documentation of the respective CS31 slave.

Diagnosis system of the AC500 series:

The Diagnosis system of the AC500 series provides the errors in the following format:

Error messages AC500 series:

Format	e.g. name of PLC browser command diagshow all	Description
Error class	Class	1 to 4 (see AC500 documentation)
Faulty component	Comp	11 (COM1 interface, here for the CS31 system bus)
Faulty device	Dev	Address of CS31 slave with error
Faulty module	Mod	CS31 type of CS31 slave with error (e.g. 5 for analog input/ output)
Faulty channel	Ch	See existing documentation of CS31 slave
Error code	Err	See existing documentation of CS31 slave

A CS31 slave error is indicated by an error LED on the CS31 slave. The error LED remains on even after elimination of the error and is switched off only after the error has been acknowledged by the CS31 bus master.

The acknowledgment of a CS31 slave error can take place via the CS31 bus master by means of the function block `CS31QU_EXT` (see AC500 documentation).

1.4 Replacement devices: CPU

For AC31 devices of the 90 series, AC31 adapters (replacement devices) are available for the exchange of the CPU.

1.4.1 Replacement device 07KT9x-AD

1.4.1.1 Introduction

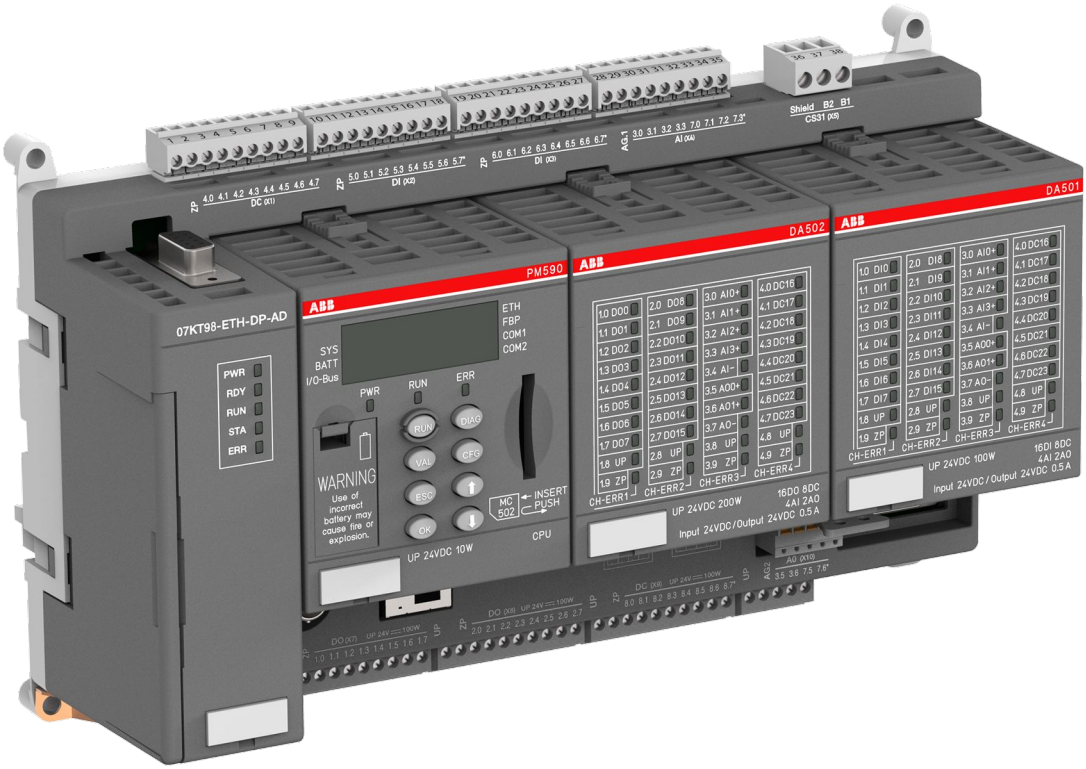


Fig. 18: 3ADR331183S0015

The replacement device versions 07KT9x-AD of the AC31 adapter series replace the existing devices 07KT94 and 07KT98 of the AC31 devices of the 90 series.

Versions:

- 07KT94-ARC-AD: I/O module DA501, I/O module DA502, CPU EC581
- 07KT98-ARC-AD: I/O module DA501, I/O module DA502, CPU PM590-ARC

During the development of the replacement devices, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07KT98 remains valid and serves as reference (system description Advant Controller 31 *http://www.abb.de/search.aspx?abbcontext=products&q=2cdc120009M0**). The document structure of this document is based on the document structure of the existing documentation.

This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices 07KT9x-AD can be found in the operating and assembly instructions of device 07KT9x-AD: 3ADR020082M0401.

Please observe the system data for CS31 bus *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

For general information on the CPU, please refer to the AC500 documentation (e.g. error diagnosis via the LED display).

In addition to the CPU, the replacement devices 07KT9x-AD are based on the modules DA501 and DA502 of the AC500 series. All I/O channels are protected against reverse polarity, reverse supply, short circuit and continuous overvoltages up to 30 V DC. For further information on these modules, please refer to the AC500 documentation.

The description of the protective functions, error indications and diagnosis options contained in the existing documentation are no longer valid. Please refer to the AC500 documentation (DA501-/ DA502 modules and CPU) concerning this information.

1.4.1.2 Central unit 07KT98

1.4.1.2.1 Short description

The central unit 07KT9x-AD acts as

- bus master in the decentralized automation system.
  Slave operation is not possible.
- Advant Controller 31 or as stand-alone central unit.

Main features:

- 16 digital inputs with LED display.
  Caution! Electrical isolation/potential reference has changed.
- 16 digital outputs with LED display.
  Caution! Electrical isolation/potential reference has changed.
- 16 digital inputs/outputs with LED display.
  Caution! Electrical isolation/potential reference has changed.
- 8 individually configurable analog inputs. Available modes *Chapter 1.4.1.3.1.7 “Connection of the 8 configurable analog inputs” on page 37*.
  Caution! Electrical isolation/potential reference has changed.
- 4 individually configurable analog outputs.
  Caution! Electrical isolation/potential reference has changed.
- 2 counters for counting frequencies up to 50 kHz, configurable in 10 different modes.
  Caution! Each counting input requires an external resistor of 470 Ω / 1 W that is connected upstream. The potential reference has changed.
- 1x serial interface COM2
  – Modbus RTU, master and slave
  – An online access (RS-232 programming interface for PC/Automation Builder)
  – A free protocol (communication via the blocks COM_SEND and COM_REC)

- 1x serial diagnosis interface DIAG
  Caution! No electrical isolation to supply voltage L+/M.
- LED LCD display to indicate operating conditions and error messages
- Fastening by screws or snapping onto top-hat rail
- Lithium battery TA521
- Various operating buttons for user input
- Comprehensive diagnosis functions
- Integrated Flash EPROM, RAM and memory for storing programs and data
- Exchangeable SD memory card MC502

Project planning/ commissioning:

07KT98-ARC-AD: Software: Automation Builder (see AC500 documentation)

07KT94-ARC-AD: Software: 907PC331

1.4.1.2.2 Functionality

Comparison: Existing device vs. replacement device:

Designation	Existing device: 07KT98	Replacement device: 07KT9x-AD	Note
User program	1 MB	CPU PM590: 2 MB storage, memory card slot	-
User data	1 MB + 256 kB RETAIN + 128 kB (Flash EPROM)	CPU PM590: 2 MB storage, memory card slot	-
Digital inputs	24 in 3 groups (8 each), electrically isolated	16 in 2 groups (8 each). Caution: Potential reference/electrical isolation	Potential reference/electrical isolation has changed ([1]).
Digital outputs	16 transistor outputs in 2 groups (8 each), electrically isolated	16 in 2 groups (8 each). Caution: Potential reference/electrical isolation	Potential reference/electrical isolation has changed ([1]).
Digital inputs/outputs	8 in 1 group, electrically isolated	16 in 2 groups (8 each). Caution: Potential reference/electrical isolation	Potential reference/electrical isolation has changed ([1]).
Analog inputs	8 in 1 group, individually configurable to 0 ... 10 V, 0 ... 5 V, ±10 V, ±5 V, 0 ... 20 mA, 4 ... 20 mA, Pt100 (2-wire or 3-wire), differential inputs, digital inputs	8 in 1 group, individually configurable 0..10 V, ±10 V, 0..20 mA, 4 ... 20 mA, Pt100/ PT1000/ Ni1000 (2-wire or 3-wire), differential inputs, digital inputs	Potential reference has changed ([1]). Some wiring adjustments are required in part. 5 V measuring ranges can be shown with 10 V measuring range.
Analog inputs (can also be configured as digital inputs)	Yes	Yes	Caution: AGND reference to ZP no longer M

Designation	Existing device: 07KT98	Replacement device: 07KT9x-AD	Note
Analog outputs	4 in 1 group, individually configurable to ± 10 V, 0 ... 20 mA, 4 ... 20 mA	4 in 1 group, individually configurable to ± 10 V, 0 ... 20 mA, 4 ... 20 mA	Caution: AGND reference to ZP no longer M ([1]). Some wiring adjustments are required in part.
Serial Interfaces	COM1, COM2 as MODBUS interfaces, for programming and test functions as well as freely programmable interfaces	COM2 (programming function, test function, free protocol) DIAG (diagnosis interface)	The serial COM1 interface of 07KT9x is no longer available. The serial diagnosis interface DIAG has a reduced range of functions and is not electrically isolated from the supply voltage L +/M.
Parallel interface	For connection to coupler	For connection to coupler	Additional information upon request.
System bus interface	CS31	CS31	Caution: Terminal "Shield" is internally connected to FE (functional earth).
High-speed counter	Integrated, many functions configurable	Integrated, many configurable operating modes	At the counting input, an external resistor of 470 Ω / 1 W must always be connected upstream. For further information on high-speed counters, please refer to the AC500 documentation.
Real time clock	Integrated	Integrated	-
Memory card	SmartMedia Card: Storage medium for operating system, user program and user data	SD memory card MC502: for the backup of user data, storage of the user program and update of the internal CPU firmware	-
Display LEDs	For signal states, operating conditions and error messages	Indication on LEDs and LCD display	-
Supply voltage	24 V	24 V	-
Data buffering	With lithium battery 07 LE 90	With lithium battery TA521	-

Designation	Existing device: 07KT98	Replacement device: 07KT9x-AD	Note
Programming software	907 AC 1131 as of V 4.1 (07KT98 with ARCNET interface) 907 AC 1131 as of V 4.3 (07KT98 with PROFIBUS-DP interface)	Automation Builder as of V1.1	-
Processing time	Processing time: 65% bit, 35% word, for 1 kB program, typ. 0.07 ms	Cycle time for 1 instruction (CPU PM590). Binary: min. 0.002 µs, word: min. 0.004 µs, floating point: min. 0.004 µs	-

([1]): ↳ *further information on page 29*

Comparison: Replacement device versions:

	07KT94-ARC-AD	07KT98-ARC-AD
ARCNET	x	x
CS31	x	x
Parallel interface for connection to coupler	-	x
Cycle time for 1 instruction	CPU EC581: n.a.	CPU PM590: -> Binary: min. 0.002 µs -> Word: min. 0.004 µs -> Floating point: min. 0.004 µs

Versions available for 07 KT 98 central units:

Please refer to previous chapter ↳ *"Comparison: Replacement device versions:" on page 26*.

Suitable SmartMedia cards:

The 07KT9x-AD systems use memory cards of the type "SD Memory Card MC502".

1.4.1.3 Device configuration

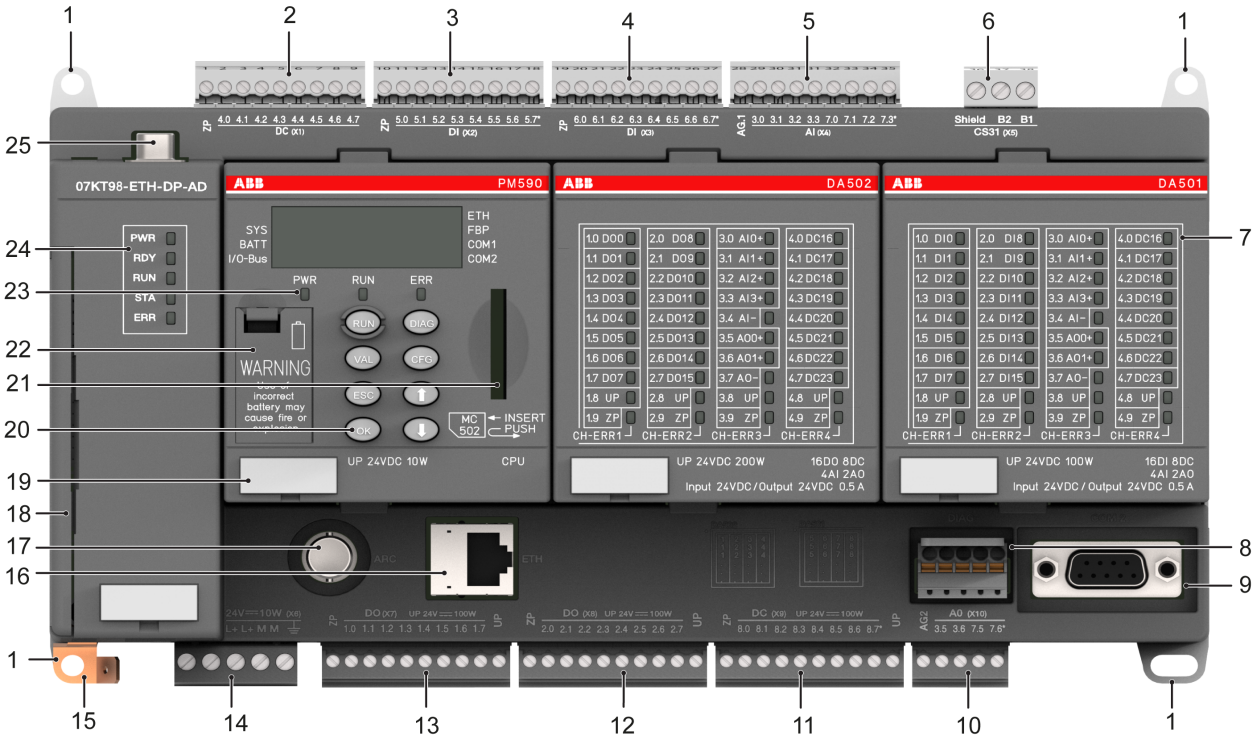


Fig. 19: 3ADR333186F0015_07KT98-ETH-DP-AD_Front

For information on the available I/O modules DA501 and DA502, please refer to the AC500 documentation. The CPU module used (here: PM590) depends on the model version.

No.	Description
1	Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
2	Digital inputs/outputs for DA502
3	Digital inputs for DA501
4	Digital inputs for DA501
5	Analog inputs for DA501/DA502
6	CS31 Interface
7	Status LEDs for DA501/DA502
8	DIAG: Serial interface (diagnosis)
9	COM2: Serial interface (thread UNC 4-40)
10	Analog outputs for DA501/DA502 ±10 V, 0 ... 20 mA, 4 ... 20 mA in one group
11	Digital inputs/outputs for DA501
12	Digital outputs for DA502

No.	Description
13	Digital outputs for DA502
14	Supply voltage connection 24 V DC (CPU and coupler)
15	Earth connection (FE). Connection for 6.3 mm Faston.
16	Ethernet: Network interface (function depends on device version)
17	Interface for ARCNET (BNC)
18	External networking interface
19	TA525: Label
20	8 operating buttons
21	SD memory card
22	Battery compartment for lithium battery TA521
23	3 system LEDs
24	5 status LEDs (only for PROFIBUS)
25	Connection for PROFIBUS (optional) (function depends on device version)

1.4.1.3.1 Electrical connection

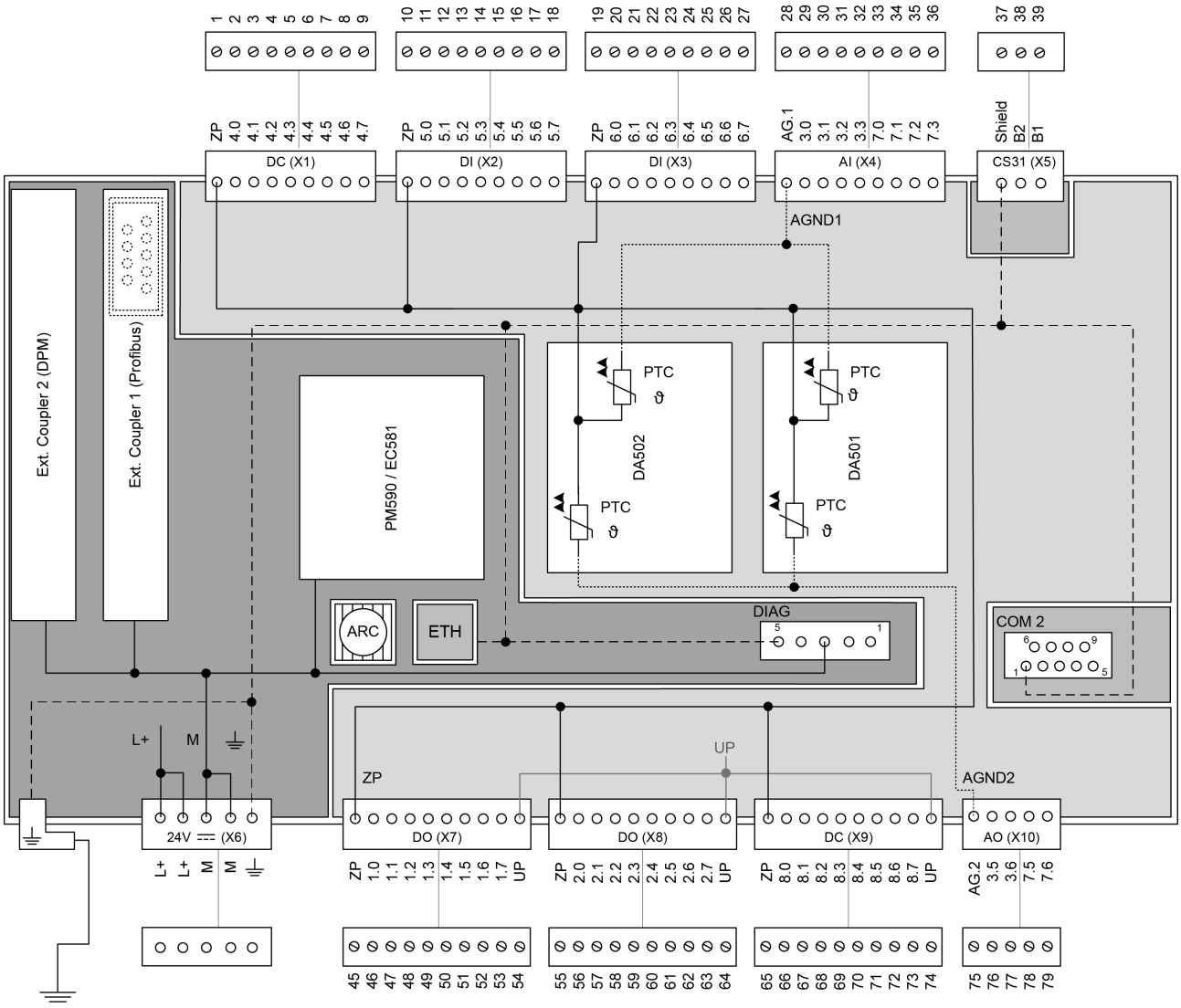


Fig. 20: Terminal assignment 07KT9x-AD

DIAG	No electrical isolation (M)
COM2	Electrically isolated
CS31	Electrically isolated
Ethernet	Electrically isolated
ARCNET	Electrically isolated
DA501/DA502	Electrically isolated

Further information on earthing: ↳ *Chapter 1.3.1.7 “Earthing” on page 9*.

Application example for connecting the inputs and outputs

Please observe the following information: ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*

Connection of the supply voltage

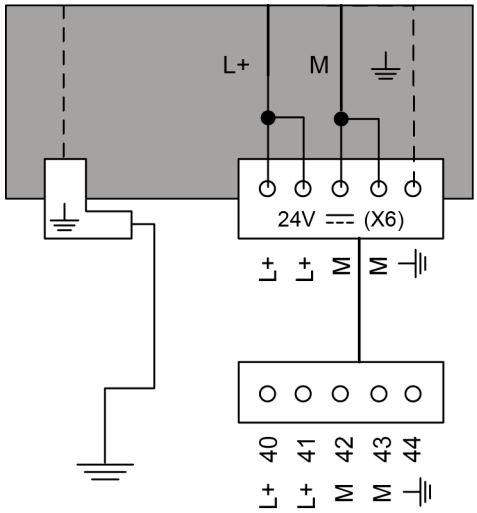


Fig. 21: Connection of the supply voltage

Connector (X6):

Connector / Terminal	Pin	Assignment / Signal
X6 / L+	40	Supply voltage +24 V DC
X6 / L+	41	Supply voltage +24 V DC
X6 / M	42	Earth connection (0 V)
X6 / M	43	Earth connection (0 V)
X6 / functional earth	44	The functional earth (FE) is connected to the Faston terminal inside the device. Ensure that no earth loops are created and that FE and Faston are connected to the same earthing potential.

- In addition to connecting the supply voltage (L+/M) to X6, the supply voltage (UP/ZP) must be connected to all connectors.
- ZP must be connected to all connectors (X1, X2, X3, X7, X8, X9).
- UP must be connected to all connectors (X7, X8, X9).
- L+/M and UP/ZP must always be supplied with voltage.

Connection for CS31 system bus

Connector (X5):

Connector / Terminal	Pin	Assignment / Signal
X5 / shield	37	Shield (functional earth)
X5 / B2	38	BUS2
X5 / B1	39	BUS1

Terminal "Shield" is internally connected to FE. The previous earthing measures, e.g. with clip at the switchgear cabinet, are still required. ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*

If 07KT9x-AD is connected to one of the bus ends, a 120 Ω resistor must be connected for bus termination. The device 07KT9x-AD always functions as master. Slave operation is not possible. Further information on CS31 bus: ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*

Connection of digital inputs

See ↳ *further information on page 29*.

Connector X2:

Connector / Terminal	Pin	Assignment / Signal
X2 / ZP	10	ZP
X2 / 5.0	11	DA501 / DI0
X2 / 5.1	12	DA501 / DI1
X2 / 5.2	13	DA501 / DI2
X2 / 5.3	14	DA501 / DI3
X2 / 5.4	15	DA501 / DI4
X2 / 5.5	16	DA501 / DI5
X2 / 5.6	17	DA501 / DI6
X2 / 5.7	18	DA501 / DI7

Connector (X3):

Connector / Terminal	Pin	Assignment / Signal
X3 / ZP	19	ZP
X3 / 6.0	20	DA501 / DI8
X3 / 6.1	21	DA501 / DI9
X3 / 6.2	22	DA501 / DI10
X3 / 6.3	23	DA501 / DI11
X3 / 6.4	24	DA501 / DI12
X3 / 6.5	25	DA501 / DI13
X3 / 6.6	26	DA501 / DI14
X3 / 6.7	27	DA501 / DI15

In contrast to the existing device 07KT98, the function of the digital inputs is only possible if voltage UP is connected.

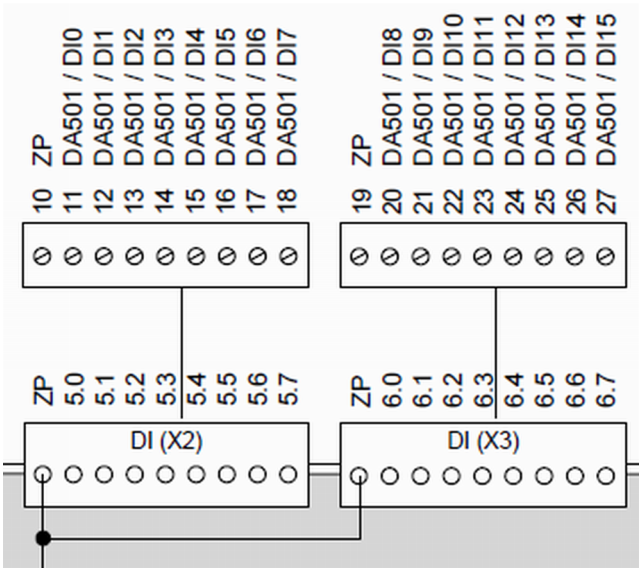


Fig. 22: Arrangement of the 16 digital inputs

The digital input states are always indicated by the LEDs DI0-DI15:

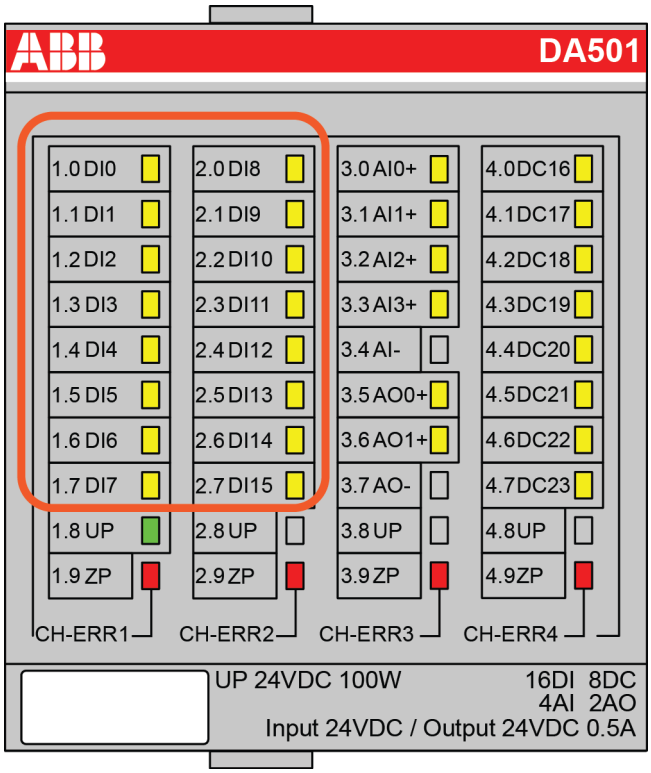


Fig. 23: DA501 LED status indication

Characteristics of the digital inputs:

- All 16 inputs have the same potential ZP as all other inputs/outputs. The electrical isolation included in the existing devices is no longer available.
- Input delay (0->1 or 1->0): typically 0.1 ms, configurable from 0.1 to 32 ms.

The signal coupling of the input signals is no longer realized via optocoupler. All channels of the DA501 and DA502 modules have reference to ZP. The AGND1/AGND2 of the analog channels are internally connected to ZP via PTC resistors. For information on terminal assignment, refer to figure Fig. 20).

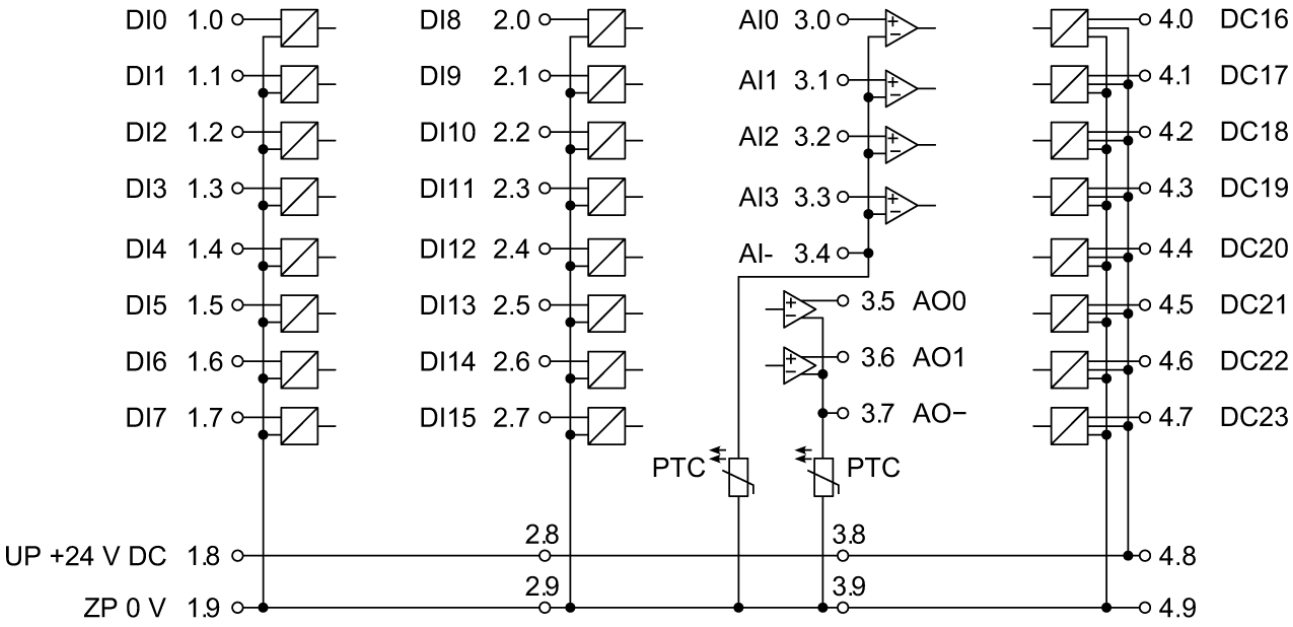


Fig. 24: Circuit arrangement of DA501 module

Connection of the digital outputs

See ↳ *further information on page 29*.

Connector (X7):

Connector / Terminal	Pin	Assignment / Signal
X7 / ZP	45	ZP
X7 / 1.0	46	DA502 / DO0
X7 / 1.1	47	DA502 / DO1
X7 / 1.2	48	DA502 / DO2
X7 / 1.3	49	DA502 / DO3
X7 / 1.4	50	DA502 / DO4
X7 / 1.5	51	DA502 / DO5
X7 / 1.6	52	DA502 / DO6
X7 / 1.7	53	DA502 / DO7
X7 / UP	54	UP

Connector (X8):

Connector / Terminal	Pin	Assignment / Signal
X8 / ZP	55	ZP
X8 / 2.0	56	DA502 / DO8
X8 / 2.1	57	DA502 / DO9
X8 / 2.2	58	DA502 / DO10
X8 / 2.3	59	DA502 / DO11
X8 / 2.4	60	DA502 / DO12
X8 / 2.5	61	DA502 / DO13
X8 / 2.6	62	DA502 / DO14
X8 / 2.7	63	DA502 / DO15
X8 / UP	64	UP

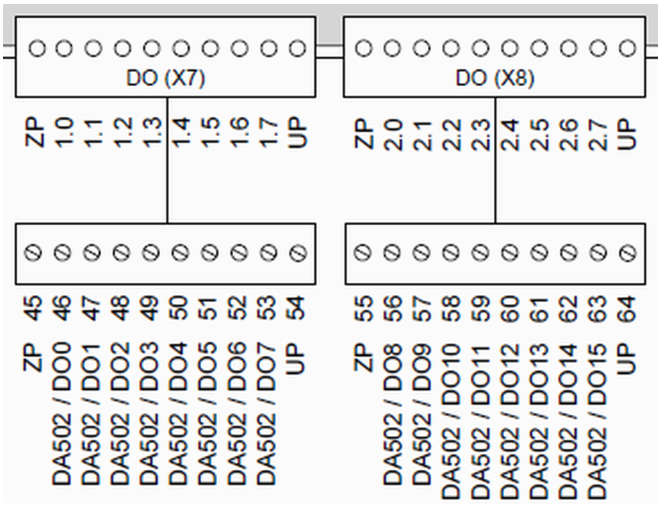


Fig. 25: Arrangement of digital outputs

Characteristics of the digital outputs:

- The digital output states are always indicated by the LEDs DO0-DO15 on DA501 module.
- All 16 outputs have the same potential ZP as all other inputs/outputs. The electrical isolation included in the existing devices is no longer available.
- Diagnosis: Stored errors are indicated via an LED and can be accessed by the CPU (see AC500 documentation).

Circuit arrangement of digital outputs:

Please observe the following information:

Fig. 24

↳ *"Circuit arrangement of the digital inputs/outputs:" on page 37*

Connection of the digital inputs/outputs

Connector (X1):

Connector / Terminal	Pin	Assignment / Signal
X1 / ZP	1	ZP
X1 / 4.0	2	DA502 / DC16
X1 / 4.1	3	DA502 / DC17
X1 / 4.2	4	DA502 / DC18
X1 / 4.3	5	DA502 / DC19
X1 / 4.4	6	DA502 / DC20
X1 / 4.5	7	DA502 / DC21
X1 / 4.6	8	DA502 / DC22
X1 / 4.7	9	DA502 / DC23

Connector (X9):

Connector / Terminal	Pin	Assignment / Signal
X9 / ZP	65	ZP
X9 / 8.0	66	DA501 / DC16
X9 / 8.1	67	DA501 / DC17
X9 / 8.2	68	DA501 / DC18
X9 / 8.3	69	DA501 / DC19
X9 / 8.4	70	DA501 / DC20
X9 / 8.5	71	DA501 / DC21
X9 / 8.6	72	DA501 / DC22
X9 / 8.7	73	DA501 / DC23
X9 / UP	74	UP

The arrangement of the 16 digital inputs/outputs is shown below:

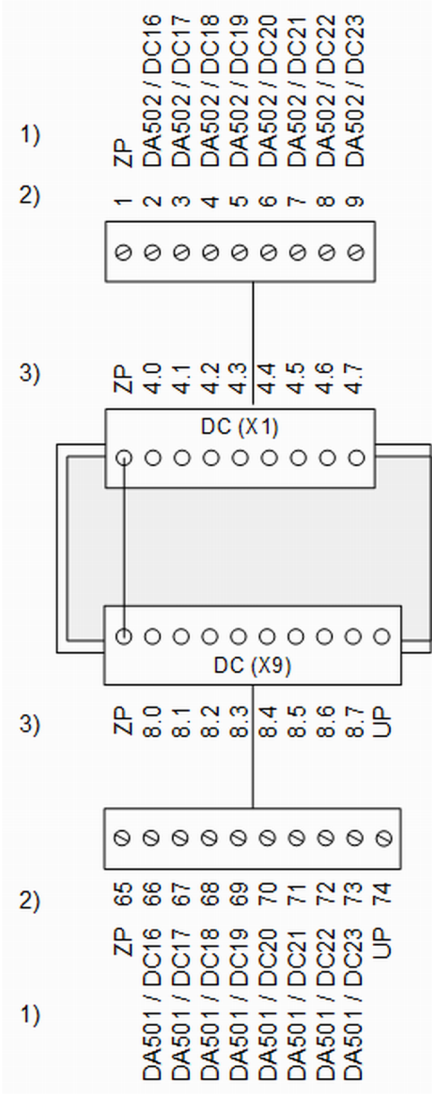


Fig. 26: Digital inputs/outputs

1) Module assignment
2) Terminal number
3) Terminal

Characteristics of the digital inputs/outputs:

- The digital input/output states are always indicated via the LEDs DC16 - DC23 on DA501 or DA502.
- All 16 inputs/outputs have the same potential ZP as all other inputs/outputs. The electrical isolation included in the existing devices is no longer available.
- Diagnosis: Stored errors are indicated via an LED and can be accessed by the CPU (see AC500 documentation).
- The inputs/outputs can be configured as input and as output. The outputs can also be read back.
- Input delay (0->1 or 1->0): typically 0.1 ms, configurable from 0.1 to 32 ms.
- The total current consumption of all 16 DC channels must not exceed 4 A.
- The total current consumption of all 16 DO and 16 DC channels must not exceed 12 A.

