Technical Documentation

07KR52 Central Unit

1SBC 0116 01 R1001

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Chapter 1

Presentation / operation

Presentation / operation

This chapter gives you an introduction to the 07KR52 automation, from the overall architecture to the operational rules of the central unit.

1. Presentation

The 07KR52 is a central unit which has integrated binary and analog inputs / outputs enabling simplified control or regulation of an application.

The 07KR52 can fill your requirements ranging from a compact machine fitted with a few automated functions to large installations.

It is therefore possible to realize distributed applications throughout a site, in a workshop or a machine where each central unit is close to the sensor/actuator. A single twisted pair connects the whole setup. The sensor information is transmitted over this, after central unit processing, to the actuators as well as the distributed intelligent units. The MODBUS® communication interface is also available to further extend the 07KR52 possibilities and the integration with other enterprise systems. The developments in this field are continual.

Many users on all continents have already realized numerous climatic management applications with this type of PLC.

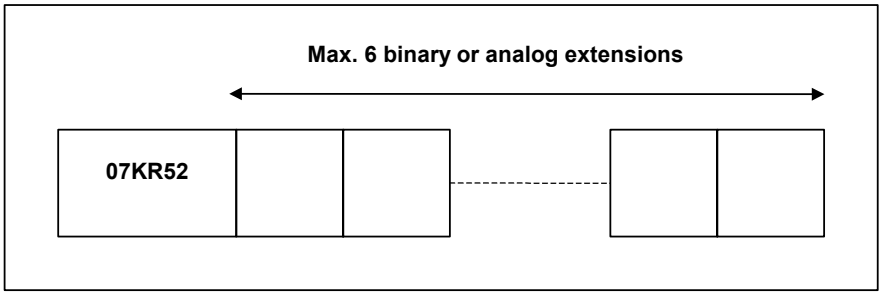


Figure 1-1: Central unit with extensions

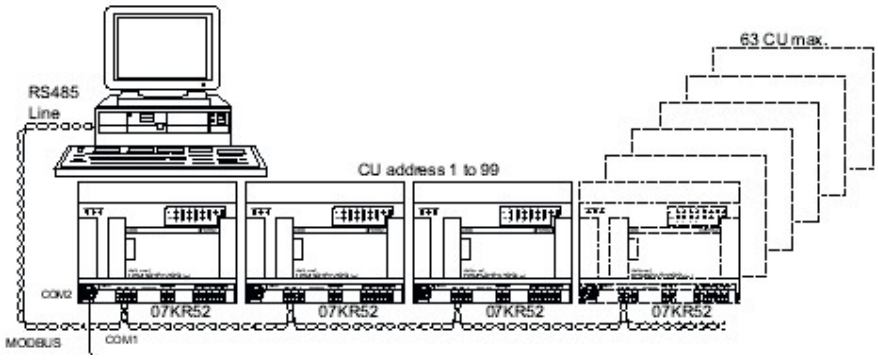


Figure 1-2: Network with PC, central units

2. General implementation rules

2.1. Central units with extensions

It's possible to increase the number of inputs / outputs of the basic central unit by adding up to 6 local extension units of type, binary or analog.

2.2. Configuration examples

The 07KR52 central units may, for instance, be connected to a **Supervision** over a MODBUS® network (see Figure 1-2).

The programming uses also the RS485 connection

2.3. Cabling techniques

Connection to a central unit is simple and complies with common electrical usage. The utilization is presented in chapter 4.

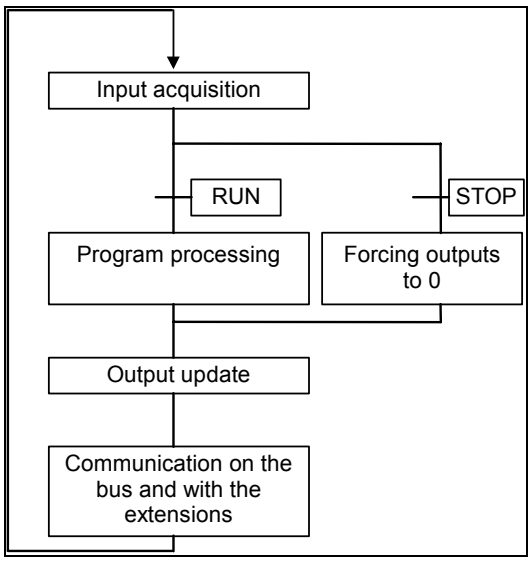


Figure 1-3: Program execution cycle

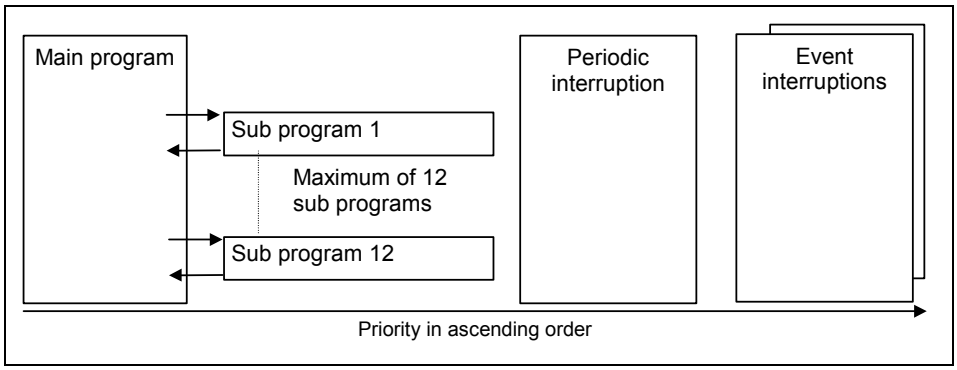


Figure 1-4: Task priorities

2.4. Program execution

The central unit microprocessor ensures the cyclic execution of the system as shown in Figure 1-3.

The internal processing:

- PLC monitoring and control
- and processing requests from the terminal operator,

is executed in parallel with the previously described cycle.

The main program is processed sequentially. It may call up to a maximum of 12 sub-programs. Each sub-program may be called numerous times in the main program.

Three types of interruptions may be executed parallel to the main program:

- A cyclic interruption
- A warning interruption triggered by an event on the I 62.03 input
- A warning interruption triggered by an event on the I 62.02 input

The interruptions have priority over the main program execution. If all three interruptions are triggered simultaneously then the interruption triggered by I 62.03 has priority over the I 62.02 input interruption, which in turn has priority over the cyclic interruption. Once an interruption has been launched it cannot be interrupted by another (Figure 1-4).

The execution duration of a cycle (bus cycle + program cycle) is controlled by the central unit. Any excess of the cycle time, defined by the user in AC31GRAF, is signaled by the ERR Led at the front of the central unit as of the first program cycle.

2.5. Power on / program launch

The central unit executes a complete series of auto tests at each startup. The program can only be launched if no errors have been detected.

The auto tests verify the following:

- the program syntax,
- the data transmission,
- the status of the extensions,
- the status of the remote units, if there is a master central unit,
- the startup conditions (reset or not of internal memories).

The central unit start-up procedure is as follows:

Warning: the default configuration of central unit for the first usage is MODBUS® address 99.

Switching to programming mode can be undertaken with a MODBUS® command

Transfer of the program and parameters with backup to the FLASH EPROM

The central unit must remain connected for 12 hours to charge the battery and to take advantage of a week's internal data backup (see following § 2.6).

2.6. Power cuts or drops

The central unit disposes of a time delay in order to save the necessary information for the next startup should there be a power drop or cut.

The battery also enables the backup of the program internal data. The backup period of a battery charged for 12 hours that has almost attained its life expectancy, or that has had repeated discharges, is slightly less than 10 days. In typical cases the backup duration is slightly more than 21 days for a 12 hour battery charge.

A prior configuration of the central unit is required for a complete or partial backup of the data (see chapter 4). All of the functions and internal data will be set to 0 in the absence of a configuration.

The intermediate calculations of the functions, used by the user program, that are necessary for the following cycles are placed in the variables known as historical variables. It is also possible to save the historical variables.

3. References

Products	Description	References
Central unit		
07KR52 230VAC	Extensible central unit: With 5 isolated 24 V d.c. inputs and 4 incorporated 250 V a.c. / 2 A relay outputs 4 PT1000 or PTC 1000 analog inputs (+ resistance 274 Ohms in series) and 1 analog output 0-10 V. RS485 connection for programming or MODBUS® communication 24 V d.c. power for inputs. 230 V a.c. power supply	1SBP260034R1001

Chapter 2

Technical Specifications

Technical specifications

This chapter presents the products, their general specifications and utilization conditions.

1. General utilization conditions

The 07KR52 units were developed in compliance with European directives, the major national and international IEC 1131-1 and IEC 1131-2 standards and the EN61131-2 product standard concerning PLC equipment.

Ambient conditions	
- Temperature :	
operational: horizontal	0°C to + 55°C
vertical	0°C to + 40°C
storage	- 40°C to + 75°C
transport	- 25°C to + 75°C
- Humidity :	DIN 40040 class F without condensation
annual average	≤ 75 %
up to 30 days per year	95 %
occasionally	85 %
- Atmospheric pressure :	DIN 40050
operational	≥ 800 hPA (≤ 2000 m)
storage	≥ 600 hPA (≤ 3500 m)
Mechanical specifications	
- Protection index	IP20
- Unit	UL V2
- Vibration stress	CEI68-2-6 test Fc
- Shock stress	CEI68-2-27 test Ea
Power supply tolerances	
- 230 V a.c. (50 / 60 Hz)	195,5 to 253 V (- 15 %, + 10 %)

Technical specifications

Creepage distances and clearances	IEC 664 and DIN VDE0160
Insulation test	IEC 1131-2
Electromagnetic compatibility	
Immunity tests against:	
- Electrostatic discharge	IEC 1000-4-2 (level 3)
- Radiated fields	IEC 1000-4-3 (level 3)
- Fast transient bursts	IEC 1000-4-4 (level 3)
- High energy pulse	IEC 1000-4-5
- Conducted high frequencies	IEC 1000-4-6 (level 3)
Voltage drops and short power cutoffs	
- D.C. power supply	Duration of the power cutoffs: ≤ 10 ms Time between 2 voltage drops: ≥ 1 s
- A.C. power supply	Duration of the power cutoffs: ≤ 20 ms Time between 2 voltage drops: ≥ 1 s
Clearance	IEC 664-664A DIN VDE 0160
Dielectric test	IEC 1131-2
Mountings	
- DIN rail	35 mm
- Screw fittings	4 mm diameter screw (M4)
Connections	
- Connectors	Removable terminal blocks (2.5 mm²)
- Section for:	
Earth	Rigid or multi-conductor wire AWG 14 (1.95 mm²)
Inputs	Rigid or multi-conductor wire AWG 18 (0.96 mm²) to AWG 14 (1.95 mm²)
Outputs	Rigid or multi-conductor wire AWG 14 (1.95 mm²)
Power supply	Rigid or multi-conductor wire AWG 14 (1.95 mm²)
Bus	Twisted pair AWG 24 (0.22 mm²) to AWG 18 (0.8 mm²)
- Screws tightening torque	0.8 Nm (given as an indication only)
Interface	
- For programming	1x RS 485 (Connector 3 points)

