Multichannel Controller Module

705010

Operating Manual

70501000T90Z001K000

V4.00/EN/00575595/2023-08-09

1.1 Available technical documentation

The documents specified below are available for the measuring, control, and automation system JUMO mTRON T (previous document number in parentheses).

NOTE!
Documentation for the automation system JUMO variTRON: See operating manual of the concerning central processing unit JUMO variTRON (705002, 705003, ...).

1.1.1 General information

Product	Type of documentation	No.	Printed	PDF file
Measuring, control, and automation system	Data sheet	70500000T10...	-	X
	System manual[1]	70500000T90... (B 705000.0)	X	-
	Setup program manual	70500000T96... (B 705000.6)	-	X
	System description[2]	70500000T98... (B 705000.8)	-	X

[1] Accessory subject to charge

[2] Includes an overview of the purpose and content of all documents

1.1.2 Base units

Product	Type of documentation	No.	Printed	PDF file
Central processing unit	Data sheet	70500100T10...	-	X
	Operating manual	70500100T90... (B 705001.0)	-	X
	Modbus interface description	70500100T92... (B 705001.2.0)	-	X
	PROFIBUS-DP interface description	70500103T92... (B 705001.2.3)	-	X
	digiLine interface description	70500106T92...	-	X
	Installation instructions	70500100T94... (B 705001.4)	X	X
	CODESYS OPC server operating manual	70500151T90... (B 705001.5.1)	-	X
	Process engineering application operating manual	70500152T90...	-	X
	Operating manual Thyristor power controller (type 70906x; integration in the measuring, control, and automation system)	70500153T90...	-	X

1.1.3 Input/output modules

Product	Type of documentation	No.	Printed	PDF file
Multichannel controller module	Data sheet	70501000T10...	-	X
	Operating manual	70501000T90... (B 705010.0)	-	X
	Installation instructions	70501000T94... (B 705010.4)	X	X
Relay module 4-channel	Data sheet	70501500T10...	-	X
	Operating manual	70501500T90... (B 705015.0)	-	X
	Installation instructions	70501500T94... (B 705015.4)	X	X
Analog input module 4-channel	Data sheet	70502000T10...	-	X
	Operating manual	70502000T90... (B 705020.0)	-	X
	Installation instructions	70502000T94... (B 705020.4)	X	X
Analog input module 8-channel	Data sheet	70502100T10...	-	X
	Operating manual	70502100T90... (B 705021.0)	-	X
	Installation instructions	70502100T94... (B 705021.4)	X	X
Analog output module 4-channel	Data sheet	70502500T10...	-	X
	Operating manual	70502500T90...	-	X
	Installation instructions	70502500T94...	X	X
Digital input/ output module 12-channel	Data sheet	70503000T10...	-	X
	Operating manual	70503000T90... (B 705030.0)	-	X
	Installation instructions	70503000T94... (B 705030.4)	X	X

1.1.4 Special modules

Product	Type of documentation	No.	Printed	PDF file
Router module	Data sheet	70504000T10...	-	X
	Installation instructions	70504000T94... (B 705040.4)	X	X

1.1.5 Operating, visualization, recording

Product	Type of documentation	No.	Printed	PDF file
Multifunction panel 840	Data sheet	70506000T10...	-	X
	Operating manual	70506000T90... (B 705060.0)	-	X
	Modbus interface description	70506000T92... (B 705060.2.0)	-	X
	Installation instructions	70506000T94... (B 705060.4)	X	X
Operating panels	Data sheet	70506500T10...	-	X
	Operating manual	70506500T90...	-	X

1.1.6 Power supply units

Product	Type of documentation	No.	Printed	PDF file
24 V power supply units	Data sheet	70509000T10...	-	X
	Operating instructions QS3.241		X	-
	Operating instructions QS5.241		X	-
	Operating instructions QS10.241		X	-

1 Introduction

1.2 Safety information

1.2.1 Warning symbols

DANGER!
This symbol indicates that **personal injury caused by electrical shock** may occur if the respective precautionary measures are not carried out.

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 **damage to assets 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 DOCUMENTATION!
This symbol – placed on the device – indicates that the associated **device documentation has to be observed**. This is necessary to recognize the kind of the potential hazards as well as the measures to avoid them.

1.2.2 Note signs

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

REFERENCE!
This symbol refers to **further information** in other sections, chapters, or manuals.

FURTHER INFORMATION!
This symbol is used in the tables and refers to **further information** in connection with the table.

DISPOSAL!
This device and the batteries (if installed) must not be disposed in the garbage can after use! Please ensure that they are disposed properly and in an **environmentally friendly manner**.

1.2.3 Intended use

The modules described are intended for measuring, control, and automation tasks in an industrial environment, as described in the technical data. Other uses or uses beyond those defined are not viewed as intended uses.

The modules are built according to the relevant standards and directives as well as the applicable safety regulations. Nevertheless, incorrect use may lead to bodily injury or property damage.

To avoid danger, the modules may only be used:

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

Even if a module is used correctly and according to the intended use, it may still cause application-related dangers (e.g. due to missing safety devices or incorrect settings).

1.2.4 Qualification of personnel

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

It is intended for technically qualified personnel who have received special training and have the appropriate knowledge in the field of automation technology (measuring, process, and control 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 Introduction

1.3 Acceptance of goods, storage, and transport

1.3.1 Checking the delivery

- Ensure that the packaging and contents are not damaged
- Check that the delivery is complete using the delivery papers and the order details
- Inform the supplier immediately if there is any damage
- Store damaged parts until clarification is received from the supplier

1.3.2 Notes on storage and transport

- Store the module in a dry and clean environment. Observe the admissible ambient conditions (see "Technical data")
- The transport of the module is to be shockproof
- The original packaging provides optimum protection for storage and transport

1.3.3 Returning goods

In the event of repair, please return the module in a clean and complete state.
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 can be downloaded online from the manufacturer's website (use the search function if necessary).

Protection against electrostatic discharge (ESD)

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

When returning electronic modules or components, please note the following:

- Sensitive components must only be packaged in an ESD-protected environment. Workspaces such as this divert electrostatic charges to ground in a controlled manner and prevent static charges due to friction capacities.
- Only use packaging 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.

1.3.4 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

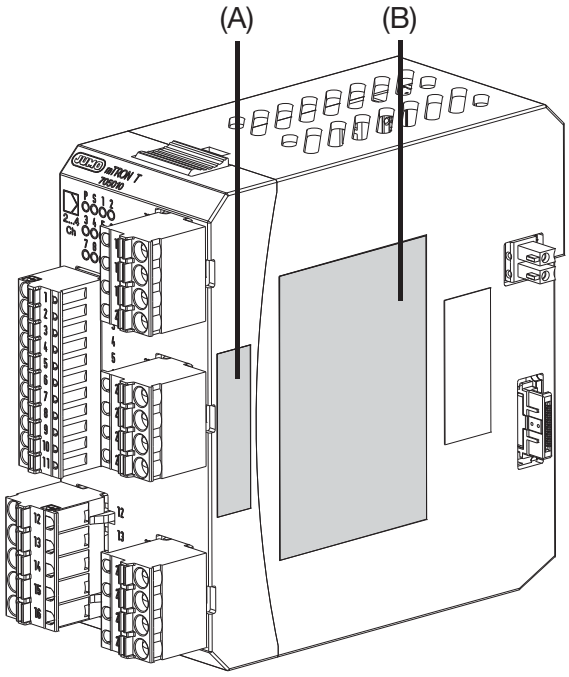
1.4 Identifying the device version

1.4.1 Nameplates

Position

The nameplate (B) is affixed to the module case.

Additional nameplates with reduced information are located on the module insert (A) and inside the module case (C; not shown). This duplicate identification marking via nameplates (A) and (C) is important when replacing a module insert or retrofitting optional modules.



Content

The nameplates contain important information. This includes:

Description	Designation on the nameplate	Example
Device type (A + B + C)	Typ	705010/18-113-36
Part no. (A + B + C)	TN	00XXXXXX
Fabrication number (A + B + C)	F-Nr	0070033801211010006
Voltage supply (B)	-	DC 24 V +25/-20 %

Device type

Compare the specifications on the nameplate with the order.

Identify the supplied device version using the order details of the respective module.

Part no. (TN)

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

Fabrication no. (F-Nr)

Among other things, the fabrication number contains the date of production (year/week).

Example: F-Nr = 0070033801211010006

The figures concerned are in positions 12, 13, 14, and 15 (from the left).

The device was therefore produced in the 1st calendar week of 2011.

NOTE!
In case of a module with extra code 879, an additional label on the front that shows the fabrication number (as of the production date in the third week of 2018) is affixed.

Identifying the optional modules

The device type (Typ) also contains information about factory-fitted optional modules (in the example above – 705010/18-113-36 – this is string 113). The optional modules can be identified by the order details.

This chapter contains additional information to identify optional modules:

⇨ Chapter 10 "Retrofitting inputs/outputs", page 143

NOTE!
The information on the nameplates must also be considered when replacing the module insert (Chapter 3.3 "Replacing module inserts", page 26).

1.4.2 Order details

	(1)	**Basic type**
705010		Multichannel controller module, 2x universal input, 2x digital input, 2x relay output
	(2)	**Basic type extension**
1		2 relays (N/O contact)
2		2 logic outputs 0/15 V
	(3)	**Version**
8		With factory settings
	(4)	**Option slot 1**
0		Not used
1		Analog input 2
2		Relay (changeover contact)
3		2 relays (N/O contacts with common pole)
4		Analog output
5		2 digital inputs
6		Solid-state relay 1 A
7		2 open-collector outputs
	(5)	**Option slot 2**
0		Not used
1		Analog input 2
2		Relay (changeover contact)
3		2 relays (N/O contacts with common pole)
4		Analog output
5		2 digital inputs
6		Solid-state relay 1 A
7		2 open-collector outputs
	(6)	**Option slot 3**
0		Not used
2		Relay (changeover contact)
3		2 relays (N/O contacts with common pole)
4		Analog output
5		2 digital inputs
6		Solid-state relay 1 A
7		2 open-collector outputs
	(7)	**Voltage supply**
36		DC 24 V +25/-20 %
	(8)	**DNV GL approval**
000		Without approval
062		With DNV GL approval[1]
	(9)	**DIN approval**
000		Without approval
056		With DIN approval (DIN EN 14597)
	(10)	**Extra codes**
000		Without extra code
879		AMS2750/CQI-9[2]

[1] The power supply unit used must also have a DNV GL or GL type approval (e.g. type 705090).

[2] For the calibration certificate the channels to be checked are to be defined with the thermocouple type and the desired measuring points.

	(1)		(2)	(3)		(4)	(5)	(6)		(7)		(8)		(9)		(10)
Order code		/			-				-		/		,		,	
Order example	705010	/	1	8	-	0	0	0	-	36	/	000		000		000

1.4.3 Scope of delivery

1 multichannel controller module in the ordered version
1 Installation instructions

1.4.4 Accessories

Description	**Part no.**
Modules for option slots (expansion boards):	
Analog input – without approval acc. to DIN EN 14597 and without DNV approval	00776489
Analog input	00569497
Relay (changeover contact)	00569498
2 relays (N/O contacts with common pole)	00569499
Analog output	00569500
2 digital inputs	00569501
Solid-state relay 1 A	00569502
2 open-collector outputs	00569503

1 Introduction

2.1 Brief description

The multichannel controller module supports up to four PID controller channels (cascadable). In the standard version, two high-quality universal analog inputs for thermocouples, RTD temperature probes, resistance transmitters, resistance/potentiometers, and standard signals are available. Two digital inputs (DC 0/24 V) and two digital outputs as a relay with N/O contact (AC 230 V / 3 A) or as a logic output (DC 0/15 V) are also available as part of the standard version. Due to the three option slots (option 1, 2, and 3), the module can be extended up to four universal analog inputs, eight digital inputs, three analog outputs, or eight digital outputs.

The digitized input values/states are available in the system for further processing. The digital and the analog outputs can be actuated by the system or directly by the module.

The module operates independently, even if the central processing unit fails or the higher-ranking system malfunctions. This behavior can be configured.

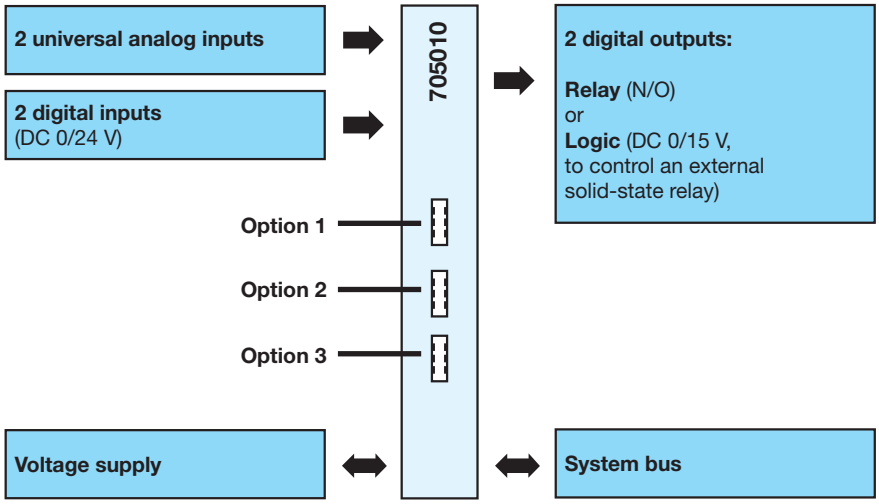
As a temperature regulator (TR) according to DIN EN 14597 the module is used in heat-generating and heat-transferring plants to control the temperature of liquids or gases (mode of action: 1.B).

LEDs are used to indicate applied voltage supply, the module operating status, as well as the status of the digital inputs/outputs.

For expansion of the inputs/outputs or for service work, the module insert can be easily pulled out of the case at the front. The case including the bus PCB remains mounted on the DIN rail.

A setup program or the multifunction panel 840 allows the user to comfortably configure and parameterize the multichannel controller module.

2.2 Block diagram



2 Description

3.1 General information on installation/dismounting

DANGER!
With multichannel controller module 705010 and relay module 705015, the load circuits from relay or solid state relay outputs can be operated with a dangerous electrical voltage (e.g. 230 V).
There is a risk of electric shock.
Prior to the installation/dismounting of these modules or the removal of the module insert, the load circuits are to be disconnected from the voltage and the terminal strips are to be removed from the module. This work must only be performed by qualified personnel.

WARNING!
The modules must never be installed in areas with an explosion hazard.
There is the risk of an explosion.
The entire system must only be used outside of areas with an explosion hazard.

Mounting site

All modules have protection type IP20 and are only intended for use in fireproof control cabinets or switch boxes. The mounting site should be virtually vibration-free. Electromagnetic fields caused by equipment such as motors or transformers should be avoided.

Multifunction panel 840 has protection type IP67 at the front and is intended for installation in a panel cut-out. The rear has protection type IP20.

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 modules. The mounting site must be free from dust, powder, and other suspended matter so that the cooling slots do not become blocked.

DIN rail

All modules are mounted on a DIN rail according to DIN EN 60715 (35 mm × 7.5 mm × 1 mm). For reasons of stability, the spacing of the fastening screws for the DIN rail should not exceed 200 mm. The minimum distances for the modules that are specified in the module-specific installation or operating instructions must be observed.

Installation position

The DIN rail should be mounted horizontally so that all modules are arranged vertically. Otherwise the admissible ambient temperature range will be restricted.

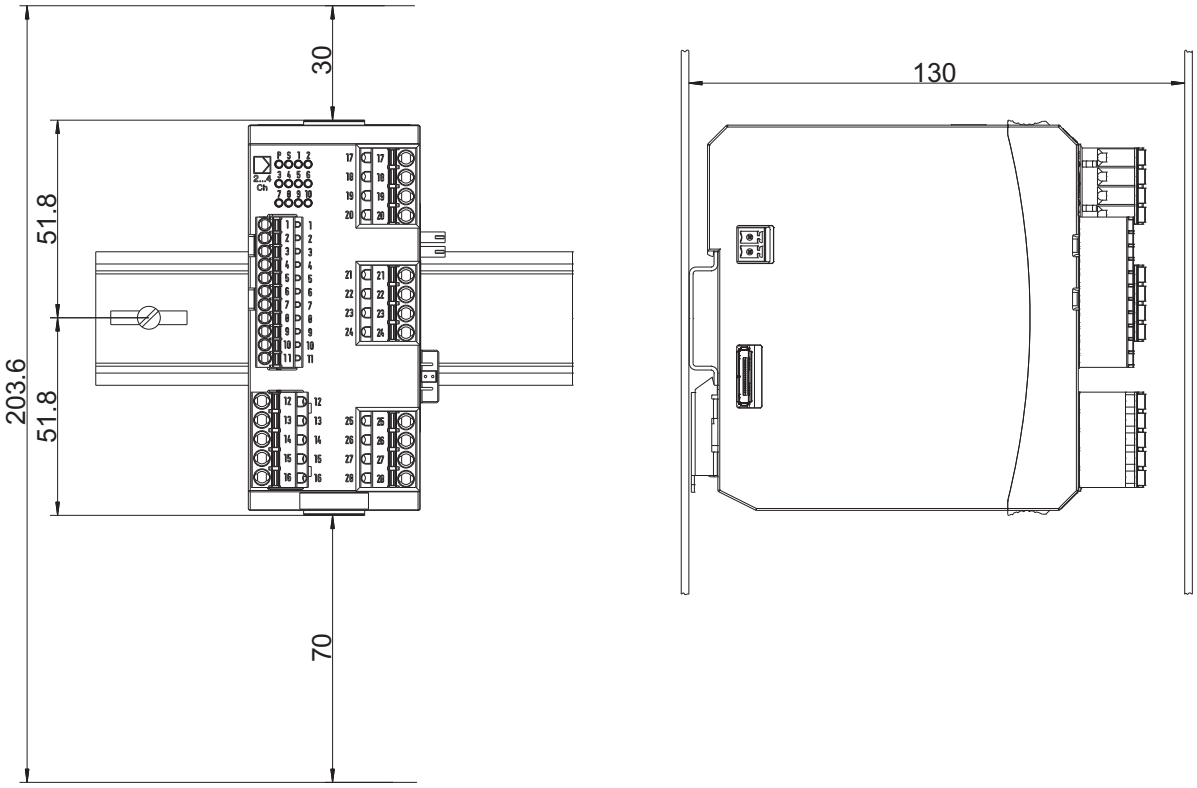
Space requirement

The modules require the minimum distances shown in the following figure for the purpose of installation/dismounting and for future maintenance or replacement. In the event of shorter distances the minimum bending radius of the cables, the performance of the electrical installation, and the clear arrangement of the plant are no longer guaranteed.

Cleaning

Only use a dry cloth for cleaning the modules (protection type IP20).

Minimum distances



3.2 Installation/dismounting on DIN rail

All modules in the system are intended for installation on a DIN rail according to DIN EN 60715 (35 mm × 7.5 mm × 1 mm).

The following must always be installed on the left, at the start of the DIN rail:

- A central processing unit *or*
- A router module

These modules connect the input/output modules to the voltage supply and the system bus.

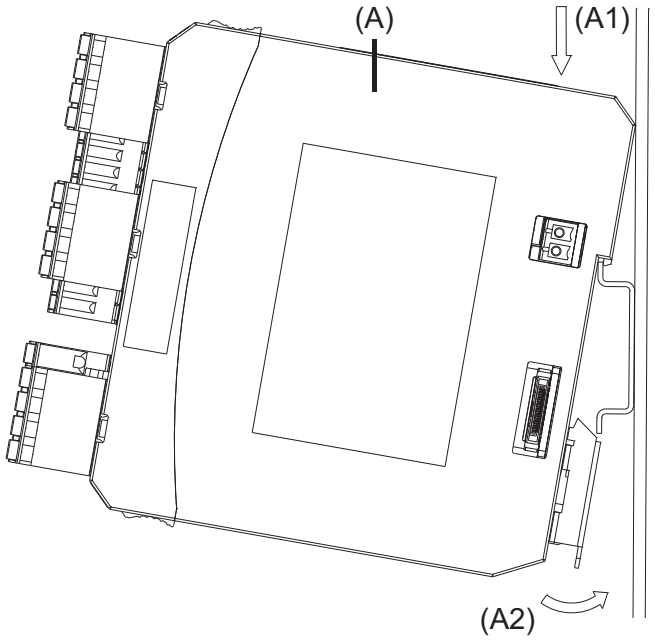
NOTE!
To determine the required minimum width of the DIN rail, the widths of the individual modules are to be added (see technical data of the modules in the respective data sheet or the module-specific installation instructions).
The widths of the cover (17.5 mm) and both end brackets (each 9.5 mm) should also be taken into consideration: 17.5 mm + 2 × 9.5 mm = 36.5 mm.

NOTE!
Modules with a recent production date have two fixing knobs on the right side of the case and on the left two round holes (for greater torsional strength of the entire module assembly). If a module with fixing knobs is to be inserted into an existing module assembly and the adjacent module does not have the corresponding holes, the fixing knobs must be completely removed to ensure electrical contact between the modules. For example, a cutter knife and a file can be used for removal.

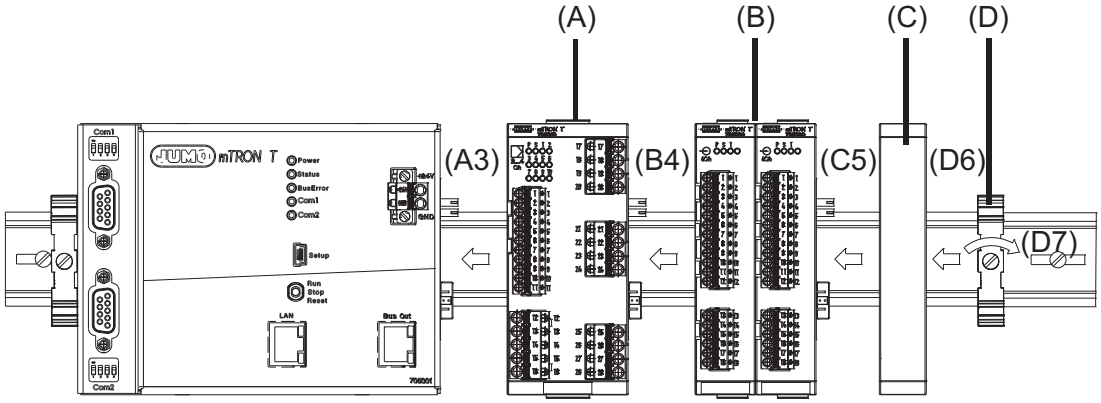
3.2.1 Input/output modules

In a sequence at the user's discretion, input/output modules can be arranged to the right next to a base unit or a router module.

Installation, using the example of a multichannel controller module 705010



Example installation

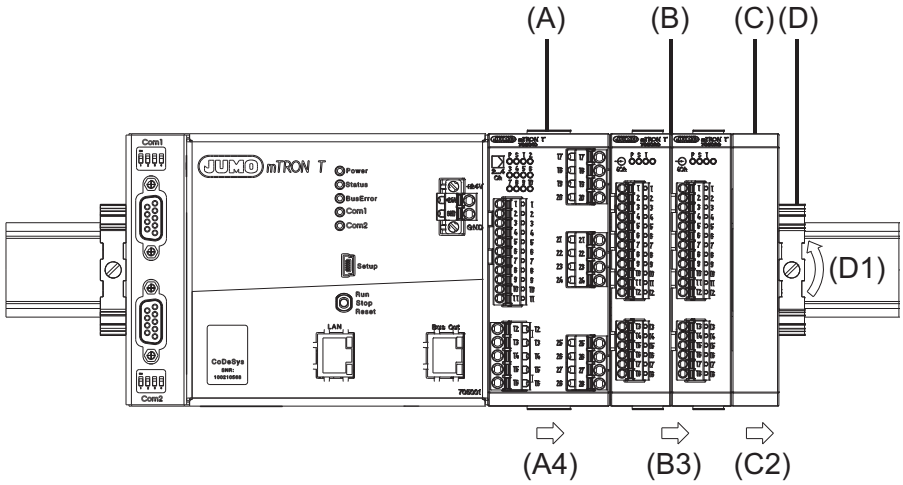


Procedure:

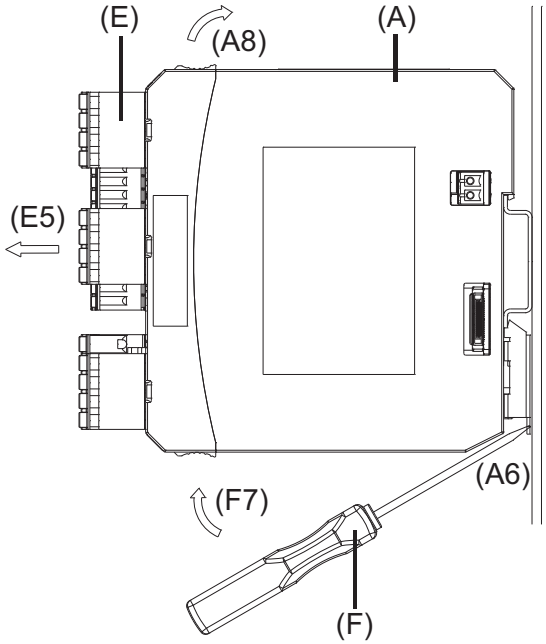
Step	Activity
1	Mount the multichannel controller module (A) in the DIN rail from above (A1).
2	Pivot the multichannel controller module (A) downward until it snaps into place (A2).
3	Move the multichannel controller module (A) to the left against the previous module (A3) until the plug connections for the voltage supply and the system bus are connected.
4	Position additional modules (B) and move to the left against the previous module (B4).
5	After the final module, position the cover (C) on the DIN rail and move to the left against the module (C5).

Step	Activity
6	After attaching the cover, position the end bracket (D) on the DIN rail and move to the left against the cover (D6).
7	Fasten the end bracket (D) using a screwdriver (D7). For this purpose, ensure that the end bracket and the cover are positioned flush against the final module.

Dismounting, using the example of a multichannel controller module 705010



Removing the multichannel controller module from the DIN rail



Procedure:

Step	Activity
1	Fully release the end bracket (D) using a screwdriver (D1), press upward from below, pivot toward the front, and remove from the DIN rail. Note: The end bracket does not need to be removed from the DIN rail if there is sufficient space to the side to move it at least 20 mm to the right.
2	Move the cover (C) to the right (C2) until the side contacts of the neighboring module are exposed. Then release the cover at the bottom using a screwdriver, press upward, and remove from the DIN rail. Note: The cover does not need to be removed from the DIN rail if there is sufficient space to the side to move it at least 20 mm to the right.
3	Move the modules (B) on the right next to the multichannel controller module that is to be replaced (A) a minimum of 20 mm to the right (B3). ? These modules are isolated from the voltage supply and the system bus.
4	Move the multichannel controller module (A) to the right (A4) until the side contacts of the neighboring module (here: central processing unit) – on the left, next to the multichannel controller module that is to be replaced – are exposed. ? The multichannel controller module is isolated from the voltage supply and the system bus. This is a prerequisite for the dismounting of the multichannel controller module.
5	If required, pull off the wired terminals (E) of the multichannel controller module (A) toward the front (E5).
6	Insert a suitable screwdriver (F) into the unlocking slot of the multichannel controller module (A6) and press upward (F7).
7	Pivot the multichannel controller module (A) upward off the DIN rail (A8) and remove it.

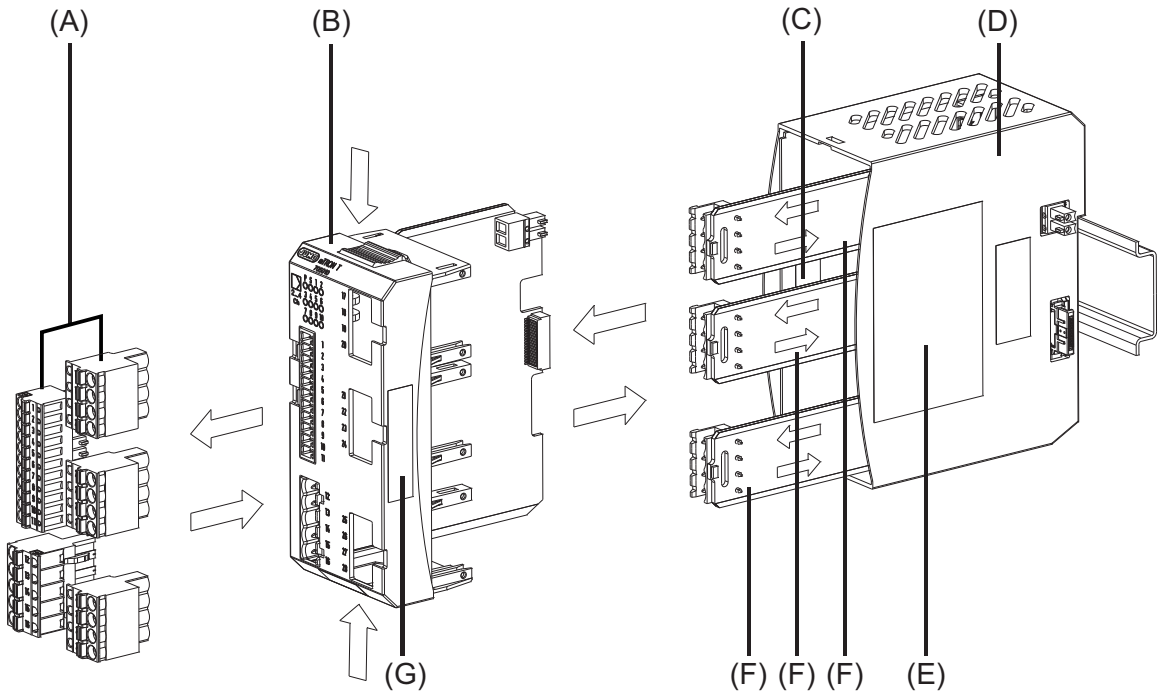
3 Installation

3.3 Replacing module inserts

3.3.1 Input/output modules

DANGER!
With multichannel controller module 705010 and relay module 705015, the load circuits from relay or solid state relay outputs can be operated with a dangerous electrical voltage (e.g. 230 V).
There is a risk of electric shock.
The load circuits are to be disconnected from the voltage supply prior to removing the wired terminal strips. This work must only be performed by qualified personnel.

Replacement of a module insert, using the example of a multichannel controller module 705010



For service purposes (or when retrofitting options for the multichannel controller module), the case (D) can remain in the system; only the module insert (B) is replaced. For this purpose, the system does not need to be isolated from the voltage supply (hot swapping). If it is an optional module, the operation of the rest of the system (mandatory modules) is not interrupted. In the case of a mandatory module, the whole system goes into "Stop" system state (see setup program manual).

The system will detect a module insert of the same type that has been replaced and will automatically reconfigure it. Retrofitted functions for the multichannel controller module (expansion slots) must be configured using the setup program or the multifunction panel.

The new module insert also has a new nameplate (G), which will differ from the old one at least with regard to the fabrication number, and is no longer identical to nameplates (E) and (C) on the case (D).

Therefore, in the event of replacement, the module insert will be supplied along with a new nameplate that will be affixed to the case (D) in place of the old nameplate (C). This means that the specifications of nameplates (G) and (C) once again correspond to one another.

CAUTION!
Only module inserts of the same type may be used for the replacement.
Otherwise, the function of the system may be affected.
The module inserts can be clearly identified using the nameplate.

CAUTION!
With the multichannel controller module 705010, a new module insert may contain retrofitted inputs or outputs that have not yet been configured.
This can lead to unintended behavior, particularly at the outputs and the actuators connected to them.
Prior to using the retrofitted inputs or outputs, ensure that these have been configured correctly.

Removing the module insert

Step	Activity
1	Disconnect load circuits from the relay or solid state relay outputs.
2	Pull off the wired terminal strips (A) toward the front.
3	Press the old module insert (B) together on the grooved surfaces at the top and bottom and remove from the case (D).
4	For the multichannel controller module, also remove the modules (F) of the expansion slots from the case (D) toward the front, if required.