Circuit arrangement of the digital inputs/outputs:

Following is a diagram of the circuitry of a digital input/output with varistors for demagnetization when switching off inductive loads:

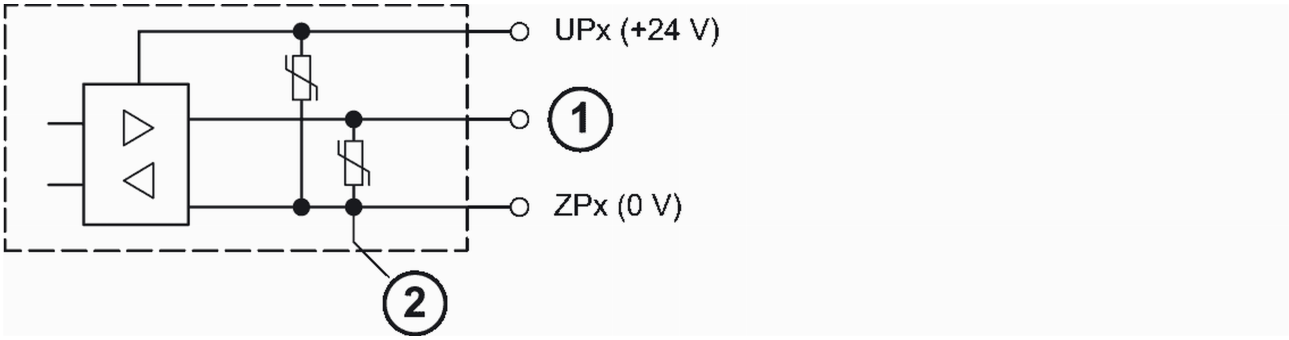


Fig. 27: Circuit arrangement

1 Digital input/output
2 For demagnetization when switching off inductive loads

The technical input data contained in the existing documentation are no longer valid.

Data	Value
Input signal voltage	24 V DC
0 signal	-3 V ... +5 V
Undefined signal state	> +5 V ... < +15 V
1 signal	+15 V ... +30 V

The varistor protection circuit has changed. The varistors for demagnetization are no longer located between UP and the respective channel, but rather between ZP and the respective channel. It is no longer possible to connect the voltage supply UP to connector X5 and thus use the input voltage range from -30 V to 30 V. At the inputs, only voltages from -3 V to +30 V may be applied. UP must always be connected to all connectors (X7, X8, X9).

Connection of the 8 configurable analog inputs

Connector (X4):

Connector / Terminal	Pin	Assignment / Signal
X4 / AG.1	28	AGND1
X4 / 3.0	29	DA502 / AI0+
X4 / 3.1	30	DA502 / AI1+
X4 / 3.2	31	DA502 / AI2+
X4 / 3.3	32	DA502 / AI3+
X4 / 7.0	33	DA501 / AI0+
X4 / 7.1	34	DA501 / AI1+

Connector / Terminal	Pin	Assignment / Signal
X4 / 7.2	35	DA501 / AI2+
X4 / 7.3	36	DA501 / AI3+

To be able to use the analog inputs, UP must be connected. L+/M and UP/ZP must always be supplied with voltage.

The analog channels offer self-protective functions and diagnosis options in the following situations:

- Above range of analog value (input)
- Above range of analog value (output)
- Below range of analog value (input)
- Below range of analog value (output)
- Wire breakage
- Short circuit

For further information on behavior and indication of these errors, please refer to the AC500 documentation. The arrangement of the 8 analog inputs is shown below on X4.

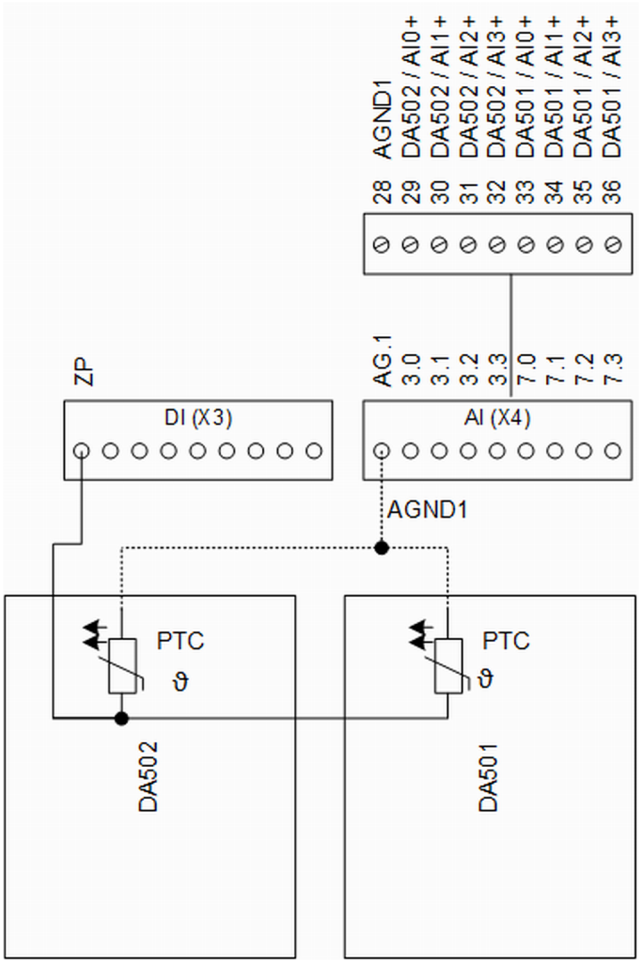


Fig. 28: Arrangement of the analog inputs

Reference to earth ZP: connect ZP to several connectors. In the example, ZP is connected to connector X3.

Characteristics of the analog inputs:

- The 8 analog inputs are not electrically isolated. The internal PTC connection is connected to earth ZP (existing device: earth M). Depending on sensor type or measuring principle, this may result in wiring adjustments.
- Resolution:
  - Range 0 ... 10 V: 12 bit
  - Range -10 ... +10 V: 12 bit + sign
  - Range 0 ... 20 mA: 12 bit
  - Range 4 ... 20 mA: 12 bit
  - Range RTD (Pt100, PT1000, Ni1000): 0.1 °C

Connection examples for analog transmitters are shown below.

AC31 adapter

Measuring ranges ± 10 V / 0 ... 10 V:

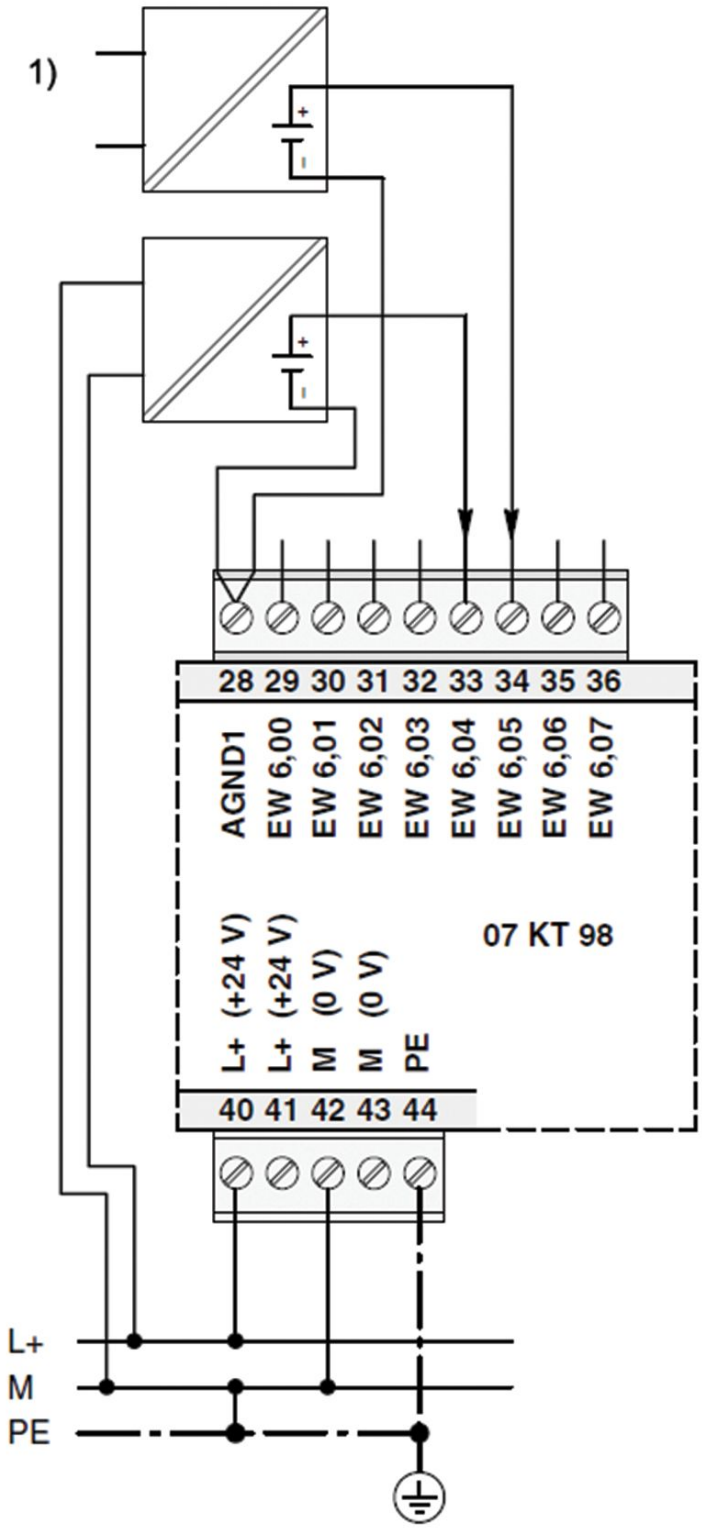


Fig. 29: 07KT98_voltage input with externally supplied 4-wire voltage sensors

1) External sensor supply

Due to the internal electrical isolation of the sensor voltage supply, no change to the wiring is necessary.

UP must be connected to connectors X7, X8 and X9. The internal voltage supply to the ADC channels is no longer provided by L+ but by UP in the modules DA501 and DA502.

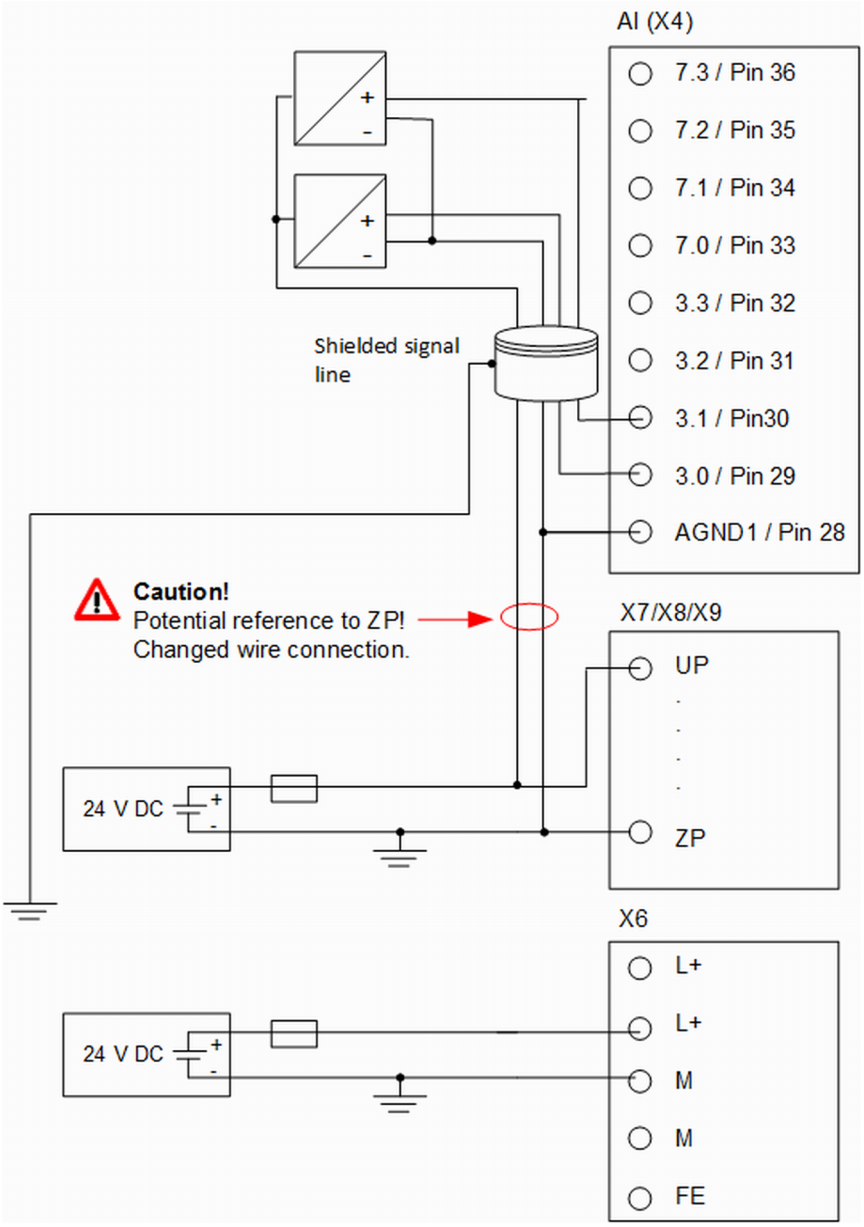


Fig. 30: Voltage input with externally supplied 3-wire voltage sensors

Measuring ranges 4 ... 20 mA (passive-type two pole sensors):

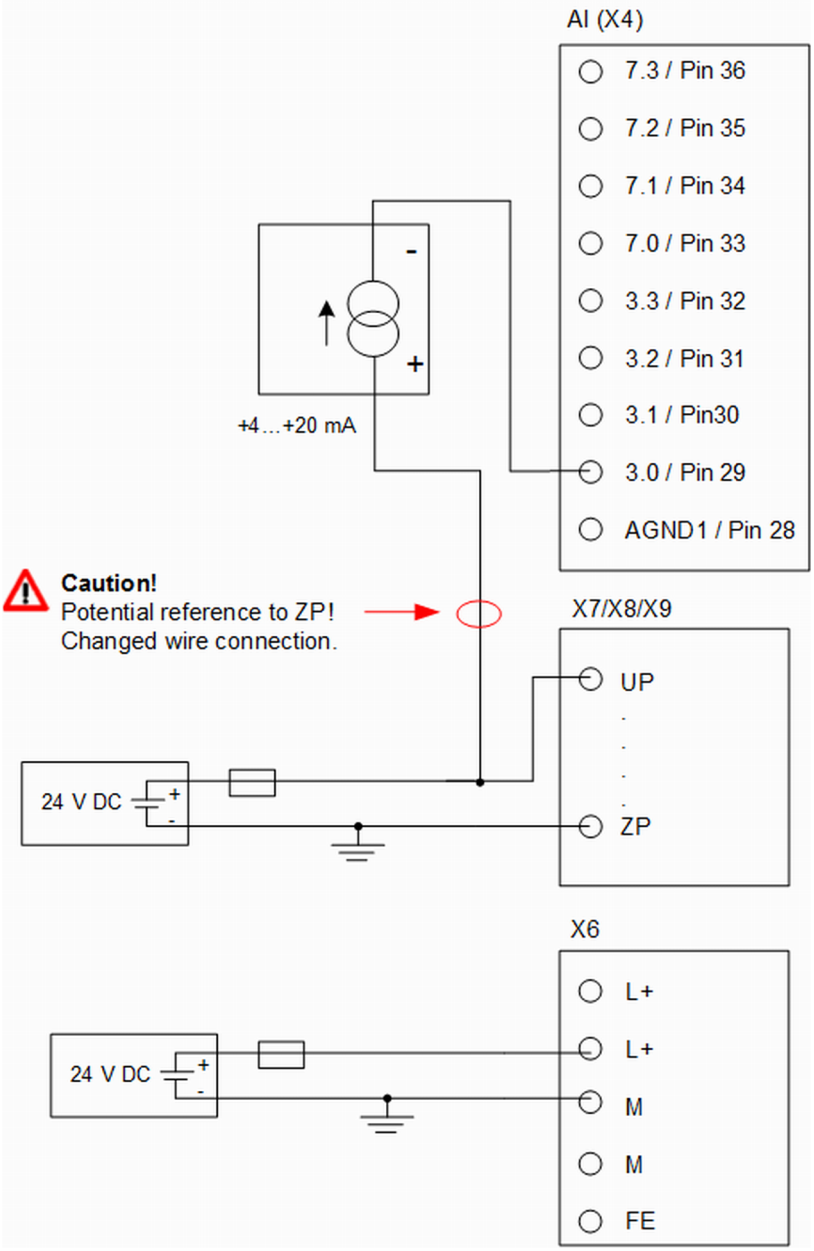


Fig. 31: Connection of current sensors 4 ... 20 mA to the analog inputs

If the analog current sensors 4 ... 20 mA are supplied from a separate power supply unit, the 0 V/GND connection of the power supply unit must be connected to the ZP connection of the 07KT9x-AD.

Protective functions:

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies a current in excess of 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 sensors without current peaks higher than 25 mA. If this is not possible, protect the input by connecting a 10-volt zener diode in parallel to I+ and I-.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Measuring range 0 ... 20 mA (active sensors with external supply):

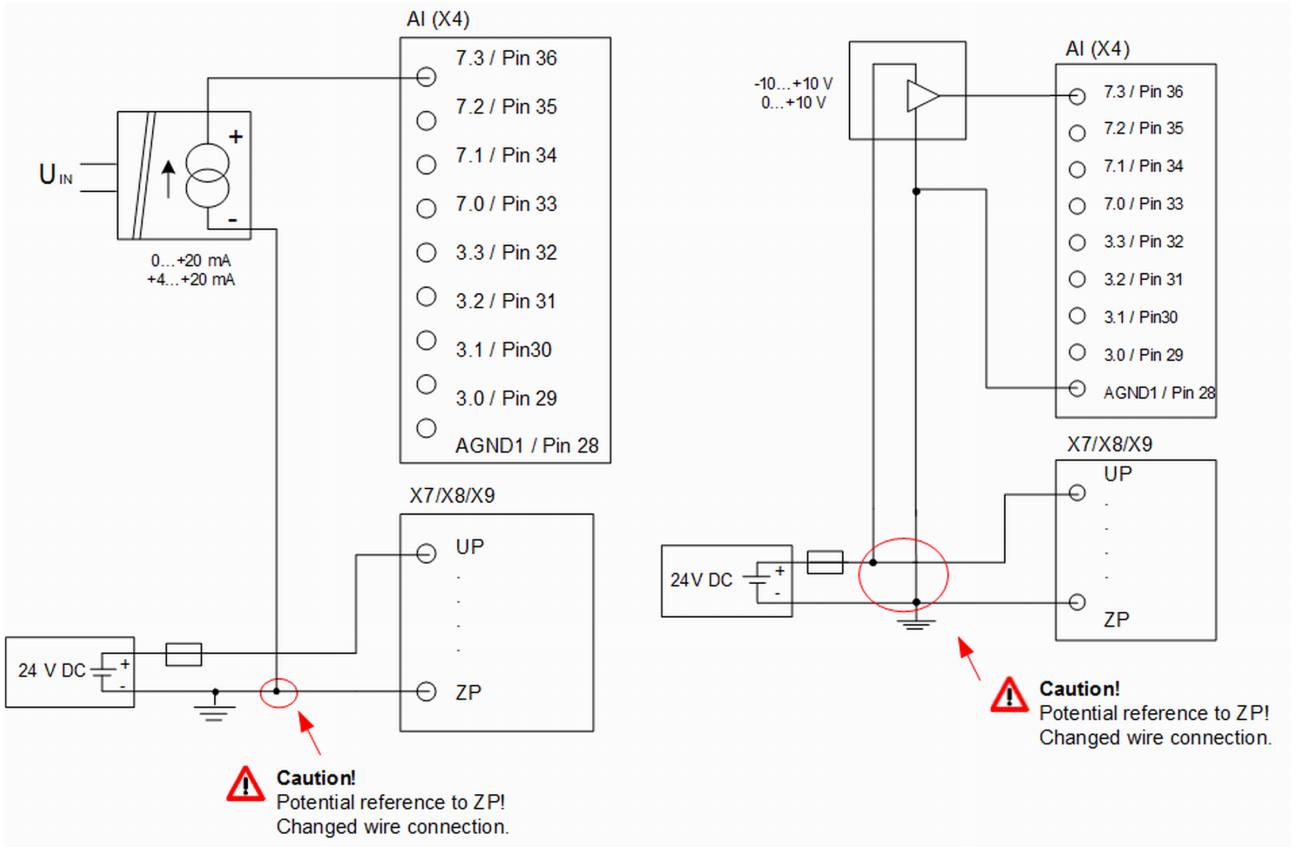


Fig. 32: Connection of current sensors 0 ... 20 mA to the analog inputs

Please note that in the example the 0 V supply (ZP) must be used as reference potential.

For further information on protective functions, error indication and diagnosis, please refer to the AC500 documentation.

Measuring ranges ± 10 V / 0 ... 10 V as differential inputs:

Differential inputs are very useful when applying analog sensors with non-isolated installation at the site (e.g. if the minus terminal is earthed on site). The measurement via differential inputs considerably improves the measuring accuracy and prevents earth loops.

When configuring differential inputs, always two adjacent analog channels belong together (e.g. the channels 3.0 and 3.1). In this case, both channels are configured according to the desired operating mode. The channel with the lower channel number must be the one with the even number (e.g. channel 3.0).

The converted analog value is available at the odd channel (e.g. channel 3.1) and can be determined by means of the Automation Builder. The analog value is calculated by subtracting the input values: input value at the channel with the higher channel number minus input value on channel with lower channel number.

CAUTION!

Risk of faulty measurements!

The minus pole at the sensors must not have too much potential difference with respect to ZP (max. ± 1 V within the full signal range).

– Ensure that the potential difference never exceeds ± 1 V.
– No change to the wiring is necessary. The connection of the sensor corresponds to the one of the existing device 07KT98.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Measuring range -50 °C ... +400 °C and -50 °C ... +70 °C with Pt100 as temperature sensor in 2-wire configuration:

Figure range:

Range	Assigned figure range
-50 C ... 400 °C	-500 ... +4000
-50 C ... 70 °C	-500 ... +700

The following measuring ranges can be configured:

Measuring ranges:

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt100	-50 °C ... +70 °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

Measuring values above range, below range and wire breaks are monitored and indicated.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Measuring range -50 °C ... +400 °C and -50 °C ... +70 °C with Pt100 as temperature sensor in 3-wire configuration:

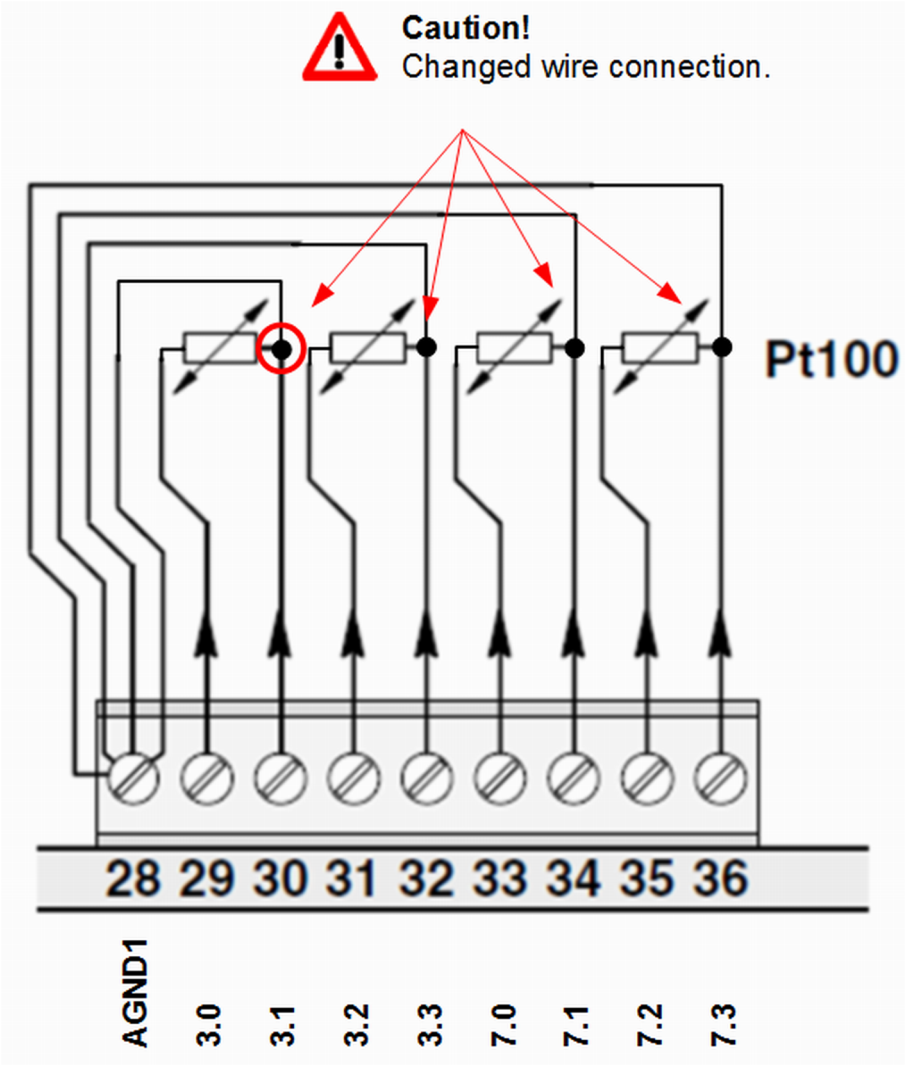


Fig. 33: Connection of Pt100 temperature sensors in 3-wire configuration

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.

Figure range:

Range	Assigned figure range
-50 C ... 400 °C	-500 ... +4000
-50 C ... 70 °C	-500 ... +700

The following measuring ranges can be configured:

Measuring ranges:

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt100	-50 °C ... +70 °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

Measuring values above range, below range and wire breaks are monitored and indicated.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Use of analog inputs as digital inputs:

Data	Value
Input signal voltage ■ Signal 0 ■ Undefined signal state ■ Signal 1	24 V DC ■ -30 V ... +5 V ■ +5 V ... +13 V ■ +13 V ... +30 V
Input resistance	approx. 3.5 kΩ
Conversion cycle	1 ms (for 4 inputs + 2 outputs) 1 s when measuring with resistance thermometer Pt/Ni

ZP serves as reference signal for the inputs.

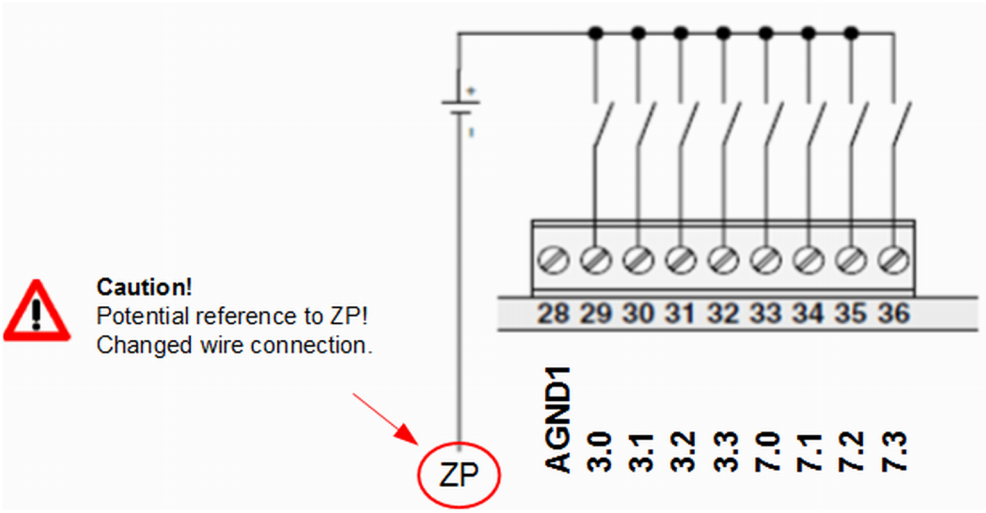


Fig. 34: Use of analog inputs as digital inputs

Connection of the 4 configurable analog outputs

Connector / Terminal	Pin	Assignment / Signal
X10 / AG.2	75	AGND2
X10 / 3.5	76	DA502 / AO0+
X10 / 3.6	77	DA502 / AO1+
X10 / 7.5	78	DA501 / AO0+
X10 / 7.6	79	DA501 / AO1+

UP must be connected to connectors X7, X8 and X9. The internal voltage supply to the ADC channels is no longer provided by L+ but by UP in the modules DA501 and DA502.

The arrangement of the 4 analog outputs is shown below:

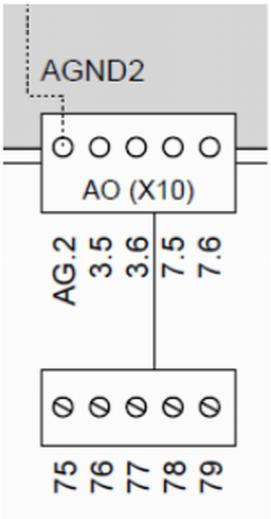


Fig. 35: Arrangement of the analog outputs

Resolution: 12 bit (+ sign)

The 4 analog outputs are not electrically isolated and have a reference to ZP internally via PTC resistors.

Output areas ±10 V / 0 ... 20 mA / 4 ... 20 mA:

No change to the wiring is necessary. The sensor is connected the same way as with the existing device 07KT98. Output load capability of voltage output: max. ±10 mA.

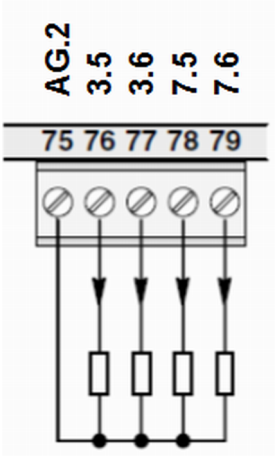


Fig. 36: Connection of output loads (voltage and current) to analog outputs

Battery and battery replacement

The AC31 adapters use another battery (lithium battery TA521).

For further information, please refer to the AC500 documentation.

Serial interface COM1

The serial interface COM1 is no longer available.

Programming can be performed via the serial interface COM2.

Serial interface DIAG:

The serial interface DIAG is used for diagnosis and configuration. The DIAG interface is not electrically isolated and thus only intended for connection with the Automation Builder.

In the CPU or Automation Builder, the DIAG interface is accessed via the FBP interface. Consequently, the information of the DIAG interface appears on the CPU display under the FBP interface.

Connector / Pin	Assignment / Signal
DIAG / 1	Not connected
DIAG / 2	TX
DIAG / 3	M
DIAG / 4	RX
DIAG / 5	FE

Serial interface COM2

Connector / Pin	Assignment / Signal
COM2 / 1	FE
COM2 / 2	TX
COM2 / 3	RX
COM2 / 4	RTS
COM2 / 5	CTS
COM2 / 6	Not connected
COM2 / 7	Signal Ground
COM2 / 8	Signal Ground
COM2 / 9	+5 V

The assignment of the serial interface COM2 has not changed.

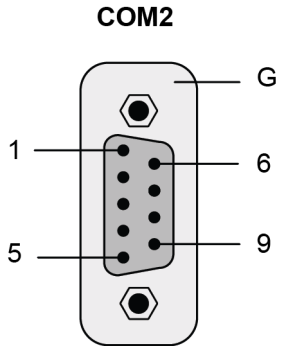


Fig. 37: Serial interface COM2

G: Housing FE (shield)
1: FE FE (shield)
2: TxD Transmit data (output)
3: RxD Receive data (input)
4: RTS Request to send (output)
5: CTS Clear to send (input)
6: NC -
7: SGND Signal ground (SGND)
8: 0 V out -
9: +5 V out Reserved

Networking interface

The existing device 07KT9x-AD has a parallel interface for connection to the coupler. Additional information upon request.

1.4.1.3.2 SmartMedia Card 07 MC 90

The content of this chapter is invalid. Another memory card is used in the CPU (SD Memory Card MC502).

For further information on the memory card, please refer to the AC500 documentation.

1.4.1.3.3 High-speed counter

When using the counter inputs (terminal 4.0 and 4.1), an external resistor 470 Ω / 1 W must be connected upstream. There are 10 operating modes available. The terminal 1.0 can be configured as output for the high-speed counters. Please note that this can result in delays of up to 2.5 ms.

For further information on high-speed counters, please refer to the AC500 documentation.

1.4.1.3.4 Technical data for 07KT98-AD

The technical data described in the existing documentation (chapter 2.2.7) are invalid for the AC31 adapter and are replaced by the following data.