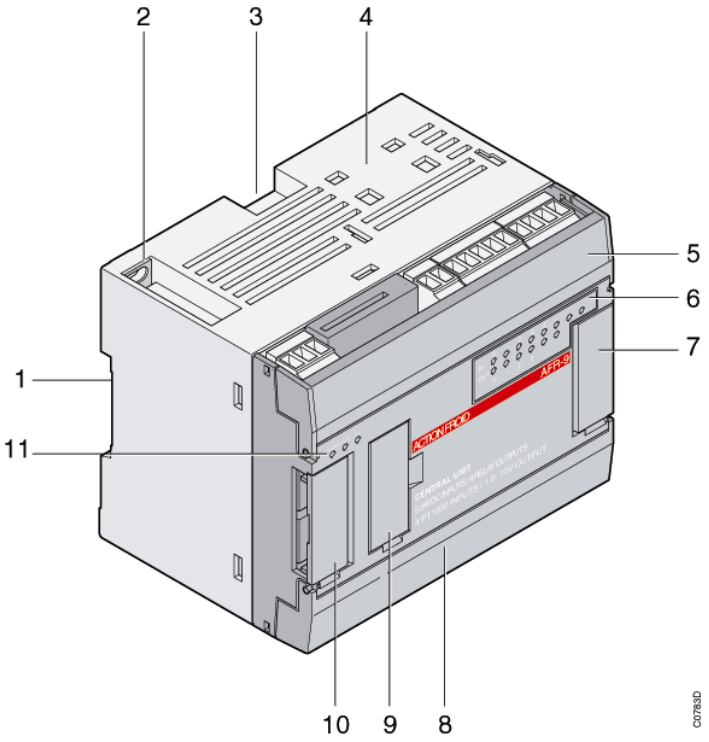


Figure 2-1: Central unit front

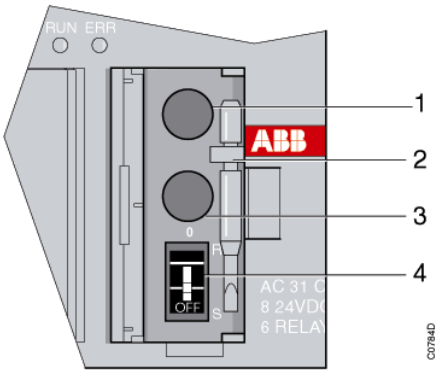


Figure 2-2: Enlargement of 9 without cover

2. Central unit

2.1. Central unit front side (see Figure 2-1)

1 - Location for DIN rail
2 - Plate fixture with earth unit
3 - Lock for DIN rail mounting
4 - Location for external dual connector
5 - Location of the cable connectors
    - for 24 V d.c. power output for binary inputs
    - for binary inputs
    - for analog inputs
    - for analog output
6 - Visualization unit for the status of the 5 inputs / 4 binary outputs
7 - Location of the connector for the connection of input/output extensions
8 - Location of:
    - the RS485 interface for programming or MODBUS® communication
    - connector for the central unit power supply cabling
    - connectors for the binary outputs cabling
    - mini Din connector (not used)
9 - Location of the potentiometers (unused) and the On/Off button (see enlargement).
10 - PLC status visualization area:
    - POWER: power on
    - RUN: program running
    - ERR: error(s) present

Enlargement of item 9 without cover (see Figure 2-2)

1 - Screwdriver for adjusting potentiometer (unused)
2 - Central unit program ON/OFF button

2.2. Technical specifications

	07KR52
Number of Inputs/Outputs	
- Incorporated binary inputs	5
- Incorporated binary outputs	4
- Incorporated analog inputs	4
- Incorporated analog output	1
- Maximum number of extension units per central unit	6
- Maximum number of binary inputs	1096
- Maximum number of binary outputs	1046
- Maximum number of analog inputs	496
- Maximum number of analog outputs	136
Interface	
- Interface for MODBUS® communication - Interface for programming	1x RS 485 (Connector 3 points)
Memory	
- User program memory size : without ONLINE	17 647 words (typically. : 9 kInstructions)
with ONLINE	8 000 words (typically. : 4 kInstructions)
- User program memory and the constants	Flash EPROM
- Data memory	SRAM
- Data backup :	Yes with battery
Backup autonomy	21 days at 25°C
Charge time under power	100 % in 12 h

	07KR52
Functionality	
- Execution time for 1kbytes:	
100% binary instructions	0,4 ms
65% binary, 35 % words	1,2 ms
- Internal bits	2016
- Internal words	2016
- Internal double words	128
- Chain steps	2016
- Word constants	496
- Double word constants	127
- Timers	42 simultaneously
Time range	from 1 ms to 596 h 30 (24 days and 20 h 30)
- Counters	unlimited
Counter range	- 32767 to + 32767
- High speed counter function:	
Incremental encoder	1 with max frequency of 5 kHz on inputs I62.00 and I62.01
Stand-alone counter	2 to 7 kHz on inputs I62.00 and I62.01
- Interruptions	Delay of 250 µs
by alarm (on rising edge)	2 on inputs I62.02 and I62.03
cyclic	1 (from 1 ms to 2 s) or 5 ms to 2 s on master
max length	1,5 ms on master or 3 ms on slave/standalone
- User program protection in the central unit	yes with password
- Clock: Drift (typical)	4.3 min / month at 25°C
Programming	
- Programming Interface	1x RS 485 (Connector 3 points)
- Programming software	AC31GRAF under Windows® (IEC 1131-3) 907AC1131 under Windows® (IEC 1131-3)
- Program execution	sequential triggered by clock or triggered by alarm (interruptions)
- Sub-program :	12
Levels	1
- Operation set :	
Basic functions	Boolean, arithmetic, comparison
Advanced functions	over 60

Technical specifications

	07KR52
- Weight	850 g
Mains	
- Power supply voltage :	
Nominal value	230 V a.c.
Admissible range	195,5 to 253 V
Frequency	50 / 60 Hz
- Consumption :	
maximum	< 20 VA
central unit alone typical.	30 mA
Maximum configuration typical.	100 mA
- Polarity reversal protection	no
- 24 V d.c. isolated power for the inputs:	yes (500 Vrms 1 min)
Voltage range	19 to 30 V
Output current	300 mA
Short circuit protection	yes
- Dissipation	10 W
Incorporated binary inputs	
- Number of inputs	5
- two way	no
- Isolation of inputs / electronic	1500 Vrms 1 min.
- Input types	PNP
- Input voltage:	
Nominal value	24 V d.c.
Signal at 0 (IEC 1131-2)	0 to + 5 V
Signal at 1 (IEC 1131-2)	+ 15 to + 30 V
- Input current at 24 V d.c.:	For inputs 0 and 1 : 10 mA For inputs 2 to 4 : 7 mA
- 0 V common	yes
- Input status display	yes (yellow leds)
- Filtering time:	
Standard input	< 5 ms
Input with counter configuration	70 µs
Input with interruption configuration	90 µs
- Sensors	Dry contacts (M / A, switch, …)
wire diameter	< 2.5 mm^2
- Cable length :	
Unshielded (not for the high speed counter inputs)	300 m
Shielded	500 m
Non standard inputs	50 m

Technical specifications

	07KR52
Incorporated binary outputs	
- Number of outputs NC / NO (inverter)	1 relay
- Number of outputs Normally Closed	1 relay
- Number of outputs Normally Open	2 relays
- Isolation of the outputs / electronic	1500 Vrms 1 min
- Total charging current under voltage:	
direct 24 V d.c. resistive load / inrush current L / R = 20 ms L / R = 30 ms L / R = 40 ms L / R = 60 ms	 2 A / 5 A 2 A 1 A 0,6 A 0,35 A
24 to 230 V a.c.	2 A AC-1 1A AC-3 0,5 A AC-15
- Total charging current	4 x 2 A
- Output leakage current	-
- Output waste voltage	-
- Breaking capacity under 120 V a.c. (contact rating code B300) (UL)	2 A
- Breaking capacity under 250 V a.c. (contact rating code B300) (UL)	2 A (1,5 A according to UL)
- Breaking capacity (power)	500 VA (a.c.), 60 W (d.c.)
- Output status display	yes (yellow leds)
- Switching frequency: for resistive loads for inductive loads for lamps	 < 1 Hz < 0,2 Hz < 0,2 Hz
- Number of switches: relays O62,01 ; O62,02 ; O62,03 relays O62,00 for AC-1 for AC-15	 1 million 3 millions 1 million 100 000
- Pulse / h	100 maximum (900 000 / year)
- Varistor on contact relays O62,00 relays O62,01 ; O62,02 ; O62,03	 yes No
- Type of charge	electrovalve, contactor, 230 V a.c. 50 Hz, size A9
- Overload and short circuit protection	Envisage externally
- Over voltage protection	Envisage externally
- Output diagnostics	no
- Cable length :	
unshielded	150 m
shielded	500 m
- Diameter of connecting wire to charges	cage 2.5 mm^2

Technical specifications

	07KR52				
Analog inputs					
- Sensor type	**0-10V**	**PT1000**	**PTC1000**	**NTC 3K**	**NTC 10K**
- Assembly	2 wires	2 wires	2 wires	2 wires	2 wires
- 0 V common	Yes with 2 access terminals	Yes with 2 access terminals	Yes with 2 access terminals	Yes with 2 access terminals	Yes with 2 access terminals
- Nominal range:	0 - 10 V	-62.5 to +176.2 °C	-50 to +71.9 °C (with a 274 Ω resistance, 1% in series with the sensor)	-40 to +20 °C	-50 to +100°C
- Maximum values	+/- 30 V	--	>719	--	--
- Value in open circuit	32767	> 1762		< -400	< -500
- Value in short circuit	0	< -625	< -500	> +200	> +1000
- Isolation of inputs / electronic	No	No	No	No	No
- Resolution	12 bits	0.1°C	0.1°C	0.1°C	0.1°C
- Min resolution at input (± 1LSB)	5 mV	0.1°C	0.1°C	0.1°C	0.1°C
- Full scale precision	+/-50mV	1°C	1°C	depend on NTC specification	depend on NTC specification
- Word value range read by the central unit	0/+32767	-625/+1762	-500/+719	-400/+200	-500/+1000
- Input impedance	> 30KΩ				
- Linearization		yes	yes	yes	yes
- Dissipation sensor:		< 0.1 mW	< 0.1 mW	< 2.5 mW	< 2.5 mW
- Acquisition time including filtering time for all channels	2s	2s	2s	2s	2s
- Diagnosis	No	No	No	No	No
- Cable length:					
shielded	500m *	500m *	500m *	500m *	500m *
unshielded	150m *	150m *	150m *	150m *	150m *

* Necessary to add impedance cable like offset
exemple with cable 10Ω/100meters necessary to add Offset = 2,5° in PT1000

Possibility to use 4-20mA sensors with configuration 0-10V and with external resistance 249 Ω in parallel.

Table for NTC sensors :

°Celsius	NTC 3KΩ	NTC 10KΩ	Value IW in CPU
	R (Ohms)		
-50°		329.20 K	-500
-40°	15.10 K		-400
-30°	13.30 K		-300
-25°		86.39 K	-250
-20°	11.00 K		-200
-15°		53.39 K	-150
-10°	8.60 K	42.25 K	-100
-5°		33.89 K	-50
0°	6.30 K	27.28 K	0
+5°		22.05 K	+50
+10°	4.5 K	17.96 K	+100
+15°		14.68 K	+150
+20°	3.10 K	12.09 K	+200
+25°		10.00 K	+250
+30°		8.31 K	+300
+35°		6.94 K	+350
+40°		5.82 K	+400
+45°		4.91 K	+450
+50°		4.16 K	+500
+80°		1.66 K	+800
+100°		0.97 K	+1000

	07KR52
Analog output	
- Number	1
- Range	0 to 10 V (0 to 32767)
- Resolution	10 bits (10 mV), option 12 bits possible
- Precision	1 % of the full scale (100 mV)
- Fan-out	2 mA
- Speed	According to cycle
- Power on Reset	yes, 0 V at start-up
- Visualization of value or output status	no

	07KR52
Other specifications	
- Mounting	Din 35 mm rail or plate
- Utilization temperature	0 to + 55 °C, as per IEC 1131-2
- Board varnishing	selective
- Protection index	20
- Standards constraints	IEC 1131-2, EN 55011 (Class B), Marking EC
- Unit connection to local earth	yes, systematically undertaken by mounting the unit to the Din rail
- Switches for MODBUS® address	No, by user program
- Average program execution speed	1.5 ms per Kinstructions on bits 6 ms per Kinstructions on words

3. Dimensions (in mm)

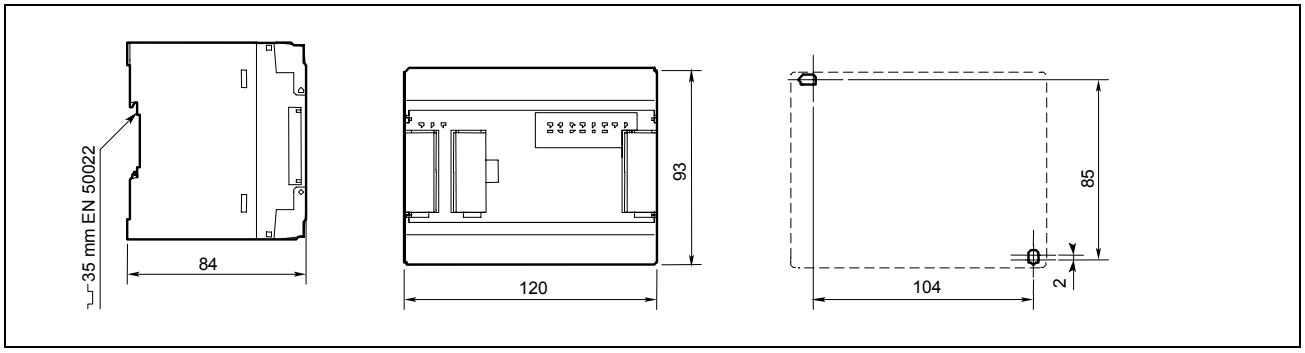


Figure 2-3: 07KR52 central unit

Chapter 3

Installation

Installation

Installation

The Installation chapter presents the cabling principle of the 07KR52, the general setup rules and the addressing rules.