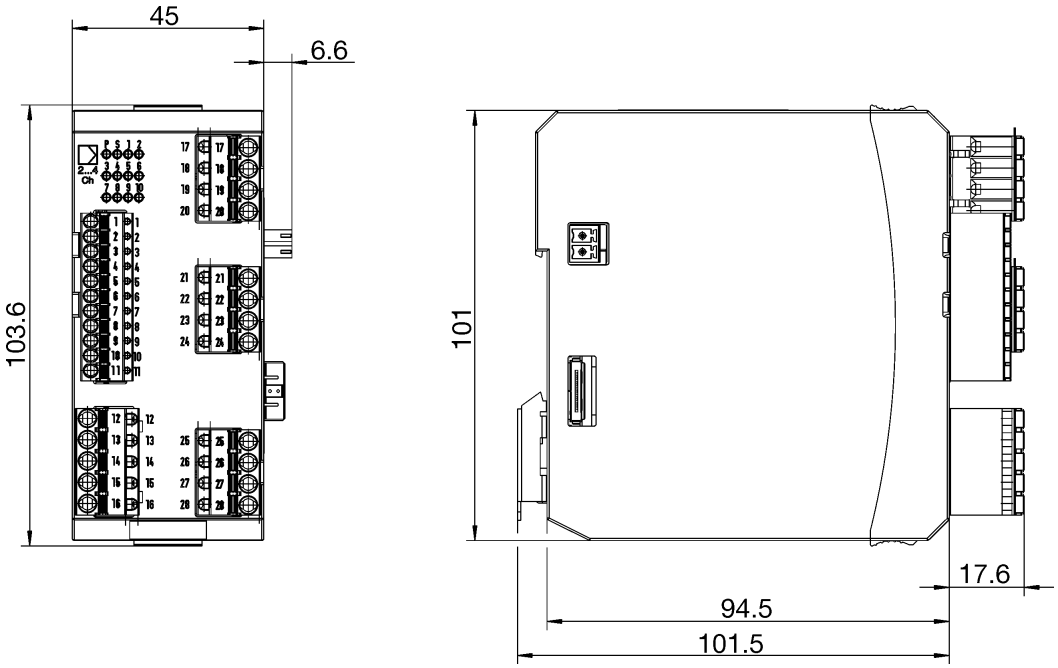
Mounting the module insert

Step	Activity
1	Affix the new nameplate in place of the old nameplate (C) in the case.
2	For the multichannel controller module, also insert the modules (F) of the expansion slots into the case (D), if required.
3	Hold the new module insert (B) at the grooved surfaces on the top and bottom and insert them into the case (D). For this purpose, ensure that the board of the module insert slides into the guide rails of the case. For the multichannel controller module, also ensure that the modules (F) of the expansion slots slide in the guide rails of the module insert.
4	Reattach the wired terminal strips (A).

NOTE!
When mounting the module insert, ensure that the snap holders (under the grooved surfaces) audibly snap into place.

NOTE!
The availability of the system can be increased through the storage of module inserts and modules for expansion slots.

3.4 Dimensions



4.1 Installation notes

NOTE!
These installation notes apply for the entire measuring, control, and automation system and, on some occasions, are only applicable for a specific module.
The respective connection diagram shows the context.

Requirements for the personnel

- Work on the modules must only be carried out to the extent described and, like the electrical connection, only by qualified personnel.
- Before plugging and unplugging connection cables ensure that the person performing the work is electrostatically discharged (e.g. by touching grounded metallic parts).

Cables, shielding, and grounding

- When selecting the cable material, when installing, and when performing the electrical connection of the module, the regulations of DIN VDE 0100 "Erection of power installations with rated voltages up to 1000 V" and the respective national regulations (e.g. on the basis of IEC 60364) are to be observed.
- Certain cables must be heat resistant up to at least 80 °C at maximum load. The relevant instructions in the connection diagram of the affected modules must be observed.
- Route input, output, and supply cables 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 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 equipotential bonding is correct.
- When connecting the device to an external PELV electrical circuit, the existing internal SELV electrical circuit becomes a PELV electrical circuit whereby the protection against electrical shock is provided through double/reinforced insulation and voltage limitation – but here no connection to the protective ground is required.

4 Electrical connection

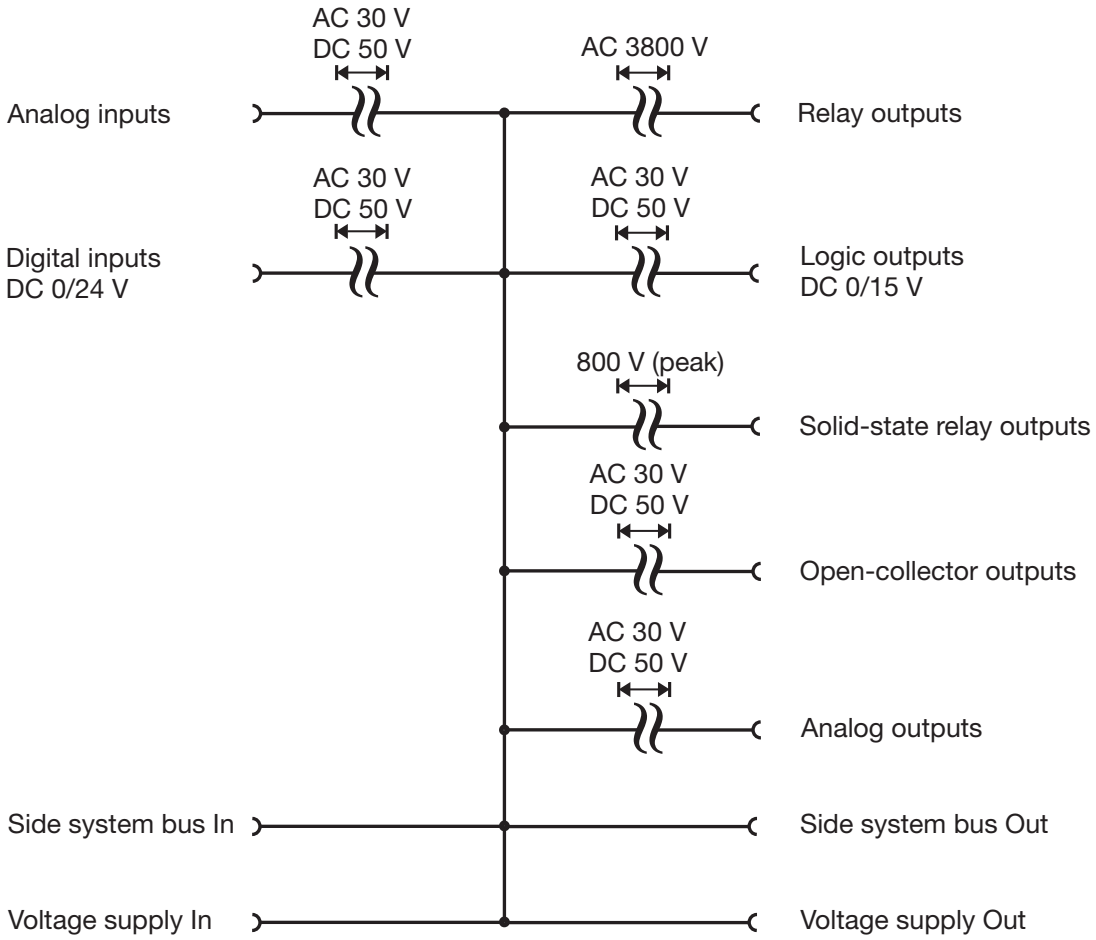
Electrical safety

- Isolate power supply units from the voltage supply on the primary side if there is a risk of touching parts with dangerous electrical voltage (e.g. 230 V) in the course of work.
- The fuse rating of the power supply units on the primary side should not exceed a value of 10 A (inert).
- With modules with relay or solid state relay outputs, the load circuits can be operated with a dangerous electrical voltage (e.g. 230 V). Disconnect load circuits from the voltage supply during installation/dismounting and electrical connection.
- In order to prevent the destruction of the relay or solid state relay outputs in the event of an external short circuit in the load circuit, the load circuit should be fused to the maximum admissible output current.
- The modules are not suitable for installation in areas with an explosion hazard.
- In addition to a faulty installation, incorrectly set values on the module could also impair the correct function of the following process. Therefore, ensure that safety devices independent of the module (e.g. overpressure valves or temperature limiters/monitors) are available 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 meets the standards and regulations cited in the technical data.
- The USB device interface and voltage supply in the central processing unit 705001 are **not** electrically isolated. In general, please observe the specifications regarding electrical isolation.

4.2 Galvanic isolation



Inputs/outputs	Galvanically isolated from each other
Relay outputs	Yes
Logic outputs DC 0/15 V	Yes
Solid state relay outputs	Yes
Open-collector outputs	Outputs of different expansion slots
Analog outputs	Yes
Digital inputs DC 0/24 V	Inputs of different modules (motherboard, expansion slots)
Analog inputs	Yes

NOTE!
Signals to digital inputs belonging to one module (motherboard or expansion slot) must have the same ground reference to avoid undefined signal levels.

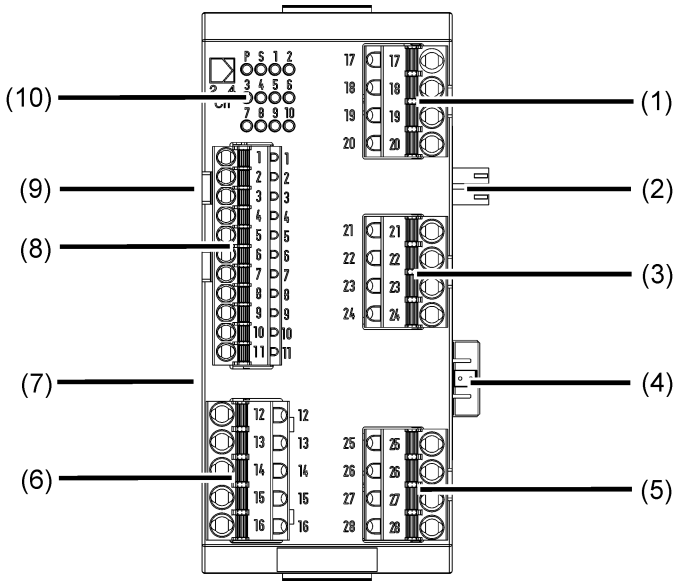
4 Electrical connection

4.3 Connection diagram

CAUTION!
At maximum load, the temperature may exceed 60 °C at the terminals.
As a result the insulation of the cable may be damaged.
The cable must be heat resistant up to at least 80 °C.

CAUTION!
The controller module configuration does not necessarily correspond to the intended application during initial startup (e.g. "Independent controller" operating mode active).
This may result in undefined plant behavior.
Therefore, where possible during startup, no actuators should be connected and load current circuits should be isolated. The plant installer is essentially responsible for the startup process.

4.3.1 Display and connection elements

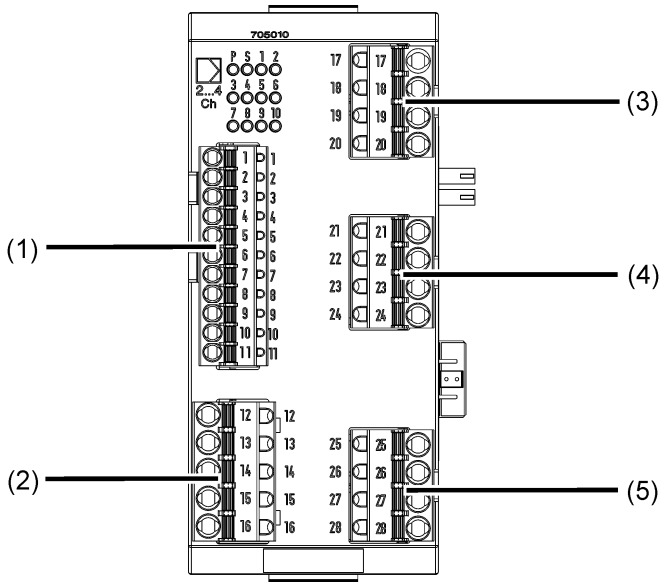


(1) Terminal strip expansion slot 1
(2) Voltage supply Out, DC 24 V
(3) Terminal strip expansion slot 2
(4) Side system bus Out
(5) Terminal strip expansion slot 3
(6) Terminal strip digital outputs 3, 4
(7) Side system bus In
(8) Terminal strip analog inputs 1, 2
and digital inputs 1, 2
(9) Voltage supply In, DC 24 V
(10) Status displays (LED):
P = Voltage supply and operating mode
S = Status
1 to 10 = Digital inputs/outputs (LED is lit: active)

4 Electrical connection

4.3.2 Overview of inputs and outputs

This overview shows the position of the inputs and outputs in relation to the terminal strips. The assignment to the individual terminals is described in the following sections.

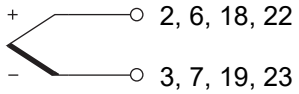
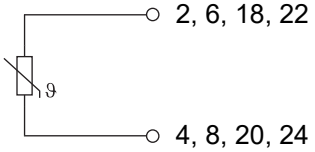
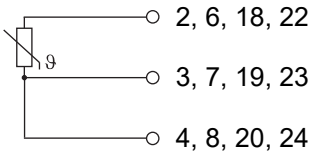
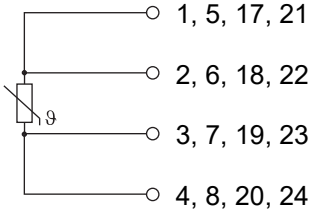
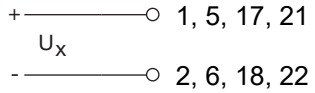
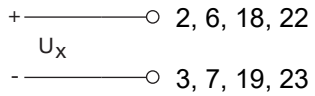
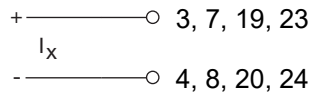
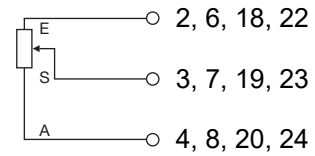
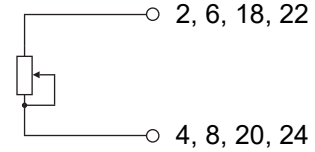


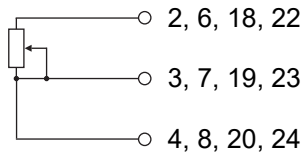
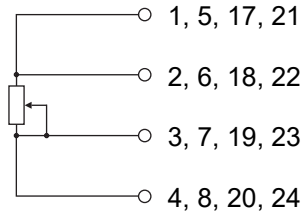
	Standard version	Optional			
(1)	Analog input 1				
	Analog input 2				
	Digital input 1				
	Digital input 2				
(2)	Digital output 3				
	Digital output 4				
(3)		Analog input 3	Digital input 5	Analog output 1	Digital output 5
			Digital input 6		Digital output 6
(4)		Analog input 4	Digital input 7	Analog output 2	Digital output 7
			Digital input 8		Digital output 8
(5)			Digital input 9	Analog output 3	Digital output 9
			Digital input 10		Digital output 10

The approval according to DIN EN 14597 is only valid when probes are connected which are suitable for use according to DIN EN 14597 and only in the specified temperature range (see data sheet 705010).

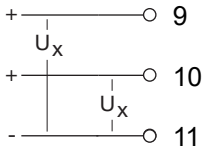
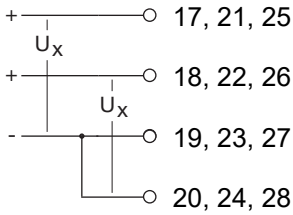
4.3.3 Analog inputs

Input 1, 2: Standard version; input 3, 4: Option

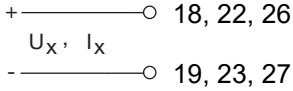
Connection	Input	Terminals	Symbol and terminal designation
Thermocouple	1 2 3 4	2 and 3 6 and 7 18 and 19 22 and 23	
RTD temperature probe 2-wire circuit	1 2 3 4	2 and 4 6 and 8 18 and 20 22 and 24	
RTD temperature probe 3-wire circuit	1 2 3 4	2 to 4 6 to 8 18 to 20 22 to 24	
RTD temperature probe 4-wire circuit	1 2 3 4	1 to 4 5 to 8 17 to 20 21 to 24	
Voltage DC 0(2) to 10 V	1 2 3 4	1 and 2 5 and 6 17 and 18 21 and 22	
Voltage DC 0 to 1 V	1 2 3 4	2 and 3 6 and 7 18 and 19 22 and 23	
Current DC 0(4) to 20 mA, Heater current AC 0 to 50 mA, Heater current DC 0 to 20 mA	1 2 3 4	3 and 4 7 and 8 19 and 20 23 and 24	
Resistance transmitter A = Start E = End S = Slider	1 2 3 4	2 to 4 6 to 8 18 to 20 22 to 24	
Resistance/potentiometer 2-wire circuit	1 2 3 4	2 and 4 6 and 8 18 and 20 22 and 24	

Connection	Input	Terminals	Symbol and terminal designation
Resistance/potentiometer 3-wire circuit	1 2 3 4	2 to 4 6 to 8 18 to 20 22 to 24	
Resistance/potentiometer 4-wire circuit	1 2 3 4	1 to 4 5 to 8 17 to 20 21 to 24	

4.3.4 Digital inputs

Connection	Input	Terminals	Symbol and terminal designation
Digital input DC 0/24 V, standard version (Input 1: Counting input)	1 2	9 and 11 10 and 11	
Digital input DC 0/24 V, optional Terminals 19 and 20, 23 and 24 as well as 27 and 28 are internally linked.	5 6 7 8 9 10	17 and 19 18 and 20 21 and 23 22 and 24 25 and 27 26 and 28	

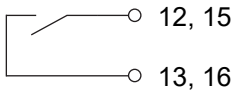
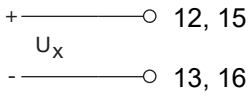
4.3.5 Analog outputs

Connection	Output	Terminals	Symbol and terminal designation
Analog output DC 0/2 to 10 V or DC 0/4 to 20 mA (configurable), optional	1 2 3	18 and 19 22 and 23 26 and 27	

4.3.6 Digital outputs

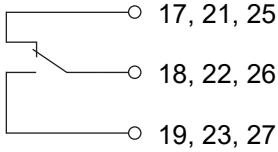
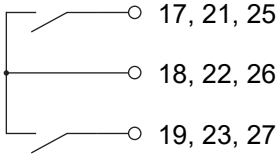
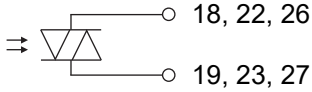
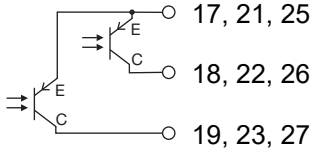
Standard version

In the standard version the controller module is equipped with relay or logic outputs (see “Order details”).

Connection	Output	Terminals	Symbol and terminal designation
Relay output (N/O)	3 4	12 and 13 15 and 16	
Logic output DC 0/15 V	3 4	12 and 13 15 and 16	

The digital output numbering starts with 3. This allows the direct assignment to the LEDs of the digital outputs (LED 3 to 10).

Optional

Connection	Output	Terminals	Symbol and terminal designation
Relay output (changeover contact)	5 7 9	17 to 19 21 to 23 25 to 27	
Relay output (N/O)	5 6 7 8 9 10	17 and 18 18 and 19 21 and 22 22 and 23 25 and 26 26 and 27	
Solid-state relay	5 7 9	18 and 19 22 and 23 26 and 27	
Open-collector output C = Collector E = Emitter	5 6 7 8 9 10	17 and 18 17 and 19 21 and 22 21 and 23 25 and 26 25 and 27	

4 Electrical connection

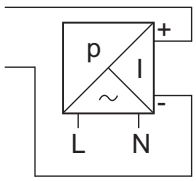
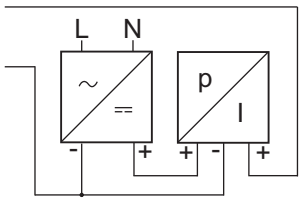
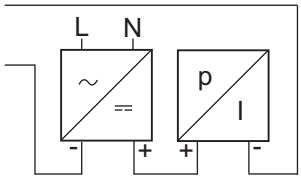
4.4 Connection examples

This chapter provides some examples to illustrate the connection of the inputs and outputs of the module.

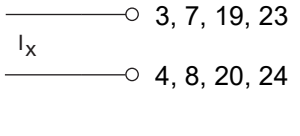
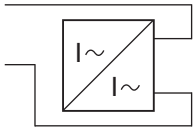
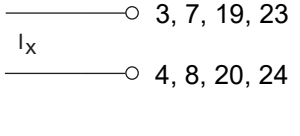
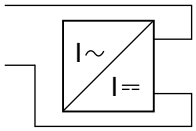
NOTE!
Details for the load of the inputs and outputs are given in the "Technical data" and the information for the galvanic isolation (electric strenght). This information has to be observed when connecting. In addition, the notes in the instructions of the connected external device must be observed (if applicable).

4.4.1 Analog inputs

The following table shows examples of the connection of a transmitter with current output (standard signal) to an analog input of the multichannel controller module. The examples – with the exception of the 2-wire transmitter – also generally apply to a transmitter with voltage output; in this case, however, the different terminal designations must be considered.

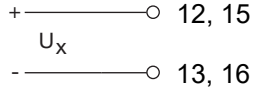
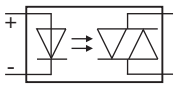
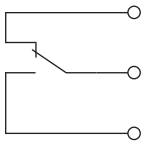
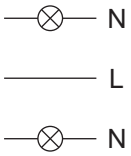
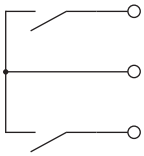
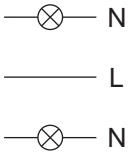
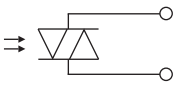
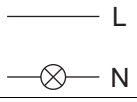
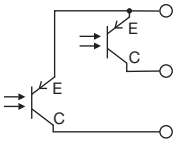
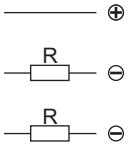
Input	Symbol and terminal designation	Example of external wiring
Current DC 0(4) to 20 mA	+ 3, 7, 19, 23 I_x - 4, 8, 20, 24	 4-wire transmitter
Current DC 0(4) to 20 mA	+ 3, 7, 19, 23 I_x - 4, 8, 20, 24	 3-wire transmitter with external power supply
Current DC 4 to 20 mA	+ 3, 7, 19, 23 I_x - 4, 8, 20, 24	 2-wire transmitter with external power supply

The following table shows an example of the connection of a current transformer for heater current monitoring to an analog input of the multichannel controller module.

Input	Symbol and terminal designation	Example of external wiring
Heater current AC 0 to 50 mA		 Current transformer AC/AC
Heater current DC 0 to 20 mA		 Current transformer AC/DC

4.4.2 Digital outputs

The following table shows examples how to use the differrent digital outputs of the multichannel controller module.

Output	Symbol and terminal designation	Example of external wiring
Logic output DC 0/15 V		 External solid-state relay
Relay output (changeover contact)		
Relay output (N/O)		
Solid-state relay		
Open-collector output C = Collector E = Emitter		

4 Electrical connection

4.5 Functional test

The **voltage supply** must be tested on completion of the electrical connection:

Signal	Meaning
The "P" LED (Power, green or orange) **is lit**	The module is being supplied with voltage through the side contacts.
The "P" LED (Power, green or orange) **is not lit**	The module is not supplied with voltage or there is a problem with the electrical function of the LED. Remedy: • Check the voltage supply to the side contacts of the preceding module (top contact +24 V, bottom contact GND). • Check voltage supply at the "+24 V" and "GND" terminals of the base unit or router module. • Check power supply unit and connection between the power supply unit and the base unit or router module. If the "Power" LED does not light up despite a voltage supply being present, the module insert or – if the bus board inside the case is faulty – the entire module must be replaced.

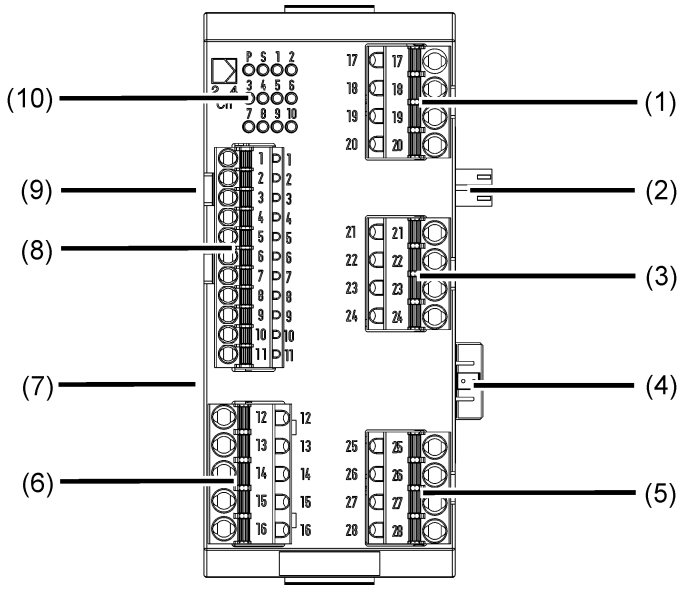
Startup

The check described above completes the process of installation and electrical connection. For startup, use the additional documentation (operating manual or system manual).

The "Introduction" section of this document contains an overview of all documentation for the measuring, control, and automation system.

5.1 Display and connection elements

This overview shows the position of the display and connection elements.



(1) *Expansion slot 1*:
- Analog input 3
- Digital inputs/outputs 5, 6
- Analog output 1

(2) Voltage supply Out, DC 24 V

(3) *Expansion slot 2*:
- Analog input 4
- Digital inputs/outputs 7, 8
- Analog output 2

(4) Side system bus Out

(5) *Expansion slot 3*:
- Digital inputs/outputs 9, 10
- Analog output 3

(6) Digital outputs 3, 4

(7) Side system bus In

(8) Analog inputs 1, 2
and digital inputs 1, 2

(9) Voltage supply In, DC 24 V

(10) LEDs:

P = Voltage supply and operating mode

S = Status

1 to 10 = Digital inputs/outputs 1 to 10

5 Operation

5.2 LED displays

"P" LED (Power)

The LED is permanently lit in green or blue if the module is being supplied with voltage.
It also indicates the operating mode of the controller module:
Green: Normal operation
Blue: Independent operation

"S" LED (Status)

This LED indicates the status of the module. Diagnostics requires the setup program or a Web browser as appropriate.

LEDs "1" to "10"

The LEDs indicate the status of the relevant digital input or output.
LED lights up yellow = digital input or output is active

5.2.1 Display modes

The following table lists all possible states of the "S" LED (Status).

Display mode	Description	Green symbol	Red symbol
---	LED state not relevant	---	---
Off	LED off	○	○
On	LED on (permanently lit)	■	●
Flickering	LED flickers (50 ms on, 50 ms off)	■■■■	●●●●
Single flickering	LED flashes briefly (50 ms on, 200 ms off)	■□□□□	●○○○○
Blinking	LED flashes (200 ms on, 200 ms off)	■□■□■	●○●○●
Single flash	LED flashes once (200 ms on, 1000 ms off)	■□□	●○○
Double flash	LED flashes twice (on/off/on for 200 ms each time, 1000 ms off)	■■□□	●●○○
Triple flash	LED flashes three times (on/off/on/off/on for 200 ms each time, 1000 ms off)	■■■□□	●●●○○
Quadruple flash	LED flashes four times (on/off/on/off/on/off/on for 200 ms each time, 1000 ms off)	■■■■□□	●●●●○○
Blinking red/green	LED flashes red and green (200 ms red, 200 ms green)	●■●■	
On green/ Single flickering red	LED lights up green, flashes red (50 ms red)	■●	

5.2.2 System states and errors

The following table lists all the system states and errors that are indicated by the "S" LED (Status). In most cases, further diagnostics must be performed with the setup program.

Category	"S" LED (Status)	Meaning	Diagnostics with	Recommended action
Start error		Module error (hardware does not start up)	LED	Replace module
Start error		Internal error (bootloader) Various errors during startup (e.g. no memory, initialization error)	LED	Replace module
Start error		No firmware	LED	Replace module
Start error		Incorrect optional board 1, 2, 3 (actual/target)	LED	Check optional board and replace, load, or remove as required; replace module if necessary
Bus status		No connection to central processing unit	LED	Check whether the central processing unit is running; check cabling and topology
Bus status		System in "Stop" (INIT) state – no error, only in start phase	LED	
Bus status		System in "Stop" (PREOP) state – no error, only in start phase	LED	
Operation	 (Priority 1)	Module not calibrated (LED flashes red-green) or module in calibration mode (calibrate/test; LED flickers red-green)	LED/setup program	
Operation	 (Priority 2)	Collective alarm (incl. out of range)	LED/setup program	
Operation	 (Priority 3)	System in "Stop" (SAFEOP) state – no error	LED	
Operation	 (Priority 3)	System in "Run" (OP) state – no error	LED	

5 Operation

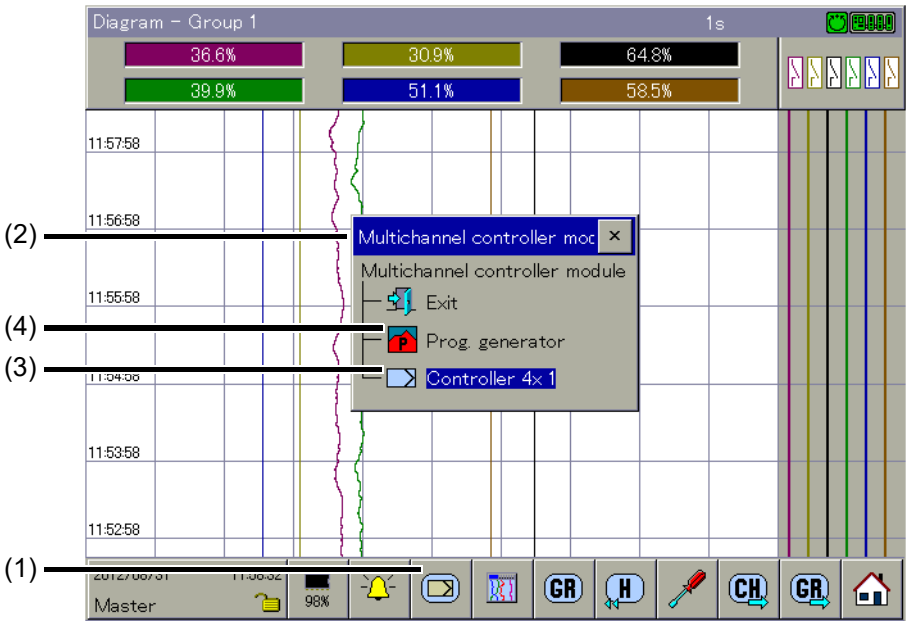
5.3 Operation on the multifunction panel

The basic steps for operation and visualization are described in the operating manual of the multifunction panel (B 705060.0).

This operating manual describes how to operate the controller channels of the multichannel controller module (controller module).

Operation of the program generator and configuration of the program editor are covered in the operating manual for the central processing unit (B 705001.0).

Multifunction panel – "Controller" button



(1) "Controller" button (operation)

(2) "Controller" menu (opened with the "Controller" button)

(3) Operate multichannel controller module; opens the controller screen

(4) Operate program generator; opens the generator screen

⇨ Operating manual for central processing unit (B 705001.0)

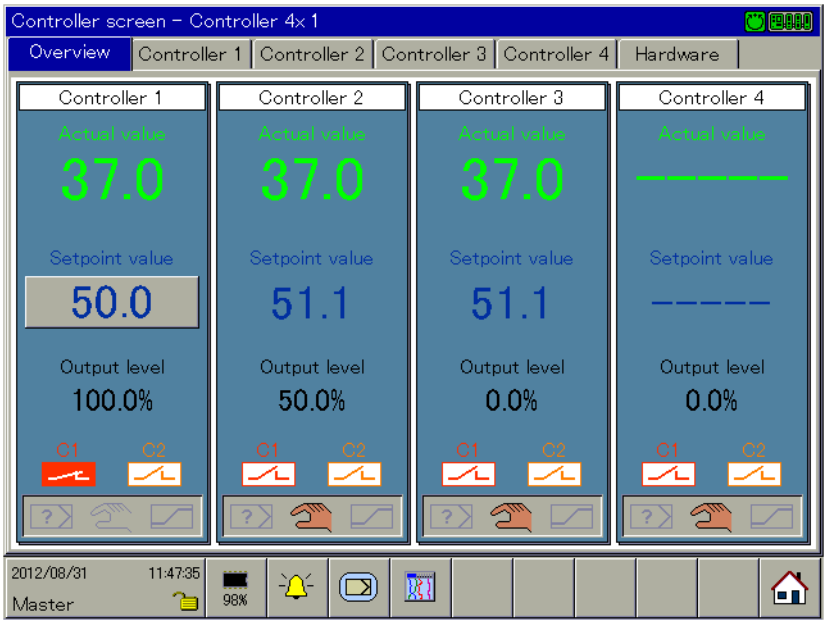
To operate the controller channels of the multichannel controller module, select the "Controller 4x ..." entry. If multiple multichannel controller modules are available, they will be arranged one below the other and assigned different numbers. The multichannel controller module in this example has been assigned the number 1.

