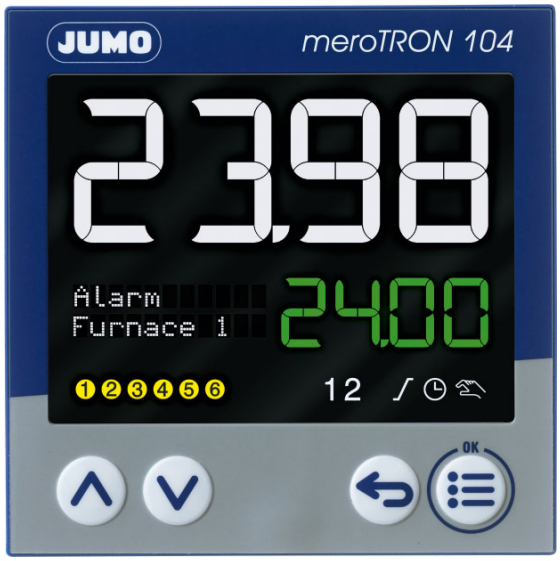
JUMO meroTRON 104/108/116

Modular one-channel/two-channel controller with PLC function



Operating Manual

70305100T90Z001K000

V4.00/EN/00759151/2024-02-19

Further information and downloads

qr-703051-en.jumo.info

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1.1 Safety information

General

This manual contains information that must be observed in the interest of your own safety and to avoid material damage. This information is supported by symbols which are used in this manual as indicated.

Please read this manual before starting up the device. Store this manual in a place that is accessible to all users at all times.

If difficulties occur during startup, please do not intervene in any way that could jeopardize your warranty rights!

Warning symbols

WARNING!

This symbol in connection with the signal word indicates that **personal injury** may occur if the respective precautionary measures are not carried out.

CAUTION!

This symbol in connection with the signal word indicates that **material damage or data loss** will occur if the respective precautionary measures are not taken.

CAUTION!

This symbol indicates that **components could be destroyed** by electrostatic discharge (ESD = Electro Static Discharge) if the respective cautionary measures are not taken.

Only use the ESD packages intended for this purpose to return device inserts, assembly groups, or assembly components.

READ THE DOCUMENTATION!

This symbol, which is attached to the device, indicates that the associated **documentation for the device** must be **observed**. This is necessary to identify the nature of the potential hazard, and to take measures to prevent it.

Note symbols

NOTE!

This symbol refers to **important information** about the product, its handling, or additional benefits.

REFERENCE!

This symbol refers to **additional information** in other sections, chapters, or other manuals.

FURTHER INFORMATION!

This symbol is used in tables and indicates that **further information** is provided after the table.

DISPOSAL!

At the end of its service life, the device and any batteries present do not belong in the trash! Please ensure that they are **disposed of** properly and in an **environmentally friendly** manner.

1 Introduction

1.2 Intended use

The device is designed for use in an industrial environment as specified in the technical data. Other uses beyond those defined are not viewed as intended uses.

The device has been manufactured in compliance with applicable standards and directives as well as the applicable safety regulations. Nevertheless, improper use may lead to personal injury or material damage.

To avoid danger, only use the device:

- For the intended use
- When in good order and condition
- When taking the technical documentation provided into account

Risks resulting from the application may arise, e.g. as the result of missing safety provisions or wrong settings, even when the device is used properly and as intended.

1.3 Qualification of personnel

This document contains the necessary information for the intended use of the device to which it relates.

It is intended for staff with technical qualifications who have been specially trained and have the appropriate knowledge in the field of automation technology.

The appropriate level of knowledge and the technically fault-free implementation of the safety information and warnings contained in the technical documentation provided are prerequisites for risk-free mounting, installation, and startup as well as for ensuring safety when operating the described modules. Only qualified personnel have the required specialist knowledge to correctly interpret and implement the safety information and warnings contained in this document in specific situations.

1.4 Acceptance of goods, storage, and transport

1.4.1 Checking the delivery

- Ensure that the packaging and its contents are undamaged.
- Check the delivery for completeness against the packing slip and order details.
- Inform the supplier immediately if there is any damage.
- Store damaged parts until clarification is received from the supplier.

1.4.2 Important information about storage and transport

- Store the device in a dry, clean environment. Observe the admissible ambient conditions (see "Technical data")
- Protect the device from shock during transport
- The original packaging provides optimum protection for storage and transport

1.4.3 Returning goods

If repairs are needed, return the complete device in clean condition.

Use the original packaging to return goods.

Accompanying letter for repair

Please include the completed accompanying letter for repair when returning goods.

Do not forget to state the following:

- Description of the application and
- Description of the error that has occurred

The accompanying letter for repair (supplementary sheet for product returns) can be downloaded online from the manufacturer's website:

http://productreturn.jumo.info

Protection against electrostatic discharge (ESD)

(ESD = electrostatic discharge)

To prevent damage due to ESD, electronic modules or components must be handled, packaged, and stored in an ESD-protected environment. Measures that protect against electrostatic discharge and electric fields are described in DIN EN 61340-5-1 and DIN EN 61340-5-2 "Protection of electronic devices from electrostatic phenomena".

When sending back electronic modules or components, please note the following:

- Pack sensitive components only in an environment providing protection against ESD. Workspaces such as this divert electrostatic charges to ground in a controlled manner and prevent static charges due to friction.
- Use only packaging intended specifically for ESD-sensitive modules/components. These must consist of conductive plastics.

No liability can be assumed for damage caused by ESD.

CAUTION!

Electrostatic charges occur in non-ESD-protected environments.

Electrostatic discharges can damage modules or components.

▶ For transport purposes, use only the ESD packaging provided.

1.4.4 Disposal

Disposing of the device

DISPOSAL!

Devices and/or replaced parts should not be placed in the refuse bin at the end of their service life as they consist of materials that can be recycled by specialist recycling plants.

Dispose of the device and the packaging material in a proper and environmentally friendly manner.

For this purpose, observe the country-specific laws and regulations for waste treatment and disposal.

Disposing of the packaging material

The entire packaging material (cardboard packaging, inserts, plastic film, and plastic bags) is fully recyclable.

1 Introduction

1.5 Identifying the device version

1.5.1 Nameplate

The nameplate is affixed to the housing.

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The nameplate contains important information. This includes:

Description	Designation on the nameplate	Example
Device type	Typ	703054/8-1294120-23/214
Part no.	TN	00123456
Fabrication number	F-Nr.	0070033801321430006
Voltage supply	-	AC 110 to 240 V, 48 to 63 Hz

Device type (Typ)

Compare the specifications on the nameplate with the order.

Identify the supplied device version using the order details (order code).

Part no. (TN)

The part no. uniquely identifies an article in the catalog. It is important for communication between the customer and the sales department.

Fabrication number (F-Nr.)

The fabrication number indicates, among other things, the date of manufacture (year/week).

Example: F no. = 007003380132143 0006

The characters in question are digits 12, 13, 14, and 15 (from the left).

The device was therefore produced in the 43rd week of 2021.

1.5.2 Order details

	(1)	Basic type
703051		**Type 703051** (format 116: 48 x 48 mm) 1 analog input (universal), 1 digital input, 1 digital input/output (switchable), 2 relays (NO contact) incl. 2 timers, ramp and program functions (4 programs), setup program (download)
703052		**Type 703052** (format 108H: 48 x 96 mm) 1 analog input (universal), 1 digital input, 1 digital input/output (switchable), 2 relays (NO contact) incl. 2 timers, ramp and program functions (4 programs), setup program (download)
703053		**Type 703053** (format 108Q: 96 x 48 mm) 1 analog input (universal), 1 digital input, 1 digital input/output (switchable), 2 relays (NO contact) incl. 2 timers, ramp and program functions (4 programs), setup program (download)
703054		**Type 703054** (format 104: 96 x 96 mm) 1 analog input (universal), 1 digital input, 1 digital input/output (switchable), 2 relays (NO contact) incl. 2 timers, ramp and program functions (4 programs), setup program (download)
	(2)	**Version**
8		Standard with default settings[a]
9		Customer-specific configuration (specifications in plain text)
	(3)	**Option 1**
00		Not used
01		1 analog input (universal)
02		1 counting input 12.5 kHz
03		3 digital inputs
04		1 relay (changeover contact 8 A; only for types 703052, 703053, 703054)
05		1 relay (NO contact 3 A)
06		2 relays (NO contact 3 A; only for types 703052, 703053, 703054)
07		1 solid state relay 1 A
08		1 digital output (logic 0/14 V)
09		1 analog output
10		1 digital output (logic 0/22 V, galvanically isolated)
12		1 Ethernet interface (Modbus TCP, setup program; only for types 703051, 703052, 703053)
13		1 PROFINET IO Device interface (2 × RJ45; only for types 703051, 703052, 703053); **option 2 not applicable**
14		2 open-collector outputs

	(4)	**Option 2**
00		Not used
01		1 analog input (universal)
02		1 counting input 12.5 kHz
03		3 digital inputs
04		1 relay (changeover contact 8 A; only for types 703052, 703053, 703054)
05		1 relay (NO contact 3 A)
06		2 relays (NO contact 3 A; only for types 703052, 703053, 703054)
07		1 solid state relay 1 A
08		1 digital output (logic 0/14 V)
09		1 analog output
10		1 digital output (logic 0/22 V, galvanically isolated)
11		1 RS485 interface (Modbus RTU; only for types 703051, 703052, 703053)
14		2 open-collector outputs
	(5)	**Option 3** (only for types 703052, 703053, 703054)
00		Not used
01		1 analog input (universal)
02		1 counting input 12.5 kHz
03		3 digital inputs
04		1 relay (changeover contact 8 A);
05		1 relay (NO contact 3 A)
06		2 relays (NO contact 3 A)
07		1 solid state relay 1 A
08		1 digital output (logic 0/14 V)
09		1 analog output
10		1 digital output (logic 0/22 V, galvanically isolated)
14		2 open-collector outputs
	(6)	**Option 4** (only for types 703052, 703053, 703054)
00		Not used
01		1 analog input (universal)
02		1 counting input 12.5 kHz
03		3 digital inputs
04		1 relay (changeover contact 8 A);
05		1 relay (NO contact 3 A)
06		2 relays (NO contact 3 A)
07		1 solid state relay 1 A
08		1 digital output (logic 0/14 V)
09		1 analog output
10		1 digital output (logic 0/22 V, galvanically isolated)
14		2 open-collector outputs
	(7)	**Option 5** (only for type 703054)
00		Not used
12		1 Ethernet interface (Modbus TCP, setup program)
13		1 PROFINET IO Device interface (2 × RJ45); **option 6 not applicable**

	(8)	**Option 6** (only for type 703054)
00		Not used
11		1 RS485 interface (Modbus RTU)
	(9)	**Voltage supply**
23		AC 110 to 240 V +10/-15 %, 48 to 63 Hz
42		AC/DC 24 V +10/-15 %, AC 48 to 63 Hz
	(10)	**Extra codes**
000		Without extra code
214		Math and logic module
221		Structured text
234		Second control channel
278		Functions for plastics technology ("plast")
879		AMS2750/CQI-9[b]

[a] The language of the device texts can be adjusted (German, English, French, Spanish).

[b] The thermocouple type and the required measuring points (calibration points) must be defined for the calibration certificate. The device must be used as a permanently installed field device. Use as a mobile field testing device for SAT and TUS tests is not admissible. – Only in conjunction with customer-specific configuration.

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		
Order code		/		-		-		-		-		-		-		-		/		, ...[a]
Order example	703054	/	8	-	01	-	03	-	09	-	09	-	12	-	11	-	23	/	214	, ...	

[a] List extra codes in sequence and separate using commas.

1.5.3 Scope of delivery

1 device in the ordered version
1 quick start guide
1 mounting frame (only for type 703051)
2 mounting elements (only for types 703052, 703053, and 703054)

1.5.4 Accessories

Description	Part no.
1 USB cable, A connector to Micro-B connector, 3 m	00616250
1 USB flash drive, 2 GB[a]	00505592
Activation for math/logic module	00759820
Activation for structured text	00759922
Activation for second control channel	00759951
Retaining bracket for DIN rail, for type 703051 (48 mm × 48 mm)[b]	00375745
Retaining bracket for DIN rail, for type 703053 (96 mm × 48 mm)[b]	00375749
Retaining bracket for DIN rail, for type 703054 (96 mm × 96 mm)[b]	00754309
Stainless steel case for type 703054 (96 mm × 96 mm)[b]	00628452
Surface-mounted housing for type 703053 (96 mm × 48 mm)[b]	00361257
Surface-mounted housing for type 703054 (96 mm × 96 mm), with lid[b]	00750965
Intermediate frame for housing extension (suitable for part no. 00750965)[b]	00728860
Optional modules for retrofitting (depends on device, see order details):	
1 analog input (universal)	00760068
1 counting input 12.5 kHz	00760076
3 digital inputs	00760077
1 relay (changeover contact 8 A)	00760078
1 relay (NO contact 3 A)	00760090
2 relays (NO contact 3 A)	00760092
1 solid state relay 1 A	00760093
1 digital output (logic 0/14 V)	00760094
1 analog output	00760095
1 digital output (logic 0/22 V, galvanically isolated)	00760096
1 RS485 interface (Modbus RTU)	00760048
1 Ethernet interface (Modbus TCP, setup program)	00760045
1 PROFINET IO Device interface (2 × RJ45)	00773311
2 open-collector outputs	00760014

[a] The indicated USB flash drive has been tested and is designed for industrial applications. Other brands with a larger memory capacity can also be used. However, no liability is assumed for these other brands.

[b] Without UL approval.

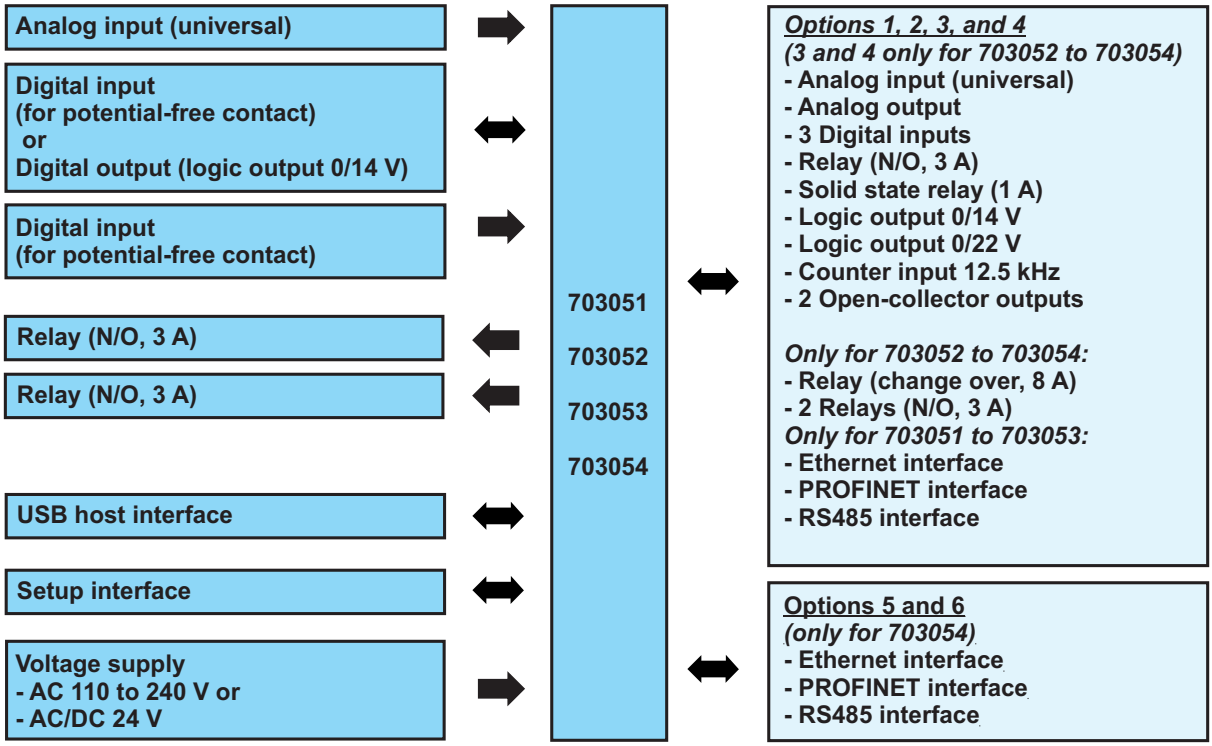
1.6 Brief description

This controller series comprises four universally usable compact controllers with one or two control channels in various DIN formats for controlling temperature, pressure, and other process variables.

The devices are characterized by a simple, clearly structured operation that is supported with texts. Process values and parameters are shown by two 18-segment LCD displays. Types 703052, 703053, and 703054 also have a pixel matrix LCD display for displaying text. Additional display elements provide information about the switch positions of the outputs and about certain functions (e.g. ramp function/program, timer, manual mode). The devices are operated using a membrane keyboard with 4 keys and can be used under harsh environmental influences thanks to the high IP65 protection type.

Depending on the hardware design, the devices can be used as a two-state controller, three-state controller, three-step controller, position controller, or continuous controller. The basic type includes autotuning, a ramp function, a program controller, manual mode, limit value monitoring functions, digital control signals, extensive timer functions, and a service counter. Users can also upgrade the devices with a math and logic function and with a structured text code functionality for complex control tasks and process steps. The structured text code functionality also gives users flexibility in how they can operate the device, as it enables direct access to the display and operating keys. And the extra code 278 enables the use of even more functionalities, such as a boost function to clear the nozzles, or a startup ramp for hot runner technology.

1.7 Block diagram



1 Introduction

1.8 Device types

meroTRON 116: type 703051 (format 116)

meroTRON 108: type 703053 (format 108Q)

meroTRON 108: type 703052 (format 108H)

meroTRON 104: type 703054 (format 104)

2.1 Installation instructions

WARNING!

The device is not designed for use in potentially explosive areas.

Explosion hazard.

▶ Only deploy the device outside of potentially explosive areas.

Mounting site

The device is designed for installation in a panel cut-out within a closed switch cabinet. The front of the device and housing have different protection types (see technical data).

Climatic conditions

The ambient temperature and the relative humidity at the mounting site must correspond to the technical data. Aggressive gases and vapors have a negative effect on the operating life of the device. The mounting site must be free from dust, powder, and other suspended solids.

Installation position

The device can be installed in any position.

The maximum admissible ambient temperature only applies for the installation with the display in a vertical position.

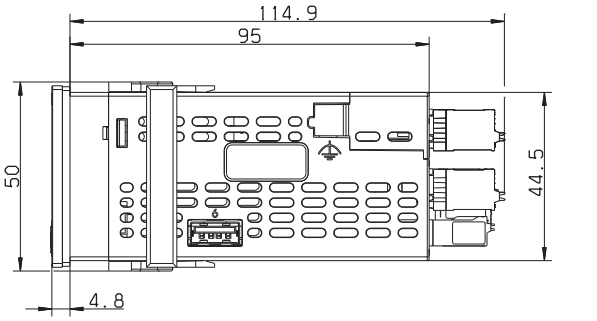
Technical data

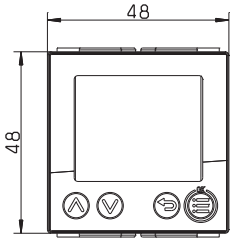
⇨ chapter 11 "Technical data", Page 131

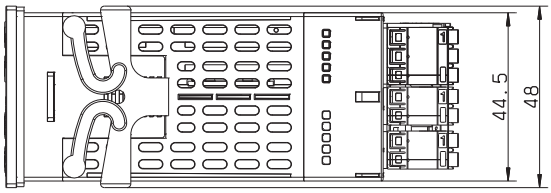
2 Mounting

2.2 Dimensions

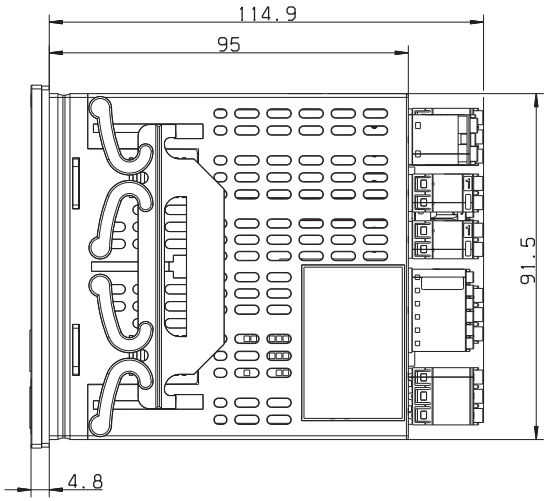
Format 116 (48 mm × 48 mm)

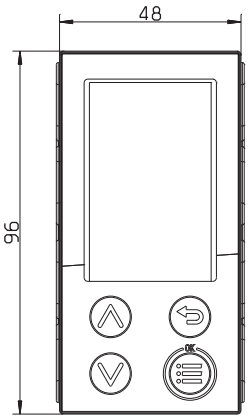


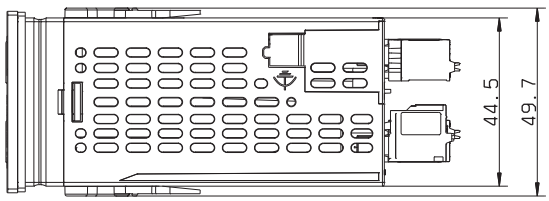




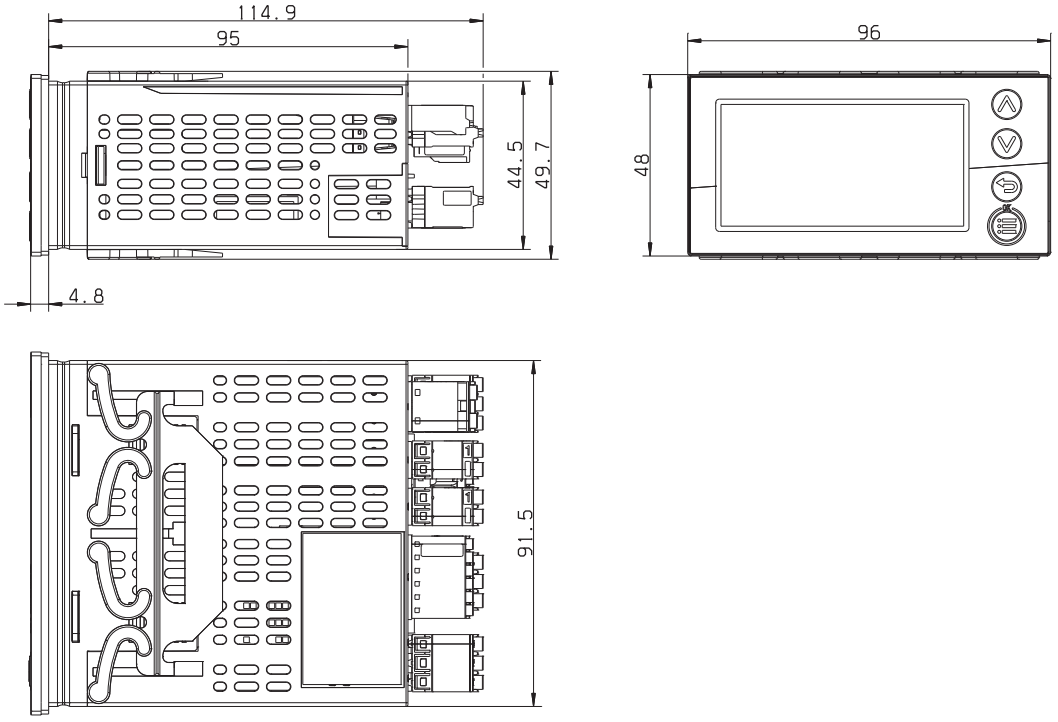
Format 108H (48 mm × 96 mm)



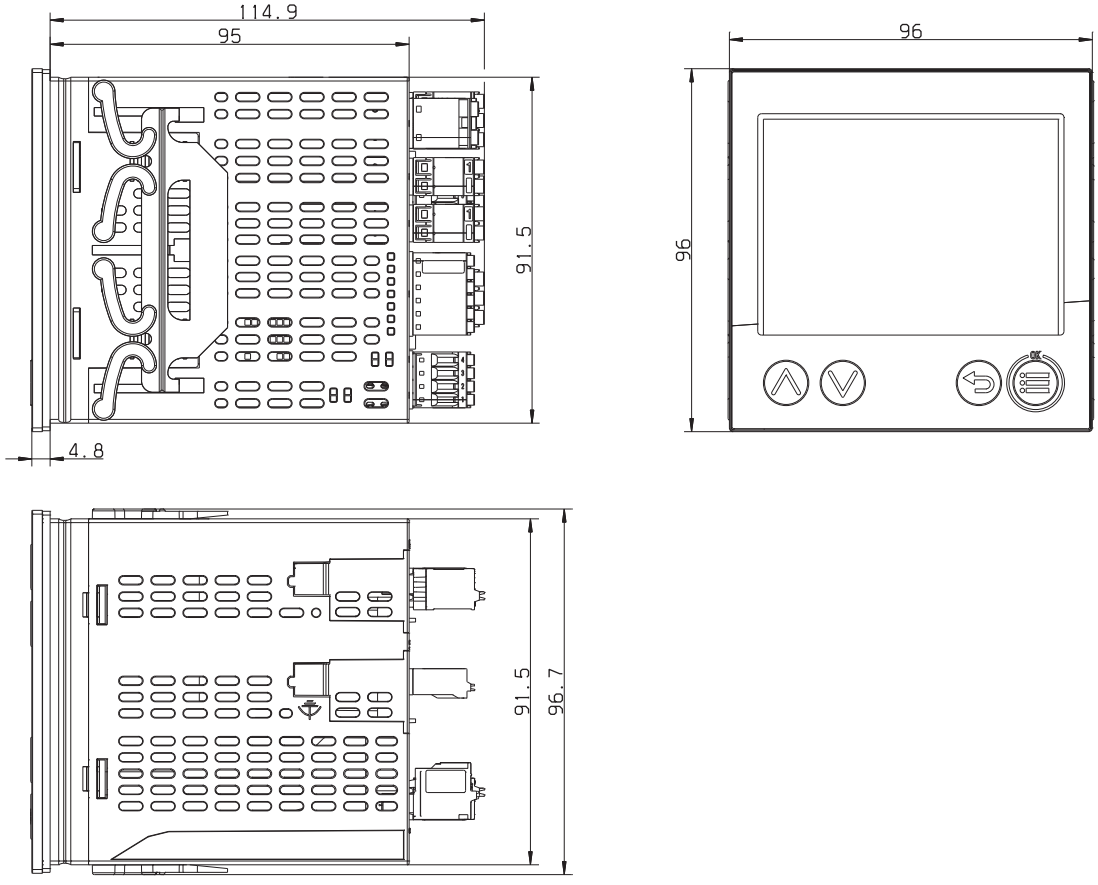




Format 108Q (96 mm × 48 mm)



Format 104 (96 mm × 96 mm)



2 Mounting

Panel cut-outs according to DIN IEC 61554

Format (front frame dimensions)	**Panel cut-out (width x height)**	**Minimum spacing of panel cut-outs (for close mounting)**	
		Horizontal	Vertical
116 (48 mm × 48 mm)	$45^{+0.6}$ mm × $45^{+0.6}$ mm	45 mm[a]	30 mm
108H (48 mm × 96 mm)	$45^{+0.6}$ mm × $92^{+0.8}$ mm	35 mm	45 mm
108Q (96 mm × 48 mm)	$92^{+0.8}$ mm × $45^{+0.6}$ mm	45 mm	35 mm
104 (96 mm × 96 mm)	$92^{+0.8}$ mm × $92^{+0.8}$ mm	35 mm	45 mm

[a] When connecting a USB flash drive to the device, allow for sufficient distance if necessary.

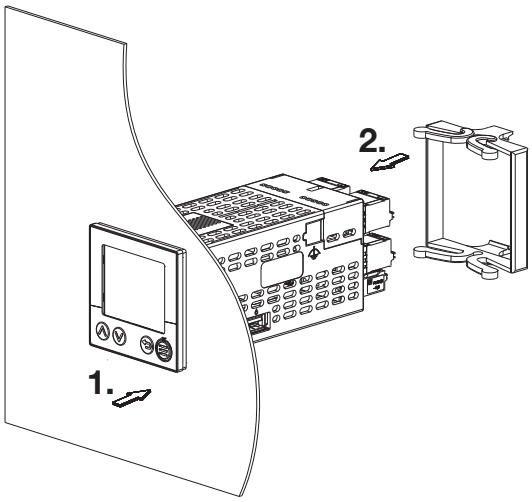
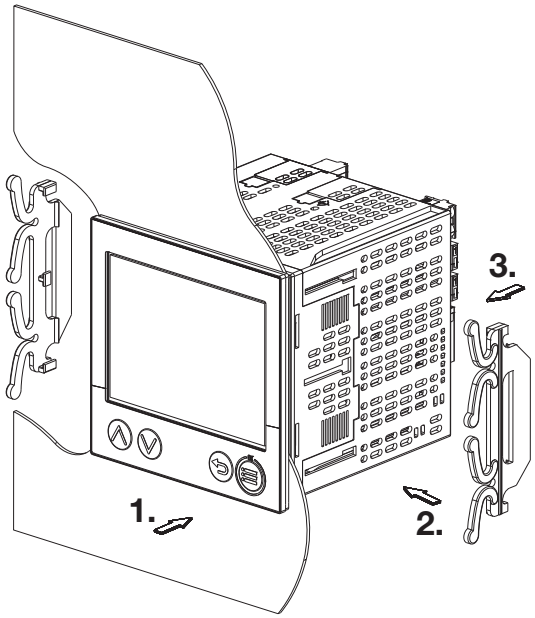
2.3 Panel mounting

CAUTION!

The front of the device and housing have different protection types!

The protection type IP65 (front-side) is only guaranteed if the seal is flush and even.

▶ Use the mounting frame or both mounting elements as shown in the figure and ensure an even attachment!

Device in the format 116	Devices in the formats 108H, 108Q, and 104
	
1. Insert the device from the front into the panel cut-out and ensure that the seal is correctly positioned. 2. Push the mounting frame from the panel rear onto the device body and press the springs against the panel rear until the detent lugs engage in their slots and the frame is sufficiently fastened.	1. Insert the device from the front into the panel cut-out and ensure that the seal is correctly positioned. 2. From behind the panel, insert both mounting elements at the side into the three recesses of the device case using the guide lugs. 3. Press both mounting elements evenly with the springs against the panel rear until the detent lugs engage in their slots and the frame is sufficiently fastened.

2.4 Cleaning

The front of the device (front foil) can be cleaned with standard detergents, rinsing and cleaning agents.

CAUTION!

The front of the device is not resistant to aggressive acids and lyes, scouring agents, and cleaning with a pressure cleaner.

Use of these media can cause damage.

▶ Only clean the front of the device with suitable agents.

2 Mounting

3.1 Installation notes

Requirements for personnel

- Work on the device must only be carried out to the extent described and, like the electrical connection, only by qualified personnel.
- Before plugging and unplugging connecting cables, it must be ensured that the acting person is electrostatically discharged (by touching grounded metallic parts, for example).