Further information: ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*

General data

Data	Value
Number of digital inputs	16
Number of digital outputs	16
Number of digital inputs/outputs	16
Number of analog inputs	8
Number of analog outputs	4
Supply voltages:	
-> UP	-> X7 / UP (pin 54), X7 / ZP (pin 45) -> X8 / UP (pin 64), X8 / ZP (pin 55) -> X9 / UP (pin 74), X9 / ZP (pin 65) See Fig. 20
-> Fuse for UP	16 A
-> Power consumption for UP	300 W (per 100W on X7, X8 and X9)
-> L+	X6 / L+ (pin 40), X6 / L+ (pin 41) X6 / M (pin 42), X6 / M (pin 43) See Fig. 20
-> Fuse for L+	10 A
-> Power consumption for L+	10 A
-> Electrical isolation between UP and L+	Yes
Number of serial interfaces	1x COM2 (for diagnosis and programming with the Automation Builder software)
Number of serial interfaces (diagnosis)	1x DIAG (for diagnosis with the Automation Builder software)
Number of parallel interfaces	1 special interface for connection of an external coupler
Program memory	PM590 2MB

Data	Value
Resolution of the integrated real-time clock	1 s
Data of the high-speed hardware counter installed:	
-> Number of operating modes	-> 10
-> Counting range	-> 0 ... 4,294,967,295 (double word format, 32 bit)
-> Counting frequency	-> Depending on operating mode Note: At the counting input, an external resistor of 470 Ω / 1 W must always be connected upstream.
Cycle time for 1 instruction	Binary: min. 0.002 µs, word: min. 0.004 µs, floating point: min. 0.004 µs
Operating and error indications	Display via LEDs and CPU display. For details, please refer to the AC500 documentation
Connection technology	Detachable screw-type terminal blocks
Supply terminals, CS31 system bus	max. 1 x 2.5 mm² or max. 2 x 1.5 mm²
All other terminals	max. 1 x 1.5 mm²

For further information, please refer to the existing documentation.

Supply of devices

Data	Value
Rated supply voltage	24 V DC
Supply voltages:	
-> UP	X7 / UP (pin 54), X7 / ZP (pin 45) X8 / UP (pin 64), X8 / ZP (pin 55) X9 / UP (pin 74), X9 / ZP (pin 65) See Fig. 20
-> Fuse for UP	10 A
-> Power consumption for UP	300 W (per 100W on X7, X8 and X9)
-> L+	X6 / L+ (pin 40), X6 / L+ (pin 41) X6 / M (pin 42), X6 / M (pin 43) See Fig. 20
-> Fuse for L+	10 A
-> Power consumption for L+	10 A

Data	Value
-> Protection against reversed voltage	Yes
-> Electrical isolation between UP and L+	Yes

For further information, please refer to the existing documentation.

Lithium battery

Data	Value
Battery for buffering RAM contents and real-time clock	Lithium battery TA521
Buffer time at 25 °C	Typ. 3 years

Digital inputs

Data	Value
Number of channels per device	16
Connections	Connector X2 (terminals X5.0…X5.7) Connector X3 (terminals X6.0…X6.7)
Division of channels in groups	2 groups with 8 channels (not electrically isolated!)
Voltage supply	UP (supplies module DA501 and 502)
Common reference potential:	
-> for group 1 (8 channels)	ZP (terminals 5.0 ... 5.07)
-> for group 2 (8 channels)	ZP (terminals 6.0 ... 6.07)
Electrical isolation:	■ Electrical isolation from group to group is no longer available. ■ Electrical isolation from DA501 and DA502 (reference ZP) to the rest of the device (reference M) is available. ■ On DA501 and DA502, all channels have the same potential ZP. Voltage supply UP/ZP. ■ AGND1 and AGND2 of the analog channels are internally connected to ZP via PTC resistors Fig. 20.
Configurability of the inputs	Input delay configurable (0.1 ms, 1 ms, 8 ms and 32 ms). Default: 0.1 ms.
Channels for high-speed counters	↳ *Chapter 1.4.1.3.4.6 “Digital inputs/outputs” on page 56* Channels for high-speed counters are implemented with the inputs/outputs (channels: 4.0 and 4.1).

Data	Value
Indication of the input signals	One yellow LED each per channel. The LED corresponds functionally to the input signal.
Input signal voltage:	24 V DC
-> 0 signal	-3 V…+5 V
-> Undefined signal state	+5 V ... + 15 V
-> 1 signal	+15 V ... + 30 V
Input current per channel:	
-> Input voltage = +24 V	Typ. 5.0 mA
-> Input voltage = + 5 V	> 1 mA
-> Input voltage = +13 V	> 2 mA
-> Input voltage = +30 V	< 8.0 mA
Max. cable length unshielded	600 m
Max. cable length shielded	1000 m

For further information, please refer to the existing documentation.

Digital outputs

Data	Value
Number of channels per device	16 high-side switches
Connections	Connector X7 (terminals 1.0 ... 1.7) Connector X8 (terminals 2.0 ... 2.7)
Division of channels in groups	2 groups with 8 channels each (not electrically isolated!)
Common voltage supply	UP (supplies module DA501 and 502)
Common reference potential ZP:	
-> for group 1	ZP (terminals 1.0 ... 1.7)
-> for group 2	ZP (terminals 2.0 ... 2.7)

Data	Value
Electrical isolation	■ Electrical isolation from group to group is no longer available. ■ Electrical isolation from DA501 and DA502 (reference ZP) to the rest of the device (reference M). ■ On DA501 and DA502, all channels have the same potential ZP. Voltage supply UP/ZP. ■ AGND1 and AGND2 of the analog channels are internally connected to ZP via PTC resistors. Fig. 20
Indication of the output signals	One yellow LED each per channel. The LED corresponds functionally to the output signal.
Output current:	
-> Rated value	500 mA at UP = 24 V
-> Residual current at 0 signal	< 0.5 mA
Demagnetization with inductive load	Internally via varistor
Switching frequency with inductive load	max. 0.5 Hz
Switching frequency with lamp load	max. 11 Hz at max. 5 W
Max. cable length	1000 m (shielded) 600 m (unshielded)
Short-circuit proof / overload proof	Yes
Protection against reversed voltage of process supply voltage	Yes
Resistance to feedback against 24 V signals	Yes
Total load current (all DO channels, 1.0...1.7 max. 4A and 2.0…2.7)	max. 4 A
Total load current (all DC channels, 4.0..4.7 max. 8A and 8.0…8.7)	max. 8 A
Total load current (via UP) 16 DO channels and 16 DC channels	max. 12 A (all UP terminals must be connected)

For further information, please refer to the existing documentation.

Digital inputs/outputs

Data	Value
Number of channels per device	16 inputs/outputs
Connections	Connector X1 (terminals 4.0 ... 4.7) Connector X9 (terminals 8.0 ... 8.7)
Division of channels in groups	2 groups of 8 channels each Group 1: terminals 4.0 ... 4.7 Group 2: terminals 8.0 ... 8.7
Common reference potential ZP	All digital I/O channels of the DA501 and DA502 module
Common voltage supply	UP (supplies DA501 and DA502 module)
Electrical isolation	Electrical isolation from group to group is no longer available. Electrical isolation from DA501 and DA502 (reference ZP) to the rest of the device (reference M). On DA501 and DA502, all digital channels have the same potential ZP. AGND1 and AGND2 of the analog channels are internally connected to ZP via PTC resistors. Fig. 20
Configurability of the inputs:	
-> Input delay	Typ. 0.1 ms, configurable from 0.1...32 ms
Indication of the input/output signals	1 yellow LED per channel. The LED is ON in "High" signal state (1 signal)
Input signal voltage (when used as input)	↯ *“Circuit arrangement of the digital inputs/outputs:” on page 37*.
-> 0 signal	-3 V ... + 5 V
-> 1 signal	+15 V ... + 30 V
Input current per channel	↯ *Chapter 1.4.1.3.4.4 “Digital inputs” on page 53*.
Output current / switching frequency / inductive loads	↯ *Chapter 1.4.1.3.4.5 “Digital outputs” on page 54*.
Total load current (all DC channels, 4.0..4.7 max. 8A and 8.0…8.7)	max. 8 A
Total load current (all DO channels, 1.0...1.7 max. 4A and 2.0…2.7)	max. 4 A
Total load current (via UP) 16 DO channels and 16 DC channels	max. 12 A (all UP terminals must be connected)
Max. cable length	↯ *Chapter 1.4.1.3.4.4 “Digital inputs” on page 53* ↯ *Chapter 1.4.1.3.4.5 “Digital outputs” on page 54*

For further information, please refer to the existing documentation.

Analog inputs

Data	Value
Number of channels per device	8
Connections	Connector X4 (terminals 3.0 … 3.3 and 7.0…7.3)
Division of channels in groups	1 group with 8 channels (evenly distributed among the modules DA501 and DA502 internally)
Common reference potential for analog inputs (8 channels)	AGND1 (terminals 3.0 … 3.3 and 7.0…7.3) Caution: Internal reference to ZP via PTC resistors Fig. 20
Electrical isolation	No Fig. 20
Max. permissible potential difference between terminal ZP (minus the supply voltage) and terminals AGND (minus the analog inputs and outputs)	± 1 V Caution: The internal reference is no longer M but ZP. *further information on page 29*
Indication of the input signals	8 yellow LEDs to indicate the signal statuses of the analog inputs (4 LEDs per DA501 module and DA502 module)
Configurability (optional per channel) *Chapter 1.4.1.3.1.2 “Connection of the supply voltage” on page 30*	0 ... 10 V, ± 10 V (also with differential signal), 0 ... 20 mA, 4 ... 20 mA Pt100 -50 ... +400 °C and -50 ... +70 °C Pt1000 -50…+400 °C (2-wire and 3-wire configuration) Digital input
Input resistance per channel:	
-> Voltage input	> 100 kΩ
-> Current input	approx. 330 kΩ
-> Digital input	approx. 3.5 kΩ
Time constant of the input filter	Voltage: 100 µs, current: 100 µs
Conversion cycle	1 ms (for 4 inputs and 2 outputs) 1 s when measuring with resistance thermometer Pt/Ni

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The "Examples for the conversion cycle" from the existing documentation 07KT98 are no longer valid.

Data	Value
Resolution in bits:	
-> Ranges	±10 V, 0 ... 10 V 12 bit plus sign
-> Ranges	0 ... 20 mA, 4 ... 20 mA 12 bit without sign
-> Range	Pt100, PT1000, Ni1000: 0.1 °C
Resolution in mV, µA:	
-> Range	±10 V approx. 2.5 mV
-> Range	0 ... 10 V approx. 2.5 mV
-> Range	0 ... 20 mA approx. 5 µA
-> Range	4 ... 20 mA approx. 4 µA
Relationship between input signal and hex code	-100 % ... 0 ... +100 % = 9400H ... 0000H ... 6C00H (-27648 ... 0 ... 27648 decimal)
Conversion error of the analog values due to non-linearity. Adjustment error on delivery and resolution in the nominal range	Typ. 0.5 %, max. 1 %
Use as digital input:	
-> Signal 0	-30 V ... +5 V
-> Undefined signal state	+5 V ... +13 V
-> Signal 1	+13 V ... +30 V
Max. cable length 2-core shielded and conductor cross section > 0.14 mm²	100 m

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies a current in excess of 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 sensors without current peaks higher than 25 mA. If this is not possible, protect the input by connecting a 10-volt zener diode in parallel to I+ and I-.

For further information, please refer to the existing documentation.

Analog outputs

Data	Value
Number of channels per device	4
Connections	Connector X10 (terminals 3.5, 3.6, 7.5 and 7.6)
Reference potential	AGND2 (terminals 3.5, 3.6, 7.5 and 7.6)
Electrical isolation	No Fig. 20
Max. permissible potential difference between terminal ZP (minus the supply voltage) and terminals AGND (minus the analog inputs and outputs)	± 1 V Caution: The internal reference is no longer M but ZP. Fig. 20
Indication of output signal	4 yellow LEDs to indicate the signal statuses of the analog outputs (2 LEDs each at DA501 and DA502)
Output signal ranges (configurable)	-10 V ... 0, 0 ... +10 V 0 ... 20 mA 4 ... 20 mA
Output load capability of voltage output	max. ±10 mA
Resolution	12 bit (+ sign)
Resolution (1 LSB), range 10 V ... 0, 0 ... +10 V	approx. 5 mV
Relationship between output signal and hex code	-100 % ... 0 ... +100 % = 9400H ... 0000H ... 6C00H (-27648 ... 0 ... 27648 decimal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs) 1 s when measuring with resistance thermometer Pt/Ni
Conversion error of the analog values due to non-linearity Adjustment error on delivery and resolution in the nominal range	Typ. 0.5 %, max. 1 %
Max. cable length, 2-core shielded and conductor cross section > 0.14 mm²	100 m

For further information, please refer to the existing documentation.

Connection of the serial interfaces COM2

The COM1 interface is no longer available. The assignment of the COM2 interface remains the same as in the existing device. Programming in Automation Builder can be performed via the COM2 interface.

Data	Value
Interface standard	EIA RS-232
Programming	07KT94-ARC-AD: 907 PC 331 07KT98-ARC-AD: Automation Builder
Program change	07KT94-ARC-AD: 907 PC 331 07KT98-ARC-AD: Automation Builder
Man-Machine Communication	Yes, e.g. via Automation Builder
Electrical isolation	Fig. 20
Potential differences	In order to avoid potential differences between the replacement device 07KT98-AD and the peripheral devices connected to COM2, these devices are supplied by the socket in the switchgear cabinet.
Terminal assignment and description of the COM2 interface	↳ *Chapter 1.4.1.3.1.11 “Serial interface COM2” on page 50*

For further information, please refer to the existing documentation.

Serial interface DIAG:

Data	Value
Programming	07KT94-ARC-AD: 907 PC 331 07KT98-ARC-AD: Automation Builder
Program change	07KT94-ARC-AD: 907 PC 331 07KT98-ARC-AD: Automation Builder
Electrical isolation	No Fig. 20

Connection to the CS31 system bus

When configuring the CS31 interface (connector X5), select the COM1 interface of CPU PM590 in Automation Builder.

The shield connection must be internally connected to FE.

Data	Value
Interface standard	EIA RS-485
Connection:	
-> as master PLC	Yes
-> as slave PLC	No
Setting of the CS31 module address	No, the master has no module address
Electrical isolation	Yes Fig. 20
Terminal assignment and description of the CS31 system bus interface	*Chapter 1.4.1.3.1.3 “Connection for CS31 system bus” on page 30* Note that the shield connection is internally connected to FE.

LED display

Data	Value
LEDs for signaling:	
-> State of digital inputs	1 yellow LED per channel
-> State of digital outputs	1 yellow LED per channel
-> State of digital inputs/outputs	1 yellow LED per channel
-> Supply voltage available (Supply)	1 green LED
-> Battery	1 red LED (name: ERR) at the CPU
-> Program is running (RUN)	1 green LED
-> Controller-specific errors	1 red LED (name: ERR) at the CPU
-> CS31 system bus	Indication on CPU display under COM1 (CS31 is assigned to COM1 within the CPU)
-> Overload / short circuit of digital outputs	Red LEDs on modules DA501/ DA502 and at the CPU via ERR-LED. An indication on the display is possible.

High-speed hardware counter

At the counting input, an external resistor of 470 Ω / 1 W must always be connected upstream. For further information on high-speed counters, please refer to the AC500 documentation.

Data of the high-speed hardware counter installed:

Data	Value
Number of operating modes	10
Counting range	0 ... 4,294,967,295 (double word format, 32 bit)
Counting frequency	Depending on operating mode
Used inputs	4.0 and 4.1
Used outputs	1.0

Mechanical data

Data	Value
Width x height x depth	Replacement device: 239.5 x 138 x approx. 80.9 mm Existing device: 240 x 140 x 85 mm
Weight	Replacement device 07KT94-ARCNET: 910 g Replacement device 07KT98-ARCNET: 945 g Existing device: 1.6 kg
Dimensions for mounting	See operating and assembly instructions of the replacement device (3ADR020082M0401)

Ordering data

Order No.	Scope of delivery
1SAP 801 000 R0061	CPU: 07KT94-ARCNET
1SAP 801 400 R0060	CPU: 07KT98-ARCNET

1.4.1.3.5 ARCNET description

Central units with integrated ARCNET coupler (Attached Resource Computer Network):

- 07KT94-ARC-AD
- 07KT98-ARC-AD

Technical Data

In the replacement device, addresses cannot be set via DIP switch. Instead, the ARCNET interface is configured in the Automation Builder.

Data	Value
Connector	ARC (BNC connector)
ARCNET interface	For coaxial cable connection

Data	Value
Recommended system cable	Cable RG 62 A/U (characteristic impedance 93 Ω) Cable length 300 m in case of ARCNET bus with 8 stations. For further information, please refer to the AC500 documentation (chapter ARCNET).
Signaling	Indication on CPU display
Electrical isolation	Yes Fig. 20

ARCNET short description

The ARCNET interface is configured in the Automation Builder. For further information on the ARCNET interface for the respective CPU, please refer to the AC500 documentation.

The ARCNET system

The general information about the ARCNET system is still valid. For further information on ARCNET, please refer to the AC500 documentation.

Description of the PROFIBUS-DP coupler

The current AC31 adapters do not support a PROFIBUS-DP coupler.

Description of the CANopen master coupler

The current AC31 adapters do not support a CANopen master coupler.

Description of the Ethernet coupler

The current AC31 adapters do not support an Ethernet coupler.

1.5 Replacement devices: I/O modules

For AC31 devices of the 90 series, AC31 adapters (replacement devices) are available for the exchange of individual I/O modules.

1.5.1 Replacement device 07DC91-AD

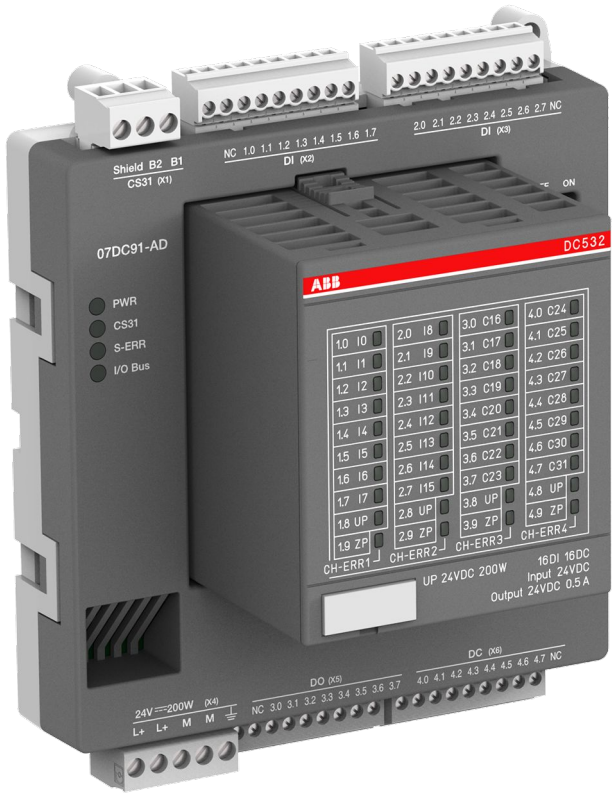

Fig. 38: 3ADR331192S0015_07DC91-AD

The replacement device 07DC91-AD of the AC31 adapter series replaces the existing device 07DC91 of the 90 series.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07DC91 remains valid and serves as reference (system description Advant Controller 31 *http://www.abb.de/search.aspx?abbcontext=products&q=2cdc120009M0**). The document structure of this document is based on the document structure of the existing documentation.

This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices 07DC91-AD can be found in the operating and assembly instructions of device 07DC91-AD: 3ADR020083M0401. Please note that for device 07DC91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus ↬ *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

1.5.1.1 Device configuration

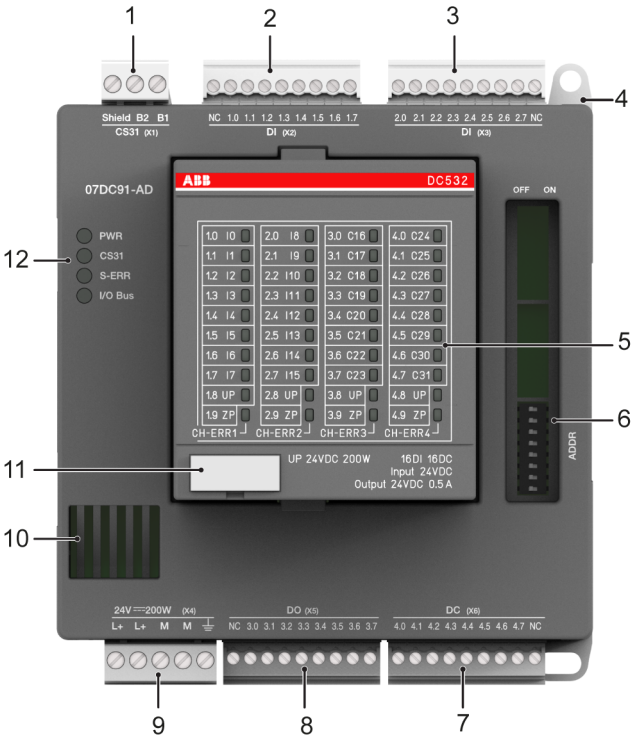

Fig. 39: 3ADR333196F0015_07DC91-AD_Front

No.	Description
1	Connection for CS31 bus (X1)
2	8 digital inputs 24 V DC (X2)
3	8 digital inputs 24 V DC (X3)
4	Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5	Status LEDs for DC532
6	DIP switch for address setting (ADDR)
7	8 digital inputs/outputs 24 V DC / 0.5 A (X6)
8	8 digital outputs (X5)
9	Supply 24 V DC (X4)
10	Ventilation
11	TA525: Label
12	4 Status LEDs

1.5.1.2 LED display

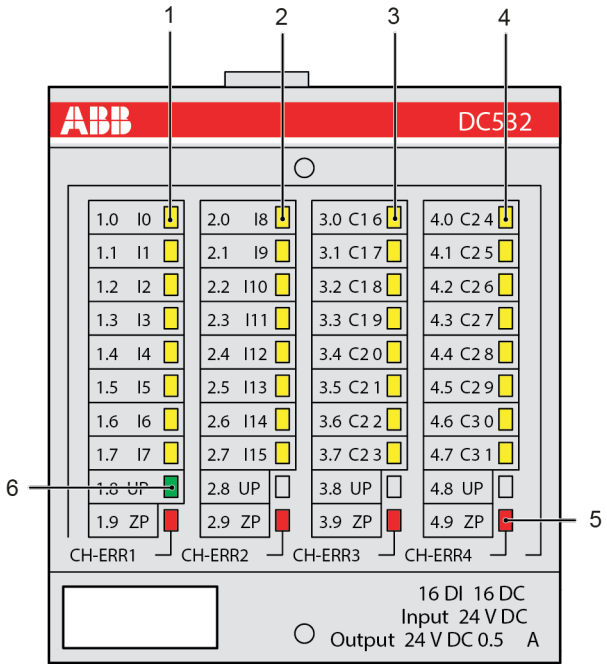

Fig. 40: Front view: DC532

No.	Displays of module
1	8 yellow LEDs to indicate the signal status of the digital inputs (X2).
2	8 yellow LEDs to indicate the signal status of the digital inputs (X3).
3	8 yellow LEDs to indicate the signal status of the digital outputs (X5).
4	8 yellow LEDs to indicate the signal status of the digital inputs/outputs (X6).
5	4 red LEDs to indicate errors (of DC532 module).
6	1 green LED to indicated the status of the supply voltage of the DC532 module (is supplied via X4).

The replacement device does not provide a test button to measure functionality.

1.5.1.3 Electrical connection

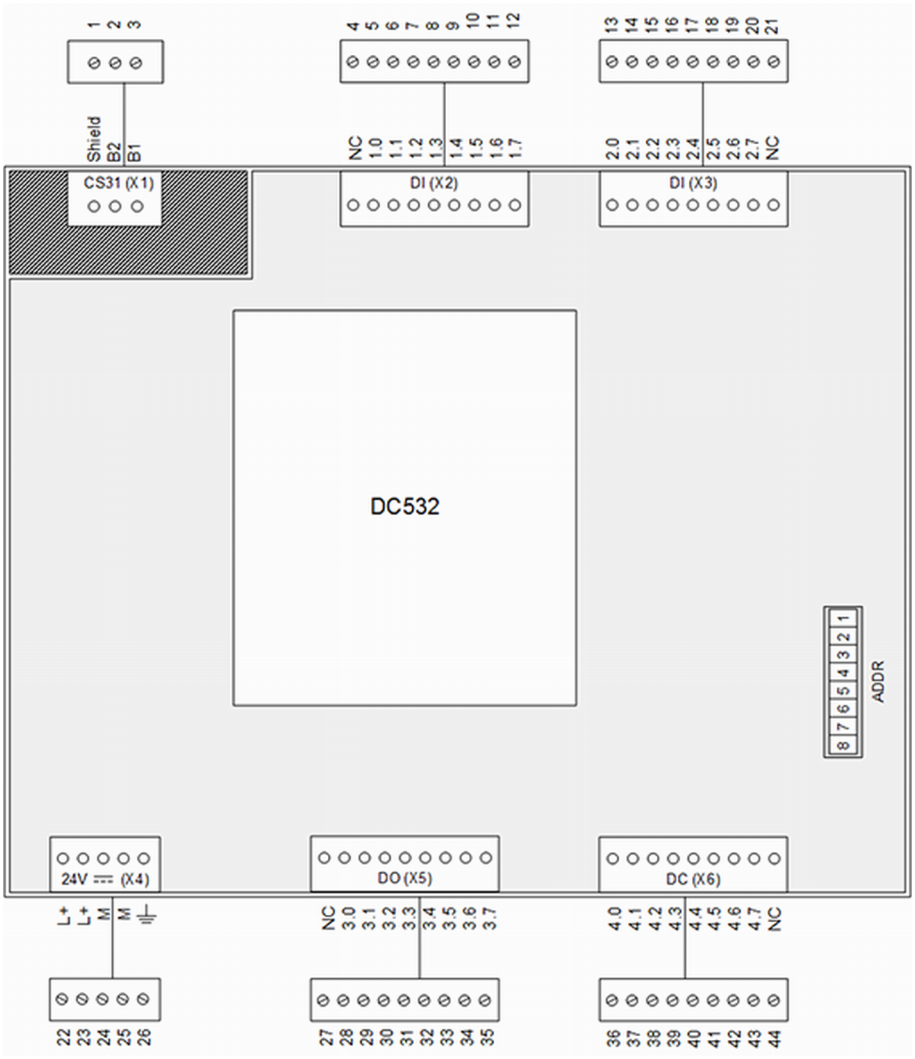

Fig. 41: Electrical connection

Pin assignment CS31 (X1):

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

The shield connection of the CS31 system bus is not electrically connected to the functional earth of the supply voltage.

Pin assignment DI (X2):

Connector / Terminal	Pin	Assignment / Signal
X2 / NC	4	No internal connection
X2 / 1.0	5	DC532 / I0
X2 / 1.1	6	DC532 / I1
X2 / 1.2	7	DC532 / I2
X2 / 1.3	8	DC532 / I3
X2 / 1.4	9	DC532 / I4
X2 / 1.5	10	DC532 / I5
X2 / 1.6	11	DC532 / I6
X2 / 1.7	12	DC532 / I7

Pin assignment DI (X3):

Connector / Terminal	Pin	Assignment / Signal
X3 / 2.0	13	DC532 / I8
X3 / 2.1	14	DC532 / I9
X3 / 2.2	15	DC532 / I10
X3 / 2.3	16	DC532 / I11
X3 / 2.4	17	DC532 / I12
X3 / 2.5	18	DC532 / I13
X3 / 2.6	19	DC532 / I14
X3 / 2.7	20	DC532 / I15
X3 / NC	21	No internal connection

Pin assignment DC (X6):

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.0	36	DC532 / C24
X6 / 4.1	37	DC532 / C25

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.2	38	DC532 / C26
X6 / 4.3	39	DC532 / C27
X6 / 4.4	40	DC532 / C28
X6 / 4.5	41	DC532 / C29
X6 / 4.6	42	DC532 / C30
X6 / 4.7	43	DC532 / C31
X6 / NC	44	No internal connection

Pin assignment DO (X5):

Connector / Terminal	Pin	Assignment / Signal
X5 / NC	27	No internal connection
X5 / 3.0	28	DC532 / C16
X5 / 3.1	29	DC532 / C17
X5 / 3.2	30	DC532 / C18
X5 / 3.3	31	DC532 / C19
X5 / 3.4	32	DC532 / C20
X5 / 3.5	33	DC532 / C21
X5 / 3.6	34	DC532 / C22
X5 / 3.7	35	DC532 / C23

Pin assignment 24 V DC 200 W (X4):

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	22	L+
X4 / L+	23	L+
X4 / M	24	M
X4 / M	25	M
X4 / FE	26	FE

The device 07DC91-AD has 16 digital outputs, each with 0.5 A output current. This results in a maximum output current of 8 A. With an output current of 4 A and higher, both terminals (L+) of connector X4 must be used.

CAUTION!

System damage caused by voltage!

The exchange of a replacement device under voltage can cause permanent system damage (destruction).

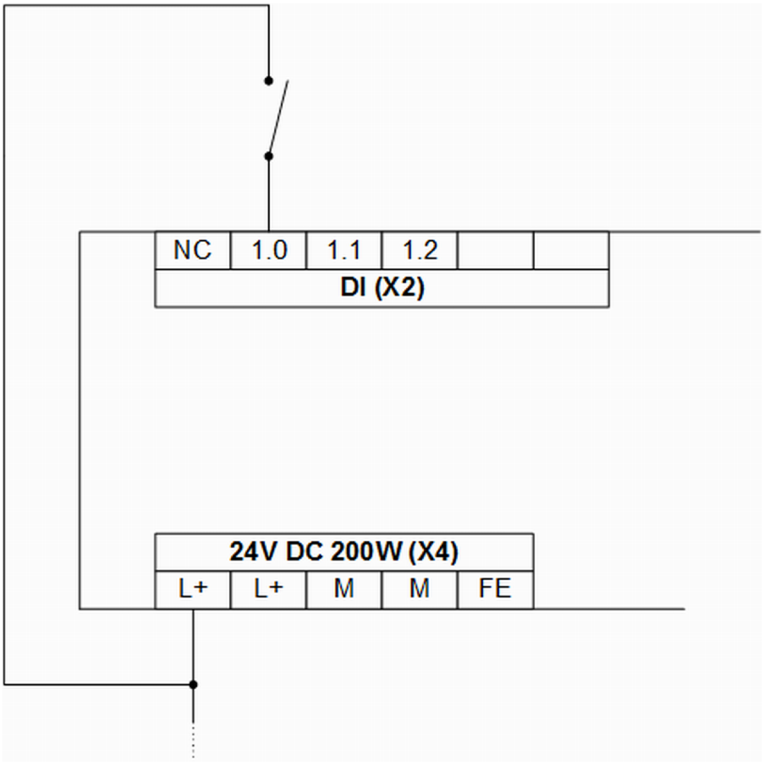

Fig. 42: Connection example: digital input

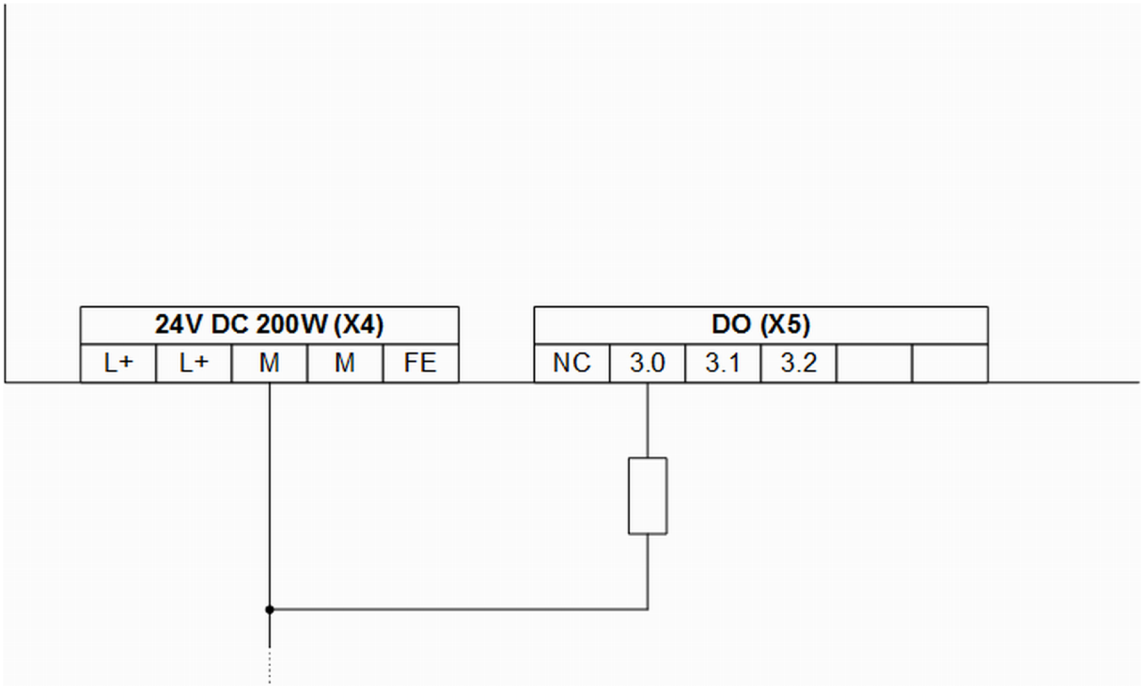

Fig. 43: Connection example: digital output

1.5.1.4 Addressing

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 slave).

CS31 bus (16 inputs / 16 outputs):

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X2 / 1.0
			X2 / 1.1
			X2 / 1.2
			X2 / 1.3
			X2 / 1.4
			X2 / 1.5
			X2 / 1.6
			X2 / 1.7
2	8 bit input (send)	0 ... 7	X3 / 2.0
			X3 / 2.1
			X3 / 2.2

Byte	Type	Bit	Connector / Terminal
			X3 / 2.3
			X3 / 2.4
			X3 / 2.5
			X3 / 2.6
			X3 / 2.7
3	8 bit output (receive)	0 ... 7	X5 / 3.0
			X5 / 3.1
			X5 / 3.2
			X5 / 3.3
			X5 / 3.4
			X5 / 3.5
			X5 / 3.6
			X5 / 3.7
4	8 bit output (receive)	0 ... 7	X6 / 4.0
			X6 / 4.1
			X6 / 4.2
			X6 / 4.3
			X6 / 4.4
			X6 / 4.5
			X6 / 4.6
			X6 / 4.7

CS31 bus (24 inputs / 16 outputs):

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X2 / 1.0 ... 1.7
2	8 bit input (send)	0 ... 7	X3 / 2.0 ... 2.7
3	8 bit output (receive)	0 ... 7	X5 / 3.0 ... 3.7
4	8 bit input (send)	0 ... 7	X6 / 4.0 ... 4.7
5	8 bit output (receive)	0 ... 7	X6 / 4.0 ... 4.7

1.5.1.5 I/O configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the DIP switch is arranged on the lower printed circuit board instead.