5.3.1 Multichannel controller module

Operation of the multichannel controller module includes the following settings and functions:

- Setpoint value entry
- Display of actual value, setpoint value, output level, switch setting of outputs, self-optimization, manual mode, and ramp function
- Start of self-optimization
- Changeover to manual mode
- In manual mode: Specification of output level or actuator opening and closing
- Display of inputs and outputs (hardware) of the multichannel controller module

Controller screen – overview of controller channels 1 to 4 (controller 1 to 4)



This screen provides an overview of all controller channels that are switched on:

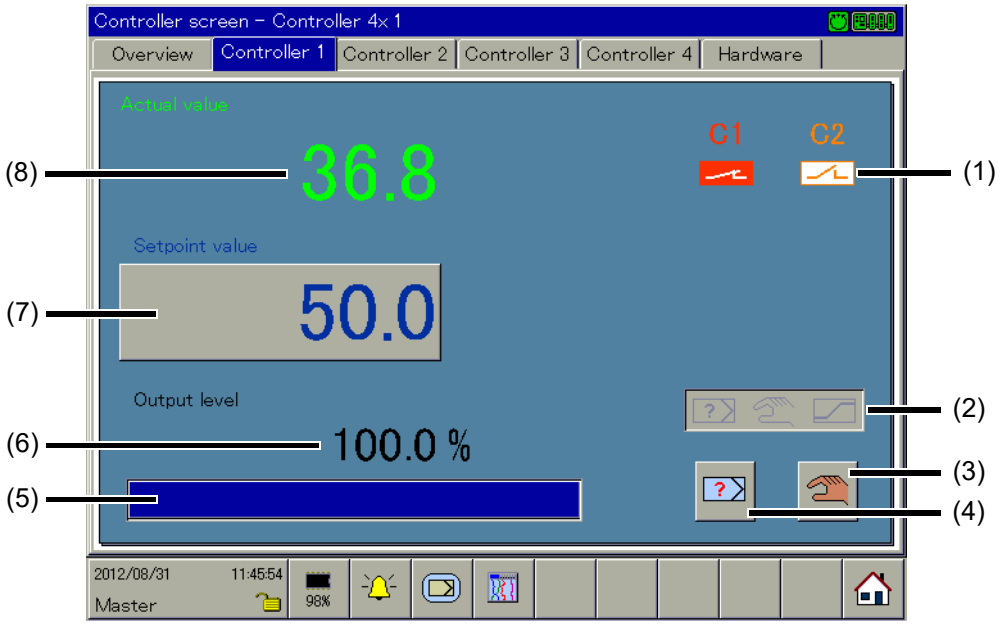
- Actual value
- Setpoint value (display or input field; depends on the configuration and user rights)
- Output level
- Switch setting for outputs of the controller channel (K1, K2)
- Self-optimization, manual mode, ramp function (active/not active)

Controller channel 4 is switched on in this example; the actual value and setpoint value have not yet been configured.

To select a particular controller channel, select the relevant tab at the top of the window. If a controller channel is switched off, a gray area appears in the overview and the tab is not available. If only one controller channel is switched on, the controller screen for that particular controller channel is displayed instead of this overview.

Select the tab on the right to open an overview screen with the inputs and outputs of the multichannel controller module.

Controller screen – controller channel 1: Two-state controller in automatic mode



(1) Switch setting of output 1 (K1) and 2 (K2) of the controller channel

(2) Display of self-optimization, manual mode, ramp function (from left to right)

(3) Changeover to manual mode

(4) Self-optimization start/stop

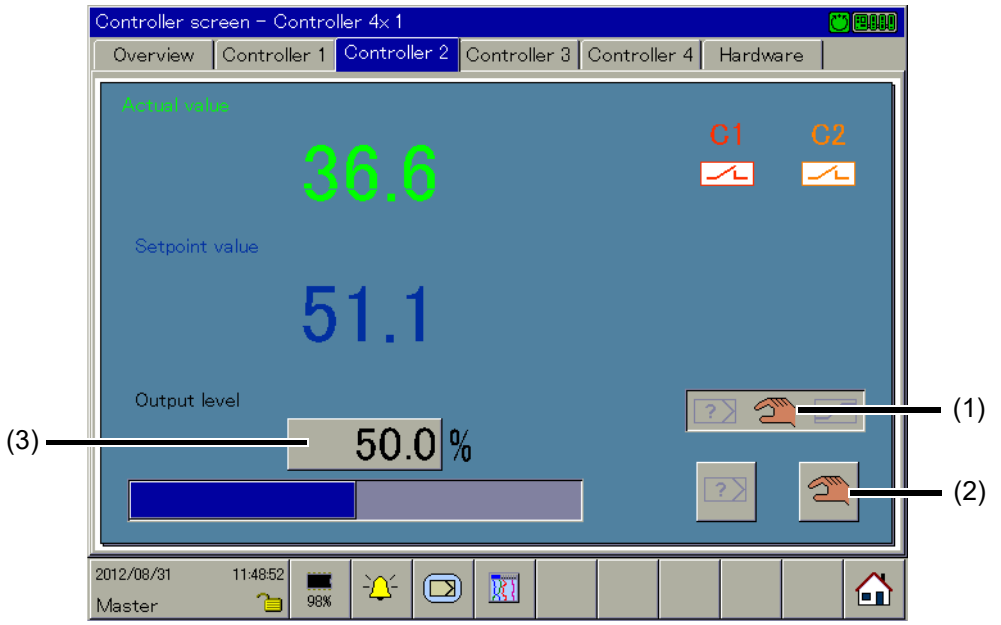
(5) Display of output level (bar graph)

(6) Display of output level (percent)

(7) Input field for setpoint value or setpoint value display (depends on configuration)

(8) Display of actual value

Controller screen – controller channel 2: Two-state controller in manual mode

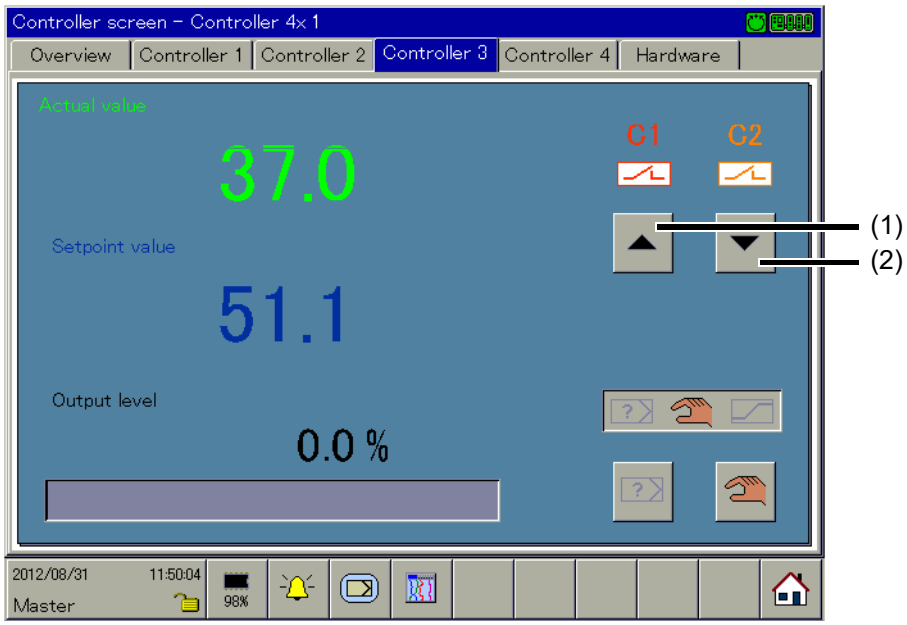


(1) Manual mode is active

(2) Changeover to automatic mode

(3) Input field for output level

Controller screen – controller channel 3: Modulating controller in manual mode



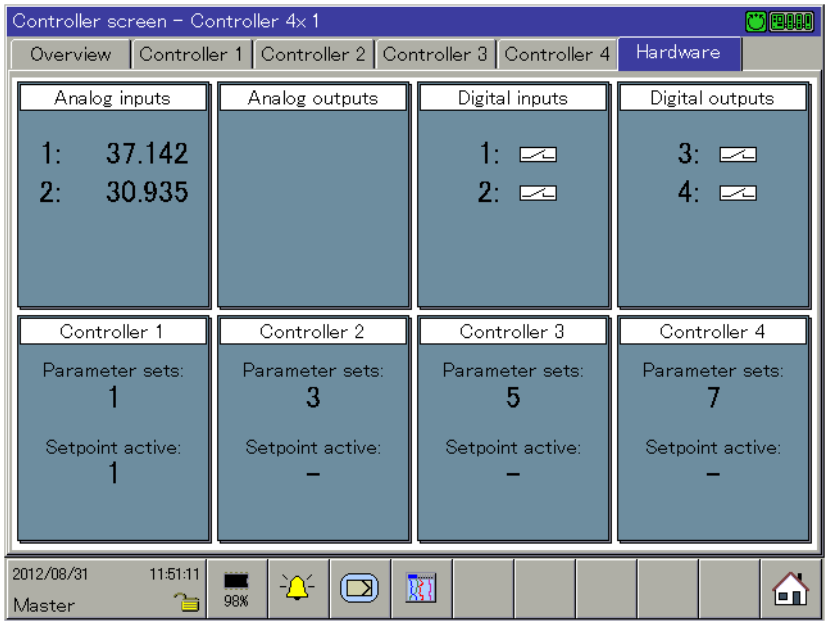
(1) Open actuator

(2) Close actuator

NOTE!
If the modulating controller is in manual mode, the actuator can also be opened and closed in the "Stop" system state.

NOTE!
If the output level feedback of the position controller is "out of range", the current position of the actuator can no longer be determined. In this case, the actuator can be operated with buttons (1) and (2), as for the three-step controller. The commands "Open actuator" or "Close actuator" are issued for as long as the relevant button is held.

Controller screen – overview of the inputs and outputs of the multichannel controller module



This screen provides an overview of the inputs and outputs of the multichannel controller module:

- Measured value of analog inputs (including display of measuring range overflow and underflow)
- Signal of analog outputs (optional)
- Switching status of digital inputs and outputs

Information about controller channels 1 to 4 is also displayed:

- Number of the active parameter block
- Number of the active setpoint value (when using the setpoint value function)

NOTE!
The parameters described in this section can be configured either with the setup program or with the multifunction panel (exception: Device data and replacement values).

6.1 Analog selector

The analog selector contains all analog signals that are available in the multichannel controller module for configuration.

The following table lists all analog signals. The entry in the "Type" column indicates the source of the signal:

- Internal only: Internal signal that is only available inside the multichannel controller module.
- Internal: Internal signal of the multichannel controller module (including signals of analog inputs)
  The signal is also transmitted to the base unit via the system bus, to allow it to be used by other modules.
- External: External input (NV_...) that must be linked in the NV connecting list to a signal from another module (see Chapter 6.14 "NV connecting list", page 111).
  The signal name "NV_..." indicates the intended use; in principle, the signal can also be used for other purposes.

Category	Signal	Type	Description
Inactive			No signal selected
Further signals	SamplingRate	Internal only	Sampling rate of controller module
Controller	NV_C01ActualValue to NV_C04ActualValue	External	Actual value for controller channel 1 to 4
	NV_C01Setpoint to NV_C04Setpointt	External	Setpoint value for controller channel 1 to 4
	C01OutpLevelMon to C04OutpLevelMon	Internal	Output level (display value) of controller channel 1 to 4
	C01OutpLevel1 to C04OutpLevel1	Internal	Output level at first controller output (continuous) of controller channel 1 to 4
	C01OutpLevel2 to C04OutpLevel2	Internal	Output level on second controller output (continuous) of controller channel 1 to 4
	C01Diff to C04Diff	Internal	Difference between setpoint value and actual value of controller channel 1 to 4
	C01ActualValue to C04ActualValue	Internal	Actual value of controller channel 1 to 4 (as of system version 05)
	C01Setpoint to C04Setpoint	Internal	Setpoint value of controller channel 1 to 4 (as of system version 05)

Category	Signal	Type	Description
Setpoints	NV_SP01Ext to NV_SP04Ext	External	External setpoint value for setpoint value function 1 to 4
	SP01RampOutput to SP04RampOutput	Internal	Current setpoint value of ramp function 1 to 4
	SP01Active to SP04Active	Internal	Active setpoint value (external setpoint value + setpoint value) of setpoint value function 1 to 4
	SP01Setpoint1 to SP04Setpoint1	Internal	Setpoint value 1 (fixed setpoint value or correction value) of setpoint value function 1 to 4
	SP01Setpoint2 to SP04Setpoint2	Internal	Setpoint value 2 (fixed setpoint value or correction value) of setpoint value function 1 to 4
	SP01Setpoint3 to SP04Setpoint3	Internal	Setpoint value 3 (fixed setpoint value or correction value) of setpoint value function 1 to 4
	SP01Setpoint4 to SP04Setpoint4	Internal	Setpoint value 4 (fixed setpoint value or correction value) of setpoint value function 1 to 4
Analog inputs	AI01 to AI04	Internal	Measured value of analog input 1 to 4
Mathematics	Math01 to Math04	Internal	Result of math function 1 to 4
	NV_M01Flag to NV_M04Flag	External	Any analog value 1 to 4 (freely available)
Hardware counter	HWCounter	Internal	Counter reading of hardware counter
NVAnalogOutputs	NV_AO01 to NV_AO03	External	Signal for controlling analog output 1 to 3

6.2 Digital selector

The digital selector contains all digital signals that are available in the multichannel controller module for configuration.

The following table lists all digital signals. The entry in the "Type" column indicates the source of the signal:

- Internal only: Internal signal that is only available inside the multichannel controller module.
- Internal: Internal signal of the multichannel controller module (including signals of digital inputs).
  The signal is also transmitted to the base unit via the system bus, to allow it to be used by other modules.
- External: External input (NV_...) that must be linked in the NV connecting list to a signal from another module (see Chapter 6.14 "NV connecting list", page 111).
  The signal name "NV_..." indicates the intended use; in principle, the signal can also be used for other purposes.

Category	Signal	Type	Description
Inactive			No signal selected
Further signals	MasterNotConnected	Internal only	No connection to the base unit via the system bus (controller module operates independently)
Controller	C01ContrLoopMonit to C04ContrLoopMonit	Internal only	Alarm signal of control loop monitoring of controller channel 1 to 4
	C01OutpLevelMonit to C04OutpLevelMonit	Internal only	Alarm signal of output level monitoring of controller channel 1 to 4
	C01ManualMode to C04ManualMode	Internal	Manual mode active on controller channel 1 to 4
	C01TuneActive to C04TuneActive	Internal	Self-optimization active for controller channel 1 to 4
	C01Output1 to C04Output1	Internal	Switch position of first controller output of controller channel 1 to 4
	C01Output2 to C04Output2	Internal	Switch position of second controller output of controller channel 1 to 4
	C01CollAlarm to C04CollAlarm	Internal	Collective alarm of controller channel 1 to 4 (configurable with signals from the digital selector)

Category	Signal	Type	Description
Controller (continued)	NV_C01TuneStart to NV_C04TuneStart	External	Start self-optimization for controller channel 1 to 4
	NV_C01TuneStop to NV_C04TuneStop	External	Abort self-optimization for controller channel 1 to 4
	NV_C01ParamSet to NV_C04ParamSet	External	Changeover from parameter block 1 to parameter block 2 for controller channel 1 to 4
	NV_C01ManualMode to NV_C04ManualMode	External	Changeover to manual mode for controller channel 1 to 4
	NV_C01Stop to NV_C04Stop	External	Switch off controller channel 1 to 4
Setpoints	SP01RampTolBand to SP04RampTolBand	Internal	Alarm signal of tolerance band monitoring of ramp function 1 to 4
	NV_SP01Changeover1 to NV_SP04Changeover1	External	Bit 0 of setpoint changeover of setpoint value function 1 to 4
	NV_SP01Changeover2 to NV_SP04Changeover2	External	Bit 1 of setpoint changeover of setpoint value function 1 to 4
Analog inputs	AI01Alarm1 to AI04Alarm1	Internal	Alarm signal 1 of analog input 1 to 4
	AI01Alarm2 to AI04Alarm2	Internal	Alarm signal 2 of analog input 1 to 4
Digital inputs 🕮	DI01, DI02, DI05 to DI10	Internal	Signal of digital input 1, 2, 5 to 10
NVDigitalOutputs	NV_DO03 to NV_DO10	External	Signal for controlling digital output 3 to 10
Limit monitoring	LI01 to LI04	Internal	Output signal of limit value monitoring 1 to 4
	NV_LI01Confirmation to NV_LI04Confirmation	External	Signal to acknowledge the output signal of limit value monitoring 1 to 4
Mathematics	Logic01 to Logic04	Internal	Result of logic function 1 to 4
Signal rejections	NV_SR01 to NV_SR08	External	Signal for activating signal suppression of digital input 1, 2, 5 to 10
Alarm 🕮	CollectiveAlarm	Internal	Controller module collective alarm
HW counter	HWCounterSignal	Internal	Signal of hardware counter in "fill" operating mode (as switch-off signal when threshold value reached)
Digital links	DigitalLink01 to DigitalLink04	Internal	Result of binary linking 1 to 4

Digital inputs

If the HW counter is activated, the signal of digital input 1 is inactive.

Alarm

The collective alarm of the controller module is made up of all functions for which the "Collective alarm" alarm type has been activated, along with the controller channel collective alarms (collective alarm 1 to 4).

6 Configuration

6.3 "Independent controller" operating mode

The controller module can be configured for independent operation. This enables it to continue to operate if communication fails between the controller module and the central processing unit.

⇨ Chapter 6.4 "Device data", page 56

Principle

If the "**Independent controller**" operating mode is **enabled**, the controller module can continue to perform control tasks with the remaining resources if communication fails (all internal functions continue to run).

Otherwise, if the "**Independent controller**" operating mode is **not enabled**, the controller channels and outputs of the controller module switch off if communication fails.

The controller module detects within 2 seconds whether the conditions for changeover to independent mode are present. These include:

- No connection to the central processing unit via the system bus (failure of all communication)
- Central processing unit changes to the "Stop" system state (failure of cyclical communication)

When changing to independent mode, the controller module continues to operate with the most recent valid setpoint inputs, provided it has been configured accordingly ("Last setpoint value for independent mode" parameter). This affects the setpoint input both via external signals (NV_...) and through internal functions or calculations.

A controller module that has been configured for independent mode also operates in independent mode during system startup until the "Run" system state is achieved.

Prerequisites

One prerequisite for independent mode is that the actual value of a controller channel is obtained via an analog input of the controller module. Likewise, the output level must be supplied through an analog or digital output of the controller module to the control path.

If external signals (NV_...) are also used in normal operation, these are no longer available after changeover to independent operation. The relevant replacement values are used instead. You can only configure these with the setup program and must adjust them to the relevant application with appropriate dimensioning.

⇨ Chapter 6.14.5 "Replacement values (overview)", page 122

NOTE!
When configuring the controller module, a digital input for switching off the relevant controller channel is to be included where applicable. This is the only way to ensure that a controller channel can also be switched off when in independent mode.

Display of operating mode

In addition to the voltage supply, the two-color "P" LED (Power) also indicates the operating mode of the controller module:

- Green: Normal operation, communication present with the central processing unit
- Orange: Independent operation, no communication with the central processing unit

The operating mode is also displayed on the multifunction panel.

Self-optimization

If the "**Independent controller**" operating mode is **enabled**, self-optimization can be started at any time, provided it is permitted in general (configuration of self-optimization). The controller parameters determined are saved in the controller module once self-optimization is complete and are also transmitted to the central processing unit and saved there permanently. If communication with the central processing unit is not possible, the controller parameters are saved in the controller module only.

CAUTION!
When communication becomes possible again, the controller parameters saved in the central processing unit are transmitted to the controller module.
The previously determined controller parameters in the controller module are overwritten.
Repeat self-optimization if necessary.

If the controller module changes to "Independent controller" operating mode while self-optimization is in progress, the self-optimization is aborted.

If the "**Independent controller**" operating mode is **not enabled**, self-optimization can only be started if there is communication present between the controller module and the central processing unit.

Manual mode

In "Independent controller" operating mode, the manual output level can still be changed in the "Stop" system state and the actuator can be opened and closed.

Replacing the controller module

The behavior following controller module (or module insert) replacement depends on the set operating mode and the compatibility of the software versions in the central processing unit and controller module:

- **"Independent controller" enabled**: If the software versions are incompatible, the controller module starts up with its own configuration; the system itself does not start up if an incompatible controller module software version is detected.
  If the software versions are compatible and a connection is present, the controller module adopts the configuration from the central processing unit.
- **"Independent controller" not enabled**: The controller module only runs under the control of the central processing unit. This requires compatible software versions and a connection to be present.

Firmware update

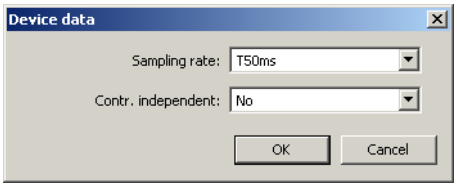
During a firmware update, the system enters the "Stop" state and all outputs are switched off. Afterward, the controller module starts with the factory settings, which means that the "Independent controller" operating mode is not permitted. An "Independent controller" setting that has been previously configured does not become active again until the configuration has been transferred from the central processing unit to the controller module.

CAUTION!
A firmware update affects the controller module function.
The control is interrupted for up to 60 seconds.
Take control path out of operation during the firmware update!

6.4 Device data

The settings apply for the entire controller module.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Sampling rate	Sampling rate of the internal inputs and external inputs (system bus)	
	T50ms	The signal is sampled every 50 ms.
	T100ms	The signal is sampled every 100 ms.
	T150ms	The signal is sampled every 150 ms.
	T200ms	The signal is sampled every 200 ms.
	T250ms	The signal is sampled every 250 ms.
Contr. independent 📖	Enable "Independent controller" operating mode.	
	Yes	"Independent controller" operating mode is enabled.
	No	"Independent controller" operating mode is not enabled.

Independent controller

The controller module can operate independently, meaning that if communication fails between the controller module and the central processing unit, the control task continues to be performed.

⇨ Chapter 6.3 ""Independent controller" operating mode", page 54

Status after change of configuration

The settings are available immediately after configuration.

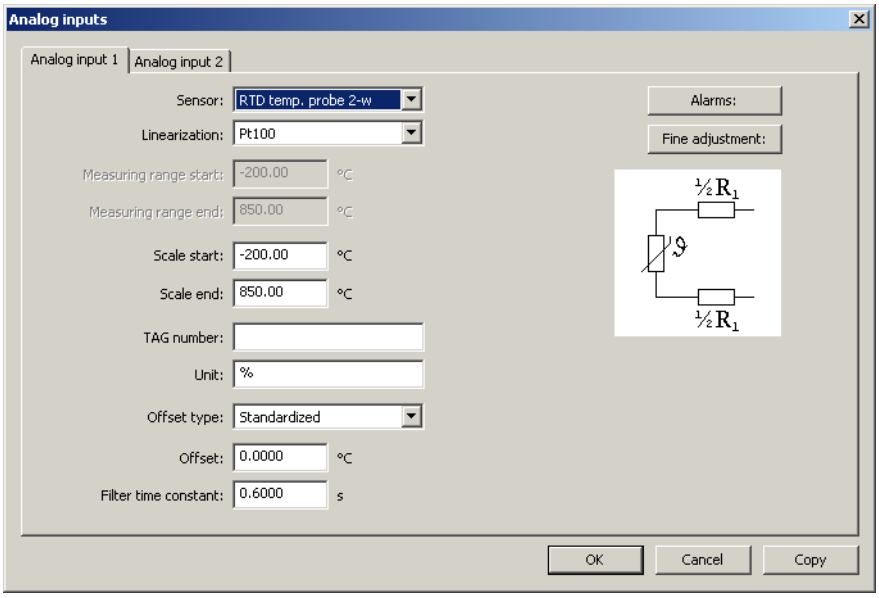
Behavior after power on

The settings are available immediately after initialization.

6.5 Analog inputs

The analog inputs (maximum of four) are universal measuring inputs for RTD temperature probes, thermocouples, resistance transmitters, resistance/potentiometers, and standard signals.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Sensor	Selection of measuring probe for the relevant analog input	
	Inactive	No sensor selected
	RTD temp. probe 2-w	RTD temperature probe in 2-wire circuit
	RTD temp. probe 3-w	RTD temperature probe in 3-wire circuit
	RTD temp. probe 4-w	RTD temperature probe in 4-wire circuit
	Resistance transmitter	Resistance transmitter
	Thermocouple	
	Heater current	Heater current AC 0 to 50 mA or heater current DC 0 to 20 mA
	Current 0 to 20 mA	Standard signal
	Current 4 to 20 mA	Standard signal
	Voltage 0 to 1 V	Standard signal
	Voltage 0 to 10 V	Standard signal
	Voltage 2 to 10 V	Standard signal

Parameter	Selection/settings	Description
	Resistance/potentiometer 2-w	Resistance/potentiometer in 2-wire circuit
	Resistance/potentiometer 3-w	Resistance/potentiometer in 3-wire circuit
	Resistance/potentiometer 4-w	Resistance/potentiometer in 4-wire circuit
Linearization	Available options and factory settings depend on the measuring probe selected.	
🕮	Linear	
	Pt50	GOST 6651-94
	Pt100	DIN EN 60751
	Pt500	DIN EN 60751
	Pt1000	DIN EN 60751
	Pt100J	JIS 1604
	Pt100G	GOST 6651-94
	KTY	Type KTY11-6
	Cu50	GOST 6651-94
	Cu100	GOST 6651-94
	Ni100	DIN EN 60751
	NiCr-CuNi_E	DIN EN 60584
	Cu-CuNi_T	DIN EN 60584
	Fe-CuNi_J	DIN EN 60584
	Cu_CuNi_U	
	Fe-CuNi_L	
	NiCr-Ni_K	DIN EN 60584
	Pt10Rh-Pt_S	DIN EN 60584
	Pt13Rh-Pt_R	DIN EN 60584
	Pt30Rh-Pt6Rh_B	DIN EN 60584
	NiCrSi-NiSi_N	DIN EN 60584
	W5Re-W26Re_C	
	W3Re-W25Re_D	
	W3Re-W26Re	
	Chromel-Copel	GOST 8.585-2001
	Chromel-Alumel	GOST 8.585-2001
	Platinel II	
	Customer-specific	Customer-specific linearization using grid points (pairs of values) or 4th order polynomial

Parameter	Selection/settings	Description
Measuring range start 🕮	Factory setting depends on sensor and linearization.	
	-99999 to +99999	Start value of the measuring range (for resistance transmitter, standard signal, and potentiometer) to detect out of range
Measuring range end 🕮	Factory setting depends on sensor and linearization.	
	-99999 to +99999	End value of measuring range (see above) to detect out of range
Scale start 🕮	Factory setting depends on sensor and linearization.	
	-99999 to +99999	Start value of display range
Scale end 🕮	Factory setting depends on sensor and linearization.	
	-99999 to +99999	End value of display range
TAG number	7 characters (as of system version 05: 42 characters)	Identification marking (documentation in PLC)
Unit	5 characters (**%**)	Unit for numerical representation of measured value
Offset type 🕮	Type of measured value offset	
	Standardized	Offset of standardized measured value (after linearization)
	Physical	Offset of physical measured value (before linearization)
Offset 🕮	-100 to **0** to +100 As of system version 04: -99999 to **0** to +99999	Correction value
Filter time constant 🕮	0 s to **0.6 s** to 100 s	Time constant for adjusting the digital input filter (0 s = filter off)
Cold junction	Selection of cold junction (for thermocouple)	
	Internal Pt100	Internal Pt100 temperature probe
	External constant	Constant cold junction temperature
Ext. reference temp.	-20 to **0** to +200	Cold junction temperatures (for thermocouple and constant cold junction temperature)
Resistance Ra or Ro 🕮	**0** Ω to 4000 Ω	For Resistance transmitter: Resistance Ra between sliding contact (S) and start (A), if the sliding contact is positioned at the start. For Resistance/potentiometer: Offset resistance Ro
Resistance Rs or Rx 🕮	6 Ω to **1000** Ω to 4000 Ω	For Resistance transmitter: Resistance range Rs of sliding contact For Resistance/potentiometer: Shifting resistance range Rx

Parameter	Selection/settings	Description
Resistance Re 🕮	**0** Ω to 4000 Ω	For Resistance transmitter: Resistance Re between sliding contact (S) and end (E), if the sliding contact is positioned at the end.

Linearization

Linearization must be selected according to the sensor (measuring probe).

The predefined linearizations can be supplemented with **customer-specific linearization**.

⇨ Chapter 8.1 "Customer-specific linearization", page 127

Measuring range

In case of customer-specific linearization, these values can not be changed here. They are identical to the settings made there for "Measuring range start" and "Measuring range end".

Scale

In case of customer-specific linearization, these values are initially identical to the settings made there for "Measuring range start" and "Measuring range end". Here, the scale range can be additionally restricted.

Offset type

To offset plant-specific deviations, the measured value can be offset for each analog input. When doing this, the offset type is used to specify the type of measured value offset.

"**Standardized**" offset type: The measured value is offset after linearization. In the case of an RTD temperature probe or thermocouple, the temperature value (°C or °F) determined by the linearization is offset.

"**Physical**" offset type: The physical measured value is offset before linearization. In the case of an RTD temperature probe, this relates to the resistance in ohms; in the case of a thermocouple, it relates to the thermoelectric voltage in mV.

A typical application scenario for the "physical" offset type is compensation of the lead wire resistance in an RTD temperature probe in a 2-wire circuit.

Offset

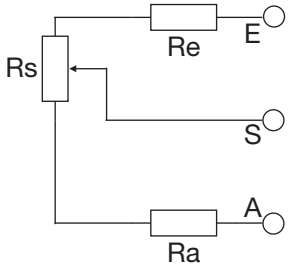
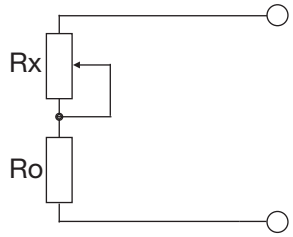
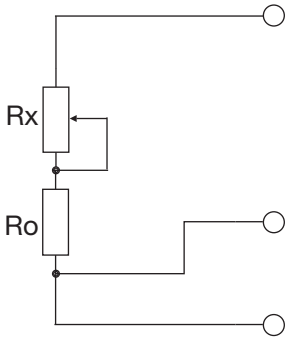
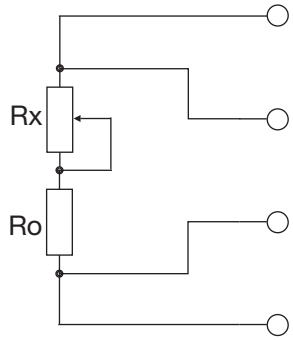
A positive or negative form of the correction value is added to the measured value (entering a negative correction value reduces the measured value).

Filter time constant

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 a high level of attenuation of interference signals, a slow reaction time of the actual value display, and 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.

<table>
<tr>
<td>Resistance transmitter
 
</td>
<td>Resistance/potentiometer in 2-wire circuit
 
</td>
</tr>
<tr>
<td>Resistance/potentiometer in 3-wire circuit
 
</td>
<td>Resistance/potentiometer in 4-wire circuit
 
</td>
</tr>
</table>

Status after change of configuration

The input values before the change of configuration are not saved; the new input values are available approx. 2 seconds after the change of configuration.