Cables, shielding, and grounding

- When selecting the electrical wiring material as well as when installing and connecting the device electrically, comply with the requirements of DIN VDE 0100 "Low-voltage electrical installations" and the applicable country-specific regulations (for example, based on IEC 60364).
- It may be necessary to adhere to special notes relating to the heat resistance of cables (see connection diagram).
- Route input, output, and supply lines separately and not parallel to one another.
- Only use shielded and twisted probe and interface cables. Do not route the lines close to current-carrying components or cables.
- For temperature probes, ground the shielding on one side in the control cabinet.
- Do not perform loopthroughs on the grounding cables, but instead route the cables individually to a shared grounding point in the control cabinet; in doing so, ensure that the cables are as short as possible.
  Ensure that the potential equalization is correct.

Electrical safety

- The device is intended to be installed in control cabinets or plants. Ensure that the customer's fuse protection does not exceed 20 A. Disconnect the device from the mains voltage on all poles prior to starting service or repair work.
- The relay's load circuit can be operated with a hazardous electrical voltage (e.g. 230 V). De-energize the load circuit during mounting/dismounting and electrical connection.
- To prevent the relay contacts being destroyed in the case of an external short-circuit in the load circuit, the latter must be fuse-protected as per the maximum admissible relay current (see technical data).
- The device is not suitable for installation in potentially explosive areas.
- In addition to a faulty installation, incorrectly set values on the device can also impair the correct function of the downstream process. Therefore, ensure that safety devices independent of the device, e.g., overpressure valves or temperature limiters/monitors, are present and that it is only possible for qualified personnel to define settings. Please observe the corresponding safety regulations in this context.

References to other information

- The electromagnetic compatibility conforms to the standards and regulations cited in the technical data.
- In general, please observe the specifications regarding electrical isolation.

Setup interface

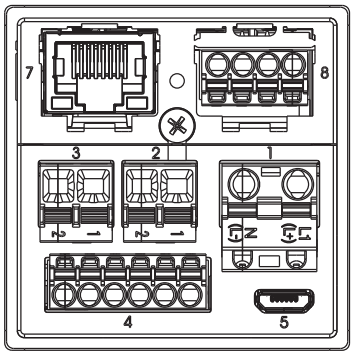
- The setup interface (USB) is not intended for a permanent connection. Always disconnect the USB cable from the device as soon as you have finished working with the setup program.

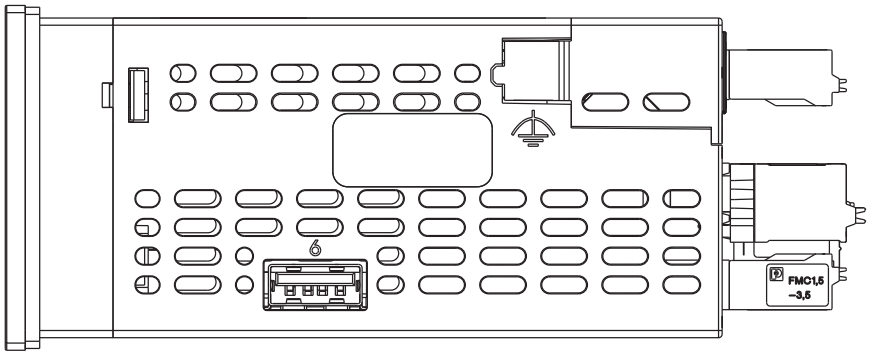
3 Electrical connection

3.2 Connection elements

3.2.1 Type 703051

Format 116





Element	Connection
1	Voltage supply L1(L+), N(L-)
2	Digital output 1 (relay)
3	Digital output 2 (relay)
4	Terminals 1 to 4: Analog input 1

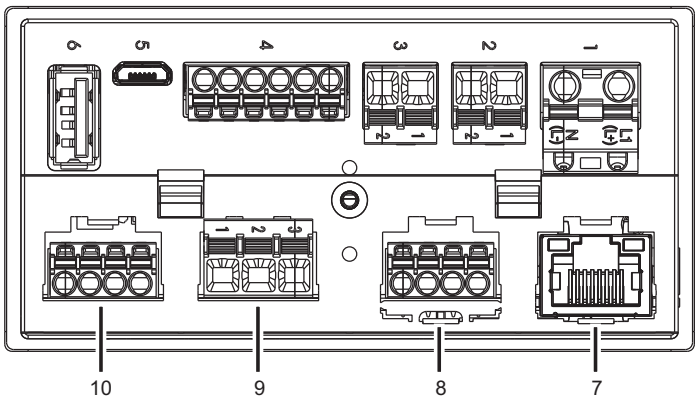
Element	Connection
4	Terminals 4 and 6: Digital input 2 (potential-free contact)
4	Terminals 5 and 6: Digital input 1 (potential-free contact) or digital output 3 (logic 0/14 V)
5	USB device interface
6	USB host interface

Element	Connection
7	Option 1[a] (with PROFINET: port 1)
8	Option 2[a] (with PROFINET: port 2)

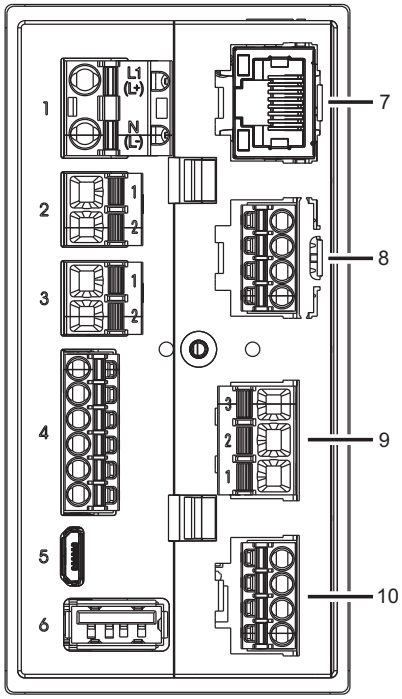
[a] The connection element depends on the option (see order details).

3.2.2 Types 703052, 703053, 703054

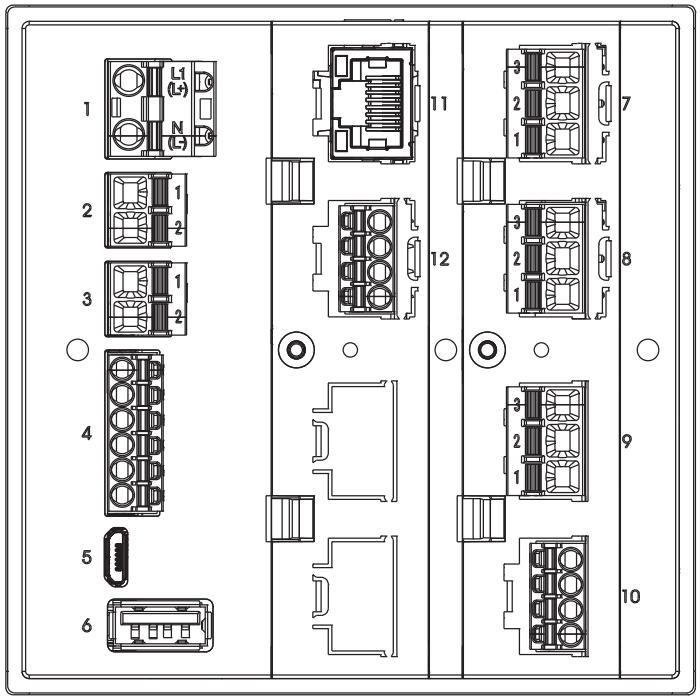
Format 108Q



Format 108H



Format 104



Element	Connection
1	Voltage supply L1(L+), N(L-)
2	Digital output 1 (relay)
3	Digital output 2 (relay)
4	Terminals 1 to 4: Analog input 1
4	Terminals 4 and 6: Digital input 2 (potential-free contact)

Element	Connection
4	Terminals 5 and 6: Digital input 1 (potential-free contact) or digital output 3 (logic 0/14 V)
5	USB device interface
6	USB host interface
7	Option 1[a] (with PROFINET: port 1)
8	Option 2[a] (with PROFINET: port 2)

Element	Connection
9	Option 3[a]
10	Option 4[a]
11	Option 5 (with PROFINET: port 1)
12	Option 6[a] (with PROFINET: port 2)

[a] The connection element depends on the option (see order details).

3 Electrical connection

3.3 Connection diagram

CAUTION!

In unfavorable conditions, the temperature may exceed 60 °C at the terminals.

As a result, the insulation of the cables connected at the terminals may be damaged.

- ▶ The affected cables must be heat-resistant up to at least 80 °C.
- ▶ Relay (changeover contact, 8 A): The affected cables must be heat-resistant up to at least 90 °C.

NOTE!

There is an individual connection diagram on the housing that corresponds to the ordered device version.

NOTE!

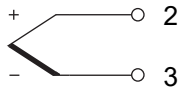
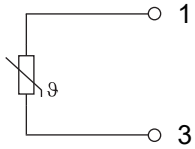
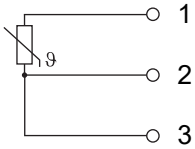
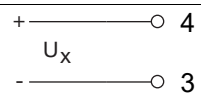
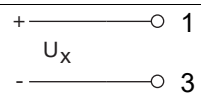
Only copper conductors are allowed to be connected to the terminals.

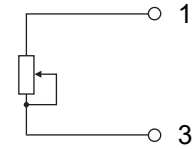
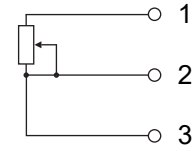
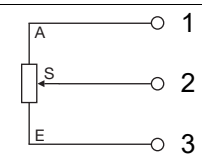
3.3.1 Analog inputs

Analog input 1: standard feature

Analog inputs 2 to 5: optional (options 1 to 4, see order details)

Only an optional analog input can be used as a heater current input.

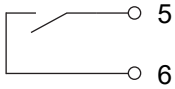
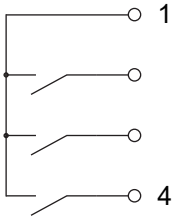
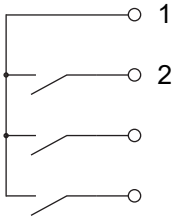
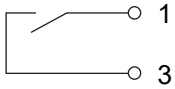
Measuring probe/ standard signal	Symbol and terminal designation
Thermocouple	
RTD temperature probe two-wire circuit	
RTD temperature probe three-wire circuit	
Voltage DC 0 to 10 V (for analog input 1: only usable if digital input 2 is not used)	
Voltage DC 0 to 1 V	

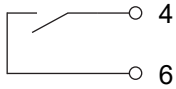
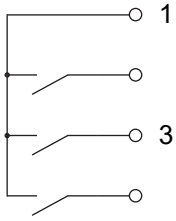
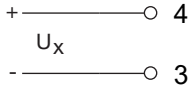
Measuring probe/ standard signal	Symbol and terminal designation
Current DC 0(4) to 20 mA Heater current AC/DC (only for option)	
Resistance/potentiometer two-wire circuit	
Resistance/potentiometer three-wire circuit	
Resistance transmitter A = Start E = End S = Slider	

3.3.2 Digital inputs

Digital inputs 1 and 2: standard feature

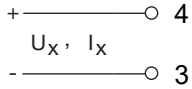
Digital inputs 3 to 14: optional (options 1 to 4, see order details)

Input	Version	Symbol and terminal designation
1	Digital input for potential-free contact (only usable if digital output 3 is not used)	
	Inputs 3, 4, 5 for option 1 Inputs 6, 7, 8 for option 2 Inputs 9, 10, 11 for option 3 Inputs 12, 13, 14 for option 4	
3 6 9 12	3 digital inputs for potential-free contact: Input for contact 1	
5 8 11 14	3 digital inputs for potential-free contact: Input for contact 3	
3 6 9 12	Counting input (12.5 kHz): Input for potential-free contact (instead of input DC 0/ 24 V)	

Input	Version	Symbol and terminal designation
2	Digital input for potential-free contact (can only be used if analog input 1 is not used as input DC 0 to 10 V)	
4 7 10 13	3 digital inputs for potential-free contact: Input for contact 2	
3 6 9 12	Counting input (12.5 kHz): Input DC 0/24 V (instead of input for potential-free contact)	

3.3.3 Analog outputs

Analog outputs 1 to 4: optional (options 1 to 4, see order details)

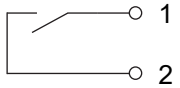
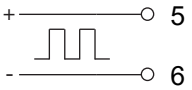
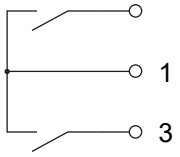
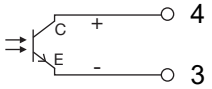
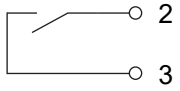
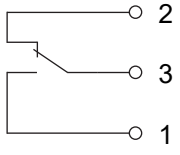
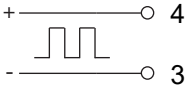
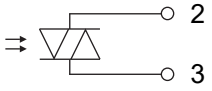
Output	Version	Symbol and terminal designation
1 2 3 4	DC 0 to 10 V or DC 0/4 to 20 mA (configurable)	

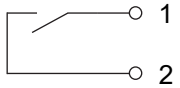
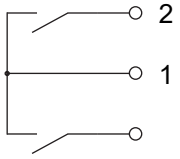
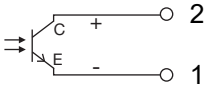
3 Electrical connection

3.3.4 Digital outputs

Digital outputs 1 to 3: standard feature

Digital outputs 4 to 11: optional (options 1 to 4, see order details)

Output	Version	Symbol and terminal designation
1	Relay (NO contact)	
3	Logic output 0/14 V (only usable if digital input 1 is not used)	
	Output 4 for option 1 Output 6 for option 2 Output 8 for option 3 Output 10 for option 4	
4 6 8 10	2 relays (NO contact): Relay 1	
	2 open-collector outputs: OC 1	
	Relay (NO contact)	
	Relay (changeover contact)	
	Logic output 0/14 V Logic output 0/22 V	
	Solid state relay	

Output	Version	Symbol and terminal designation
2	Relay (NO contact)	
	Output 5 for option 1 Output 7 for option 2 Output 9 for option 3 Output 11 for option 4	
5 7 9 11	2 relays (NO contact): Relay 2	
	2 open-collector outputs: OC 2	

3.3.5 RS485 interface

Optional (option 2 or 6, see order details)

Interface	Symbol and terminal designation		
RS485	RxD/TxD+ — 4 RxD/TxD- — 3		

NOTE!

A twisted connecting cable with shielding must be used to connect the RS485 interface. To avoid transmission errors, only the signals listed above and, if necessary, GND may be routed in the connecting cable.

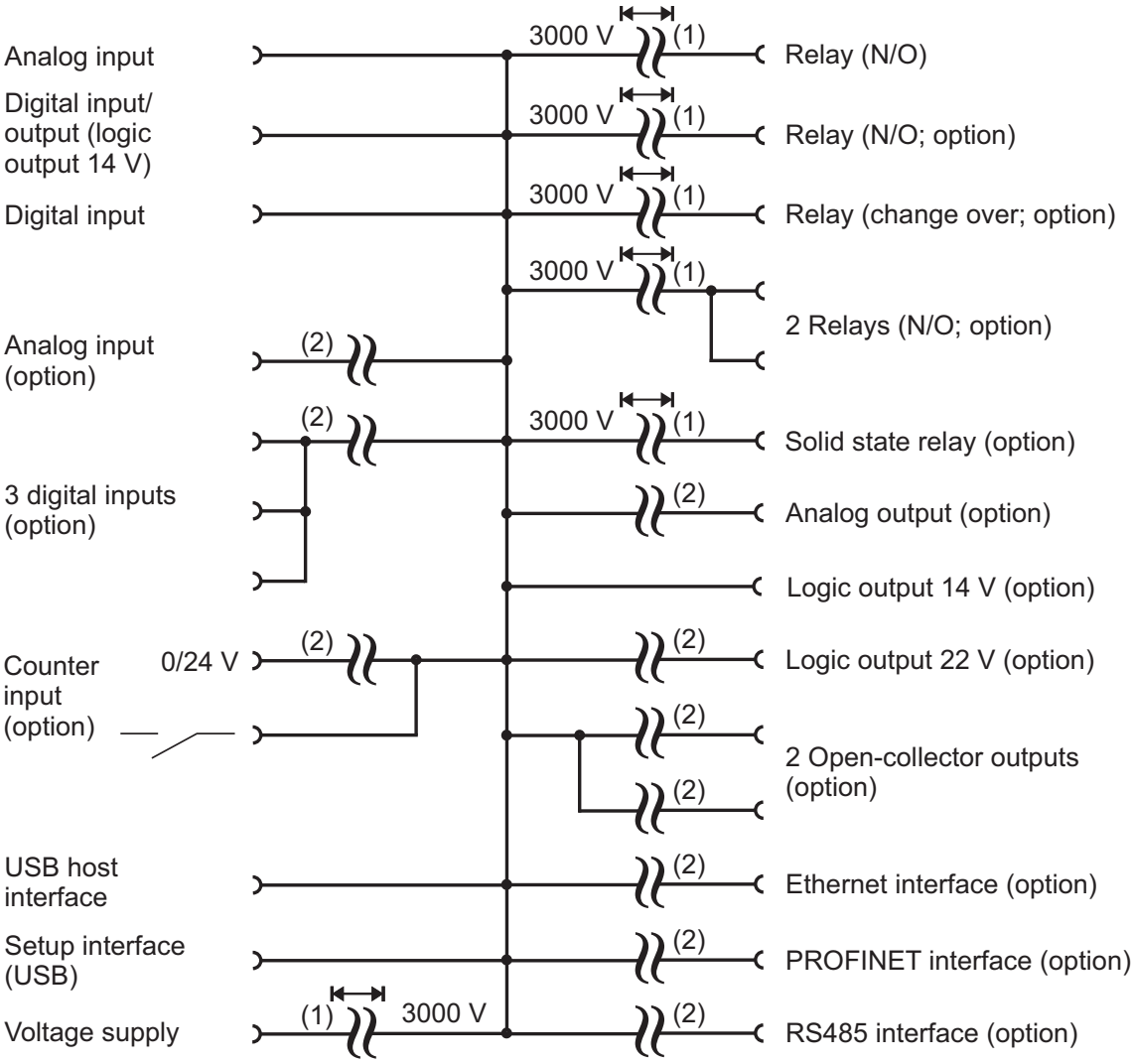
To ensure fault-free operation, terminating resistors are required at the beginning and end of an RS485 transmission path.

3.3.6 Voltage supply

Version (see nameplate)	Symbol and terminal designation	Version (see nameplate)	Symbol and terminal designation
AC 110 to 240 V	L1 — L1/L+ N — N/L-	AC/DC 24 V	L+ — L1/L+ L- — N/L-

3 Electrical connection

3.4 Galvanic isolation



1 The voltage specifications correspond to the test voltages (alternating voltage, rms values) according to DIN EN 61010-1 (VDE 0411-1):2020-03 for type testing.

2 Functional galvanic isolation for connection of SELV or PELV electrical circuits.

CAUTION!

The standard analog input and the setup interface (USB) are not galvanically isolated.

▶ Do not connect the USB with a grounded sensor if the ground of the PC is also grounded (e.g. a desktop PC).

The device is operated using four keys on the front.

NOTE!

Certain basic functions can be configured via the default pre-assignment of the operating levels on the device. The free setup program is required to be able to make use of the full functional range of the device. This is available to download.

The setup program provides the user with an easy and comfortable way to configure the device using a PC.

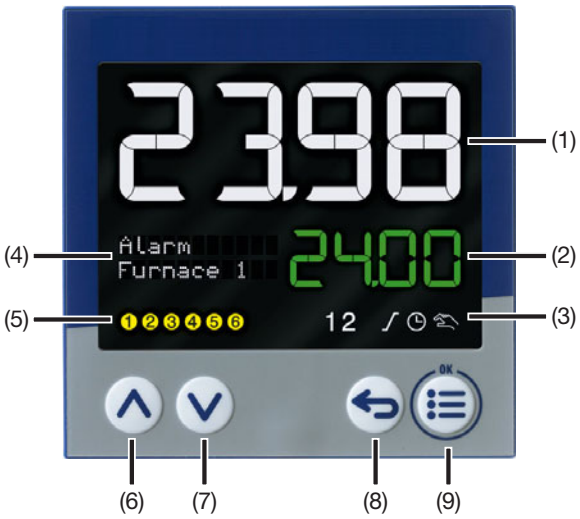
The user also has the possibility to compile other parameters using the setup program, so that these are also available on the device for configuration. The individual parameters can be assigned to different operating levels in the device.

Downloading the setup program

The free setup program is available for download on the following website:

meroTRON-meroVIEW.jumo.info

4.1 Display and control elements



1 18-segment LCD display (e.g. actual value), four-digit, white;
on type 703051 (116) it is also for displaying menu items, parameters, and text

2 18-segment LCD display (e.g. setpoint value), four-digit (on 703051 (116): eight-digit), green;
on type 703051 (116) it is also for displaying menu items, parameters, and text;
"OK" will display upon leaving editing mode (if changes were made)

3 Basic display (basic status) 1 or 2, ramp function/program, timer, manual mode

4 On types 703052 (108H), 703053 (108Q), and 703054 (104): pixel matrix LCD display for displaying menu items, parameters, values, and customer-specific texts

5 Switch position of the digital outputs (yellow = active)

6 Up (in the menu: increase value, select previous menu item or parameter; in basic display: increase setpoint value)

7 Down (in menu: reduce value, select next menu item or parameter; in basic display: reduce setpoint value)

8 Back (in menu: back to previous menu level, exit editing mode without change; in basic display: configurable function)

9 Menu/OK (long press: switch between basic displays 1 and 2; short press: call up main menu, switch to submenu/level, switch to editing mode, exit editing mode with change)

4 Operation

Symbols (activity displays)

Symbol	Off	Lights up	Flashes
Basic display (basic status) 1 	Device is in basic display 2.	Device is in basic display 1 or in another operating level. Also illuminates during set-up transfer and signalizes that the symbols displayed refer to basic display 1 with controller 1 and timer 1.	---
Basic display (basic status) 2 	Device is not in basic display 2.	Device is in basic display 2. The symbols refer to controller 2 and timer 2.	---
The following displays refer to the controller and timer of the active basic display (controller 1 and timer 1, or controller 2 and timer 2).			
Ramp function/program 	Ramp function or program controller is not configured.	Ramp function or program controller is configured but not active.	Ramp function or program controller is active.
Timer 	Timer is not configured.	Timer is configured but not active.	Timer is active (running).
Manual mode 	Manual mode is not active (= automatic mode).	Manual mode is active. The outputs can be manually controlled using the "Up" and "Down" keys: Increase/decrease output level (or for three-step controller: Open/close actuator).	---

Button functions

Button or button combination (permanent)	Function		
	In the basic display (basic status)	**When navigating**	**When editing**
Up 	Increase setpoint value In manual mode: Increase output level (or open actuator in the case of the three-step controller)	Select previous menu item or parameter	Increase value or go up in picklist
Down 	Decrease setpoint value In manual mode: Decrease output level (or close actuator in the case of a three-step controller)	Select next menu item or parameter	Decrease value or go down in picklist

Button or button combination (permanent)	Function		
	In the basic display (basic status)	**When navigating**	**When editing**
Back short (< 2 s) 	Function configurable (default setting: without function)	Move to menu level above	Leave editing mode without changes
Back long (> 2 s) 	Function configurable (default setting: switch to manual mode / end manual mode)	---	---
Menu/OK short (< 2 s) 	Call up main menu	Call up sub-menu or switch to editing mode	Leave editing mode with changes
Menu/OK long (> 2 s) 	Switch between basic display 1 and basic display 2 (if basic display 2 is available)	---	---
Up + Down long (> 2 s)  + 	Start/stop autotuning	---	---

4 Operation

4.2 Language selection

After switching on the device for the first time, the user can either confirm the flashing displayed language with "OK" or select another language using the "Up"/"Down" keys and then confirm this with "OK".

If, at a later point, another user is to also have the option of selecting a language, the configuration parameter "Language select. aft. Power-On" must be set to "Yes" (Configuration > Basic settings; only possible in setup program per default). After applying the national language, this parameter is automatically set to "No", so that language selection is not necessary the next time the device is switched on.

If the operating levels are pre-assigned per default, the language of the device texts can be changed at any time on the device in the configuration settings (regardless of the language selected after switch-on).

4.3 Basic display (basic status)

The device has two basic displays (basic statuses). Both basic displays are available per default. Basic display 2 can be deactivated or activated when configuring operation (parameter "Number of basic displays").

The displays and functions specific to the timers and controllers in a basic display refer to the applicable controller or timer:

Basic display 1: Controller 1, timer 1
Basic display 2: Controller 2, timer 2

The user can switch between basic display 1 and basic display 2 using the key function "Menu/OK long (> 2 s)". The active basic display is shown by the applicable LED "1" or "2".

The (activated) basic display 2 is still available if the device is solely used as a one-channel controller (controller 1) (controller 2 is optional).

NOTE!

If the text "Set clock" is displayed after power-on, this message must be confirmed with the "Menu/OK" key. The date and time should then be set immediately (configuration).

After power-on again, the text is no longer displayed, even if the date and time have not yet been set!

The following displays and functions are supported in each of the basic displays.

Displays

The values for the analog signals are shown in the displays as a function of the configuration (Configuration > Display/operation).

Default setting:

- Display 1 (top 18-segment display): Analog input 1
- Display 2 (bottom 18-segment display): Current setpoint value of controller 1 (in basic display 1) or controller 2 (in basic display 2)
- Display 3 (top line of the pixel matrix display, only for types 703052 (Format 108H), 703053 (108Q), 703054 (104)): No display
- Display 4 (bottom line of the pixel matrix display, only for types 703052, 703053, 703054): No display

"Up" and "Down" keys for direct access

If configured as applicable, the following values from the process value selector can be changed directly using the "Up" and "Down" keys (Configuration > Display/operation > Basic display 1/2 > Up-/Down key):

- Current setpoint value (default setting)
- Timer remaining running time
- Current date and current time

(All other values from the process value selector can be selected during configuration, but cannot be edited in the device.)

In addition, all values from the configuration selector can also be used.

"Back" key

The function of the "Back" key can be configured directly (Configuration > Display/operation > Basic display 1/2). A distinction is made here between a short (< 2 s) and long (> 2 s) key press. The following functions can be assigned to the key in each case:

- Switch to manual mode/end manual mode (default setting is a long press)
- Start/stop autotuning

The "Back" key can also be used for other functions by selecting it as the control signal from the digital selector (binary selector) when configuring a function (also deactivate the directly configured key function if necessary).

Current setpoint value

The current setpoint value can be adjusted directly using the "Up" and "Down" keys (for default configuration, please see above).

Timer mode

The "Display change upon timer start" function (Configuration > Display/operation > Basic display 1/Basic display 2) has the effect that, once the timer is started ("Timer" symbol flashing), the timer's runtime or the remaining running time is shown on the bottom display.

When the operation is configured as applicable, the "Up" and "Down" keys can be used to change the timer remaining running time (please see above).

Manual mode

With the corresponding configuration (see above), the "Back" key can be used to switch to manual mode. Default setting: Press the key for more than 2 seconds. To end manual mode, press the "Back" key again.

The "Manual mode" symbol is illuminated during manual mode.

Autotuning

Autotuning is started and also stopped by pressing and holding (> 2 s) the "Up" and "Down" keys at the same time.

With the corresponding configuration (see above), autotuning can also be started or stopped by using the "Back" key.

Whilst autotuning is running, the text "Autotuning active" is displayed.

Display texts

In the top and bottom display (for a device in format 116) or in the top and bottom line of the pixel matrix display (for devices in the formats 108H, 108Q, and 104), a configurable display text can be shown from the text blocks (text numbers 700 to 800). The text display is controlled by a digital signal in each case (Configuration > Display/operation > Basic display 1/Basic display 2 > Display texts).

Text display using ST code

It is possible to create an application to display text using the "structured text" option (extra code). The ST editor (part of the setup program) has two system variables (dword_out01, dword_out02) for this purpose. These can be used to control the text display in the top and bottom display (or line in the case of the pixel matrix display). The text to be displayed is also selected here by specifying the text number from the text blocks (text numbers 700 to 800).

USB flash drive

If a USB flash drive is inserted (USB host interface), the display changes to the USB menu. The following functions are available there (select using the "Up" and "Down" keys):

- USB -> CONFIG: Transfer a configuration on the USB flash drive to the device.
- CONFIG -> USB: Extract the configuration from the device and save it on the USB flash drive.
- DATA -> USB: Save the data recorded by the data logger on the USB flash drive (CSV file).
- SERVICE DATA -> USB: Extract the service data from the device and save on the USB flash drive (only for service purposes).

The selected function can be started by pressing the "Menu/OK" key. "OK" is displayed following successful execution. The USB flash drive can then be removed.

4.4 Controller

Controller (fixed-setpoint controller) and program controller are controlled/operated using digital signals (binary signals). The signals must be assigned to the individual functions during configuration. Per default controller 1 is active as the fixed-setpoint controller (2-state controller).

The following options are available for operating the program controller directly on the device:

- Using the "Back" key
- Using digital push-buttons (flags)
- Assigning the required parameters from the process value selector to an operating level (for example: program number, starting time, program start)

Configuration examples (program controller)

Prerequisite: The program controller has been configured to "On".

Program start via long-press of the "Back" key

1. If necessary, deactivate any existing "Back" key function in the applicable basic display (default setting: manual mode):
   Configuration > Display/operation > Basic display 1/2 > Long-press "Back" key (> 2 s): Without function
2. Configure program start:
   Program editor > Program controller > Control signals > Start signal: operation > Display 1/2 Long-press "Back" key

Once the configuration has been transferred to the device, the program can be started by a long-press of the "Back" key.

NOTE!

To prevent a program being started unintentionally, the "short Back key (< 2 s)" function should not be used for the program start.

Operation via individual parameters in an operating level (here in level 1)

1. If necessary, remove an existing control signal configuration for the program start (no signal is selected per default):
   Program editor > Program controller > Control signals > Start signal: No selection
2. Configure the input of the program number:
   User interface > Level 1 > Parameter: process value selector > Program operation > Program parameters > Start data > Program number
3. Configure the input of the starting time (date and time):
   User interface > Level 1 > Parameter: process value selector > Program operation > Program parameters > Start data > Start time > Starting point

4. Configure the program start:
   User interface > Level 1 > Parameter: process value selector > Program operation > Program parameters > Program start

Once the configuration has been transferred to the device, the parameters "Program number", "Starting time", and "Program start" will be available in level 1.

After entering the program number and a future starting time if required (optional), the program can be started via the parameter "Program start". To do this, the parameter value must be changed from "OFF" to "ON" (the device automatically resets this to "OFF" afterwards).

NOTE!

The program can be started at a specific point in the future. To do this, the values (date and time) of the parameter "Starting time" must be configured as applicable. After this, set the parameter "Program start" from OFF to ON. The program will actually only start at the set point in time.