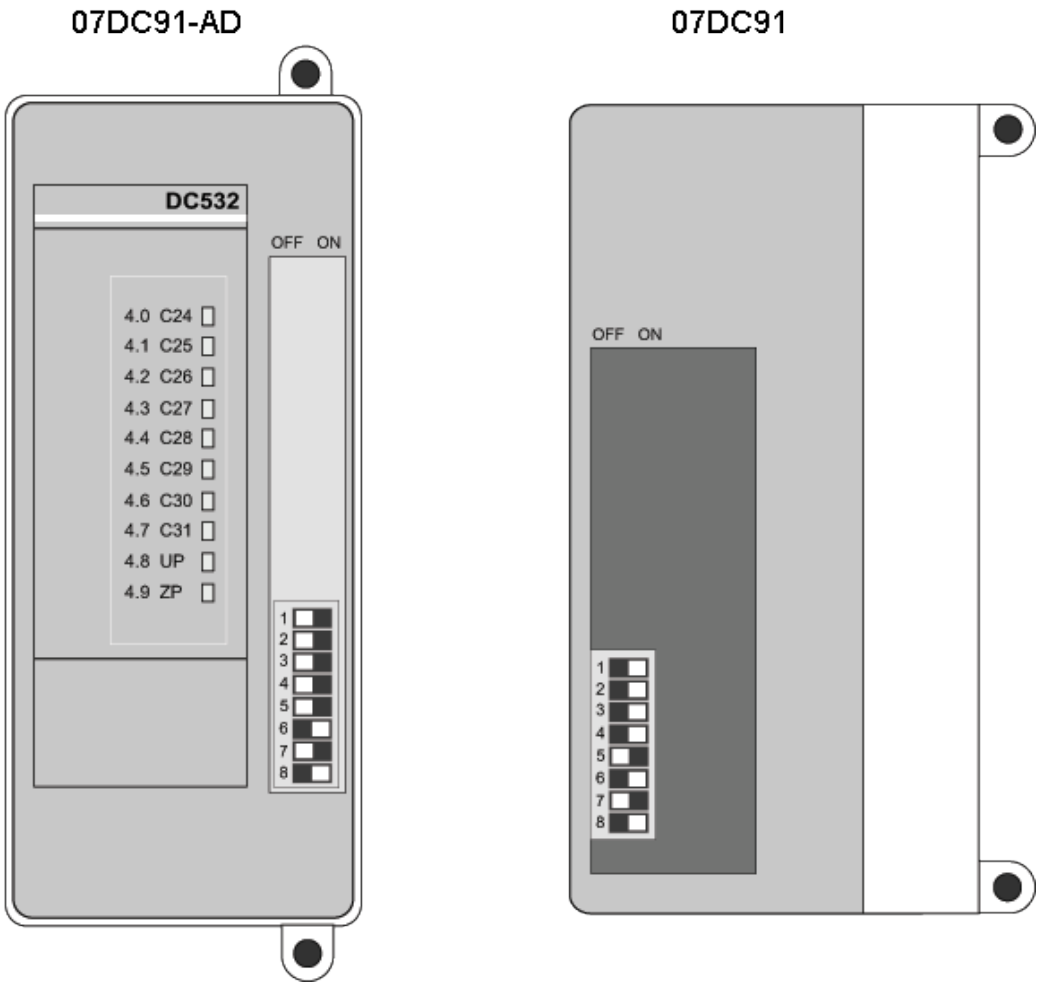

Fig. 44: 07DC91-AD: DIP switch

The DIP switches are read by the device only once after the supply voltage has been connected.

For further information, please refer to the existing documentation.

1.5.1.6 Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.

- After successful initialization of the CS31 bus communication, the CS31 LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal statuses of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the Flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device 07DC91-AD are switched off. The inputs remain active. The outputs are also switched off in case of a malfunction of the CS31 bus.

1.5.1.7 Diagnosis and Displays

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Diagnosis information of the CS31 bus:

Error description	Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error	0	43	1	Internal error
Channel error	0, 4, 8, 12 ([1])	46	4	Overload or short circuit on a digital output

([1]): The channel numbers are grouped as follows:

0 - for X5/3.0, X5/3.1, X5/3.2, X5/3.3

4 - for X5/3.4, X5/3.5, X5/3.6, X5/3.7

8 - for X6/4.0, X6/4.1, X6/4.2, X6/4.3

12 - for X6/4.4, X6/4.5, X6/4.6, X6/4.7

The error codes that are transferred by the replacement device via the CS31 bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

Device LEDs:

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31	CS31 bus communication	Green	No CS31 bus communication	CS31 bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal Flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

LEDs of the S500 module DC532:

LED	Status	Color	LED off	LED on	LED flashes
I0…I7 (see No. 1 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
- I8…I15 (see No. 2 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
C16…C23 (see No. 3 in the following figure)	Digital outputs	Yellow	Output is not activated	Output is activated	-
C24…C31 (see No. 4 in the following figure)	Digital inputs or digital outputs	Yellow	Input or output is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-

LED	Status	Color	LED off	LED on	LED flashes
Error indications left (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	-
Error indications right (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	Overload or short circuit on a channel of the corresponding group
Indication supply voltage (see No. 6 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

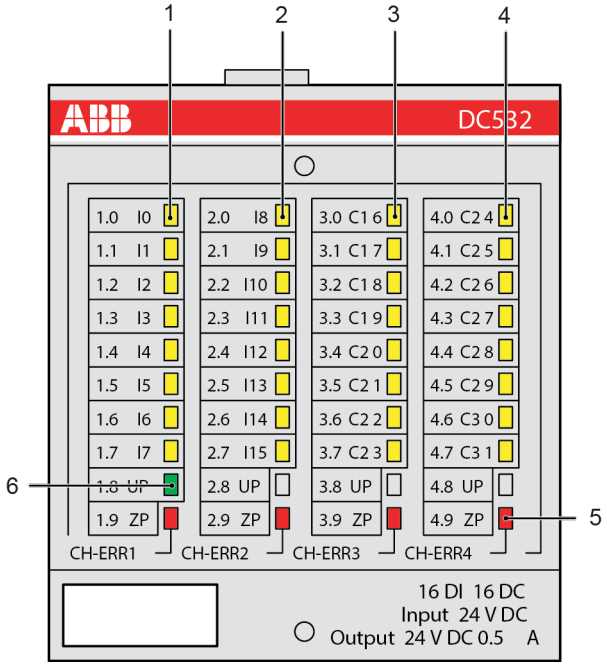

Fig. 45: Front view: DC532

1.5.1.8 Technical Data

This section provides additional information on section *Chapter 1.3 “System data and CS31 bus system data” on page 5*. In case of doubt, the following information applies.

1.5.1.8.1 Technical Data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 22), X4/L+ (pin 23), X4/M (pin 24), X4/M (pin 25)

Data	Value
-> Fuse for L+	10 A, fast acting
- Electrical isolation	No
Current consumption:	
-> via L+	0.19 A and max. 0.5 A per output
- Inrush current via L+ (when voltage is switched on)	0.17 A²s
Power consumption	Replacement device: 200 W Existing device: 202 W
Max. power dissipation within the module (outputs unloaded)	Replacement device: 6 W Existing device: 5 W
Address setting and configuration	DIP switch on right side of the housing
Operating and error indications	Replacement device: 41 LEDs Existing device: 33 LEDs

For further information, please refer to the existing documentation.

CAUTION!

System damage caused by voltage!

Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

1.5.1.8.2 Technical Data of the Digital Inputs

Data	Value
Connections	X2/1.0, X2/1.1, X2/1.2, X2/1.3, X2/1.4, X2/1.5, X2/1.6, X2/1.7, X3/2.0, X3/2.1, X3/2.2, X3/2.3, X3/2.4, X3/2.5, X3/2.6, X3/2.7
Input type according to EN 61131-2	Type 1 (realized through current sink)
Input delay: 0 -> 1 or 1 -> 0 ([1])	Replacement device: Typ. 8 ms Existing device: Typ. 7 ms
Indication of the input signals	Replacement device: One yellow LED per channel. The LED corresponds functionally to the input signal. Existing device: One green LED per channel. The LED corresponds functionally to the input signal.
Input signal voltage:	24 V DC

Data	Value
-> 0 signal	Replacement device: -3 V…+5 V Existing device: -30 V…+5 V
-> Undefined signal	Replacement device: > +5 V…< +15 V Existing device: > +5 V…< +13 V
-> 1 signal	Replacement device: +15 V…+30 V Existing device: +13 V…+30 V
-> Residual ripple at 0 signal	Replacement device: within -3 V…+5 V Existing device: within -30 V…+5 V
-> Residual ripple at 1 signal	Replacement device: within +15 V…+30 V Existing device: within +13 V…+30 V
Input current per channel:	
Input voltage +24 V	Replacement device: Typ. 5 mA Existing device: Typ. 7 mA
Input voltage +5 V	Replacement device: > 1 mA Existing device: ≥ 1 mA
Input voltage +15 V	Replacement device: > 5 mA Existing device: ≥ 2 mA (at input voltage +13 V)
Input voltage +30 V	Replacement device: < 8 mA Existing device: ≤ 9 mA
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Protection against reversed voltage	Yes
Overvoltage protection	Up to 30 V DC

([1]): Input delay of the S500 module DC532. The transmission rate via serial buses has not been taken into account.

For further information, please refer to the existing documentation.

1.5.1.8.3 Technical Data of the Digital Outputs

Data	Value
Connections	X5/3.0, X5/3.1, X5/3.2, X5/3.3, X5/3.4, X5/3.5, X5/3.6, X5/3.7
Type of digital outputs	High-side switch
Demagnetization with inductive load	Internally with a varistor (with other circuitry)
Switching frequency with ohmic load	On request
Output voltage at signal 1	X4 / L+ (typ. 24 V) -0.8 V
Output delay: 0 -> 1 or 1 -> 0	On request
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m

For further information, please refer to the existing documentation.

1.5.1.8.4 Technical data of the configurable inputs/outputs

Data	Value
Connections	X6/4.0, X6/4.1, X6/4.2, X6/4.3, X6/4.4, X6/4.5, X6/4.6, X6/4.7
Use as digital input	See *Chapter 1.5.1.8.2 “Technical Data of the Digital Inputs” on page 77*
Use as digital output	See *Chapter 1.5.1.8.3 “Technical Data of the Digital Outputs” on page 79*

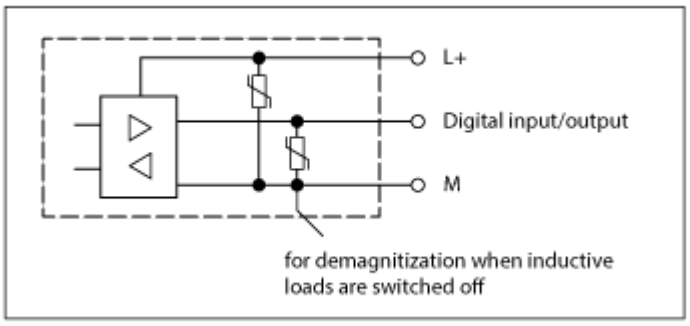

Fig. 46: Protective circuits inputs/outputs

Due to the changed protective circuit on the inputs and outputs, the restrictions concerning the input signal voltage described in the existing documentation no longer apply.

When the channels of connector X6 are to be used as inputs, the respective outputs (high-end switches) must be switched off.

1.5.1.8.5 Connection to the CS31 system bus

Data	Value
Connections	X1/B2, X1/B1
CS31 type	04 (digital input/output)
Termination resistor	Not available (must be provided externally if needed)

1.5.1.8.6 Mechanical data

Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 351 g (incl. terminals) Existing device: 450 g
Dimensions for mounting	See operating and assembly instructions of the replacement device (3ADR020083M0401)

1.5.1.8.7 Assembly / Disassembly

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

CAUTION!

System damage caused by voltage!

The exchange of a replacement device under voltage can cause permanent system damage (destruction).

1.5.1.8.8 Ordering data

Order No.	Scope of delivery
1SAP 800 300 R0010	Digital input/output module 07DC91-AD 1x 5-pole terminal block (5.08 mm grid space) 1x 3-pole terminal block (5.08 mm grid space) 4x 9-pole terminal blocks (3.81 mm grid space)

1.5.2 Replacement device 07AI91-AD

1.5.2.1 Introduction

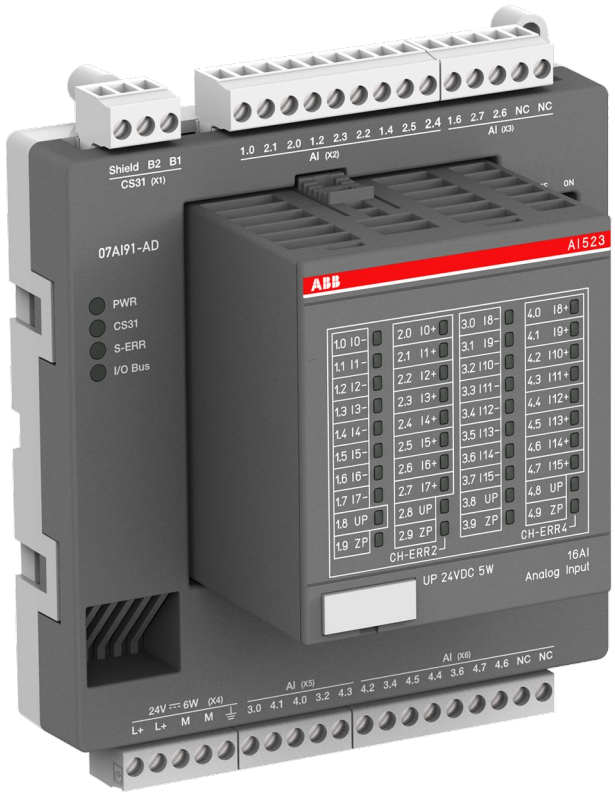

Fig. 47: 3ADR331191S0015_07AI91-AD

The replacement device 07AI91-AD of the AC31 adapter series replaces the existing device 07AI91 of the 90 series.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07AI91 remains valid and serves as reference (system description Advant Controller 31 *http://www.abb.de/search.aspx?abbcontext=products&q=2cdc120009M0**). The document structure of this document is based on the document structure of the existing documentation.

This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices 07AI91-AD can be found in the operating and assembly instructions of device 07AI91-AD: 3ADR020086M0401. Please note that for the existing device 07AI91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

1.5.2.2 Device configuration

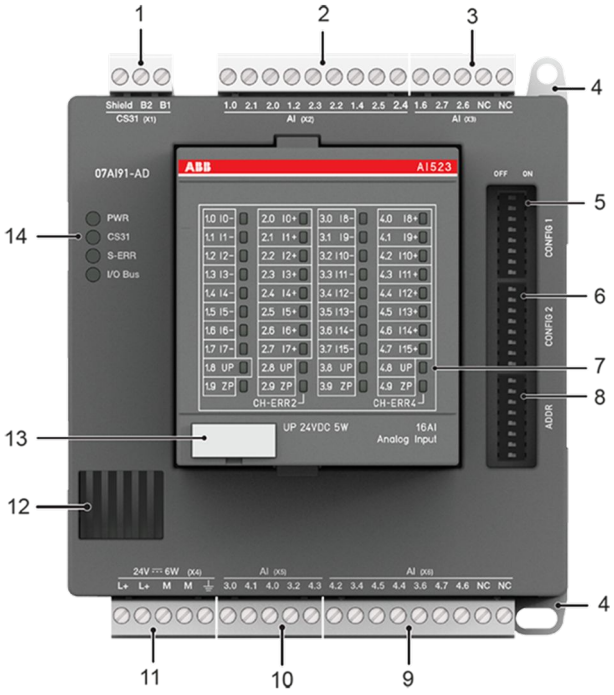

Fig. 48: Front view: 07AI91-AD

No.	Description
1	Connection for CS31 bus (X1)
2	Analog inputs (X2) 2.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)
3	Analog inputs (X3) 1.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)
4	Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5	DIP switch for CONFIG1
6	DIP switch for CONFIG2
7	Status LEDs for AI523
8	DIP switch for ADDR
9	Analog inputs (X6) 2.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)
10	Analog inputs (X5) 1.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)
11	Supply 24 V DC (incl. AI523)

No.	Description
12	Ventilation
13	TA525: Label
14	4 Status LEDs of complete device

In contrast to the existing device, the following measuring ranges are not available in the replacement device: ± 500 mV, ± 50 mV. Temperature measurement with thermocouples is also not possible.

The replacement device does not perform a self-calibration.

1.5.2.2.1 LED display

The LED display on the replacement device is changed:

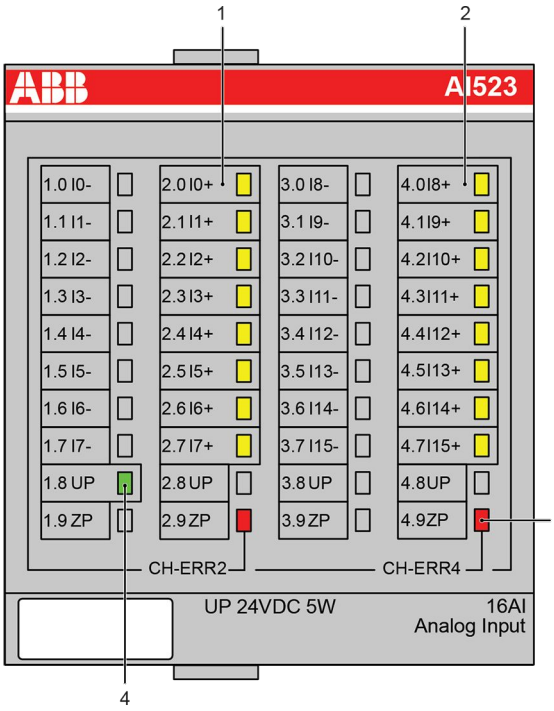

Fig. 49: Front view: 07AI91-AD

No.	Display of module
1	8 yellow LEDs to indicate the signal status of the analog inputs (X2 and X3)
2	8 yellow LEDs to indicate the signal status of the analog inputs (X5 and X6)
3	2 red LEDs to indicate errors (of AI523 module)
4	1 green LED to indicated the status of the supply voltage of the AI523 module (is supplied via X4)

The replacement device does not provide a test button to measure functionality.

1.5.2.2.2 Electrical connection

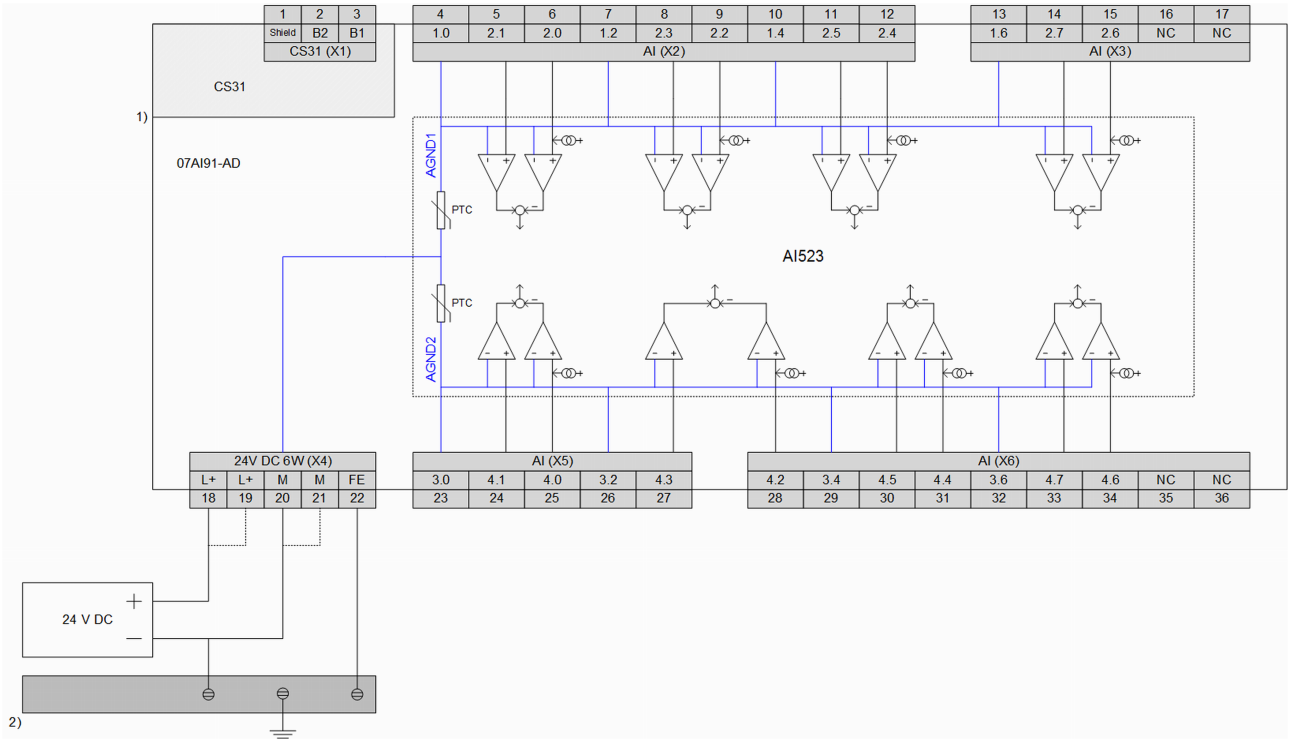

Fig. 50: Electrical connection

1 Electrical isolation
2 Switchgear cabinet earthing

Please observe the following information:

- The **Shield** connections of the CS31 system bus and **FE** of the supply voltage have no connection within the device.
- The process voltage must be included in the earthing concept of the control system (e.g. earthing of the minus pole).
- The connections of all sensors must be electrically isolated from the mounting environment of the sensors. The cable shields of the temperature sensors are earthed to the switchgear cabinet at the entry into the cabinet. The setting of the module address as well as the configuration of the analog channels are performed by means of DIP switches (see next pages).
- Unused inputs must be configured as "not evaluated" (DIP switch).
- The current sources in AI523 are configurable and therefore not always active. The current sources are connected alternately with the multiplex method. Consequently, the device does not have 8 current sources.
- The module address and the analog channels are set with DIP switches.

Pin assignment CS31 (X1):

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

Pin assignment AI (X2):

Connector / Terminal	Pin	Assignment / Signal
X2 / 1.0	4	AI523 / I0- (AGND1)
X2 / 2.1	5	AI523 / I1+
X2 / 2.0	6	AI523 / I0+
X2 / 1.2	7	AI523 / I2- (AGND1)
X2 / 2.3	8	AI523 / I3+
X2 / 2.2	9	AI523 / I2+
X2 / 1.4	10	AI523 / I4- (AGND1)
X2 / 2.5	11	AI523 / I5+
X2 / 2.4	12	AI523 / I4+

Pin assignment AI (X3):

Connector / Terminal	Pin	Assignment / Signal
X3 / 1.6	13	AI523 / I6- (AGND1)
X3 / 2.7	14	AI523 / I7+
X3 / 2.6	15	AI523 / I6+
X3 / NC	16	Not connected
X3 / NC	17	Not connected

In module AI523, the signals I0-, I2-, I4- and I6- are internally connected to an analog earth. The potential difference of the analog earth to M is ±1 V (max.). The replacement device has no current sources on pins 16 and 17. If necessary, these current sources can be connected to individual measurement channels via the configuration (DIP switch).

Pin assignment 24 V DC 6W (X4):

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	18	L+
X4 / L+	19	L+

Connector / Terminal	Pin	Assignment / Signal
X4 / M	20	M
X4 / M	21	M
X4 / FE	22	FE

Pin assignment AI (X5):

Connector / Terminal	Pin	Assignment / Signal
X5 / 3.0	23	AI523 / I8- (AGND2)
X5 / 4.1	24	AI523 / I9+
X5 / 4.0	25	AI523 / I8+
X5 / 3.2	26	AI523 / I10- (AGND2)
X5 / 4.3	27	AI523 / I11+

Pin assignment AI (X6):

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.2	28	AI523 / I10+
X6 / 3.4	29	AI523 / I12- (AGND2)
X6 / 4.5	30	AI523 / I13+
X6 / 4.4	31	AI523 / I12+
X6 / 3.6	32	AI523 / I14- (AGND2)
X6 / 4.7	33	AI523 / I15+
X6 / 4.6	34	AI523 / I14+
X6 / NC	35	Not connected
X6 / NC	36	Not connected

In module AI523, the signals I8-, I10-, I12- and I14- are internally connected to an analog earth. The potential difference of the analog earth to M is ±1 V (max.). The replacement device does not have current sources on pins 35 and 36. If necessary, these current sources can be connected to individual measurement channels via the configuration (DIP switch).

CAUTION!

System damage caused by voltage!

The exchange of a replacement device under voltage can cause permanent system damage (destruction).

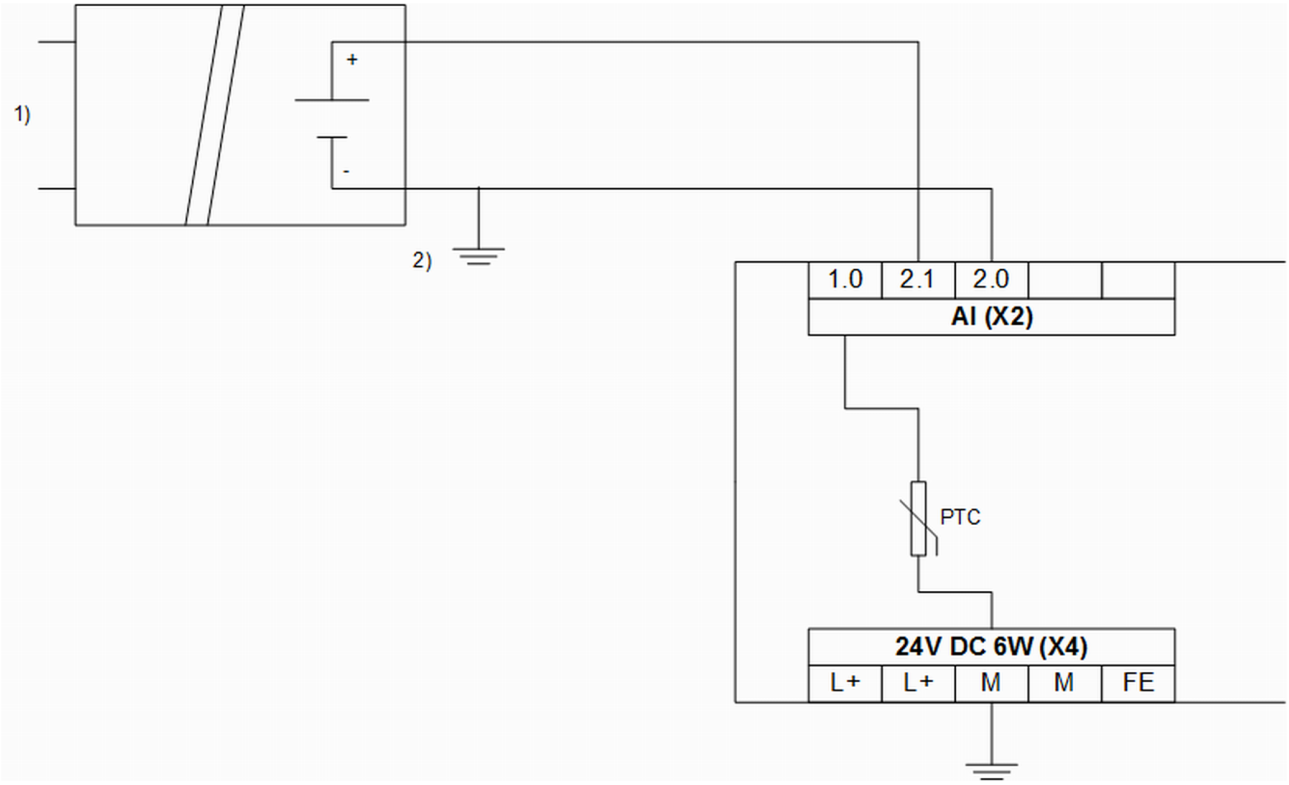

Fig. 51: Differential voltage input

1) Electrically isolated power supply of analog sensor
2) Earthing at sensor
   ±10 V or ±5 V at differential inputs

On the replacement devices, the wire-break detection is also active in case of a differential voltage measurement. For this purpose, each measuring channel is internally pulled to "plus" by means of a high-impedance resistor. As a result, the individual potentials of the differential voltage measurement must also be referenced to M. Completely isolated voltages are **not** symmetrized to M by the inputs.

The potential difference of the earthing at the sensor to M must not be too big (max. ± 1 V for the whole signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs.

Analog signal lines must be routed in shielded cables. The shield must be earthed on both sides and should be earthed to replacement device and signal source / signal sink as close as possible.

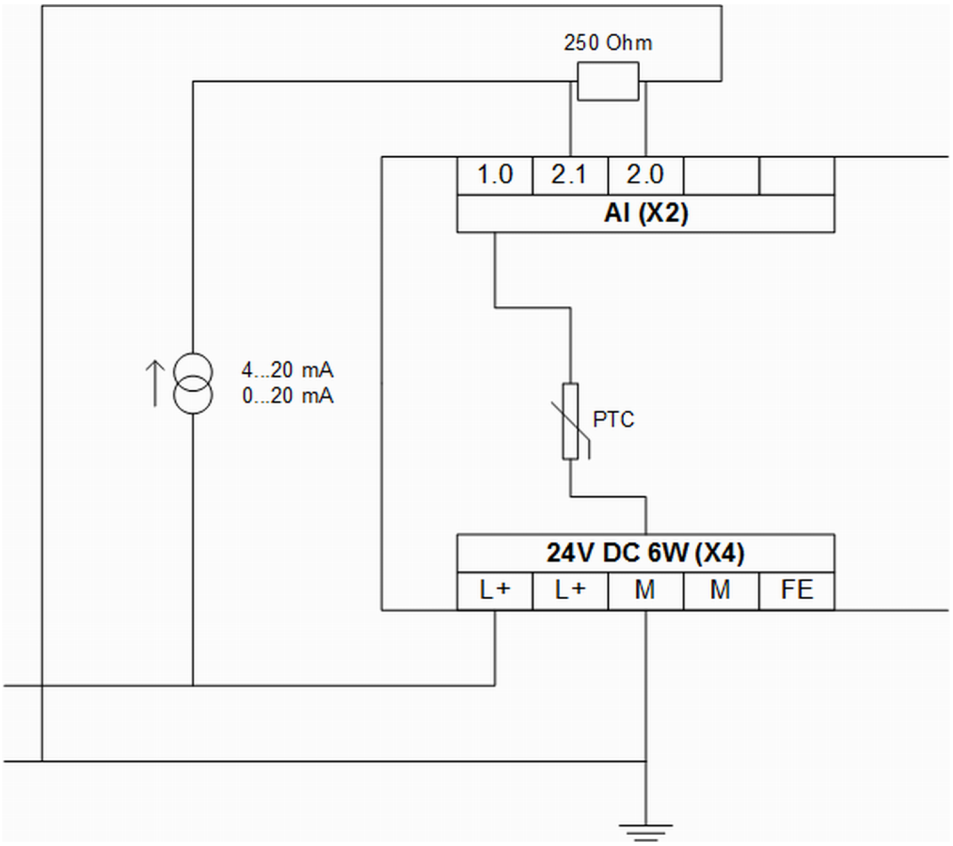

Fig. 52: Current input with external resistor

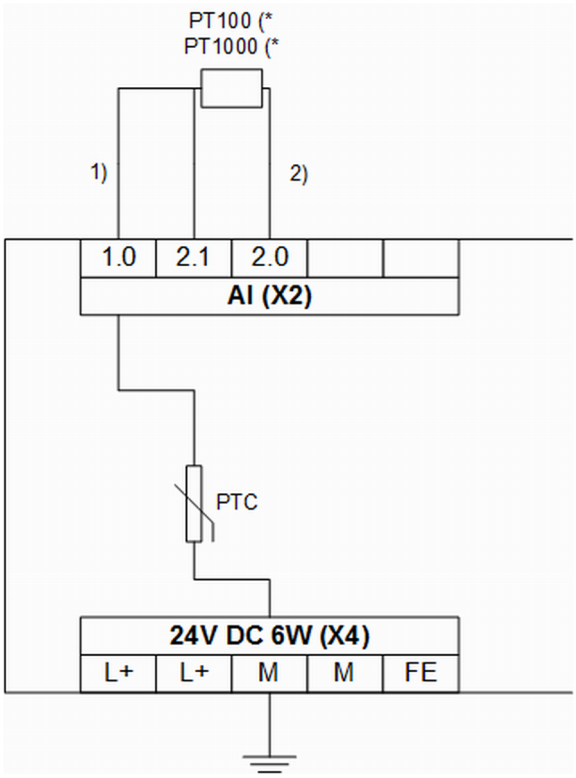

Fig. 53: Resistance thermometer

1) Return conductor
2) Twisted wire pair in the cable
(*) 3-wire

For temperature measurements with PT100/PT1000 resistors, the wiring to the existing device must be changed. A 4-wire temperature measurement is not possible with the replacement device. Based on the above figure, a 3-wire temperature measurement can be implemented.

1.5.2.2.3 Configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the DIP switch is arranged on the lower printed circuit board instead.