1. Setting up an 07KR52 system

The 07KR52 is designed to operate in an environment with severe industrial conditions. A smooth operation can only be ensured if a certain number of rules are adhered to. These rules are based on the assembly conditions, the principles for cabling the inputs/outputs, earthing and the different types of power supplies.

1.1. Assembly conditions

It is possible to mount the 07KR52 with two types of fittings. It may be installed in a horizontal or vertical position:

- either on a DIN rail (35 mm) by using the support lock.
- or by a screw (3 mm diameter M3), the fixing holes placed at the base of the units enabling plate mounting.

For a cabinet assembly:

operating temperature from 0 to 55°C, envisage sufficient free volume around the units to allow the heat to dissipate correctly. It is recommended that the cabinet be fitted with a ventilation system..

Warning : avoid placing heat generating devices next to the products (transformers, mains, power contactors, ...).

All electrical connections are effectuated through removable terminal blocks with an acceptable wire section equal to 2.5 $mm^{2.}$

The tightening torque, for reference, is equal to 0,8 Nm.

1.2. Input/output cabling

Use rigid wires or AWG 18 (0.96 mm^2) to AWG 14 (1.95 mm^2) multi-conductor wires for the inputs and rigid wires or AWG 14 (1.95 mm^2) multi-conductor wires for the outputs.

Certain precautions should be taken to reduce installation disturbances from the surroundings. The cables carrying low voltage signals should not be placed in the same sleeve as the power cables.

One must distinguish between two types of signals:

- 230 V a.c. power supply
- analog signals (use shielded cables) and low voltage (24 V d.c.).

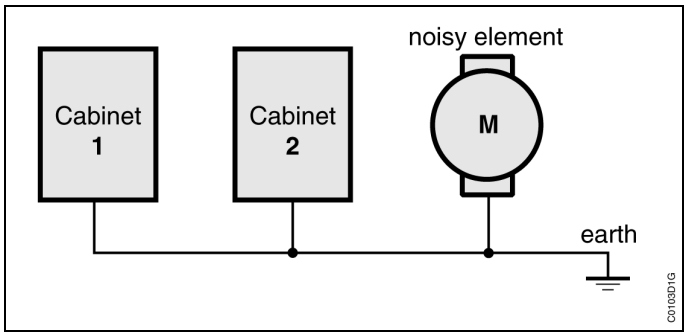


Figure 3-1 : Recommended connections with noise generating devices

1.3. Earthing

1.3.1. Basic earthing principles

Use rigid wires or AWG 14 (1.95 mm^2) multi-conductor wires.

The earth and mains wires should be connected in star.

All 07KR52 components of a cabinet should be connected to the same earth.

The 07KR52 central unit is fitted with an earth plate with the DIN rail mounting system. Also, if the central unit is screwed directly to a metal plate, the screw located at the top left of the central unit (as seen from the front) ensures an electrical connection to the earth via the earth plate.

This earthing provides protection against electromagnetic disturbances.

The safety earthing cable (on terminal block) should be connected to the cabinet chassis.

1.3.2. Earthing principles for numerous cabinets

The noise generating devices (actuators, motors, etc.) should not be earthed in-between two cabinets. The earthing should be done near to the element causing the most disturbance (see Figure 3-1).

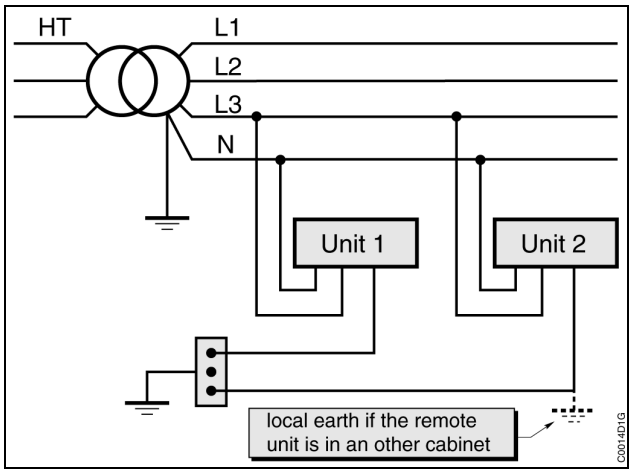


Figure 3-2 : Power supply – Neutral T-T regime

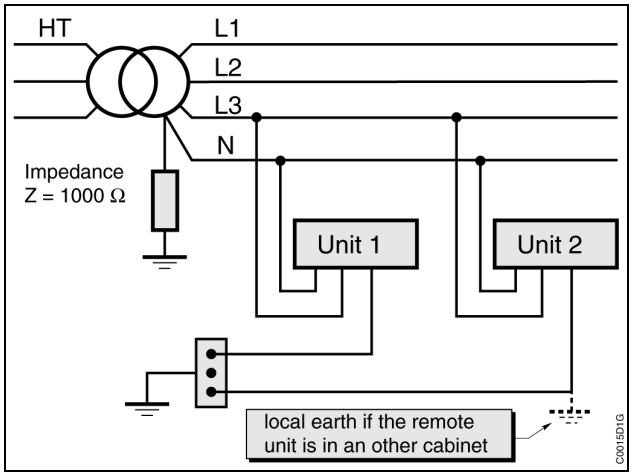


Figure 3-3 : Power supply – Neutral I-T

1.4. Different power supply types

The main difference between them is situated at the connection level of the neutral and the metallic parts to the earth:

- neutral T-T : The neutral is connected to the earth. All of the metallic parts are earthed (see Figure 3-2).

- neutral I-T : The neutral is isolated in relation to the earth and the metallic parts are earthed. (see Figure 3-3).

Each cabinet (including the 24 V version) in a disturbed environment should be fitted with an isolated shielded transformer.

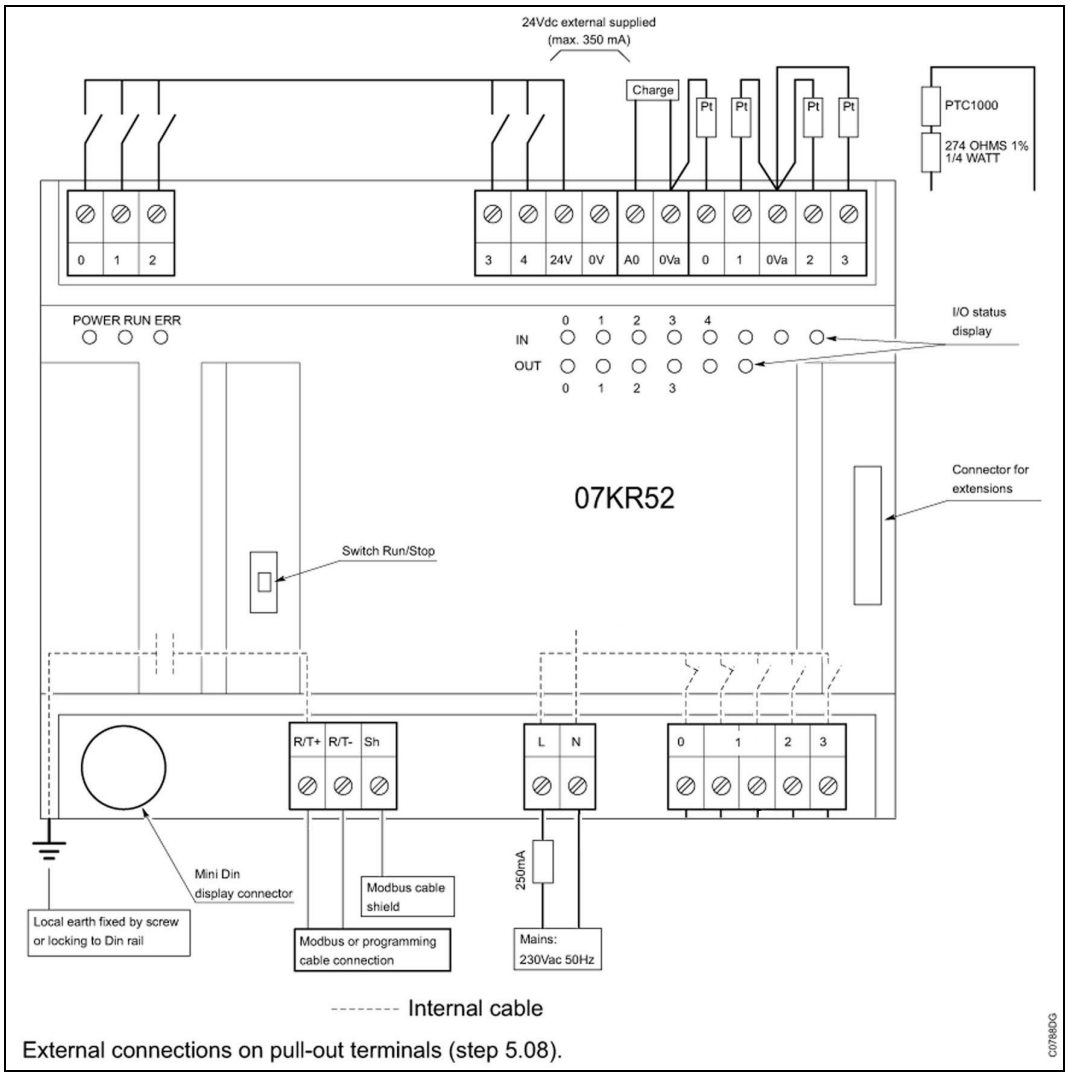


Figure 3-4 : Cabling of the 07KR52 central unit

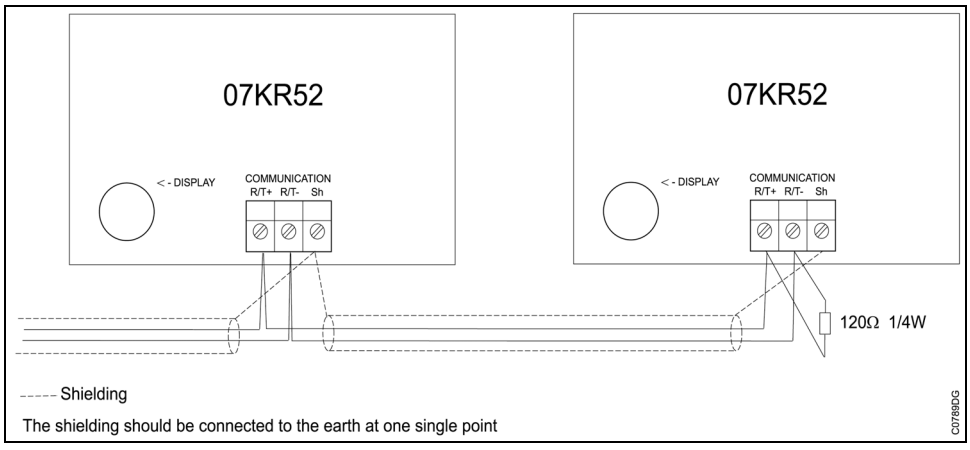


Figure 3-5 : Cabling of the 07KR52 central units on a MODBUS® network

2. Cabling central units

2.1. Power supply

Use rigid or AWG 14 (1.95 mm^2) multi-conductor wires.

The connection of an external thermal fuse is necessary to provide material protection.

An internal 24 V d.c. power supply is available. This power supply provides the power for the binary inputs of the unit and its extensions. The internal power supply is protected against short circuits and overloads. In the case of a short circuit or overload it is available, once again, approximately 10 seconds after the elimination of the defect.

It is also possible to use an external 24 V d.c. power supply. In this case do not forget to connect the 24 V d.c. power supply earth to that common to the inputs (terminal block C).

2.2. Inputs/outputs cabling

Use rigid or AWG 18 (0.96 mm^2) to AWG 14 (1.95 mm^2) multi-conductor wires for the Boolean inputs and the rigid or AWG 14 (1.95 mm^2) multi-conductor wires for the Boolean outputs. Refer to the specifications of the PT1000 and PTC1000 sensors for the wire specifications of the analog inputs. The characteristics of the analog output wire depend on the sensor used.