If the starting point is not in the future, the program will be started immediately.

The date and time of the device must be set correctly for this function.

4.5 Manual mode

After changing over to manual mode – for all controller types except the three-step controller – either the current output level or a specific, adjustable output level is displayed and output (configurable). The "Up" and "Down" buttons can be used to change the output level.

For the three-step controller, the actuator gradually opens each time the "Up" button is pressed (display "Open"), and gradually closes each time the "Down" button is pressed (display "Close").

It is also possible to switch to manual mode through a digital signal.

Manual mode can be generally inhibited in the configuration. It is also possible to inhibit manual mode through a digital signal.

NOTE!

The controller automatically changes to manual mode in the event of overrange or underrange (even if manual mode is disabled or locked).

4.6 Operating levels

Main menu

The "Menu/OK" key must be pressed to switch from the basic display (basic status) to the main menu (menu).

The user must individually configure the operating levels available in the device beforehand using the setup program. A basic configuration is available per default which can be customized and supplemented.

The content of the "Device info" level is fixed (display of device information and counter statuses).

Navigating through the menus

The individual sub-menus (levels) in the main menu can be selected by pressing the "Up" and "Down" keys. The user can access the selected level by pressing the "Menu/OK" key. The same applies when selecting a sub-level or a parameter (editing mode). The "Back" key returns the user to the superordinate level or takes them out of editing mode without changes.

To change a parameter, the desired value or setting must be selected in editing mode using the "Up" and "Down" buttons. The change is taken over by pressing the "Menu/OK" key, and the user exits editing mode. If the function "Save parameter automatically" is active, the user will exit editing mode automatically after approx. 5 seconds, and the change is taken over.

If no further keys are pressed, the device automatically switches to the basic display 1 after 180 seconds (default setting, configurable).

Example for changing a configuration parameter

The following example applies to the default configuration of the operating levels.

Changing offset value of analog input 1

1. Press the "Menu/OK" key to change from the basic display (basic status) to the main menu (menu).
2. Press the "Down" (or "Up") key repeatedly until the "Configuration level" level appears.
3. Press the "Menu/OK" key to switch to the level.
4. Press the "Down" (or "Up") key repeatedly until the "Analog input 1" sub-level appears.
5. Press the "Menu/OK" key to switch to the sub-level.
6. Press the "Down" (or "Up") key repeatedly until the "Offset" parameter appears.
7. Press the "Menu/OK" button to switch to editing mode.
   The current value "0.0" flashes (default setting).
8. Change the current value using the "Down" (or "Up") key until the new value is shown.
9. Press the "Menu/OK" key to apply the new value and to exit editing mode.
   Successful application of the new value is confirmed by "OK" being displayed.
   The new value is shown (not flashing).
10. Press the "Back" key several times to return to the basic display (basic status).
    The device always returns to basic display (basic status) 1.

4.7 Level inhibit

Access to the individual levels can be inhibited to prevent unintentional or unauthorized operation.

Button or button combination (permanent)	Function		
	In the basic display (basic status)	When navigating	When editing
Down + Menu/OK very long (> 5 s)  + 	Call up menu for level inhibit	---	---

The degree of inhibition can be selected using the "Up" and "Down" buttons and confirmed using the "Menu/OK" button.

Degree of inhibition (inhibited levels)
None (all levels free; default setting)
Level 4
Levels 4 + 3
Levels 4 + 2
Levels 4 + 3 + 2
Complete (levels 4 + 3 + 2 + 1)

4.8 Device information

Device-specific information and counter statuses are displayed in this menu.

4.8.1 General

Device name

The device name can be changed using the setup program (Configuration level > Basic settings).

Time

Current date and current time

4.8.2 Versions

Software version

Device software version (e.g. 433.01.02)

The software version number is composed of the basic version (433), the device version (in the example: 01), and the current version (in the example: 02).

Bootloader Version

Version of the bootloader

VDN Version

Version of a special device version

ST code version

Version of the "ST code" extra code

SW version PROFINET

Software version of the PROFINET module

Display HW identification

Hardware version of the display module

CPU HW identification

Hardware version of the CPU module

Power supply unit HW identification

Hardware version of the power supply unit module

Option x HW identification (if available)

Hardware version of the applicable option module (option 1, option 2, etc.)

4.8.3 Ethernet

This menu item is available if the device is equipped with an Ethernet interface.

IP address

IP address of the Ethernet interface

Subnet mask

Subnet mask of the Ethernet interface

MAC address

MAC address of the Ethernet interface

4.8.4 PROFINET

This menu item is available if the device is equipped with a PROFINET interface.

Station name

Device name of the PROFINET IO device (assigned by the IO controller)

IP address

IP address of the internal Ethernet interface

Subnet mask

Subnet mask of the internal Ethernet interface

Gateway

Gateway address of the internal Ethernet interface

MAC address

MAC address of the internal Ethernet interface

MAC port 1

MAC address of the PROFINET interface, port 1

MAC port 2

MAC address of the PROFINET interface, port 2

Status

Status of the PROFINET interface

PROFINET version

Version (revision) of the PROFINET software

4.8.5 Service

The counters are configured using the setup program (Configuration > Service).

Service counter 1

Counter status of service counter 1

Service counter 2

Counter status of service counter 2

Operating time

Operating hours counter reading

4.9 Error messages

Display	Possible cause	Measures
<<<<	Measuring range underflow Short-circuit (probe/line) Break (probe/line) Polarity	Check sensor and line (break, short-circuit, polarity). Check connection terminals. Check configuration (signal type, linearization, resistance measuring range, scaling).
>>>>	Measuring range overflow	
----	Break (probe/line) Polarity	
----	No valid input value (internal error)	For optional modules: Check that the module is fitted correctly. Switch-off the device and switch it on again.
----	Division by zero Incorrect math value or ST code value	Check math function. Check ST code.
****	Display capacity exceeded	Display the value in another display that has more digits.
++++	When the cold junction temperature is displayed: - Temperature outside the permissible range - Analog input not configured for thermocouple	Check configuration of the analog input.

In the event of an error, the controller switches to manual mode.

4 Operation

5 Configuration

This chapter describes the configuration based on the menu items and parameters in the setup program ("Identification" and "Configuration" areas).

The default settings are shown in bold in the tables.

Beyond this, there are additional functions that can be configured or executed with the setup program. These functions are described in separate chapters:

⇨ chapter 8 "Online parameters", Page 113

⇨ chapter 9 "Start-up parameters", Page 119

5.1 Identification

Device version

The device version is specified in this menu:

- Device type
- Optional inputs and outputs as well as interfaces
- Math/logic extra codes and ST code

The following options are available for this purpose:

- User setting: The device version is selected by the user in the setup program.
- Automatic detection: The device version is read out from the connected device and transferred to the setup program.
- Automatic detection with read out of setup file: The configuration is additionally read out from the device here and transferred to the setup program.

Connection diagram

The user can use this function to create a connection diagram that shows the current terminal assignment of the device.

There are some text entry fields that can be used for the description at the bottom edge of the connection diagram. Alternatively, the texts from the file info header of the setup file can also be used here (setting in the context menu, see below). There is also one field for the date (editable) and one for the signature.

There is a print function, incl. print preview and printer selection, available via the context menu (mouse pointer in the connection diagram, right mouse button). The features for the protocol to be printed are also defined here (page margins, line type, use of texts from the file info header).

5 Configuration

5.2 Selectors

Selectors contain signals that are available for configuration. These are device signals (e.g. analog and digital inputs or internal signals), and signals that are transferred to the device via an interface (external inputs, flags, digital push-buttons).

The signal designation "... controller 1/2" means that the signal is present on controller 1 and on controller 2 (controller 2 is optional). The same applies to the signals of the timer, counter (hardware counter, optional), service counter, and operation.

Signals that cannot be configured because of the device version are shown in the setup program in red.

Analog selector

Category	Signal	Description
No selection		No signal selected.
Analog inputs	Analog input 1 to analog input 5	Signals from the analog inputs
Controller	Actual value – controller 1/2	Actual value on the controller input
	Setpoint value – controller 1/2	Active setpoint value on the controller input
	Controller output 1 (analog) – controller 1/2	Signal on controller output 1 (0 to +100 %; e.g. for heating)
	Controller output 2 (analog) – controller 1/2	Signal on controller output 2 (-100 to 0 %; e.g. for cooling)
	Controller differential – controller 1/2	Difference between setpoint value and actual value of the controller
	Output level display – controller 1/2	Controller output level (-100 % to +100 %)
Setpoint values	Current setpoint value – controller 1/2	Setpoint value selected through the setpoint changeover
	Interface setpoint value – controller 1/2	Setpoint value provided via interface.
	Setpoint value 1 – controller 1/2 to setpoint value 4 – controller 1/2	Setpoint values that can be selected through the setpoint changeover.
	Program setpoint – controller 1/2	Current program setpoint value
	Ramp setpoint value – controller 1/2	Current value of the setpoint ramp
	Ramp end value – controller 1/2	End value of the setpoint ramp (corresponds to the specified setpoint value)

Category	Signal	Description
Program controller	Setpoint value 1	Current program setpoint 1 (controller 1)
	Setpoint value 2	Current program setpoint 2 (controller 2)
	End setpoint value 1	Setpoint value 1 at the end of the program section
	End setpoint value 2	Setpoint value 2 at the end of the program section
	Remaining section time	Remaining running time of the current program section in seconds (remaining time)
	Remaining program time	Remaining running time of the program in seconds (remaining time)
	Section run time	Runtime of the current program section in seconds (already elapsed time)
	Program run time	Runtime of the program in seconds (already elapsed time)
	Segment number	Number of current program section
	Program number	Number of current program
Timer	Runtime – timer 1/2	Runtime of the timer in seconds (already elapsed time)
	Remaining running time – timer 1/2	Remaining running time of the timer in seconds (remaining time)
	Timer value – timer 1/2	Timer value in seconds (set timer time)
External analog inputs	Ext. analog input 1 to ext. analog input 16	Signals of the external analog inputs (via interface)
Flags	Flag 1 to flag 8	Signals of the analog flags Flags are variables that are available in the device as intermediate storage. The values are saved on the device (no data loss in the event of power failure).
Math result	Math result 1 to math result 4	Results of the math formulae (formula 1 to formula 4)
Counter (hardware counter)	Number of pulses – counter 1/2/3/4	Number of pulses counted
	Pulse period – counter 1/2/3/4	Determined pulse period
	Output value – counter 1/2/3/4	Output value of the counter (depending on the function)
ST code analog outputs	ST analog output 1 to ST analog output 10	Signals of the analog outputs from the PLC module (application created with ST code)
Service	Terminal temperature	Temperature on the connection terminals (only for thermocouple)
	Operating time	Operating hours counter reading (in hours or days, configuration dependent)
Service counter	Service counter 1/2	Service counter reading (number or time, configuration dependent)
System	Sampling rate	Sampling rate and processing cycle of the device (see Configuration > Basic settings)
	ST code runtime	Current system runtime of the ST code
	Max. ST code runtime	Maximum system runtime of the ST code

Digital selector

Category	Signal	Description
No selection		No signal selected.
Digital inputs	Digital input 1 to digital input 14	Signals of digital inputs
Controller	Controller disabled – controller 1/2	The signal is active when the controller is disabled.
	Autotuning active – controller 1/2	The signal is active during autotuning.
	Manual mode active – controller 1/2	The signal is active during manual mode.
	Control loop alarm – controller 1/2	Control loop monitoring alarm signal
	Output level alarm – controller 1/2	Output level monitoring alarm signal
	Switching output 1 – controller 1/2	Signal on controller output 1 (e.g. for heating with inverse control direction)
	Switching output 2 – controller 1/2	Signal on controller output 2 (e.g. for cooling with inverse control direction)
Ramp	End signal (ramp) – controller 1/2	The signal is active after ramp end until the next setpoint value change.
	Tolerance band signal (ramp) – controller 1/2	The signal is active while the actual value is outside the ramp tolerance band.
Program	Program active	The signal is active while the program is running (also while the program is stopped).
	Tolerance band signal (program)	The signal is active while the actual value is outside the program tolerance band.
Control contacts	Operating contact 1 to operating contact 4	Operating contacts of the program generator
Limit value outputs	Limit value output 1 to limit value output 8	Alarm signals of limit value monitoring functions
Timer	Timer output – timer 1/2	The signal is active from timer start until the timer elapses (high or low, configurable).
	Tolerance band signal – timer 1/2	The signal is active if the timer has been started but is not yet running due to a breach of the tolerance band (actual value is outside the valid range).
	After-run signal – timer 1/2	The signal is active after the timer elapses for the duration of the after-run time (or until acknowledgement).
	Stop signal – timer 1/2	The signal is active while the timer is stopped.
	Timer activated – timer 1/2	The signal is active if the timer has been activated in the configuration.
Digital control signals	Digital control signal 1 to digital control signal 8	Output signals of the respective function (configurable)
External digital inputs	Ext. digital input 1 to ext. digital input 16	Signals of the external digital inputs (via interface)

Category	Signal	Description
Flags	Digital flag 1 to digital flag 8	Signals of the digital flags Flags are variables that are available in the device as intermediate storage. The values are saved on the device (no data loss in the event of power failure).
	Digital push-button 1 to digital push-button 8	Signals of the digital push-buttons Digital push-buttons that have been set to "High" are automatically reset after a few seconds.
Logic	Logic result 1 to logic result 4	Results of the logic formulae (formula 1 to formula 4)
ST code digital outputs	ST digital output 1 to ST digital output 10	Signals of the digital outputs (binary outputs) from the PLC module (application created with ST code)
ST code alarm outputs	ST alarm output 1	Alarm signal from the PLC module (application created with ST code)
ST code error	ST error	Error signal from the PLC module (application created with ST code)
Service data	Service signal 1/2	The signal is activated if the service counter has reached the set limit value and remains active until acknowledgement.
Operation	Short-press Back key 1/2	Function in basic display 1 or 2 (1/2): The signal is active (for the duration of a sampling period) after briefly pressing the "Back" key (< 2 s).
	Long-press Back key 1/2	Function in basic display 1 or 2 (1/2): The signal is active (for the duration of a sampling period) after pressing and holding the "Back" key (> 2 s).
System	System started	The signal is active (High) as soon as the device's boot process is completed.
	Slave timeout COM1	With Modbus RTU (RS485 interface): The signal is active (High), if the device (Modbus slave) has detected a timeout (failure of the Modbus master).
	Slave timeout COM1 inverted	As above but inverted signal.
	Slave timeout TCP1	For Modbus TCP – master 1: The signal is active (High), if the device (Modbus slave) has detected a timeout (failure of the Modbus master 1).
	Slave timeout TCP1 inverted	As above but inverted signal.
	Slave timeout TCP2	For Modbus TCP – master 2: The signal is active (High), if the device (Modbus slave) has detected a timeout (failure of the Modbus master 2).
	Slave timeout TCP2 inverted	As above but inverted signal.
	Time lost	The signal is active (High) after power-on when the date and time have to be set again.

5 Configuration

5.3 Basic settings

The basic settings of the device are specified in this menu.

Parameter	Selection/text/value	Description
Device name	**<Device name>** (editable)	Device designation (in the "Device information" menu)
Language	**German** English French Spanish	National language of display texts
Language select. aft. Power-On	No (empty) **Yes (check)**	Language selection after switching on the next time If "Yes", the user can select the national language for the device texts after the next time the device is switched on - following the change to the configuration. After applying the national language, this parameter is automatically set to "No", so that language selection is not necessary the next time the device is switched on.
Temperature Unit	**Deg. Celsius** Deg. Fahrenheit	Temperature unit for the display on the device and in the setup program (automatic conversion from °C to °F)
Temperature unit interface	**Deg. Celsius** Deg. Fahrenheit	Temperature unit for temperature values transferred via an interface.
Sampling rate (system)	50 ms 150 ms **250 ms** 500 ms	Sampling rate and processing cycle of the device (reading in the inputs, internal processing, updating the outputs) The sampling rate 50 ms is automatically increased by the device to 150 ms if necessary.
Mains frequency	**50 Hz** 60 Hz	Mains frequency of the voltage supply
Display protection	********** (enter password)	Display protection for the setup project Without a password (default setting), the project is always displayed in the setup program. If there is a password and it is entered incorrectly, the project is not displayed. The password is transferred to the device together with the configuration and saved in the device. It has no effect on the display of the device, however. Once the configuration has been extracted from the device, the password protects the display of the applicable project in the setup program.
Set clock when time lost	No (empty) **Yes (check)**	If "Yes" is selected, the text "Set clock" is displayed after power-on if the date and time have been lost in the device. After power-on again, the text is no longer displayed, even if the date and time have not yet been set!

Parameter	Selection/text/value	Description
Setup info text	(enter text)	Individual text (to describe the device, for example) The text is transferred to the device together with the configuration and saved in the device. It is not visible there, however. Once the configuration has been extracted from the device, the text is available in the setup program.

The following basic settings can also be configured on the device if the operating levels are pre-assigned per default.

Parameter	Selection/text/value	Description
Language	(see above)	(see above)
Temperature Unit	(see above)	(see above)
Current date/time 📖	<Date> <Time>	The current date and current time of the device are shown and can be changed. (Change using the setup program: Online parameters > Date and time)
IP address assignment	**Automatic**	The IP address of the device is obtained from a DHCP server.
	Manual	The IP address must be assigned manually.
IP address (for a device with Ethernet interface)	0.0.0.0 to 255.255.255.255 (**223.223.223.1**)	Manually assigned IP address of the device The IP address can be edited in sections (1/4 to 4/4). (Change using the setup program: Online parameters > Ethernet) The current IP address is shown in the device info (Device information > Ethernet).
Device address	**1** to 254	Modbus device address (Modbus slave) (Change using setup program: Configuration > RS485 interface)

NOTE!

The date and time of the device must be set correctly for the following functions:

- Data logger
- Program start at a specific time (date and time)

5 Configuration

5.4 Display/operation

Settings are implemented in this menu that affect the function of the displays and the device keys.

The description under "Basic display 1" (basic status 1) also applies to "Basic display 2" (basic status 2). The timer and controller-specific functions under "Basic display 1" and "Basic display 2" concern control channel 1 or 2, respectively, and timer 1 or 2 respectively (fixed assignment).

General settings

Parameter	Selection/text/value	Description
Timeout (operation)	30 to **180** 0 = Switched off	Time period (in seconds) after which the device automatically returns to the basic display 1 (basic status 1) if no key is pressed.
Running speed	1 to 3 (**2**)	Running speed of the display text
Power ON delay	**0** to 300 s	Start delay time (in seconds) after Power ON All functions of the device are only active after this time has elapsed.
Auto save	Yes	Editing mode is automatically exited after approx. 5 seconds and a change is applied.
	No	The "Menu/OK" button must be pressed to exit editing mode with the application of a change.
Number of basic displays	1, **2**	Number of basic displays (basic statuses) 1 = only basic display 1 available 2 = basic displays 1 and 2 available; change between the basic displays using the "Menu/OK" key (> 2 s)
Key lock	Digital selector **No selection**	Digital signal (high active) for inhibiting the buttons
Display off	Digital selector **No selection**	Digital signal (high active) for switching off all displays
Menu level inhibit The level inhibit can be adjusted on the device using a key combination. 📖		Access to the individual operating levels can be inhibited:
	None	No level inhibited
	Level 4	Level 4 inhibited
	Levels 4 + 3	Levels 4 + 3 inhibited
	Levels 4 + 2	Levels 4 + 2 inhibited
	Levels 4 + 3 + 2	Levels 4 + 3 + 2 inhibited
	Complete	Levels 4 + 3 + 2 + 1 inhibited
Additional functions	Expansion 1 to expansion 16	Reserved functions for service purposes. Only activate when instructed to do so by service personnel! Click checkbox to activate the function.

Level inhibit

⇨ chapter 4.7 "Level inhibit", Page 38

Basic display 1

Parameter	Selection/text/value	Description
Display 1	Analog selector **Analog input 1**	Analog signal that is shown in the first 18-segment display (top, white).

Parameter	Selection/text/value	Description
Display 2	Analog selector **Controller x current setpoint value**	Analog signal that is shown in the second 18-segment display (bottom, green).
Display 3	Analog selector **No selection**	Analog signal that is shown in the top line of the pixel matrix display (only for formats 108H, 108Q, and 104).
Display 4	Analog selector **No selection**	Analog signal that is shown in the bottom line of the pixel matrix display (only for formats 108H, 108Q, and 104).
Display change when starting the timer		Display change when starting the timer:
	Without function	No display change
	Residual timer time	Display of the remaining timer run time
	Timer run time	Display of the timer run time
Short-press back button (< 2 s)	**Without function** Manual mode Start autotuning	Function of the "Back" button when short-pressing the button (less than two seconds) Additional functions of the button can be selected in the configuration of the individual device functions (digital selector).
Long-press Back key (< 2 s)	Without function **Manual mode** Start autotuning	Function of the "Back" button when long-pressing the button (more than two seconds) Additional functions of the button can be selected in the configuration of the individual device functions (digital selector).

Basic display 1 – display texts

Two texts can be displayed in the basic display (basic status). The display is controlled by a digital signal. This way, an alarm text can, for example, be displayed in a simple way if a limit value is exceeded. To do so, the signal of the limit value monitoring function must be used to control the text display.

Parameter	Selection/text/value	Description
Top text display	Digital selector **No selection**	Digital signal (high active) for activating the top text display
Text list entry no.	**700** to 800 (enter text number) Do not use texts 1 to 699!	The text to be displayed (without scroll function) is selected by specifying the text number from the text blocks (see Chapter "User interface"). Texts 700 to 800 can be edited by the user there. Device in format 108H, 108Q and 104: The text is displayed in line 3 (pixel matrix, top line). Device in format 116: The text is displayed in line 1.
Bottom text display	Digital selector **No selection**	Digital signal (high active) for activating the lower text display

Parameter	Selection/text/value	Description
Text list entry no.	**700** to 800 (enter text number) Do not use texts 1 to 699!	The text to be displayed (with scroll function) is selected by specifying the text number (see above). Device in format 108H, 108Q, and 104: The text is displayed in line 4 (pixel matrix, lower line). Device in format 116: The text is displayed in line 2.

Basic display 1 – Up/Down key

In the basic display (basic status), a process value or configuration value can be changed directly using the "Up" and "Down" keys.

Parameter	Selection/text/value	Description
Parameter	Selector **Current setpoint value**	Select the process value or configuration parameter from the selector. Only one of the following values may be selected as a process value: - Current setpoint value - Timer remaining running time - Current date/time There is no restriction when selecting a configuration parameter.
Description 1 to description 4	(enter text)	Description (designation) of the process value or configuration value in language 1 to language 4 (sequence of the device texts) Enter individual text or use default text. Device in format 116: The text is not displayed in the basic display.
Text list entries (number of texts)	(Display only)	Shows the number of texts (parameter values) which are available to select for the applicable parameter. These texts are transferred from the set-up program to the text list, and occupy the corresponding number of text lines there (in the range from 300 to 699).

5.5 Analog inputs

The device has a universal analog input for connecting various measuring probes (sensors) as a standard feature. Up to 4 further analog inputs are possible as an optional extra (depending on the device type).

Parameter	Selection/text/value	Description
Signal type	No sensor	No sensor selected
	2-wire RTD temperature probe	RTD temperature probe in 2-wire circuit
	3-wire RTD temperature probe	RTD temperature probe in 3-wire circuit
	2-wire resistance/potentiometer	Resistance/potentiometer in 2-wire circuit
	3-wire resistance/potentiometer	Resistance/potentiometer in 3-wire circuit
	Resistance transmitter	Resistance transmitter
	Thermocouple	Thermocouple
	0...10 V	Voltage signal
	0 to 1 V	Voltage signal
	0...20 mA	Current signal
	4...20 mA	Current signal
	Heater current 50 mA 📖	Current signal (AC) for heater current monitoring; only with optional analog input
Temperature		Only for resistance/potentiometer, resistance transmitter, voltage, current: This selection is important for the automatic conversion in case of a change in the temperature unit (°C/°F) (see basic settings).
	None	The value is not a temperature.
	Relative	The value is a temperature difference.
	Absolute	The value is a temperature value.
Unit	<Enter text> **%**	Value unit (if it is not a temperature)

Parameter	Selection/text/value	Description
Linearization	**Pt100**	Only for RTD temperature probe
	Pt1000	
	GOST Pt100	
	L / Fe_CuNi	Only with thermocouple
	J / Fe_CuNi	
	U / Cu-CuNi	
	T / Cu-CuNi	
	K / NiCr-Ni	
	E / NiCr-CuNi	
	N / NiCrSi-NiSi	
	S / Pt10Rh-Pt	
	R / Pt13Rh-Pt	
	B / Pt30Rh-Pt6Rh	
	C / W5Re-W26Re	
	D / W3Re-W25Re	
	A1 / W5Re-W20Re	
	L / Chromel®-Copel®	
	Chromel®-Alumel®	
	Linear	Only for resistance/potentiometer, resistance transmitter, voltage, current, heater current
	Customer-specific 1	Customer-specific linearization with 4th order polynomial or grid points (configurable with setup program)
	Customer-specific 2	
Resistance measuring range	0...400 Ω **0...4000 Ω**	Measuring range for resistance/potentiometer and for RTD temperature probe with customer-specific linearization
Measuring range start		Lower limit of the measuring range (depending on sensor and linearization)
Measuring range end		Upper limit of the measuring range (depending on sensor and linearization)
Start of display range		Lower limit of display range (depending on sensor and linearization)
End of display range		Upper limit of display range (depending on sensor and linearization)
Decimal places		Number of decimal places for the numerical display of the measured value
	Auto	Automatic
	XXXXX.	No decimal place
	XXXX.X	One decimal place
	XXX.XX	Two decimal places
	XX.XXX	Three decimal places
Measurement offset	-19999 to 99999 (**0**)	Correction value for the measured value All measured values are moved by the same correction value (see fine adjustment).
Filter time const. 📖	0 to 100 (**0.6**)	Time constant (in seconds) for adjusting the digital input filter (0 s = filter off)

Parameter	Selection/text/value	Description
Cold junction temperature		Only with thermocouple: selection of the cold junction temperature
	Internal	Internal temperature is used.
	Constant	Constant temperature can be entered.
Constant	-30 to +85 (**25**)	Only for thermocouple: Constant cold junction temperature
Resistance Ra or Ro 🕮	**0** to 4000 (Ω)	For resistance transmitter: Resistance Ra between slider (S) and start (A), if the slider is positioned at the start. For resistance/potentiometer: Offset resistance Ro
Resistance Rs or Rx 🕮	0 to 4000 (**1000**) (Ω)	For resistance transmitter: Resistance range Rs of the slider For resistance/potentiometer: Shifting resistance range Rx
Resistance Re 🕮	**0** to 4000 (Ω)	For resistance transmitter: Resistance Re between slider (S) and end (E), if the slider is positioned at the end.

NOTE!

If analog input 1 has been configured with signal type "0 to 10 V" or "No sensor", digital input 2 cannot be used.

Heater current monitoring

This function monitors the heater current of the heating element. To acquire the heater current, a current transformer is required which provides an output signal of AC 0 to 50 mA. This is used as the input signal for one of the optional analog inputs.

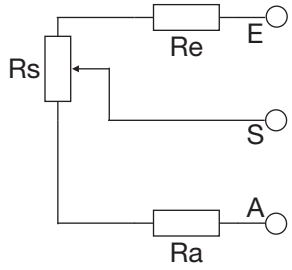
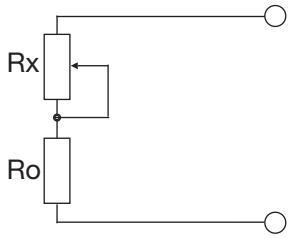
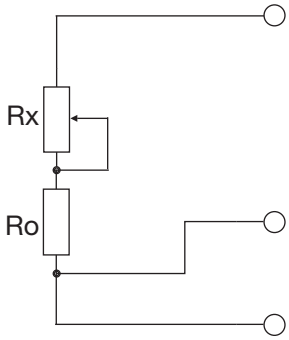
By using the limit value monitoring function, the analog input signal can be monitored so that an alarm signal is output if the set limit value is exceeded or not met.

Filter time const.

The filter time constant is used to adjust the digital input filter (2nd order filter). If the input signal changes suddenly, approx. 26 % of the change is recorded following a period that corresponds to the filter time constant (2 × filter time constants: approx. 59 %; 5 × filter time constants: approx. 96 %). A large filter time constant means: high attenuation of interference signals, slow reaction of the actual value display, low limit frequency (low-pass filter).

Resistance Ra or Ro, Rs or Rx, Re

The overall resistance Ra + Rs + Re (or Ro + Rx) must not exceed 4000 Ω.

Resistance transmitter	Resistance/potentiometer in 2-wire circuit	Resistance/potentiometer in 3-wire circuit
		

5.6 Customized linearization

The user can create an individual linearization characteristic line for the analog input with the customer-specific linearization. Two procedures are available for this (type of linearization): formula or grid points (value pairs).

The text entered under "designation" is not used at another point in the setup program, but serves merely as text in the sense of a brief description.

Formula

Linearization is specified using a formula with five coefficients (4th order polynomial).

Polynomial: $y = X4*x^4 + X3*x^3 + X2*x^2 + X1*x + X0$

Parameter	Selection/text/value	Description
Measuring range start	-19999 to 99999 (**0**)	Start value of the y axis (linearized value)
Measuring range end	-19999 to 99999 (**100**)	End value of the y axis (linearized value)
X0	-1999 to 9999 (**0**)	Absolute component of the polynomial (point of intersection with the y axis)
X1	-1999 to 9999 (**0**)	Coefficient of the linear component (x)
X2	-1999 to 9999 (**0**)	Coefficient of the quadratic component (x^2)
X3	-1999 to 9999 (**0**)	Coefficient of the cubic component (x^3)
X4	-1999 to 9999 (**0**)	Coefficient of the quartic component (x^4)

"Display graphic" button (displaying linearization on a graphic):

Use this button to create a graphic of the linearization.

The graphic includes the characteristic lines for both types of linearization where applicable, namely the formula and the grid points (table).

The display range for the graphic is initially determined by the "measuring range start" and "measuring range end" values (y values); it can be temporarily changed in the display by entering different x values.

Grid points

Linearization is specified by entering up to 40 grid points (pairs of values X,Y). The value X stands for the physically measured value (resistance in Ω or voltage in mV) for a RTD temperature probe or thermocouple. With the other signal types, the input variable is scaled to 0 to 100% (for voltage/current signal of measuring range, for resistance/potentiometer of resistance Rx, for resistance transmitter of overall resistance). The value Y is the linearized value (e.g., temperature in °C).

Parameter	Selection/text/value	Description
Measured value (X)	-19999 to 99999 (**0**)	Value of the relevant grid point on the x axis
Linearized value (Y)	-19999 to 99999 (**0**)	Value of the relevant grid point on the y axis

Button  **(calculating the polynomial using the grid points):**

After entering the value pairs, use this button to calculate a polynomial that describes the progression of the linearization characteristic line.