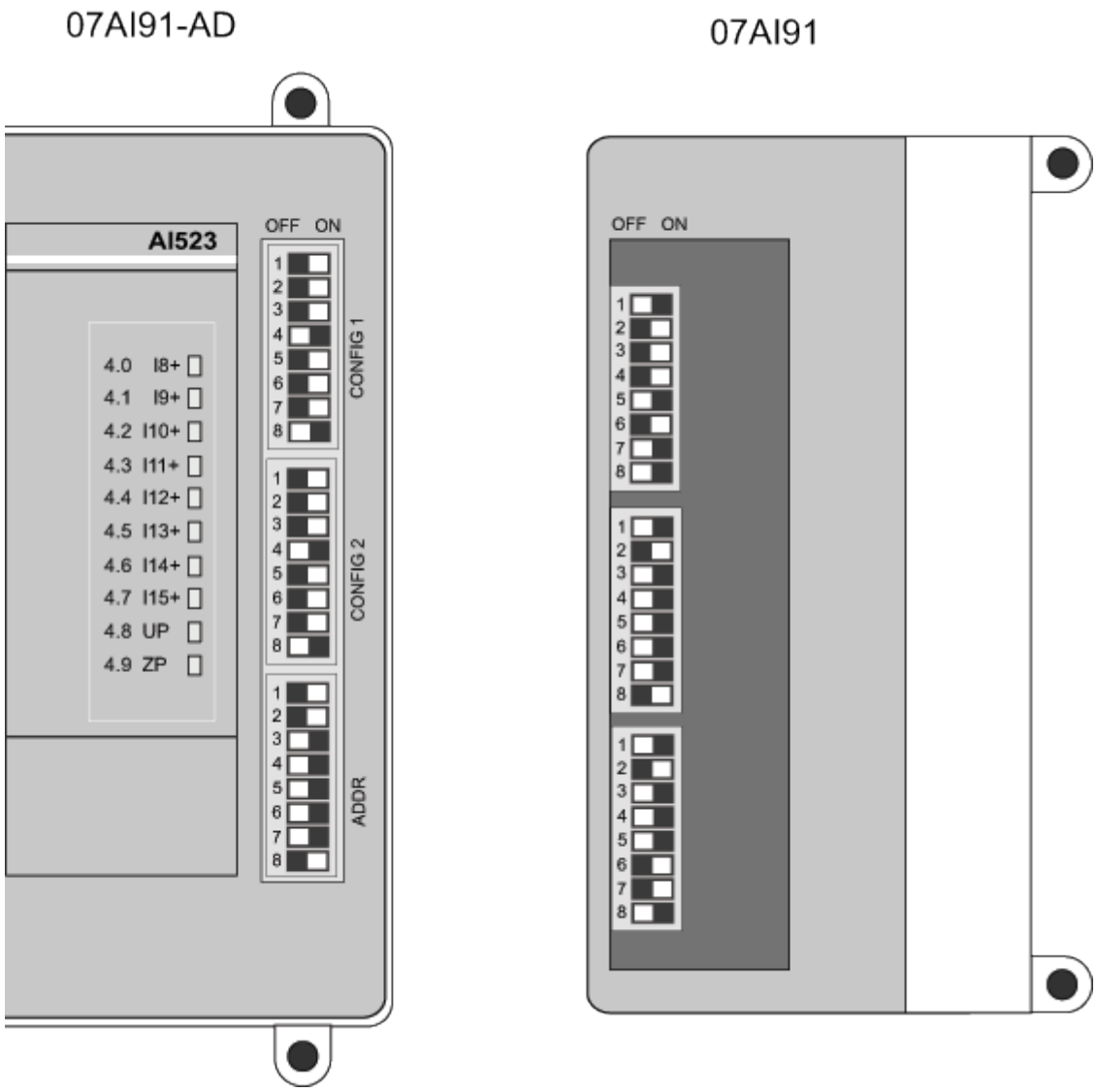

Fig. 54: DIP switch: 07AI91-AD

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is not supported for the replacement device. This DIP switch must be switched off.

On address DIP switch 3 (assignment of analog value), only the CS31 format is supported in the replacement device. This DIP switch must be switched on. The setting of the line frequency suppression (address DIP switch 1 and 2) has no effect on the existing device 07AI91.

The following settings of DIP switches CONFIG 1 and CONFIG 2 are not implemented in the replacement device and must not be selected:

- *± 500 mV*
- *± 50 mV*
- *J-type thermocouple with linearization*
- *K-type thermocouple with linearization*
- *S-type thermocouple with linearization*

For further information, please refer to the existing documentation.

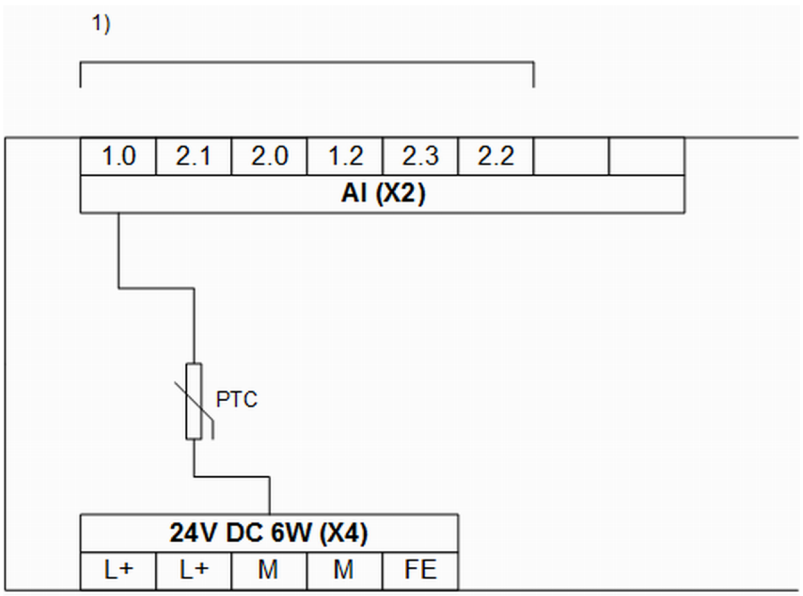

Fig. 55: "Configuration pair" not used

1) Channel 0 and channel 1 are not used -> DIP switch "No evaluation of channels"

If both channels of a "configuration pair" are not used, set the DIP switches to "No evaluation of channels".

The DIP switches are read by the device only once after the supply voltage has been connected.

1.5.2.2.4 Measuring ranges of the input channels

All input signals are not evaluated as differential signals. Two input channels are used to implement a differential measurement.

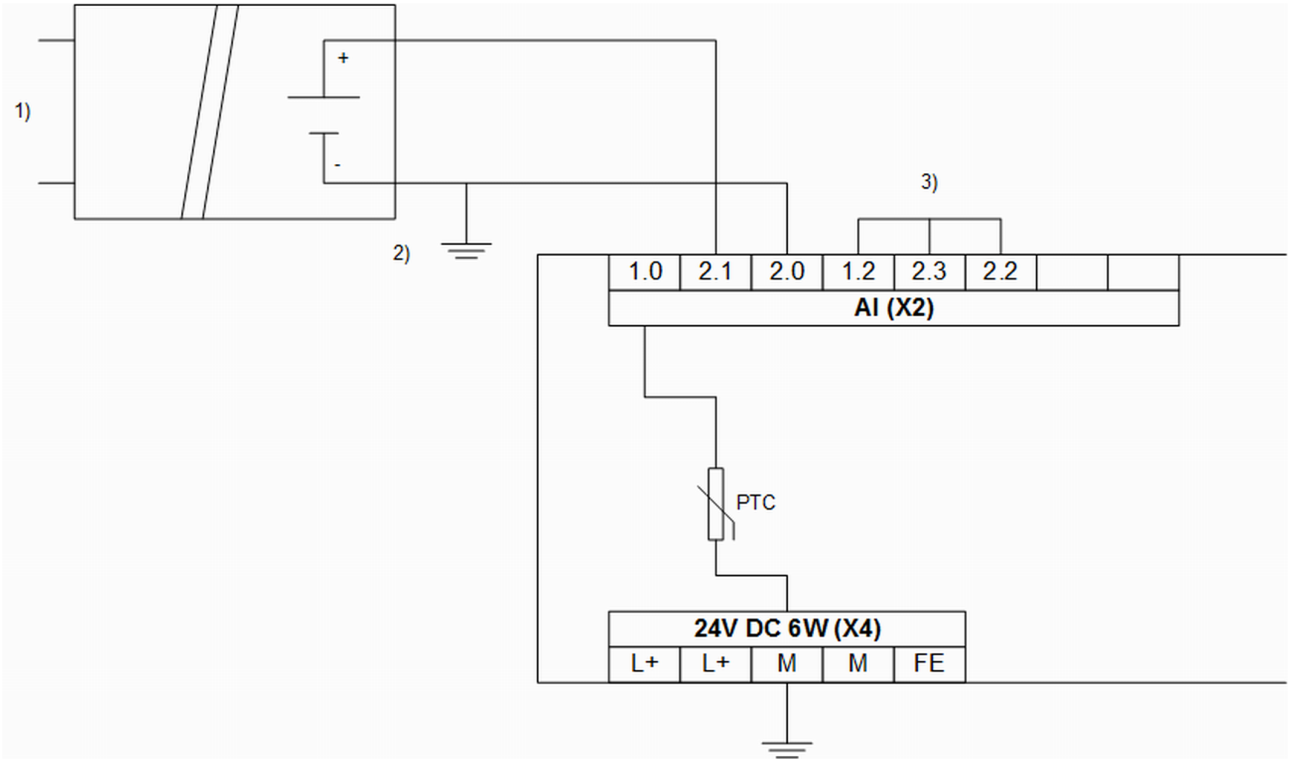

Fig. 56: Only one channel of a "configuration pair" is used

1) Electrically isolated power supply of analog sensor
2) Earthing at sensor
3) Channel not used
   ± 10 V, ± 5 V at differential inputs

If only one channel of a "configuration pair" is used (e.g. channel 0 and 1), then the other channel must be short-circuited during a voltage measurement. Short-circuited in this context means that for instance the connections 1.2, 2.3 and 2.2 are connected. Otherwise the channel not used reports that the range has been exceeded.

± 10 V / ± 5 V / ± 500 mV / ± 50 mV:

The measuring ranges ± 500 mV and ± 50 mV no longer exist.

4 ... 20 mA / 0 ... 20 mA:

No change to existing documentation.

Pt 100 / Pt 1000:

To measure the temperature by means of resistors, a constant current is supplied by the replacement device. This imprint no longer occurs at terminals 16, 17, 35 and 36. Therefore the wiring must be changed for the temperature measurement.

Further information:

Fig. 50

Fig. 53

Figures 5.2-4 and 5.2-5 from the existing documentation of the 07AI91 are not valid for the replacement device.

Terminals 7, 10, 13, 26, 29 and 32 can no longer be used as connection bases. The terminals are only used for the 3-wire temperature measurement.

In case of a wire-breakage, the numerical value +32767 is output. This is followed by an error message via the CS31 system bus.

If only one channel of a "configuration pair" is used (e.g. channel 0 and 1), then the other channel must be connected with a resistor (e.g. 120 Ω Pt100 measuring range, 1200 Ω Pt1000 measuring range). Otherwise an error message is indicated.

Connection of other temperature-dependent resistors:

Other temperature-dependent resistors cannot be used for the replacement device.

Thermocouples type J, type K, type S:

Thermocouples cannot be evaluated with the replacement device. The respective section in the existing documentation (incl. figure 5.2-6) are not valid for device 07AI91.

Configuration for unused channels:

See existing documentation 07AI91.

Relationship between the measuring values and the location of the bits in a 16 bit word:

The measuring ranges ± 500 mV and ± 50 mV no longer exist.

Measuring range ±5 V:

- Replacement device: 11 bit resolution plus sign
- Existing device: 12 bit resolution plus sign

All measuring ranges for thermocouples are no longer available.

1.5.2.2.5 Addressing

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data *Chapter 1.3 “System data and CS31 bus system data” on page 5*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 slave).

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported.

CS31 system bus:

Type	Byte	Connector / Terminal
Word input (send) 0	1	X2 / 2.1, X2 / 2.0
	2	
Word input (send) 1	3	X2 / 2.3, X2 / 2.2
	4	
Word input (send) 2	5	X2 / 2.5, X2 / 2.4
	6	
Word input (send) 3	7	X3 / 2.7, X3 / 2.6
	8	
Word input (send) 4	9	X5 / 4.1, X5 / 4.0
	10	
Word input (send) 5	11	X5 / 4.3, X6 / 4.2
	12	
Word input (send) 6	13	X6 / 4.5, X6 / 4.4
	14	
Word input (send) 7	15	X6 / 4.7, X6 / 4.6
	16	

When the measuring values are bipolar, use data type "Int input" instead of "Word input".

1.5.2.2.6 Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal statuses of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the Flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the inputs remain active.

1.5.2.2.7 Diagnosis and display

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Diagnosis information of the CS31 bus:

Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error:			
0	43	1	Internal error
Channel error:			
0 ... 7	45	9	Cut wire (is also indicated if the current in measuring range 4 ... 20 mA is less than 2 mA)
0 ... 7	49	10	Analog value is out of measuring range

The error codes that are transferred by the replacement device via the CS31 bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

An exceedance of the measuring range is signaled even if nothing is connected to an analog voltage input.

Device LEDs:

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31	CS31 bus communication	Green	No CS31 bus communication	CS31 bus communication	Only diagnosis, no data transfer. Transmission is disturbed.

LED	Status	Color	LED off	LED on	LED flashes
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal Flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

LEDs of the S500 module AI523:

LED	Status	Color	LED off	LED on	LED flashes
I1+, I3+, I5+, I7+ (see No. 1 in the following figure)	Analog inputs	Yellow	Input is not activated	Input is activated (brightness depends on value of analog signal).	-
I9+, I11+, I13+, I15+ (see No. 2 in the following figure)	Analog inputs	Yellow	Input is not activated	Input is activated (brightness depends on value of analog signal).	-
Error indication left (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	Cut wire on a channel of the corresponding group
Error indication right (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	Cut wire on a channel of the corresponding group
Indication supply voltage (see No. 4 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

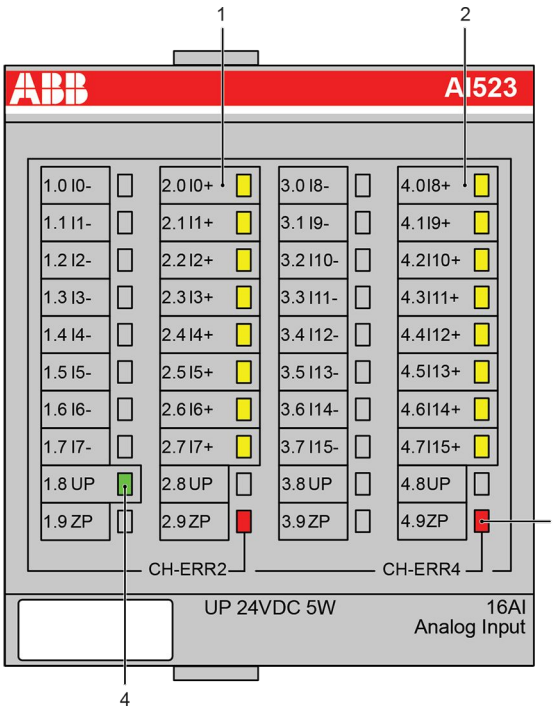

Fig. 57: 07AI91-AD_Front

1.5.2.2.8 Technical Data

This section provides additional information on section *Chapter 1.3 "System data and CS31 bus system data" on page 5*. In case of doubt, the following information applies.

Technical Data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 18), X4/L+ (pin 19), X4/M (pin 20), X4/M (pin 21)
-> Fuse for L+	10 A, fast acting
- Electrical isolation	No
Current consumption:	
-> via L+	0.19 A
- Inrush current via L+ (when voltage is switched on)	0.22 A²s
Power consumption	Replacement device: 6 W Existing device: 3 W
Address setting and configuration	DIP switch right side of housing
Max. line length of analog lines, line cross section > 0.14 mm²	100 m

For further information, please refer to the existing documentation.

CAUTION!

System damage caused by voltage!

Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Technical Data of the analog inputs

Data	Value
Connections	[X2 / 2.1, X2 / 2.0], [X2 / 2.3, X2 / 2.2], [X2 / 2.5, X2 / 2.4], [X3 / 2.7, X3 / 2.6], [X5 / 4.1, X5 / 4.0], [X5 / 4.3, X6 / 4.2], [X6 / 4.5, X6 / 4.4], [X6 / 4.7, X6 / 4.6]
Reference connections (AGND1)	X2 / 1.0, X2 / 1.2, X2 / 1.4, X3 / 1.6
Reference connections (AGND2)	X5 / 3.0, X5 / 3.2, X6 / 3.4, X6 / 3.6
Max. potential difference AGND1/2 <-> M	± 1 V
Type of inputs	Voltage bipolar, current unipolar, temperature measurement
Line frequency suppression	Not available
Time constant of the input filter	Replacement device: Voltage: 100 µs, current 100 µs Existing device: no RC combination available
Conversion cycle	Replacement device: 2 ms over 8 inputs, 1 s during temperature measurement Existing device: 30 ms to 150 ms, depending on configuration
Protection against reversed voltage	Yes
Overvoltage protection	Up to 30 V DC

For further information, please refer to the existing documentation.

Analog voltage input

Data	Value
Input resistance	Replacement device: > 100 kΩ Existing device: > 1 MΩ
Measuring ranges nominal values	Replacement device: ± 10 V, ± 5 V Existing device: ± 10 V, ± 5 V, ± 500 mV, ± 50 mV
Resolution	12 bit + sign (measuring range ± 10 V) 11 bit + sign (measuring range ± 5 V)
Total error	Replacement device: ± 1 % of full range value Existing device: ± 0.5 % of full range value
Common mode input voltage range (e.g. X2 / 2.1, reference e.g. X2 / 1.0 (AGND1))	-10 V ... +10 V

For further information, please refer to the existing documentation.

Current input 0 … 20 mA / 4 … 20 mA

Total error:

Replacement device: ±1 % of full range value ± tolerance of current-sensing resistor

Existing device: ±0.5 % of full range value + tolerance of current-sensing resistor

Pt100/Pt1000 input

Data	Value
Measurement method	Replacement device: 3-wire configuration Existing device: 4-wire configuration. It is no longer possible to connect sensors in series.
Evaluation errors in measuring range -50…+400 °C	Replacement device: ± 1 % of full range value Existing device: ± 0.5 % of full range value at Pt100, ± 1 % of full range value at Pt1000
Current source for Pt100/Pt1000 resistors	The replacement device has a constant current source that is alternately connected to up to 8 analog channels (depending on configuration).

Unused input channels

See existing documentation 07AI91.

Connection of other temperature-dependent resistors

Other temperature-dependent resistors cannot be used in the replacement device.

Input with thermocouples

Thermocouples cannot be used in the replacement device. The existing documentation is no longer valid.

Connection to the CS31 bus

Data	Value
Connections	X1 / B2, X1 / B1
CS31 type	01 (analog input)
Termination resistor	Not available (must be provided externally if needed)

Mechanical data

Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 384 g Existing device: 450 g
Dimensions for mounting	See operating and assembly instructions of the replacement device (3ADR020086M0401)

Mounting information

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

Ordering data

Order No.	Scope of delivery
1SAP 800 200 R0010	Analog input module 07AI91-AD 1x 3-pole terminal block 3x 5-pole terminal blocks 2x 9-pole terminal blocks

1.5.3 Replacement device 07AC91-AD

1.5.3.1 Introduction

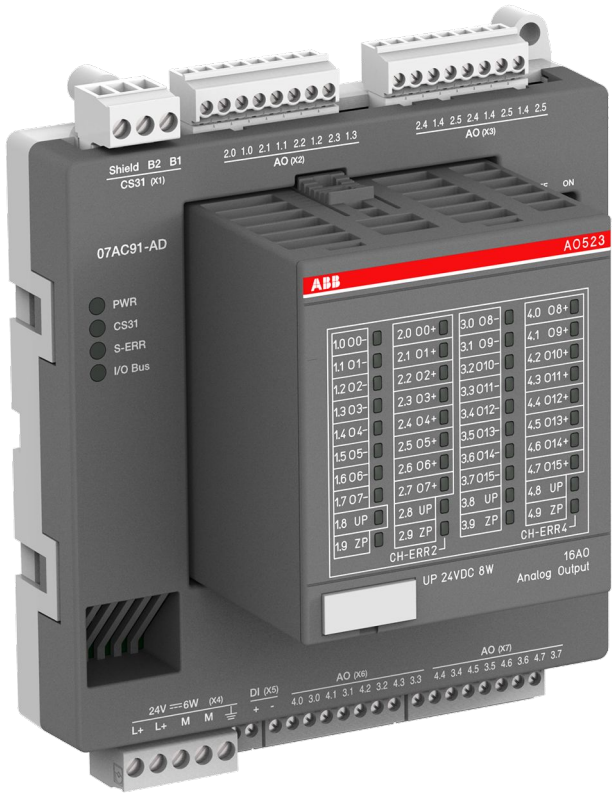

Fig. 58: 3ADR331193S0015_07AC91-AD

The replacement device 07AC91-AD of the AC31 adapter series replaces the existing device 07AC91 of the AC31/90 series in operating mode **8 bit**. The replacement device 07AC91-AD2 is available for operating mode **12 bit**.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07AC91 remains valid and serves as reference (system description Advant Controller 31 *http://www.abb.de/search.aspx?abbcontext=products&q=2cdc120009M0**).

The document structure of this document is based on the document structure of the existing documentation.

This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices 07AC91-AD can be found in the operating and assembly instructions of device 07AC91-AD: 3ADR020084M0401. Please note that for the existing device 07AC91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

1.5.3.2 Device configuration

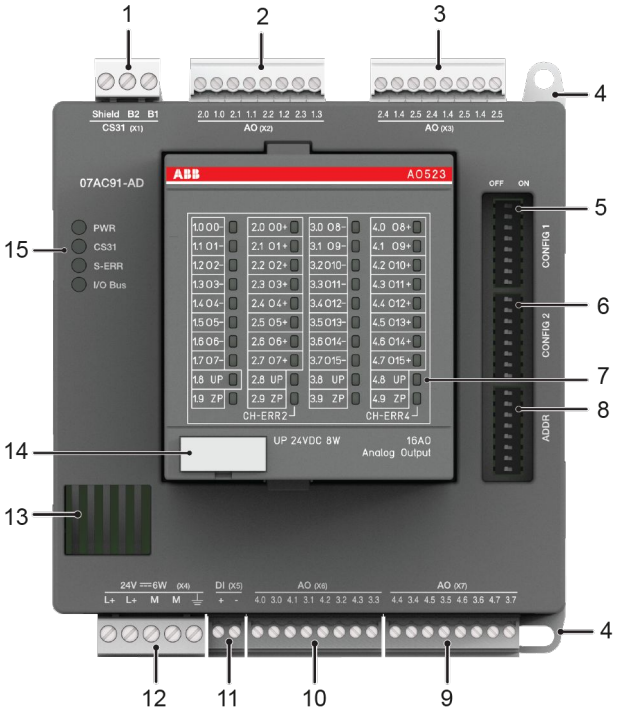

Fig. 59: Front view: 07AC91-AD

No.	Description
1	Connection for CS31 bus (X1)
2	Analog outputs (X2): 0 ... 10 V, 0 ... 20 mA
3	Analog outputs (X3): 0 ... 10 V
4	Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5	DIP switch for CONFIG1
6	DIP switch for CONFIG2
7	Status LEDs for AO523
8	DIP switch for ADDR
9	Analog outputs (X7): 0 ... 10 V
10	Analog outputs (X6): 0 ... 10 V, 0 ... 20 mA
11	Enabling input for analog outputs (X5)
12	Supply 24 V DC (incl. AO523)
13	Ventilation

No.	Description
14	TA525: Label
15	4 Status LEDs

When using a control system (PLC/central unit) that is configured via the Automation Builder software (e.g. 07KT98-ARC-AD), the connection element ANAI4_20 is no longer available.

1.5.3.2.1 LED display

The LED display on the replacement device is changed:

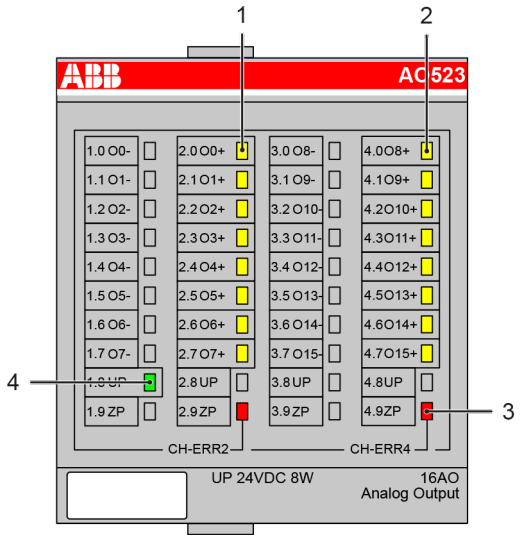

Fig. 60: AO523

No.	Display of module
1	8 yellow LEDs to indicate the signal status of the analog inputs (X2 and X3)
2	8 yellow LEDs to indicate the signal status of the analog inputs (X6 and X7)
3	2 red LEDs to indicate errors (of AO523 module)
4	1 green LED to indicated the status of the supply voltage of the AO523 module (is supplied via X4)

The replacement device does not provide a test button to measure functionality.

1.5.3.2.2 Electrical connection

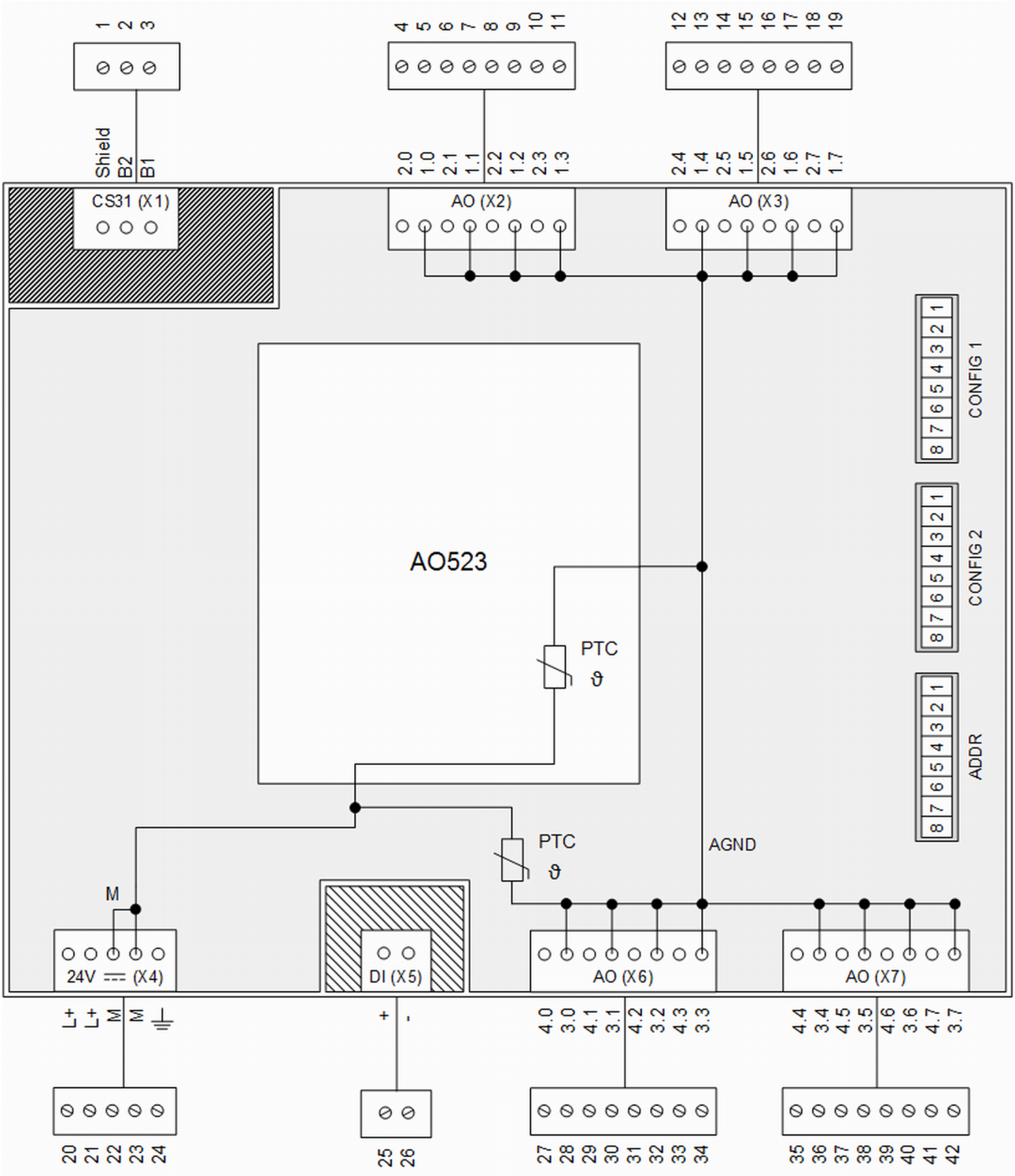

Fig. 61: Electrical connection

AC31 adapter

Please observe the information contained in the existing documentation. In section "Fig. 5.4-2: Electrical connection of the analog input/output module 07AC91", only the information concerning operating mode 8 bit is relevant for the replacement device 07AC91-AD.

Pin assignment CS31 (X1):

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

Pin assignment AO (X2):

Connector / Terminal	Pin	Assignment / Signal
X2 / 2.0	4	AO523 / O0+
X2 / 1.0	5	AO523 / O0- (AGND)
X2 / 2.1	6	AO523 / O1+
X2 / 1.1	7	AO523 / O1- (AGND)
X2 / 2.2	8	AO523 / O2+
X2 / 1.2	9	AO523 / O2- (AGND)
X2 / 2.3	10	AO523 / O3+
X2 / 1.3	11	AO523 / O3- (AGND)

Pin assignment AO (X3):

Connector / Terminal	Pin	Assignment / Signal
X3 / 2.4	12	AO523 / O4+
X3 / 1.4	13	AO523 / O4- (AGND)
X3 / 2.5	14	AO523 / O5+
X3 / 1.5	15	AO523 / O5- (AGND)
X3 / 2.6	16	AO523 / O6+
X3 / 1.6	17	AO523 / O6- (AGND)
X3 / 2.7	18	AO523 / O7+
X3 / 1.7	19	AO523 / O7- (AGND)

Pin assignment 24 V DC 9W (X4):

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	20	L+
X4 / L+	21	L+
X4 / M	22	M
X4 / M	23	M
X4 / FE	24	FE

Pin assignment DI (X5):

Connector / Terminal	Pin	Assignment / Signal
X5 / +	25	IN+
X5 / -	26	IN- (electrically isolated earth)

Pin assignment AO (X6):

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.0	27	AO523 / O8+
X6 / 3.0	28	AO523 / O8- (AGND)
X6 / 4.1	29	AO523 / O9+
X6 / 3.1	30	AO523 / O9- (AGND)
X6 / 4.2	31	AO523 / O10+
X6 / 3.2	32	AO523 / O10- (AGND)
X6 / 4.3	33	AO523 / O11+
X6 / 3.3	34	AO523 / O11- (AGND)

Pin assignment AO (X7):

Connector / Terminal	Pin	Assignment / Signal
X7 / 4.4	35	AO523 / O12+
X7 / 3.4	36	AO523 / O12- (AGND)
X7 / 4.5	37	AO523 / O13+
X7 / 3.5	38	AO523 / O13- (AGND)
X7 / 4.6	39	AO523 / O14+
X7 / 3.6	40	AO523 / O14- (AGND)

Connector / Terminal	Pin	Assignment / Signal
X7 / 4.7	41	AO523 / O15+
X7 / 3.7	42	AO523 / O15- (AGND)

The signals Ox- are internally linked to an AGND area. The potential AGND is connected to the potential M via PTC resistors. Potential difference AGND to M ±1 V (max.).