Behavior after power on

All analog inputs are initialized and start their measurements over (no statuses are saved with power off).

Error processing

The behavior in the event of deviation above or below the measuring range (out of range) can be configured. The settings should be made in:

- Controller configuration
- Limit value monitoring
- Analog outputs

The settings made there also apply for probe/conductor breaks or probe/conductor short-circuits. This produces a safe state for operation in the event of an error.

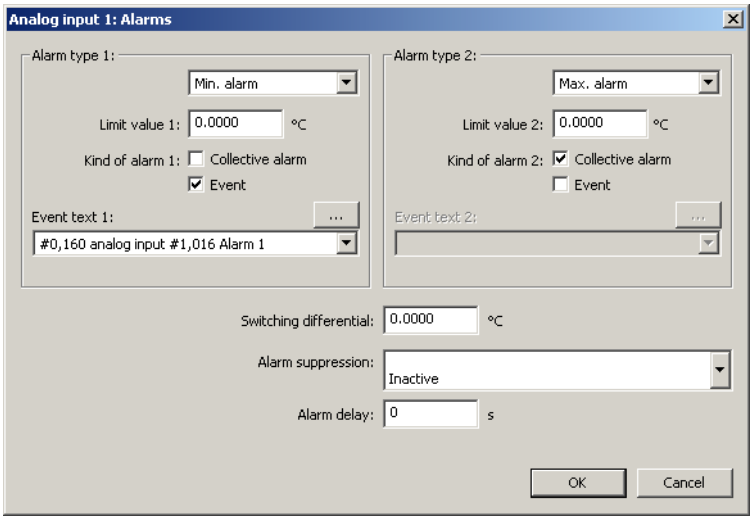
Error detection depends on the type of measuring probe (see technical data, measuring circuit monitoring).

6.5.1 Alarms

Limit value monitoring with one or two alarms and various alarm types can be activated for each analog input. In addition, this function is required in order to trigger the collective alarm of the controller module if the event of deviation above or below the measuring range (out of range).

This limit value monitoring is available in addition to the functions described in Chapter 6.11 "Limit value monitoring", page 100 and is independent of these.

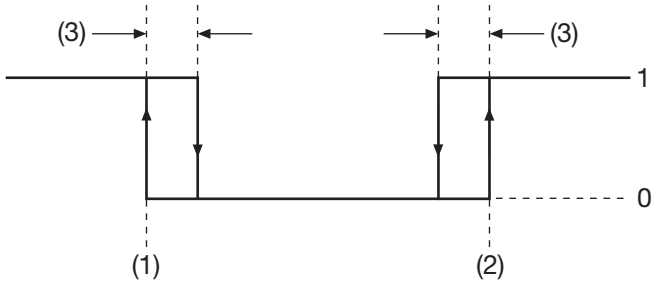
Setup dialog



Parameters

Parameter	Selection/settings	Description
Alarm type 1, 2 📖	**Off**	Monitoring is not active.
	Min. alarm	Alarm is issued if the limit value is not met.
	Max. alarm	Alarm is issued if the limit value is exceeded.
Limit value 1, 2	-99999 to **0** to +99999	Limit value at which an alarm is issued.
Kind of alarm 1, 2	The alarm type is **not** set by default.	
	Collective alarm	Alarm results in collective alarm of controller module.
	Event	Alarm results in an entry (event text) in the event list.
Event text 1, 2 📖	Use default text or select other text from the list.	Text that is entered in the event list for an alarm (if Kind of alarm = "Event").
Switching differential 📖	**0** to 99999	Used to suppress constant switching operations in the event of minor fluctuations of the input signal around the limit value.
Alarm suppression	Digital selector (**Inactive**)	Signal to activate the alarm suppression
Alarm delay	**0 s** to 65535 s	Delay time for alarm activation

Alarm type and switching differential



(1) Min. alarm/limit value
(2) Max. alarm/limit value
(3) Switching differential

1 Alarm on
0 Alarm off

Event text

Setup program: Selection of text from a list

Click the "..." button to open a list with the text numbers and the associated texts. The texts can be edited.

Multifunction panel: Selection of text using the text number

The setup program is required to view and edit the texts.

Collective alarm for out of range

In the event of deviation above or below the measuring range (out of range, O-o-R) or – depending on the type of measuring probe – in the event of a probe/conductor break or probe/conductor short-circuit, the collective alarm of the module can also be triggered. To do this, you must activate at least one alarm type and select the "Collective alarm" alarm type.

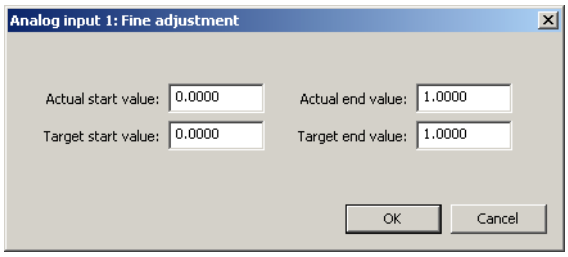
If the alarm type is only being activated for this purpose, the measuring range start (for Min. alarm) or measuring range end (for Max. alarm) must be entered as a limit value. Otherwise, in the event of deviation above or below the value – for example if the default value 0 is retained – this also results in a module collective alarm.

The collective alarm of the module is entered in the event list of the central processing unit, which enables you to identify the affected module. If there is also a need to identify the affected analog input, you must also activate the "Event" alarm type and select an appropriate event text.

6.5.2 Fine adjustment

You can use customer-specific fine adjustment to correct the measured values of the analog input. In contrast to 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.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Actual start value	-99999 to **0** to +99999	Lower display value
Target start value	-99999 to **0** to +99999	Lower reference value
Actual end value	-99999 to **1** to +99999	Upper display value
Target end value	-99999 to **1** to +99999	Upper reference value

Example

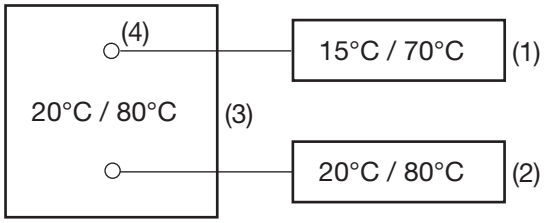
The temperature inside a furnace is measured with an RTD temperature probe and displayed. Due to the temperature drift of the sensor, the true temperature (reference measurement) deviates from the displayed value. The amount of deviation is different at the upper and lower measuring points, meaning that measured value offset is not suitable.

Actual start value: 15 °C (displayed value)

Target start value: 20 °C (reference measurement)

Actual end value: 70°C (displayed value)

Target end value: 80 °C (reference measurement)



(1) Display value

(2) Reference value

(3) Furnace

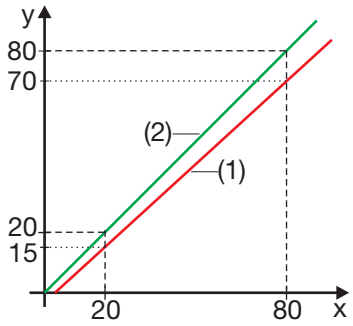
(4) Sensor in RTD temperature probe

Performing fine adjustment

1) Determine the lower value (as low and constant as possible) with the reference measuring device.
   Example: Set furnace temperature to 20 °C.
2) Enter the display value as the actual start value and the reference value as the target start value.
   Example: Enter 15 and 20.
3) Determine the upper value (as high and constant as possible) with the reference measuring device.
   Example: Increase furnace temperature to 80 °C.
4) Enter the display value as the actual end value and the reference value as the target end value.
   Example: Enter 70 and 80.

Characteristic line

The following diagram shows the changes in the characteristic line caused by the fine adjustment (point of intersection with the x axis as well as the gradient).



y	Display value	(1)	Characteristic line before fine adjustment
x	Reference value	(2)	Characteristic line after fine adjustment

Resetting the 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

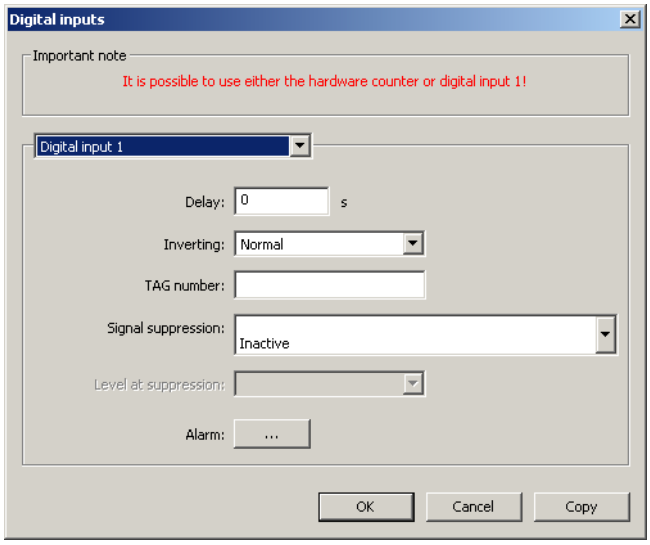
6 Configuration

6.6 Digital inputs

A maximum of eight digital inputs are available (input 1, 2, 5 to 10). Digital input 1 can be used as a counter input for up to 10 kHz.

The status of a digital input is indicated by the relevant LED. The display corresponds to the output signal to the system bus.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Delay	**0 s** to 65535 s	Delay time during change of input signal from Low to High (or from High to Low in the case of active inverting)
Inverting	Inversion of the input signal	
	Normal	Not inverted
	Inverse	Inverted
TAG number	7 characters (as of system version 05: 42 characters)	Identification marking (documentation in PLC)
Signal suppression 🕮	Digital selector (**Inactive**)	Signal (high-active) for suppression of the input signal
Level at suppression	Output level during active signal suppression	
	Inactive	Low level (0)
	Active	High level (1)

Signal suppression

When signal suppression is active, the input signal and the inverting and delay parameters are irrelevant. In this case, a fixed signal with a configurable level is issued (to the system bus).

Status after change of configuration

The output signal to the system bus always adopts the status that corresponds to the current configuration.

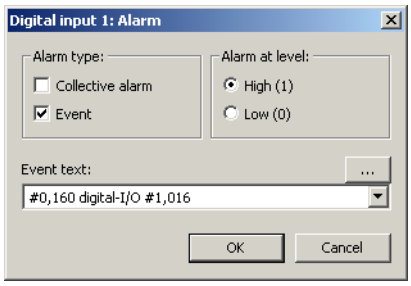
Behavior after power on

After initialization, the input signals are available immediately, according to their configuration.

6.6.1 Alarm

Signal monitoring can be activated for each digital input.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Alarm type	The alarm type is **not** set by default.	
	Collective alarm	Alarm results in collective alarm of controller module.
	Event	Alarm results in an entry (event text) in the event list.
Alarm at level	**High (1)**	Alarm at high level (1)
	Low (0)	Alarm at low level (0)
Event text 🕮	Use default text or select other text from the list.	Text that is entered in the event list for an alarm (if Alarm type = "Event").

Event text

Setup program: Selection of text from a list

Click the "..." button to open a list with the text numbers and the associated texts. The texts can be edited.

Multifunction panel: Selection of text using the text number

The setup program is required to view and edit the texts.

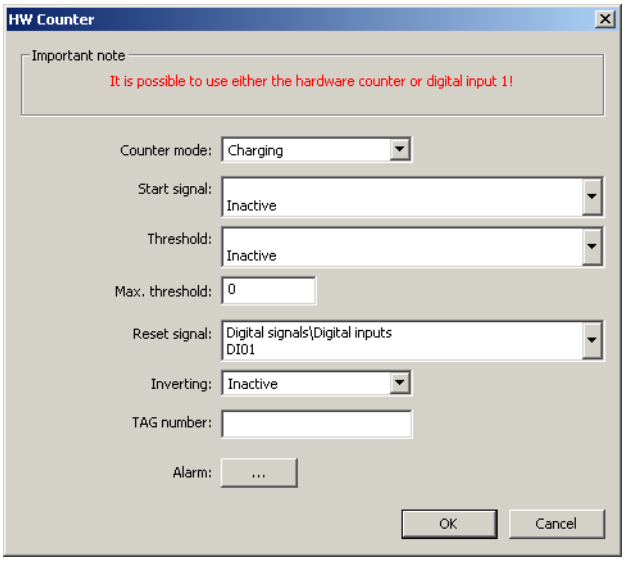
6 Configuration

6.7 HW Counter

The controller module is equipped with a counter (hardware). Digital input 1 should be used as a counter input (up to 10 kHz). The counter counts the rising edges of the input signal.

The counter reading and the switch-off signal (counter signal) are available in the analog selector or digital selector.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Counter mode 📖	**Inactive** Counting Charging	Counter is not active. Counter is running continuously. Counter is delivering switch-off signal.
Start signal	Digital selector (**Inactive**)	Signal (active for rising edge) to start the counter (in "Charging" counter mode)
Threshold	Analog selector (**Inactive**)	Analog signal for specifying the switch-off limit (in "Charging" counter mode)
Max. threshold	**0** to 65535	Switch-off limit (in "Charging" counter mode); active if no analog signal has been selected (Threshold = Inactive).
Reset signal	Digital selector (**Inactive**)	Signal for resetting the counter
Inverting	Inversion of the reset signal	
	Inactive	Reset with high level (1)
	Active	Reset with low level (0)
TAG number	7 characters (as of system version 05: 42 characters)	Identification marking (documentation in PLC)

"Counting" counter mode

The counter runs continuously. When it reaches the max. counter reading 65535 (0xFFFF), it starts again at 0. (The switch-off signal is always 0.)

"Charging" counter mode

The counter is started with the rising edge of the start signal. This means:

- The counter reading is set to 0.
- The switch-off signal changes from 0 to 1.
- The counter is ready for counting.

The counter counts the rising edges of the input signal; in the process, the switch-off signal changes from 1 to 0 if:

- the switch-off limit is reached (Threshold or Max. threshold),
- the max. counter reading 65535 is reached (counter overrun), or
- the counter is reset (reset signal).

In such cases, the counter still continues to run as long as the input signal delivers counting pulses, even beyond the max. counter reading (starts again at 0).

If the counter is started again with the start signal while a counting procedure is running, the switch-off signal remains at 1; only the counter starts to count again from 0.

Status after change of configuration

Changing the configuration sets the counter reading to 0.

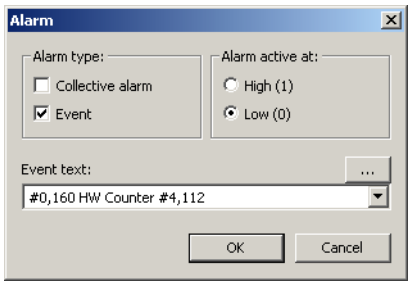
Behavior after power on

After initialization, the counter starts with the value of 0 in the set counter mode.

6.7.1 Alarm

The switch-off signal can be monitored in the "Charging" counter mode.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Alarm type	The alarm type is **not** set by default.	
	Collective alarm	Alarm results in collective alarm of controller module.
	Event	Alarm results in an entry (event text) in the event list.
Alarm at level	High (1)	Alarm at high level (1)
	Low (0)	Alarm at low level (0)
Event text	Use default text or select other text from the list.	Text that is entered in the event list for an alarm (if Alarm type = "Event").

Event text

Setup program: Selection of text from a list

Click the "..." button to open a list with the text numbers and the associated texts. The texts can be edited.

Multifunction panel: Selection of text using the text number

The setup program is required to view and edit the texts.

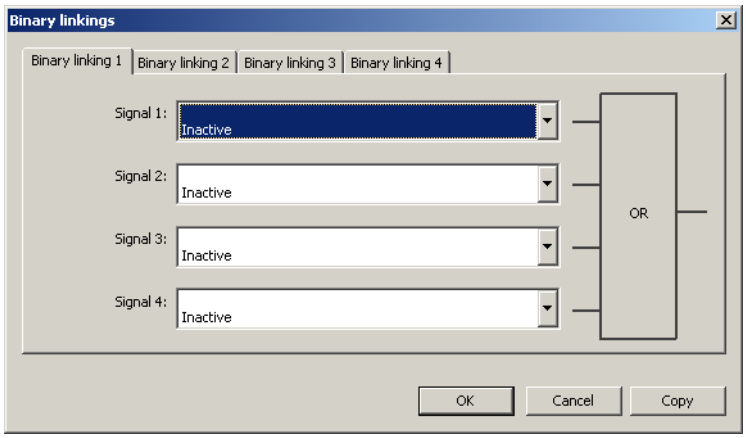
6.8 Binary linkings

A maximum of four unrelated links with up to four signals each (digital selector) can be configured. The signals within a link are linked with OR.

Use the "Copy" button to transfer the selected link to another link and to then make changes there as desired.

The result of a link is available in the digital selector.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Name (as of system version 05)	Use default text or select other text from the list.	Designation or description To edit, the text list must be opened via the "..." button.
Signal 1	Digital selector (**Inactive**)	First signal for the link
Signal 2	Digital selector (**Inactive**)	Second signal for the link
Signal 3	Digital selector (**Inactive**)	Third signal for the link
Signal 4	Digital selector (**Inactive**)	Fourth signal for the link

Status after change of configuration

The results of the links are available immediately, according to their configuration.

Behavior after power on

After initialization, the results of the links are available immediately, according to their configuration.

6 Configuration

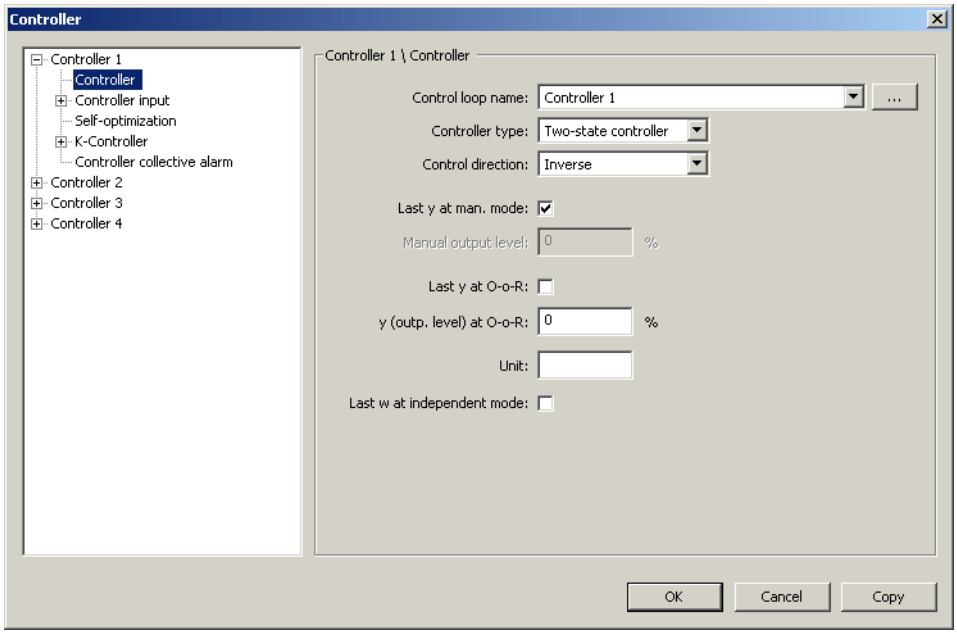
6.9 Controller

Four controllers (controller channels) are available. The parameters listed here can be configured independently of each other for controller 1 to controller 4.

6.9.1 Controller (features)

This screen is used to specify the name of the control loop, the controller type, the control direction, and the output level for changeover to manual mode and for deviation above or below the measuring range.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Control loop name 🕮	Use default text or select other text from the list.	Designation of control loop (The factory setting depends on the controller channel.)
Controller type 🕮	**Off**	Controller channel is switched off (factory setting for controller 2 to controller 4)
	Two-state controller	Controller with a switched output (factory setting for controller 1)
	Three-state controller	Controller with two continuous or switched outputs (e.g. for heating/cooling)
	Modulating controller	Controller with two switched outputs (for motor actuator)

Parameter	Selection/settings	Description
Controller type (continued)	Continuous controller	Controller with a continuous output (analog signal)
	Position controller	Continuous controller with integrated position controller (for motor actuator)
Control direction	Direct	The controller output level is positive if the actual value is greater than the set-point value (cooling).
	Inverse	The controller output level is positive if the actual value is smaller than the set-point value (heating).
Last y at man. mode	Transfer of the last output level at changeover to manual mode	
	Not selected (empty)	Output level is not transferred ("Manual output level" parameter is active).
	Selected (checkmark)	Output level is transferred ("Manual output level" parameter is not active).
Manual output level	**0** to 100 (-100 to +100 for three-state controller)	Output level (%) after changeover to manual mode
Last y at O-o-R	Transfer of the last output level in the event of deviation above or below the measuring range (out of range = O-o-R)	
	Not selected (empty)	Output level is not transferred ("y (outp. level) at O-o-R" parameter is active).
	Selected (checkmark)	Output level is transferred ("y (outp. level) at O-o-R" parameter is not active).
y (outp. level) at O-o-R	**0** to 100 (-100 to +100 at three-state controller)	Output level (%) in the event of deviation above or below the measuring range
Unit	5 characters (**%**)	Unit for numerical representation of the actual value and setpoint value on controller screen
Last w at independent mode	The last valid setpoint value is retained at changeover to independent mode.	
	Not selected (empty)	Setpoint value can change (depending on configuration).
	Selected (checkmark)	Setpoint value is retained.

Control loop name

Setup program: Selection of text from a list

Click the "..." button to open a list with the text numbers and the associated texts. The texts can be edited.

Multifunction panel: selection of text using the text number

The setup program is required to view and edit the texts.

Controller type

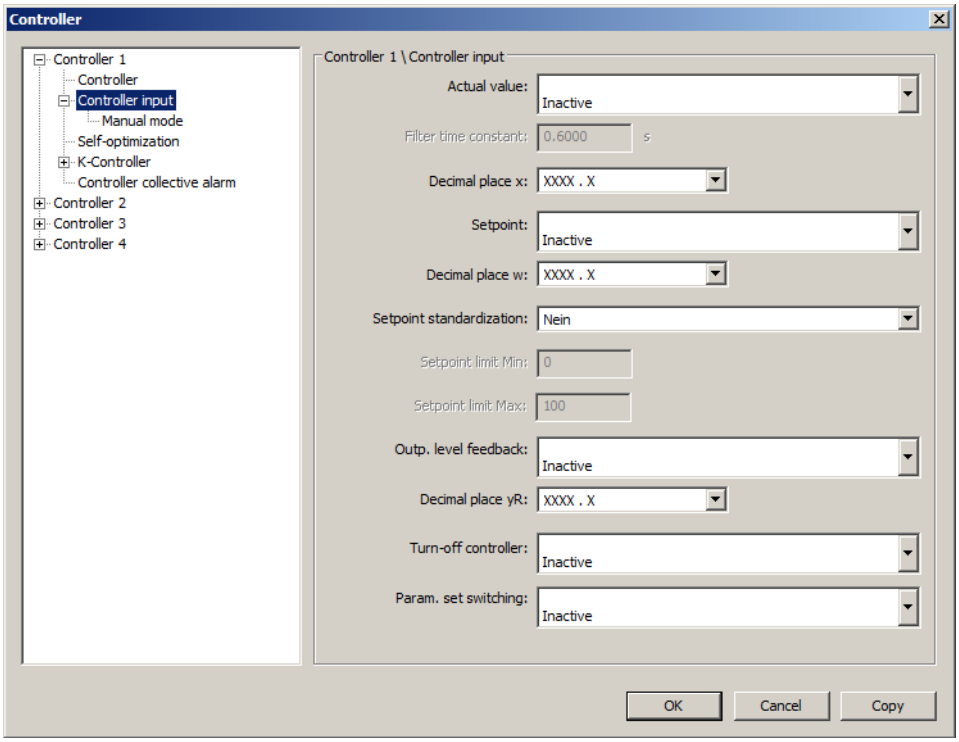
Description of controller types:

⇨ Chapter 7.2 "Controller types", page 125

6.9.2 Controller input

This menu is used to configure the input signals of the controller – incl. the signals for switching off the controller and for parameter block changeover – and the parameters for manual mode.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Actual value	Analog selector (**Inactive**)	Analog signal as process value
Filter time constant	0 s to **0.6 s** to 100 s	Time constant for adjusting the digital input filter (0 s = filter off) Parameter is only relevant for external actual value (NV_...).
Decimal place x	Decimal places of actual value (x)	
	Auto	Automatic
	XXXXX.	No decimal places
	XXXX.X	One decimal place
	XXX.XX	Two decimal places
	XX.XXX	Three decimal places
	X.XXXX	Four decimal places
Setpoint 🕮	Analog selector (**Inactive**)	Analog signal as controller setpoint value

Parameter	Selection/settings	Description
Decimal place w	Decimal places of setpoint value (w)	
	(Selection options as for Decimal place x)	
Setpoint standardization (as of system version 04) 📖	Standardization of the setpoint value for the slave controller within a cascade control	
	No	Function is not active.
	Yes	Function is active.
Setpoint limit min	-99999 to **0** to +99999	Lower setpoint value limit (only with activated setpoint standardization)
Setpoint limit max	-99999 to **100** to +99999	Upper setpoint value limit (only with activated setpoint standardization)
Outp. level feedback	Analog selector (**Inactive**)	Analog signal as output level feedback
Decimal place y_R	Decimal places of output level feedback (y_R)	
	(Selection options as for Decimal place x)	
Param. set switching	Digital selector (**Inactive**)	Signal (high-active) for changeover from parameter block 1 to parameter block 2
Turn-off controller	Digital selector (**Inactive**)	Signal (high-active) for switching off the controller If "Inactive" is selected, the controller is always switched on.

Setpoint

If you are only using an **analog signal for setpoint input**, select it directly from the analog selector, for example "NV_C01Setpoint". It is then not possible to specify a fixed setpoint value or a correction value. The ramp function is not available in this case either.

If you require a **fixed setpoint value**, select the setpoint value for the relevant controller channel here, for example "SP01Setpoint1". You can then enter the setpoint value in the setpoint value configuration (setpoint value function) or on the controller screen of the multifunction panel.

If you are using an **analog signal in conjunction with a correction value as a setpoint value**, select the active setpoint value of the setpoint value function, for example "SP01Active". You can then enter the correction value in the setpoint value configuration (setpoint value function) or on the controller screen of the multifunction panel. During this, the current value of the analog signal (external setpoint value), the correction value (setpoint value), and the active setpoint value (external setpoint value + setpoint value) are displayed on the controller screen.

To use the **ramp function**, select the current setpoint value of the ramp function, for example "SP01RampOutput". Here, the ramp end value corresponds to the active setpoint value (external setpoint value + setpoint value). Enter the setpoint value as the ramp end value in the setpoint value configuration or on the controller screen (multifunction panel).

⇨ Chapter 6.10 "Setpoint values", page 94

Setpoint standardization

With activated setpoint standardization the controller‘s setpoint input signal is limited to 0 to 100 and is standardized to the setpoint limits (setpoint limit min, setpoint limit max).

Standardization of the setpoint input allows to realize a cascade control. The controller channel in question is then used as slave controller within the cascade control.

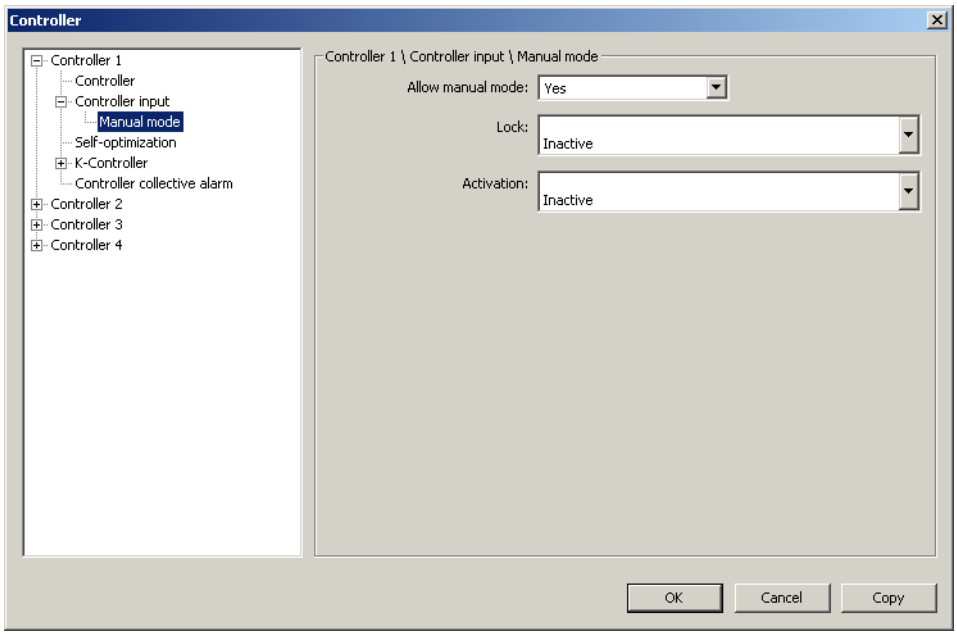
Example of configuration: Controller 1 = master controller, controller 2 = slave controller (master controller and slave controller within one controller module);
setpoint value of controller 2 = C01OutpLevel1 (output level at output 1 of controller 1)

Examples of setpoint standardization

Setpoint value limits		**Input value at the "setpoint" controller input [%]**	**Active setpoint value**
Min	**Max**		
0	100	-10	0
		0	0
		50	50
		100	100
		110	100
20	80	0 to 100	20 to 80
80	20	0 to 100	80 to 20
-50	50	0 to 100	-50 to 50

Manual mode

Setup dialog



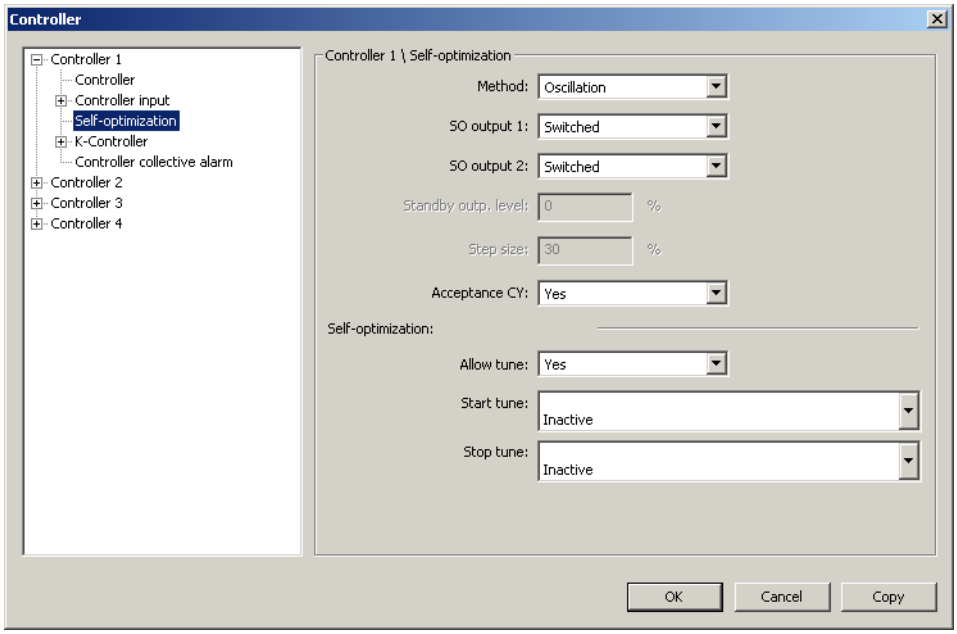
Parameters

Parameter	Selection/settings	Description
Allow manual mode	Allow manual mode generally	
	No	Manual mode is not permitted
	Yes	Manual mode is permitted
Lock	Digital selector (**Inactive**)	Signal (high-active) for locking changeover to manual mode during active controlling (automatic mode).
Activation	Digital selector (**Inactive**)	Signal (high-active) for changeover to manual mode Requirement: Manual mode must be generally permitted and not locked.