The calculated coefficients are incorporated into the formula. The characteristic lines for both types of linearization then correspond to each other.

If the x values do not increase in a straight line, the linearization is not applied. In this case, it is impossible to display the graphic or calculate the polynomial.

"Display graphic" button (displaying linearization on a graphic):

Use this button to create a graphic of the linearization.

The graphic includes the characteristic lines for both types of linearization where applicable, namely the grid points (table) and the formula.

The display range for the graphic is initially determined by the smallest and largest grid points; it can be temporarily changed in the display by entering different x values.

5.7 Digital inputs

The device is equipped with 2 digital inputs that are provided to connect a potential-free contact. Up to 12 further digital inputs are possible as an optional extra (depending on the device type).

Parameter	Selection/text/value	Description
Polarity inversion	**No**	Input signal not inverted.
	Yes	Input signal inverted.

NOTE!

Digital input 1 can only be used if digital input 3 is not active (no signal source assigned).

NOTE!

Digital input 2 can only be used if analog input 1 has not been configured with signal type "0 to 10 V", or "No sensor".

5.8 Controller

The general features of the controller are defined in this menu.

Controller 1: Control channel 1 (as a standard feature)

Controller 2: Control channel 2 (optional)

Parameter	Selection/text/value	Description
Controller type 📖	Off	Controller disabled
	2-state controller (per default for controller 1)	Two-state controller Controller with a switched output
	3-state controller	Three-state controller Controller with two switched outputs (for example, for heating/cooling) The combination of a continuous (e.g., for heating) and a switched output (e.g., for cooling) is also possible.
	Three-step controller	Three-step controller Controller with two switched outputs (for motor actuator)
	Position controller	Continuous Controller with Integrated Position Controller Controller with two switched outputs (output level feedback required)
	Continuous controller	Continuous controller Controller with a continuous output (analog signal)
Control direction	Direct	The controller output level is positive if the actual value is greater than the setpoint value (cooling).
	Inverse	The controller output level is positive if the actual value is smaller than the setpoint value (heating).
Manual mode	**Enabled**	Changeover to manual mode possible (through key/button operation or digital signal)
	Disabled	Changeover to manual mode is inhibited.
Output level in manual mode 📖		Output level after changeover to manual mode
	Input	Configurable value (see "Input" parameter)
	Last output level	Last output level before changeover
	Average value	Averaged value (see filter period)
Input (manual output level)	-100 to +100 (**0**)	Output level (in percent) in manual mode
Output level in the event of fault 📖		Output level in the event of a fault (outside of the measuring range)
	Safety value	Configurable value (see "Replacement value" parameter)
	Last output level	Last output level before occurrence of fault
	Average value	Averaged value (see filter period)
Safety value	-100 to +100 (**0**)	Output level (in percent) in the event of a fault
Y filter period	1 to 3600 (**1**)	Time period (in minutes) for determining the output level average value

Parameter	Selection/text/value	Description
Additional functions	Expansion 1 to expansion 4	Reserved functions for service purposes. Only activate when instructed to do so by service personnel! Click checkbox to activate the function.

Controller type

Description of the controller types:

⇨ chapter 5.9.1 "Controller types", Page 75

Output level in manual mode, output level in the event of fault

For modulating controller:

- Last output level, average value: actuator is stationary
- 0: actuator closes
- 100: actuator opens

Behavior after power on

The controller outputs are inactive during the initialization phase (output level 0 %, relay in standby mode).

5.8.1 Controller input

The controller input signals are assigned in this menu.

Parameter	Selection/text/value	Description
Actual value	Analog selector **Analog input 1**	Analog signal as controller actual value
Setpoint value	Analog selector **Controller 1/2 – current setpoint value**	Analog signal as controller setpoint value
Output level feedback	Analog selector **No selection**	Analog signal for output level feedback
External manual output level	Analog selector **No selection**	Analog signal for specifying the manual output level Specifying the manual output level using an analog signal takes priority over the fixed standard value. Changing the manual output level via operation is then not possible in this case.
Manual/auto changeover	Digital selector **No selection**	Signal (high-active) for changeover to manual mode
Manual mode inhibit	Digital selector **No selection**	Signal (high active) for inhibiting manual mode
Parameter block changeover 1/2	Digital selector **No selection**	Signal (high-active) for changeover from parameter block 1 to parameter block 2
Controller ON	Digital selector **No selection**	Signal (high-active) for switching on the controller With "No selection", the signal is not evaluated. The controller is then always active.
Controller OFF	Digital selector **No selection**	Signal (high-active) for switching off the controller The signal "Controller OFF" has priority over the signal "Controller ON".

5.8.2 Autotuning

This menu is used to implement settings for the autotuning.

WARNING!

During autotuning according to the oscillation method, output value limits Y1 and Y2 are not active for switched outputs or solid state outputs.

The output level may exceed or fall below the set limits.

▶ It must be ensured that this does not result in damage to the plant.

Parameter	Selection/text/value	Description
Method 📖	Step response	Step response method
	Vibration	Oscillation method
Locking	**Enabled**	Autotuning is enabled.
	Disabled	Autotuning is inhibited.
Controller output type 1		Type of the first controller output The cycle time is calculated on the basis of the type of controller output.
	Automatic	Automatic setting based on the configuration If the controller output signal is assigned to several digital outputs (e.g., output 1: relay; output 4: logic), the digital output with the smaller number is relevant (here: output 1).
	Relay	Relay output
	Analog	Analog output
	Solid state/logic	Solid state relay output, open-collector output, or logic output
Controller output type 2	(like output type 1)	Type of the second controller output (for three-state controller, three-step controller, or position controller)
Standby output	-100 to +100 (**0**)	Output level (in percent) at start of autotuning for step response method
Step size	10 to 100 (**30**)	Size of output level step (in percent) for step response method
Application of switching period		Application of Cy cycle time after completion of autotuning
	Off	The determined value will not be applied.
	On	The determined value will be applied.
Start/stop	Digital selector **No selection**	Signal (active for rising edge) for starting and stopping autotuning Autotuning is started by a rising edge. If autotuning is active, it is stopped by a rising edge.
Inhibit (signal)	Digital selector **No selection**	Signal (high-active) for inhibiting autotuning

Method

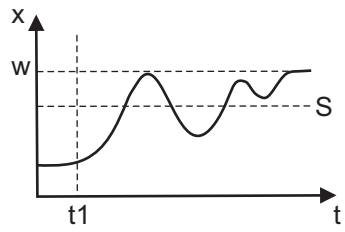
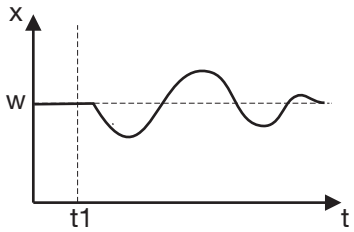
The standard method is the oscillation method, whereas the step response method is used specifically in the plastics industry. With the oscillation method, the output level is set alternately to 100 % and 0 %, which produces oscillation of the control variable. With the step response method, a step of a specified size is made from the standby output. In both cases, the controller determines the optimum controller parameters from the response of the actual value.

Optimization according to the oscillation method

In the case of a large control deviation between the setpoint value and actual value (for example, in the startup phase), the controller determines a switching line around which the control variable performs a forced oscillation during autotuning. The switching line is determined so that the actual value does not exceed the setpoint value if possible.

In the case of minor control deviation (e.g. if the control loop is in a steady state during operation), oscillation is forced around the setpoint value. Here, the setpoint value is exceeded in any case.

The controller automatically chooses between two procedures depending on the extent of the control deviation:

Autotuning during the startup phase	Autotuning during operation
	

x = actual value

w = setpoint value

S = switching line

t1 = start of autotuning

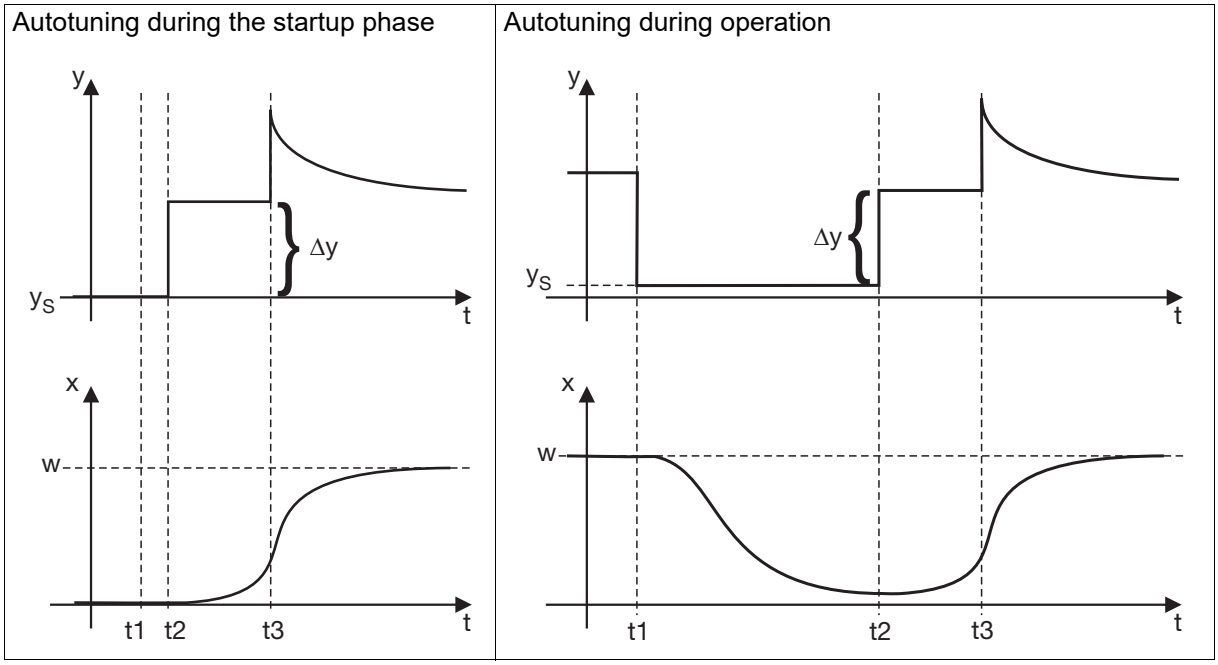
Optimization according to the step response method

Initially, a configurable standby output is produced until the actual value "settles" to a constant. This is automatically followed by a configurable output level step (step size) to the control process.

Main applications of the step response method:

- Optimization immediately after "power on" during startup (considerable time saving, standby output setting = 0 %)
- Control process does not oscillate easily (for example, extremely well insulated furnace with low losses, long oscillation period)
- Actual value must not exceed the setpoint value
  If the output level is known for the corrected setpoint value, overshooting is prevented with the following setting:
  Standby output + step size ≤ output level in corrected state

The progression of the output level and actual value depends on the status of the process at the point when autotuning starts:



y = output level

y_S = standby output

x = actual value

w = setpoint value

Δy = step size

t1 = start of autotuning

t2 = time of output level step

t3 = end of autotuning

Optimized controller parameters

With both autotuning methods, the parameters for PI or PID controller structure are optimized according to the configured controller type and the configured "Control structure" parameter: proportional band Xp (P component), derivative time Tv (D component), and reset time Tn (I component).

The cycle time Cy and the filter time constant dF are also optimized.

Configured controller type	Configured parameter	Optimized parameters	Optimized control structure
Two-state controller	Control structure 1 = PI	Xp1, Tn1, Cy1, dF	PI
	All other settings	Xp1, Tv1, Tn1, Cy1, dF	PID
Three-state controller	Control structure 1 = PI or control structure 2 = PI	Xp1, Xp2, Tn1, Tn2, Cy1, Cy2, dF; (Tv1/2 = 0)	PI
	All other settings	Xp1, Xp2, Tv1, Tv2, Tn1, Tn2, Cy1, Cy2, dF	PID
Three-step controller	Control structure 1 = PI	Xp1, Tn1, dF	PI
	All other settings	Xp1, Tv1, Tn1, dF	PID
Continuous controller	Control structure 1 = PI	Xp1, Tn1, dF	PI
	All other settings	Xp1, Tv1, Tn1, dF	PID
Continuous Controller with Integrated Position Controller	Control structure 1 = PI	Xp1, Tn1, dF	PI
	All other settings	Xp1, Tv1, Tn1, dF	PID

The configured control structure is not changed by the optimization if it is a PI or PID control structure. In all other cases, it is optimized to PID control structure.

For 1st order control processes, the parameters required for the PI control structure are optimized, independently of the "Control structure" configured parameter.

Requirements for autotuning

The following aspects must be considered before starting autotuning:

- Is the suitable controller type configured?
- Check and/or adjust the control action of the controller.
- Is it possible to sufficiently influence the process value in manual mode?
- For a three-step controller or position controller, the actuator time (tt) must be determined and adjusted in the parameterization.

Starting autotuning

Autotuning is started by long-pressing the "Up" and "Down" buttons at the same time for at least 5 s. The ongoing autotuning is also stopped (aborted) in the same way.

With the corresponding configuration, autotuning can also be started or stopped by pressing the "Back" button or through a digital signal. To do so, the controller must not be in manual mode and autotuning must not be inhibited.

A corresponding reference text appears on the display while autotuning is running. Autotuning is completed when the display automatically changes to the basic display (basic status). The duration of autotuning depends on the process.

NOTE!

Autotuning must be performed under real operating conditions; it can be performed any number of times.

NOTE!

If the actual value leaves the measuring range during autotuning, the autotuning process is aborted. In this case, the configured parameters are not changed.

5.8.3 Control loop monitoring

Control loop monitoring monitors the control response during startup of a plant and in the event of a setpoint step by analyzing the change of the actual value during an output level change. The alarm signal is activated if the actual value does not respond according to the specifications.

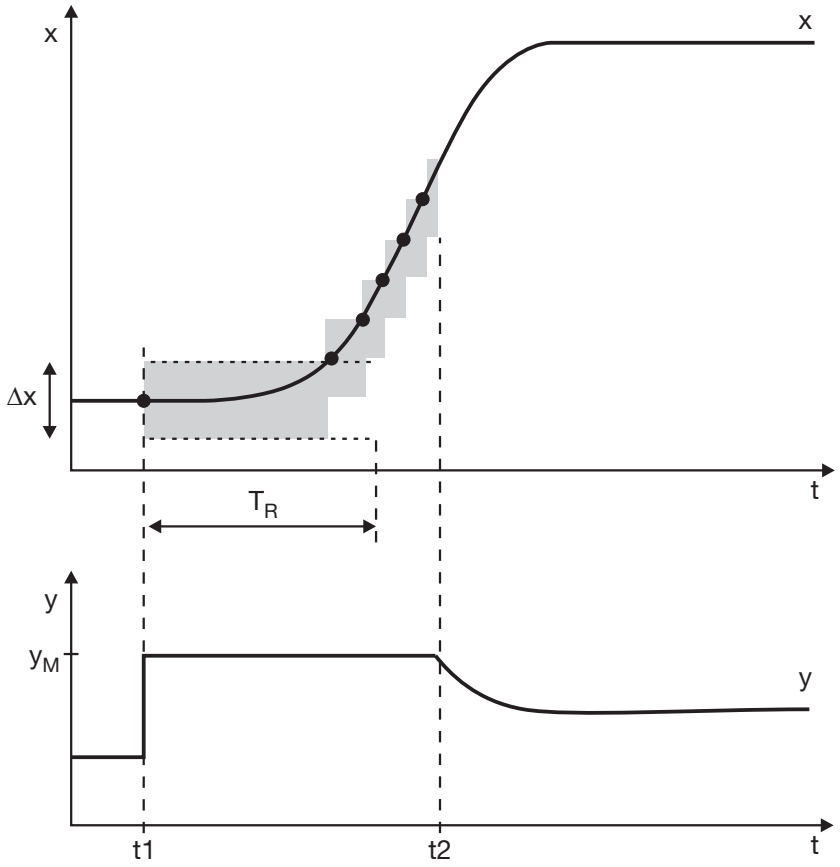
Parameter	Selection/text/value	Description
Function	**Off**	Control loop monitoring is not active.
	On	Control loop monitoring is active.
Response time	**0** to 9999	Time period (in seconds) in which the actual value must leave the monitoring band. "0" setting means: Response time = reset time Tn
Monitoring band	**0** to 1999	Range that the actual value must leave within the response time. "0" setting means: Monitoring band = 0.5 × proportional band (Xp)

Description of the function

Monitoring starts as soon as the maximum output level is produced in heating mode (see example) or as soon as the minimum output level is produced in cooling mode. Starting from this point, the actual value must leave the monitoring band – the range around the current value at the start of monitoring – within the response time. If it is not, the alarm signal is activated.

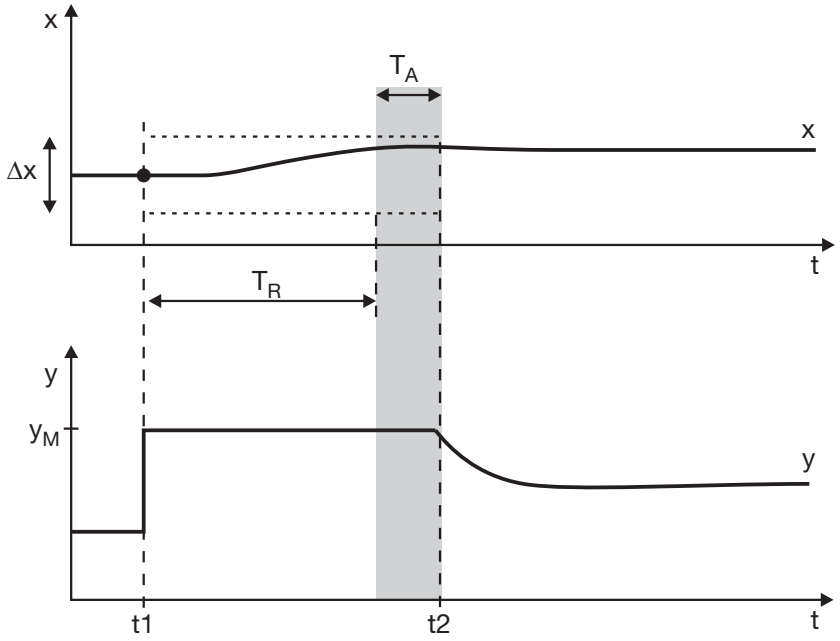
On leaving the monitoring band, the actual value at the time is used as a reference value for a new monitoring band. The response time starts over.

Monitoring ends as soon as the maximum or minimum output level is no longer produced.



x	Actual value	Δx	Monitoring band
y	Output level	y_M	Max. output level (for example, 100 %)
t1	Start of monitoring	T_R	Response time
t2	End of monitoring		

If the actual value does not leave the monitoring band within this timeframe, an alarm signal is generated. The alarm signal is maintained for as long as the maximum or minimum output level is produced and the actual value is within the monitoring band.



x	Actual value	Δx	Monitoring band
y	Output level	y_M	Max. output level (for example, 100 %)
t1	Start of monitoring	T_R	Response time
T_A	Alarm period	t2	End of monitoring

An alarm may be caused by:

- Partial or total failure of heating elements or other parts in the control loop
- Reversal of the control direction (for example, "direct" instead of "inverse")

Functional limitations

The control loop monitoring is not active in the following cases:

- Autotuning active
- Manual mode
- Output level is not at its maximum limit (heating mode) or minimum limit (cooling mode)

Parameter dimensioning

The controller parameters must be optimally adjusted for the control loop monitoring to function correctly, e.g. using autotuning. If alarms occur temporarily, despite the plant operating correctly, either the **response time** must be increased, or the **monitoring band** must be narrowed. To do this, plot the approach curve, e.g. with the startup function of the setup program.

5.8.4 Output level monitoring

Output level monitoring monitors the output level in the corrected state. The output level must be within a definable range around a mean output level. If it is not, the alarm signal is activated.

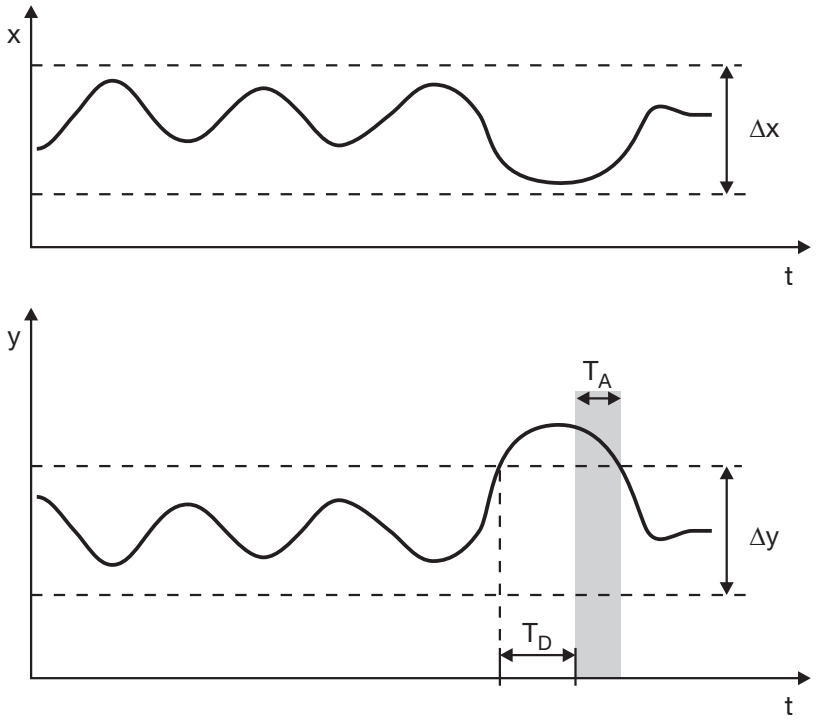
Parameter	Selection/text/value	Description
Function	**Off**	Output level monitoring is not active.
	On	Output level monitoring is active.
Determination time	0 to 9999 (**350**)	Calculation time (in seconds) for the mean output level

Parameter	Selection/text/value	Description
Output level band	0 to 100 (**10**)	Monitored output level band (admissible range around the mean output level)
Alarm delay	**0** to 9999	Delay time (in seconds) for alarm triggering
Control differential band	0 to 9999 (**1**)	Control differential band (admissible range around the actual value in corrected state)

Description of the function

Once the output level monitoring has been activated, determination of the mean output level starts as soon as the actual value is within the control differential band. When the mean output level has been determined, the current output level must be within the monitored output level band. If it is not, the alarm signal is activated.

In the event of a setpoint value change, output level monitoring is temporarily deactivated until the actual value returns to the control differential band. The mean output level is then determined again.



x	Actual value	Δx	Control differential band
y	Output level	Δy	Monitored output level band
T_D	Alarm delay	T_A	Alarm period

Application examples:

- Monitoring of faults on heating elements
- Reporting of faults during operation

Functional limitations

Output level monitoring is not active in the following cases:

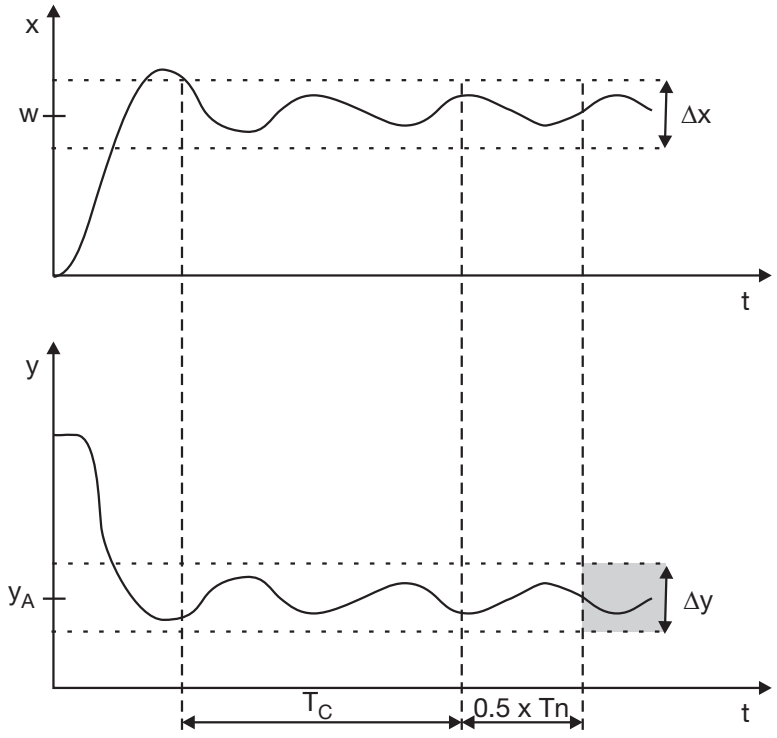
- Proportional band Xp = 0
- Autotuning active
- Manual mode
- Ramp function active
- Controller operating as program controller

Parameter dimensioning

Appropriate dimensioning of parameters used for determining the mean output level is required for the output level monitoring to function correctly.

The **control differential band** around the actual value defines the corrected state. It should be dimensioned so that it is adhered to during normal operation. The progression of the actual value can, for example, be recorded with the startup function of the setup program. Determination of the mean output level starts when the actual value enters the control differential band. Calculation of the mean output level starts over if there is temporary deviation from the control differential band during output level determination or if the setpoint value is changed by more than 0.5 × control differential band Δx.

A mean output level is calculated via the **determination time** using a moving average. The time chosen should be long enough to ensure as accurate a calculation as possible. The determination time is followed by a waiting period of 0.5 x reset time Tn, during which it is checked whether the actual value and output level move within the specified limits. If one of the limits is exceeded, the calculation restarts. After successful calculation, the output level monitoring is active.



x	Actual value	w	Setpoint value
y	Output level	y_A	Average output level
T_C	Determination time	Tn	Reset time
Δy	Output level band	Δx	Control differential band

5.8.5 Controller setpoint values

The setpoint value for the fixed-setpoint controller can be specified by an analog signal (external setpoint value) or by one of 4 fixed setpoint values (selection via setpoint changeover).

Parameter	Selection/text/value	Description
External setpoint value	Analog selector **No selection**	Analog signal for specifying the setpoint value
Correction	**Off**	No correction of the external setpoint value
	Up/Down key	If setpoint value 1 is active (selected via setpoint changeover), it serves as the correction value for the external setpoint value. The "Up" and "Down" keys can be used to change the correction value.
Setpoint values 1 to 4: Setpoint limit min.	**-1999** to 9999	Minimum admissible setpoint value (lower input limit)
Setpoint values 1 to 4: Setpoint limit max.	-1999 to **9999**	Maximum admissible setpoint value (upper input limit)
Setpoint values 1 to 4: Setpoint value	-1999 to 9999 (**0**)	Fixed setpoint value (value range depends on the input limits) Setpoint value 1 can be used as the correction value for the external setpoint value (see above).
Setpoint changeover – signal 1 📖	Digital selector **No selection**	Signal (bit 0) for controlling setpoint changeover
Setpoint changeover – signal 2	Digital selector **No selection**	Signal (bit 1) for controlling setpoint changeover
Boost function 📖	**None**	The function is inactive.
	Delta	The setpoint value is increased by the boost value.
	Percent	The setpoint value is increased by percentage (boost value as percentage value).
Boost value	**0** to 9999	Absolute value or percentage value (see above).
Boost signal	Digital selector **No selection**	Digital signal for starting the boost phase
Boost duration	**0** to 65535	Duration (in seconds) of the boost phase

Setpoint changeover

Signal 2 (Bit 1)	Signal 1 (Bit 0)	Active setpoint value
0	0	Setpoint value 1
0	1	Setpoint value 2
1	0	Setpoint value 3
1	1	Setpoint value 4

Boost function

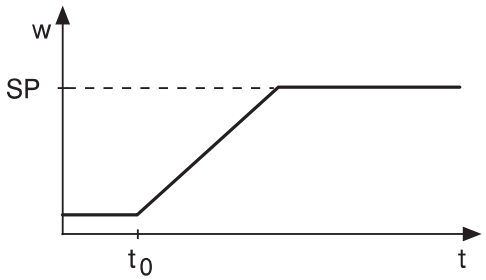
NOTE!

This function is available in the setup program if the "hot-runner" module has been activated (Identification > Device version > Device configuration). This function is available in the device per default if the device was ordered with the extra code 278. Subsequent activation using the setup program is not possible.

The boost function allows the setpoint value to be increased by a particular value for a certain duration. The boost function is typically used to release nozzles in the plastics industry during the production process.

5.8.6 Ramp function

The ramp function is used for a constant change of setpoint value w, starting from the current ramp value (= actual value at time t_0 of the setpoint value change) up to the ramp end value SP (default setpoint value).



A tolerance band can be set around the setpoint value curve to monitor the actual value. If the actual value deviates from the tolerance band, the tolerance band signal (ramp) is activated and the ramp is stopped.

NOTE!

If the device operates as a program controller, the ramp function is not active.

NOTE!

The ramp function is not active in manual mode. After switching from manual mode to automatic mode, the actual value is applied as the current ramp value (ramp starts).

Parameter	Selection/text/value	Description
Function	**Off**	Ramp function is not active.
	Minutes	Ramp function is active. Unit of ramp slope: Kelvin per minute
	Hours	Kelvin per hour
	days	Kelvin per day
Positive gradient	**0** to 999	Value for positive ramp slope
Negative gradient	**0** to 999	Value for negative ramp slope
Tolerance band	**0** to 9999	Amount of admissible upward and downward deviation of the actual value (standard tolerance band around setpoint value)
Ramp stop	Digital selector **No selection**	Signal (high active) for stopping the ramp (setpoint value remains constant at the current value)

Parameter	Selection/text/value	Description
Ramp off	Digital selector **No selection**	Signal (high active) for switching off the ramp function (setpoint value immediately assumes the specified end value)
Ramp restart	Digital selector **No selection**	Signal (high-active) for aborting and restarting the ramp (with actual value as setpoint value)
Additional functions	Expansion 1 Expansion 2	Reserved functions for service purposes. Only activate when instructed to do so by service personnel! Click checkbox to activate the function.

Response in case of an error

In the event of a fault (above or below the measuring range, probe/conductor breaks or probe/conductor short-circuits), the ramp function is interrupted. Once the fault is over, the actual value is applied as the current ramp value.

Behavior after power on

After power on, the actual value is applied as the current ramp value (ramp starts).

Hot-runner function

NOTE!