- Cabling of the inputs and outputs : see Figure 3-4

2.3. Output protection

The relay outputs may be protected externally against parasites generated by an inductive load with:

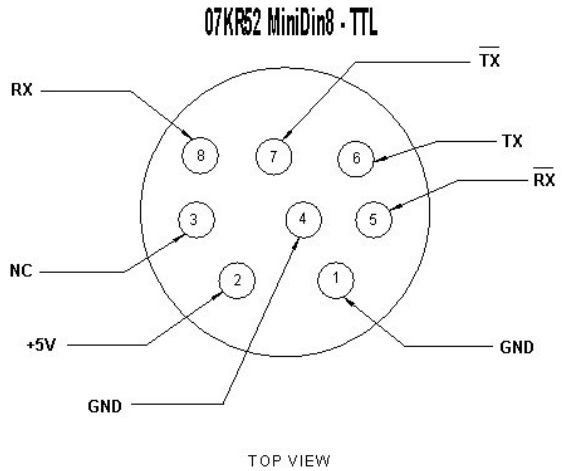
- a varistor or an RC module, in alternating current
- a free-wheel diode, in direct current

The presence of an external thermal fuse, connected to the common power supply of the outputs, protects the output connected devices.

2.4. Cabling of the 07KR52 central units on a MODBUS® network

See Figure 3-5.

2.5. Assignment on Mini Din 8 (Display option)



Chapter 4

Configuration

Configuration

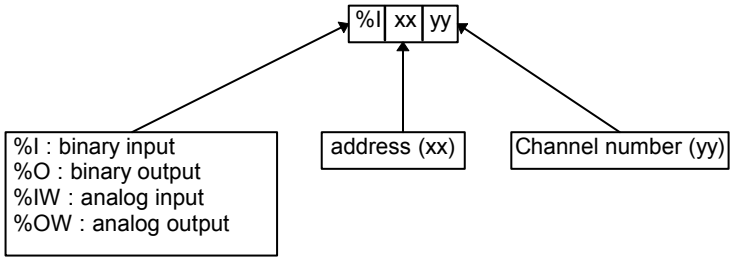
1. Addressing

1.1. Input / output variables

The 07KR52 central unit inputs/outputs are defined by:

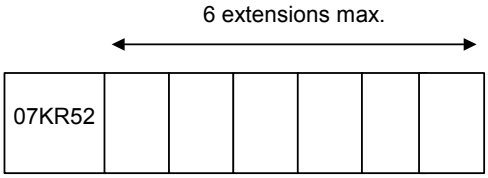
- their type (input or output, binary or analog),
- the central unit address
- their channel number on the central unit.

They are recognized in the following manner by the program: %I xx.yy



1.2. Addressing central units with extensions

A maximum of 6 binary or analog extensions may be connected to a central unit in any order

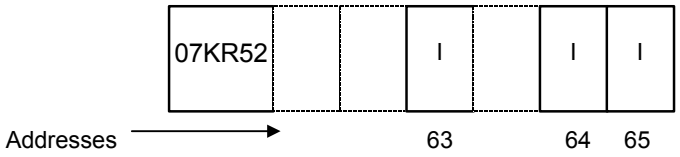


- **Central Unit**

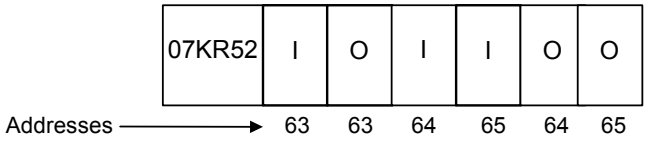
⇨ The address 62 is assigned to the inputs / outputs of a central unit.

⇨ The addresses of the extensions are assigned automatically according to the order of the extensions:

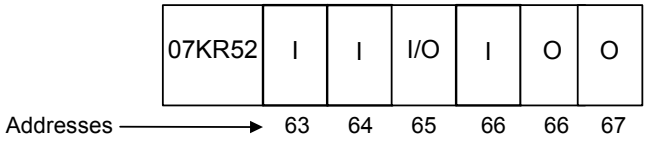
- the first binary inputs extension takes the address 63, and those that follow are incremented by 1, up to 79.



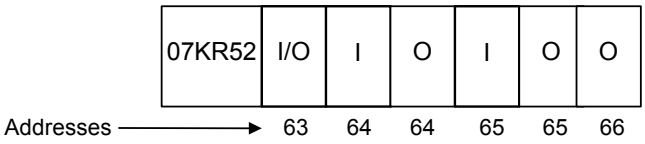
- the first binary outputs extension also takes the 63 address and those that follow are incremented by 1, up to 79



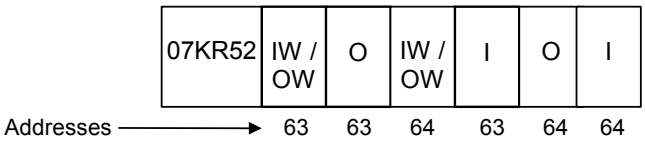
- - an extension with mixed or configurable inputs / outputs is considered by the addressing as an input extension **and** an output extension => The address of the following binary extension, whether it is input or output, is incremented by 1.



In order to optimize the addressing, the mixed or configurable inputs/outputs extension, or extensions, will be situated at the extremities.



- the address of the first analog extension starts at 63 and is incremented for the following by 1, up to 79.



2. List of variables

5 types of variables exist and are used in the user program :

- ⇨ The physical binary or analog input/output variables.
- ⇨ The internal bit, word or double word variables used by the user program for intermediate calculations.
- ⇨ The indirect bit, word or double word constants.
- ⇨ The chain steps : A chain step enables undertaking sequential operations. Each chain step allows the definition of a stage. Only one stage may be active at any time.
- ⇨ The historical values : some functions require the execution of a certain number of program cycles before executing. A historical value is an internal registry used by this type of function to store the result of the program cycle n-1 function during the course of the function.

The historical values are not directly accessible in the user program.

Comments about the historical values :

The maximum number of historical values used in the main program is set to 1000 and to 256 in the sub-programs.

The list of the functions and their historical values is available in the annex.

The historical values of the timer functions are independent of the list of historical values of the other functions. An unlimited number of timer functions are authorized within a program, however the number of simultaneous timer functions is limited to 42.

Type	Variables		Description
	from	to	
Binary inputs	I 00.00	I 61.15	Free, to be used as internal bits or for slave central units
	I 62.00	I 62.04	Binary inputs to central units I62.00 and I62.01 may be configured for counting I62.02 and I62.03 may be configured as inputs to capture interruptions
	I 62.08	I 62.15	Reserved variables
	I 63.00	I 79.15	Binary inputs on central unit extensions
Analog inputs	IW 00.00	IW 61.15	Free, to be used as internal bits or for slave central units
	IW 62.00	IW 62.01	Reserved variables
	IW 62.02	IW 62.05	PT1000 and PTC1000 0-10V and NTC analog inputs
	IW62.06	IW62.07	Free, to be used as internal words
	IW 62.08		Seconds (0...59)
	IW 62.09		Minutes (0...59)
	IW 62.10		Hours (0...23)
	IW 62.11		Days of the week (1...7)
	IW 62.12		Days of the month
	IW 62.13		Month
	IW 62.14		Year
	IW 62.15		Information word : bit 0: for class 2 error detection
	IW 63.00	IW 79.15	Analog inputs on the extensions of a central unit
Binary outputs	O 00.00	O 61.15	Free, to be used as internal bits or for central unit slaves
	O 62.00	O 62.03	Binary outputs on the central units
	O 62.04	O 62.15	Reserved variables
	O 63.00	O 79.15	Binary outputs on the extensions of the central units.
Analog outputs	OW 00.00	OW 61.15	Free, to be used as internal words or for central unit slaves
	OW 62.00		Analog output, range 0 to 10 V (0 to 32767)
	OW 62.01	OW 62.15	Reserved variables
	OW 63.00	OW 79.15	Analog outputs on the extensions of the central units

Type	Variables		Description
	from	to	
Chain steps	S 000.00	S 125.15	Chain steps
Internal bits	M 000.00	M 099.15	Internal bits useable in the program
	M 230.00	M 254.15	Internal bits useable in the program
	M 255.00		2 Hz oscillator variable
	M 255.01		1 Hz oscillator variable
	M 255.02		0.5 Hz oscillator variable
	M 255.03		0.01667 Hz oscillator variable (period = 1 minute)
	M 255.04	M 255.07	Reserved variables
	M 255.08		Variable for detecting the operation of the MODBUS® communication on the programming/ MODBUS® serial
	M 255.09		Permutation variable of the MODBUS® / programming protocols
	M 255.10	M 255.14	Diagnosis bits
	M 255.15		Variable, always set to "0" on startup, which may be used for the detection of the first program cycle
Internal words	MW 000.00	MW 099.15	Internal words useable in the program
	MW 230.00	MW 253.15	Internal words useable in the program
	MW 254.00	MW 254.07	Class 1 errors information
	MW 254.08	MW 254.15	Class 2 errors information
	MW 255.00	MW 255.07	Class 3 errors information
	MW 255.08	MW 255.15	Class 4 errors information
Internal double words	MD 00.00	MD 07.15	Double words useable in the program
Bit constants	K 00.00	K 00.01	Indirect bit constants
Word constants	KW 00.00	KW 00.15	System word constants reserved for the configuration not accessible by AC31GRAF
	KW 01.00	KW 31.15	Indirect word constants
Double word constants	KD 00.00		System double word constant reserved for the cycle time, not accessible by AC31GRAF
	KD 00.01	KD 07.15	Indirect double word constants
System internal historical values	Not accessible		Historical values

3. Initialization

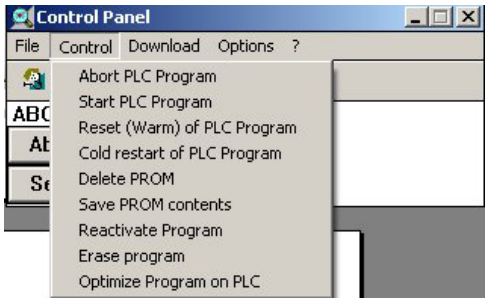
The 07KR52 are delivered in programming mode on RS485 interface (factory settings) in order to be able to download the program to the PLC for the first time.

Warning: Several cases can modify the interface protocol on RS485, in MODBUS® protocol slave 99 instead of programming mode.

⇨ Action on STOP / RUN button if there is no program in PLC

⇨ If by selecting the *"Control"* menu in the *"Control panel"* window of AC31GRAF :

- **Delete PROM and Cold restart of the PLC are used**



In this case, it will be necessary to change the internal bit M 255,09 parameter (= 1) through the MODBUS® communication in order to come back in programming mode.

See paragraph 4.1.1.3 Configuration of the RS485 serial connection to check the management of permutation of protocol on RS485 with help of KW00.06 and M255.09.

4. Data initialization and backup

4.1.1. Data backup specifications

The variables are all initialized by default at each program launch.

It is, however, possible to save the totality or a part of the data. An external battery is not necessary as the central units possess an incorporated battery (accumulator Vanadium-lithium) with an autonomy of 16 days at 25°C, which enables saving the data,. The battery recharges from 0 up to 100% in 7 hours when the power supply is on.

A battery failure is detected with on bit 3 of the status word IW 62.15. If the value of IW 62.15 is such that the bit 3 is set to 0 (xxxx xxxx xxxx 0xxx) then the battery is discharged.

The lifetime depends on the CPU usage.

A normal case:

- the power supply is OFF every night — life time = 15 years
- the power supply is OFF every week-end and holidays — life time = 12 years
- the worst case power supply is every week for 4 days — life time = 6 years

Data backup is possible by modifying the n value of the following tables

4.1.2. Initialization / Backup of the internal bits

Value n	Internal bits backed up	Internal bits initialized
n = 0 (default value)	no backup	M 000.00...M 099.15 M 230.00 M 255.15
n = 1...99	M 000.00...M n-1.15	M n.00...M 099.15 M 230.00...M 255.15
n = 100...229	M 000.00...M 099.15	M 230.00...M 255.15
n = 230...254	M 000.00...M 099.15 M 230.00...M n-1.15	M n.00...M 255.15
n < 0, n > 254	M 000.00...M 099.15 M 230.00...M 254.15	M 255.00...M 255.15

Comments:

⇨ The bits M 255.00 to M 255.03 are oscillator variables, which always start at 0.

⇨ The bits M 255.10 to M 255.14 are reserved for the diagnosis.