6.9.3 Self-optimization

Self-optimization (SO) determines the optimum controller parameters for a PI or PID controller.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Method 🕮	**Oscillation** Step response	Oscillation method Step response method
SO output 1, 2 🕮	Type of the first or second controller output	
	Switched	Relay output
	Semiconductor	Solid state relay output, open-collector output, or logic output
	Continuous	Analog output
Standby outp. level	-100 to **0** to +100	Output level at start of self-optimization (for step response method)
Step size	10 to **30** to 100	Size of output level step (for step response method)
Acceptance CY	Transfer of Cy cycle time after completion of self-optimization	
	No	No transfer
	Yes	Transfer
Allow tune	Allow self-optimization generally	
	No	Self-optimization not permitted
	Yes	Self-optimization permitted

Parameter	Selection/settings	Description
Start tune	Digital selector (**Inactive**)	Signal (high-active) for starting self-optimization Requirement: Self-optimization must be generally permitted.
Stop tune	Digital selector (**Inactive**)	Signal (high-active) for aborting self-optimization

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", page 80

⇨ "Optimization according to the step response method", page 81

SO output 1, 2

The cycle time is calculated on the basis of the type of controller output.

Optimized controller parameters

With both self-optimization methods, certain parameters are optimized according to the configured controller type and configured parameters. The controller structure is derived from the type of the optimized parameters: 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 parameter	Optimized controller structure
Two-state controller	Xp1 = any; Tv1 = 0; Tn1 > 0	Xp1, Tn1, Cy1, dF	PI
	All other settings	Xp1, Tv1, Tn1 Cy1, dF	PID
Three-state controller	Xp1 = Xp2 = any; Tv1 = 0; Tn1 > 0	Xp1, Xp2, Tn1, Cy1, Cy2, dF	PI
	All other settings	Xp1, Xp2, Tv1, Tn1, Cy1, Cy2, dF	PID
Modulating controller	Xp1 = any; Tv1 = 0; Tn1 > 0	Xp1, Tn1, dF	PI
	All other settings	Xp1, Tv1, Tn1, dF	PID
Continuous controller	Xp1 = any; Tv1 = 0; Tn1 > 0	Xp1, Tn1, dF	PI
	All other settings	Xp1, Tv1, Tn1, dF	PID
Position controller	Xp1 = any; Tv1 = 0; Tn1 > 0	Xp1, Tn1, dF	PI
	All other settings	Xp1, Tv1, Tn1, dF	PID

For first order control paths, the parameters required for the PI controller structure are optimized, independently of the configured parameters.

Error processing

If the actual value leaves the measuring range (out of range) during self-optimization, the self-optimization process is aborted. In this case, the configured parameters are not changed.

WARNING!
During self-optimization according to the oscillation method, output level 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.

NOTE!
Optimization must be performed under real operating conditions; it can be performed any number of times.

Start of self-optimization

Self-optimization can be started using any signal from the digital selector. Any other signal from the digital selector can be used to abort (stop) self-optimization.

It can also be started and stopped using the multifunction panel. Self-optimization must also be generally permitted in this case.

⇨ Chapter 5.3.1 "Multichannel controller module", page 45

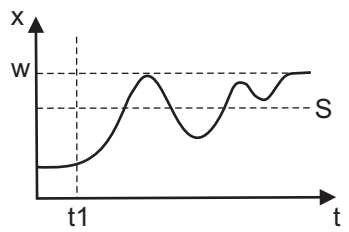
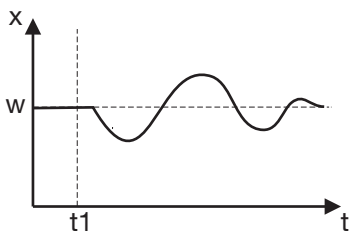
If self-optimization is started with a signal from the digital selector, it can also be stopped on the multifunction panel.

Optimization according to the oscillation method

In the case of a large control deviation between the setpoint value and actual value (e.g. in the startup phase), the controller determines a switching line around which the control variable performs a forced oscillation during self-optimization. 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:

Self-optimization during the startup phase	Self-optimization during operation
	

x Actual value
w Setpoint value
S Switching line
t1 Start of self-optimization

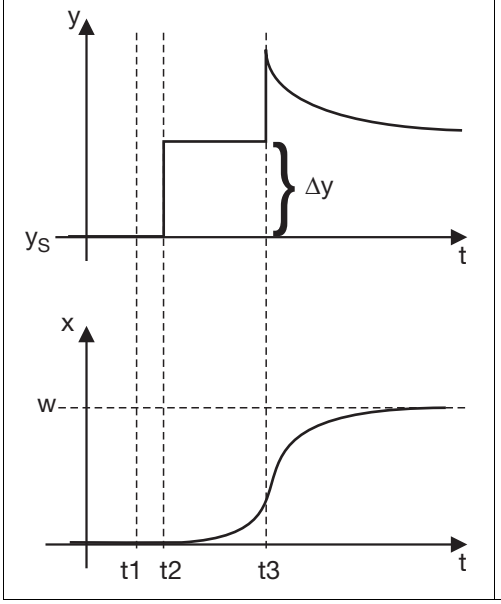
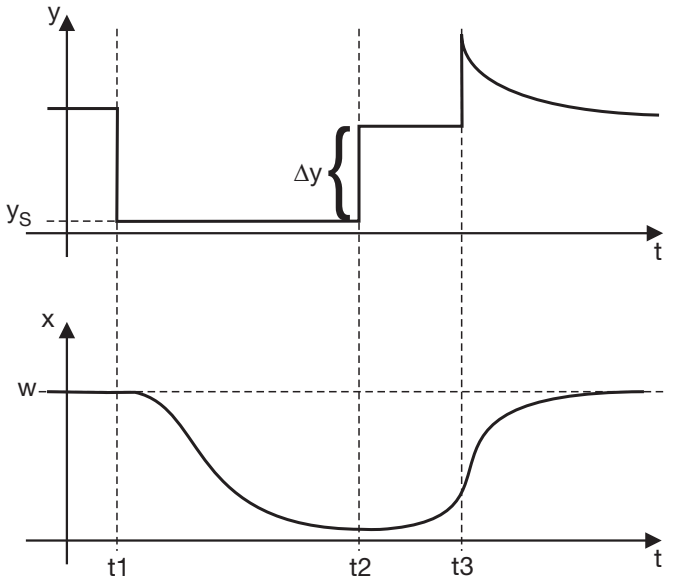
Optimization according to the step response method

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 path.

Main applications of the step response method:

- Optimization immediately after "power on" during startup (considerable time saving, standby output setting = 0 %)
- Control path does not oscillate easily (e.g. 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 of the status of the process at the point when self-optimization starts:

Self-optimization during the startup phase	**Self-optimization during operation**
	

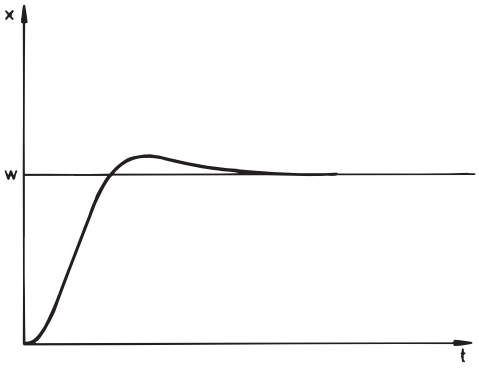
y	Output level	Δy	Step size
y_S	Standby output	t1	Start of self-optimization
x	Actual value	t2	Point of output level step
w	Setpoint value	t3	End of self-optimization

Checking the optimization

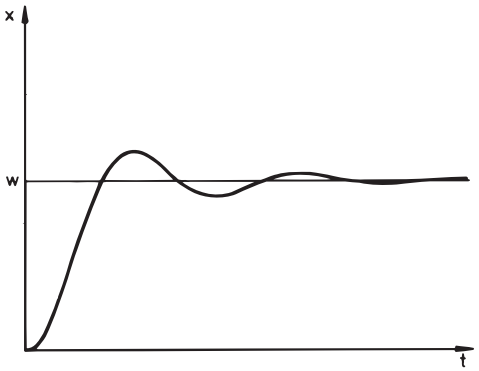
You can check for optimum adjustment of the controller to the control path by recording the startup process (e.g. with "Startup") with a closed control loop. The diagrams below indicate possible incorrect adjustments and correction of these.

Here, the guiding behavior of a third-order control path for a PID controller is plotted as an example. The procedure for setting the controller parameters can also be applied to other control paths.

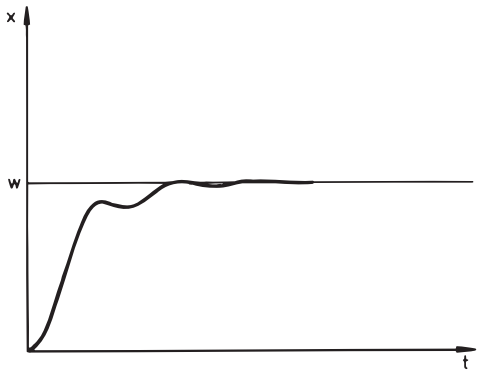
Proportional band Xp too large



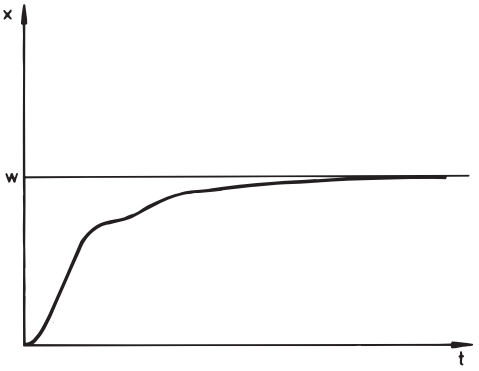
Reset time Tn and derivative time Tv too short



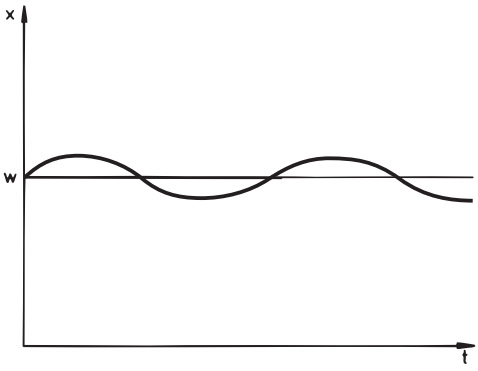
Proportional band Xp too small



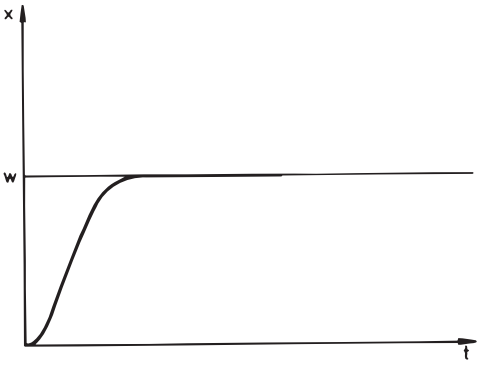
Reset time Tn and derivative time Tv too long



Cycle time Cy too great



Optimum setting



6.9.4 K-Controller

The following functions require special skills. Configuration should only be performed by specialists.

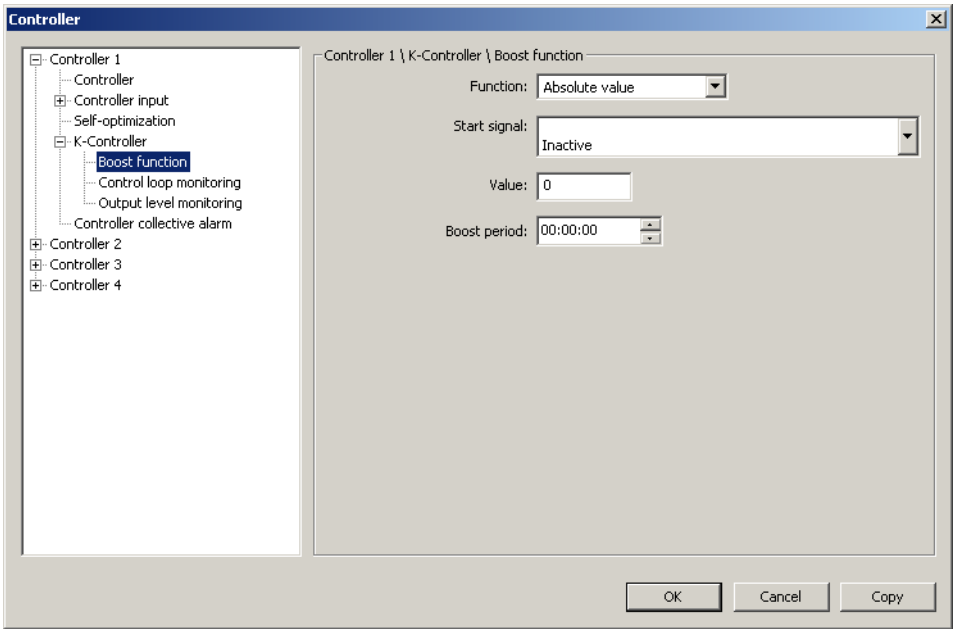
Boost function

The boost function is used to remove plastic residue in the tools during the production process. The setpoint values of all heating zones are increased by a specific value for a specific amount of time.

A setpoint value offset is also taken into account when the boost function is active.

The boost function is also active when setpoint value 2, 3, or 4 is active. If setpoint value changeover occurs during the active boost phase, the boost function is aborted.

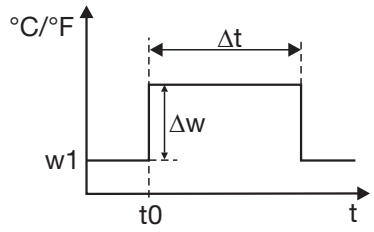
Setup dialog



Parameters

Parameter	Selection/settings	Description
Function 📖	**Without function** Absolute value Percentage value	Boost function is switched off. Setpoint value is increased by an absolute value. Setpoint value is increased by a percentage value.
Start signal	Digital selector (**Inactive**)	Signal for starting the boost function (active in the case of a falling edge)
Value	-99999 to **0** to +99999	Amount by which the setpoint value is increased (in K or % of setpoint value).
Boost period	**00:00:00** to 99:59:59	Length of boost period (hh:mm:ss)

Function



w1 Setpoint value 1

Δw Amount by which the setpoint value is increased.

t0 Start time of boost function

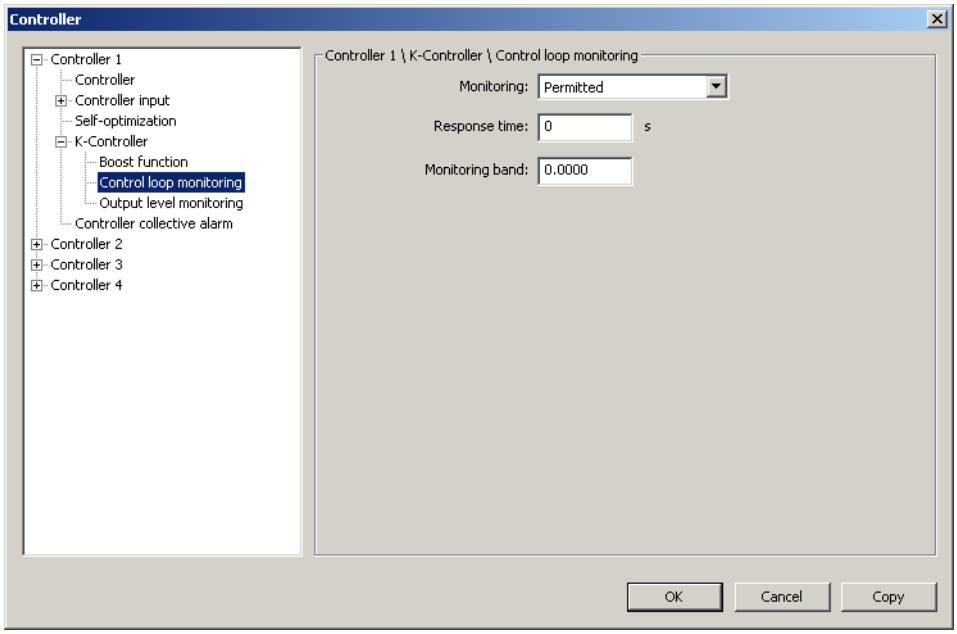
Δt Length of boost period

Control loop monitoring

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

The alarm signal is only available within the multichannel controller module in the digital selector (no transfer via system bus). It can, however, be selected as an input signal for the collective alarm of the controller channel.

Setup dialog



Parameters

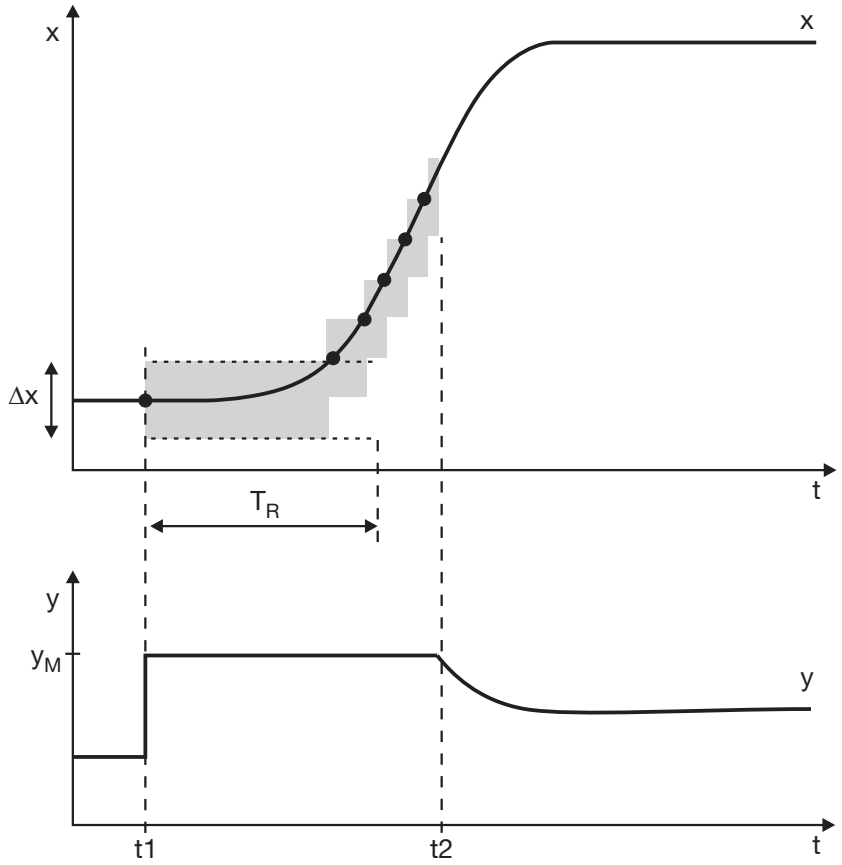
Parameter	Selection/settings	Description
Monitoring	Permitted **Not permitted**	Control loop monitoring is generally permitted Control loop monitoring is not permitted
Response time	**0 s** to 9999 s	Time period in which the actual value must leave the monitoring band. "0 s" setting means: Response time = 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 actual value at the start of monitoring – within the response time. If it does not, an alarm is triggered.

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

y Output level

t1 Start of monitoring

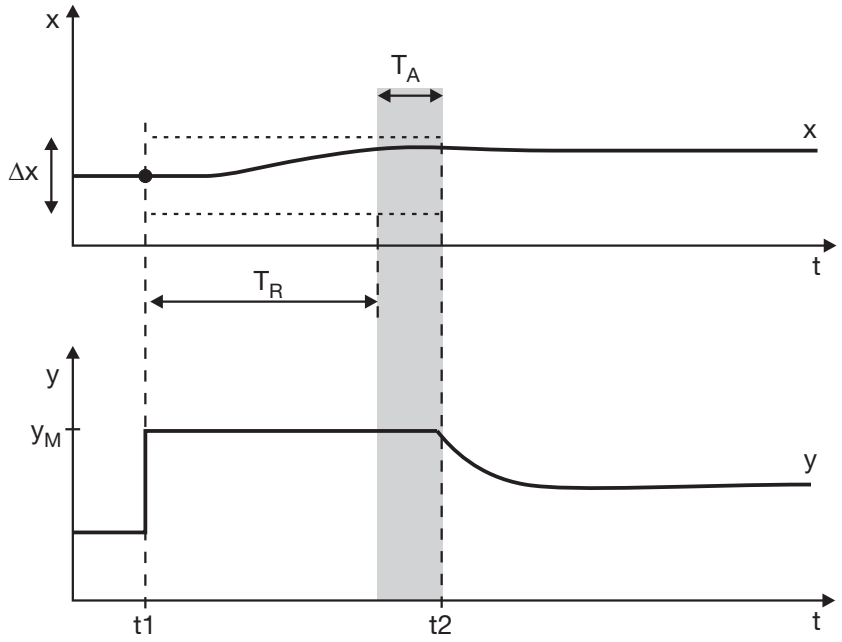
t2 End of monitoring

Δx Monitoring band

y_M Max. output level (e.g. 100 %)

T_R Response time

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 (e.g. 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 (e.g. "cooling" instead of "heating")

Functional limitations

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

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

Parameter dimensioning

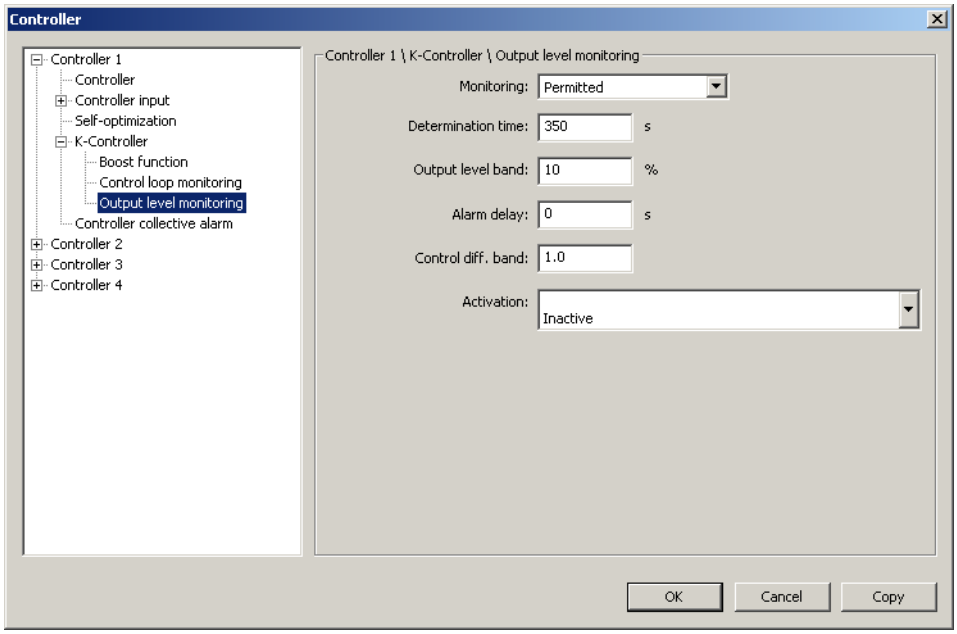
The controller parameters must be optimally adjusted for the control loop monitoring to function correctly, e.g. using self-optimization. If alarms occur temporarily, despite the plant operating correctly, either the **response time** must be increased, or the **monitoring band** must be narrowed. To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

Output value 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, an alarm is issued.

The alarm signal is only available within the multichannel controller module in the digital selector (no transfer via system bus). It can, however, be selected as an input signal for the collective alarm of the controller channel.

Setup dialog



Parameters

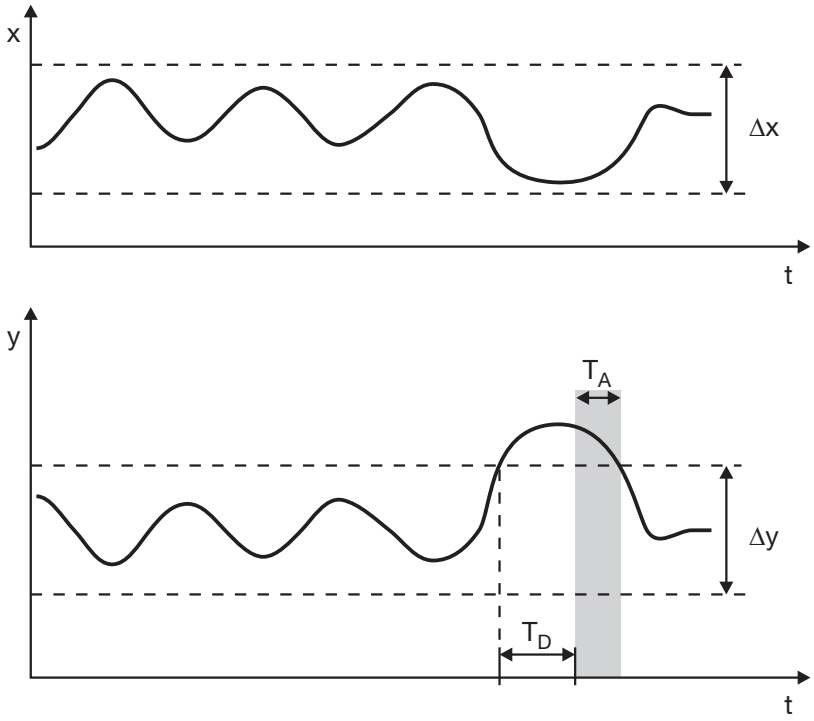
Parameter	Selection/settings	Description
Monitoring	Permitted **Not permitted**	Output level monitoring depends on the "Activation" parameter. Output level monitoring is blocked.
Determination time	0 s to **350 s** to 9999 s	Calculation time for the mean output level
Output level band	0 % to **10 %** to 100 %	Monitored output level band (admissible range around the mean output level)
Alarm delay	**0 s** to 9999 s	Delay time for alarm triggering
Control differential band	0 to **1** to 1999	Control differential band (admissible range of the actual value around the set-point value in the corrected state)
Control diff. band	0 to **1** to 1999	Control differential band (admissible range around the actual value in corrected state)

Parameter	Selection/settings	Description
Activation	Digital selector (**Inactive**)	Signal (high-active) to activate the output level monitoring Inactive = Output level monitoring is only dependent on the "Monitoring" parameter (it is active if Monitoring = Permitted).

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, an alarm is triggered.

In the event of a setpoint value change, the 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 signs of aging and faults on heating elements
- Reporting of faults during operation

Functional limitations

Output level monitoring is not active in the following cases:

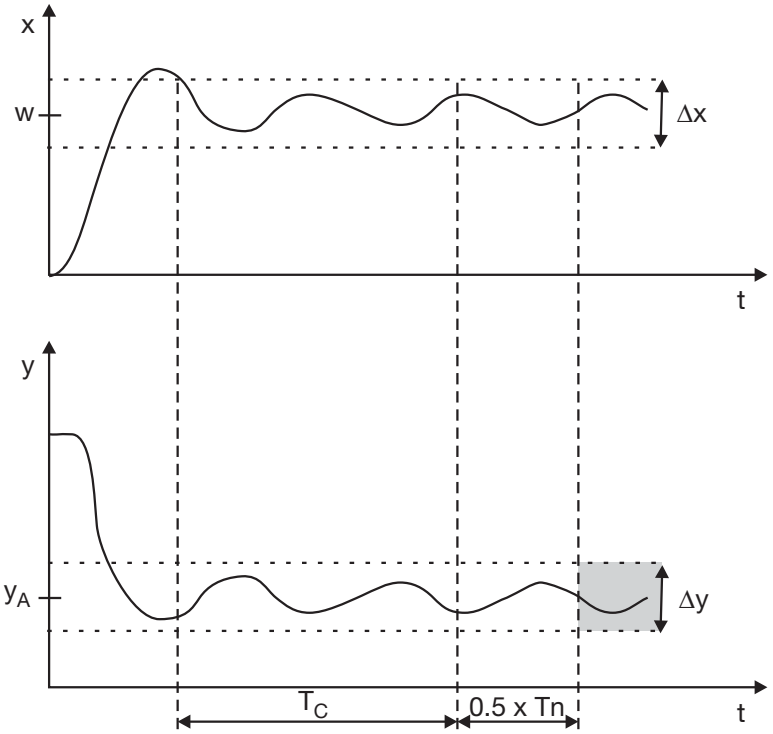
- Proportional band Xp = 0
- Self-optimization active
- Manual mode
- Ramp function is configured
- Controller is configured as program controller
- Modulating controller without output level feedback (or output level feedback in "out of range" state)
- Position controller with output level feedback in "out of range" state

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 be recorded, for example with the recording function of the multifunction panel or 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.

The **determination time** is used to calculate a mean output level by means of a moving average. The selected time should be sufficient to ensure as accurate a calculation as possible. At the determination time, a waiting time equal to 0.5 × reset time Tn ensues, during which a check is made for whether the movement of the actual value and output level is within the specified limits. If one of the limits is exceeded, the calculation starts over. The output level monitoring becomes active after successful calculation.

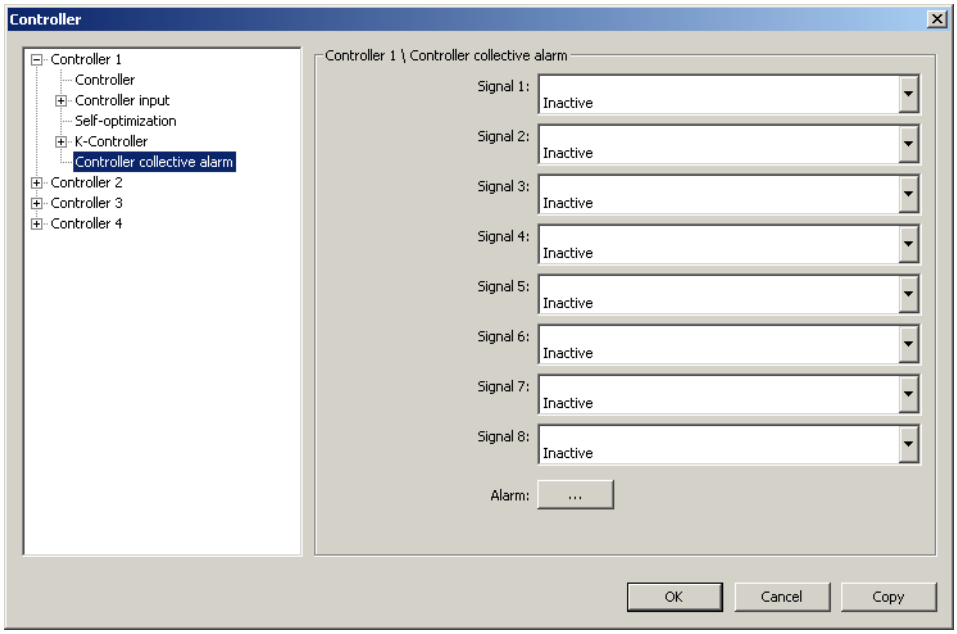


x Actual value
w Setpoint value
y Output level
y_A Mean output level
T_C Determination time
Tn Reset time
Δy Output level band
Δx Control differential band

6.9.5 Controller collective alarm

Four collective alarms are available, which are typically assigned to the four controller channels. However, they can also be used independently of the controller channels. A collective alarm is compiled from a maximum of eight signals from the digital selector (OR-linking).

Setup dialog



Parameters

Parameter	Selection/settings	Description
Signal 1 to 8	Digital selector (**Inactive**)	Selection of a maximum of eight signals for the collective alarm The output signal (result of OR-linking) is available in the digital selector.

Status after change of configuration

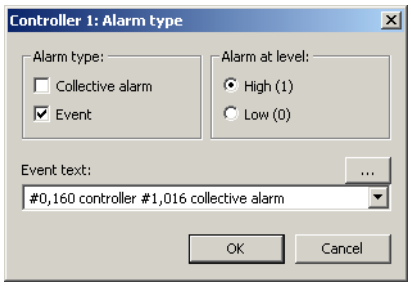
Modified parameters are incorporated immediately.

Behavior after power on

After initialization, the collective alarms are available immediately, according to their configuration.

Alarm

Setup dialog



Parameters

Parameter	Selection/settings	Description
Alarm type	The alarm type is **not** set by default.	
	Collective alarm	Alarm results in collective alarm of controller module.
	Event	Alarm results in an entry (event text) in the event list.
Alarm at level	**High (1)**	Alarm at high level (1)
	Low (0)	Alarm at low level (0)
Event text 🕮	Use default text or select other text from the list.	Text that is entered in the event list for an alarm (if Alarm type = "Event").