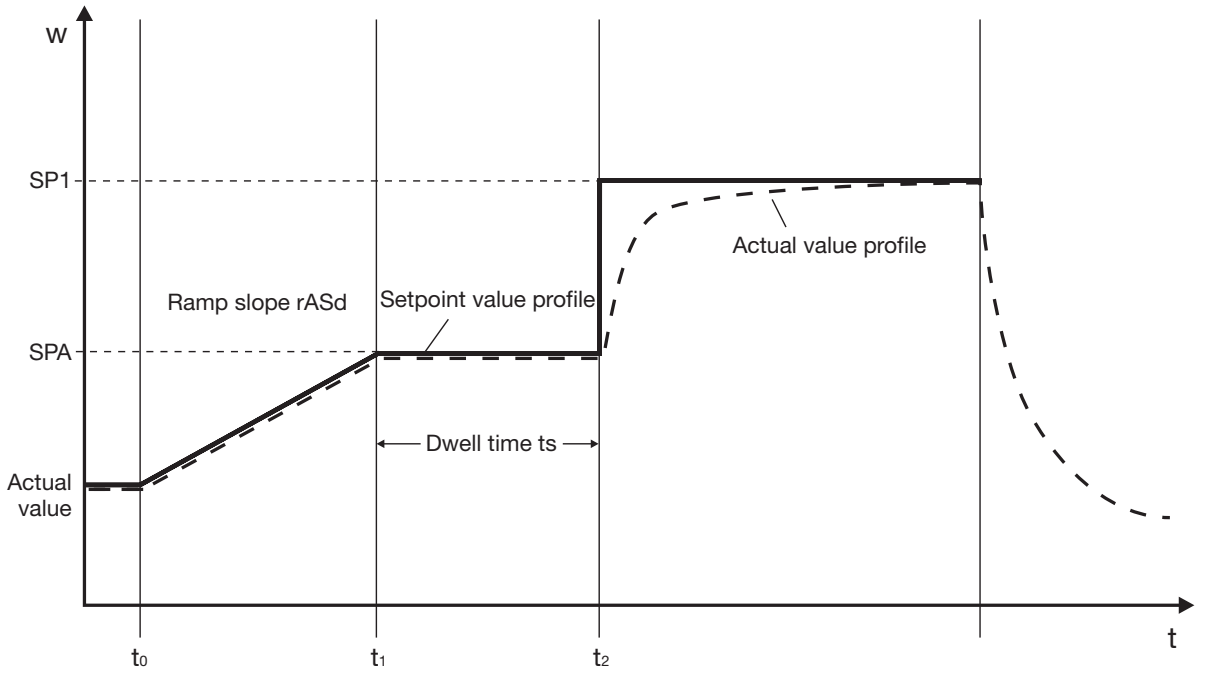
This function is available in the device per default if the device was ordered with the extra code 278. Subsequent activation using the setup program is not possible.

If the device configuration is to be changed using the setup program, it first has to be extracted from the device. The extracted setup file should also be backed up in order to be able to access the special default configuration (hot-runner function) again at a later point.

In the setup program, the "hot-runner" module is to be activated (Identification > Device version > Device configuration).

The hot-runner function is a special ramp function which is used as a so-called startup ramp for hot-runner technology in the plastics industry. It enables the gentle operation of ceramic cartridge heaters; moisture can evaporate slowly from the hygroscopic cartridge heaters during the start-up phase (warm-up phase).

The following graph demonstrates the progression of setpoint value and actual value during the start-up phase (t_0 to t_2) and the subsequent heating phase (from t_2).



At time t0 the current actual value is adopted for the start value of the ramp. In the time period t0 to t1, the stop setpoint value SPA is approached with the programmed ramp slope (gradient) rASd. In this period, the setpoint value is increased linearly. A programmable dwell time (hold time) ts then follows with the constant setpoint value SPA. Following on from this, the actual heating phase begins, in which the value is adjusted to setpoint value SP1.

The parameters can be set in the "Plastics technology" menu level (with default assignment of levels). The unit of the ramp slope rASd cannot be set there; it depends on the configuration of the ramp function.

The hot-runner function is realized by a special program. To start the hot-runner function, the start conditions for the program controller must be configured and the program has to be started (start with power on, start by control signal).

5.9 Parameter blocks

2 parameter blocks can be defined for each control channel (controller 1, controller 2).

The following table shows the parameters in a parameter block. The same parameters are also available for the second parameter block.

The transmission behavior is specified by the selection of the controller structure and determined by the configuration of the parameters for the proportional band (P component), derivative time (D component), and reset time (I component).

Parameters that appear in pairs such as Proportional band 1 and Proportional band 2 refer to the first and second controller outputs. Depending on the controller type configured, certain parameters may be omitted or ineffective.

Parameter	Selection/text/value	Description
Controller structure 1		These settings determine the control structure (transmission behavior) and relate to the first controller output.
	P	P controller
	I	I controller
	PI	PI controller
	PD	PD controller
	PID	PID controller
Controller structure 2	(see: Control structure 1)	These settings apply to the second controller output for a three-state controller.
Proportional band 1 (Xp1)	**0** to 99999	Value for the proportional band The controller structure has no effect if Xp = 0 (behavior identical to limit value monitoring function)! For a continuous controller, Xp must be > 0.
Proportional band 2 (Xp2)	**0** to 99999	
Derivative time 1 (Tv1)	0 to 99999 (**80**)	The derivative time (in seconds) influences the differential component (D component) of the controller output signal. The effect of the D-term increases as the derivation time increases.
Derivative time 2 (Tv2)	0 to 99999 (**80**)	
Reset time 1 (Tn1)	0 to 99999 (**350**)	The reset time (in seconds) influences the integral component (I component) of the controller output signal. The greater the reset time, the less effect the I component has.
Reset time 2 (Tn2)	0 to 99999 (**350**)	
Cycle time 1 (Cy1)	0 to 99999 (**20**)	The cycle time (in seconds) should be chosen so that the energy supply to the process is as continuous as possible without overloading the switching elements.
Cycle time 2 (Cy2)	0 to 99999 (**20**)	
Contact spacing (Xsh)	**0** to 999	Spacing between the two control contacts for a three-state controller, three-step controller, and continuous controller with integrated position controller
Switching differential 1 (Xd1)	0 to 999 (**1**)	Hysteresis for a switching controller with proportional band Xp = 0
Switching differential 2 (Xd2)	0 to 999 (**1**)	

Parameter	Selection/text/value	Description
Actuator time (TT)	5 to 3000 (**60**)	Control valve runtime range used (in seconds) for a three-step controller and continuous controller with integrated position controller
Working point (Y0)	-100 to +100 (**0**)	Working point correction (in percent) for a P or PD controller (correction value for the output level) If the actual value has reached the setpoint value, the output level corresponds to the working point Y0.
Max. output level limit (Y1)	0 to **100**	Admissible maximum output level (in percent; only effective if Xp > 0)
Min. output level limit (Y2)	**-100** to +100	Admissible minimum output level (in percent; only effective if Xp > 0) Three-state controller: A negative value must be set for the second controller output to be active.
Min. relay switch-on time 1 (Tk1)	0 to 60 (**0.25**)	Minimum ON period (in seconds) to limit the switching frequency for switched outputs (digital outputs) Recommended setting if a relay is used as a controller output: ≥ 0.15 s
Min. relay switch-on time 2 (Tk2)	0 to 60 (**0.25**)	

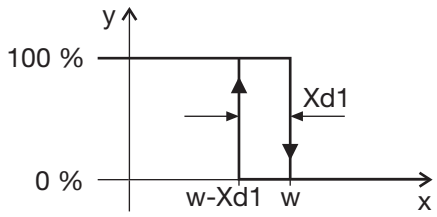
5.9.1 Controller types

Two-state controller

This controller has a switched output and can be parameterized with P, PI, PD, or PID transmission behavior. The proportional band Xp must be greater than 0 for the controller structure to take effect.

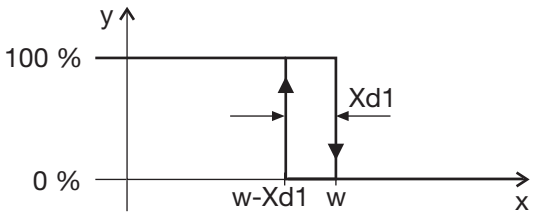
If Xp = 0, the behavior corresponds to the function of limit value monitoring with switching differential Xd1 (working point Y0 = 0 %):

Y0 = 0 %

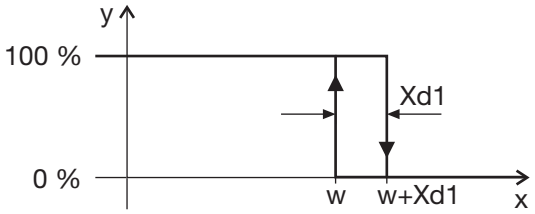


Influence of working point Y0 on the switching behavior:

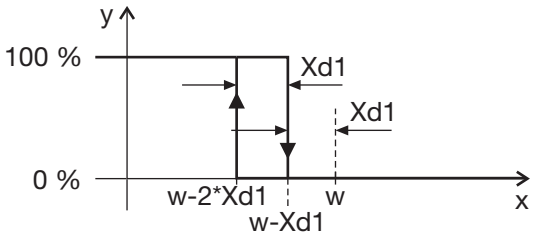
Y0 = 0 %



Y0 = 100 %



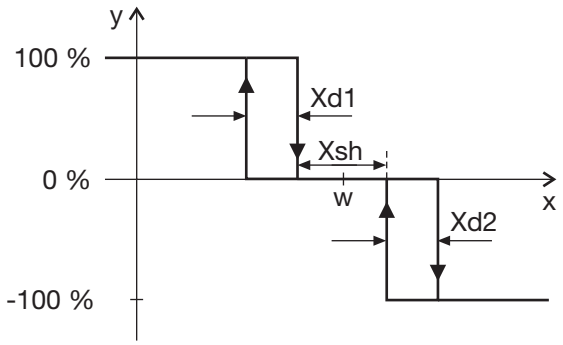
Y0 = -100 %



Three-state controller

This controller has two outputs, which can be configured as continuous (analog output) or switched (digital output). In both cases, the controller can be parameterized with P, PI, PD, or PID transmission behavior. The proportional bands Xp1 and Xp2 must be greater than 0 for the controller structure to take effect.

If Xp1 = 0 and Xp2 = 0, the behavior corresponds to the function of limit value monitoring with switching differential Xd1 and Xd2, and contact spacing Xsh (working point Y0 = 0 %):



Three-step controller

This controller has two switched outputs and can be parameterized with PI or PID transmission behavior. The proportional band Xp must be greater than 0 for the controller structure to take effect.

The three-step controller is used for actuator drives with three switching statuses (actuator open, closed, hold).

Continuous controller

This controller has a continuous output (analog output) and can be parameterized with P, PI, PD, or PID transmission behavior. The proportional band Xp must be greater than 0 for the controller structure to take effect (the setting Xp = 0 is not normally used in practice).

Position controller

This controller is a continuous controller with integrated position controller and two switched outputs (digital outputs) with PI or PID transmission behavior.

The position controller is used for actuator drives with three switching statuses (actuator open, closed, hold). Output level feedback is required.

If the output level feedback is "out of range", the current position of the actuator can no longer be determined. In this case, the actuator can be operated with the keys "Up" (open) and "Down" (close) as for the three-step controller.

5.10 Analog outputs

The device can optionally be equipped with up to 4 analog outputs.

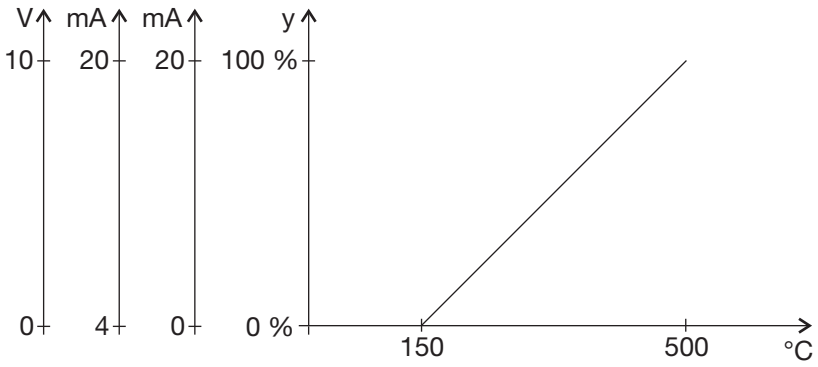
Parameter	Selection/text/value	Description
Signal source	Analog selector **No selection**	Analog signal that is issued on the analog output. In the event of "No selection" a voltage of 0 V or 0 mA is output (depending on the signal type).
Signal type		Physical output signal
	0...10 V	Voltage signal
	0...20 mA	Current signal
	4...20 mA	Current signal
Scaling start 📖	-19999 to 99999 (**0**)	Start value of the input signal range
Scaling end 📖	-19999 to 99999 (**100**)	End value of the input signal range
Response in case of an error 📖		Value of the output signal in case of a fault
	Replacement value	Configurable value (see "Replacement value" parameter)
	LOW value according to NAMUR NE 43	Only for signal type 4 to 20 mA: Fixed value for underrange/short-circuit
	HIGH value according to NAMUR NE 43	Only for signal type 4 to 20 mA: Fixed value for overrange/probe break
Replacement value	**0.0** to 10.25 V or **0.0** to 21.0 mA	Replacement value for the output signal in the event of a fault (value range depending on the signal type)

Scaling start, scaling end

An input signal range is assigned to the physical output signal range by scaling. If, for example, a temperature with a range from 150 °C to 500 °C (input signal range) is issued via the analog output with signal type 0 to 20 mA (output signal range), the zero point is set to 150 (corresponds to 0 mA) and the end value is set to 500 (corresponds to 20 mA).

The default setting corresponds to an input signal range of 0 to 100 (for example, an output level of 0 % to 100 % for a controller output).

The following graphic shows the scaling for the example above with different output signals (y-axes).



Response in case of an error

The behavior in the event of a detected deviation above or below the measuring range (out of range) can be configured. The settings made there also apply for probe/conductor breaks or probe/conductor short-circuits. This results in a safe state for operation in the event of an fault.

Only for signal type 4 to 20 mA: The following table shows the fixed values according to NAMUR recommendation NE 43 that are output in the event of a malfunction with the corresponding configuration.

Signal type	LOW value	HIGH value
4 to 20 mA	3.6 mA	21 mA

Behavior after power on

A voltage of 0 V is output during the device's initialization phase (depending on the configuration). Once the initialization is complete, the output signal depends on the signal source and the configured signal type.

5.11 Digital outputs

The device has 3 digital outputs as a standard feature (logic 0/14 V, 2 relays). On top of that, up to 8 additional digital outputs in different versions are optionally available depending on the device type (relay, logic 0/14 V, logic 0/22 V, solid state relay, open collector).

Parameter	Selection/text/value	Description
Signal source	Digital selector **No selection**	Signal that is issued at the digital output. Default setting for digital output 1: **Controller 1 – switching output 1 (digital)** In the event of "No selection" the output signal does not correspond to the active status.
Signal inverting	**No**	Output signal not inverted.
	Yes	Output signal inverted.

NOTE!

If digital output 3 is active (signal source assigned), digital input 1 cannot be used.

Voltage supply for transmitter

A digital output with the version "Logic 0/22 V" can also be used as the voltage supply for transmitters (see technical data). In this case a digital flag should be used as the signal source. The digital flag must be set to "On" in the configuration.

Behavior after power on

The outputs are not active during the device's initialization phase (depending on the configuration). Once the initialization is complete, the output signal corresponds to the signal of the source (inverted if necessary).

5.12 Limit value monitoring functions

The device is equipped with 8 limit value monitoring functions that can be individually configured. The following configuration parameters are available for each of the 8 limit value monitoring functions.

Parameter	Selection/text/value	Description
Function 📖	**Without function**	
	AF1	Limit value above and below the setpoint value
	AF2	As for AF1, output signal inverted
	AF3	Limit value below the setpoint value
	AF4	As for AF3, output signal inverted
	AF5	Limit value above the setpoint value
	AF6	As for AF5, output signal inverted
	AF7	Fixed limit value (independent of the setpoint value)
	AF8	As for AF7, output signal inverted
Actual value X	Analog selector **Analog input 1**	Analog signal as actual value (signal to be monitored)
Setpoint W	Analog selector **Controller 1 – current setpoint value**	Analog signal as setpoint value (reference signal for AF1 to AF6)
Limit value AL	-19999 to 99999 (**0**)	Admissible deviation (AL) of the actual value
Switching behavior 📖		Standard of monitoring band for AF1 and AF2
	Symmetrically	Standard monitoring band, formed by the limit value (AL)
	Non-standard	Non-standard monitoring band, formed by the limit value (AL) and limit value 2 (AL2)
Limit value AL2	-19999 to 99999 (**0**)	For non-standard switching behavior: Second limit value (AL2) to implement an asymmetrical monitoring band; only for AF1 and AF2 The limit value (AL) is below the setpoint value; the second limit value (AL2) is above the setpoint value.
Hysteresis	0 to 99999 (**1**)	Switching thresholds of the output signal (difference from limit value)
Position of hysteresis 📖		Position of hysteresis around the limit value
	Symmetrically	The hysteresis is positioned with half above and half below the limit value.
	Non-standard left	The hysteresis is positioned below the limit value (typically).
	Non-standard right	The hysteresis is positioned above the limit value (typically).
Startup alarm suppression 📖		Behavior of the limit value monitoring function after a change to the setpoint value, the limit value, or following power on
	Off	Limit value monitoring always operates according to its alarm function.
	On	Alarm suppression after power on or if limit value or setpoint value is changed

Parameter	Selection/text/value	Description
Switch-On delay	**0** to 9999	Delay time (in seconds) for activation of the output signal if alarm condition is present.
Switch off Delay	**0** to 9999	Delay time (in seconds) for deactivation of the output signal if alarm condition is no longer present.
Pulse time	**0** to 9999	The output signal is deactivated automatically after this time (in seconds), even if the alarm condition is still present. If the alarm condition occurs again, the function re-starts (edge-triggered).
Response in case of an error		Output signal in the event of a fault (e.g., in the event of overrange or underrange)
	Off	Output signal inactive
	On	Output signal active
Locking	Digital selector **No selection**	Signal (high-active) for suppressing the output signal
Lock	**Off**	Self-locking is not active. The output signal is reset as soon as the actual value is back in the valid range.
	On	Self-locking is active. Self-locking can only be acknowledged if the actual value is back in the valid range.
	Always acknowledgeable	Self-locking is active. Self-locking can always be acknowledged. After acknowledgement, the output signal remains inactive, even if the alarm condition is still present (actual value is outside the valid range). Only once the actual value has reached the valid range again and then left it again is the output signal activated.
Acknowledgement	Digital selector **No selection**	Signal (high-active) for acknowledging the output signal in case of self-locking
Additional functions	Expansion 1 to Expansion 5	Reserved functions for service purposes. Only activate when instructed to do so by service personnel! Click checkbox to activate the function.

Function

For the AF1 to AF6 alarm functions, the final limit value depends on the setpoint value – the entered limit value is added to or subtracted from the setpoint value. The AF7 and AF8 alarm functions work with a fixed limit value which corresponds to the limit value entered.

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Startup alarm suppression

Function of the startup alarm suppression:

- After power on, the alarm signals for the limit value monitoring function remains inactive, even if the actual value is in the alarm range.
- If the limit value or setpoint value is changed so that the actual value is then within the alarm range, while the actual value is outside of the alarm range, the alarm signal remains inactive.
- The limit value monitoring only starts to operate according to its alarm function again once the actual value has left the alarm range. This means that the alarm signal remains inactive until the actual value returns to the alarm range.

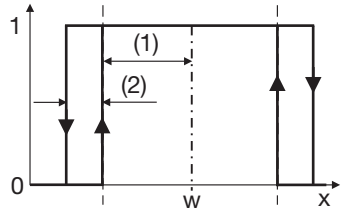
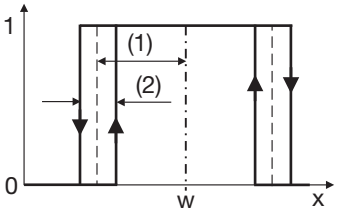
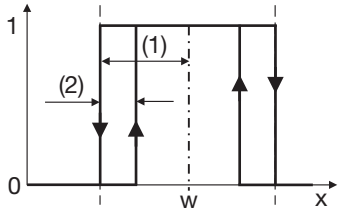
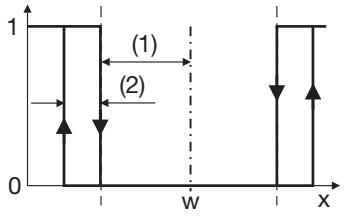
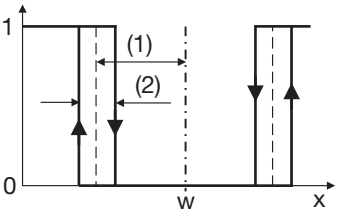
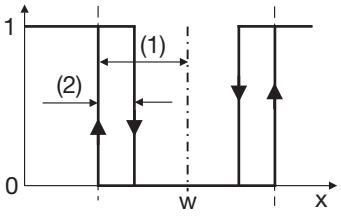
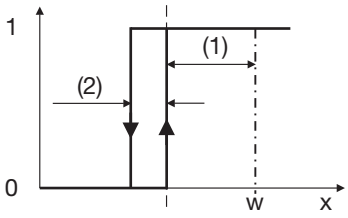
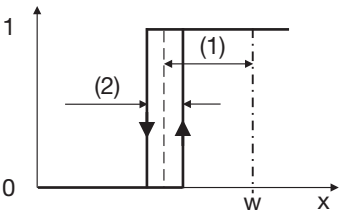
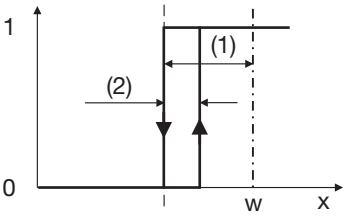
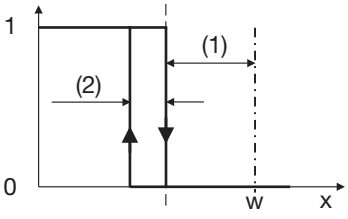
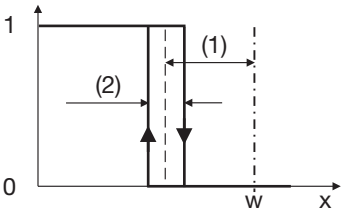
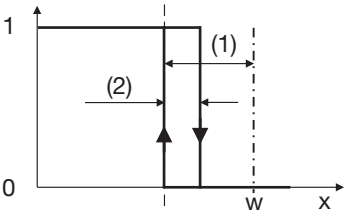
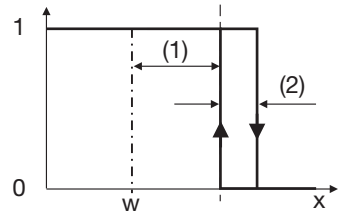
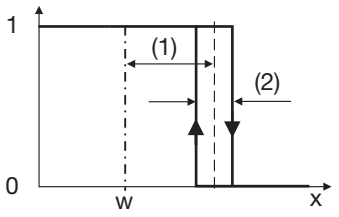
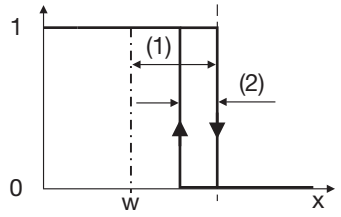
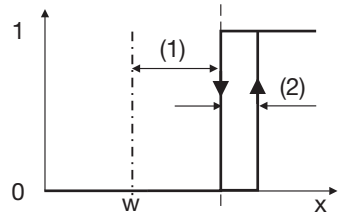
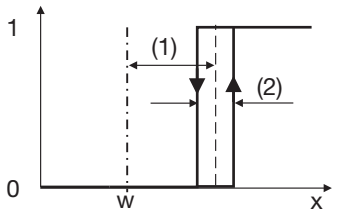
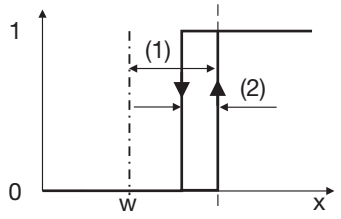
Behavior after power on

The output signal status is not saved via power off. The limit value monitoring function starts after completion of initialization according to its configuration.

5.12.1 Alarm functions and switching behavior

This section describes the alarm functions AF1 to AF8 and the position of the hysteresis (non-standard left, standard, non-standard right).

Limit value in relation to the setpoint value

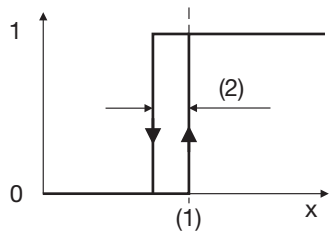
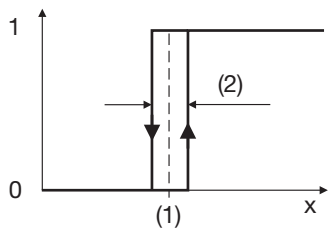
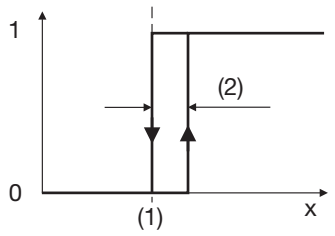
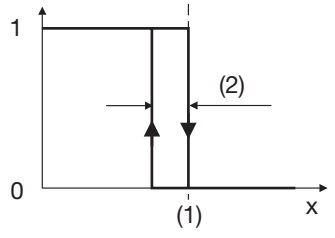
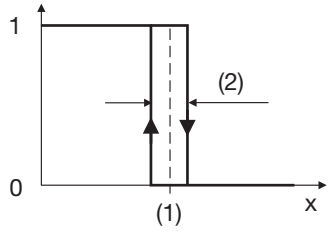
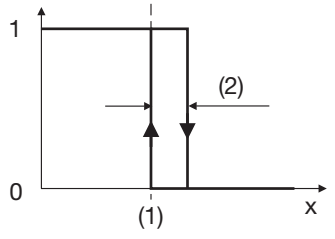
	Non-standard left	Symmetrically	Non-standard right
AF1			
AF2			
AF3			
AF4			
AF5			
AF6			

0 = output signal not active
1 = output signal active

x = actual value
w = setpoint value

(1) Limit value (AL)
(2) Hysteresis

Fixed limit value

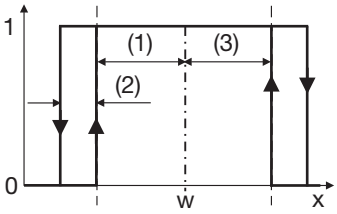
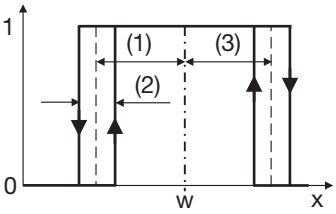
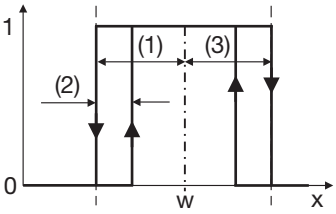
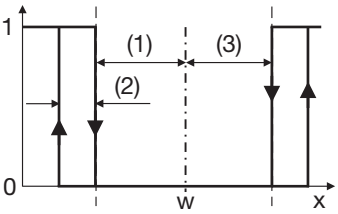
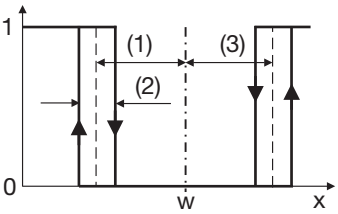
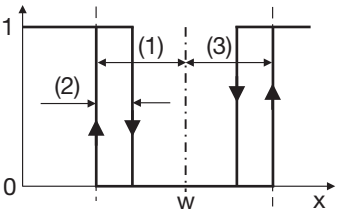
	Non-standard left	Symmetrically	Non-standard right
AF7			
AF8			

0 = output signal not active
1 = output signal active

x = actual value

(1) Limit value (AL)
(2) Hysteresis

Limit value in relation to the setpoint value – non-standard monitoring band

	Non-standard left	Symmetrically	Non-standard right
AF1			
AF2			

0 = output signal not active
1 = output signal active

x = actual value
w = setpoint value

(1) Limit value (AL)
(2) Hysteresis
(3) Limit value 2 (AL2)

5.13 Timer

The device has 2 timers that can be used to implement various, time-dependent functions.

Parameter	Selection/text/value	Description
Function	**Inactive**	Timer is not activated.
	Timer	Timer is activated.
Behavior after power on	**Abort (Stop)**	Timer is aborted.
	Continuation	Timer continues to run for the remaining running time.
	Restart	Timer restarts at the timer time. The lead time is not considered in case of a restart.
Time display		Timer time unit (for input and display on the device)
	mm:ss	Minutes:Seconds
	hh:mm	Hours:Minutes
	dd:hh	Days:Hours
Timer value		Time after timer start The setting range depends on the configured time unit:
	00:00 to 59:59	mm:ss
	00:00 to 23:59	hh:mm
	00:00 to 99:23	dd:hh
Lead time	**0** to 9999	Time before timer start (in seconds)
After-run time	-1 to 9999 (**0**)	Time after timer end (in seconds) -1 = active until acknowledged The after-run signal is active during the after-run time.
Tolerance band	**0** to 99999	Standard tolerance band (in Kelvin) around the setpoint value After the timer is started, the timer time only runs from the point in time when the actual value reaches the tolerance band. 0 = Start without tolerance band
Tolerance band actual value	Analog selector **No selection**	Actual value for tolerance band function
Tolerance band setpoint value	Analog selector **No selection**	Setpoint value for tolerance band function
Start signal	Digital selector **No selection**	Signal (active for rising edge) to start the timer The start signal only works while the timer is not running or during the after-run time (not during the lead time or runtime).
Cancellation signal	Digital selector **No selection**	Signal (active for rising edge) to abort the timer The abort signal only works during the runtime (not during the lead time or after-run time).
Stop signal	Digital selector **No selection**	Signal (high active) for stopping the timer The stop signal only works during the lead time and runtime (not during the after-run time).

Parameter	Selection/text/value	Description
Restart signal	Digital selector **No selection**	Signal (active for rising edge) to reset and restart the timer The restart signal only works during the runtime (not during the lead time or after-run time); it cannot be used to start the timer. The lead time is not considered in case of a restart.
Acknowledgement signal	Digital selector **No selection**	Only if after-run time ≠ 0: signal (active for rising edge) to acknowledge the end signal
Output signal	**Not inverted**	The output signal is "High" while the timer is running.
	Inverted	The output signal is "Low" while the timer is running.
Additional functions	Expansion 1	Reserved function for service purposes. Only activate when instructed to do so by service personnel! Click checkbox to activate the function.

Timer signals (output signals)

Timer output: The signal is active from the start until the timer elapses (high or low, configurable).

Tolerance band signal: The signal is active if the timer has been started but is not yet running due to a breach of the tolerance band (actual value is outside the valid range).

If, after the timer starts, the actual value moves out of the valid range, the timer is stopped (stop signal active) until the actual value reaches the valid range again. The tolerance band signal is not active in this case.

After-run signal: The signal is active after the timer elapses for the duration of the after-run time (or until acknowledgement).

Stop signal: The signal is active while the timer is stopped.

Timer activated: The signal is active if the timer has been activated in the configuration. It is not necessary for it to have been started.

Timer symbol (display)

Off: Timer is not active (function = off)

Lights up: Timer is active (function = on)

Flashes: Timer is active and running (symbol also flashes during lead time, if timer was stopped, and during the after-run time)

Behavior after power on

The timer output signals are inactive during the device's initialization phase. The runtime and remaining running time are saved via power off on the device. The behavior after power on is configurable.