⇨ The M 255.15 bit cannot be backed up and is always reset to 0 at the launch of any program. Consequently, it may be used to detect the first program cycle.

4.1.3. Initialization / Backup of internal words

Value n	Internal words backed up	Internal words initialized
n = 0 (default value)	no backup	MW 000.00...MW 099.15 MW 230.00...MW 239.15 MW 255.00...MW 255.15
n = 1...99	MW 000.00...MW n-1.15	MW n.00...MW 099.15 MW 230.00...MW 239.15 MW 255.00...MW 255.15
n = 100...229	MW 000.00...MW 099.15	MW 230.00...MW 239.15 MW 255.00...MW 255.15
n = 230...255	MW 000.00...MW 099.15 MW 230.00...MW n-1.15	MW n.00...MW 255.15
n < 0, n > 255	MW 000.00...MW 099.15 MW 230.00...MW 239.15 MW 255.00...MW 255.15	no initialization

4.1.4. Initialization / Backup of internal double words

Value n	Internal double words backed up	Internal double words initialized
n = 0 (default value)	no backup	MD 000.00...MD 007.15
n = 1…8	MD 000.00...MD n-1.15	MD n.00...MD 007.15
n < 0, n > 8	MD 000.00...MD 007.15	no initialization

4.1.5. Initialization / Backup of chain steps

Value n	Chain steps backed up	Chain steps initialized
n = 0 (default value)	no backup	S 000.00...S 125.15
n = 1...125	S 000.00...S n-1.15	S n.00...S 125.15
n < 0, n > 125	S 000.00...S 125.15	no initialization

4.1.6. Initialization / Backup of historical values

Value n	Historical values backed up	Historical values initialized
n = 0 (default value)	no backup	initialization of all the historical values
n < 0, n > 0	backup of all the historical values	no initialization

A change in the data initialization parameters is taken into account immediately.

4.1.7. Central unit reaction to class 3 errors

The AC 31 central units possess a diagnosis system aimed at ensuring a rapid and efficient localization of faults. This diagnosis system is divided into 4 error classes:

- Class 1: fatal error
- Class 2: serious error
- Class 3: light error
- Class 4: warning

In the case of a class 1 or 2 error, the program has aborted or has not launched. For a class 4 error, the program has not stopped.

In the case of a class 3 error, it is possible to abort or continue the program:

⇨ No stoppage if the "PLC reaction to class 3 errors" configuration parameter is set to "Warning" (configuration by default).

⇨ Automatic program stoppage by selecting **"Abort".**

A change of this parameter is taken into account immediately

4.1.8. Communication parameters (Programming / MODBUS® serial interface)

The communication parameters are defined as follows, according to the modes:

Mode	Default parameters	Modification of parameters
Programming	9 600 Bauds no parity 8 data bits 1 stop bit	parameters non modifiable
MODBUS®	9 600 Bauds no parity 8 data bits 1 stop bit	modification of parameters by using the SINIT function in the user program

Speed modification with the help of the SINIT function:

Value of the speed parameter (in Bauds)

From 9600 to 19200	the speed value is written directly.
33600	the speed value is written through Code **44**
38400	the speed value is written through Code **38**
57600	the speed value is written through Code **25**
75000	the speed value is written through Code **19**
76800	the speed value is written through Code **18**
115200	the speed value is written through Code **12**

Mode	Delay time	System constant KW 00.06
Programming	3 characters	KW 00.06 > 1000
MODBUS®	1 character (by default)	1101 < KW 00.06 < 1199

4.1.9. The central unit cycle time

The central unit program executes in cycles for the duration that is defined in the *"Cycle time declaration* " system parameter. This value is expressed in milliseconds

For a master central unit : the cycle is between 0 and 100 ms where only multiples of 5 ms are authorized.

When the 0 value is selected then the cycle time is the minimum time which the central unit requires for each cycle. In this case the cycle time is not constant.

Calculation of a cycle time:

The cycle time Tc can be calculated by the user by using the following equation:

$Tc \geq Tg + Tp$

where Tg = extension management time

and Tp = the program execution time.

The program execution time corresponds to the addition of all the times of the functions present in the user program (see the list of times in the annex).

In general, the program execution time for 1 000 bytes is:

⇨ 0.4 ms for 100% of binary instructions

⇨ 1.2 ms for 65% of binary instructions and 35% of word instructions.

The bus transmission time is calculated from the installation configuration. It requires adding together the times of all the units on the bus. The total time for the extensible remote units is given by adding the unit time and the times of the connected extensions

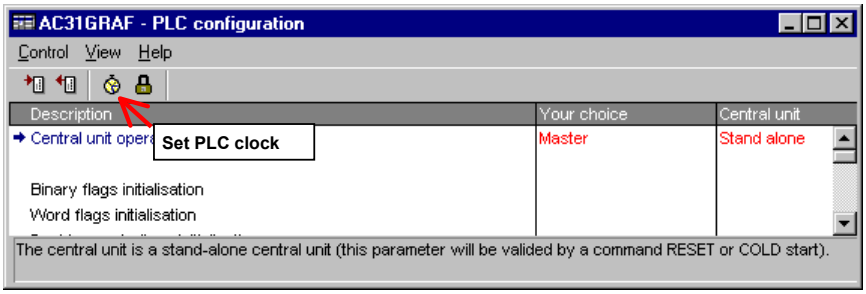


Figure 4-1 : A clock is available on the central units

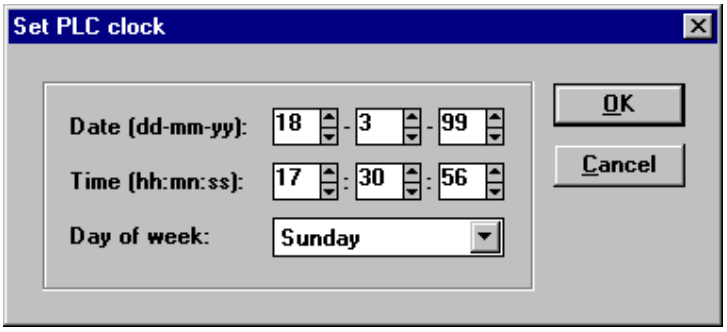


Figure 4-2 : Clock update

4.1.10. Clock

A clock is available on the central units (see Figure 4-1).

Drift (typical) 4.3 min / month at 25 °C

The clock parameters are accessible:

⇨ Either in the following variables:

IW 62.08	seconds (0...59)
IW 62.09	minutes (0...59)
IW 62.10	hours (0...23)
IW 62.11	days of the week (1...7) Monday = 1
IW 62.12	days of the month (1...depending on the month)
IW 62.13	months (1...12)
IW 62.14	years (00...99)

⇨ Or by using the UHR function

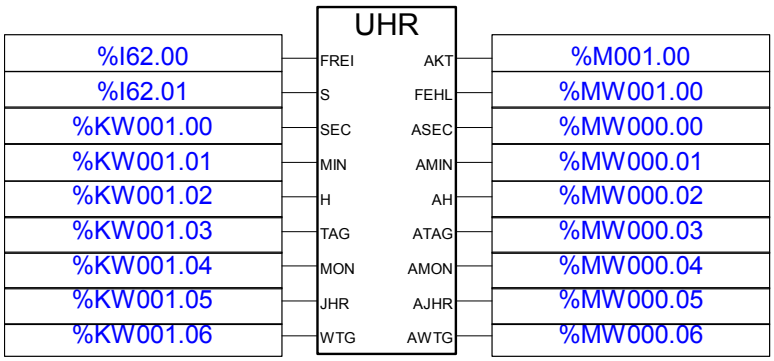
Updating the clock

The clock update can be undertaken in two ways:

⇨ Through the AC31GRAF software in the configuration window, by clicking on the "Set PLC clock" icon (see Figure 4-2).

⇨ Through programming using the UHR function.

Here is an example using the UHR function:



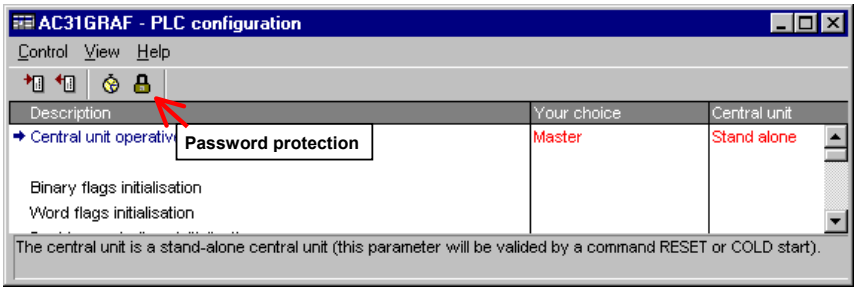


Figure 4-3 : Write access denied

Figure 4-4 : Password consisting of 4 values

Figure 4-5 : Re-enter the password to unlock

4.1.11. xPassword

A password can be defined to deny central unit program write and read access to unauthorized persons.

The password is given by the AC31GRAF software in the configuration window, by clicking on the *"Password protection"* icon (see Figure 4-3). The password is composed of 4 hexadecimal values (from 0 to F) (see Figure 4-4). It is invalidated by clicking on the *"Password protection"* again and re-entering the password (see Figure 4-5).

4.1.12. Configuration of an 07KR52 analog input type

The PTC1000 / PT1000 / 0-10V / PTC sensor selection may be undertaken, channel-by-channel, by writing a value to the 12746 memory address, using function bloc COPY.

The value is determined in the following manner:

Bit 0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Value	Channel configuration
0	1	All channels are on PTC1000
1 to 4	0	The corresponding channel is on PT1000
1 to 4	1	The corresponding channel is on PTC1000
5 to 8	1	The corresponding channel is on 0-10 V
9 to 12	1	The corresponding channel is on NTC
13	0	The channels in NTC following table 3KΩ (see below)
13	1	The channels in NTC following table 10KΩ (see below)

Some example of with value for configuration:

Warning:

Priority: Bit 0 PTC sensor choice

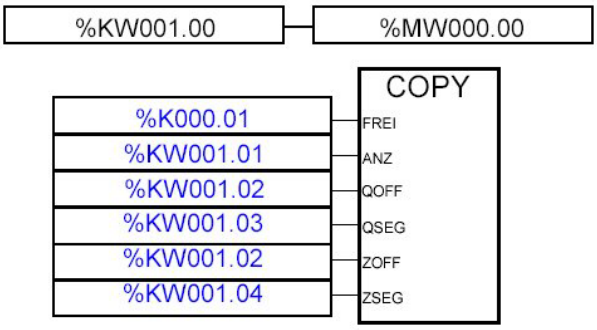
To configure in NTC the channels must be also select in 0-10V if not NTC selection is not used

Value = 0 : All channels are on PT1000
Value = 1 All channels are on PTC1000
Value = 480 All channels are on 0-10V
Value = 8160 All channels are on NTC 3K
Value = 16352 All channels are on NTC 10K

After that, you can select also channels by channels:

Value = 6 : channels 0 and 1 on PTC1000 and channels 2 and 3 on PT1000
Value = 24 : channels 2 and 3 on PTC1000 and channels 0 and 1 on PT1000
Value = 390 : channels 0 and 1 on PTC1000 and channels 2 and 3 on 0-10V
Value = 6528 : channels 0 and 1 on PT1000 and channels 2 and 3 NTC 3K
Value = 12678 : channels 0 and 1 on PTC1000 and channel 2 on 0-10V and 3 on NTC 10K

Writing a value to a memory address is undertaken with the following program:



where	KW001.00 = 16	setting value
	KW001.01 = 1	number of values to copy
	KW001.02 = 0	memory offset
	KW001.03 = 7168	MW000.00 memory address
	KW001.04 = 12746	

The memory addresses are indicated in the annexes.

4.1.13. Configuration of the RS485 serial connection

It is possible to change the communication mode while the central unit is running, for instance to program remotely.

The two communication modes used are as follows:

⇨ Programming mode to program and test the central unit

⇨ MODBUS® slave mode

You must configure the KW 00,06 and M 255,09 parameters, according to the following table, to use one of these communication modes:

Configuration	Communication mode
M 255,09 = 1 KW 00,06 = XX (indifferent)	Prog / test mode
M 255,09 = 0 KW 00,06 = 1001 (address = 00)	Prog / test mode
M 255,09 = 0 KW 00,06 = 11xx (address = xx)	MODBUS® slave mode address xx

M 255,09 is modified by the MODBUS® command.