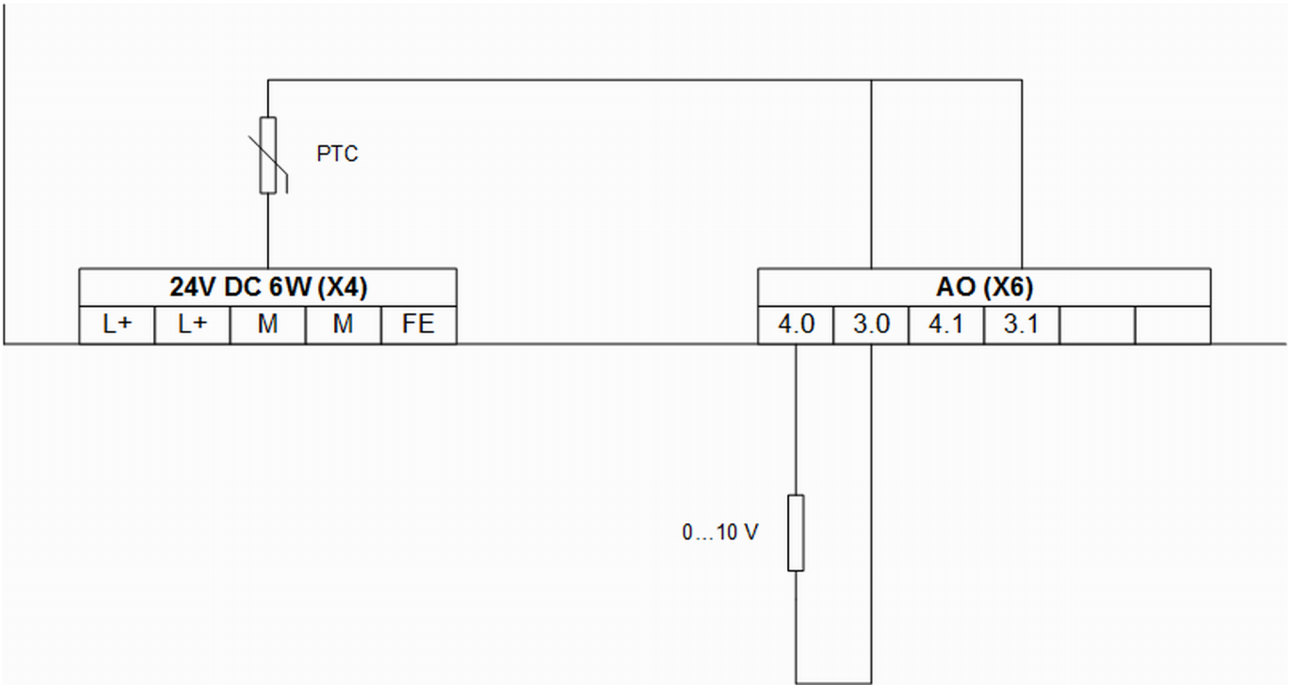

Fig. 62: Voltage output

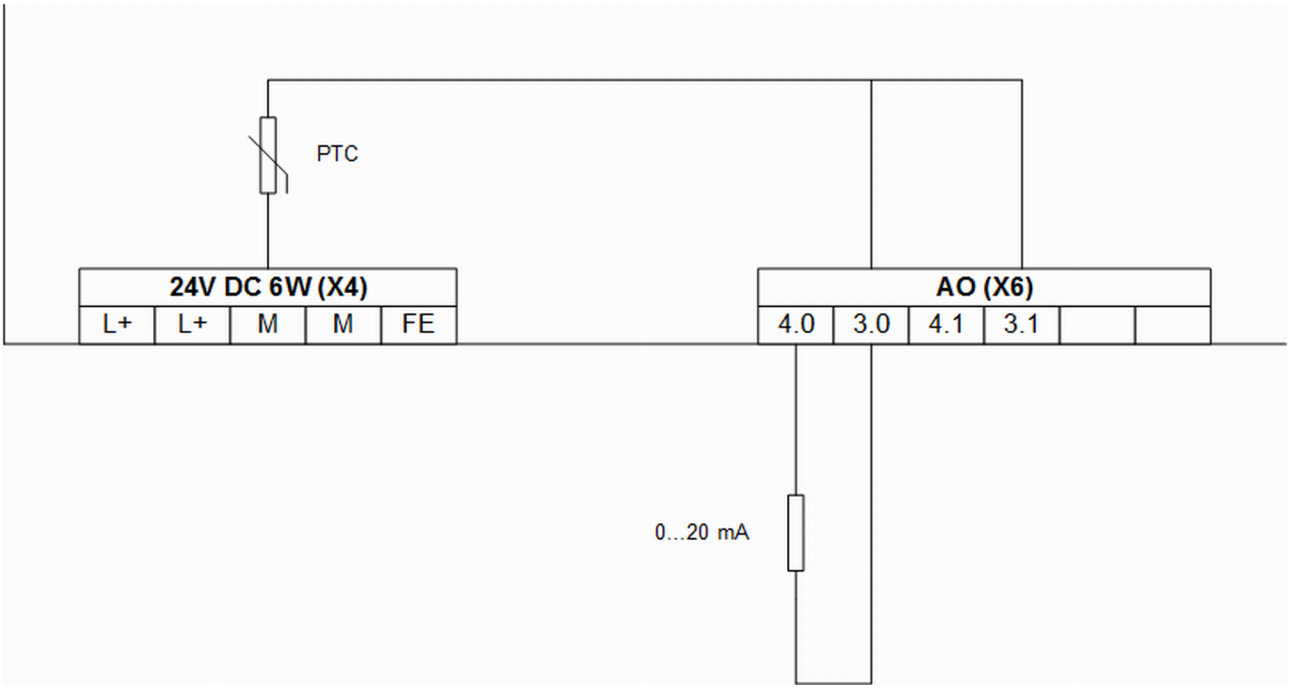

Fig. 63: Current output

Analog signal lines must be routed in shielded cables. The shield must be earthed on both sides and should be earthed to replacement device and signal source / signal sink as close as possible.

1.5.3.2.3 Configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the DIP switch is arranged on the lower printed circuit board instead.

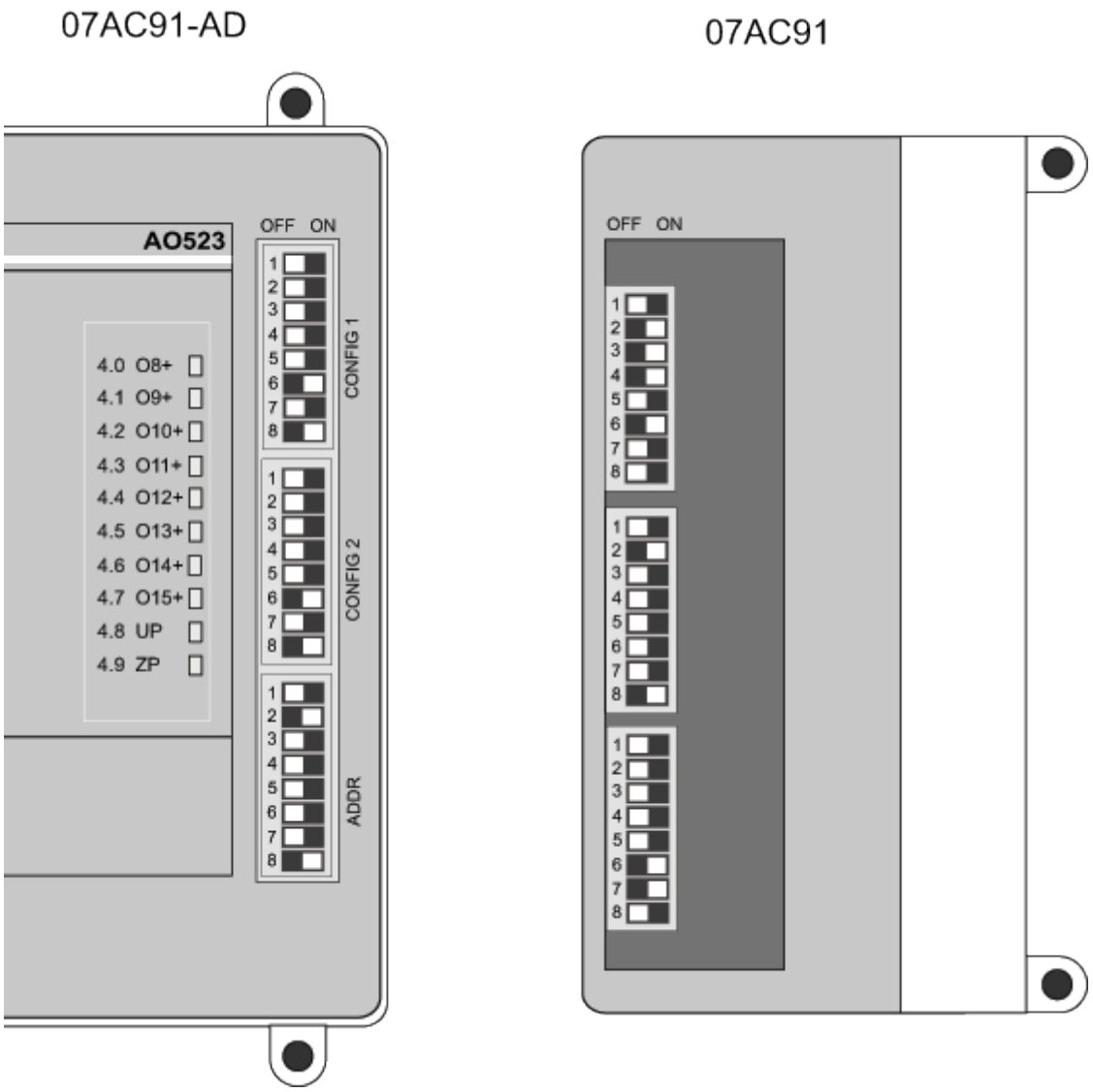

Fig. 64: DIP switch: 07AC91-AD

Please observe the following:

- All channels must be configured as outputs.
- The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported. This DIP switch must be switched off. The outputs on connector X3 and X7 cannot be configured as current outputs.
- The operating mode (address DIP switch 1) must be set to "8 bit".
- The DIP switches are read by the device only once after the supply voltage has been connected.

For further information, please refer to the existing documentation.

1.5.3.2.4 Measuring ranges of the analog channels

For the replacement device 07AC91-AD, only the operating mode "8 bit" is relevant.

The outputs of the S500 module AO523 have a 12 bit resolution. The values that are to be transmitted via the CS31 bus and output by the replacement device have only a 8 bit resolution. For this reason, the overall resolution achieved is only 8 bits.

1.5.3.2.5 Addressing

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported.

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data ↬ *Chapter 1.3 “System data and CS31 bus system data” on page 5*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 slave).

CS31 bus:

Type	Byte	Position in Word	Connector / Terminal
Word output (received) 0	1	High	X2 / 2.1
	2	Low	X2 / 2.0
Word output (received) 1	3	High	X2 / 2.3
	4	Low	X2 / 2.2
Word output (received) 2	5	High	X3 / 2.5
	6	Low	X3 / 2.4
Word output (received) 3	7	High	X3 / 2.7
	8	Low	X3 / 2.6
Word output (received) 4	9	High	X6 / 4.1
	10	Low	X6 / 4.0
Word output (received) 5	11	High	X6 / 4.3
	12	Low	X6 / 4.2
Word output (received) 6	13	High	X7 / 4.5
	14	Low	X7 / 4.4
Word output (received) 7	15	High	X7 / 4.7
	16	Low	X7 / 4.6

1.5.3.2.6 Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal statuses of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the Flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device are switched off. The outputs are also switched off in case of a malfunction of the CS31 bus.

1.5.3.2.7 Diagnosis and display

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Diagnosis information of the CS31 bus:

Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error:			
0	43	1	Internal error

The error codes that are transferred by the replacement device via the CS31 bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

Device LEDs:

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31	CS31 bus communication	Green	No CS31 bus communication	CS31 bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal Flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

S500 module AO523 LEDs:

LED	Status	Color	LED off	LED on	LED flashes
O0+…O7+ O8+…O15+ (see No. 1 + 2 in the following figure)	Analog outputs	Yellow	Output is not activated	Output is activated (brightness depends on value of analog signal).	-
Error indication left (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-
Error indication right (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-
Indication supply voltage (see No. 4 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

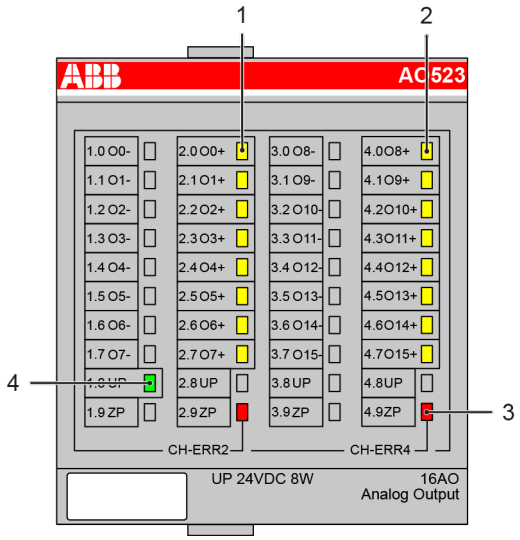

Fig. 65: AO523

1.5.3.2.8 Technical Data

This section provides additional information on section ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*. In case of doubt, the following information applies.

For the device 07AC91-AD, only the operating mode "8 bit" is relevant.

Technical Data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 20), X4/L+ (pin 21), X4/M (pin 22), X4/M (pin 23)
-> Fuse for L+	10 A, fast acting
- Electrical isolation	No
Current consumption:	
-> via L+	0.19 A + output load
- Inrush current via L+ (when voltage is switched on)	0.18 A²s
Power consumption	Replacement device: 9 W Existing device: 5 W

For further information, please refer to the existing documentation.

CAUTION!

System damage caused by voltage!

Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Technical Data of the binary input

Data	Value
Input current at input voltage +24 V	Typ. 6 mA
Protection against reversed voltage	Yes
Overvoltage protection	No

The enabling input is a proprietary input.

For further information, please refer to the existing documentation.

Technical Data of the analog outputs

Data	Value
Connections	X2 / 2.0, X2 / 2.1, X2 / 2.2, X2 / 2.3, X3 / 2.4, X3 / 2.5, X3 / 2.6, X3 / 2.7, X6 / 4.0, X6 / 4.1, X6 / 4.2, X6 / 4.3, X7 / 4.4, X7 / 4.5, X7 / 4.6, X7 / 4.7
Reference connections (AGND)	X2 / 1.0, X2 / 1.1, X2 / 1.2, X2 / 1.3, X3 / 1.4, X3 / 1.5, X3 / 1.6, X3 / 1.7, X6 / 3.0, X6 / 3.1, X6 / 3.2, X6 / 3.3, X7 / 3.4, X7 / 3.5, X7 / 3.6, X7 / 3.7
Type of outputs	Voltage unipolar, current unipolar
Configurability	No inputs are available Replacement device: 8 current outputs Existing device: 16 current outputs
Output load capability, as voltage output	Replacement device: ± 10 mA Existing device: +20 mA, -10 mA
Short-circuit-proof	Yes
External supply protection	Up to 30 V DC

For further information, please refer to the existing documentation.

Connection to the CS31 system bus

Data	Value
Connections	X1/B2, X1/B1
CS31 type	03 (analog output)
Termination resistor	Not available (must be provided externally if needed)

Mechanical data

Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 363 g Existing device: 450 g
Dimensions for mounting	See assembly instructions 07AC91-AD (3ADR020084M0401)

Mounting information

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

Ordering data

Order No.	Scope of delivery
1SAP 800 000 R0010	Analog output module 07AC91-AD 1x 2-pole terminal block (3.81 mm grid space) 1x 3-pole terminal block (5.08 mm grid space) 1x 5-pole terminal block (5.08 mm grid space) 4x 8-pole terminal blocks (3.81 mm grid space)

1.5.4 Replacement device 07AC91-AD2

1.5.4.1 Introduction

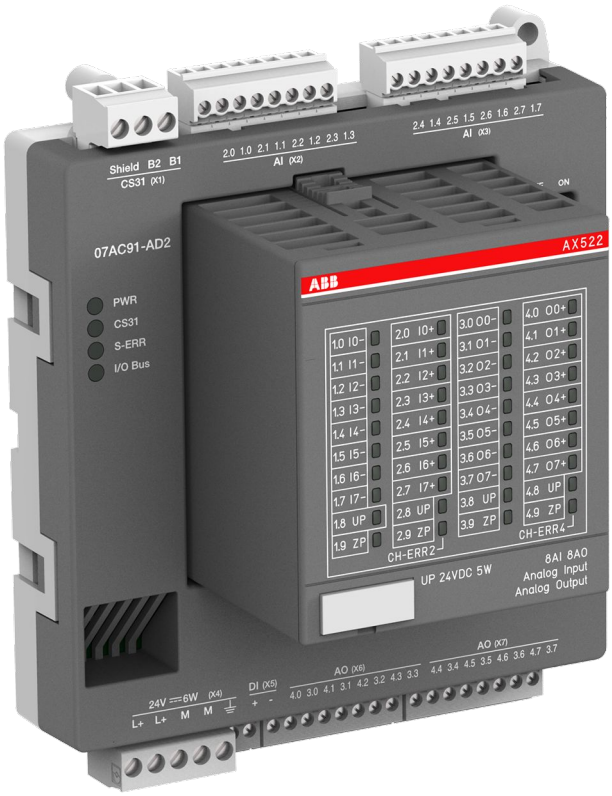

Fig. 66: 3ADR331194S0015_07AC91-AD2

The replacement device 07AC91-AD2 of the AC31 adapter series replaces the existing device 07AC91 of the AC31/90 series in operating mode **12 bit**. The replacement device 07AC91-AD is available for operating mode **8 bit**.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07AC91 remains valid and serves as reference (system description Advant Controller 31 *http://www.abb.de/search.aspx?abbcontext=products&q=2cdc120009M0**). The document structure of this document is based on the document structure of the existing documentation.

This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices 07AC91-AD2 can be found in the operating and assembly instructions of device 07AC91-AD2: 3ADR020085M0401. Please note that for the existing device 07AC91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

1.5.4.2 Device configuration

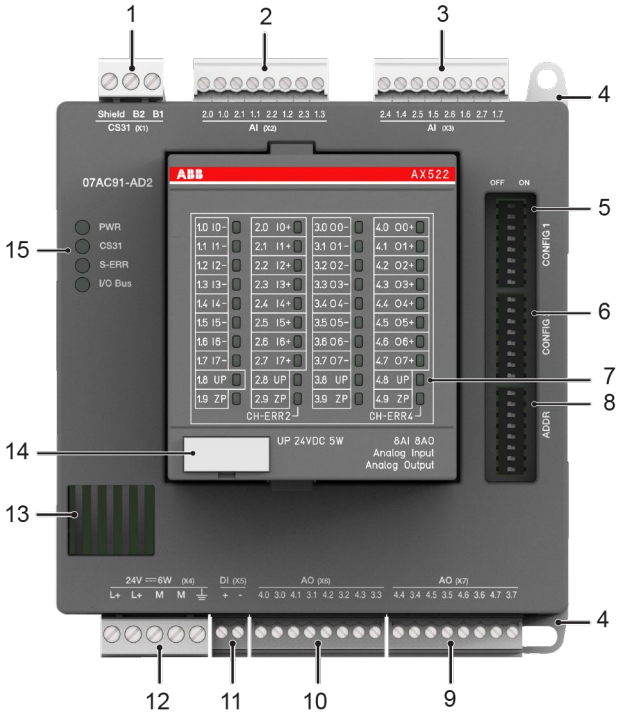

Fig. 67: Front view: 07AC91-AD2

No.	Description
1	Connection for CS31 bus (X1)
2	Analog inputs (X2): -10 V…+10 V, 0…20 mA
3	Analog inputs (X3): -10 V…+10 V, 0…20 mA
4	Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5	DIP switch for CONFIG1
6	DIP switch for CONFIG2
7	Status LEDs for AX522
8	DIP switch for ADDR
9	Analog outputs (X7): -10 V…+10 V
10	Analog outputs (X6): -10 V…+10 V, 0…20 mA
11	Enabling input for analog outputs (X5)
12	Supply 24 V DC (incl. AX522)
13	Ventilation

No.	Description
14	TA525: Label
15	4 Status LEDs

When using a control system (PLC/central unit) that is configured via the Automation Builder software (e.g. 07KT98-ARC-AD), the connection element ANAI4_20 is no longer available.

1.5.4.2.1 LED display

The LED display on the replacement device is changed:

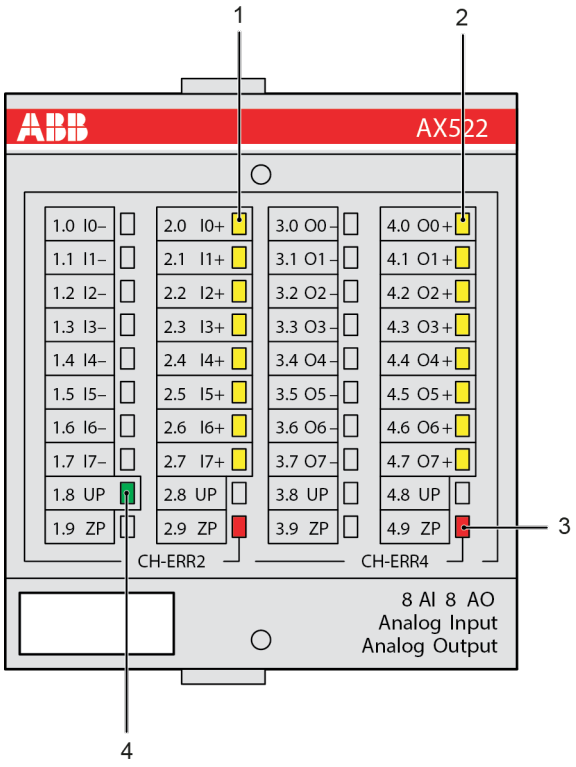

Fig. 68: AX522

No.	Display of module
1	8 yellow LEDs to indicate the signal status of the analog inputs (X2 and X3)
2	8 yellow LEDs to indicate the signal status of the analog inputs (X6 and X7)
3	2 red LEDs to indicate errors (of AX522 module)
4	1 green LED to indicated the status of the supply voltage of the AX522 module (is supplied via X4)

AC31 adapter

The replacement device does not provide a test button to measure functionality.

1.5.4.2.2 Electrical connection

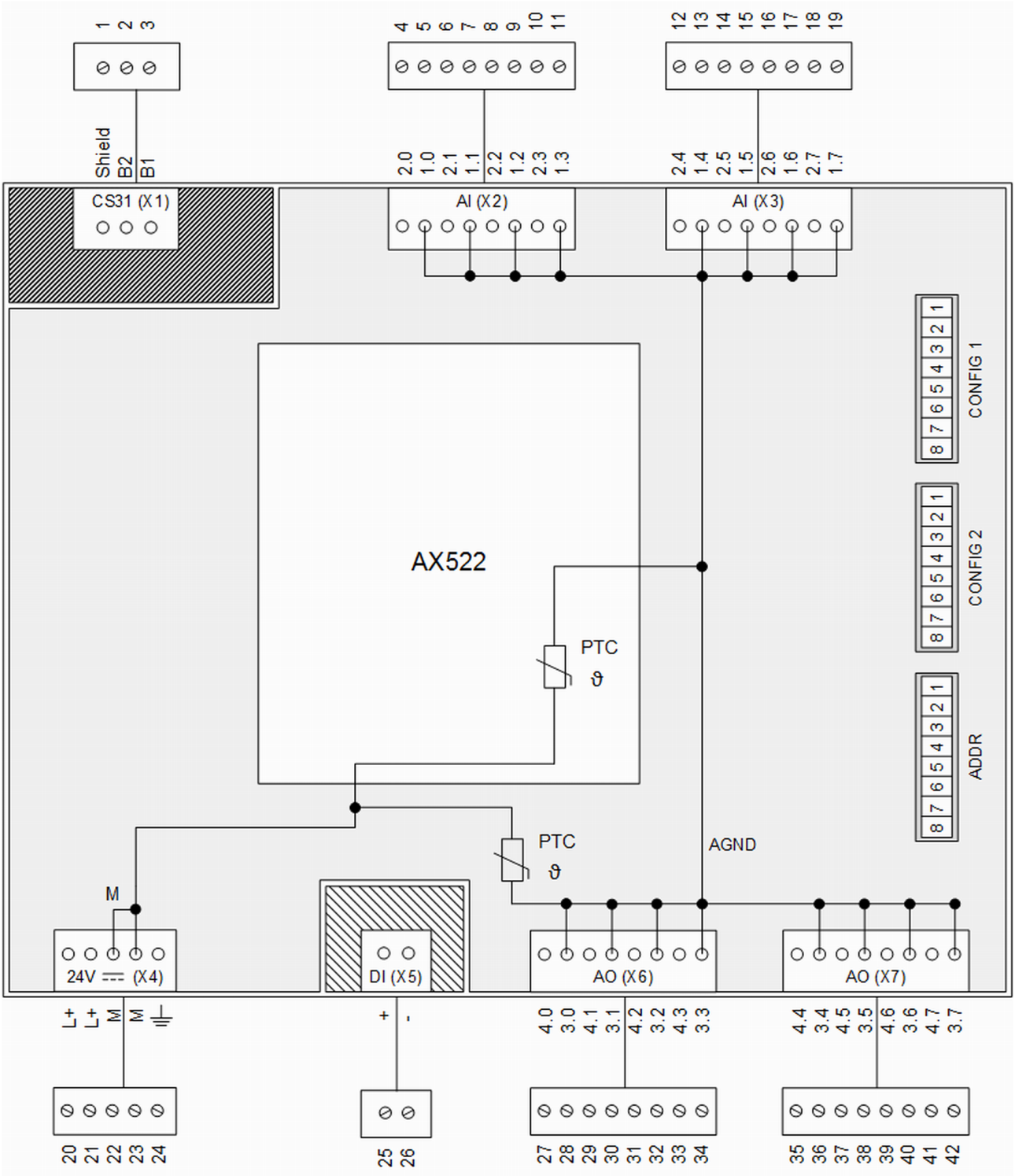

Fig. 69: Electrical connection

Please observe the information contained in the existing documentation. In section "Fig. 5.4-2: Electrical connection of the analog input/output module 07AC91", only the information concerning operating mode 12 bit is relevant for the replacement device 07AC91-AD2.

Pin assignment CS31 (X1):

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

Pin assignment AI (X2):

Connector / Terminal	Pin	Assignment / Signal
X2 / 2.0	4	AX522 / I0+
X2 / 1.0	5	AX522 / I0- (AGND)
X2 / 2.1	6	AX522 / I1+
X2 / 1.1	7	AX522 / I1- (AGND)
X2 / 2.2	8	AX522 / I2+
X2 / 1.2	9	AX522 / I2- (AGND)
X2 / 2.3	10	AX522 / I3+
X2 / 1.3	11	AX522 / I3- (AGND)

Pin assignment AI (X3):

Connector / Terminal	Pin	Assignment / Signal
X3 / 2.4	12	AX522 / I4+
X3 / 1.4	13	AX522 / I4- (AGND)
X3 / 2.5	14	AX522 / I5+
X3 / 1.5	15	AX522 / I5- (AGND)
X3 / 2.6	16	AX522 / I6+
X3 / 1.6	17	AX522 / I6- (AGND)
X3 / 2.7	18	AX522 / I7+
X3 / 1.7	19	AX522 / I7- (AGND)

Pin assignment 24 V DC 6W (X4):

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	20	L+
X4 / L+	21	L+
X4 / M	22	M
X4 / M	23	M
X4 / FE	24	FE

Pin assignment DI (X5):

Connector / Terminal	Pin	Assignment / Signal
X5 / +	25	IN+
X5 / -	26	IN- (electrically isolated earth)

Pin assignment AO (X6):

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.0	27	AX522 / O0+
X6 / 3.0	28	AX522 / O0- (AGND)
X6 / 4.1	29	AX522 / O1+
X6 / 3.1	30	AX522 / O1- (AGND)
X6 / 4.2	31	AX522 / O2+
X6 / 3.2	32	AX522 / O2- (AGND)
X6 / 4.3	33	AX522 / O3+
X6 / 3.3	34	AX522 / O3- (AGND)

Pin assignment AO (X7):

Connector / Terminal	Pin	Assignment / Signal
X7 / 4.4	35	AX522 / O4+
X7 / 3.4	36	AX522 / O4- (AGND)
X7 / 4.5	37	AX522 / O5+
X7 / 3.5	38	AX522 / O5- (AGND)
X7 / 4.6	39	AX522 / O6+
X7 / 3.6	40	AX522 / O6- (AGND)

Connector / Terminal	Pin	Assignment / Signal
X7 / 4.7	41	AX522 / O7+
X7 / 3.7	42	AX522 / O7- (AGND)

The outputs on connector X7 cannot be configured as current outputs.

The signals Ix- and Ox- are internally linked to an AGND area. The potential AGND is connected to the potential M via PTC resistors. Potential difference AGND to M ± 1 V maximal.

To enable wire-break detection, each input is internally pulled to "plus" by means of a high-impedance resistor. As a result, the maximum voltage is read when nothing is connected. Do not replace the AX522 module while voltage is connected.

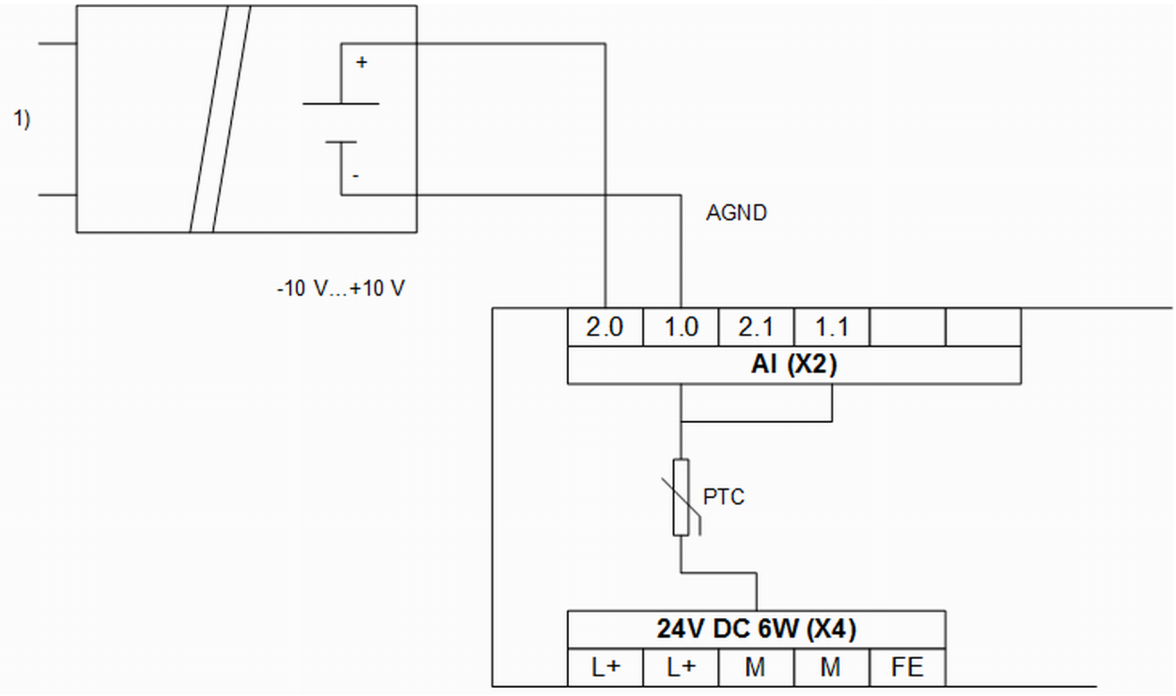

Fig. 70: Voltage input

1) Electrically isolated power supply of analog sensor

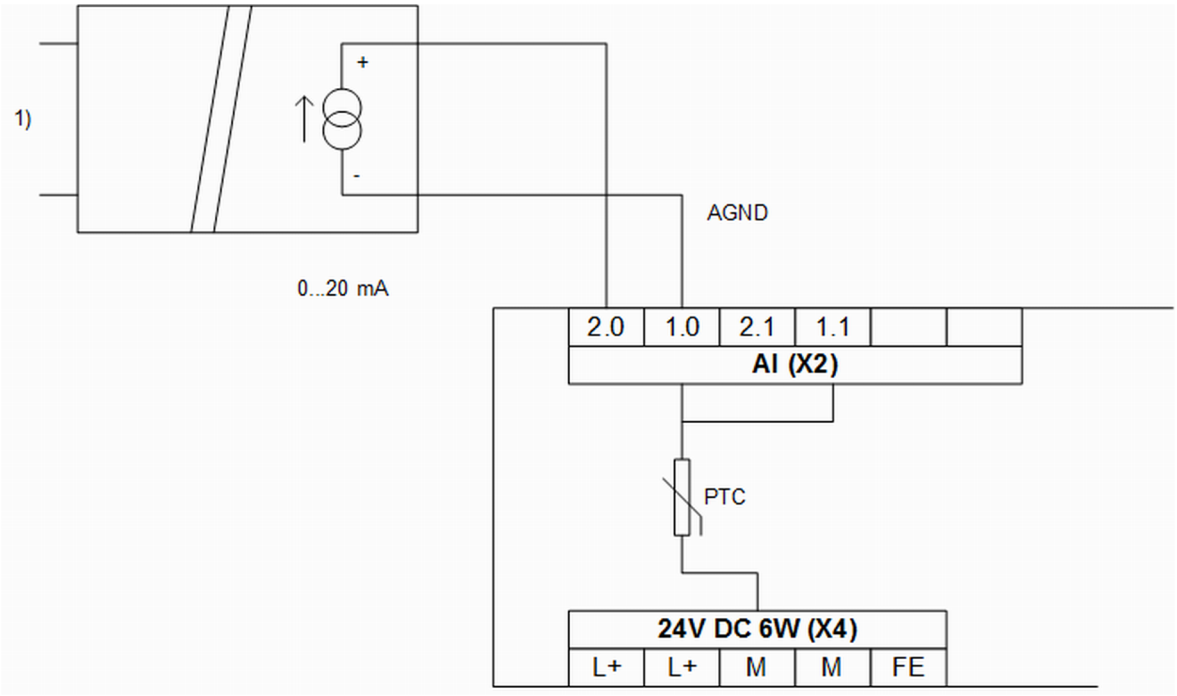

Fig. 71: Current input

1) Electrically isolated power supply of analog sensor

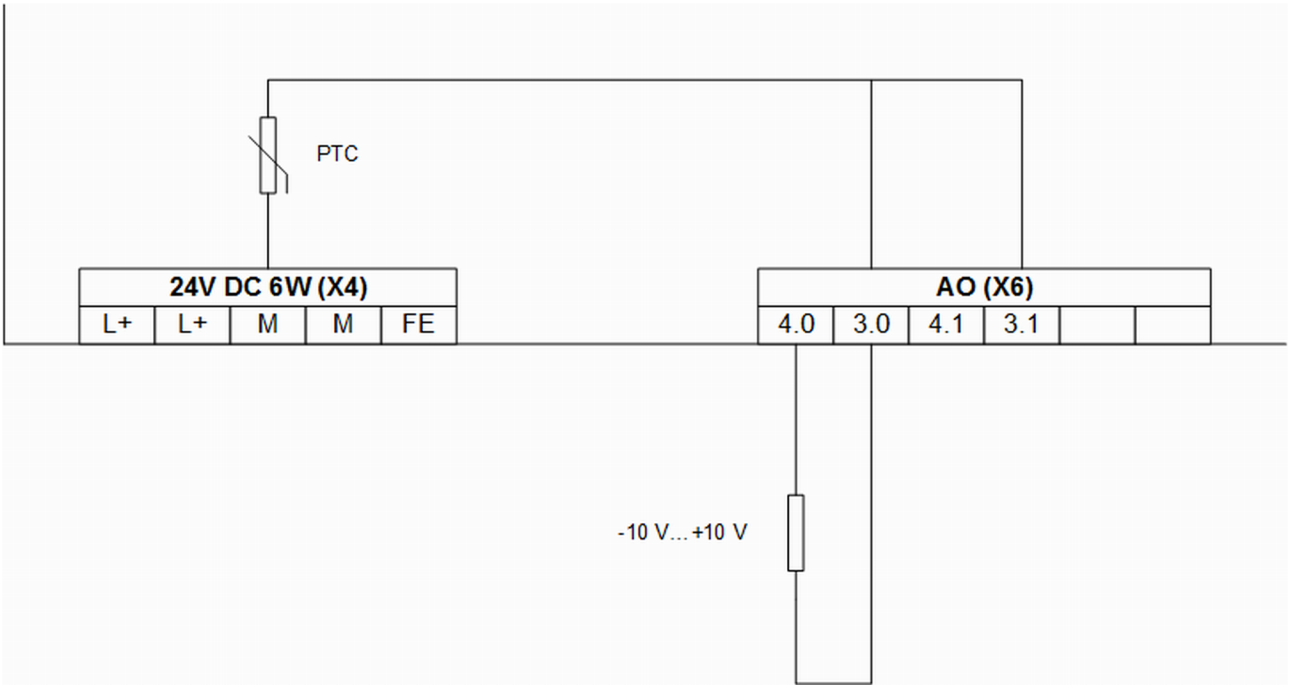

Fig. 72: Voltage output

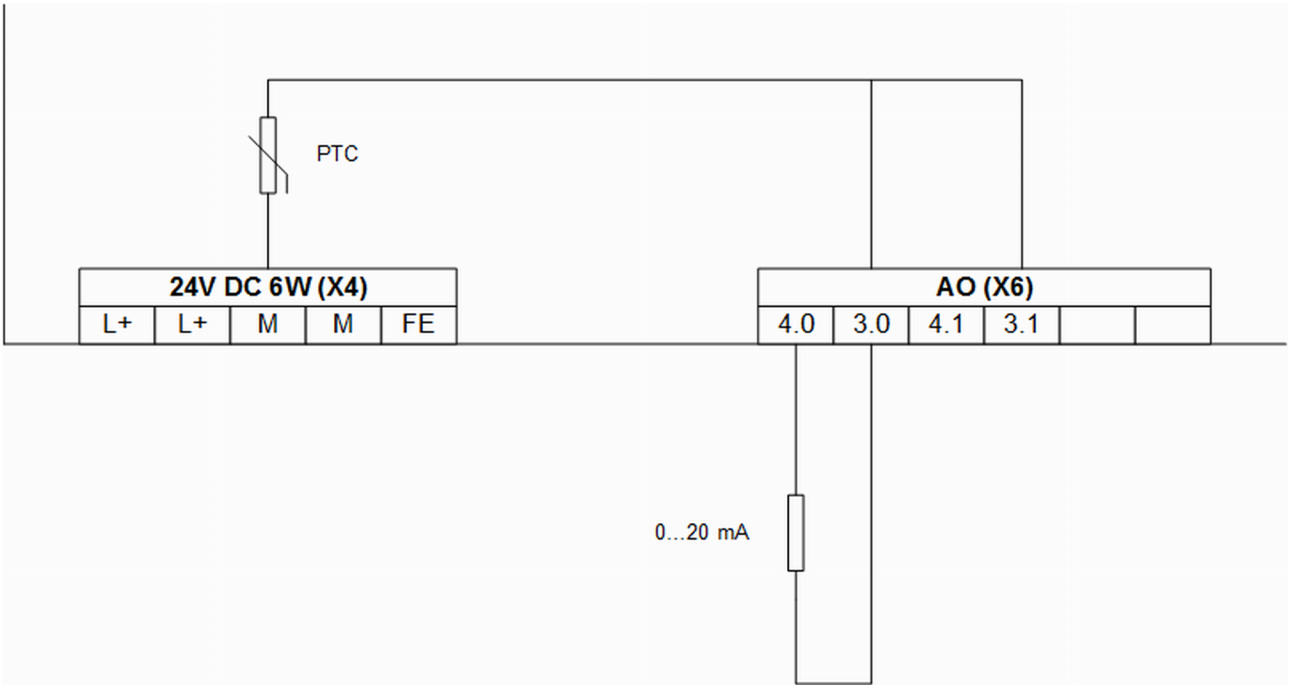

Fig. 73: Current output

Analog signal lines must be routed in shielded cables. The shield must be earthed on both sides and should be earthed to replacement device and signal source / signal sink as close as possible.