Event text

Setup program: Selection of text from a list

Click the "..." button to open a list with the text numbers and the associated texts. The texts can be edited.

Multifunction panel: Selection of text using the text number

The setup program is required to view and edit the texts.

6 Configuration

6.10 Setpoint values

The separate setpoint value function enables flexible configuration of the setpoint values and the ramp function. Up to four setpoint values are available for each setpoint value function; changeover of these setpoint values is controlled by two digital signals.

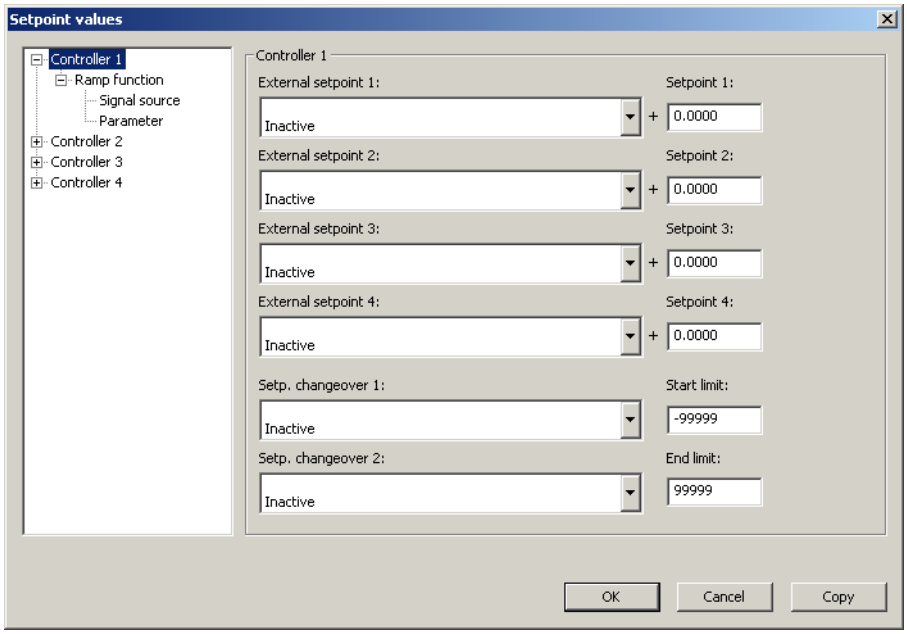
An analog signal is selected from the analog selector as a setpoint value (external setpoint value 1 to 4). A correction value (setpoint value 1 to 4) can be used to influence this signal. If no analog signal is selected (Inactive), the correction value is used as a fixed setpoint value.

The output signal of the setpoint value function is the "active" setpoint value (e.g. SP01Active as result of setpoint value function 1).

NOTE!
Setpoint value functions 1 to 4 are intended for controller channels 1 to 4; the active setpoint value is not automatically used as the setpoint value of the controller channel, however but must be assigned first in the controller configuration (see Chapter 6.9.2 "Controller input", page 74).

NOTE!
If an analog signal is used as a setpoint value without a correction value, it can also be directly assigned in the controller configuration. In this case, setpoint value limitation, setpoint changeover, and the ramp function are not available.
Equally, a fixed setpoint value can be assigned directly in the controller configuration (see Chapter 6.9.2 "Controller input", page 74).

Setup dialog



Parameters

Parameter	Selection/settings	Description
External setpoint 1	Analog selector (**Inactive**)	Analog signal as setpoint 1

Parameter	Selection/settings	Description
Setpoint 1 🕮	-99999 to **0** to +99999	Fixed setpoint 1 or correction value
External setpoint 2	Analog selector (**Inactive**)	Analog signal as setpoint 2
Setpoint 2	-99999 to **0** to +99999	Fixed setpoint 2 or correction value
External setpoint 3	Analog selector (**Inactive**)	Analog signal as setpoint 3
Setpoint 3	-99999 to **0** to +99999	Fixed setpoint 3 or correction value
External setpoint 4	Analog selector (**Inactive**)	Analog signal as setpoint 4
Setpoint 4	-99999 to **0** to +99999	Fixed setpoint 4 or correction value
Setp. changeover 1 🕮	Digital selector (**Inactive**)	Binary value (bit 0) for controlling setpoint changeover
Setp. changeover 2 🕮	Digital selector (**Inactive**)	Binary value (bit 1) for controlling setpoint changeover
Start limit	**-99999** to +99999	Minimum admissible setpoint value
End limit	-99999 to **+99999**	Maximum admissible setpoint value

Setpoint

This value is used as a fixed setpoint value if no external setpoint value has been selected (Inactive). Otherwise, this value is used as a correction value (offset, negative or positive) for the external setpoint value.

If a setpoint value has already been specified using the multifunction panel, it is displayed here and can be changed if necessary.

Setpoint changeover

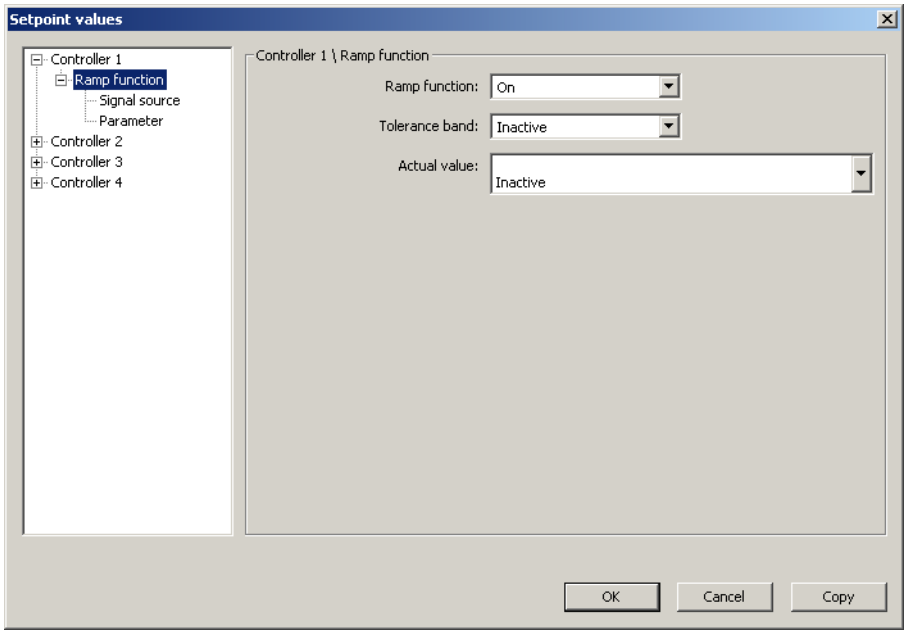
Setpoint changeover 2 (bit 1)	Setpoint changeover 1 (bit 0)	Active setpoint value
0	0	1
0	1	2
1	0	3
1	1	4

6.10.1 Ramp function

The ramp function enables a steady change of the setpoint value up to the ramp end value (active setpoint value). The ramp start value is specified with an analog signal (e.g. current actual value) or with a fixed start value.

A tolerance band can be set around the setpoint value line to monitor the actual value. If the actual value deviates from the tolerance band, a digital signal (tolerance band signal) is activated.

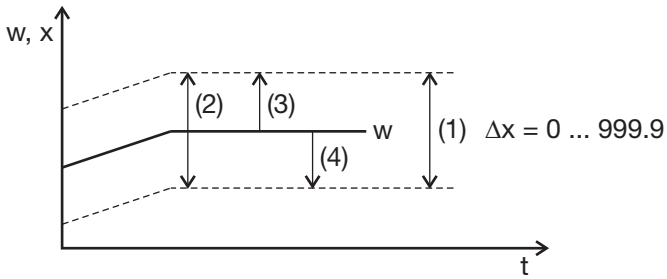
Setup dialog



Parameters

Parameter	Selection/settings	Description
Ramp function	**Off**	Ramp function is switched off.
	On	Ramp function is switched on.
Tolerance band	Monitoring of deviation of the actual value from the current setpoint value (tolerance band = admissible deviation)	
🕮	**Inactive**	No monitoring
	Symmetric	Monitoring of the upper and lower tolerance band limits
	Above setpoint value	Monitoring of the upper tolerance band limit
	Below setpoint value	Monitoring of the lower tolerance band limit
Actual value	Analog selector (**Inactive**)	Monitored actual value of the relevant controller

Tolerance band



(1) Tolerance band
(2) Symmetric (upper and lower limits)
(3) Above setpoint value (upper limit)
(4) Below setpoint value (lower limit)

Error processing

The ramp end value is specified by the active setpoint value (output signal of setpoint value function). If this signal is "out of range", this affects the output signal of the ramp function. The following circumstances may arise:

Active setpoint value (output signal of set-point value function)	Output signal of ramp function
Underrange	Error value 1.0E+37
Overrange	Error value 2.0E+37
No value	Error value 3.0E+37
Valid value	Current ramp value

If the active setpoint value has returned to a valid value, the ramp function is continued with the last ramp value that was valid before the error occurred.

If during such an error event, the ramp function is started, stopped, aborted, or switched off, a differentiation must be made between the cases below:

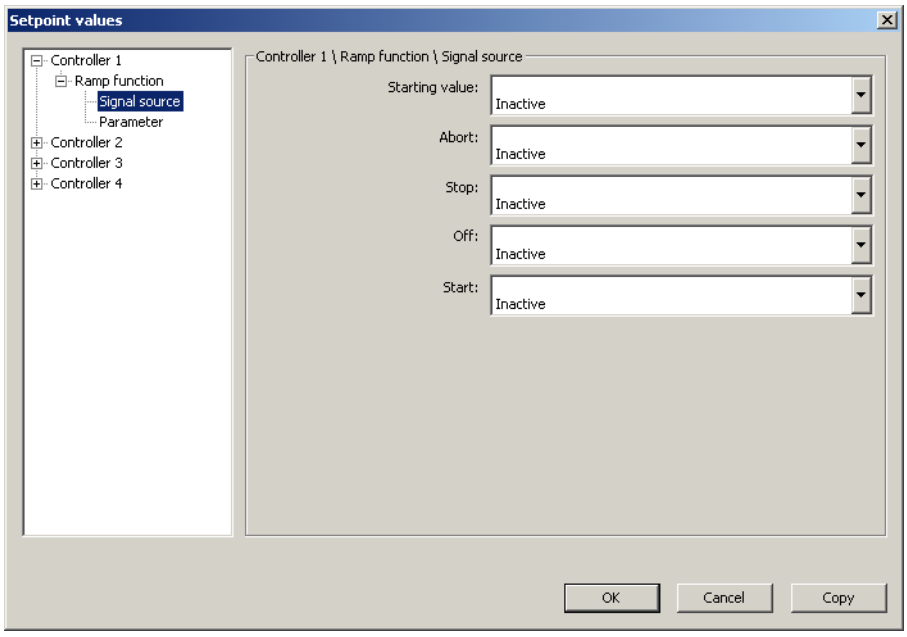
Action	Output signal of ramp function
Start	When the error event is over, the ramp function starts and the current ramp value is issued.
Stop	This action is not possible in the event of an error.
Abort	When the error event is over, the ramp start value is issued.
Switch-off	When the error event is over, the ramp end value is issued.

Tolerance band monitoring is not active during an error event.

6 Configuration

Signal source

Setup dialog



Parameters

Parameter	Selection/settings	Description
Starting value	Analog selector (**Inactive**)	Ramp start value is specified with analog signal (e.g. current actual value of relevant controller).
Abort	Digital selector (**Inactive**)	Signal (high-active) for aborting the ramp (setpoint value adopts the value at the start of the ramp).
Stop 🕮	Digital selector (**Inactive**)	Signal (high-active) for stopping the ramp (setpoint value remains constant at the current value).
Off	Digital selector (**Inactive**)	Signal (high-active) for switching off the ramp function (setpoint value immediately assumes the specified end value).
Start 🕮	Digital selector (**Inactive**)	Signal (high-active) for starting the ramp

Stop

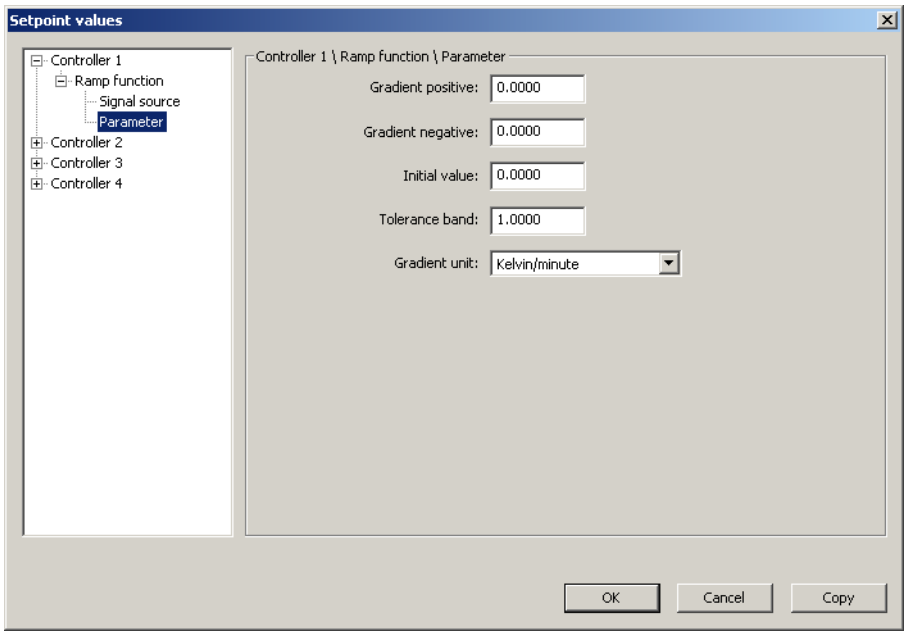
If the ramp is stopped while a controller is in manual mode, the "manual mode active" digital signal of the relevant controller channel must be selected (C01ManualMode to C04ManualMode).

Start

The ramp can be started in synchronism with a digital signal. If no digital signal is selected, the ramp starts upon entry of a new setpoint value, which then progresses with the specified ramp slope.

Parameter

Setup dialog



Parameters

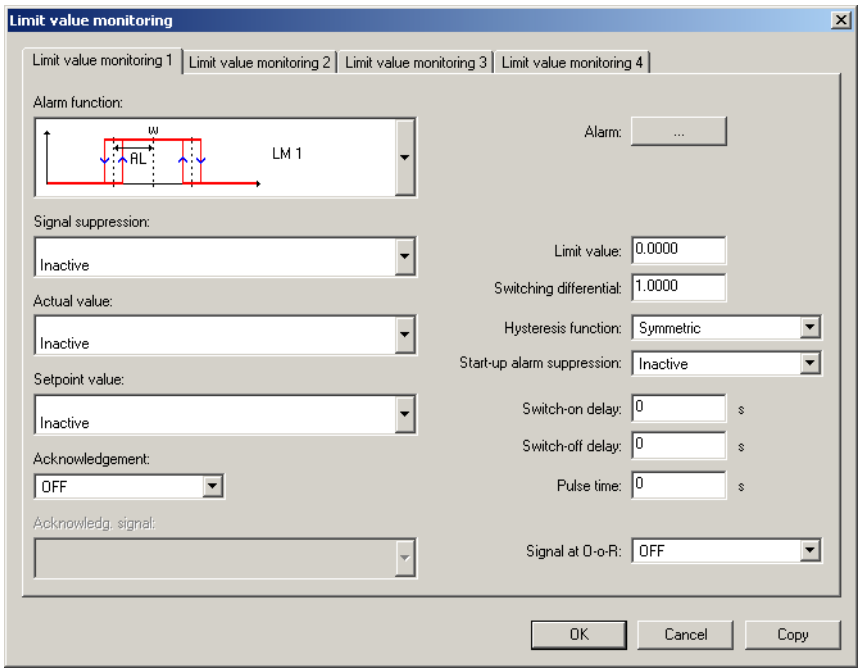
Parameter	Selection/settings	Description
Gradient positive	**0** to 999.9	Value for positive ramp slope
Gradient negative	**0** to 999.9	Value for negative ramp slope
Initial value	**0** to 999.9	Adjustable ramp start value (used if no analog signal has been selected as the start value)
Tolerance band	0 to **1** to 999.9	Amount of admissible upward and downward deviation of the actual value (setpoint value is in center) ⇨ "Tolerance band", page 96
Gradient unit	**Kelvin/minute** Kelvin/hour Kelvin/day	Unit of ramp slope

6 Configuration

6.11 Limit value monitoring

One of eight alarm functions can be selected for each of the four instances of limit value monitoring in order to monitor a chosen input value (actual value) in relation to a fixed limit value or a limit value relating to the setpoint value (setpoint value ± limit value). Each instance of limit value monitoring issues an output signal.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Alarm function 📖	**Inactive**	Limit value monitoring is inactive.
	AF1	Limit value above and below the setpoint value (monitoring band around 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
	AF8	As for AF7, output signal inverted
Name (as of system version 05)	Use default text or select other text from the list.	Designation or description To edit, the text list must be opened via the "..." button.
Signal suppression	Digital selector (**Inactive**)	Signal (high-active) for suppressing the output signal

Parameter	Selection/settings	Description
Actual value	Analog selector (**Inactive**)	Analog signal as actual value (signal to be monitored)
Setpoint value	Analog selector (**Inactive**)	Analog signal as setpoint value (reference signal for AF1 to AF6)
Acknowledgement	Condition for acknowledgement of the output signal (self-maintaining)	
	OFF	No acknowledgement required (output signal is deactivated automatically if the alarm condition is no longer present).
	If inactive	Acknowledgement only possible if alarm condition is no longer present.
	Always	Acknowledgement is always possible.
Acknowledg. signal	Digital selector (**Inactive**)	Signal (high-active) for acknowledging the output signal
Limit value	-99999 to **0** to +99999	Admissible deviation of the actual value
Switching differential	0 to **1** to 99999	Switching thresholds of the output signal (difference from limit value)
Hysteresis function 📖	Switching differential position around the limit value	
	Symmetric	Switching differential is positioned with half above and half below the limit value.
	Asymmetric left	Switching differential is below the limit value (typically).
	Asymmetric right	Switching differential is above the limit value (typically).
Start-up alarm suppression 📖	Alarm suppression during start-up phase	
	Inactive	Limit value monitoring always operates according to its alarm function.
	Active	No alarm after power on or if limit value or setpoint value is changed
Switch-on delay	**0** to 65535 s	Delay time for activation of the output signal if alarm condition is present.
Switch-off delay	**0** to 65535 s	Delay time for deactivation of the output signal if alarm condition is no longer present.
Pulse time	**0** to 65535 s	Output signal is deactivated automatically after this time.
Signal at O-o-R	Output signal in the event of deviation above or below the measuring range	
	OFF	Output signal inactive
	ON	Output signal active

Alarm function

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

⇨ Chapter 6.11.2 "Alarm and hysteresis functions", page 104

Hysteresis function

The designations "Asymmetric left" and "Asymmetric right" typically relate to alarm functions AF3/AF4 and AF7/AF8. The designation is not conclusive for alarm functions AF1/AF2 and AF5/AF6.

⇨ Chapter 6.11.2 "Alarm and hysteresis functions", page 104

Start-up alarm suppression

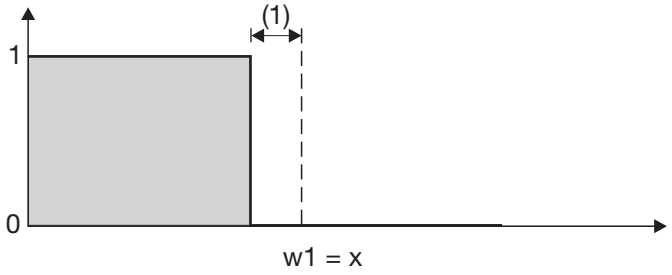
Active start-up alarm suppression means:

- After power on, the output signal 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 output 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 output signal remains inactive until the actual value returns to the alarm range.

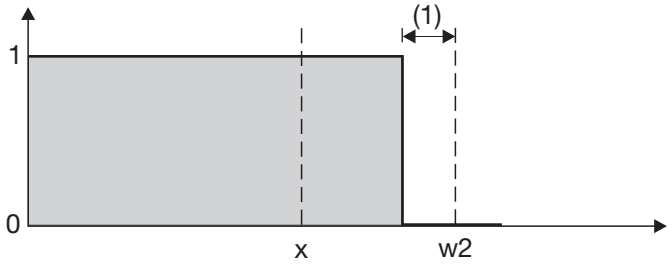
Example of active start-up alarm suppression

The following example shows monitoring of the actual value "x" with the alarm function AF4 (without switching differential) for a specified limit value (1). The setpoint value is changed from w1 to w2.

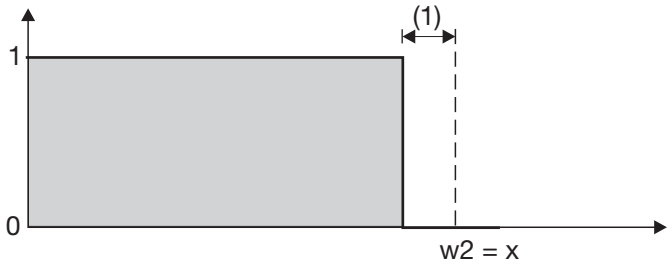
Output state: The output signal is not active as the actual value is outside of the alarm range (gray area).



Change of setpoint value: The output signal remains inactive, although the actual value is now within the alarm range.



Adjusted state: The actual value has left the alarm range and reached the new setpoint value. The output signal remains inactive until the actual value returns to the alarm range.



Status after change of configuration

Modified parameters are incorporated immediately. If a switch-on delay was active before or during the configuration change, the delay time starts over.

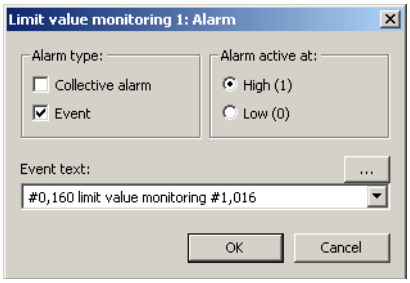
Behavior after power on

The output signal status is not saved. Limit value monitoring starts after initialization according to its configuration.

6.11.1 Alarm

In addition to evaluation of the limit value monitoring output signal, there is also the option to make an entry in the event list in the case of an alarm or to form a collective alarm.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Alarm type	The alarm type is **not** set by default.	
	Collective alarm	Alarm results in collective alarm of controller module.
	Event	Alarm results in an entry (event text) in the event list.
Alarm active at	**High (1)**	Alarm at high level (1)
	Low (0)	Alarm at low level (0)
Event text 🕮	Use default text or select other text from the list.	Text that is entered in the event list for an alarm (if Alarm type = "Event").

Event text

Setup program: Selection of text from a list

Click the "..." button to open a list with the text numbers and the associated texts. The texts can be edited.

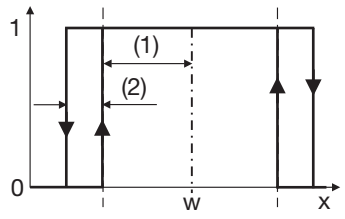
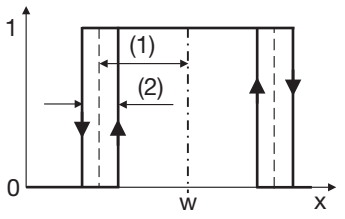
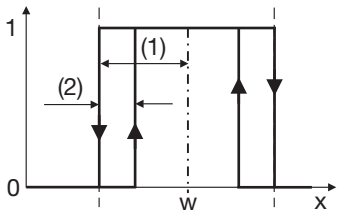
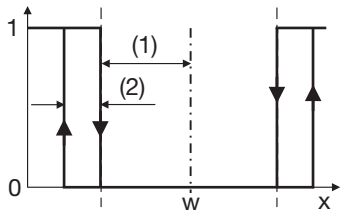
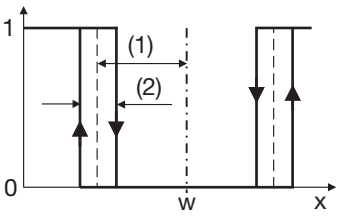
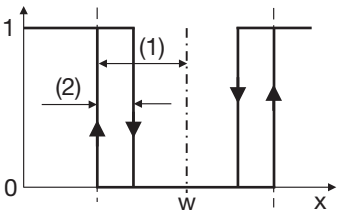
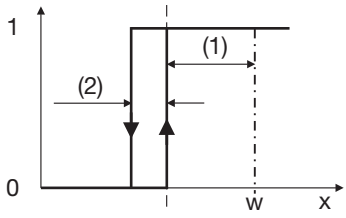
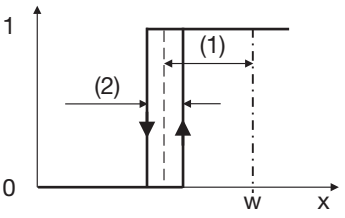
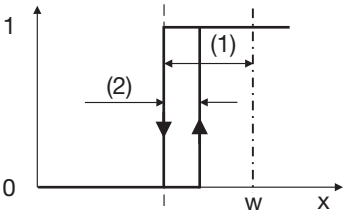
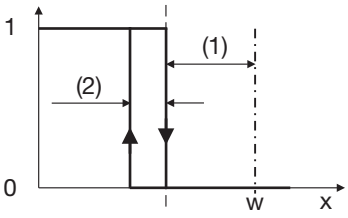
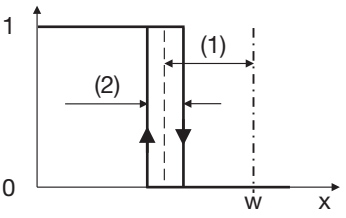
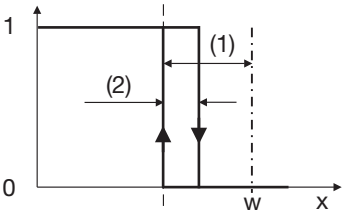
Multifunction panel: Selection of text using the text number

The setup program is required to view and edit the texts.

6.11.2 Alarm and hysteresis functions

This section describes the limit value monitoring alarm function AF1 to AF8 and the associated hysteresis functions (asymmetric left, symmetric, asymmetric right).

Limit value in relation to the setpoint value

	Asymmetric left	Symmetric	Asymmetric right
AF1			
AF2			
AF3			
AF4			

1 Output signal active

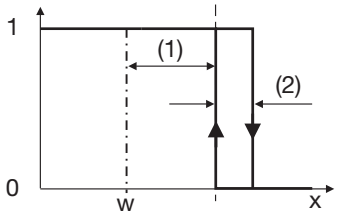
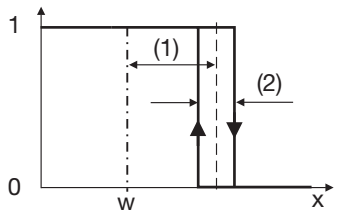
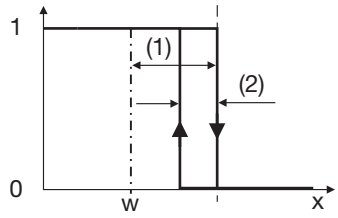
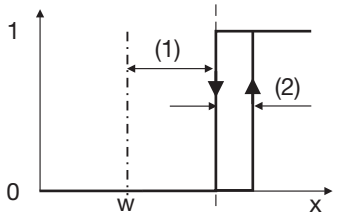
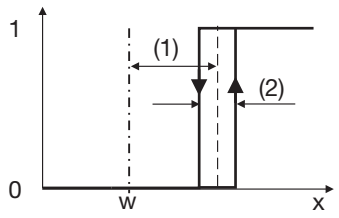
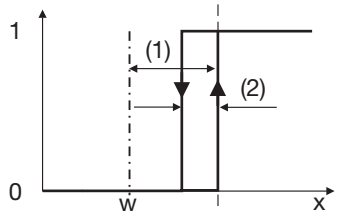
0 Output signal not active

x Actual value

w Setpoint value

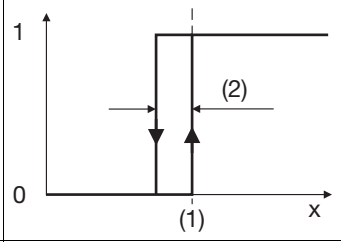
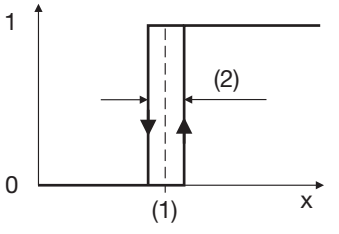
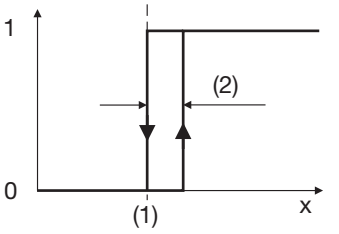
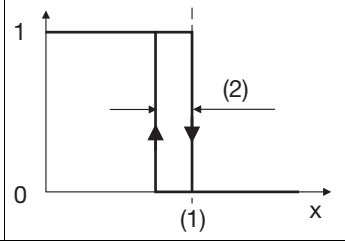
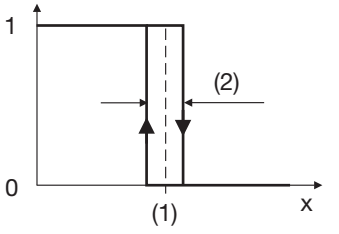
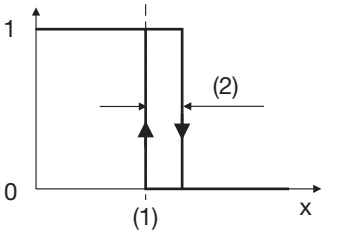
(1) Limit value

(2) Switching differential

	Asymmetric left	Symmetric	Asymmetric right
AF5			
AF6			

1 Output signal active
0 Output signal not active
x Actual value
w Setpoint value
(1) Limit value
(2) Switching differential

Fixed limit value

	Asymmetric left	Symmetric	Asymmetric right
AF7			
AF8			

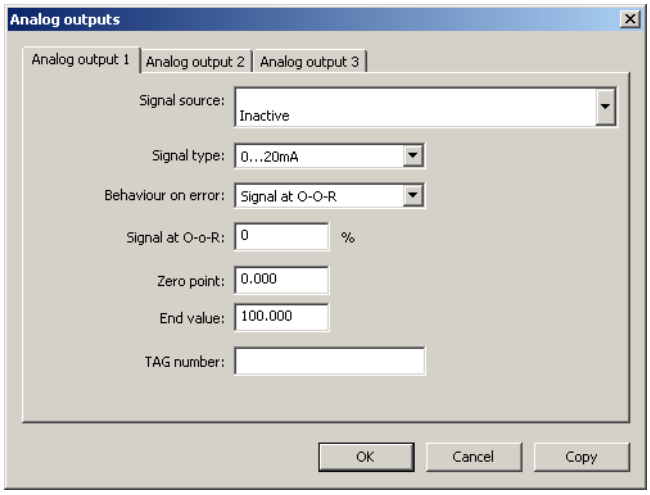
1 Output signal active
0 Output signal not active
x Actual value
(1) Limit value
(2) Switching differential

6 Configuration

6.12 Analog outputs

A maximum of three analog outputs can be configured as current or voltage outputs (standard signal) and are freely scalable.

Setup dialog



Parameters

Parameter	Selection/settings	Description
Signal source	Analog selector (**Inactive**)	Analog signal that is issued via the analog output. If "Inactive" is selected, no signal is issued.
Signal type	Physical output signal	
	0 ... 10 V	Standard signal for voltage
	2 ... 10 V	Standard signal for voltage
	0 ... 20 mA	Standard signal for current
	4 ... 20 mA	Standard signal for current
Behavior on error 📖	Value of the output signal after deviation above or below the measuring range (out of range = O-o-R) The options "NAMUR Low" and "NAMUR High" are only available for signal types 2 ... 10 V and 4 ... 20 mA.	
	NAMUR Low	Value for deviation below measured value/short-circuit according to NAMUR recommendation
	NAMUR High	Value for deviation above measured value/probe break according to NAMUR recommendation
	Signal at O-o-R	Adjustable value (see "Signal at O-o-R" parameter)
	Last value	The last value is retained.