Chapter 5

Communication

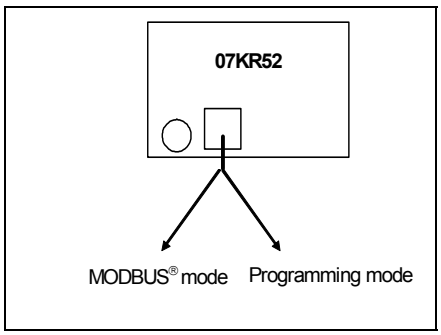


Figure 5-1 : Communication protocols

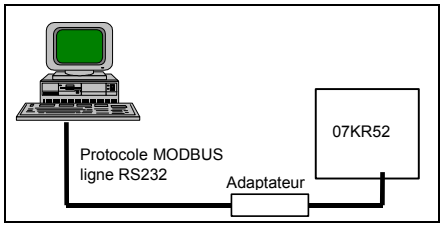


Figure 5-2 : Point to point connection with PC

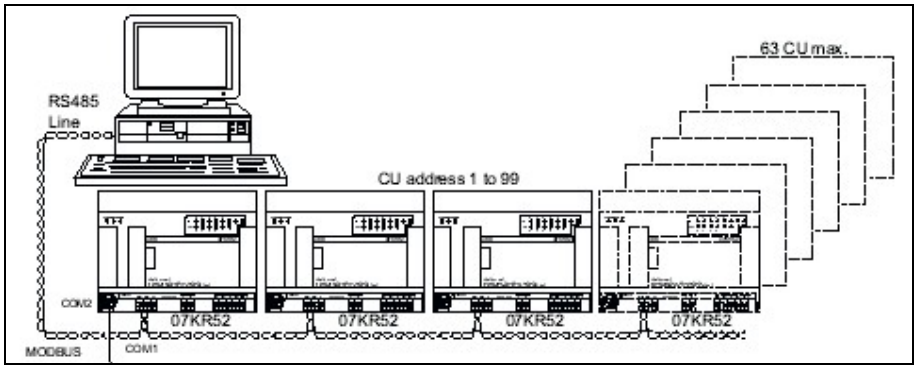


Figure 5-3: Network with PC, central units and displays

Communication

Communication is of greater importance in wide area installations. The 07KR52 system possesses interfaces adapted to different communication modes.

This chapter presents the interfaces available with the 07KR52 central units that possess two communication protocols on the same serial interface (Figure 5-1). The MODBUS® mode is the easiest and most powerful for communicating with other devices.

1. Programming and MODBUS® interface RS485

1.1. Programming

The central unit is programmed using dedicated software (AC31GRAF) and by the 3 point terminal block which is also used for MODBUS® connection.

A connection to PCs' is undertaken either by a RS485 connection via a 232 / 485 non-isolated interface or via a RS485 board in the PC and a 2 wires connection.

The 07KR52 are delivered in programming mode on RS485 interface (factory settings) in order to be able to download the program to the PLC for the first time. (see paragraph 3 initialization)

1.2. MODBUS®

1.2.1. Protocol description

The 07KR52 central unit MODBUS® protocol is the **MODICON MODBUS® RTU** protocol.

Numerous automation devices, such as PLC's, displays, variable speed drives or monitoring systems posses a standard, or optional, MODBUS® RTU interface and can therefore easily communicate with the 07KR52 central unit via the serial interface (RS485 or RS232 with adapter).

MODBUS® is a question / answer type protocol that is still occasionally called master / slave: the master sends a request to the slave and awaits the slave's reply.

The master devices on a MODBUS® network are generally central units, displays or supervisory systems. The slaves on the MODBUS® network are generally PLCs, variable speed drives, etc.

1.2.2. Serial interface specifications

Support	Serial interface: RS485 opto-isolated
Mode	half-duplex
Physical support	Shielded twisted pair connected to a 3 point terminal block
Line termination resistance	Placed by the user on the first and last connected unit (120 Ω) on RS485
Number of connection points	1 single master maximum of **63** slaves with integrated RS485 connections at 19200 bauds or 31 slaves with speed >19200 bauds maximum **255** slaves with repeaters
Protocol	MODBUS® (master / slave)
Transmission control	CRC 16
Speed	Up to 115 200 Bauds (*) (**)
Maximum length without repeater on RS485 network	500 m at 115 200 Bauds 1 000 m at 19 200 Bauds 1 500 m at 300 Bauds

(*) : estimation of the refresh time according to the communication: configuration connecting 63 central units, 10 words changed by the central unit, where transmission speed = 19 200 :
time per unit ≅ 30 ms + CU cycle time (≅ 20 ms)
total refresh time ≅ 64 x (30 ms + CU cycle time) + PC processing time

(**) : Communication speed can be modified with the SINIT function in the user program

1.2.3. Configuration as MODBUS® master

Select the "configuration" editor in AC31GRAF and select the "communication mode" parameter of the MODBUS® Master.

Correspond to the value 1100 in the KW00.06 constant.

The MODBUS® frames are then sent with the MODBUS® function.

The MODBUS® frames transmitted by the master contain the following information:

- The MODBUS® address of the interrogated slave (1 byte)
- The function code defining the master request (1 byte)
- The data to exchange (N bytes)
- The CRC16 control code (2 bytes)

The frame has a maximum total length of 240 bytes thereby enabling the exchange of a maximum of 100 data words or 255 binary data.

The slave's reply contains the request confirmation, the data to be returned and also a frame control code. The slave returns an error code in the case of an error.

Other protocol information is given in the annex.

Only the following MODBUS® operation codes may be processed by the central unit:

Function codes		**Description**
In hexadecimal	In decimal	
01 or 02	01 or 02	Read n bits
03 or 04	03 or 04	Read n words
05	05	Write a bit
06	06	Write a word
07	07	Fast reading of 8 bits
08	08	Diagnosis / initialization
0F	15	Write n bits
10	16	Write n words

The codes generated on error are:

Error codes	**Description**
00	No error
01	Unknown function code
02	Address error
03	Data error
09	Time-out exceeded
10	Control error

1.2.4. Configuration as MODBUS® slave

Select the "configuration" editor in AC31GRAF and select the "communication mode" for the desired slave number.

Warning: if the battery is empty the value in the Flash EPROM is re-used.

Usage of a backup command is recommended to avoid the loss of any communication parameters once the system is set up.

1.2.5. List of cross references

An exchange of MODBUS® data is realized in a table defined by:

- The MODBUS® address of the first exchanged variable
- The list size = the total number of variables in the list.

All the variables of the 07KR52 central unit described in the following table, can be read or written by the master MODBUS®.

- MODBUS® addressing method:

VAR 00.00 ⟶ ADDR 0

(VAR = type I,O,S,M,IW,OW,MW,KW) (Address, in decimal, of the first selected variable)

VAR XX.YY = ADDR 0 + (16 * XX) + YY

(VAR = type MD,KD) (Address of the first selected variable in decimal)

VAR XX.YY = ADDR 0 + (32 * XX) + (2 * YY)

Example : Find the MODBUS® address of variables O62.15 and M232.01 and MD002.07

O 62.15 = 4096 + (16 * 62) + 15 = **5103**

M 232.01 = 8192 + (16 * 232) + 1 = **11905**

MD002.07 = 16384 + (32 * 2) + (2 * 7) = **16462**

Variable types	Variables	MODBUS® addresses in hexadecimal	MODBUS® addresses in decimal
Binary inputs	I 00.00 I 00.01 ... I 00.15	0000 0001 ... 000F	0000 0001 ... 0015
	I 01.00 ... I 61.15	0010 ... 03DF	0016 ... 0991
	I 62.00 ... I 62.15	03E0 ... 03EF	0992 ... 1007
	I 63.00 ... I 79.15	03F0 ... 04FF	1008 ... 1279
Binary outputs	O 00.00 O 00.01 ... O 00.15	1000 1001 ... 100F	4096 4097 ... 4111
	O 01.00 ... O 61.15	1010 ... 13DF	4112 5087
	O 62.00 ... O 62.15	13E0 ... 13EF	5088 ... 5103
	O 63.00 ... O 79.15	13F0 ... 14FF	5104 ... 5375
Internal bits	M 000.00 M 000.01 ... M 000.15	2000 2001 ... 200F	8192 8193 ... 8207
	M 001.00 ... M 099.15	2010 ... 263F	8208 ... 9791
	M 230.00 ... M 254.15	2E60 ... 2FEF	11872 ... 12271
	M 255.00 ... M 255.15	2FF0 ... 2FFF	12272 ... 12287
Chain steps	S 00.00 S 00.01 ... S 00.15	3000 3001 ... 300F	12288 12289 ... 12303
	S 01.00 ... S125.15	3010 ... 37DF	12304 ... 14303

Variable types	Variables	MODBUS® addresses in hexadecimal	MODBUS® addresses in decimal
Analog inputs	IW 00.00 IW 00.01 ... IW 00.15	0000 0001 ... 000F	0000 0001 ... 0015
	IW 01.00 ... IW 62.15	0010 ... 03EF	0016 ... 1007
	IW 63.00 ... IW 79.15	03F0 ... 04FF	1008 ... 1279
Analog outputs	OW 00.00 OW 00.01 ... OW 00.15	1000 1001 ... 100F	4096 4097 ... 4111
	OW 01.00 ... OW 62.15	1010 ... 13EF	4112 ... 5103
	OW 63.00 ... OW 79.15	13F0 ... 14FF	5104 ... 5375
Internal words	MW 000.00 MW 000.01 ... MW 000.15	2000 2001 ... 200F	8192 8193 ... 8207
	MW 001.00 ... MW 099.15	2010 ... 263F	8208 ... 9791
	MW 230.00 ... MW 254.15	2E60 ... 2FEF	11872 ... 12271
	MW 255.00 ... MW 255.15	2FF0 ... 2FFF	12272 ... 12287
Internal double words	MD 00.00 MD 00.01 ... MD 00.15	4000 4002 ... 401E	16384 16386 ... 16414
	MD 01.00 ... MD 07.15	4020 ... 40FE	16416 ... 16638
Indirect word constants	KW 00.00 KW 00.01 ... KW 00.15	3000 3001 ... 300F	12288 12289 ... 12303
	KW 01.00 ... KW 31.15	3010 ... 31FF	12304 ... 12799
Indirect double word constants	KD 00.00 KD 00.01 ... KD 00.15	5000 5002 ... 501E	20480 20482 ... 20510
	KD 01.00 ... KD 07.15	5020 ... 50FE	20512 ... 20734

1.3. Reply times for MODBUS® communication

The MODBUS® processing time depends on:

- The transmission speed
- The number of frame bytes
- The central unit cycle time
- The central unit load factor

The following times are for indication purposes only.

Reply times with a 07KR52 central unit

Cycle time = 10 ms

Load factor = 80%

Speed = 9 600 Bauds

Nbr. of variables	Bits		Words	
	read (ms)	write (ms)	read (ms)	write (ms)
1	10 - 60	50	10 - 60	60
10	10 - 60	60	10 - 60	110
50	10 - 60	110	110 - 170	220
100	50 - 60	110	220 -280	390
150	50 - 110		-	-
255	50 - 110		-	-

Chapter 6

Diagnosis

Diagnosis

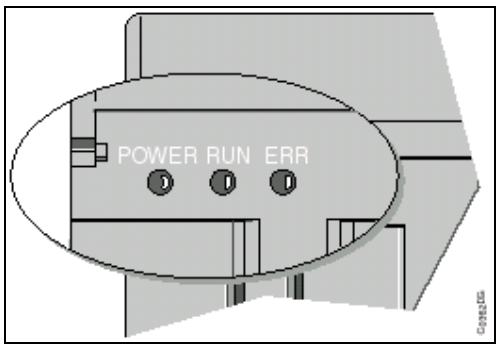


Figure 6-1 : Error detection LEDs

Diagnosis

The aim of the 07KR52 central unit diagnosis is to ensure a rapid and efficient localization of breakdowns.

1. Detected error types

The detected errors are grouped by type into four error classes.

Class 1 errors: fatal errors	**Class 2 errors: serious errors**	**Class 3 errors: light errors**	**Class 4 errors: warnings**
Access to the Flash EPROM is no longer assured. - Flash EPROM checksum error	The operating system functions correctly but the execution of the user program is not guaranteed. Detected errors: - Defective RAM - Too many timers active simultaneously	Communication errors. Stopping the program depends on the user choice during configuration according to the application. Detected errors: - Disconnected unit - Bus error - NCB / NCBR error - Cycle time too short - Addressing fault	Errors occurring on the units or syntax errors whose effects will only become apparent later. The user decides which actions to initialize according to the application. - Internal unit error - Cut wire *1, overload, short-circuit - Analog output level error - Defective 10V output - Program size, program syntax, sub-program or interruption program error - Too many historical values - All of the units on the bus are not initialized*2

*1 error detected if prior configuration by programming with the CS31CO block

*2 error detected if prior software configuration with the "PLC configuration" menu of the Control window..