5.14 Hardware counter (12.5 kHz)

The device can optionally be equipped with up to 4 fast counting inputs (up to 12.5 kHz).

Each counting input provides three values which are available in the analog selector:

- Counter value (output value of the counter, depending on the function of the counter)
- Number of pulses
- Pulse period

Parameter	Selection/text/value	Description
Function	**Inactive**	The counter is switched off.
	Counter	Counting of pulses
	Frequency	Calculation of the frequency (Hz)
	Speed	Calculation of the rotational speed (rpm)
	Speed	Calculation of the speed (m/min)
	Flow	Calculation of the totalized flow rate (l/s) Calculating the totalized flow rate can be implemented using ST code (optional).
Factor	-19999 to 99999 (**1**)	The value of the counter is influenced using the factor. Examples: • Adaptation to the resolution of the pulse generator • Conversion of the totalized flow rate unit
Inhibit signal	Digital selector **No selection**	Only for "Counter" function: Signal (high active) for interrupting the counting Counting is active when the signal is "Low".
Reset signal	Digital selector **No selection**	Only for "Counter" function: Signal (high active) for resetting the counter

Behavior after power on

The counter value is only saved via power off with the "Counter" function. For all other functions, the counting/calculation is re-started following power on.

5.15 Data logger

The data logger can be used to record 4 analog and 4 digital signals. The storage interval can be configured between 1 minute and 1 hour. The recording process is based on the ring buffer principle. With a storage interval of 10 minutes, the data can be recorded for approx. 2 years before the oldest data starts to be overwritten.

The data can be extracted by means of a USB flash drive (CSV file). The entire storage is always extracted here. The CSV file contains the following information for each storage time (column headers):

- Number of the data record (starting with 1)
- Date and time (storage time)
- Analog signals 1 to 4 (if configured, the signal designation is used)
- Digital signals 1 to 4 (if configured, the signal designation is used)

The data in the device can be deleted using the setup program.

The data is also deleted by updating the device software, but not by changing the device configuration, however. The data is also not deleted by deactivating the data recording.

Parameter	Selection/text/value	Description
Function	**Inactive**	The recording is not active.
	Active	The selected data is recorded in the set interval (storage interval).
Storage interval	1 to 60 (**10**)	Storage interval in minutes

Analog signals

Parameter	Selection/text/value	Description
Analog signals No. 1 to No. 4	Selector	Select the analog signal to be recorded from the selector. No selection: There is no recording.
Description No. 1 to No. 4	<Enter text>	Designation of the analog signal Enter individual text or use default text.

Digital signals

Parameter	Selection/text/value	Description
Digital signals No. 1 to No. 4	Selector	Select the digital signal to be recorded from the selector. No selection: There is no recording.
Description No. 1 to No. 4	<Enter text>	Designation of the digital signal Enter individual text or use default text.

NOTE!

The date and time of the device must be set correctly for this function.

5.16 Service

The device has 2 service counters.

A service counter can count the switch-on duration or the switching frequency of a digital signal (binary signal). The service signal is activated once the limit value is reached and remains active until acknowledgement.

In addition, an operating hours counter is available that determines the device's operation duration.

Parameter	Selection/text/value	Description
Service interval	**0** to 10000000	Limit value (number or time in hours or days)
Function	**Counter switch. operation**	Counts the switching frequency of a digital signal.
	Time in hours	Counts the switch-on duration of a digital signal in hours.
	Time in days	Counts the switch-on duration of a digital signal in days.
Signal to be monitored	Digital selector **No selection**	Digital signal whose switching frequency or switch-on duration is counted.
Acknowledgement signal	Digital selector **No selection**	Digital signal (high active) for acknowledging (resetting) the service signal
Operation hours counter (only for service counter 1)	**Off**	Function is switched off The counter is reset to 0.
	Display in hours	Device operating time in hours
	Display in days	Device operating time in days

Behavior after power on

Counter readings are maintained after power off (readings are saved on the device in hours).

5.17 Digital control signals

This function enables a single binary input signal to be processed (edge detection, delay, pulses, pulse function) or enables the simple logical linking of up to 3 binary input signals. The output signal of this function is termed the digital control signal (binary control signal).

Up to 8 digital control signals can be individually configured. The following configuration parameters are available for each of the 8 control signals.

Parameter	Selection/text/value	Description
Signal source	Digital selector **No selection**	Input signal (or 1st signal source for OR/AND/XOR link)
Function	**Without function**	The output signal corresponds to the input signal (with inverting if necessary).
	Pulses	A pulse-like signal is output as long as the input signal is active (high).
	Delay	The output signal follows the course of the input signal, whereby the transfer from low to high status and vice versa is delayed.
	Pulse function	For the rising edge of the input signal, the output signal is activated and deactivated once the pulse time has elapsed (even if the input signal is still active). When the edge of the input signal rises again, the function re-starts.
	Rising edge	The output signal is activated for the duration of a cycle interval for the rising edge of the input signal.
	Falling edge	The output signal is activated for the duration of a cycle interval for the falling edge of the input signal.
	OR function	Logical OR linking of the input signals (1st, 2nd, 3rd signal source)
	AND function	Logical AND link
	XOR function	Logical XOR link
2nd signal source OR/ AND/XOR	Digital selector **No selection**	Second input signal for the logical link
3rd signal source OR/ AND/XOR	Digital selector **No selection**	Third input signal for the logical link
Polarity inversion	**No**	Output signal (control signal) not inverted
	Yes	Output signal (control signal) inverted
Switch-on time (or delay time)	**0** to 9999	Pulses: Switch-on time (high status; in seconds) Delay: Delay time (in seconds) for the transition from low to high status
Switch-off time (or delay time)	**0** to 9999	Pulses: Switch-off time (low status; in seconds) Delay: Delay time (in seconds) for the transition from high to low status
Pulse time	**0** to 9999	Time (in seconds) for pulse function

Behavior after power on

The control signals are not active during the device's initialization phase (depending on the configuration).

5 Configuration

5.18 Flags

Flags are variables that are available in the device as intermediate storage. They can be edited on the device or written and extracted via an interface (with the applicable configuration). The values are saved on the device (no data loss in the event of power failure).

Analog flag

The following configuration parameters are available for each of the 8 analog flags.

Parameter	Selection/text/value	Description
Analog flag	-19999 to 99999 (**0**)	Flag value
Temperature		This selection is important for the automatic conversion in case of a change in temperature unit (°C/°F) (see basic settings).
	None	The value is not a temperature.
	Relative	The value is a temperature difference.
	Absolute	The value is a temperature value.
Unit	<Enter text> **%**	Value unit (if it is not a temperature)
Decimal places		Decimal places for the numerical display of the value
	Auto	Automatic
	XXXXX.	No decimal place
	XXXX.X	One decimal place
	XXX.XX	Two decimal places
	XX.XXX	Three decimal places
Start of display range	-19999 to 99999 (**0**)	Minimum admissible value
End of display range	-19999 to 99999 (**100**)	Maximum admissible value

Digital flag

The following configuration parameter is available for each of the 8 digital flags.

Parameter	Selection/text/value	Description
Digital flag	**Off**	"Low" binary value
	On	"High" binary value

Digital push-buttons

8 digital push-buttons are also available in the digital selector. These can be set to "High" via operation on the device (if the operating levels have been configured as applicable). They are automatically reset after a few seconds.

Device functions, such as starting the timer, can be started from the device menu, using the digital push-buttons.

5.19 Math/logic

NOTE!

This function is available in the setup program if the "Math/logic" module has been activated (Identification > Device version > Device configuration). To access this function in the device, it must be enabled with the setup program (online parameters > Enabling of extra codes).

This optional math and logic function can be used to link analog (math) or binary (logic) values. Four configurable formulae can be created for this.

In addition, functions for calculating the differential, ratio, and relative humidity are also provided. In this case, two analog values (variables a and b) are linked to each other. The dry-bulb temperature and the wet-bulb temperature are required for calculating the relative humidity and should be determined with a psychrometric humidity sensor.

For a math formula or logic formula: Use the "Formula editor" button to open an editor that can be used to create formulae by selecting variables and operators.

The following configuration parameters are available for each of the four formulae.

Parameter	Selection/text/value	Description
Function	**Without function**	Function is switched off.
	Difference (a - b)	Differential of variable a and variable b
	Ratio (a/b)	Ratio of variable a to variable b
	Humidity (a; b)	Calculation of relative humidity
	Math formula	Mathematical links with freely selectable variables and operators
	Logic formula	Logical links with freely selectable variables and operators
Linearization (only for math formula)	Selector **Linear**	Linearization of the math result
Temperature		This selection is important for the automatic conversion in case of a change in temperature unit (°C/°F) (see basic settings).
	None	The result is not a temperature.
	Relative	The result is a temperature difference.
	Absolute	The result is a temperature value.
Unit	<Enter text> **%**	Result unit (if it involves a temperature)
Start of display range	-19999 to 99999 (**0**)	Lower limit of display range
End of display range	-19999 to 99999 (**100**)	Upper limit of display range
Decimal places		Decimal places for the numerical display of the value
	Auto	Automatic
	XXXXX.	No decimal place
	XXXX.X	One decimal place
	XXX.XX	Two decimal places
	XX.XXX	Three decimal places
Variable a	Analog selector **No selection**	Analog signal a (for calculating the differential, ratio, and humidity)
Variable b	Analog selector **No selection**	Analog signal b (for calculating the differential, ratio, and humidity)

Parameter	Selection/text/value	Description
Save at power off (only for math formula or logic formula)		
	No	The result is not saved.
	Yes	The result is saved and is available again after power on.
Response in case of an error (only for math formula)		Value of the output signal in the event of a fault (e.g., in case of overrange or underrange)
	Output error value	The math error value 5.0E+37 is output (display: ----).
	Output replacement value	The replacement value is output (see "Replacement value in the event of a fault" parameter).
Replacement value in the event of a fault	-19999 to 99999 (**0**)	Replacement value for output in the event of a fault
Additional functions	Expansion 1 Expansion 2	Reserved functions for service purposes. Only activate when instructed to do so by service personnel! Click checkbox to activate the function.

NOTE!

The trigonometric functions (SIN, COS, and TAN operators) use degrees (360).

Behavior after power on

If the function "Response at restart" is not active, the output value is set to 0 and the calculation restarted following power on.

5.20 ST code

NOTE!

This function is available in the setup program if the "ST code" module has been activated (Identification > Device version > Device configuration). To access this function in the device, it must be enabled with the setup program (online parameters > Enabling of extra codes).

The user has the option to create his/her own application using the "structured text" option (extra code).

The application is created with the ST editor, which is part of the setup program, in the PLC programming language "structured text". The finished application is transmitted to the device and continuously processed there. There is a debugger function available for testing and troubleshooting.

Variables bool_in

Parameter	Selection/text/value	Description
bool_in01 to bool_in10	Digital selector **No selection**	Boolean input variables for the application to be created

Variables real_in

Parameter	Selection/text/value	Description
real_in01 to real_in10	Analog selector **No selection**	Real input variables for the application to be created

Variables bool_out

Parameter	Selection/text/value	Description
bool_out01 to bool_out10	<Enter text> STBA01, STBA02, ...	Designation or description of the Boolean output variables for the application to be created

Variables real_out

The following configuration parameters are available for each of the 10 variables (real_out01 to real_out10).

Parameter	Selection/text/value	Description
Description	<Enter text> STAA01, STAA02, ...	Designation or description of the real output variables for the application to be created
Temperature		This selection is important for the automatic conversion in case of a change in temperature unit (°C/°F) (see basic settings).
	None	The value is not a temperature.
	Relative	The value is a temperature difference.
	Absolute	The value is a temperature value.
Unit	<Enter text> **%**	Value unit (if it is not a temperature)
Start of display range	-19999 to 99999 (**0**)	Lower limit of the display range Smaller values are considered invalid (display: ----).
End of display range	-19999 to 99999 (**100**)	Upper limit of the display range Larger values are considered invalid (display: ----).

Parameter	Selection/text/value	Description
Decimal places		Decimal places for the numerical display of the value
	Auto	Automatic
	XXXXX.	No decimal place
	XXXX.X	One decimal place
	XXX.XX	Two decimal places
	XX.XXX	Three decimal places

ST editor

Press the corresponding button to start the ST editor.

NOTE!

There is a separate manual for the ST editor available with further information.

5.21 RS485 interface

The device can optionally be equipped with an RS485 interface, which supports the Modbus protocol (Modbus RTU) as master or slave.

For use of the Modbus protocol, see also:

chapter 5.25 "Modbus frames for reading", Page 100

chapter 5.26 "Modbus frames for writing", Page 100

Parameter	Selection/text/value	Description
Protocol	**Modbus slave**	The device acts as a Modbus slave.
	Modbus master	The device acts as a Modbus master.
Baud rate	**9600**	9600 baud
	19200	19200 baud
	38400	38400 baud
	115200	115200 baud
Data format	**8 - 1 - no parity**	8 data bits, 1 stop bit, no parity
	8 - 1 - odd parity	8 data bits, 1 stop bit, odd parity
	8 - 1 - even parity	8 data bits, 1 stop bit, even parity
	8 - 2 - no parity	8 data bits, 2 stop bits, no parity
Min. response time	0 to 500 (**40**)	The minimum response time (in milliseconds) is adhered to by the Modbus slave before it sends a response following a data request. After receiving a response, the Modbus master waits during this period before sending a new request.
Modbus slave:		
Device address	**1** to 254	Modbus device address
Timeoutmonitoring	**No**	No monitoring
	Yes	The monitoring is active.
Timeout	250 to 99999 (**2000**)	Time period for timeout monitoring. After this time, a failure of the Modbus master is identified and the signal "Slave-Timeout COM1" is activated (see digital selector).
Modbus master:		
Timeout	60 to 10000 (**200**)	A request sent by the master is defined as faulty if no answer is received within this time.
Scan cycle	60 to 99999 (**500**)	The Modbus master requests data from the Modbus slave at these intervals.

NOTE!

Changes to the interface parameters only become active once the device has restarted (power on).

NOTE!

There is a separate Modbus interface description available with further information. Amongst other things, this includes the Modbus addresses of all device data, process value, and configuration parameters available via Modbus.

Behavior after power on

The inputs are set to 0 (binary) or "NOINPUT" (analog) during the device's initialization phase. Once the initialization is complete, the values transferred via Modbus are applied.

5.22 Modbus TCP

The device can optionally be equipped with an Ethernet interface, which supports the Modbus protocol (Modbus TCP) as master or slave, among other things.

If the device is a Modbus slave, two external devices (Master 1 and Master 2) can access the device at the same time. If it is a Modbus master, it can communicate with up to two external devices (Device 1, Device 2).

For use of the Modbus protocol, see also:

chapter 5.25 "Modbus frames for reading", Page 100

chapter 5.26 "Modbus frames for writing", Page 100

Modbus slave

The device acts as a Modbus slave.

Parameter	Selection/text/value	Description
Port	0 to 1024 (**502**)	Device's TCP port (for Modbus TCP) Changes to the port are not applied until after the device has been restarted (power on).
Master 1, Master 2:		
Timeoutmonitoring	**No**	No monitoring
	Yes	Monitoring by the device (Modbus slave) is active.
IP address	**0.0.0.0**	IP address of the Modbus master (for timeout monitoring) The address must be set manually.
Timeout	250 to 99999 (**2000**)	Time period for the timeout monitoring. After this time, a failure of the Modbus master is identified and the signal "Slave-Timeout TCP1" (for Master 1) or "Slave-Timeout TCP2" (for Master 2) is activated (see digital selector).

Modbus master

The device acts as a Modbus master.

Parameter	Selection/text/value	Description
Timeout	60 to 10000 (**2000**)	A request sent by the device (Modbus master) is defined as faulty if no answer is received within this time.
Scan cycle	100 to 99999 (**500**)	The device (Modbus master) requests data from the Modbus slave at these intervals.
Device (Slave) 1, device (Slave) 2:		
IP address	**0.0.0.0**	IP address of Modbus slave The address must be set manually.
Port	0 to 1024 (**502**)	TCP port of Modbus slave (for Modbus TCP)

NOTE!

To ensure that fixed IP addresses are used, the DHCP must be deactivated in the devices involved, if applicable.

The transfer times in an Ethernet network depend in part on the network architecture and the capacity utilization. This may result in delays during updates of process values.

NOTE!

There is a separate Modbus interface description available with further information. Amongst other things, this includes the Modbus addresses of all device data, process value, and configuration parameters available via Modbus.

Behavior after power on

The inputs are set to 0 (binary) or "NOINPUT" (analog) during the device's initialization phase. Once the initialization is complete, the values transferred via Modbus are applied.

5.23 External analog inputs

External analog inputs are variables that can be written and extracted via an interface. The values are not saved on the device (data loss in the event of power failure).

The following configuration parameters are available for both of the 16 external analog inputs.

Parameter	Selection/text/value	Description
Unit	<Enter text> **%**	Value unit (if it is not a temperature)
Temperature		This selection is important for the automatic conversion in case of a change in temperature unit (°C/°F) (see basic settings).
	None	The value is not a temperature.
	Relative	The value is a temperature difference.
	Absolute	The value is a temperature value.
Decimal places		Decimal places for the numerical display of the value
	Auto	Automatic
	XXXXX.	No decimal place
	XXXX.X	One decimal place
	XXX.XX	Two decimal places
	XX.XXX	Three decimal places
Start of display range	-19999 to 99999 (**0**)	Lower limit of display range
End of display range	-19999 to 99999 (**100**)	Upper limit of display range
Reset signal	Digital selector **No selection**	The reset signal (high active) sets the external analog input to a status of "no input signal".

5.24 External digital inputs

External digital inputs are variables that can be written and extracted via an interface. The values are not saved on the device (data loss in the event of power failure).

The following configuration parameters are available for both of the 16 external digital inputs.

Parameter	Selection/text/value	Description
Reset signal	Digital selector **No selection**	The reset signal (high active) sets the external digital input to a binary value of 0.
Polarity inversion	**No**	Input signal not inverted.
	Yes	Input signal inverted.

5.25 Modbus frames for reading

This function is used to compile up to 8 Modbus frames for reading process values from external devices (via interface) individually for each opposite end. The process values (analog and binary values) are written to the selected variables (external inputs) from the received Modbus telegram and are available for use in the device. Each frame can be used to configure up to 6 frame entries with a process value each, which are then grouped and transmitted in a Modbus telegram.

NOTE!

Configuration and use of the Modbus frames are described in the separate Modbus interface description.

5.26 Modbus frames for writing

This function can be used to compile up to 8 Modbus frames for writing the device's process values to external devices (via interface) individually for each opposite end. The device writes the process values (analog and binary values) to the frames, where they are available for external devices.

Each frame can be used to configure up to 6 frame entries with a process value each, which are then grouped and transmitted in a Modbus telegram.

NOTE!

Configuration and use of the Modbus frames are described in the separate Modbus interface description.

5.27 PROFINET

This function is supported as of version 433.02.xx of the device software.

With this function, 2 modules (slots) with process values (analog and binary values) can be individually configured for communication via the PROFINET interface.

In module 1, up to 41 input values and 41 output values can be transmitted (9 analog and 32 binary values each).

Module 2 allows the transmission of 10 input values and 10 output values (analog values only).

NOTE!

Configuration and use of the modules are described in the separate PROFINET interface description.

6.1 Operating levels

The user must configure the operating levels (menu levels) to be available in the device using the setup program. A basic configuration is available per default which can be customized and supplemented.

NOTE!

When selecting the parameters for the operating levels, the setup program does not check for any interdependencies to other parameters. This means it is possible, for example, to place the parameter "Signal type" in the configuration level without also selecting the parameter "Linearization". As a result, the signal type can be changed on the device, but not the linearization. The user is therefore responsible for selecting all the required parameters.

NOTE!

Diacritical characters (umlaut characters, accented characters) cannot be displayed on a 116 format device. The texts may have to be modified.

Menu levels (level 1 to level 4)

The description (designation) of a menu level can be edited in 4 languages.

A level which has no parameters is not displayed in the device.

Parameter	Selection/text/value	Description
Description 1 to description 4	(enter text)	Description (designation) of the menu level in language 1 to language 4 (sequence of device languages) Enter individual text or use default text.

Sub-levels

The description (designation) of a sub-level can be edited in 4 languages. To edit, mark the line and click the applicable button (or double-click on the line).

The sequence of the sub-levels can be changed ("Sort entry" buttons).

Parameter	Selection/text/value	Description
Description 1 to description 4	(enter text)	Description (designation) of the sub-level in language 1 to language 4 (sequence of device languages) Enter individual text or use default text.

Parameter

Select the corresponding line and click "Edit" in order to edit a parameter (or double-click the corresponding line).

The buttons at the bottom edge of the editing window can be used to switch between the parameters without having to close the editing window. Button "X" deletes the configuration of the applicable parameter.

The sequence of the parameters can be changed ("Sort entry" buttons).

Parameter	Selection/text/value	Description
Sub-level (only for levels 2 to 4)	No selection	No sub-level selected. The applicable parameter is not applied to the menu. A parameter that already exists in the menu is deleted.
	<Sub-level>	The applicable parameter is assigned to the selected sub-level.
Parameter	Selector	Select the process value or configuration parameter from the selector. The configuration parameters can be read and written (R/W). Apart from a few exceptions, the process values are only readable (R/O). Editable process values in the operating levels: - Current date/current time - Digital push-button 1 to 8 - Program number (for the program start) - Starting time (of the program) - Program start
Description 1 to description 4	(enter text)	Description (designation) of the parameter in language 1 to language 4 (sequence of device texts) Enter individual text or use default text.
Number of texts	(Display only)	Shows the number of texts (parameter values) which are available to select for the applicable parameter. These texts are transferred from the set-up program to the text list, and occupy the corresponding number of text lines there (in the range from 300 to 699).

Level 1 (default setting: startup level)

This level can include up to 16 parameters (process values or configuration parameters).

All parameters are located in the same level.

Level 2

This level can include up to 96 parameters (process values or configuration parameters).

The parameters can be assigned to up to 4 sub-levels.

Level 3

This level can include up to 76 parameters (process values or configuration parameters).

The parameters can be assigned to up to 4 sub-levels.

Level 4

This level can include up to 36 parameters (process values or configuration parameters).

The parameters can be assigned to up to 8 sub-levels.

6.2 Text list

The text list contains 800 texts in the four device languages. Per default, texts 1 to 699 are pre-assigned or reserved and should not be changed by the user.

Texts 700 to 800 are intended for the user to use freely.

The applicable text number uniquely identifies a text. When configuring certain functions, the text number is used to select a text. The language in which the selected text is displayed depends on the set device language (see basic settings).

The texts in a language can be changed in the right-hand column (target language).

NOTE!

Diacritical characters (umlaut characters, accented characters) cannot be displayed on a 116 format device. The texts may have to be modified.

6 User interface

7.1 Program controller

The program controller (program generator) is configured in this menu.

Parameter	Selection/text/value	Description
Program controller 🕮	**Off**	The device operates as a fixed-setpoint controller ("Fixed value" operating mode).
	On	The device operates as a program controller ("Automatic" and "Stop" operating modes).
Program start 🕮	**Program start**	The program starts at the first programmed setpoint value.
	At the actual value	The programs starts with the actual value as the first setpoint value.
Program repeat	**No**	No program repeat
	Yes	The program is cyclically repeated.
Start with power on	**No**	No automatic program start after power on
	Yes	Automatic program start after power on
Program progression	**Ramp**	Setpoint value change as ramp
	Step	Setpoint value change as step
Tolerance band 🕮	**0** to 9999	Tolerance band for setpoint value 1 (for monitoring the actual value) 0 = tolerance band not active
Time display		Time unit for displaying the program times
	mm:ss	Minutes:Hours
	hh:mm	Hours:Minutes
	dd:hh	Days:Hours
Hot-runner startup ramp 🕮	**No**	The function is not active.
	Yes	The startup ramp for hot-runner technology is active.
Operating contacts in basic status	Contact 1 to contact 4	These operating contact are used if the program is not running (program controller in basic status). Click checkbox to activate the contact.
	Not selected (empty)	Operating contact is not active.
	Selected (checkmark)	Operating contact is active.
Start signal	Digital selector **No selection**	Signal (active for rising edge) to start the program
Cancellation signal	Digital selector **No selection**	Signal (active for rising edge) to end the program (program abort)
Stop signal	Digital selector **No selection**	Signal (high active) for stopping the program
Next section signal	Digital selector **No selection**	Signal (active for rising edge) to switch to the next program section
Additional functions	Expansion 1 to expansion 16	Reserved functions for service purposes. Only activate when instructed to do so by service personnel! Click checkbox to activate the function.

7 Program editor

Program controller

Operating modes of the program controller:

- Fixed value: The device operates as a fixed-setpoint controller.
- Automatic: The device operates as a program controller. The program is active and is being processed.
- Stop: The device operates as a program controller. The program is active, but has been stopped.

NOTE!

The device operates as a fixed-setpoint controller before program start, during the lead time (time period between activation of the program start, e.g. via start signal, and the time for program start determined by the date and time) and following program end. If the control should not be active during this phase, the controller may only be switched on during the active program. Here, the signal "Program active" can be used:
Configuration > Controller > Controller input > Controller ON signal: Program > Program active

Program start

A program can be started in the following ways:

- during power on (with applicable configuration of the program controller)
- via a start signal (with applicable configuration of the program controller)
- by using the special parameter "Program start" (if this is available in an operating level)

NOTE!

The program can be started at a specific point in the future. Here, the parameter "Start date" must be used. This must be placed in an operating level beforehand, during the configuration of the user interface. The values of the parameter (date and time) must be set to the desired starting time. After this, the program start must be activated (e.g. via a start signal). The program will actually only start at the set starting point.

If the starting point is not in the future, the program will be started immediately.

The date and time of the device must be set correctly for this function.

Tolerance band

In the "Automatic" and "Stop" operating modes, when the tolerance band is active, a check is continuously performed as to whether the actual value is within the tolerance band. If the actual value deviates from the tolerance band, the tolerance band signal is activated and the program stopped.

The tolerance band is not active in the "Fixed value" operating mode – or during the lead time and after program end.

NOTE!

The tolerance band is symmetrical to setpoint value 1 and applies for all program sections.

Furthermore, a tolerance band can be defined on a section-by-section basis for each of the two setpoint values in the program. Here, too, if the tolerance band is breached, the tolerance band signal is activated and the program stopped.

Hot-runner startup ramp

The hot-runner function is a special ramp function which is used as a so-called startup ramp for hot-runner technology in the plastics industry. It enables the gentle operation of ceramic cartridge heaters; moisture can evaporate slowly from the hygroscopic cartridge heaters during the start-up phase (warm-up phase).

⇨ chapter 5.8.6 "Ramp function", Page 70

Behavior after power on

The current program status is not saved via power off. The behavior after power on is configurable (automatic start).

7.2 Program administration

Using the program editor, the user can create a program for two setpoint values and four operating contacts with up to 24 program sections.

Settings that affect the program sequence (e.g. program start, setpoint value change as a step or ramp, program repeat) are configured in the program controller configuration (accessible in the program editor via the "Program controller" button).

Parameter	Selection/text/value	Description
Program name	<Enter text>	Free choice of name for the program
Program controller (button)	Press button	Use this button to open a menu for configuring the program controller.
Cut (button)	Press button	Use this button to cut lines (program sections) that have been marked.
Copy (button)	Press button	Use this button to copy lines that have been marked.
Insert (button)	Press button	Use this button to insert lines that have been cut or copied above a selected line.
New (button)	Press button	Use this button to insert a new line above a marked line.
Remove (button)	Press button	Use this button to delete lines that have been marked.
No. (number)	Select section to be programmed (starting with section 1)	Number of program section
Setpoint value 1 (preferably for controller 1)	-1999 to 9999	Setpoint value 1 in corresponding program section The input limits depend on the controller configuration (controller 1, setpoint value 1: limit min., limit max.).
Setpoint value 2 (preferably for controller 2)	-1999 to 9999	Setpoint value 2 in corresponding program section The input limits depend on the controller configuration (controller 2, setpoint value 1: limit min., limit max.).
Dur.	 **00:01** to 59:59 **00:01** to 23:59 **00:01** to 99:23	Duration of program section Setting range and unit depend on the program controller configuration ("Time display" parameter): mm:ss hh:mm dd:hh

Parameter	Selection/text/value	Description
Control contacts	Activation of operating contacts (contact 1 to contact 4) by selection (drop-down list)	
	Selected (checkmark)	Operating contact is active Active operating contacts are displayed in the "Operating contacts" field.
	Not selected	Operating contact is not active
Tolerance band min. 1 	0 to 9999	The value is subtracted from setpoint value 1.
Tolerance band max. 1	0 to 9999	The value is added to setpoint value 1.
Tolerance band min. 2	0 to 9999	The value is subtracted from setpoint value 2.
Tolerance band max. 2	0 to 9999	The value is added to setpoint value 2.
OK	Press button	Before the entered values are applied, it is checked whether the setpoint values lie within the limits set in the configuration of the controller.
OK with test	Press button	The whole test plan is checked to ensure compliance with the limits set in the configuration of the controller.

Tolerance band

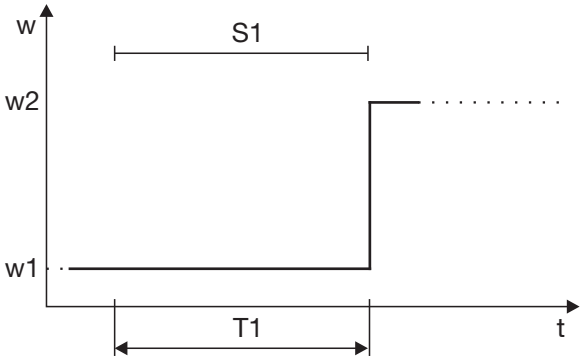
Lower tolerance band limit: Setpoint value - tolerance band min.

Upper tolerance band limit: Setpoint value + tolerance band max.

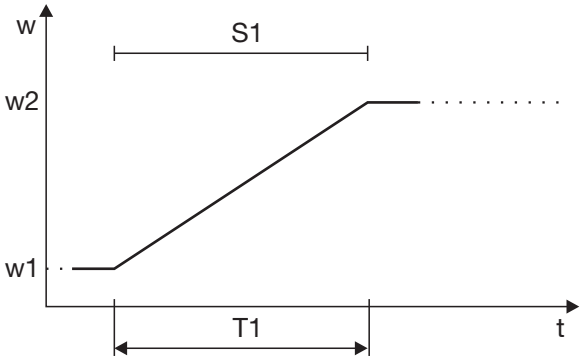
Program progression as step or ramp

The following diagrams show the progression of a setpoint value within a program section as a function of the "Program progression step" parameter (program controller configuration).

Yes (step):



No (ramp):



S1 = Program section 1
T1 = Section time 1
w1 = Setpoint value in program section 1
w2 = Setpoint value in program section 2

The programmed setpoint value determines the setpoint value at the start of the relevant program section.

With "Step", the setpoint value remains constant within a program section. It does not change until the next section that has been programmed with a different setpoint value starts.