1.5.4.2.3 Configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the DIP switch is arranged on the lower printed circuit board instead.

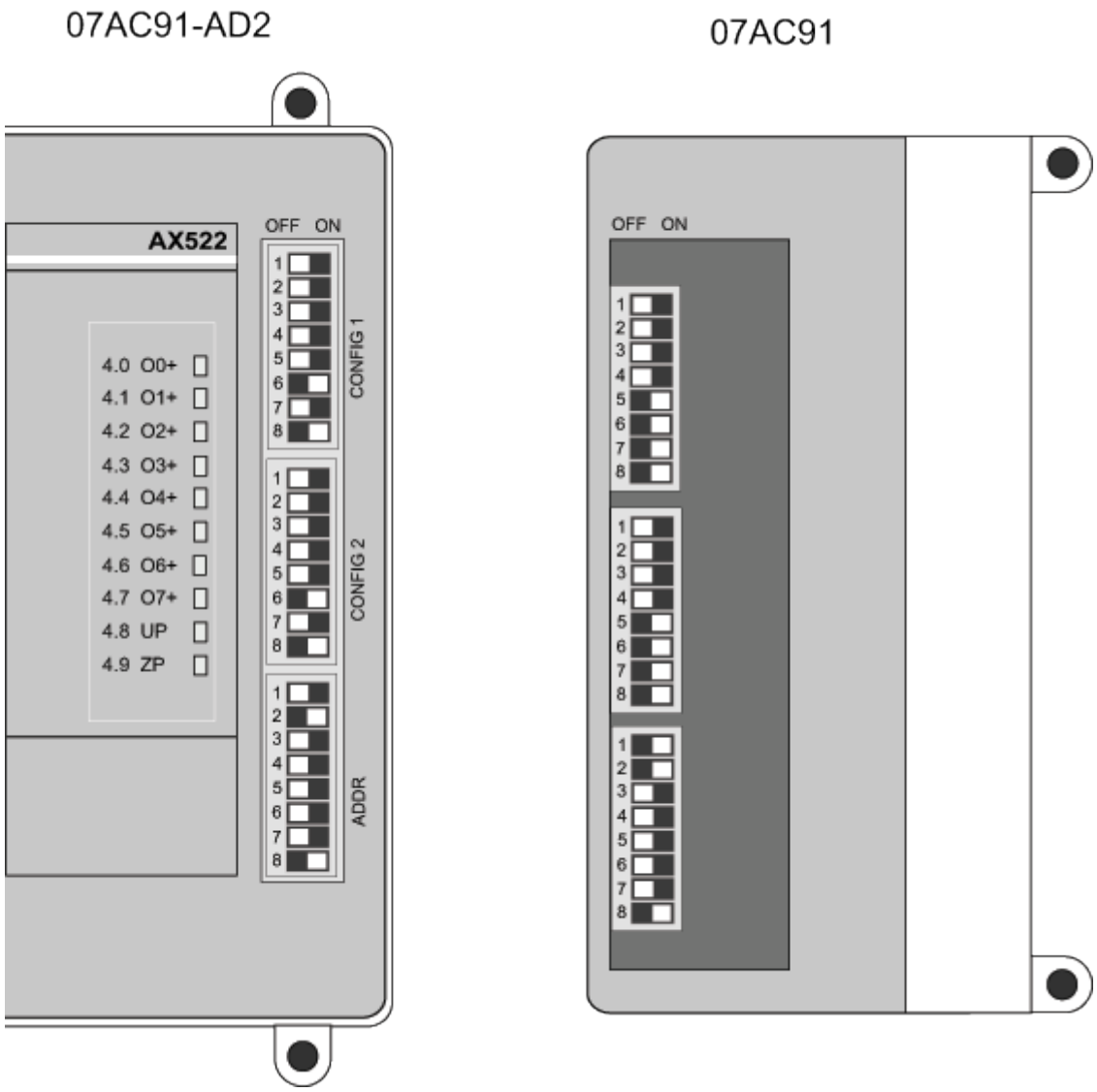

Fig. 74: DIP switch: 07AC91-AD2

Please observe the following:

- The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported. This DIP switch must be switched off. The outputs on connector X7 cannot be configured as current outputs.
- Unused voltage inputs must be configured as current inputs (due to wire-break detection AX522 S500 module).
- The operating mode (address DIP switch 1) must be set to "12 bit".
- The DIP switches are read by the device only once after the supply voltage has been connected.

For further information, please refer to the existing documentation.

1.5.4.2.4 Measuring ranges of the analog channels

For the replacement device 07AC91-AD2, only the operating mode "12 bit" is relevant.

Measuring range ± 10 V:

- Replacement device: 12-bit resolution plus sign.
- Existing device: 11-bit resolution plus sign.

1.5.4.2.5 Addressing

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported.

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data *Chapter 1.3 “System data and CS31 bus system data” on page 5*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 slave).

When the measuring values are bipolar, it is advisable to use the data type "Int input/output" instead of "Word input/output".

CS31 bus:

Type	Byte	Connector / Terminal
Word input (send) 0	1	X2 / 2.0
	2	
Word input (send) 1	3	X2 / 2.1
	4	
Word input (send) 2	5	X2 / 2.2
	6	
Word input (send) 3	7	X2 / 2.3
	8	
Word input (send) 4	9	X3 / 2.4
	10	
Word input (send) 5	11	X3 / 2.5
	12	
Word input (send) 6	13	X3 / 2.6
	14	
Word input (send) 7	15	X3 / 2.7
	16	

Type	Byte	Connector / Terminal
Word output (received) 8	17	X6 / 4.0
	18	
Word output (received) 9	19	X6 / 4.1
	20	
Word output (received) 10	21	X6 / 4.2
	22	
Word output (received) 11	23	X6 / 4.3
	24	
Word output (received) 12	25	X7 / 4.4
	26	
Word output (received) 13	27	X7 / 4.5
	28	
Word output (received) 14	29	X7 / 4.6
	30	
Word output (received) 15	31	X7 / 4.7
	32	

1.5.4.2.6 Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal statuses of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the Flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device are switched off. The inputs remain active. The outputs are also switched off in case of a malfunction of the CS31 bus.

1.5.4.2.7 Diagnosis and display

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Diagnosis information of the CS31 bus:

Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error:			
0	43	1	Internal error
Channel error:			
0 ... 7	49	10	Analog value is out of measuring range (on analog inputs)

The error codes that are transferred by the replacement device via the CS31 bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

An exceedance of the measuring range is signaled even if nothing is connected to an analog voltage input.

Device LEDs:

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31	CS31 bus communication	Green	No CS31 bus communication	CS31 bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal Flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

S500 module AX522 LEDs:

LED	Status	Color	LED off	LED on	LED flashes
I0+…I7+ (see No. 1 in the following figure)	Analog inputs	Yellow	Input is not activated	Input is activated (brightness depends on value of analog signal).	-
O0+…O7+ (see No. 2 in the following figure)	Analog outputs	Yellow	Output is not activated	Output is activated (brightness depends on value of analog signal).	-
Error indication left (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-
Error indication right (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-
Indication supply voltage (see No. 4 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

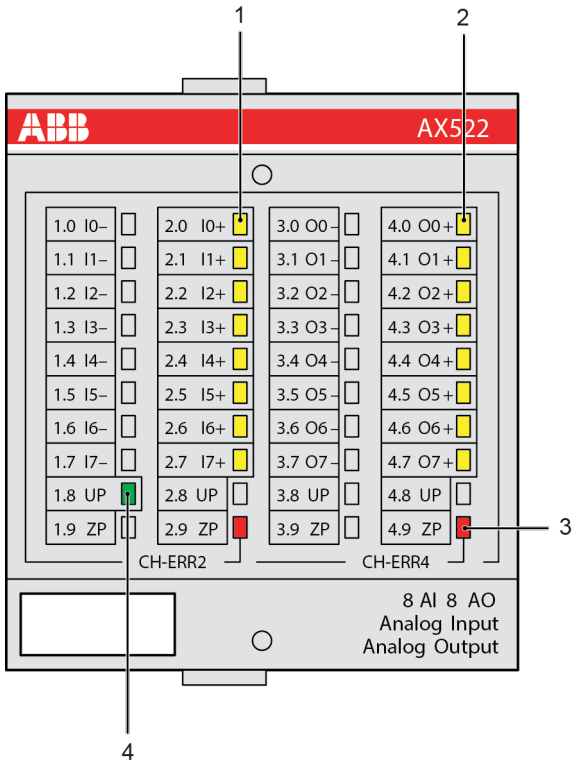

Fig. 75: AX522

1.5.4.2.8 Technical Data

This section provides additional information on section *Chapter 1.3 “System data and CS31 bus system data” on page 5*. In case of doubt, the following information applies.

For the device 07AC91-AD2, only the operating mode 12 bit is relevant.

Technical Data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 20), X4/L+ (pin 21), X4/M (pin 22), X4/M (pin 23)
-> Fuse for L+	10 A, fast acting
- Electrical isolation	No
Current consumption:	
-> via L+	0.19 A + output load
- Inrush current via L+ (when voltage is switched on)	0.16 A²s
Power consumption	Replacement device: 6 W Existing device: 5 W

For further information, please refer to the existing documentation.

CAUTION!

System damage caused by voltage!

Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Technical Data of the binary input

Data	Value
Input current at input voltage +24 V	Typ. 6 mA
Protection against reversed voltage	Yes
Overvoltage protection	No

The enabling input is a proprietary input.

For further information, please refer to the existing documentation.

Technical Data of the analog inputs

Data	Value
Connections	X2 / 2.0, X2 / 2.1, X2 / 2.2, X2 / 2.3, X3 / 2.4, X3 / 2.5, X3 / 2.6, X3 / 2.7
Reference connections (AGND)	X2 / 1.0, X2 / 1.1, X2 / 1.2, X2 / 1.3, X3 / 1.4, X3 / 1.5, X3 / 1.6, X3 / 1.7
Type of inputs	Voltage bipolar, current unipolar
Time constant of the input filter	Voltage Replacement device: 100 µs Existing device: 470 µs
Conversion cycle ([1])	Replacement device: 2 ms (over 8 inputs + 8 outputs) Existing device: 8 ms
Resolution: range ± 10 V	Replacement device: 2.4 mV, 12 bit + sign Existing device: 5 mV, 11 bit + sign

Data	Value
Protection against reversed voltage	Yes
Overvoltage protection	Up to 30 V DC

([1]): Conversion cycle of S500 module AX522. The transmission via serial buses is slower.

Unused voltage inputs must be configured as current inputs (due to wire-break detection AX522 S500 module).

For further information, please refer to the existing documentation.

Technical Data of the analog outputs

Data	Value
Connections	X6 / 4.0, X6 / 4.1, X6 / 4.2, X6 / 4.3, X7 / 4.4, X7 / 4.5, X7 / 4.6, X7 / 4.7
Reference connections (AGND)	X6 / 3.0, X6 / 3.1, X6 / 3.2, X6 / 3.3, X7 / 3.4, X7 / 3.5, X7 / 3.6, X7 / 3.7
Type of outputs	Voltage bipolar, current unipolar
Configurability	Replacement device: 4 current outputs available Existing device: 8 current outputs available
Output load capability, as voltage output	Replacement device: ± 10 mA Existing device: +20 mA, -10 mA
Short-circuit-proof	Yes
External supply protection	Up to 30 V DC

For further information, please refer to the existing documentation.

Connection to the CS31 system bus

Data	Value
Connections	X1/B2, X1/B1
CS31 type	05 (analog input/output)
Termination resistor	Not available (must be provided externally if needed)

Mechanical data

Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 362 g Existing device: 450 g
Dimensions for mounting	See assembly instructions 07AC91-AD2 (3ADR020085M0401)

Mounting information

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

Ordering data

Order No.	Scope of delivery
1SAP 800 100 R0010	Analog input/output module 07AC91-AD2 1x 2-pole terminal block (3.81 mm grid space) 1x 3-pole terminal block (5.08 mm grid space) 1x 5-pole terminal block (5.08 mm grid space) 4x 8-pole terminal blocks (3.81 mm grid space)

1.5.5 Replacement unit DC501-CS31-AD

1.5.5.1 Introduction

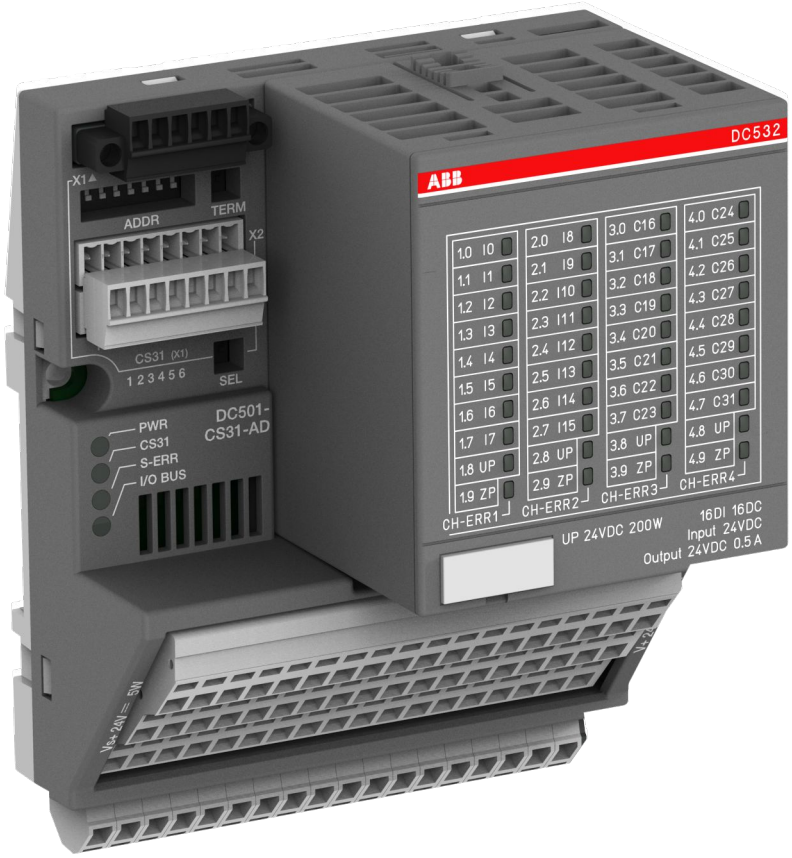

Fig. 76: 3ADR331189S0015_DC501-CS31-AD

The replacement device DC501-CS31-AD of the AC31 adapter series replaces the existing device DC501-CS31.

The existing device DC501-CS31 supported the use of so-called extension box modules to increase I/O functionality. The following modules were supported:

- Module AX501 for analog signals: 3 analog inputs, 1 analog output
- Module DI501 for digital signals: 4 digital inputs
- Module DO501 for relay output: 8 relays

The replacement device DC501-CS31-AD does not support the use of extension box modules. Instead, the functionality of modules AX501 and DI501 is integrated in the replacement device. The functionality of module DO501 is not supported.

This document describes only changes that have been integrated in the replacement device and expansions to the existing device DC501-CS31. Thus, the existing documentation of device DC501-CS31 remains valid and serves as reference *http://www.abb.de/search.aspx?abbcontext=products&q=s500%20ac1131*. The extension box modules are documented in the existing documentation of the I/O-S500 hardware. This description is replaced by this document.

This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices DC501-CS31-AD can be found in the operating and assembly instructions of device DC501-CS31-AD: 3ADR020087M0401. Please note that for device DC501-CS31 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus ↳ *Chapter 1.3 "System data and CS31 bus system data" on page 5*.

1.5.5.2 Device configuration

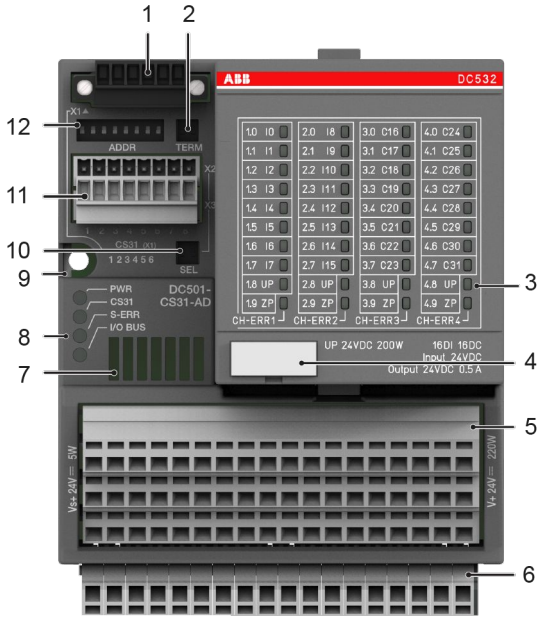

Fig. 77: Front view: DC501-CS31-AD

Device configuration:

No.	Description
1	Connection for CS31 bus (X1)
2	Bus termination (CS31)
3	Status LEDs for DC532
4	TA525: Label
5	Terminals signal level (X4) 16 digital inputs, 8 digital outputs, 8 DC voltage supply (incl. DC532)
6	Terminals signal level (plug-in power bus)

No.	Description
7	Ventilation
8	4 Status LEDs
9	Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
10	Function selector switch for I/O expansion
11	4 digital inputs (X2): 24 V DC. 3 analog inputs, 1 analog output (X3): 0 V … +10 V.
12	DIP switch for ADDR (X1)

1.5.5.2.1 LED display

The LED display on the replacement device is changed:

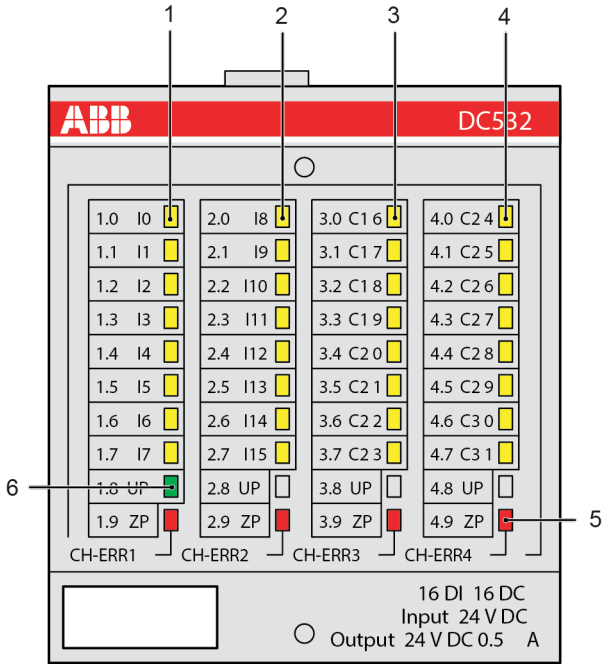

Fig. 78: Front view: DC532

No.	Displays of module
1	8 yellow LEDs to indicate the signal status of the digital inputs (X2).
2	8 yellow LEDs to indicate the signal status of the digital inputs (X3).
3	8 yellow LEDs to indicate the signal status of the digital outputs (X5).
4	8 yellow LEDs to indicate the signal status of the digital inputs/outputs (X6).

No.	Displays of module
5	4 red LEDs to indicate errors (of DC532 module).
6	1 green LED to indicated the status of the supply voltage of the DC532 module (is supplied via X4).

1.5.5.2.2 Electrical connection

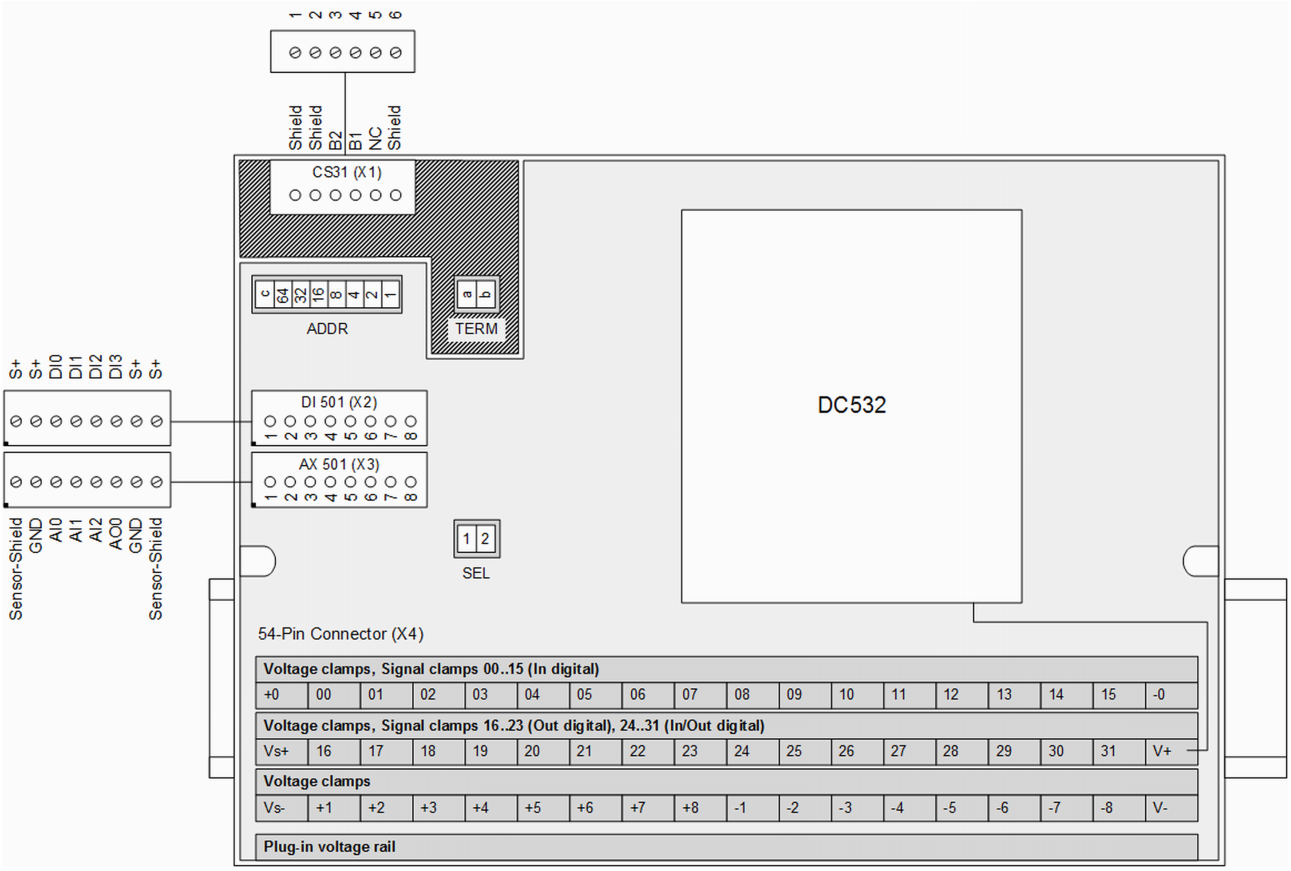

Fig. 79: Electrical connection

Pin assignment CS31 (X1):

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	Shield (internally connected to pin 2 and 6. No internal connection to functional earth)
X1 / Shield	2	Shield (internally connected to pin 1 and 6. No internal connection to functional earth)
X1 / B2	3	BUS 2
X1 / B1	4	BUS 1

Connector / Terminal	Pin	Assignment / Signal
X1 / NC	5	Not connected
X1 / Shield	6	Shield (internally connected to pin 1 and 2. No internal connection to functional earth)

Correction to existing documentation

In the existing documentation, connection X1 / 2 is incorrectly documented as "free / not connected". On the replacement device DC501-CS31-AD, the selection of the pin assignment of connector X1 is identical to the realization of device DC501-CS31. Thus, the pin assignment described in this document is valid for the replacement device and the existing device.

Pin assignment DI501 (X2):

Connector / Terminal	Pin	Assignment / Signal
X2 / S+	1	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)
X2 / S+	2	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)
X2 / DI0	3	Digital expansion input 0
X2 / DI1	4	Digital expansion input 1
X2 / DI2	5	Digital expansion input 2
X2 / DI3	6	Digital expansion input 3
X2 / S+	7	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)
X2 / S+	8	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)

Pin assignment AX501 (X3):

Connector / Terminal	Pin	Assignment / Signal
X3 / Sensor shield	1	Sensor shield
X3 / GND	2	GND
X3 / AI0	3	Analog expansion input 0
X3 / AI1	4	Analog expansion input 1
X3 / AI2	5	Analog expansion input 2
X3 / AO0	6	Analog expansion output 0
X3 / GND	7	GND
X3 / Sensor shield	8	Sensor shield

The connections X3 / 2 and X3 / 7 (GND) are directly connected to X4 / Vs-, X4 / V-. There is no AGND potential in accordance with module AX501. In module AX501, AGND is connected to GND via a resistor.

Both sensor shield connections of X3 are interconnected and jointly connected to FE via 10 MΩ || 4 nF.

The terminal blocks of X2 and X3 have the following connection data:

- Conductor cross section, single wire/ flexible: 0.14 mm² to 1.5 mm²
- Conductor cross section, flexible with wire end ferrule (without plastic ferrule): 0.25 mm² to 1.5 mm²
- Conductor cross section, flexible with wire end ferrule (with plastic ferrule): 0.25 mm² to 0.5 mm²

Pin assignment 54 pin connector (X4):

Connector / Block	Pin	Assignment / Signal
X4 / 1	+0	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 1	00	DC532 / I0
X4 / 1	01	DC532 / I1
X4 / 1	02	DC532 / I2
X4 / 1	03	DC532 / I3
X4 / 1	04	DC532 / I4
X4 / 1	05	DC532 / I5
X4 / 1	06	DC532 / I6
X4 / 1	07	DC532 / I7
X4 / 1	08	DC532 / I8
X4 / 1	09	DC532 / I9
X4 / 1	10	DC532 / I10
X4 / 1	11	DC532 / I11
X4 / 1	12	DC532 / I12
X4 / 1	13	DC532 / I13
X4 / 1	14	DC532 / I14
X4 / 1	15	DC532 / I15
X4 / 1	-0	GND
X4 / 2	Vs+	Voltage supply for electronics system (also for functionality of AX501 and DI501)
X4 / 2	16	DC532 / C16
X4 / 2	17	DC532 / C17
X4 / 2	18	DC532 / C18
X4 / 2	19	DC532 / C19

Connector / Block	Pin	Assignment / Signal
X4 / 2	20	DC532 / C20
X4 / 2	21	DC532 / C21
X4 / 2	22	DC532 / C22
X4 / 2	23	DC532 / C23
X4 / 2	24	DC532 / C24
X4 / 2	25	DC532 / C25
X4 / 2	26	DC532 / C26
X4 / 2	27	DC532 / C27
X4 / 2	28	DC532 / C28
X4 / 2	29	DC532 / C29
X4 / 2	30	DC532 / C30
X4 / 2	31	DC532 / C31
X4 / 2	V+	Voltage supply of inputs/outputs (module DC532 and auxiliary voltage)
X4 / 3	Vs-	GND
X4 / 3	+1	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+2	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+3	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+4	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+5	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+6	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+7	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+8	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	-1	GND
X4 / 3	-2	GND
X4 / 3	-3	GND
X4 / 3	-4	GND
X4 / 3	-5	GND

Connector / Block	Pin	Assignment / Signal
X4 / 3	-6	GND
X4 / 3	-7	GND
X4 / 3	-8	GND
X4 / 3	V-	GND

Connection data of spring terminals (X4):

- Conductor cross section, single wire: 0.2 mm² to 2.5 mm²
- Conductor cross section, flexible: 0.2 mm² bis 1.5 mm² (existing device: 2.5 mm² flexible)
- Conductor cross section, flexible with wire end ferrule: 0.25 mm² to 1.5 mm²

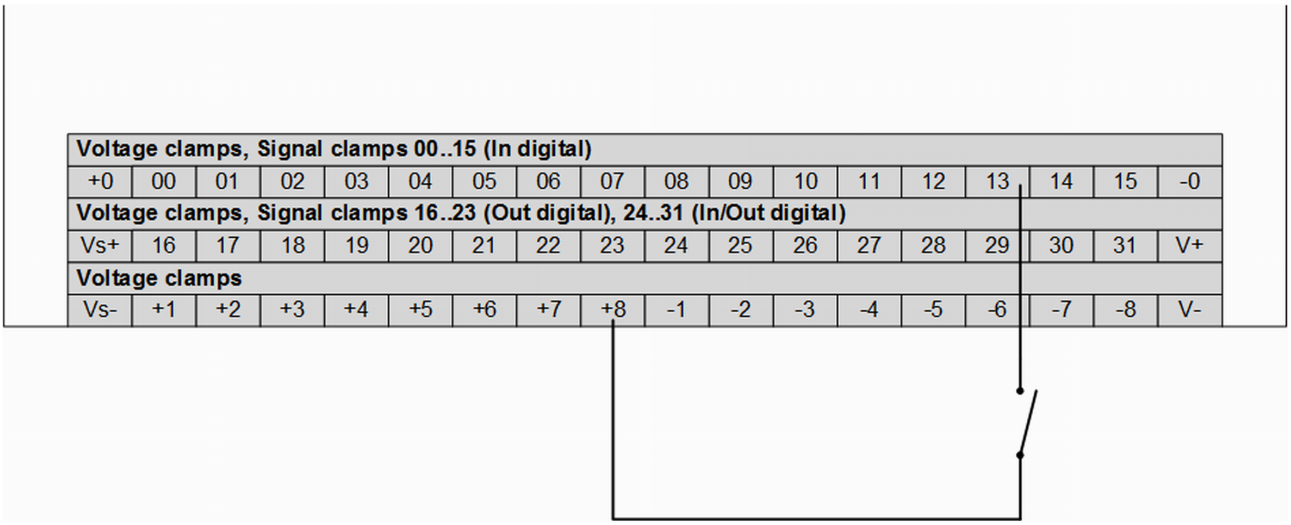

Fig. 80: Connection example: digital input (X4)