2. Error detection

The detected errors are transmitted to the central unit which signals their presence on the red ERR led situated on the front of the central unit (see Figure 6-1).

An error on a remote unit is also signaled by the ERR led of the unit concerned.

The SUPPLY led flashes on the extension when an error occurs on the extension.

As soon as the error has been detected and corrected by the user it can be acknowledged:

- ⇨ By restarting the central unit
- ⇨ Through the software
- ⇨ Or by program.

Only one error per class is memorized. If more than one error of the same class occurs at the same time:

- ⇨ Only the first is memorized.
- ⇨ The first error should be corrected and acknowledged to allow the following to be read. And so on through to the last error.
- ⇨ Those following errors that disappear, before the acknowledgment of the first error, are never signaled.

A recapitulative table:

	Class 1 errors: fatal errors	**Class 2 errors: serious errors**	**Class 3 errors: light errors**	**Class 4 errors: warnings**
Detection:	Immediate	Immediate	- Bus error: if the central unit detects a frame control error (CRC) during 9 successive cycles or a timing error or the absence of a reply from a unit. - Cycle timing error: if the system detects the overriding of the pre-defined cycle time after 16 consecutive cycles.	- Unit error: the central unit queries one slave per cycle. An error is detected between 1 and 31 cycles. - Program syntax error: The central unit detects this type of error when passing from STOP to RUN via the switch or via the software or by on-line validation of a program modification.
LED status - on the central unit: - on the extensible remote units : - on the extensions: - on non-extensible remote units:	 ERR led on RUN led off even if the RUN/STOP switch is on RUN	 ERR led on RUN led off even if the RUN/STOP switch is on RUN	 ERR led on Depending on the configuration, the RUN led is off even if the RUN/STOP switch is on RUN ERR led on or flashing according to the case Flashing SUPPLY led Error led on or flashing according to the case	 ERR led on Following a program syntax type error, the RUN led is off. ERR led on Flashing SUPPLY led Error led on
Reaction while powering up or during central unit usage:	All outputs remain on, or are set to, 0. The programming software no longer has access to the central unit. The central unit remains on RESET while the error remains present.	All outputs remain on, or are set to, 0. The programming software retains access to the central unit. The user program has not started or is stopped.	The inputs of a unit on error retain the old values for 9 cycles and are then reset to 0. The outputs of a remote unit or extension are reset to 0. No program stoppage by default. It's possible to prepare an automatic program stoppage with prior configuration (see chapter 5)	No program stoppage
Acknowledgment after error removal:	- Power on	- Power on - Software cold restart - Software warm start or RESET - Software acknowledgment	- Switch RUN/STOP from STOP to RUN - Program launch through software - Software warm restart - Software cold restart - Power on - Software acknowledgment in the "STATUS" window" - Acknowledgment through programming - Test button on the 30 and 90 series remote units	
				- Automatic acknowledgment if the error code ≤ 15

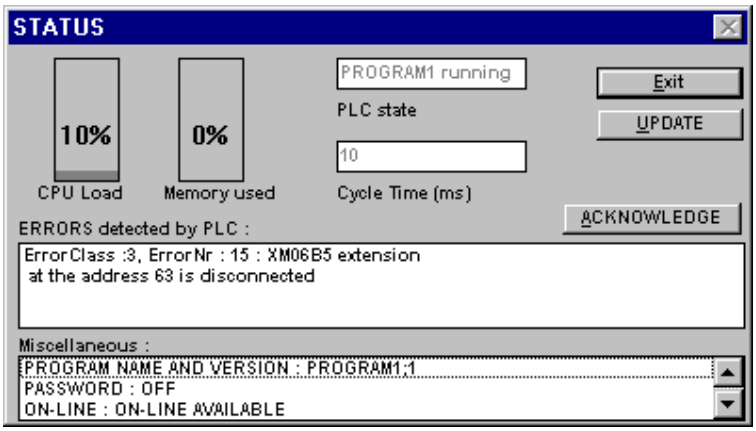


Figure 6-2 : AC31GRAF status window

3. Status through software

Detailed information concerning the status of the central unit can be obtained in AC31GRAF by clicking the *"PLC status information (diagnosis)"* icon in the Control window.

Once the status window is opened, (Figure 6-2) the data remains until the window is opened again or until updated using the *"UPDATE"* button.

⇨ The errors are described under the *"Errors detected by PLC*" message.

⇨ An error can be acknowledged by the software as soon as it has been detected and corrected by clicking on the *"ACKNOWLEDGE "* button.

4. Error management programming

Programming error management enables the central unit to immediately take an error into account and allows the programming of an instantaneous reaction.

4.1. Description of the diagnosis variables

Each error is identified by a class number, an error code within that class and the arguments. Only one error per class may be memorized and detailed by the central unit within a pre-defined group of internal variables.

The variable values can be accessed by the user for program defect management.

Comment: The class and error codes can also be accessed through the status window in AC31GRAF. The arguments are converted and displayed in text form.

	Class 1 errors: fatal errors	Class 2 errors: serious errors	Class 3 errors: light errors	Class 4 errors: warnings
Error signaled by the error bit:	M 255.10 = 1			
Type of error signaled by:	M 255.11 = 1	M 255.12 = 1	M 255.13 = 1	M 255.14 = 1
Error code in:	MW 254.00	MW 254.08	MW 255.00	MW 255.08
Detailed information in :				
Information 1	MW 254.01	MW 254.09	MW 255.01	MW 255.09
Information 2	MW 254.02	MW 254.10	MW 255.02	MW 255.10
Information 3	MW 254.03	MW 254.11	MW 255.03	MW 255.11
Information 4	MW 254.04	MW 254.12	MW 255.04	MW 255.12
Hard version of unit*	MW 254.05	MW 254.13	MW 255.05	}
Soft version of unit*	MW 254.06	MW 254.14	MW 255.06	} MW 255.12
Unit serial number*	MW 254.07	MW 254.15	MW 255.07	MW 255.13 & MW 255.14
Acknowledgment through programming in the central unit This acknowledgment only acknowledges the errors on the central unit not those signaled by a remote unit			By setting M 255.13 to 0 after the disappearance of the error	By setting M 255.14 to 0 after the disappearance of the error
Acknowledgment through programming in the central unit and remote units			With the CS31QU function block	

* Information not available on certain 07KR52units

The error bit M 255.10 is 1 if any of the error bits M 255.11 to M 255.14 are at 1. The central unit has not found an error if M 255.10 = 0.

The error bit M 255.10 is automatically reset to 0 when the error type bits are acknowledged.

A class 4 error (M 255.14=1) when MW 255.08 ≤ 15 acknowledges automatically. Class 3 or 4 type errors may be acknowledged by setting M 255.13 or M 255.14 to 0.

The information word values are updated with each new error. Resetting these words to 0 is not automatic when acknowledged but may be achieved by writing, on-line or through programming, a 0 value to these words.

4.2. Table of correspondence between the error and the diagnosis variable values

Signification of the error tables:

- Memory address = program memory address where the error was detected.
- Address = unit or defective extension address
- Channel number = number of the defective channel
- Unit type:

000	Binary inputs
001	Analog inputs
002	Binary outputs
003	Analog outputs
004	Binary inputs / outputs
005	Analog inputs / outputs
016	XO 08 R1
017	XI 16 E1
018	XC 08 L1
019	ICMK 14 F1
020	ICMK 14 N1
023	XK 08 F1
024	XO 16 N1
025	XO 08 Y1
026	XO 08R2
027	XC32L1
080	XM 06 B5
081	XE 08 B5
082	XTC 08
128	XC32L2
192	ASI-GATEWAY
224	07 CR 41
225	07 KR 51
226	07 CT 41
227	07 KT 51
230	07 KR 52
255	Master or slave central unit where the error was detected and memorized.

4.3. Class error descriptions

4.3.1. Class 1 error descriptions

Class 1 error descriptions	Error code in MW254.00 Dec Hex	Info 1 in MW 254.01	Info 2 in MW 254.02	Info 3 in MW 254.03
Flash EPROM checksum error	- -	-	-	-

4.3.2. Class 2 error descriptions

Class 2 error descriptions	Error code in MW254.08 Dec Hex	Info 1 in MW 254.09	Info 2 in MW 254.10	Info 3 in MW 254.11
Defective RAM (user program or data memory)	128_D 80_H	Memory address	-	-
Too many timers active simultaneously on the central unit during program execution (maximum 42)	255_D FF_H	-	-	-

4.3.3. Class 3 error descriptions

Class 3 error descriptions	Error code in MW255.00 Dec Hex	Info 1 in MW 255.01	Info 2 in MW 255.02	Info 3 in MW 255.03
Unit disconnected	15_D $0F_H$	Unit type	Address	-
Superposed address	18_D 12_H			
Cycle time too short	200_D $C8_H$	-	-	-

4.3.4. Class 4 error descriptions

Class 4 error descriptions	Error code in MW255.08 Dec	Hex	Info 1 in MW 255.09	Info 2 in MW 255.10	Info 3 in MW 255.11
Internal unit error	1_D	01_H	Unit type	Address	Channel number
Cut wire (detection of open circuit)*	2_D	02_H	Unit type	Address	Channel number
Analog output level error	3_D	03_H	Unit type	Address	Channel number
Overload	4_D	04_H	Unit type	Address	Channel number
Defective 10V output	5_D	05_H	Unit type	Address	Channel number
Overload + cut wire*	6_D	06_H	Unit type	Address	Channel number
Short circuit	8_D	08_H	Unit type	Address	Channel number
Short-circuit + cut wire*	10_D	$0A_H$	Unit type	Address	Channel number
Overload + short-circuit	12_D	$0C_H$	Unit type	Address	Channel number
Short-circuit + overload + cut wire*	14_D	$0E_H$	Unit type	Address	Channel number
The end of the program is not detected by the system during startup.	129_D	81_H	-	-	-
A program syntax error is detected by the system during startup	131_D	83_H	Address program	-	-
Too many historical values are detected by the system during startup (max. 256)	132_D	84_H	-	-	-
The cycle time is missing and detected by the system during startup	133_D	85_H	-	-	-
A missing label for a conditional step is detected by the system during startup.	135_D	87_H	Address program	-	-
The program is too large for the memory size	140_D	$8C_H$	-	-	-
The system detects a missing end of sub-program or interruption program during startup	142_D	$8E_H$	-	-	-
The system detects a missing interrupt program or an interrupt validation.	143_D	$8F_H$	-	-	-
The system detects too many sub-programs (max. 12) during startup.	144_D	90_H	-	-	-
The system detects too many historical values in the sub-programs during startup. (max. 128 = Sum of number of calls x number of historical values in the sub-programs)	145_D	91_H	-	-	-
The system detects a missing sub-program related to a call	146_D	92_H	-	-	-

* error detected if prior programmed configuration with the CS31CO block

Annexes

Annexes

1. Variables list

The variables used by the 07KR52 central unit are of different types:

- Bit variables (status 0 or 1)
- Word variables (range -32768 to 32767)
- Double word variables (range -2147483648 to 2147483647)
- Texts (ASCII characters)

The authorized variables are:

Inputs	
I00.00...I61.15	free for use as internal bits or with central units in slave mode
I62.00...I62.04	24 V binary inputs of the central unit
I62.05...I62.15	free for use as internal bits or with central units in slave mode
I63.00...I79.15	binary inputs of the extensions on a central unit
IW00.00...IW61.15	free for use as internal words or with central units in slave mode
IW62.00...IW62.01	reserved variables
IW62.02...IW62.05	PT1000 and PTC1000 analog inputs
IW62.06...IW62.07	free for use as internal words
IW62.08...IW62.14	clock reader
IW62.15	battery status bit 3
IW63.00...IW79.15	analog inputs of extensions on a central unit
Outputs	
O00.00...O61.15	free for use as internal bits or with central units in slave mode
O62.00	central unit relay output NC
O62.01	central unit relay output NC + NO (inverter)
O62.02...O62.03	central unit relay outputs NO
O62.04...O62.05	central unit binary outputs
O63.00...O79.15	binary outputs of extensions on a central unit
OW00.00...OW61.15	free for use as internal words or with central units in slave mode
OW62.00	analog output, range 0 to 10 V (0 to 32767)
OW62.01...OW62.15	reserved variables
OW63.00...OW79.15	analog outputs of extensions on a central unit

Annexes

Internal variables

M00.00...M99.15	
M230.00...M254.15	internal bits
M255.00...M255.15	system bits
S00.00...S125.15	chain steps
K00.00...K00.01	bit constants
MW00.00...99.15	
MW230.00...MW253.15	internal words
MW254.00...MW255.15	diagnosis words
KW01.00...KW31.15	word constants
MD00.00...MD07.15	internal double words
KD00.01...KD07.15	double word constants

Constants

# xxxxx	direct value (for example #123)
#H	hexadecimal direct value (#H 0000 ....#H FFFF)

Time values for the timer functions

KD01.00...KD07.15	double word constants
MD00.00...MD07.15	internal double words

Text

The KW00.00...KW00.15 and KD00.00 variables are called system constants and are only accessible through the configuration menu of the AC31GRAF programming software.