With "Ramp" the setpoint value follows a ramp course within a program section, as long as the next section has been programmed with a different setpoint value. The ramp slope is determined by the section time and the difference between the two setpoint values.

7 Program editor

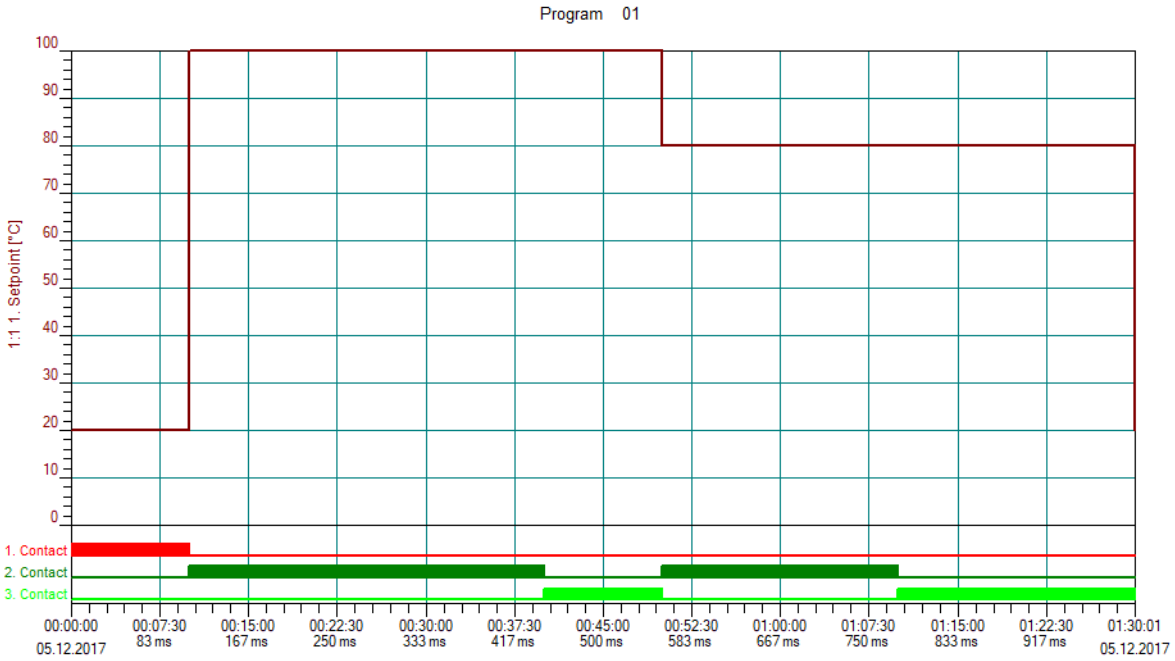
7.3 Program simulation

The program simulation produces a diagram that shows the progression of the setpoint value and the state of the operating contacts.

The following examples 1 and 2 show the different setpoint value progression as a function of the "Program progression" parameter (step or ramp). This simple program is used for this purpose:

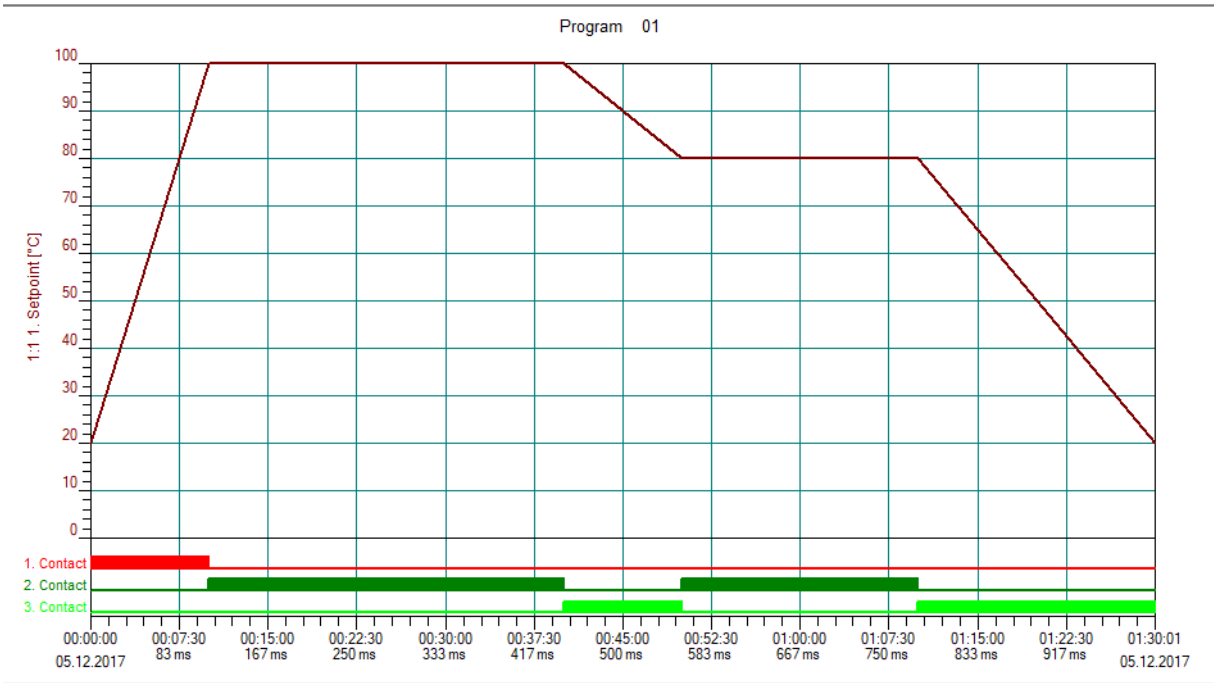
No.	1.Setpoint [°C]	Duration [mm:ss]	Control contacts
1	20.0	10:00	1
2	100.0	30:00	2
3	100.0	10:00	3
4	80.0	20:00	2
5	80.0	20:00	3
6	20.0	00:01	

Example 1: Setpoint step



The setpoint value programmed in a section (e.g. 20 in section 1) remains constant for the entire duration of this section. At the start of the next section, the setpoint value jumps to the value for this section (e.g. 100 in section 2).

Example 2: Setpoint ramp



The setpoint value programmed in a section (e.g. 20 in section 1) changes gradually during that section to the setpoint value of the next section (e.g. 100 in section 2). This produces a course in a ramp shape. For a setpoint value to remain constant in a section (e.g. 100 in section 2), the same setpoint value must be specified for the next section (e.g. 100 in section 3).

7 Program editor

The "Online parameters" area in the setup program contains functions that are only configured or executed in the setup program. These are:

- Deleting data logger
- Approval of extra codes
- Calibrate/test
- Selecting additional process values for online data

The area also contains the following functions, some of which are available on the device too – if the operating levels are assigned as applicable:

- Ethernet
- Date and time

An active connection between the setup program and the device is required for executing the functions.

The default settings are shown in bold in the tables.

8.1 Ethernet

There is an option to equip the device with an Ethernet interface.

The device may be integrated into a company network via the Ethernet interface. The following functions are supported:

- Communication with PC software such as the setup program
- Communication with a Modbus master (or Modbus slave) via Modbus TCP

Further information can be found in the interface description (Modbus).

Parameter	Selection/text/value	Description
IP address assignment	**Automatic**	The IP address of the device is obtained from a DHCP server.
	Manual	The IP address must be assigned manually.
IP address	0.0.0.0 to 255.255.255.255 (**223.223.223.1**)	Manually assigned IP address for the device The IP address may need to be requested from the administrator in question.
Subnet mask	0.0.0.0 to 255.255.255.255 (**255.255.255.0**)	Subnet mask if the IP address is manually assigned The structure of the subnet mask may need to be requested from the responsible administrator.
Standard gateway	**0.0.0.0** to 255.255.255.255	IP address of the standard gateway (router) if the IP address is manually assigned The IP address may need to be requested from the administrator in question.
DNS server IP automatic	No	The IP address of the DNS server must be assigned manually (see below).
	Yes	The IP address of the DNS server is automatically assigned.
DNS device name 🕮	<Enter text>	Symbolic device name The DNS device name can also be used for addressing the device if necessary (instead of the IP address).
DNS server	**0.0.0.0** to 255.255.255.255	Manually assigned IP address of the DNS server The IP address may need to be requested from the administrator in question.

DNS device name

The DNS device name is initially entered in the setup program. At a later point (once the setup project has been transferred), the final DNS device name is automatically formed in the device. Here the MAC address of the device is appended to the name assigned in the setup program. This ensures that a setup project can be transferred to several devices but that each device still has a unique DNS device name.

8.2 Date and time

The device's date and time are configured using this function by transferring them from the PC on which the setup program is running or setting them manually.

Parameter	Selection/settings	Description
Date/time of the device	Select "Read out permanently" button	The current date and time are cyclically read out from the device. To newly set the date and time, first cancel cyclical reading ("Stop" button).
New setting	**Use date/time from PC**	The PC's date and time settings are used for setting the device.
	Enter date/time	Date and time can be entered manually.
Set	Press button	The settings are adopted by the device.

8.3 Deleting data logger

This function is used to delete all data on the device recorded up to the present time by the data logger.

⇨ chapter 5.15 "Data logger", Page 86

The data can also be deleted during an ongoing recording. In this case, the recording continues after deleting and the numbering of the data records begins again at 1.

8.4 Fine adjustment

This function can be used to correct the measured values of an analog input. In contrast to measured value offsetting, which is used to specify a constant correction value for the entire characteristic line, fine adjustment can also be used to change the gradient of the characteristic line.

Parameter	Selection/text/value	Description
Active	**No**	The function for performing fine adjustment is not active.
	Yes	The function is active.
Device start value	-19999 to 99999 (**0**)	Fine adjustment: device measured value at the lower measuring point In contrast to measured value offsetting, which is used to specify a constant correction value for the entire characteristic line, fine adjustment can also be used to change the gradient of the characteristic line.
Device end value	-19999 to 99999 (**1**)	Fine adjustment: device measured value at the upper measuring point
Reference start value	-19999 to 99999 (**0**)	Fine adjustment: reference value at the lower measuring point
Reference end value	-19999 to 99999 (**1**)	Fine adjustment: reference value at the upper measuring point

Example

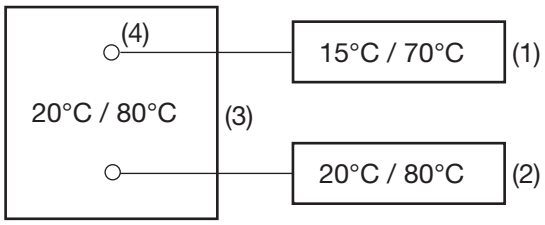
The temperature inside a furnace is measured with an RTD temperature probe connected to the device. The measured value displayed by the device deviates from the actual temperature as a result of the sensor temperature drifting. The amount of deviation is different at the lower measuring point (start value) and at the upper measuring point (end value), meaning a measured value offset correction is not suitable. The actual temperature (reference value) is determined using a reference measuring device.

Actual start value: 15 °C (measured value)

Target start value: 20 °C (reference value)

Actual end value: 70 °C (measured value)

Target end value: 80 °C (reference value)

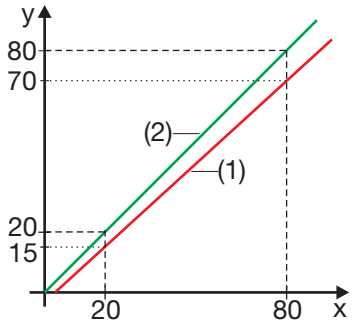


1 Display values
2 Reference values
3 Furnace
4 Sensor in RTD temperature probe

Performing fine adjustment

1) Switch off fine adjustment.
2) Run up first working point (lower measuring point, value as low and constant and possible). Read the measured value on the device, read the reference value on the reference measuring device. Note both values.
3) Run up second working point (upper measuring point, value as high and constant and possible). Read the measured value on the device, read the reference value on the reference measuring device. Note both values.
4) Switch on fine adjustment, enter device's measured values from the first and second working point (actual start value (15.0) and actual end value (70.0)); then enter the reference measuring device's reference values from the first and second working point (target start value (20.0) and target start value (80.0)).

The following diagram shows the changes in the characteristic line caused by the measured value offset (point of intersection with the x axis as well as the gradient) based on the values from the example above (x = reference value, Y = display value).



1 Characteristic line before fine adjustment
2 Characteristic line after fine adjustment

Reverse fine adjustment

The following settings must be made to reverse the fine adjustment: actual start value = target start value; actual end value = target end value

Switching off fine adjustment leads to this being reversed.

8.5 Approval of extra codes

You can use this function to activate additional functions (extra codes) for the device via the setup program.

Action	Version	Description
Generate code number	To generate a code number, click the function to select it and then click the "Next" button. Follow the other instructions.	This function is used to generate a code number to activate an extra code. The code number is required to obtain an activation code from a sales partner.
Enter activation code	To enter an activation code, click the function to select it and then click the "Next" button. Follow the other instructions.	This function is used to activate an extra code. This requires the activation code received from the sales partner.
Reset extra codes	To reset extra codes, click the function to select it and then click the "Next" button. Follow the other instructions.	This function can be used to lock an extra code that has been activated. Locked extra codes can only be activated by re-enabling. This procedure is subject to charge.

8.6 Calibrate/test

CAUTION!

The device's outputs may adopt undefined states.

This can lead to undefined states in the system.

▶ Before executing this function, disconnect the device from the system.

Hardware/software

The device's hardware and software status is displayed in this window.

Calibration constants

This window displays the calibration constants for the analog input and output.

Analog inputs

This function tests the analog inputs. To allow this to happen, the signal or resistance must be in place at the analog input.

After selecting the corresponding signal type and pressing the "Test" button, the value at the analog input is continuously measured and displayed in the "Act. value" (last value) field as well as in the display field (left; all measured values). The continuous measurement is terminated by pressing "Stop".

Analog outputs

This function tests the analog outputs. The signal at the analog output must be measured for this purpose.

After selecting the corresponding signal type and entering the setpoint value, the corresponding value is output at the analog output by pressing the "Test" button. The output value must be measured and entered in the "Measured value" field. Finally, the setpoint value and actual value (measured value) are displayed for comparison.

Digital inputs

This function is used to display the logical statuses at the digital inputs. Any inversion activated in the configuration of the respective digital input is not considered.

Read permanently: After pressing the button, the inputs are continuously read and the display is continuously updated. Reading must be ended using the "Stop" button.

Read once: The inputs are read once and the determined status is displayed each time the button is pressed.

If the status at an input is TRUE, this is indicated with a check mark in the checkbox.

Digital outputs

This function is used to set the logical statuses at the digital outputs. Any inversion activated in the configuration of the respective digital output is not considered.

Set all: All outputs are set to TRUE after the button is pressed (checkmark in checkbox).

Delete all: All outputs are set to FALSE after the button is pressed (no checkmark).

Each output can be individually set to TRUE by clicking the checkbox. The output is set back to FALSE by clicking the checkbox again.

Display

This function is used to activate all display elements of the device.

Inactive: The function is not active. The display corresponds to the standard display in calibration/testing mode.

On: All display elements are switched on.

Off: All display elements are switched off.

Changeover: The display constantly changes between the states On and Off.

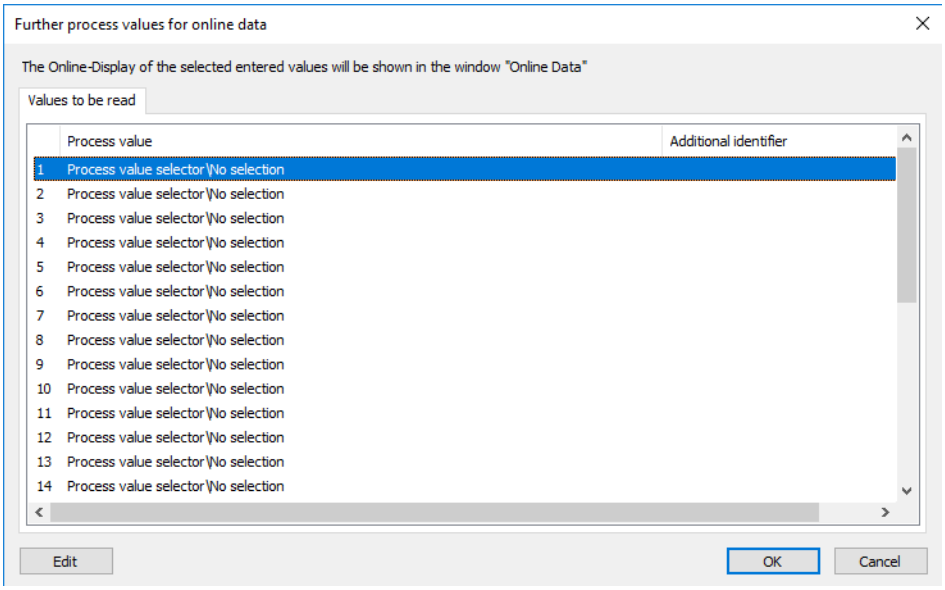
Keypad

This function is used to check all device buttons.

After pressing the "Read buttons", each press of a button on the device is shown by a red circle around the corresponding button of the device shown here:

8.7 Additional process values for online data

Additional process values to be displayed in the online data window of the setup program are selected in this window ("Additional process values" tab).



After pressing the "Edit" button (or double clicking on the relevant line), the process value for the previously marked line can be selected:

Parameter	Selection/text/value	Description
Process value	Select the process value from the selector (drop-down menu) **No selection**	Analog signal, digital signal, or value of a configuration parameter The selection you make is displayed in the online data "Selector" column along with the complete path from the selector. The value of the process value is shown in the "Value" column.
Additional identifier	Enter text (max. 30 characters)	Individual designation of the process value The text is shown in the online data "Identifier" column.
Unit	Enter text (max. 6 characters)	Process value unit The text is shown in the online data "Unit" column.

The start-up function, which is a component of the setup program, allows the visualization and recording of process values in real time. This considerably simplifies the startup of a plant.

Amongst other things, there is a print function available in the context menu (right mouse button) that can be used to print out the device configuration.

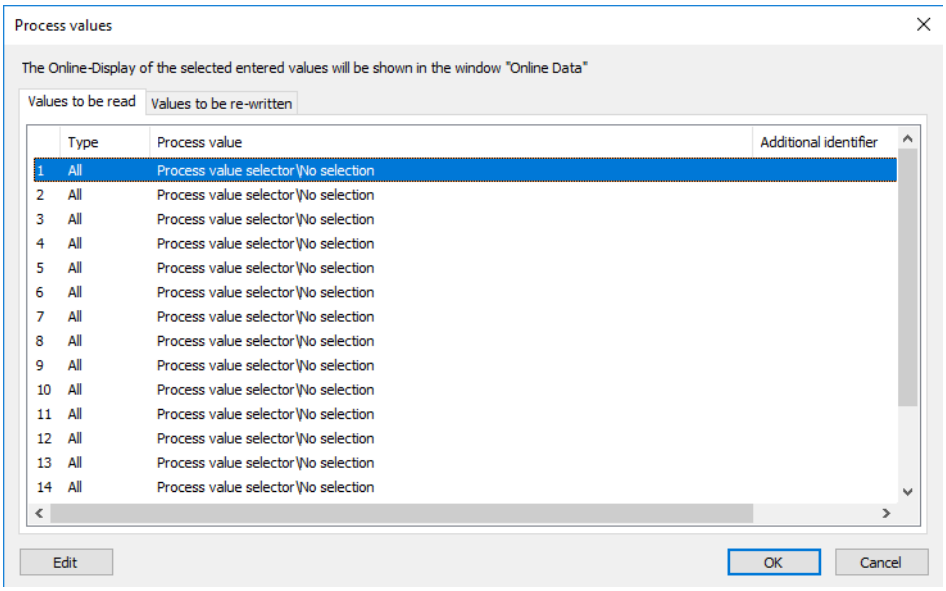
The default settings are shown in bold in the tables.

9.1 Process values

The process values for the visualization, recording, and display in the online data window of the setup program are selected in this window ("Process values for start-up" tab). A distinction is made here between readable and writable values.

Readable values

18 process values can be selected in the "Readable values" tab that are shown both in the visualization (diagram) and in the online data window. Values 1 to 12 are intended for analog process values; values 13 to 18 for digital (binary) process values.

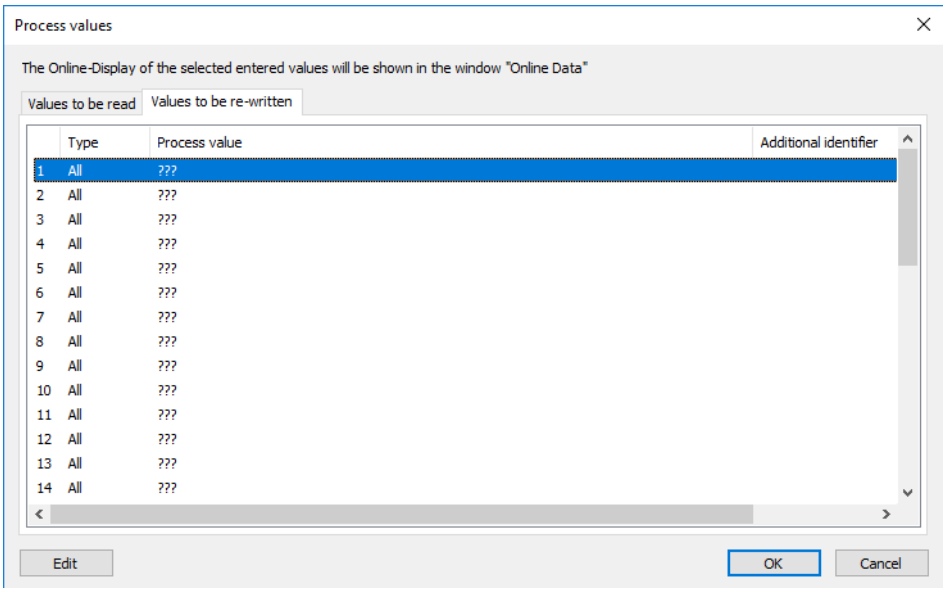


After pressing the "Edit" button (or double clicking on the relevant line), the process value for the previously marked line can be selected:

Parameter	Selection/text/value	Description
Process value	Select the process value from the selector (drop-down menu) **No selection**	Process value (analog or digital) or value of a configuration parameter
Additional identifier	Enter text (max. 30 characters)	Individual designation of the process value The text is used in the visualization and in the online data window.
Unit	Enter text (max. 6 characters)	Process value unit The text is used in the visualization and in the online data window.

Writable values

40 process values can be selected in the "Writable values" tab that are only available in the online data window and can be edited there.

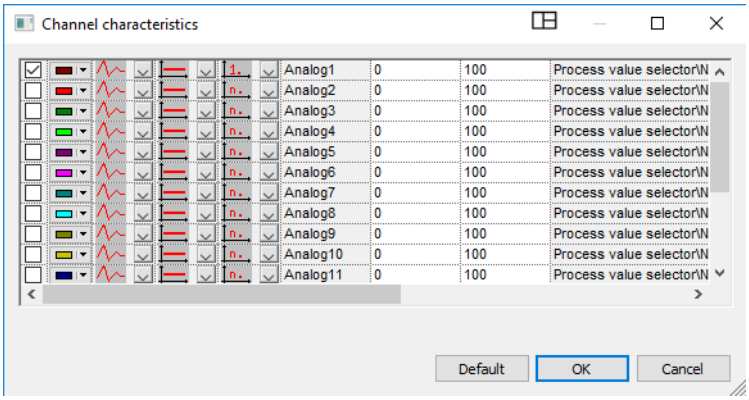


After pressing the "Edit" button (or double clicking on the relevant line), the process value for the previously marked line can be selected:

Parameter	Selection/text/value	Description
Process value	Select the process value from the selector (drop-down menu) **No selection**	Process value (analog or digital) or value of a configuration parameter
Additional identifier	Enter text (max. 30 characters)	Individual designation of the process value The text is used in the online data window.
Unit	Enter text (max. 6 characters)	Process value unit The text is used in the online data window.

9.2 Diagram

The channel properties (color, line type and width, type of y axis, scaling) for the visualization are specified in this window (open by double-clicking).



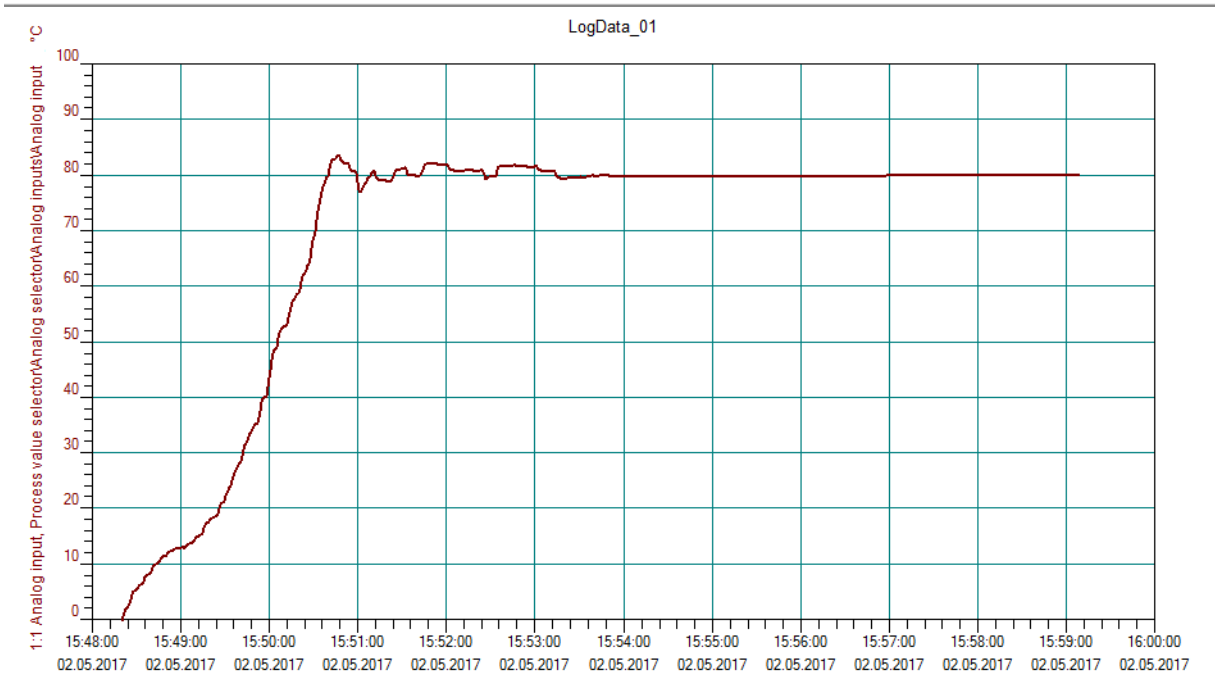
Up to 18 channels in a line chart (channels can be individually hidden) can be shown in the visualization. The X axis depicts the time course of the signals in the diagram. The values of the signals are represented on the Y-axis, whereby only one signal can ever be selected for the main y axis. The values of the other signals are represented either on additional Y axes (auxiliary y axis) or without a y axis.

A toolbar provides various functions for recording, displaying, and archiving process values.

The meaning of the symbols is explained by a tool tip function (hover over the respective symbol with the mouse pointer in the setup program).

Example

The following example shows the recorded curve of the signal at the analog input. The appropriate scaling must be selected for a correct display.



9.3 Protocol

This function is used to log and print the recorded diagram (startup protocol).

There are some text entry fields that can be used for the description at the bottom edge of the diagram. Alternatively, the texts from the file info of the setup file can also be used here (setting in the context menu, see below). There is also one field for the date (editable) and one for the signature.

There is a print function, incl. print preview and printer selection, available via the context menu (mouse pointer in the protocol, right mouse button). The features for the protocol to be printed are also defined here (page margins, line type, use of texts from the file info header).

9 Start-up parameters

10 Retrofitting of modules

General safety information

WARNING!

Danger due to hazardous electrical voltage

Incorrect handling may result in personal injury.

- ▶ Only qualified personnel are permitted to open the device.
- ▶ Before opening, take the device out of operation and disconnect all poles from the power supply.

CAUTION!

Danger due to incorrect handling

Incorrect handling may result in damage to the device or malfunctions.

- ▶ Only qualified personnel are permitted to carry out module retrofits.
- ▶ The country-specific requirements regarding changes to an electrical device must be observed.

CAUTION!

Danger due to electrostatic discharge

Device and modules may be damaged by electrostatic discharge.

- ▶ The modules may only be retrofitted at a grounded workstation and in compliance with the relevant safety measures.

WARNING!

Danger due to hazardous electrical voltage

If openings in the housing are not closed by inserting the right module, the device no longer complies with protection type IP20. The device must not be put into operation!

- ▶ Only open the housing at the slots where modules are attached.
- ▶ Only remove the tab on the cover (housing opening for the connection terminal of the functional ground) if an Ethernet or PROFINET module with threaded block (FE connection) is to be plugged in.

WARNING!

Danger due to hazardous electrical voltage

For devices in the formats 108H, 108Q, and 104: Removing the separators between the slots shortens the clearances and creepage distances (reduces insulation).

- ▶ Do not use any modules that can carry mains voltage at the applicable slots (relay, solid state relay).

CAUTION!

Danger of material damage due to modifications to the device

The device's function may change unintentionally due to errors during retrofitting or replacing modules.

- ▶ A functional test must be performed in a test environment before starting up the device in a system.

Overview of modules

The following modules are available for retrofitting optional inputs and outputs, relays, and interfaces. Use depends on the format of the device (options 1 to 6, see Table).

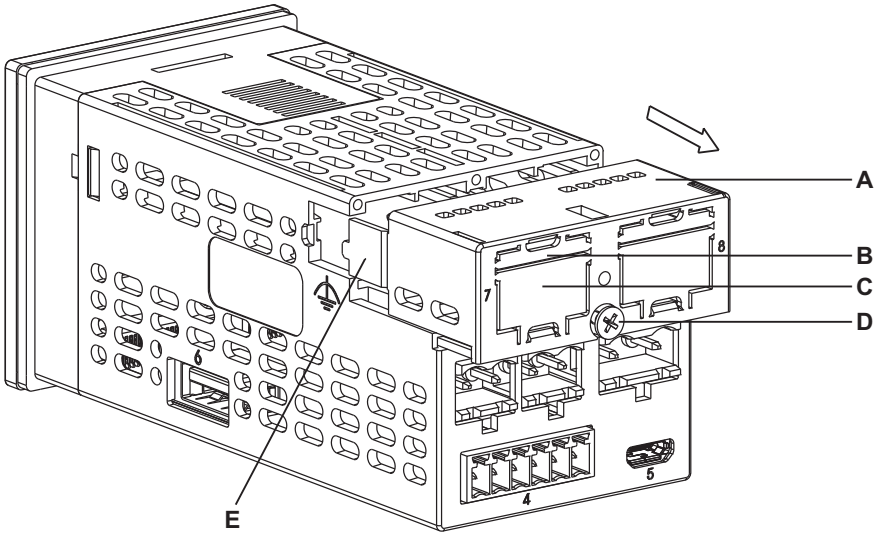
Each module can be identified using the part no. (TN) on the packaging.