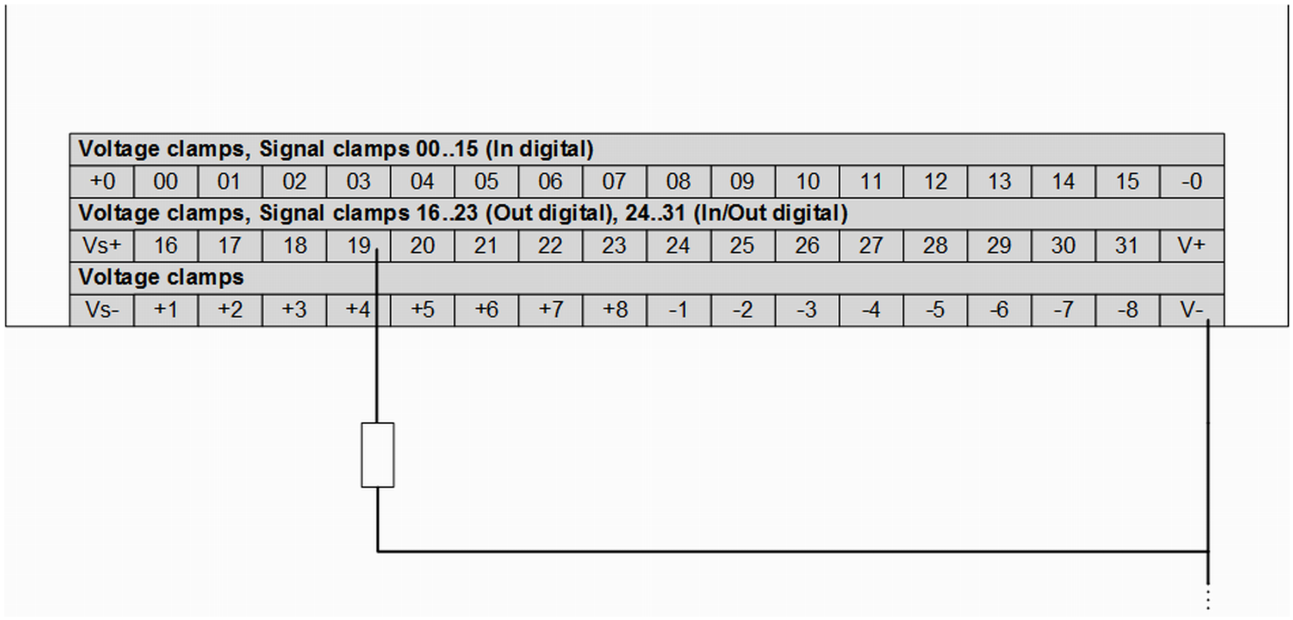

Fig. 81: Connection example: digital output

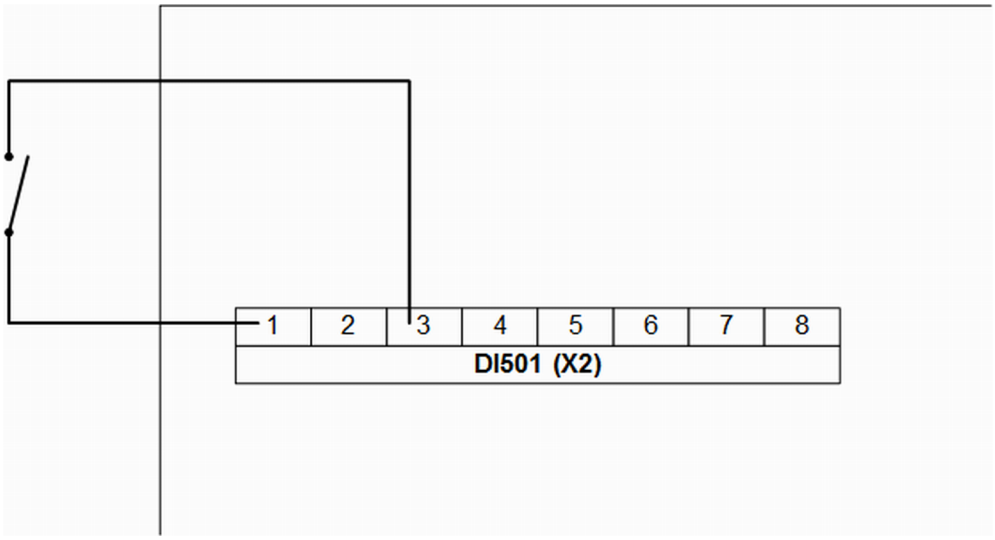

Fig. 82: Connection example: digital input (X2)

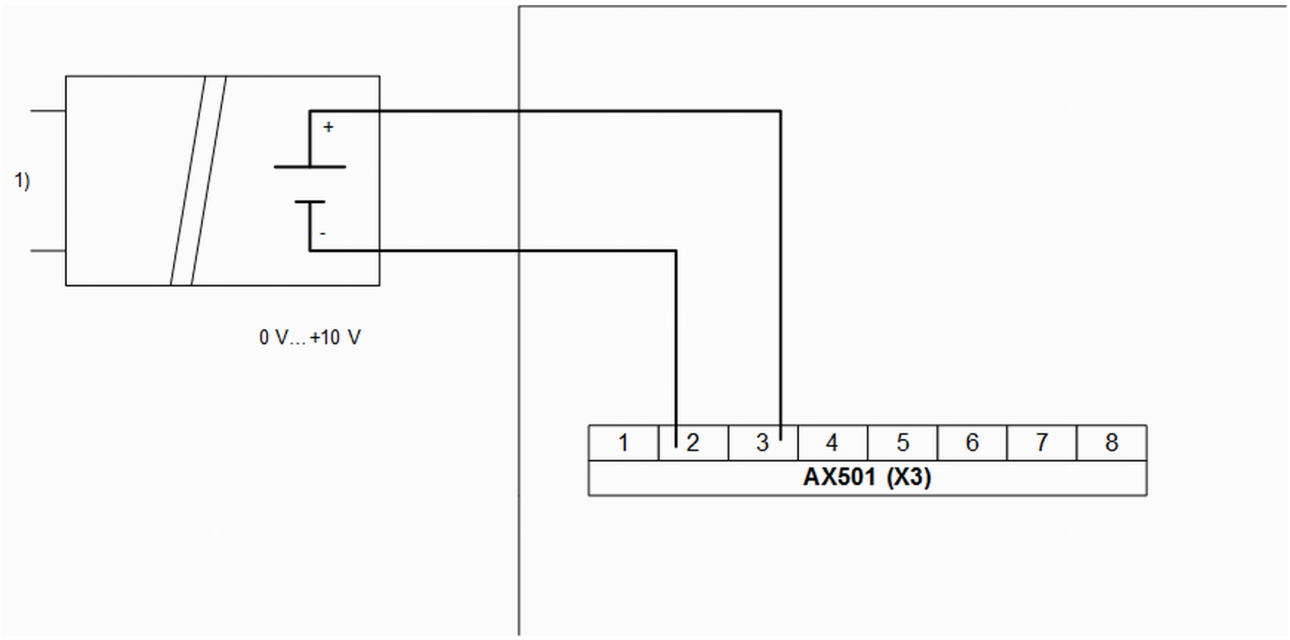

Fig. 83: Connection example: voltage input

1) Electrically isolated power supply of analog sensor.

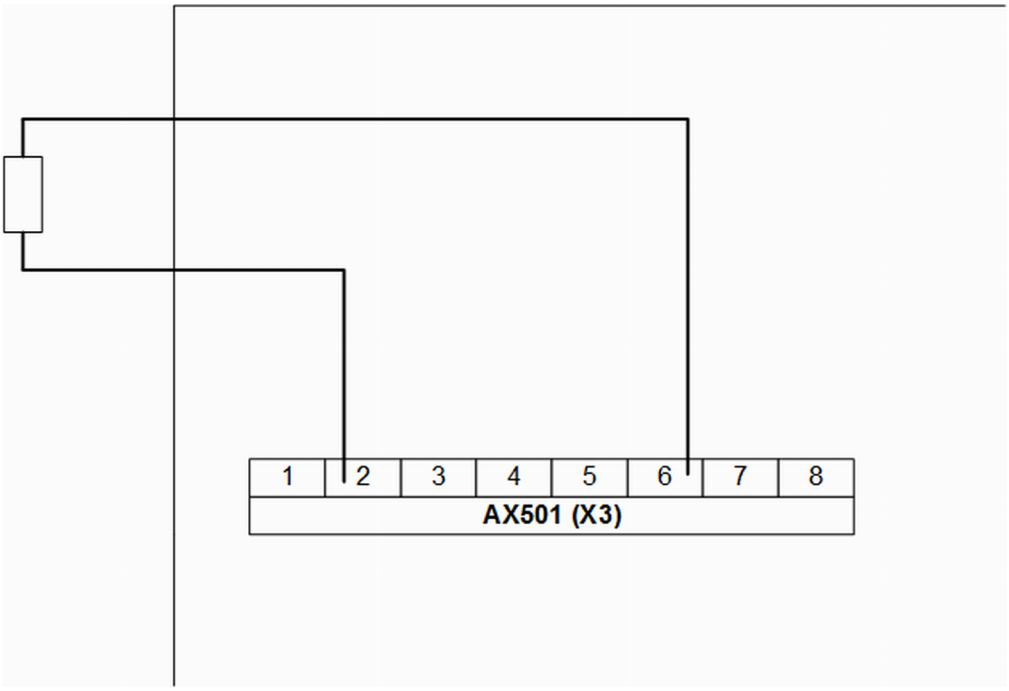

Fig. 84: Connection example: voltage output

Analog signal lines must be routed in shielded cables. The shield must be earthed on both sides and should be earthed to replacement device and signal source / signal sink as close as possible.

CAUTION!

System damage caused by voltage!

The exchange of a replacement device under voltage can cause permanent system damage (destruction).

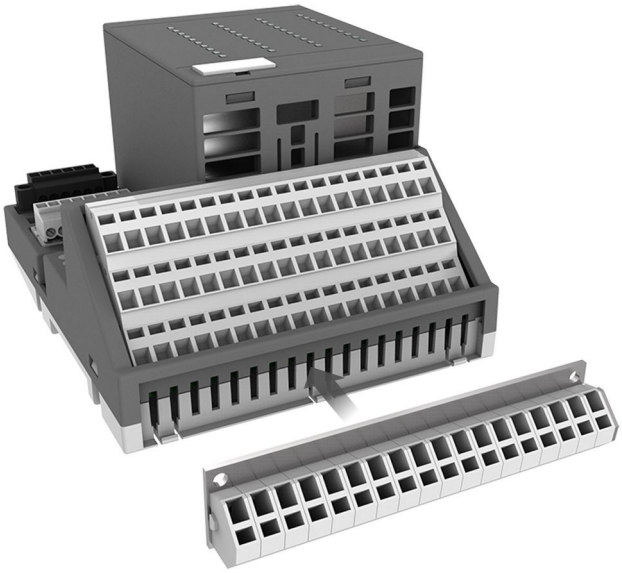

Fig. 85: Plug-in power bus

A power bus can be plugged into the replacement device. The contacts of the power bus have no electrical connection to the electronic system of the replacement device. Furthermore, no FE connection is available.

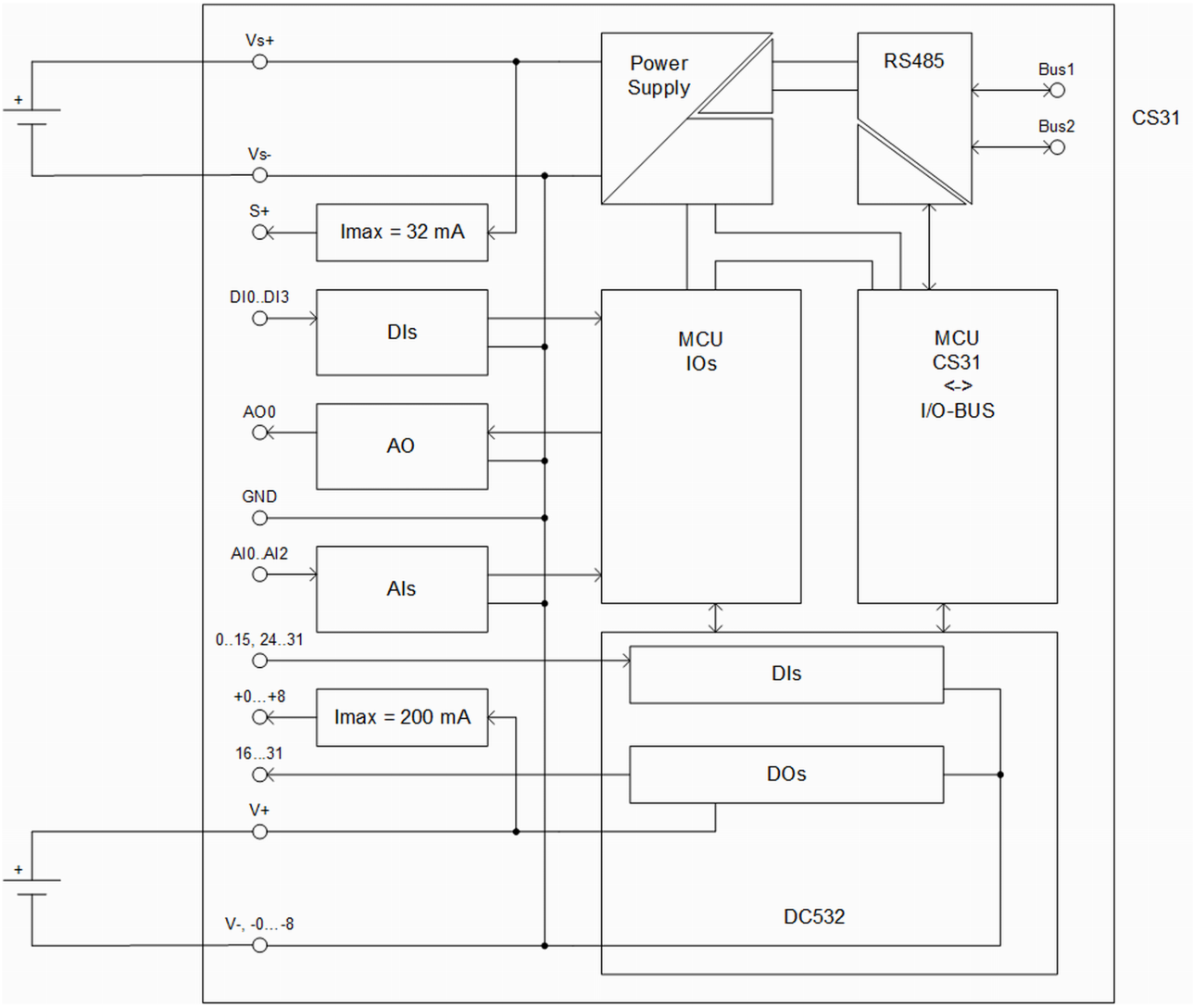

Fig. 86: Schematic diagram

For further information on earthing of the individual connections as well as shielding, please refer to ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

1.5.5.2.3 Addressing

In the existing device, the address DIP switch was arranged on the top right of the device. In the replacement device, this DIP switch is located on the left side of the device.

An additional DIP switch (SEL) has been implemented for the selection of the extension (AX501, 3AI1AO or DI501/4DI). Please note that only one extension at a time can be used.

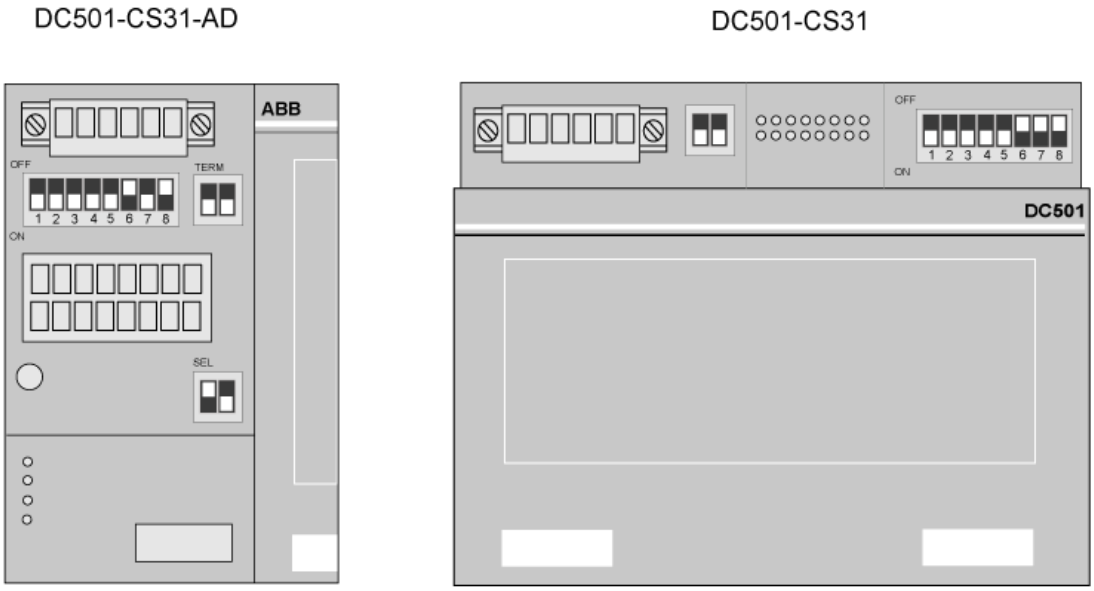

Fig. 87: DIP switch: DC501-CS31-AD

The function of the address DIP switch 1 (channel switch) available in the existing device is no longer supported. This DIP switch must be switched off.

Extension DIP switch (SEL):

S1	S2	Description
OFF	OFF	Normal, without extension
OFF	ON	Normal, with 3AI1AO/ AX501 extension
ON	OFF	Normal, with 4DI/ DI501 extension
ON	ON	Version DC501R0100, without extension

The device version DC501R0100 differs only in the data format of the CS31 system bus. Further information , .

The DIP switches are read by the device only once after the supply voltage has been connected.

For further information, please refer to the existing documentation.

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data *Chapter 1.3 “System data and CS31 bus system data” on page 5*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 slave).

CS31 system bus: 16 DI and 16 DO, normal and version DC501R0100:

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
4	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

CS31 system bus: 24 DI and 16 DO, normal:

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X4 / 24 ... 31
4	8 bit input (send, filling byte)	0 ... 7	-
5	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
6	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

CS31 system bus: 24 DI and 16 DO, version DC501R0100:

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
4	8 bit input (send)	0 ... 7	X4 / 24 ... 31
5	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

CS31 system bus: 16 DI, 16 DO, 3AI1AO, normal:

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X3 / 3
4	8 bit input (send)	0 ... 7	X3 / 4
5	8 bit input (send)	0 ... 7	X3 / 5
6	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
7	8 bit output (receive)	0 ... 7	X4 / 24 ... 31
8	8 bit output (receive)	0 ... 7	X3 / 6

CS31 system bus: 16 DI, 16 DO, 4 DI, normal:

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 3	X2 / 3 ... 6
	8 bit input (send)	4 ... 7	-
4	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
5	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

CS31 system bus: 24 DI, 16 DO, 3AI1AO, normal:

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X4 / 24 ... 31
4	8 bit input (send, filling byte)	0 ... 7	-
5	8 bit input (send)	0 ... 7	X3 / 3
6	8 bit input (send)	0 ... 7	X3 / 4
7	8 bit input (send)	0 ... 7	X3 / 5
8	8 bit input (send, filling byte)	0 ... 7	-
9	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
10	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

Byte	Type	Bit	Connector / Terminal
11	8 bit output (receive)	0 ... 7	X3 / 6
12	8 bit output (receive, filling byte)	0 ... 7	-

CS31 system bus: 24 DI, 16 DO, 4 DI, normal:

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X4 / 24 ... 31
4	8 bit input (send, filling byte)	0...7	-
5	8 bit input (send)	0 ... 3	X2 / 3 ... 6
		4 ... 7	-
6	8 bit input (send, filling byte)	0 ... 7	-
7	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
8	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

CS31 system bus: analog values:

Nominal range 0…+10 V	Digital value (decimal)	Digital value (hexadecimal)
9.961 V	255	FF
9.922 V	254	FE
…	…	…
0.039 V	1	01
0.000 V	0	00

Relationship between analog voltage and digital representation (applies to analog inputs and analog output):

$$U_{\text{Signal}} = U_{\text{Ref}} \cdot \frac{Digital\ value_{\,8\ \text{Bit}}}{256}$$

$$U_{\text{Ref}} = 10\ V$$

Fig. 88: Schematic diagram

Documentation change

The replacement device does not have an expansion bus. Expansion modules cannot be connected. For this reason, chapter "1.1.3 Addressing" of the technical description of DC501-CS31 concerning the expansion modules (e.g. DX511, DI511, DO511, AX511, AI511, AI512) is not valid for the replacement device. Possible data structures for the replacement device are indicated in the following table.

1.5.5.2.4 Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal statuses of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the Flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device are switched off. The inputs remain active. The outputs are also switched off in case of a malfunction of the CS31 bus.

1.5.5.2.5 Diagnosis and display

The replacement device transmits diagnosis information also via the CS31 bus.

Diagnosis information CS31 bus:

Error description	Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error	0	43	1	Internal error
Device error	1	45	2	No supply voltage V+ available
Channel error	0…15	46	4	Overload or short circuit on a digital output

The error codes that are transferred by the replacement device via the CS31 bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

Since in the replacement device the functionality of the extension box is integrated in the hardware, error code 6 (failure of extension box) does not occur.

The input/output functions of the extensions (AX501/ 3AI1AO, DI501/ 4DI) have no diagnoses.

Device LEDs:

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31	CS31 bus communication	Green	No CS31 bus communication	CS31 bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block ↳ *Chapter 1.3 “System data and CS31 bus system data” on page 5*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal Flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

S500 module DC532 LEDs:

LED	Status	Color	LED off	LED on	LED flashes
I0…I7 (see No. 1 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
I8…I15 (see No. 2 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
C16…C23 (see No. 3 in the following figure)	Digital outputs	Yellow	Output is not activated	Output is activated	-
C24…C31 (see No. 4 in the following figure)	Digital inputs or digital outputs	Yellow	Input or output is not activated	Input/output is activated (input voltage is indicated even if supply is switched off)	-
Indication supply voltage (see No. 6 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

LED	Status	Color	LED off	LED on	LED flashes
Error indications left (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	
Error indications right (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	Overload or short circuit on a channel of the corresponding group

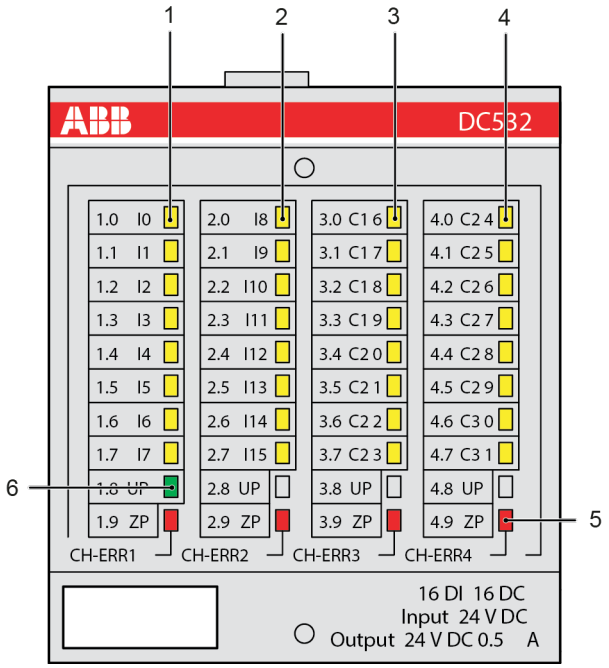

Fig. 89: Front view: DC532

1.5.5.2.6 Technical Data

This section expands the details provided in the chapter *Chapter 1.3 “System data and CS31 bus system data” on page 5* and contains information on electromagnetic compatibility. The conformity is described in the declaration of conformity, which is available on the ABB website.

To ensure proper function of the replacement device DC501-CS31-AD, both supply voltages Vs+ and V+ must be applied.

Technical Data of the complete device

Supply voltage Vs:

Data	Value
Process voltage: Fuse for Vs+	10 A, fast acting
Current consumption:	
-> via Vs+	Replacement device: 0.15 A Existing device DC501-CS31: approx. 60 ... 230 mA
- Inrush current via Vs+ (when voltage is switched on)	0.06 A²s
Power consumption	5 W

For further information, please refer to the existing documentation.

CAUTION!

System damage caused by voltage!

Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Supply voltage V:

Data	Value
Process voltage:	
-> Fuse for V+	10 A, fast acting
-> Additional V-/Vs- connections (GND)	X4 / -0, X4 / -1, X4 / -2, X4 / -3, X4 / -4, X4 / -5, X4 / -6, X4 / -7, X4 / -8
Current consumption:	
-> via V+	Replacement device: 0.15 A incl. load current Existing device DC501-CS31: approx. 100 mA without load current
- Inrush current via V+ (when voltage is switched on)	0.013 A²s
Power consumption	220 W
Power consumption outputs unloaded	6 W

Data	Value
Sensor supply voltage connections	X4 / +0, X4 / +1, X4 / +2, X4 / +3, X4 / +4, X4 / +5, X4 / +6, X4 / +7, X4 / +8
Current sensor supply voltage (all connections combined)	Replacement device: max. 200 mA Existing device DC501-CS31: Microfuse 8 A, fast acting ([1])

([1]): The existing device contained an 8 A fuse to be exchanged by the user. The replacement device has an integrated electronic current limiter instead.

For further information, please refer to the existing documentation.

CAUTION!

System damage caused by voltage!

Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Connection to the CS31 system bus

Data	Value
Connections	X1 / 3, X1 / 4
CS31 type	04 (digital input/output)

Expansion interface

The replacement device does not have an expansion interface.

Interface extension box

Analog inputs:

Data	Value
Number of channels	3
Connections	X3 / 3, X3 / 4, X3 / 5
Reference connections (GND)	X3 / 2, X3 / 7
Type of inputs	Voltage unipolar
Electrical isolation	Not available
Nominal range	0…10 V
Input resistance per channel	Replacement device: > 100 kΩ Existing device AX501: 95 kΩ

Data	Value
Time constant of the input filter	Replacement device: approx. 8 ms Existing device AX501: approx. 7 ms
Total errors (due to non-linearity, offset, resolution and temperature)	Replacement device: max. 3 % Existing device AX501: 0.6 % ± 1 digit ± 150 ppm/K
Indication of the input signals	Replacement device: Not available Existing device AX501: green LED per channel
Conversion cycle ([1])	Replacement device: 1.5 ms for all three channels Existing device AX501: 1.64 ms for all three channels
Conversion process	Successive approximation
Averaging of measured values	Not available
Resolution	8 bit
Unused voltage inputs	Can remain open or be short-circuited after GND or V+ to increase noise immunity
Overvoltage protection	Available
Overload range	± 30 V DC
Max. line length of analog lines, line cross section > 0.14 mm²	100 m

([1]): Conversion cycle of MCU of I/O processing. The transmission via serial buses is slower.

For further information, please refer to the existing documentation.

Analog output:

Data	Value
Number of channels	1
Connections	X3 / 6
Reference connections (GND)	X3 / 2, X3 / 7
Type of outputs	Voltage unipolar
Electrical isolation	Not available
Nominal range	0 ... 10 V
Output load capability	max. ± 5 mA
Indication of the output signals	Replacement device: Not available Existing device AX501: green LED per channel

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Data	Value
Resolution	8 bit
Total errors (due to non-linearity, offset, resolution and temperature)	Replacement device: max. 3 % Existing device AX501: 0.6 % ± 1 digit ± 150 ppm/K
Update cycle	1.5 ms
Unused output	remains unconnected
Short-circuit-proof	Yes ([1])
External supply protection	Up to +30 V DC (no external supply protection available for negative voltages!)
Max. line length of analog lines, line cross section > 0.14 mm²	100 m

For further information, please refer to the existing documentation.

CAUTION!

System damage caused by short-circuit!

([1]): A short-circuit can result in up to 2 W additional power dissipation in the device. If this power dissipation cannot be discharged, the replacement device can be damaged.

Digital Inputs:

Data	Value
Number of channels	4
Connections	X2 / 3, X2 / 4, X2 / 5, X2 / 6
Reference connection (GND)	X4 / Vs-
Connections switch supply	X2 / 1, X2 / 2, X2 / 7, X2 / 8
Current switch supply (all connections combined)	Replacement device: max. 32 mA Existing device DI501: max. 30 mA
Input type according to EN 61131-2	Type 1
Electrical isolation	Not available
Indication of the input signals	Replacement device: not available Existing device DI501: green LED per channel
Input delay (0->1 or 1->0)	Typ. 3 ms
Scanning cycle	500 µs

Data	Value
Input signal voltage:	
-	24 V DC
-> 0 signal	Replacement device: -3 V … +5 V Existing device DI501: -30 V … +5 V
-> Undefined signal	Replacement device: > +5 V … < +15 V Existing device DI501: > +5 V … < +13 V
-> 1 signal	Replacement device: +15 V … +30 V Existing device DI501: +13 V … +30 V
-> Residual ripple at 0 signal	Within -3 V … +5 V
-> Residual ripple at 1 signal	Within +15 V … +30 V
Input current per channel:	
-> Input voltage +24 V	Typ. 5.5 mA
-> Input voltage +5 V	≥ 0.5 mA
-> Input voltage +15 V	≥ 2 mA
-> Input voltage +30 V	≤ 8 mA
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Overvoltage protection	Available
Overload range	±30 V DC

For further information, please refer to the existing documentation.

Inputs 24 V DC

Data	Value
Connections	X4 / 00, X4 / 01, X4 / 02, X4 / 03, X4 / 04, X4 / 05, X4 / 06, X4 / 07, X4 / 08, X4 / 09, X4 / 10, X4 / 11, X4 / 12, X4 / 13, X4 / 14, X4 / 15, X4 / 24, X4 / 25, X4 / 26, X4 / 27, X4 / 28, X4 / 29, X4 / 30, X4 / 31
Input type according to EN 61131-2	Type 1
Electrical isolation	Not available
Status display	Replacement device: 1 yellow LED per input Existing device DC501-CS31: 1 green LED per input

Data	Value
Input delay (0-> 1 or 1-> 0)	Replacement device: Typ. 8 ms Existing device DC501-CS31: Typ. 3 ms
Input signal voltage:	
-	24 V DC
-> 0 signal	Replacement device: -3 V … +5 V Existing device DC501-CS31: -30 V … +5 V
-> Undefined signal	Replacement device: > +5 V … < +15 V Existing device DC501-CS31: > +5 V … < +13 V
-> 1 signal	Replacement device: +15 V … +30 V Existing device DC501-CS31: +13 V … +30 V
-> Residual ripple at 0 signal	Within -3 V … +5 V
-> Residual ripple at 1 signal	Within +15 V … +30 V
Input current per channel:	
-> Input voltage +24 V	Replacement device: typ. 5 mA Existing device DC501-CS31: typ. 4 mA
-> Input voltage +5 V	> 1 mA
-> Input voltage +15 V	> 5 mA
-> Input voltage +30 V	< 8 mA
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Overvoltage protection	Up to 30 V DC
Marking	Replacement device: not possible Existing device DC501-CS31: with label strip possible

For further information, please refer to the existing documentation.

Outputs 24 V DC

Data	Value
Connections	X4 / 16, X4 / 17, X4 / 18, X4 / 19, X4 / 20, X4 / 21, X4 / 22, X4 / 23, X4 / 24, X4 / 25, X4 / 26, X4 / 27, X4 / 28, X4 / 29, X4 / 30, X4 / 31
Type of digital outputs	High-side switches

Data	Value
Demagnetization with inductive load	Via internal varistor (see following figure)
Status display	Replacement device: 1 yellow LED per output Existing device DC501-CS31: 1 green LED per output
Output delay (0-> 1 or 1-> 0)	On request
Switching frequency:	
-> With ohmic load	Replacement device: on request Existing device DC501-CS31: ≤ 100 Hz
-> With inductive load	Replacement device: max. 0.5 Hz Existing device DC501-CS31: ≤ 2 Hz
-> With lamp load	Replacement device: max. 11 Hz at max. 5 W Existing device DC501-CS31: ≤ 10 Hz at max. 5 W
Inductive cut-off voltage	Replacement device: Typ. -67 V Existing device DC501-CS31: Typ. (voltage V) -55 V
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Marking	Replacement device: not possible Existing device DC501-CS31: with label strip possible

For further information, please refer to the existing documentation.

The following figure shows the circuitry of a digital input/output with the varistors for demagnetization when switching off inductive loads.

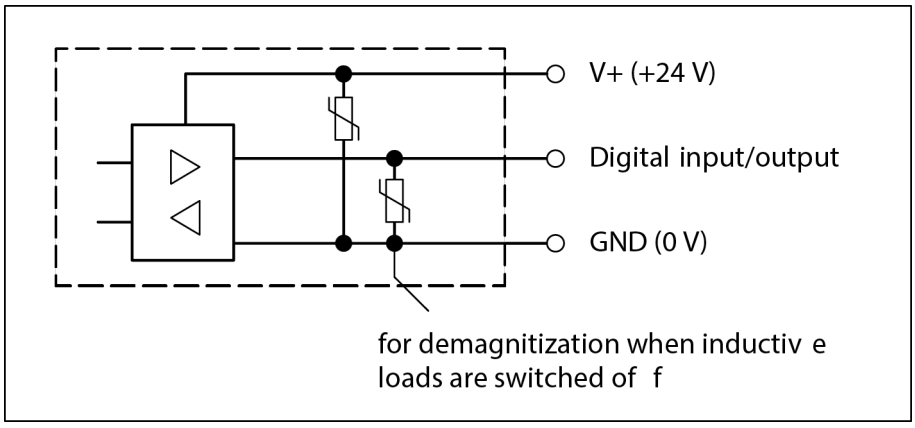

Fig. 90: Protective circuits inputs/outputs

AC31 adapter

When the channels of X4 / 24 to X4 / 31 are to be used as inputs, the respective outputs (high-end switches) must be switched off.

Mechanical data

Data	Value
Width x height x depth	Replacement device: 104 x 118 x 75.1 mm Existing device DC501-CS31: 102 x 112 x 77 mm
Weight	Replacement device: 354 g Existing device DC501-CS31: approx. 150 g
Dimensions for mounting	See operating and assembly instructions of the replacement device: 3ADR020087M0401

Mounting information

CAUTION!

System damage caused by voltage!

The exchange of a replacement device under voltage can cause permanent system damage (destruction).

Data	Value
Mounting position	Vertical, terminal block facing downward
Cooling	The natural convection cooling must not be hindered by cable ducts or other switchgear cabinet equipment (clearance between cable duct and device at least 20 mm).

Ordering data

Order No.	Scope of delivery
1SAP 800 400 R0010	Bus module CS31 16 DI, 8 DC, 8 DO, DC501-CS31-AD 1x 6-pole terminal block 2x 8-pole terminal blocks