Diagnosis variables		
sum of errors		M255.10 indicates that the central unit has detected an error
fatal error	Class 1	M255.11 detailed information in MW254.00...MW254.07
serious error	Class 2	M255.12 detailed information in MW254.08...MW254.15
light error	Class 3	M255.13 detailed information in MW255.00...MW255.08
warning	Class 4	M255.12 detailed information in MW255.08...MW255.15

M255.00	oscillator with a frequency of 2 Hz
M255.01	oscillator with a frequency of 1 Hz
M255.02	oscillator with a frequency of 0.5 Hz
M255.03	oscillator with a 1 minute period

M255.15	this bit may be used for detecting the first cycle. It is always reset to "zero" at each program launch independently of the bit backup area chosen. This bit may be read by the user and set to 1 at the end of the first cycle.

Clock	
IW62.08:	seconds (0...59)
IW62.09:	minutes (0...59)
IW62.10:	hours (0...23)
IW62.11:	day of the week (1...31)
IW62.13:	month (1...12)
IW62.14:	year (0...99)

The clock may be updated with the configuration editor of the AC31GRAF programming software or by the UHR function.

2. Function list

Binary functions		Runtimes in µs
&, AND	AND	5.1
/, OR		6
=	Allocation	3.9
=1	Exclusive OR	8.8
=R	Allocation reset memory	4.4
=S	Allocation set memory	4.45
I+	Pulse positive edge	8.95
I-	Pulse negative edge	10.6
MAJ	Majority	-
RS	Set memory dominating to 1	8.8
SR	Set memory dominating to 0	8.8

Timer functions		Runtimes in µs
ASV	OFF delay	124
ESV	ON delay	124
MOA	Monostable element "abort"	167
MOAT	Monostable element "abort" with time	213
MOK	Monostable element "constant"	170
PDM	Pulse duration modulator	640
TIME_W	Conversion Time into Words	
TOF	OFF delay with time visualization	167
TON	ON delay with time visualization	210
TP	Monostable element "constant with time visualization"	208
W_TIME	Conversion words into time	

Counter functions		Runtimes in µs
CTU	Counter	430
CTUH	Counter for encoder inputs	560
VRZ	Up/down counter	190

Comparison functions		Runtimes in µs
<	Less than	13.1
<=	Less than or equal to	12.4
<>	Unequal	13.3
=?	Equal to	13.3
>	Greater than	12.4
>=	Greater than or equal to	13.1
<D / VKLD	Less than, double word	107
= ?D / VGLD	Equal, double word	110
>D / VGRD	Greater than, double word	108

Arithmetic functions		Runtimes in µs
=W	Word allocation	8.1
+	Addition	12.8
-	Subtraction	13.8
*	Multiplication	31.8
: / DIV	Division	142
*: / MULDI	Multiplication with division	186
BETR	Absolute value	23.3
MUL2N	Multiplication by 2 to the power of N	36.2
NEG	Negation	10.6
ZUDKW	Allocation of a direct constant to a word	17
+D / ADDD	Addition, double word	114
-D / SUBD	Subtraction, double word	116
*D / MULD	Multiplication, double word	380
:D / DIVD	Division, double word	504
=D / ZUWD	Allocation, double word	40.5
SQRT	Square root	572

Word logical functions		Runtimes in µs
WAND	AND bit to bit	22.7
WOR	OR bit to bit	22.7
WXOR	Exclusive OR bit to bit	22.6
DWAND	AND combination, double word	38
DWOR	OR combination, double word	39
DWXOR	Exclusive OR combination, double word	38

Program control functions		Runtimes in µs
=PE	Conditional program end	100
CAL_FB	Sub-program call	
DI	Read direct input	
DO	Write direct output	
VTASK	Interruptions validation	

CS 31 bus functions		Runtimes in µs
CONFIO1	Configuration of one analog channel	
CONFIO4	Configuration of four analog channels	
CONFIO8	Configuration of eight analog channels	
CS31CO	Configuration of the CS 31 bus units	180
CS31QU	Error acknowledgment of units on the CS 31 bus	27.5

Communication functions		Runtimes in µs
MODBUS®	MODBUS® master for serial line COM1	
MODMASTK	MODBUS® master different port	
SINIT	Initialization and configuration of the serial interface	100

Regulation functions		Runtimes in µs
PI	Proportional-integral controller	1600
PIDT1	Proportional-integral controller with derivative	1600

Format conversion functions		Runtimes in µs
BCDDUAL / BCDBIN	BCD to binary conversion	72.5
DUALBCD / BINBCD	Binary to BCD conversion	107
DWW	Double word to word conversion	97
PACK4	Pack 4 bits in a word	355
PACK8	Pack 8 bits in a word	650
PACK16	Pack 16 bits in a word	1220
UNPACK4	Unpack a word to 4 bits	325
UNPACK8	Unpack a word to 8 bits	615
UNPACK16	Unpack a word to 16 bits	1200
WDW	Word to double word conversion	

High order functions		Runtimes in µs
AWT	Word selection gate	22
AWTB	Bit selection gate	38.4
BEG	Limiter	
BMELD	Binary values change indicator	1430
IDLB	Read binary variable, indexed	209
IDSB	Write binary variable, indexed	201
IDLm / IDL	Indexed reading of words	27.4
IDSm / IDS	Indexed writing of words	38.6
LIZU	List allocation	139
MAX	Maximum value	426
MIN	Minimum value	430
NPULSE	Pulse generator for a step motor	386
UHR	Clock usage	430

Memory access		Runtimes in µs
COPY	Copy a memory area	258
WOL	Read word with validation	21.5

Annexes

3. Mapping

This paragraph describes the correspondence between the variables and their physical memory addresses. This information is necessary for certain functions such as COPY and data exchange between the master and slave central units.

The variable address is given by the segment and offset value.

These values are expressed in hexadecimal and decimal formats.

H0000 is the segment for all variables.

The correspondence between the variable and the offset is given in the following table:

8 bits used 1 byte – 1 word used 2 bytes.

Mapping addressing method:

VAR 00.00 ⟶ ADDR 0

1- Bits : (VAR = type I,O,S,M,) (Address of the first selected variable in decimal)

VAR XX.YY = ADDR 0 + (XX * 2)

Warning: you have two areas for a type M variable - you have to use M 000.00 = ADDR 0 for the first area, and M 230.00 = ADDR 0 for the second area.

2- Words : (VAR = type IW,OW,KW,MW,) (Address of the first selected variable in decimal)

VAR XX.YY = ADDR 0 + (XX * 32) + (YY * 2)

Warning: for a KW variable type the ADDR 0 is 28672 and for you have two areas for a MW variable type - you have to use MW 000.00 = ADDR 0 for the first area, and MW 230.00 = ADDR 0 for the second area.

3- Double words : (VAR = type MD,KD) (Address of the first selected variable in decimal)

VAR XX.YY = ADDR 0 + (XX * 64) + (YY * 4)

Example : Find the mapping address of variables O 62.00 and OW 62.15, MW 240,15 and MD002.07

O 62.00 = 6912 + (62 * 2) = **7036**

OW 62.15 = 18432 + (62 * 32) + (15 * 2) = **20446**

MW 240.15 = 10368 + (10 * 32) + (15 * 2) = **10718**

MD 002.07 = 15872 + (2 * 64) + (7 * 4) = **16028**

Variables	Physical addresses	
	Hexadecimal	Decimal
I00.00...I00.07 / I00.08...I00.15 I01.00...I01.07 / I01.08...I01.15 I02.00...I02.07 / I02.08...I02.15 I61.00...I61.07/ I61.08...I61.15 I62.00...I62.07/ I62.08...I62.15 I68.00...I68.07/ I68.08...I68.15	1900 / 1901 1902 / 1903 1904 / 1905 197A / 197B 197C / 197D 1988 / 1989	6400 / 6401 6402 / 6403 6404 / 6405 6522 / 6523 6524 / 6525 6536 / 6537
M00.00...M00.07/M00.08...M00.15 M99.00...M99.07/M99.08 M99.15	1A00 / 1A01 1AC6 / 1AC7	6656 / 6657 6854 / 6855
M230.00...M230.07/M230.08 M230.15 M255.00...M255.07/M255.08 M255.15	1AC8 / 1AC9 1AFA / 1AFB	6856 / 6857 6906 / 6907
O00.00...O00.07/ O00.08...O00.15 O01.00...O01.07/ O01.08 O01.15 O02.00...O02.07/ O02.08 O02.15 O61.00...O61.07/ O61.08 O61.15 O62.00...O62.07/ O62.08 O62.15 O68.00...O68.07/ O68.08 O68.15	1B00 / 1B01 1B02 / 1B03 1B04 / 1B05 1B7A / 1B7B 1B7C / 1B7D 1B88 / 1B89	6912 / 6913 6914 / 6915 6916 / 6917 7034 / 7035 7036 / 7037 7048 / 7049
S00.00...S00.07/ S00.08...S00.15 S01.00...S01.07/ S01.08 S01.15 S125.00...S125.07/ S125.08 S125.15	3D00 / 3D01 3D02 / 3D03 3DFA / 3DFB	15616 / 15617 15618 / 15619 15866 / 15867

Variables	Physical addresses	
	Hexadecimal	Decimal
OW00.00 OW00.01 OW00.15 OW62.00 OW68.15	4800 4802 481E 4FC0 509E	18432 18434 18462 20416 20638
KW01.00 KW01.01 KW01.15 KW31.15	7020 7022 703E 73FE	28704 28706 28734 29694
KD00.00 KD00.01 KD00.15 KD07.15	7400 7404 743C 75FC	29696 29700 29756 30204
IW00.00 IW00.01 IW00.15 IW62.00 IW68.15	5200 5202 521E 59C0 5A9E	20992 20994 21022 22976 23198
MW00.00 MW00.01 MW99.00 MW99.15	1C00 1C02 2860 287E	7168 7170 10336 10366
MW230.00 MW230.15 MW255.15	2880 289E 2BBE	10368 10398 11198
MD00.00 MD00.01 MD00.15 MD07.15	3E00 3E04 3E3C 3FFC	15872 15876 15932 16380

4. Historical values

Historical values are central unit specific internal variables that enable memorizing a functions intermediate results required for numerous cycles.

In fact, certain functions require the results obtained during cycle N-1 so that cycle N will execute correctly (for example: the PI and PIDT1 controllers).

The total number of historical values used in a project is limited to 1000 in the main program and 256 in the sub-programs.

The functions and the number of historical values that they use are given in the following table:

Timer functions	
ASV	2 (supplementary memory for the timers limited to 42 variables)
ESV	2 (supplementary memory for the timers limited to 42 variables)
MOA	2 (supplementary memory for the timers limited to 42 variables)
MOK	2 (supplementary memory for the timers limited to 42 variables)
PDM	1 (supplementary memory for the timers limited to 42 variables)
TOF	2 (supplementary memory for the timers limited to 42 variables)
TON	2 (supplementary memory for the timers limited to 42 variables)
TP	2 (supplementary memory for the timers limited to 42 variables)

Counter functions	
CTU	2
CTUH	2
VRZ	3

CS31 bus communication functions	
CONFIO1	3
CONFIO4	3
CONFIO8	3
CS31CO	1

Communication functions	
MODBUS®	2
SINIT	1

Control functions	
PI	3
PIDT1	5

High order functions	
BMELD	3 + number of inputs E
NPULSE	1
UHR	1

Due to continual improvements ABB reserves the right to modify the specifications of the devices mentioned in this documentation without prior warning. The information is not of a contractual manner. Please contact the ABB office marketing these devices in your country for further details.

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