10 Retrofitting of modules

Designation	Part no.	Options for devices in the format		
		116	108H, 108Q	104
1 analog input (universal)	00760068	1, 2	1, 2, 3, 4	1, 2, 3, 4
1 counting input 12.5 kHz	00760076	1, 2	1, 2, 3, 4	1, 2, 3, 4
3 digital inputs	00760077	1, 2	1, 2, 3, 4	1, 2, 3, 4
1 relay (changeover contact 8 A);	00760078	---	1, 2, 3, 4	1, 2, 3, 4
1 relay (NO contact 3 A)	00760090	1, 2	1, 2, 3, 4	1, 2, 3, 4
2 relays (NO contact 3 A)	00760092	---	1, 2, 3, 4	1, 2, 3, 4
1 solid state relay 1 A	00760093	1, 2	1, 2, 3, 4	1, 2, 3, 4
1 digital output (logic 0/14 V)	00760094	1, 2	1, 2, 3, 4	1, 2, 3, 4
1 analog output	00760095	1, 2	1, 2, 3, 4	1, 2, 3, 4
1 digital output (logic 0/22 V, galvanically isolated)	00760096	1, 2	1, 2, 3, 4	1, 2, 3, 4
1 RS485 interface (Modbus RTU)	00760048	2	2	6
1 Ethernet interface (Modbus TCP, setup program)	00760045	1	1	5
1 PROFINET IO Device interface (2 × RJ45) only for type 70305x	00773311	1	1	5
1 PROFINET IO Device interface (2 × RJ45) only for type 70155x	30048907	1	1	5
2 open-collector outputs	00760014	1, 2	1, 2, 3, 4	1, 2, 3, 4

Retrofitting modules – device in format 116

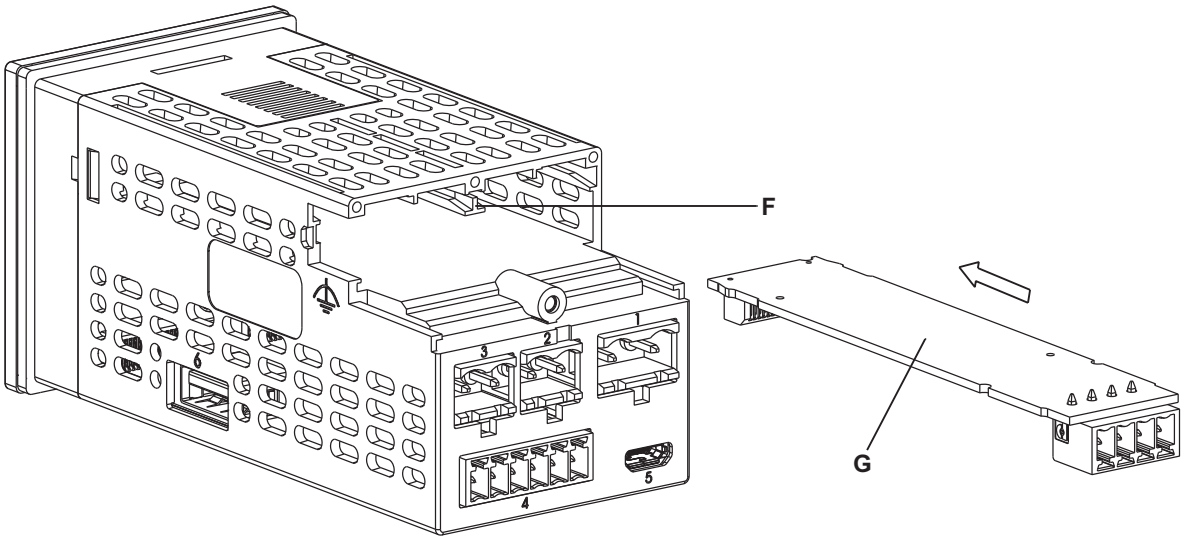
Option	Slot (number of connection element)
1	7
2	8



1. Undo screw (D) (with PH 1 screwdriver) and remove cover (A) from the housing toward the rear.
2. Break off housing opening (C) of the applicable slot from the cover.
3. For Ethernet (slot 7) or PROFINET (slots 7 and 8):

   Also remove the small housing opening (B).

   For a module with threaded block: Also remove tab (E) on the cover (housing opening for the connection terminal of the functional ground ⏚).



4. For PROFINET (slots 7 and 8):

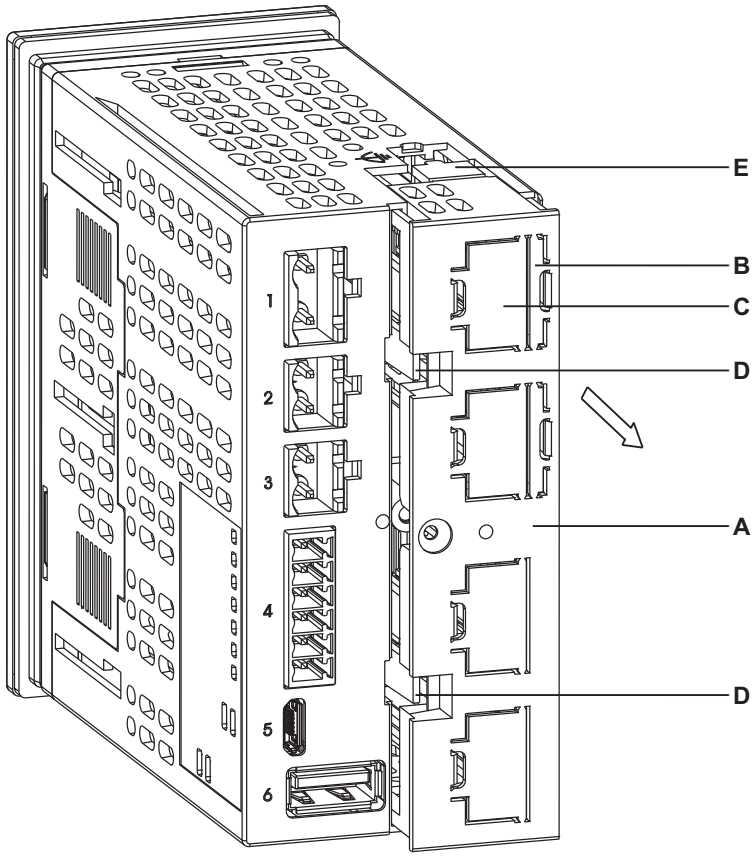
   Also break off the separator (F) between slot 7 and 8.
5. Slide in module (G) into the guide rails of the applicable slot until the limit stop (does not engage in place).
6. Place the cover from the rear onto the housing and tighten the screw.

10 Retrofitting of modules

Retrofitting modules – devices in the formats 108H and 108Q

Option	Slot (number of connection element)[a]
1	7
2	8
3	9
4	10

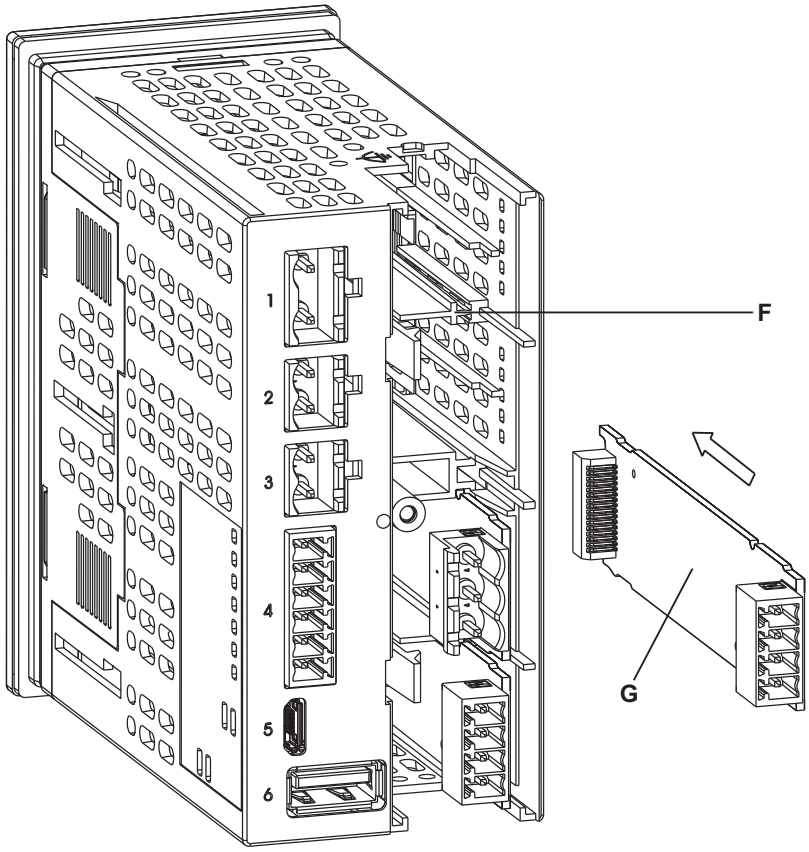
[a] The numbers are printed on the side of the housing.



1. Release both locking hooks (D) (press to the left) and remove the cover (A) from the housing toward the rear.
2. Break off housing opening (C) of the applicable slot from the cover.
3. For Ethernet (slot 7) or PROFINET (slots 7 and 8):

   Also remove the small housing opening (B).

   For a module with threaded block: Also remove tab (E) on the cover (housing opening for the connection terminal of the functional ground ⏚).

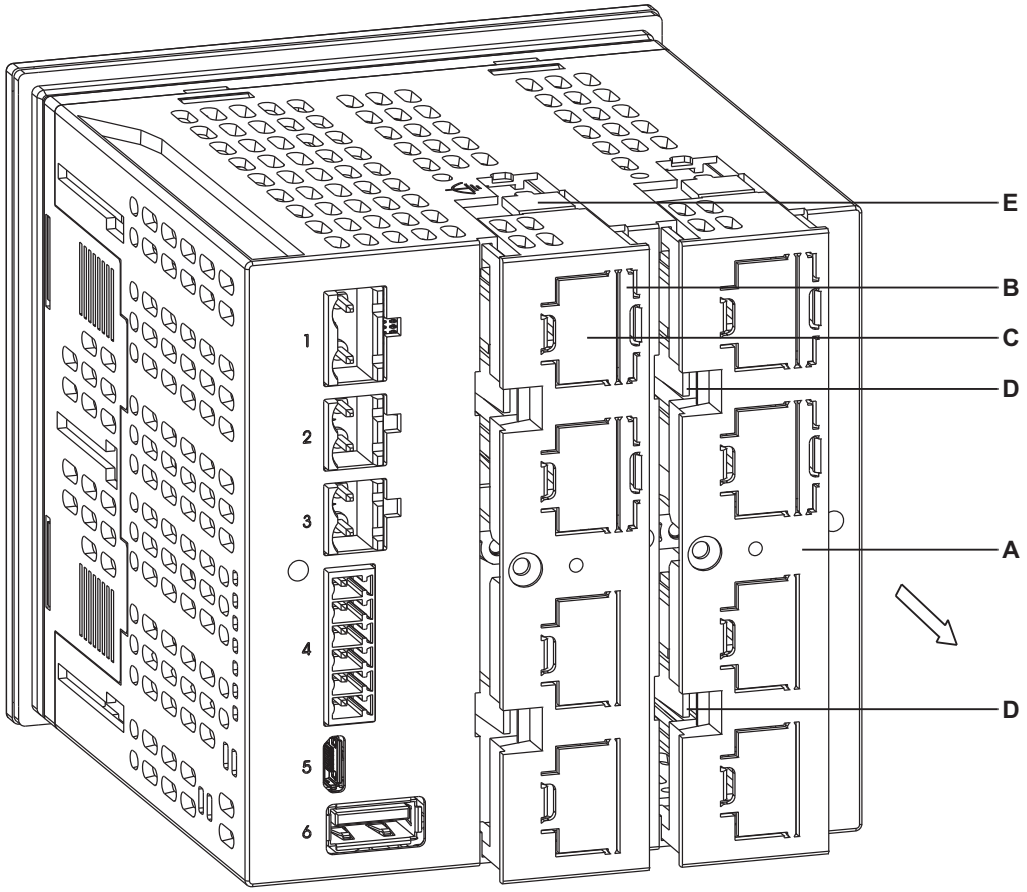


4. For PROFINET (slots 7 and 8):
   Also break off the separator (F) between slot 7 and 8.
5. Slide in module (G) into the guide rails of the applicable slot until the limit stop (does not engage in place).
6. Place the cover onto the housing from the rear until both locking hooks engage.

10 Retrofitting of modules

Retrofitting modules – device in format 104

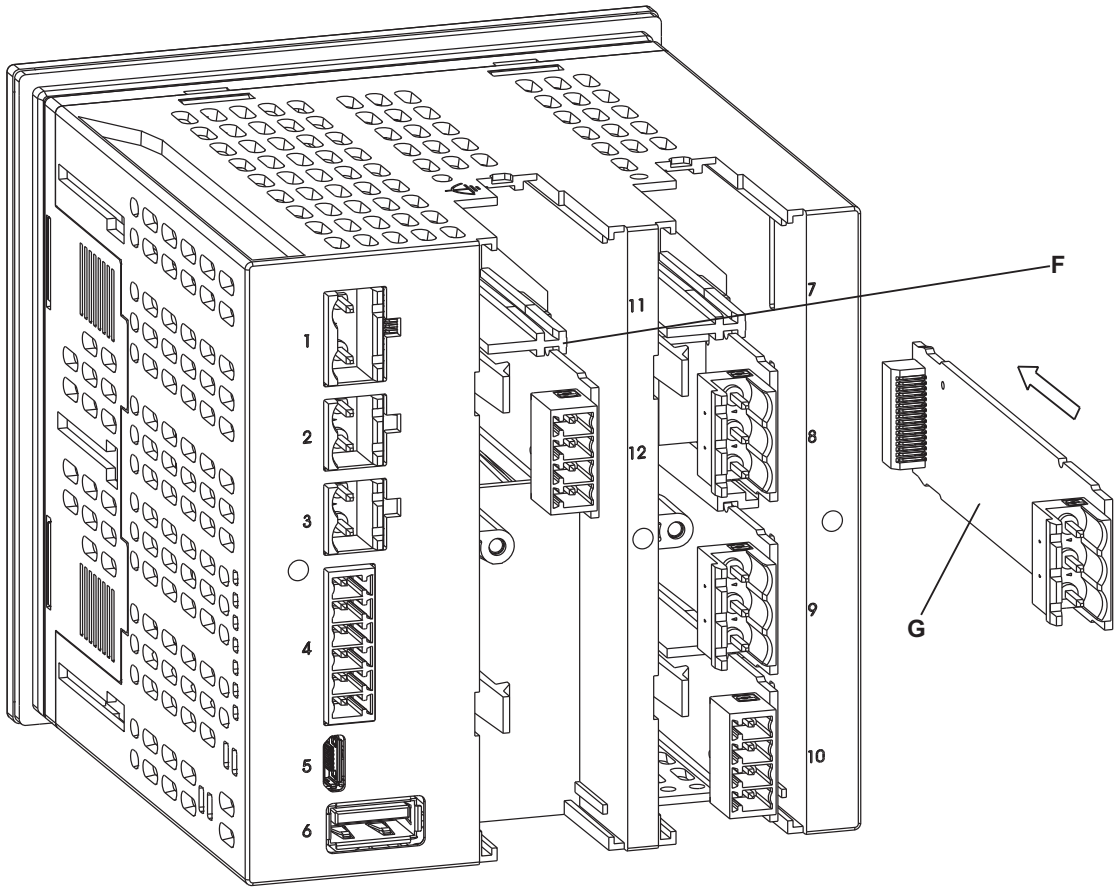
Option	Slot (number of connection element)
1	7
2	8
3	9
4	10
5	11
6	12



1. Release both locking hooks (D) (press to the left) and remove the cover (A) from the housing toward the rear.
2. Break off housing opening (C) of the applicable slot from the cover.
3. For Ethernet (slot 11) or PROFINET (slots 11 and 12):

   Also remove the small housing opening (B).

   For a module with threaded block: Also remove tab (E) on the cover (housing opening for the connection terminal of the functional ground ⏚).



4. For PROFINET (slots 11 and 12):

   Also break off the separator (F) between slot 11 and 12.

5. Slide in module (G) into the guide rails of the applicable slot until the limit stop (does not engage in place).

6. Place the cover onto the housing from the rear until both locking hooks engage.

10 Retrofitting of modules

11.1 Analog input

Thermocouples

Designation	Type	Standard	ITS	Measuring range	Accuracy[a]
Fe-CuNi	"L"	DIN 43710 (1985)	IPTS-68	-200 to +900 °C	≤ 0.25 %
Fe-CuNi	"J"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	-210 to +1200 °C	≤ 0.25 % from -100 °C
Cu-CuNi	"U"	DIN 43710 (1985)	IPTS-68	-200 to +600 °C	≤ 0.25 % from -100 °C
Cu-CuNi	"T"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	-270 to +400 °C	≤ 0.25 % from -150 °C
NiCr-Ni	"K"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	-270 to +1372 °C	≤ 0.25 % from -80 °C
NiCr-CuNi	"E"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	-270 to +950 °C	≤ 0.25 % from -80 °C
NiCrSi-NiSi	"N"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	-270 to +1300 °C	≤ 0.25 % from -80 °C
Pt10Rh-Pt	"S"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	-50 to +1768 °C	≤ 0.25 % from 20 °C
Pt13Rh-Pt	"R"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	-50 to +1768 °C	≤ 0.25 % from 50 °C
Pt30Rh-Pt6Rh	"B"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	0 to 1820 °C	≤ 0.25 % from 400 °C
W5Re-W26Re	"C"	DIN EN 60584-1:2014 IEC 60584-1:2013	ITS-90	0 to 2315 °C	≤ 0.25 % from 500 °C
W3Re-W25Re	"D"	ASTM E1751M-15	ITS-90	0 to 2315 °C	≤ 0.25 % from 500 °C
W5Re-W20Re	"A1"	GOST R 8.585-2001	ITS-90	0 to 2500 °C	≤ 0.25 % from 500 °C
Chromel®-Copel	"L"	GOST R 8.585-2001	ITS-90	-200 to +800 °C	≤ 0.25 % from -80 °C
Chromel®-Alumel®	"K"	GOST R 8.585-2001	ITS-90	-270 to +1372 °C	≤ 0.25 % from -80 °C

[a] Accuracy refers to the measuring range.

Ambient temperature influence	≤ 100 ppm/K
Cold junction	Internal or external (constant)
Cold junction temperature (external)	-30 to +85 °C (adjustable)
Sampling rate	Min. 50 ms (configurable)
Input filter	Digital filter, 2nd order; filter constant can be set from 0 to 100.0 s

RTD temperature probe

Designation	Standard	ITS	Connection type	Measuring range	Accuracy[a]	Measuring current
Pt100	DIN EN 60751:2009 IEC 60751:2008	ITS-90	Two-wire	-200 to +850 °C	≤ 0.2 %	500 µA
			Three-wire	-200 to +850 °C	≤ 0.1 %	500 µA
Pt1000	DIN EN 60751:2009 IEC 60751:2008	ITS-90	Two/three-wire	-200 to +850 °C	≤ 0.1 %	50 µA
Pt100	GOST 6651-2009 A.2	ITS-90	Two-wire	-200 to +850 °C	≤ 0.2 %	500 µA
			Three-wire	-200 to +850 °C	≤ 0.1 %	500 µA

[a] Accuracy refers to the measuring range.

Ambient temperature influence	≤ 50 ppm/K
Sensor line resistance	Max. 30 Ω per line
Sampling rate	Min. 50 ms (configurable)
Input filter	Digital filter, 2nd order; filter constant can be set from 0 to 100.0 s

Resistance transmitter and resistance/potentiometer

Designation	Measuring range	Accuracy[a]	Measuring current
Resistance transmitter	0 to 4000 Ω	≤ 0.1 % at 4000 Ω	50 µA
Resistance/potentiometer	0 to 400 Ω	≤ 0.1 %	500 µA
	0 to 4000 Ω	≤ 0.1 %	50 µA

[a] Accuracy refers to the maximum measuring range. Small measuring spans lead to reduced linearization accuracy.

Ambient temperature influence	≤ 100 ppm/K
Connection type	
Resistance transmitter	Three-wire circuit
Resistance/potentiometer	Two-wire/three-wire circuit
Sensor line resistance	Max. 30 Ω per line
Sampling rate	Min. 50 ms (configurable)
Input filter	Digital filter, 2nd order; filter constant can be set from 0 to 100.0 s

Voltage, current (standard signals); heater current

Designation	Measuring range	Accuracy[a]	Input resistance or compliance voltage
Voltage	0 to 10 V	≤ 0.1 %	> 500 kΩ
	0 to 1 V	≤ 0.1 %	> 500 kΩ
Current	4 to 20 mA	≤ 0.1 %	< 2.5 V
	0 to 20 mA	≤ 0.1 %	< 2.5 V
Heater current	AC 0 to 50 mA, 50 Hz	≤ 20 %	< 2.5 V
	DC 0 to 20 mA	≤ 1 %	< 2.5 V

[a] Accuracy refers to the maximum measuring range. Small measuring spans lead to reduced linearization accuracy.

Ambient temperature influence	≤ 100 ppm/K
Deviation below/above the measuring range	According to NAMUR recommendation NE 43 (only current input 4 to 20 mA)
Sampling rate	Min. 50 ms (configurable)
Input filter	Digital filter, 2nd order; filter constant can be set from 0 to 100.0 s

Measuring circuit monitoring

The device behavior in the event of a malfunction is configurable.

Measuring probe	Underrange	Overrange	Short-circuit (probe/line)	Break (probe/line)	Reverse polarity
RTD temperature probe	++	++	++	++	---
Resistance/potentiometer	---	++	---	++	---
Resistance transmitter	---	++	---	(+)[a]	---
Thermocouple	++	++	---	++	(+)[b]
Current 0 to 20 mA	---	++	---	---	---

Measuring probe	Underrange	Overrange	Short-circuit (probe/line)	Break (probe/ line)	Reverse polarity
Current 4 to 20 mA	++	++	++	++	++
Voltage 0 to 10 V	++	++	---	---	++
Voltage 0 to 1 V	---	++	---	---	++
Heater current	---	++	---	---	---
++ = is detected		--- = is not detected		(+) = is detected in certain conditions	

[a] Break in measuring current path is not detected.

[b] Is dependent on the set characteristic line.

11.2 Digital inputs

Input for potential-free contact	
Function	Contact closed: input is active (R_{ON} < 1 kΩ) Contact open: input is inactive (R_{OFF} > 50 kΩ)
Sampling rate	Min. 50 ms (configurable)
Counting input	
Voltage	0/24 V (logic level 0: < 3.5 V; logic level 1: > 10 V)
Counting frequency	Max. 12.5 kHz, min. 0.5 Hz

11.3 Analog output

Voltage	
Output signal	DC 0 to 10 V
Load resistance	> 500 Ω
Current	
Output signal	DC 0(4) to 20 mA
Load resistance	< 450 Ω
Accuracy	≤ 0.5 %
Ambient temperature influence	≤ 150 ppm/K

11 Technical data

11.4 Digital outputs

Relay (NO contact)	
Switching capacity	Max. 3 A at AC 230 V or DC 24 V, resistive load
Contact life	150,000 operations at rated load 350,000 operations at 1 A
Relay (changeover contact)	
Switching capacity	Max. 8 A at AC 230 V or DC 24 V, resistive load
Contact life	50,000 operations at rated load 100,000 operations at 3 A 250,000 operations at 1 A
Logic output 14 V	
Output signal	DC 0/14 V ±15 %
Current	Max. 20 mA per output (at nominal voltage 14 V); short-circuit proof
Switching time as controller output	Min. 10 ms
Logic output 22 V	(Voltage supply for transmitter)
Output signal	DC 0/22 V ±15 %
Current	Max. 30 mA per output (at nominal voltage 22 V); short-circuit proof
Switching time as controller output	Min. 10 ms
Solid state relay	
Switching capacity	Max. 1 A at AC 230 V, resistive load
Internal protective circuit	Varistor
Open-collector output	
Switching capacity	Max 1.3 A at DC 24 V

11.5 Interfaces

USB device	
Connector type	Micro-B (socket)
Standard	Low-Speed, Full-Speed, High-Speed
Line length	Max. 3 m
USB host	
Connector type	A (socket)
Standard	Low-Speed, Full-Speed
Usage	Exclusively for connecting a USB flash drive (FAT16/FAT32; see accessories)
Load current	Max. 100 mA
RS485	
Baud rate	9600, 19200, 38400, 115200
Data format	8-1-no parity, 8-1-even parity, 8-1-odd parity, 8-2-no parity
Protocol	Modbus RTU (master/slave)
Ethernet	
Connector type	RJ45 (socket)
Transfer rate	10 Mbit/s, 100 Mbit/s
Protocol	TCP/IP, DHCP, DNS; Modbus TCP (master/slave)
Connecting cable	Network cable, at least CAT5 (S/FTP)
Line length	Max. 100 m
PROFINET IO Device	
Connector type	2 x RJ45 (socket), integrated switch
Transfer rate	100 Mbit/s
Conformity class	C (CC-C)
Netload class	III (Netload Class III)
Protocol	DCP, LLDP, VLAN Priority, PTCP, MRP
Connecting cable	Network cable, at least CAT5 (S/FTP)
Line length	Max. 100 m

11 Technical data

11.6 Display

18-segment LCD displays	Upper display	Lower display
Digit height		
Type 703051 (format 116)	12.3 mm	5.9 mm
Type 703052 (format 108H)	11.5 mm	8.5 mm
Type 703053 (format 108Q)	16.5 mm	9 mm
Type 703054 (format 104)	24.8 mm	12 mm
Color	White	Green
Places, including decimal places	4	4 (8 for type 703051)
Decimal places	0, 1, 2, 3, or automatic (configurable)	

Pixel matrix LCD display (only for types 703052, 703053, and 703054)	
Pixel fields	
Type 703052 (format 108H)	2 rows each with 9 pixel fields
Type 703053 (format 108Q)	2 rows each with 8 pixel fields
Type 703054 (format 104)	2 rows each with 11 pixel fields
Number of pixels per field	8 × 5
Color	White

11.7 Electrical data

Voltage supply	(see nameplate)	
Variant 1	AC 110 to 240 V +10/-15 %, 48 to 63 Hz	
Variant 2	AC/DC 24 V +10/-15 %, AC 48 to 63 Hz	
Electrical safety	According to DIN EN 61010:2020, part 1; overvoltage category II up to 300 V mains voltage, pollution degree 2	
Power consumption	For AC 110 to 240 V	For AC/DC 24 V
Type 703051 (format 116)	Max. 4.3 W	Max. 4.5 W
Types 703052, 703053 (formats 108H, 108Q)	Max. 4.9 W	Max. 6.0 W
Type 703054 (format 104)	Max. 6.8 W	Max. 8.9 W
Electrical connection	On the back via spring-cage terminals (PUSH IN technology)	
Conductor cross section for voltage supply (connection element 1)		
Wire or stranded wire (without ferrule)	Min. 0.2 mm^2, max. 2.5 mm^2	
Stranded wire with ferrule	Without/with plastic collar: min. 0.25 mm^2, max. 2.5 mm^2	
Stripping length	10 mm	
Conductor cross sections for standard relays (connection elements 2 and 3), optional relays and solid state relays		
Wire (without ferrule)	Min. 0.2 mm^2, max. 1.5 mm^2	
Stranded wire (without ferrule)	Min. 0.2 mm^2, max. 2.5 mm^2	
Stranded wire with ferrule	Without/with plastic collar: min. 0.25 mm^2, max. 1.5 mm^2	
Stripping length	10 mm	
Conductor cross sections for standard inputs and outputs (connection element 4), optional inputs and outputs (except for relays and solid state relays), RS485 interface		
Wire or stranded wire (without ferrule)	Min. 0.2 mm^2, max. 1.5 mm^2	
Stranded wire with ferrule	Without plastic collar: min. 0.25 mm^2, max. 1.5 mm^2 With plastic collar: min. 0.25 mm^2, max. 0.75 mm^2	
Stripping length	10 mm	

11 Technical data

11.8 Environmental influences

Ambient temperature range	
Storage	-30 to +70 °C
Operation	-10 to +55 °C
Site altitude	Max. 2000 m above sea level
Climatic environmental influences	According to DIN EN 60721-3 with extended temperature range
Resistance to climatic conditions	≤ 90 % rel. humidity without condensation
Storage	According to class 1K2
Operation	According to class 3K3
Vibration	According to DIN EN 60068-2-6, table C.2
Amplitude	0.15 mm from 10 to 58.1 Hz
Acceleration	20 m/s^2 from 58.1 to 150 Hz
Shock	According to DIN EN 60068-2-27, table A.1
Peak acceleration	150 m/s^2
Shock duration	11 ms
Electromagnetic compatibility (EMC)	According to DIN EN 61326-1:2013
Interference emission	Class B[a, b]
Interference immunity	Industrial requirements

[a] The product is suitable for industrial use as well as for households and small businesses.

[b] With Ethernet interface: Class A – only for industrial use –

11.9 Case

Case type	Plastic case for panel mounting according to DIN IEC 61554 (indoor use)
Case front	Made of plastic with membrane keyboard
Panel thickness	1 to 10 mm
Case mounting	In panel using the supplied mounting frame or both mounting elements
Operating position	Any[a]
Protection type	According to DIN EN 60529, IP65 on the front, IP20 on the back
Weight	
Type 703051 (format 116)	Max. 170 g
Type 703052 (format 108H)	Max. 271 g
Type 703053 (format 108Q)	Max. 271 g
Type 703054 (format 104)	Max. 417 g

[a] The maximum admissible ambient temperature only applies for the installation with the display in a vertical position.

11.10 Approvals and approval marks

The device is approved if the relevant approval mark is pictured on the device.

c UL us	
Test facility	Underwriters Laboratories
Certificate/test no.	E201387
Inspection basis	UL 61010-1 (3rd ed.), CAN/CSA-22.2 No. 61010-1 (3rd ed.)
Valid for	All types

11 Technical data

RoHS Exempt 						
产品组别 Product group: 703051, 703052, 703053, 703054	产品中有害物质的名称及含量 China EEP Hazardous Substances Information					
部件名称 Component Name: meroTRON						
	铅 （Pb）	汞 （Hg ）	镉 （Cd）	六价铬 （Cr(VI)）	多溴联苯 （PBB）	多溴二苯醚 （PBDE）
印刷电路组件 printed circuit assemblies	X	○	○	○	○	○

本表格依据SJ/T 11364的规定编制。
This table is prepared in accordance with the provisions SJ/T 11364.
○：表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。
Indicate the hazardous substances in all homogeneous materials for the part are below the limit of the GB/T 26572.

×：表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。
Indicate the hazardous substances in at least one homogeneous material of the part exceed the limit of the GB/T 26572.

12 China RoHS

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