Parameter	Selection/settings	Description
Signal at O-o-R	**0** to 100 %	Value of the output signal in the event of deviation above or below the measuring range (in relation to the value range of the signal type)
Zero point 🕮	-1999 to **0** to +9999	Start of scaling
End value 🕮	-1999 to **100** to +9999	End of scaling
TAG number	7 characters (as of system version 05: 42 characters)	Identification marking (documentation in PLC)

Behavior on error

The behavior in the event of 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 error.

As long as the system is in "Run" state, the output signal delivers the following values in case of an error (input signal returns an error value), depending on the configuration:

Signal type	**Output value at**			
	NAMUR Low	**NAMUR High**	**Signal at o-o-r, 0 % to 100 %**	**Signal at o-o-r, 0 % to 100 %; inverted**[1]
0 to 20 mA	---	---	0 mA to 20 mA	20 mA to 0 mA
4 to 20 mA	1 mA	22 mA	4 mA to 20 mA	20 mA to 4 mA
0 to 10 V	---	---	0 V to 10 V	10 V to 0 V
2 to 10 V	0.5 V	11 V	2 V to 10 V	10 V to 2 V

[1] Inverted output signal (zero point and end value are swapped)

With the setting "Last value", the last valid value is delivered in any case.

If the connection to the base unit is interrupted or if the system is in "Stop" state, the following values are output, depending on the configuration:

Signal type	**Output value at**			
	NAMUR Low	**NAMUR High**	**Signal at o-o-r**	**Last value**
0 to 20 mA	---	---	0 mA	0 mA
4 to 20 mA	1 mA	22 mA	0 mA	0 mA
0 to 10 V	---	---	0 V	0 V
2 to 10 V	0.5 V	11 V	0 V	0 V

Limits according to NAMUR recommendation NE 43 (for information only):

	Signal type 2 to 10 V	**Signal type 4 to 20 mA**
Measurement information M	1.9 to 10.25 V	3.8 to 20.5 mA
Failure information A for deviation below measured value/short-circuit ("NAMUR Low")	≤ 1.8 V	≤ 3.6 mA
Failure information A for deviation above measured value/probe break ("NAMUR High")	≥ 10.5 V	≥ 21 mA

Error detection depends on the type of measuring probe (see technical data, measuring circuit monitoring).

Zero point and end value

Specifying the zero point and end value (scaling) assigns a value range to the physical output signal. The factory setting corresponds to a value range of 0 to 100 (e.g. output level from 0 % to 100 % for a controller output).

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

The output signal can be inverted by swapping the zero point value and the end value (zero point > end value). As a result, an increasing input signal leads to a decreasing output signal.

If the values of zero point and end value are identical, the default setting is activated.

Status after change of configuration

Modified parameters are incorporated immediately.

Behavior after power on

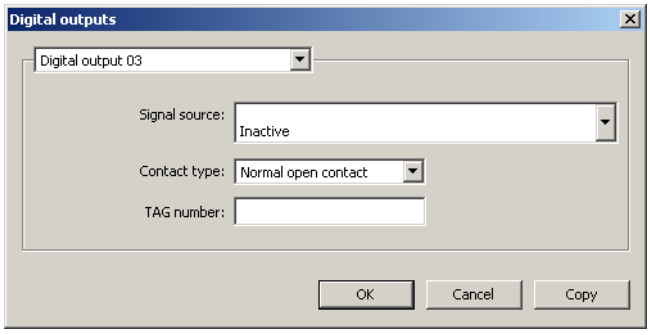
During the initialization phase of the module, the output signal adopts a value of 0 V or 0 mA. After a few seconds, as soon as the module configuration was read, the output signal corresponds to the value in "Stop" system state (depending on the configuration, see table). The current value of the input signal is applied to the output only after complete initialization of the system.

6 Configuration

6.13 Digital outputs

A maximum of eight digital outputs are available (output 3 to 10).

Setup dialog



Parameters

Parameter	Selection/settings	Description
Signal source	Digital selector (**Inactive**)	Signal that is issued via the digital output. Inactive = output inactive
Contact type 📖	Switching behavior of digital output	
	Normally open contact (NO)	The output is active if the digital signal (signal source) is active.
	Normally closed contact (NC)	The output is inactive if the digital signal (signal source) is active.
TAG number	7 characters (as of system version 05: 42 characters)	Identification marking (documentation in PLC)

Contact type

This parameter can be used to invert the status. This function is available for all types of digital output.

Type of digital output	"Active" status	"Inactive" status
Relay (N/O contact)	Closed	Open
Relay (changeover contact)	Operating position	Idle position
Logic output	High level (1)	Low level (0)
Solid state relay	Not inhibited	Inhibited
Open-collector output	Not inhibited	Inhibited

Status after change of configuration

Modified parameters are incorporated immediately.

Behavior after power on

During the initialization phase of the controller module, the output signal is inactive.

6.14 NV connecting list

The NV connecting list is used to link external inputs (NV_...) of the multichannel controller module to signals from other modules via the system bus.

The following sections provide detailed lists of module signals:

⇨ Chapter 6.14.3 "Analog signals (overview)", page 114

⇨ Chapter 6.14.4 "Digital signals (overview)", page 116

Further information about the signals can be found in the operating manual for the relevant module.

Replacement values are available in the event that these signals are not available (connection to base unit interrupted in "Stop" state). The multichannel controller module uses replacement values in normal operation and in independent mode.

⇨ Chapter 6.14.5 "Replacement values (overview)", page 122

NOTE!
There is no NV connecting list in the input/output module configuration menu on the multi-function panel. Instead, a central NV connecting list is available in the configuration menu of the base unit (CPU).

Status after change of configuration

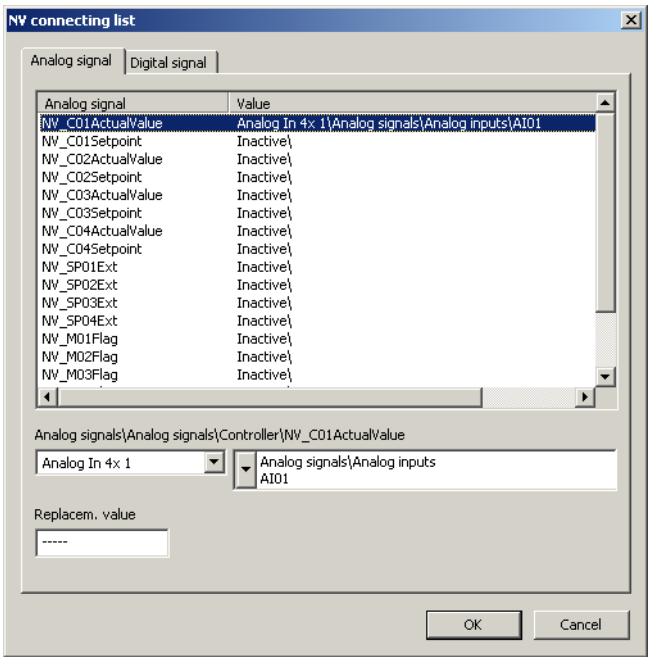
The connections are available immediately.

Behavior after power on

The connections are available immediately after system initialization.

6.14.1 Analog signals

Setup dialog



Parameters

Parameter	Selection/settings	Description
Analog signal / Value	Select input to be connected.	List of external inputs of the module If a connection has already been configured, the module and its signal are displayed in the "Value" column.
...\NV_C01Actual Value (Example)	This is the previously selected external input.	
	Select the module and – in the selector next to it on the right – the signal to connect to the external input.	List of modules in the system and the relevant signals
Replacem. value 🕮	Replacement value for the relevant signal	
	-99999 to +99999 (or invalid value: -----)	An invalid value is specified by default (display: -----).

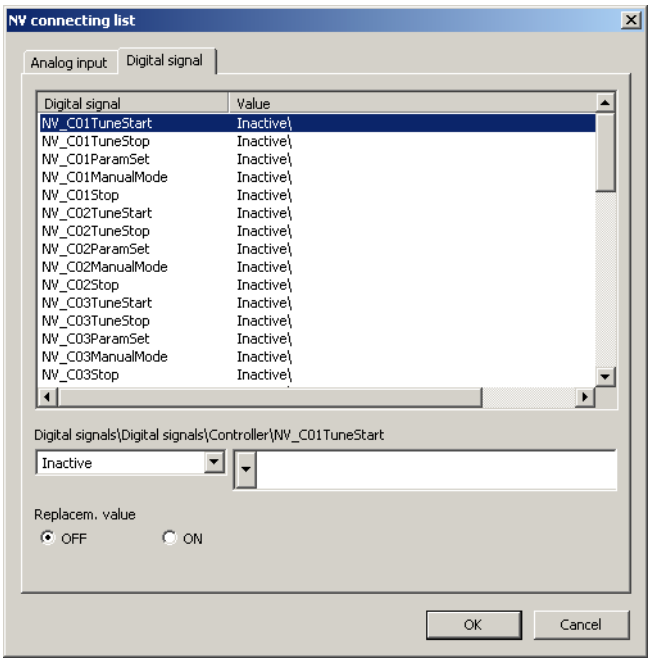
Replacement value

The replacement value is used if the relevant signal is not available (connection to base unit interrupted or system in "Stop" state).

If necessary, an invalid value can also be used (entry: -----).

6.14.2 Digital signals

Setup dialog



Parameters

Parameter	Selection/settings	Description
Digital signal / Value 🕮	Select input to be connected.	List of external inputs of the module If a connection has already been configured, the module and its signal are displayed in the "Value" column.
...\NV_C01TuneStart (Example)	This is the previously selected external input.	
	Select the module and – in the selector next to it on the right – the signal to connect to the external input.	List of modules in the system and the relevant signals
Replacem. value 🕮	Replacement value for the relevant signal	
	OFF	Low level (0)
	ON	High level (1)

Replacement value

The replacement value is used if the relevant signal is not available (connection to base unit interrupted or system in "Stop" state).

6.14.3 Analog signals (overview)

The following table contains all signals that are available in the NV connecting list for connection to the external inputs (NV_...) of the multichannel controller module.

Category	Signal	Description
Inactive		No signal selected
Central processing unit		
Analog variables	Analog variable 1 to 64	Analog variable 1 to 64 (via interface)
Program generator 1 to Program generator 9	Channel 1 SP1 to Channel 3 SP1	Setpoint value 1 of program channel 1 to 3
	Channel 1 SP2 to Channel 3 SP2	Setpoint value 2 of program channel 1 to 3
	Channel 1 SP2 to Channel 3 SP2	Setpoint value 3 of program channel 1 to 3
	Channel 1 SP4 to Channel 3 SP4	Setpoint value 4 of program channel 1 to 3
	PLC Analog output 13 to 16	Signal of PLC analog output 13 to 16
Analog PLC output block 10 to block 18	PLC Analog output 1 to 16	Signal of PLC analog output 1 to 16
Multichannel controller module		
Controller	C01ActualValue to C04ActualValue	Actual value of controller channel 1 to 4
	C01Setpoint to C04Setpoint	Setpoint value of controller channel 1 to 4
	C01OutpLevelMon to C04OutpLevelMon	Output level (display value) of controller module 1 to 4
Analog inputs	AI01 to AI04	Measured value of analog input 1 to 4
Mathematics	Math01 to Math04	Result of math function 1 to 4
HW counter	HWCounter	Counter reading of hardware counter

Category	Signal	Description
Setpoint value	SP01RampValue to SP04RampValue	Ramp end value of ramp function 1 to 4 (if ramp function switched on) or Active setpoint value (external setpoint value + setpoint value) of setpoint function 1 to 4 (if ramp function switched off)
Analog input module 4-channel		
Analog inputs	AI01 to AI04	Measured value of analog input 1 to 4
Analog input module 8-channel		
Analog inputs	AI01 to AI08	Measured value of analog input 1 to 4
Multifunction panel 840		
System bus analog inputs	Counter/Int 1 to Counter/Int 27	Current value of counter or integrator
	Counter/Int clo 1 to Counter/Int clo 27	Value of counter or integrator in most recent closed measuring period
Process image	Current process image	Number of current process image on the display of the multifunction panel 0 = process image 1, 1 = process image 2 etc. (-1 = no active process image)
Thyristor power controller, type 70906x		
Measured values master	Individual analog signals of the power controller: See operating manual 70500153T90... (or following table)	Measured values of the power controller in single-phase operation or of the master in case of three-phase economy circuit or three-phase circuit
Measured values slave/slave1		Measured values of the slave in case of three-phase economy circuit or of slave 1 in case of three-phase circuit
Measured values slave2		Measured values of slave 2 in case of three-phase circuit

6.14.4 Digital signals (overview)

The following table contains all signals that are available in the NV connecting list for connection to the external inputs (NV_...) of the multichannel controller module.

Category	Signal	Description
Inactive		No signal selected
Central processing unit		
Digital variables	Digital variable 1 to 64	Digital variable 1 to 64 (via interface)
Program generator 1 to Program generator 9	Operating contact 1 to 16	Operating contact 1 to 16 of program channels (in the three program channels, operating contacts with the same name are linked with OR)
	Mode: Basic status	Status: Program is not running (basic status)
	Mode: Automatic	Status: Program is running (automatic mode, no delay time or program end time)
	Mode: Automatic 1	Status: Program is running (automatic mode, incl. delay time and program end time)
	Mode: Standstill	Status: Program stopped during automatic mode (time base stopped)
	Mode: Delay	Status: Program start delayed (delay time runs)
	Mode: Program end	Status: Program ends (program end time runs, corresponds to length of end signal)
	Mode: Manual	Status: Manual mode
	Tolerance band channel 1 to 3	Tolerance band signal of program channel 1 to 3
	Batch control	Signal to control the batch recording (OR-linked signals "Automatic", "Standstill", and "Program end").
	PLC Binary output 28 to 32	Signal of PLC digital output 28 to 32
Limit monitoring	Limit monitoring 1 to 64	Output signal of limit value monitoring 1 to 64
Binary linking	Binary linking 1 to 8	Result of binary linking 1 to 8
	PLC Binary output 9 to 32	Signal of PLC digital output 9 to 32
Binary PLC output block 13 to block 18	PLC Binary output 1 to 32	Signal of PLC digital output 1 to 32

Category	Signal	Description
Alarm analog variables	Alarm1 ExAI1 to Alarm1 ExAI64	Alarm signal 1 of analog variable 1 to 64
	Alarm2 ExAI1 to Alarm2ExAI64	Alarm signal 2 of analog variable 1 to 64
Alarm integer variables	Alarm1 ExInt1 to Alarm1 ExInt64	Alarm signal 1 of integer variable 1 to 64
	Alarm2 ExInt1 to Alarm2ExInt64	Alarm signal 2 of integer variable 1 to 64

Category	Signal	Description
Alarms/ Faults	CAlarm/Fault	System collective alarm or system fault (central processing unit and modules)
	CAlarm/Fault ackn.	System collective alarm or system fault with acknowledgement Signal remains active until acknowledgement.
	CAlarm device	System collective alarm (central processing unit and modules)
	CAlarm ackn.	System collective alarm with acknowledgement Signal remains active until acknowledgement.
	Fault	System fault (central processing unit and modules)
	Fault ackn.	System fault with acknowledgement Signal remains active until acknowledgement.
	CAlarm Basis	Central processing unit collective alarm
	System Run	System state (Run = 1, Stop = 0)
	Reserve 1	(Reserved for future use.)
	Fieldbus error	Error at fieldbus interface
	System error mandatory	Error in a mandatory module
	System error optional	Error in an optional module
	No PLC	No PLC program available
	PLC stop	„Stop“ system state
	Battery empty	Battery alarm (central processing unit buffer battery is dead and must be replaced) Notify service department! Attention: RAM memory content is deleted!
	Battery low	Battery pre-warning (central processing unit buffer battery can be replaced within 4 weeks without data loss) Notify service department!

Category	Signal	Description
Multichannel controller module		
Controller	C01ManualMode to C04ManualMode	Manual mode active for controller channel 1 to 4
	C01TuneActive to C04TuneActive	Self-optimization active for controller module 1 to 4
	C01Output1 to C04Output1	Switch position of first controller output of controller channel 1 to 4
	C01Output2 to C04Output2	Switch position of second controller output of controller channel 1 to 4
	C01CollAlarm to C04CollAlarm	Collective alarm of controller channel 1 to 4 (can be configured with signals from the digital selector)
Setpoint	SP01RampTolBand to SP04RampTolBand	Alarm signal of tolerance band monitoring of ramp function 1 to 4
	SP01Changeover1 to SP04Changeover1	Bit 0 of setpoint changeover of setpoint value function 1 to 4
	SP01Changeover2 to SP04Changeover2	Bit 1 of setpoint changeover of setpoint value function 1 to 4
Analog inputs	AI01Alarm1 to AI04Alarm1	Alarm signal 1 of analog input 1 to 4
	AI01Alarm2 to AI04Alarm2	Alarm signal 2 of analog input 1 to 4
Digital inputs	DI01, DI02, DI05 to DI10	Signal of digital input 1, 2, 5 to 10 If the HW counter is activated, the signal of digital input 1 is inactive.
Limit monitoring	LI01 to LI04	Output signal of limit value monitoring 1 to 4
Mathematics	Logic01 to Logic04	Result of logic function 1 to 4
Miscellaneous	CollectiveAlarm	Controller module collective alarm
	HWCounterSignal	Signal of hardware counter in "fill" operating mode (as shut-down signal when threshold value reached)

Category	Signal	Description
Analog input module 4-channel		
Analog inputs	AI01Alarm1 to AI04Alarm1	Alarm signal 1 of analog input 1 to 4
	AI01Alarm2 to AI04Alarm2	Alarm signal 2 of analog input 1 to 4
Digital inputs	DI01	Signal of digital input
Alarm	CollectiveAlarm	Module collective alarm
Analog input module 8-channel		
Analog inputs	AI01Alarm1 to AI08Alarm1	Alarm signal 1 of analog input 1 to 8
	AI01Alarm2 to AI08Alarm2	Alarm signal 2 of analog input 1 to 8
Digital inputs	DI01	Signal of digital input
Alarm	CollectiveAlarm	Module collective alarm
Digital input/output module 12-channel		
Digital inputs	DI01 to DI12	Signal of digital input 1 to 12
Alarm	CollectiveAlarm	Module collective alarm
Multifunction panel 840		
System bus digital inputs	Alarm batch 1 to Alarm batch 9	Collective alarm of batch 1 to 9 (process values)
	CollectiveAlarm	Collective alarm of multifunction panel (process values)
	Fault	Fault in multifunction panel (independent of process values)
	Batch 1 active to Batch 9 active	Signal for active batch 1 to 9
	Push button 1 to Push button 18 (as of system version 02: 32)	Status of push button 1 to 18 (as of system version 02: 1 to 32) in process screen

Category	Signal	Description
Thyristor power controller, type 70906x		
Device status	Individual digital signals of the power controller: See operating manual 70500153T90... (or following table)	Device status signals
Faults master		Faults of the power controller in single-phase operation or of the master in case of three-phase economy circuit or three-phase circuit
Faults slave/ slave1		Faults of the slave in case of three-phase economy circuit or of slave 1 in case of three-phase circuit
Faults slave2		Faults of slave 2 in case of three-phase circuit
Faults master slave		Faults of master slave connection and communication
Hardware input/ output		Binary values of hardware inputs and outputs

6.14.5 Replacement values (overview)

The following table contains the replacement values with their factory settings. Replacement values can only be configured in the setup program.

Digital signals

Category	Signal	Factory setting	Description
Controller	NV_C01TuneStop to NV_C04TuneStop	On	Abort self-optimization
	NV_C01ParamSet to NV_C04ParamSet	Off	Changeover from parameter block 1 to parameter block 2
	NV_C01ManualMode to NV_C04ManualMode	Off	Changeover to manual mode
	NV_C01Stop to NV_C04Stop	Off	Controller channel active/inactive
Setpoint values	NV_SP01Changeover1 to NV_SP04Changeover1	Off	Bit 0 of setpoint changeover
	NV_SP01Changeover2 to NV_SP04Changeover2	Off	Bit 1 of setpoint changeover
NV digital inputs	NV_DO03 to NV_DO10	Off	Signal for controlling the digital output
Acknowledgement of limit value monitoring	NV_LI01Confirmation to NV_LI04Confirmation	Off	Signal for acknowledging the output signal of limit value monitoring
Signal suppression	NV_SR01 to NV_SR08	Off	Signal for activating signal suppression

Analog signals

Signal	Selection	Factory setting[1]	Description
Controller	NV_C01ActualValue to NV_C04ActualValue	---	Actual value for controller channel
	NV_C01Setpoint to NV_C04Setpoint	---	Setpoint value for controller channel
Setpoint values	NV_SP01Ext to NV_SP04Ext	---	External setpoint value (freely available)
Math	NV_M01Flag to NV_M04Flag	---	Any analog value (freely available)

[1] No value is specified by default (display: ---).

7.1 Controller parameters

NOTE!
The parameters described in this section can be entered either with the setup program or on the multifunction panel.

Two parameter blocks can be defined for each of the four controller channels. Changeover of parameter blocks is performed separately for each controller channel by a digital signal.

Setup dialog

Parameters

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

Depending on the configured controller type, certain parameters are omitted or have no effect. Parameters that appear in pairs such as Proportional band 1 and 2 refer to the first and second controller outputs.

Parameter	Setting	Description
Proportional band 1 (Xp1)	**0** to 9999	Value for the proportional band The controller structure has no effect if Xp = 0 (behavior identical to limit value monitoring)! For a continuous controller, Xp must be > 0.
Proportional band 2 (Xp2)	**0** to 9999	
Derivative time 1 (Tv1)	0 to **80** to 9999 s	The derivative time influences the differential component (D component) of the controller output signal. The greater the derivative time, the more effect the D component has.
Derivative time 2 (Tv2)	0 to **80** to 9999 s	

Parameter	Setting	Description
Reset time 1 (Tn1)	0 to **350** to 9999 s	The reset time 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 **350** to 9999 s	
Switching period 1 (Cy1)	0 to **20** to 999.9 s	When using a switched output, the cycle time should be chosen so that the energy supply to the process is as continuous as possible without overloading the switching elements.
Switching period 2 (Cy2)	0 to **20** to 999.9 s	
Contact spacing (Xsh)	**0** to 999.9	Spacing between the two control contacts for a three-state controller, modulating controller, and continuous controller with integrated position controller
Switch. differential 1 (Xd1)	0 to **1** to 999.9	Hysteresis for a switching controller with proportion band Xp = 0
Switch. differential 2 (Xd2)	0 to **1** to 999.9	
Actuator time (TT)	5 to **60** to 3000 s	Control valve running time range used for a modulating controller and continuous controller with integrated position controller
Working point (Y0)	-100 to **0** to +100 %	Working point correction for a P or PD controller (correction value for the output level) If the actual value (x) has reached the setpoint value (w), the output level (y) corresponds to the working point (Y0).
Max. outp. level limit. (Y1)	0 to **100** %	Admissible maximum output level (only effective if Xp > 0)
Min. outp. level limit. (Y2)	**-100** to +100 %	Admissible minimum output level (only effective if Xp > 0)
Relay ON period 1 (Tk1)	**0.05** to 60 s	Limits the frequency of switching for switched outputs (lower value depends on sampling rate: min. 0.05 s, max. 0.25 s)
Relay ON period 2 (Tk2)	**0.05** to 60 s	

Transmission behavior

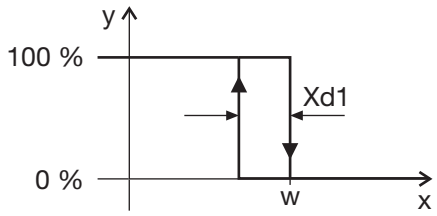
The transmission behavior (controller structure) is determined by the configuration of the parameters for the proportion band (P component), derivative time (D component), and reset time (I component).

7.2 Controller types

Two-state controller

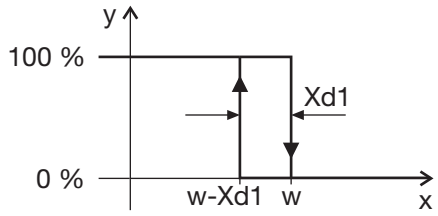
This controller has a switched output and can be parameterized with P, PI, PD, or PID transmission behavior. The proportional band Xp must be greater than 0 for the controller structure to take effect.

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

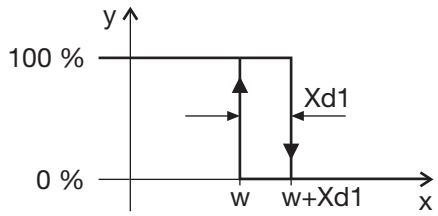


Influence of working point Y0 on the switching behavior

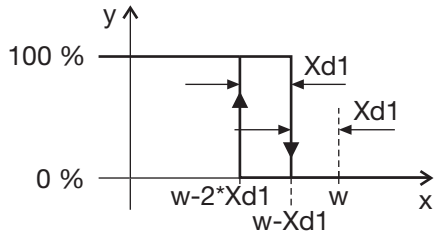
Y0 = 0 %



Y0 = 100 %



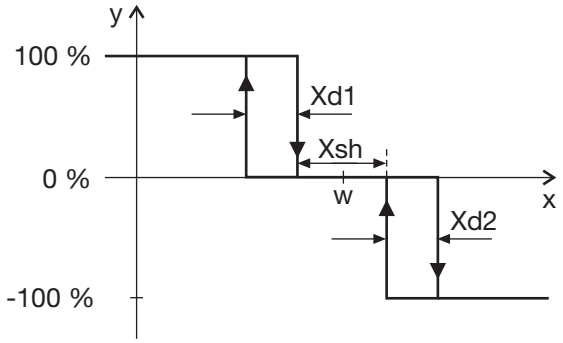
Y0 = -100 %



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 %):



Modulating 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 modulating controller is used for actuator drives with three switching statuses (actuator open, closed, hold). If output level feedback is available, the active output is deactivated when the output level limits are reached.

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 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). An 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 buttons on the controller screen of the multifunction panel, as for the modulating controller in manual mode. The commands "Open actuator" or "Close actuator" are issued for as long as the relevant button is held.

NOTE!
The parameters described in this section can only be configured with the setup program.

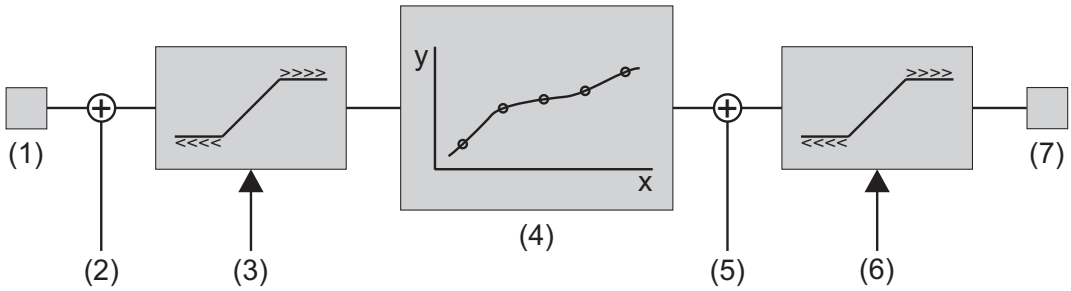
8.1 Customer-specific linearization

You can use the customer-specific linearization to create a customized linearization characteristic line for analog inputs. This characteristic line is used for all analog inputs for which the corresponding linearization has been selected in the configuration.

Customer-specific linearization can only be programmed with the setup program. Two procedures are available for this (type of linearization: grid points or formula).

NOTE!
It is possible to create different characteristic lines with grid points and formulae. The decisive factor for use in the module is, however, the characteristic line to which the formula corresponds. If when you use "OK" to exit the dialog, the grid points and formulae are not compatible, you are given a warning. You can delete the grid points or recalculate the formula on the basis of the grid points.

Signal flow



(1) Measured value

(2) Offset (physical)

(3) Measured value monitoring of standard signals (limits acc. to NAMUR)

(4) Linearization (grid points / formula)

Grid points: Domain monitoring (measured values)
Formula: Co-domain monitoring (linearized values) with respect to the measuring range (configuration parameter: Measuring range start, Measuring range end)

(5) Offset (standardized)

(6) Linearized value monitoring with respect to the scale (configuration parameter: Scale start, Scale end)

(7) Linearized value

Measured value

The table below shows the admissable measured value range of the analog inputs, depending on the chosen sensor (incl. physical offset, if applicable). These values are the minimum and the maximum input values for the customer-specific linearization.

Sensor	Lower limit	Upper limit	Comment
RTD temperature probe	0 Ω	4000 Ω	
Thermocouple	0 mV	100 mV	
Resistance transmitter	0 %	100 %	Sliding contact position, as a percentage of the overall resistance (max. 4000 Ω)
Resistance/potentiometer	0 %	100 %	Sliding contact position, as a percentage of the overall resistance (max. 4000 Ω)
Current 0 to 20 mA	0 mA	20.625 mA	Underrange is not detected.
Current 4 to 20 mA	3.8 mA	20.5 mA	
Voltage 0 to 1 V	-0.0125 V	1.03125 V	
Voltage 0 to 10 V	-0.125 V	10.3125 V	
Voltage 2 to 10 V	1.9 V	10.25 V	

NOTE!
In the case of standard signals (current, voltage), the measured value is monitored (incl. physical offset, if applicable). The current and voltage values that are specified in the table represent the limits acc. to NAMUR recommendation NE 43 (exception: lower limit for current 0 to 20 mA). A measured value beyond these limits causes an overange or an underrange (out-of-range).

Linearization

Depending on the type of linearization, either the domain or the co-domain of the linearization is monitored.

⇨ Chapter 8.1.1 "Grid points", page 129
⇨ Chapter 8.1.2 "Formula", page 130

Linearized value

The linearized value is monitored with respect to the scale range (start, end). As a result, the range of linearized values (incl. standardized offset, if applicable) is limited as follows:

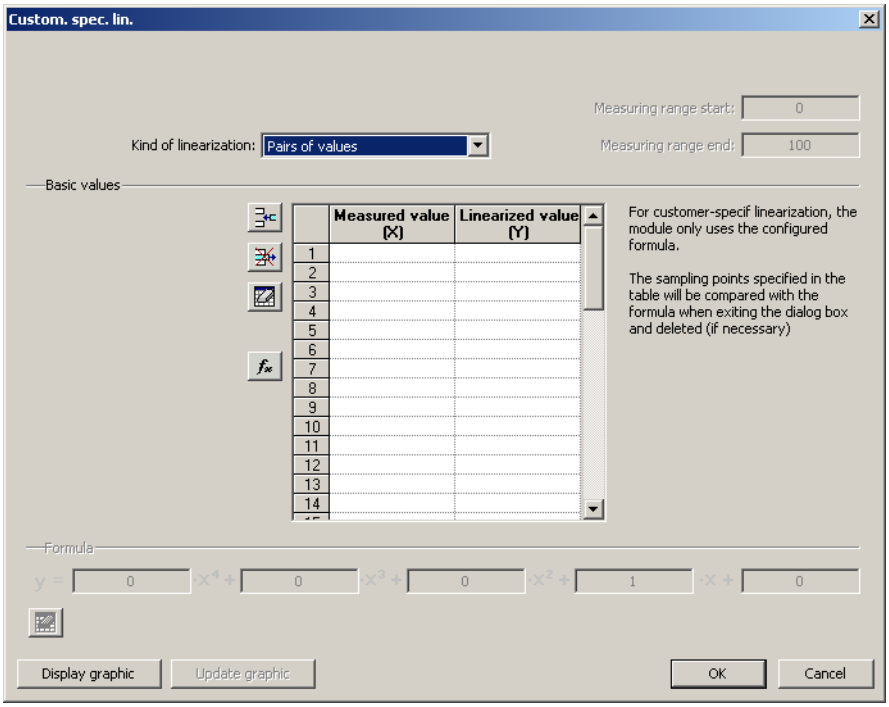
Lower limit = minimum(start, end) - |end - start| × 0.0125
Upper limit = maximum(start, end) + |end - start| × 0.03125

NOTE!
A linearized value beyond these limits causes an overange or an underrange (out-of-range).

8.1.1 Grid points

Customer-specific linearization is specified by entering up to 45 grid points (pairs of values X/ Y). Here, value X indicates the physical measured value (e.g. in mV, mA, or Ohm; depending on the sensor type) and value Y indicates the linearized value (e.g. temperature in °C).

Setup dialog



Parameters

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

The domain of the linearization (measured values, x-axis) is checked in the module and limited as follows:
Domain lower limit = Xmin - 0.0125 × (Xmax - Xmin)
Domain upper limit = Xmax + 0.03125 × (Xmax - Xmin)

NOTE!
A measured value beyond the domain limits causes an overange or an underrange (out-of-range).

Displaying linearization on a graphic ("Display graphic" button)

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 displayed graphic range is initially defined by the lowest and the highest grid point. Within the graphic, the range can be changed temporarily by entering other x-values.

Calculating the polynomial using the grid points ("fx" button)

After entering the pair of values, 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.

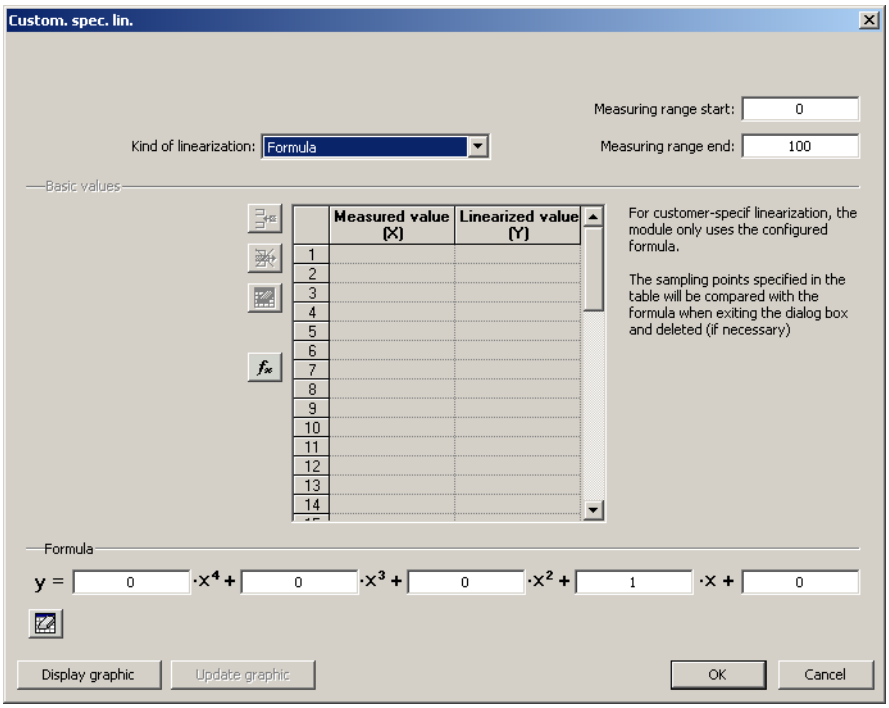
The linarization is not applied if the x-values are not monotonically increasing. In this case it is not possible to display the graphic or to calculate the polynomial.

8.1.2 Formula

Customer-specific linearization is specified using a 4th order polynomial. The polynomial is calculated for the entire linearization range.

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

Setup dialog



Parameters

Parameter	Selection/settings	Description
Measuring range start (Ymin)	-99999 to **0** to +99999	Start value of the y-axis
Measuring range end (Ymax)	-99999 to **100** to +99999	End value of the y-axis

Parameter	Selection/settings	Description
X0	-99999 to **0** to +99999	Absolute component of the polynomial (point of intersection with the y-axis)
X1	-99999 to **1** to +99999	Coefficient of the linear component (x)
X2	-99999 to **0** to +99999	Coefficient of the quadratic component (x^2)
X3	-99999 to **0** to +99999	Coefficient of the cubic component (x^3)
X4	-99999 to **0** to +99999	Coefficient of the quartic component (x^4)

The co-domain of the linearization (linearized values, y-axis) is checked in the module and limited as follows:
Co-domain lower limit = Ymin - 0.0125 × (Ymax - Ymin)
Co-domain upper limit = Ymax + 0.03125 × (Ymax - Ymin)

NOTE!
A linearized value beyond the co-domain limits causes an overange or an underrange (out-of-range).

Displaying linearization on a graphic ("Display graphic" button)

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 displayed graphic range is initially defined by the "Measuring range start" and the "Measuring range end" values (y-values). Within the graphic, the range can be changed temporarily by entering other x-values.

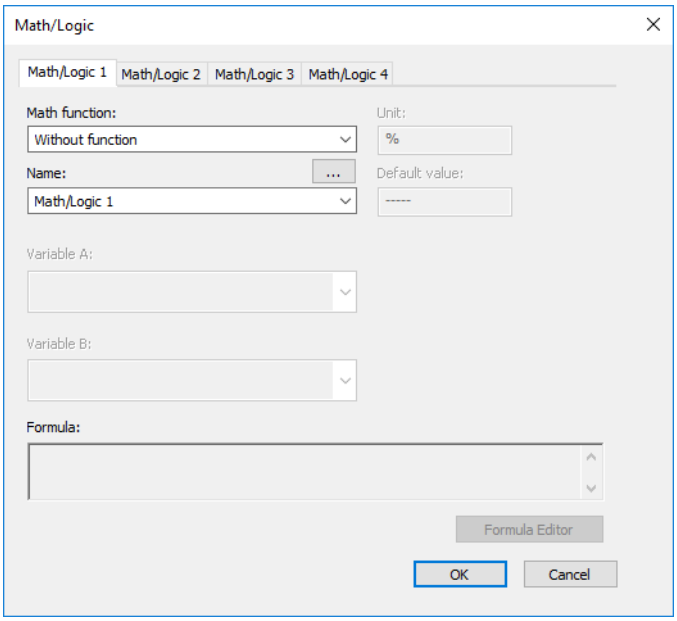
8.2 Math/Logic

The optional Math/Logic function can be used for four formulae, which can be used freely either for mathematical calculations (analog values) or for logical links (binary values).

Fixed formulae for calculating the differential, ratio, and relative humidity are also provided. In this case, two analog values (variable A and B), e.g. the measured value of analog input 1 and 2 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.

The results are available in the analog selector or digital selector. If the function is not active, the math value = 3.0E+37 and the logic value = 0 (FALSE).

Setup dialog



Parameters

Parameter	Selection/settings	Description
Math function 🕮	**Without function**	Function is switched off.
	Mathematics	Mathematical links with freely selectable variables and operators
	Logic	Logical links with freely selectable variables and operators
	Difference	Difference between the measured value and analog signal A and B (A - B)
	Ratio	Ratio between the measured value and analog signal A and B (A / B)
	Humidity	Calculation of relative humidity Analog signal A: dry-bulb temperature Analog signal B: wet-bulb temperature

Parameter	Selection/settings	Description
Name (as of system version 05)	Use default text or select other text from the list.	Designation or description To edit, the text list must be opened via the "..." button.
Unit	6 characters (**%**)	Unit in which the math result (analog value) is displayed.
Variable A	Analog selector	Analog signal A (for calculating differential, ratio, and humidity)
Variable B	Analog selector	Analog signal B (for calculating differential, ratio, and humidity)
Formula 🕮		Display of the formula created with the formula editor (for math and logic)
Default value	Replacement value for the result of the math function	
	-99999 to +99999 (or invalid value: -----)	The replacement value is used if the math function does not produce a valid result due to an invalid input value. An invalid value is specified by default (display: -----).

Function

The math and logic functions are available if the "Math/Logic" option in the setup program has been activated (Project: Hardware arrangement > Globals).

⇨ Manual for setup program B 705000.6, "Project configuration" section

To make these functions available in the controller module, enable them with the setup program (CPU: Online parameters > Enabling of extra codes).

⇨ Operating manual for central processing unit B 705001.0, "Online parameters" section

Formula

Use the "Formula Editor" button to open an editor that can be used to create formulae by selecting variables and operators. Formulae can be entered freely according to standard mathematical rules. Any number of spaces may be used within the formula symbol string. Spaces are not admissible in function designations, names of variables, or constants.

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

CAUTION!
The processing time for math formulae depends on the quantity, their complexity, and the operators used.
In the least favorable case – and if the controller module is at full capacity at the same time – this may affect the sampling rate of the controller module inputs (extension of sampling interval).
However, this only affects the sampling rate T50ms (sampling interval 50 ms); the other sampling rates are not affected by this. See Chapter 6.4 "Device data", page 56.

Error processing

The following errors or exceptions may occur:

Error or exception	Math value	Logic value
Function not active	3.0E+37	0 (FALSE)
Invalid input value and invalid replacement value (math)	3.0E+37	0 (FALSE)
Invalid input value and valid replacement value (math)	Replacement value	0 (FALSE)
System "Stop" state and controller module not independent	3.0E+37	0 (FALSE)

Status after change of configuration

Modified parameters are incorporated immediately.

Behavior after power on

Math and logic values are set to 0.

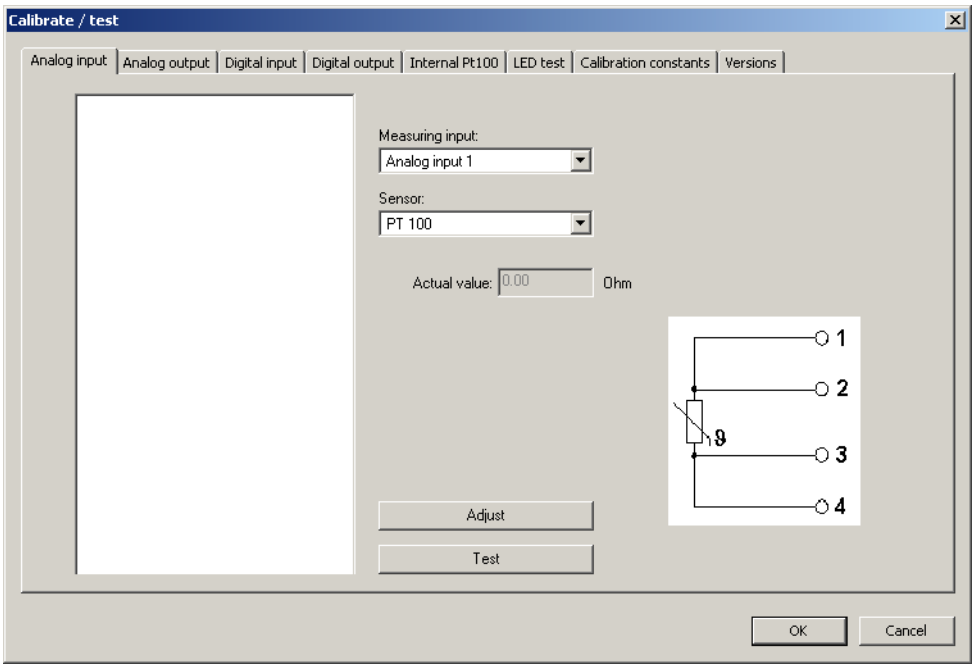
NOTE!
An active connection between the setup program and the central processing unit is required to configure the parameters described in this section.

9.1 Calibrate / test

CAUTION!
Incorrect settings may result in inadmissible changes to values or statuses.
This can have negative effects on the system function.
Individual functions must be changed only by (or under the instruction of) a service technician of the device manufacturer.

9.1.1 Analog input

Setup dialog



Parameters

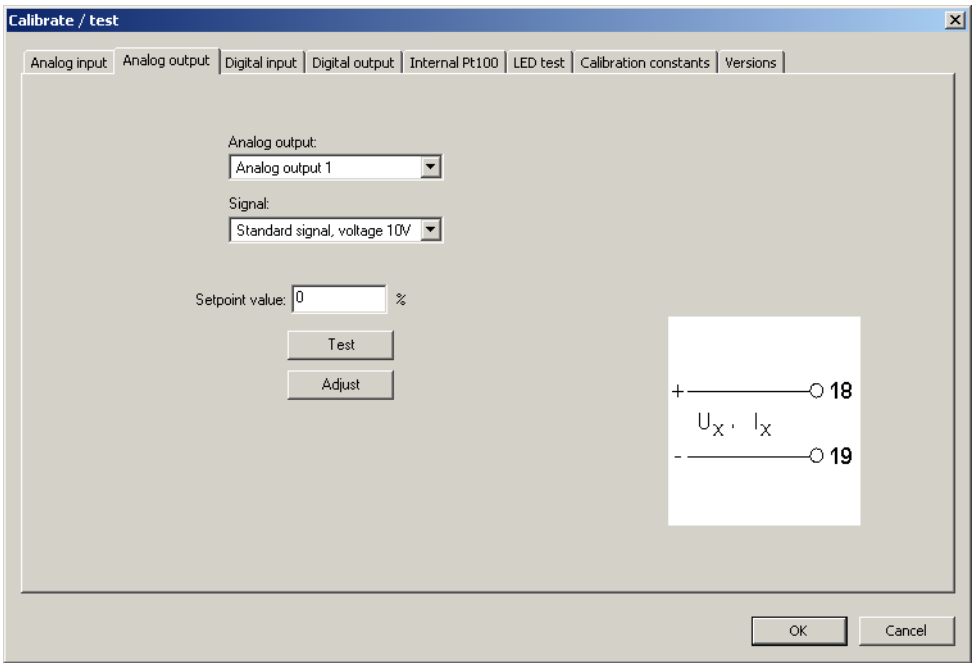
Parameter	Selection/settings	Description
Measuring input	Select input (drop-down list).	Input on which the calibration or test is to be performed.
Sensor	Select sensor (drop-down list).	Sensor type that is connected at the relevant input.
Actual value	None	Display of the actual value read out
Test 🕮	Click the "Test" button.	An additional window opens with instructions for testing (see below).

Test

The results of the test measurement are shown in the display field.

9.1.2 Analog output

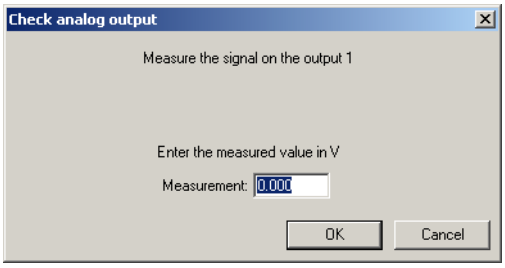
Setup dialog



Parameters

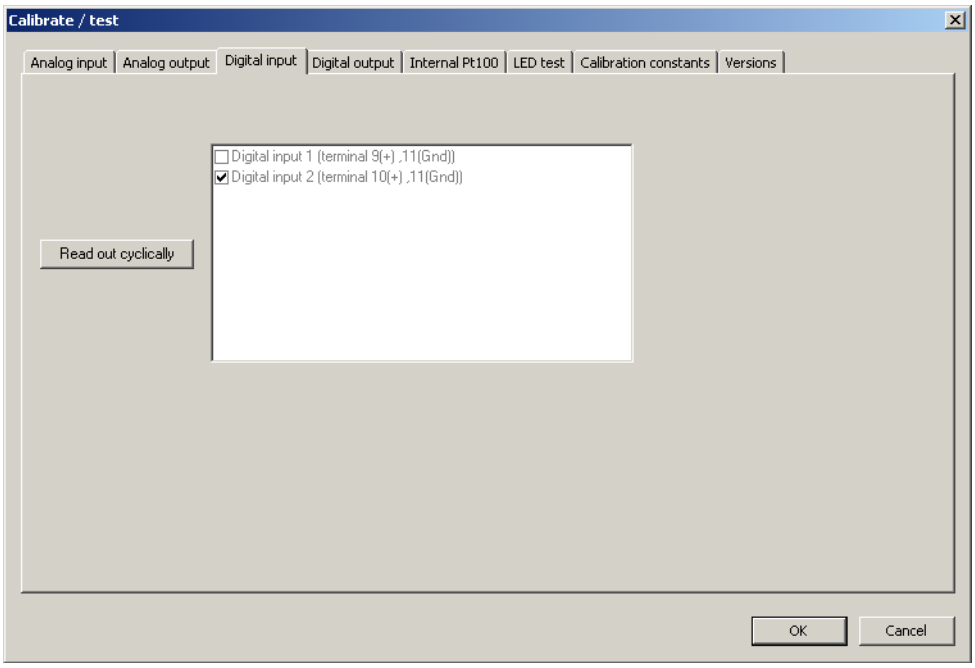
Parameter	Selection/settings	Description
Analog output	Select output (drop-down list).	Output on which the calibration or test is to be performed.
Signal	Select signal type (drop-down list).	Signal type that is issued at the relevant output.
Setpoint value	**0** to 100	Value to be issued.
Test 🕮	Click the "Test" button.	An additional window opens with instructions for testing (see below).

Test



9.1.3 Digital input

Setup dialog

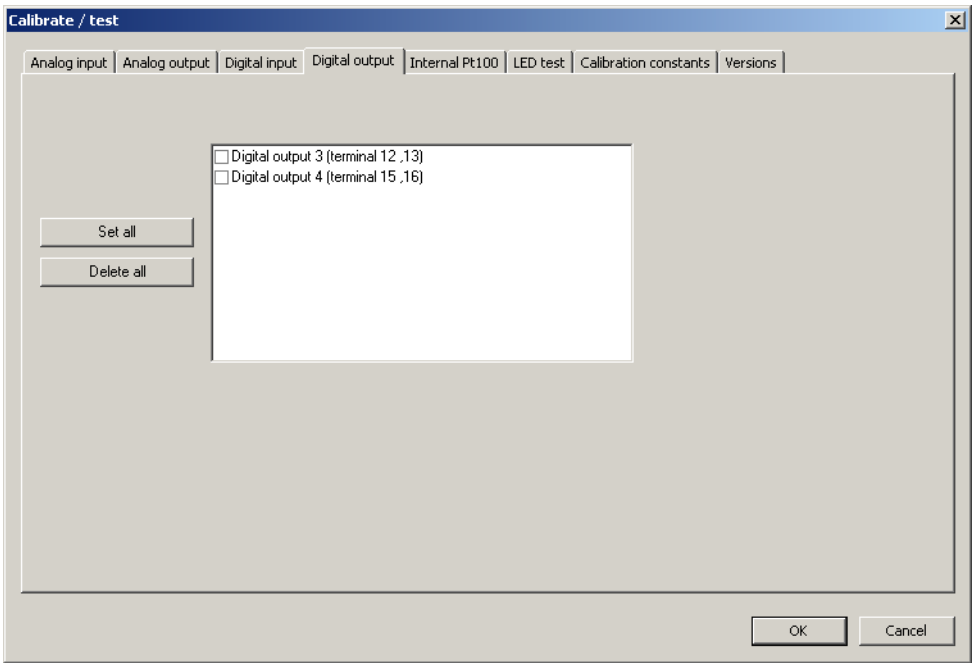


Parameters

Parameter	Selection/settings	Description
Read out cyclically	Click the "Read out cyclically" button.	All inputs are read out cyclically. If the level at an input is "High", the checkbox is activated automatically.

9.1.4 Digital output

Setup dialog



Parameters

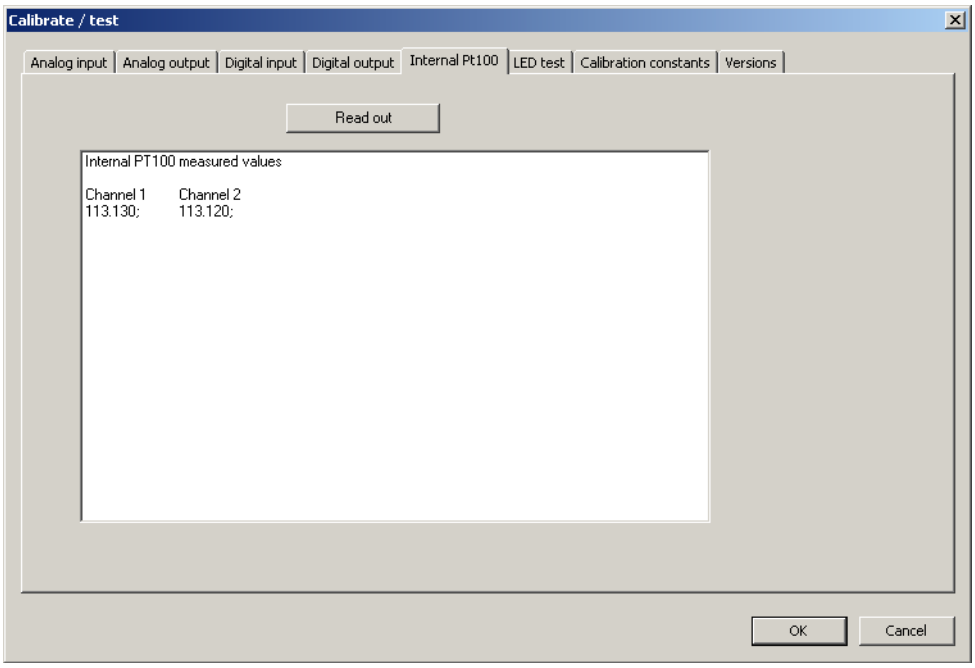
Parameter	Selection/settings	Description
Digital output 3 to Digital output n 🕮	Select output (activate checkbox). You can select multiple outputs.	An output that is selected is set to "active".
Set all	Click the "Set all" button.	All outputs are set to "active".
Delete all	Click the "Delete all" button.	All outputs are set to "inactive".

Digital output 3 to Digital output n

Type of digital output	"Active" status	"Inactive" status
Relay (N/O contact)	Closed	Open
Relay (changeover contact)	Operating position	Idle position
Logic output	High level (1)	Low level (0)
Solid state relay	Not inhibited	Inhibited
Open-collector output	Not inhibited	Inhibited

9.1.5 Internal Pt100

Setup dialog



This dialog displays the cold junction temperatures of analog inputs 1 to 4 ("Channel 1" to "Channel 4"). The cold junction temperature is required for compensating the influence of the ambient temperature for thermocouples.

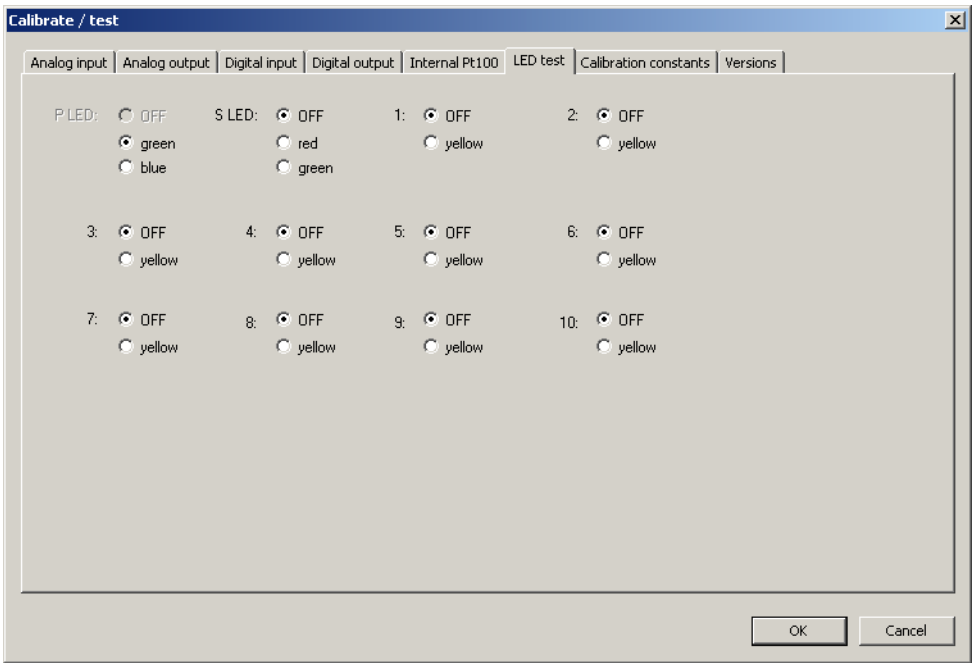
The cold junction temperature either relates to the measured value of the relevant internal Pt100 temperature probe (temperature at the terminals) or a fixed temperature value (specified manually).

The measured value of a fifth Pt100 temperature probe ("Internal") is also displayed (temperature inside the case).

Initially, the values are determined once and are displayed. To display them again, click the "Read out" button.

9.1.6 LED test

Setup dialog



Parameters

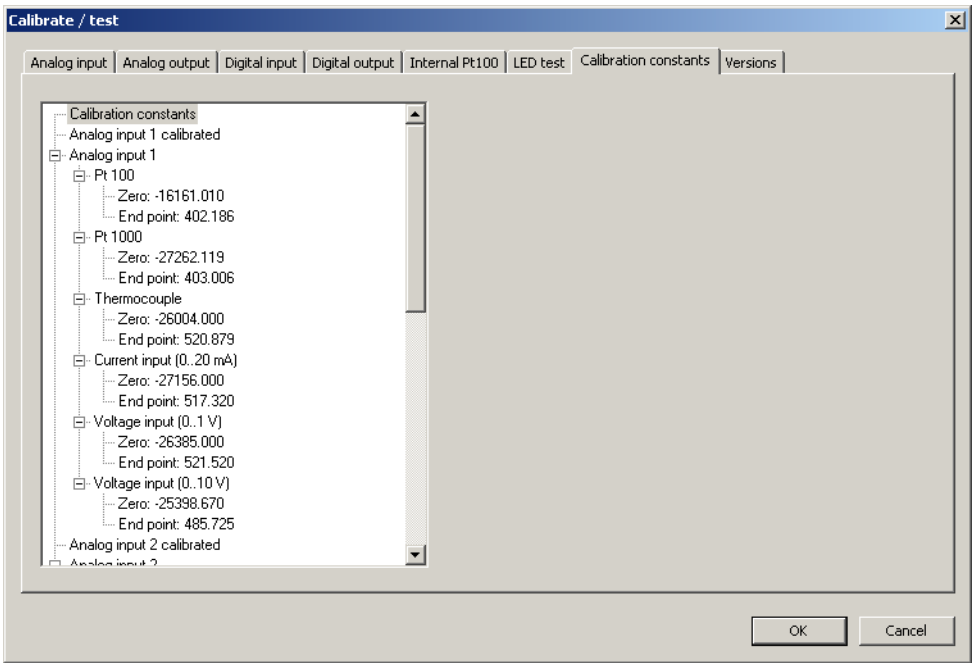
Parameter	Selection/settings	Description
P LED	To test the LED, click the required status to select it (OFF, green, or blue). After selection, the LED enters the chosen status immediately.	This function is used to test the electrical function of the "P" LED (Power).
S LED	To test the LED, click the required status to select it (OFF, red, or green). After selection, the LED enters the chosen status immediately.	This function is used to test the electrical function of the "S" LED (Status).
1 to 10	To test the LED, click the required status (OFF or yellow) to select it. After selection, the LED enters the chosen status immediately.	This function is used to test the electrical function of LEDs "1" to "10".

NOTE!
An LED maintains the set status until a new status is set or until the "LED test" dialog window is closed.

9 Online parameters

9.1.7 Calibration constants

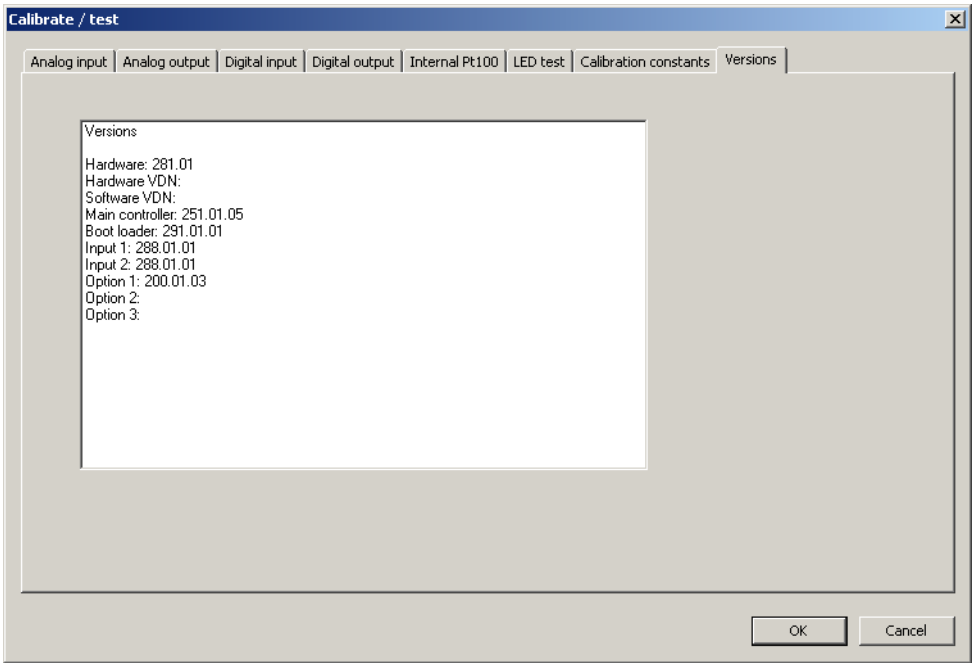
Setup dialog



This dialog displays the calibration status and the calibration constants of the analog inputs.

9.1.8 Versions

Setup dialog



This dialog displays the module versions.

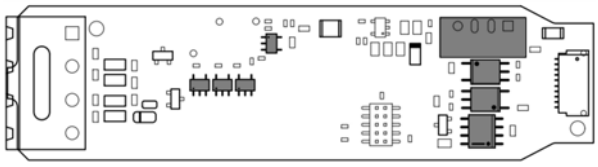
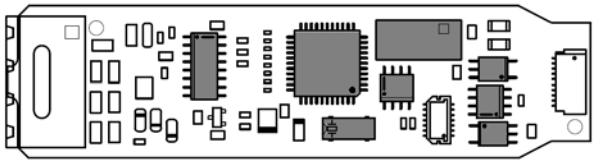
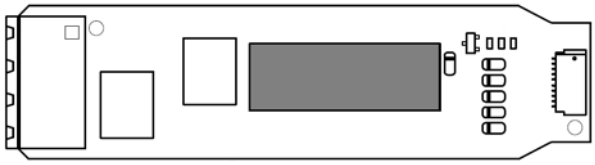
This section describes how to retrofit the modules for the optional inputs and outputs (expansion slot 1 to 3) on multichannel controller module 705010.

CAUTION!
Incorrect handling may result in damage or malfunctions.
This compromises the function of the multichannel controller module or of the system as a whole.
Only qualified personnel are permitted to carry out module retrofits. Existing country-specific requirements for changes at an electrical device have to be observed. Before a retrofit, the system must be shut down and isolated from the power supply. Prior to using the retrofitted inputs or outputs, ensure that these have been configured correctly.

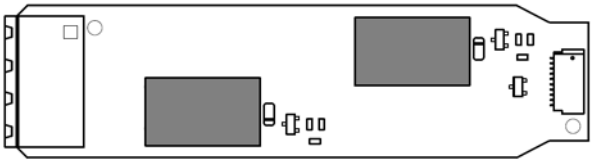
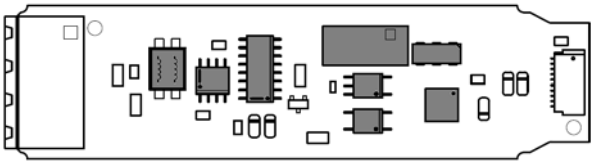
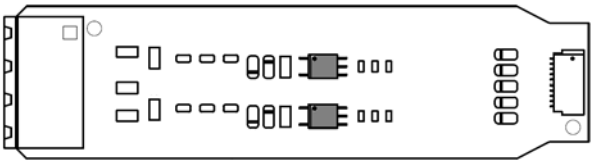
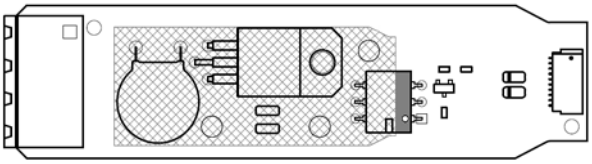
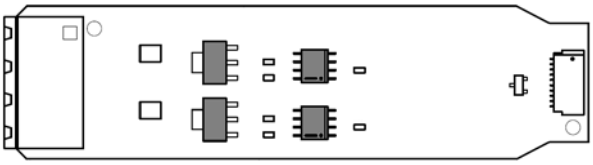
CAUTION!
Modules may be damaged by electrostatic discharge.
This compromises the function of the multichannel controller module or of the system as a whole.
Modules may only be retrofitted at a grounded workstation and in compliance with the relevant safety measures.

Identifying the module

The module can be identified using the part no. on the packaging.

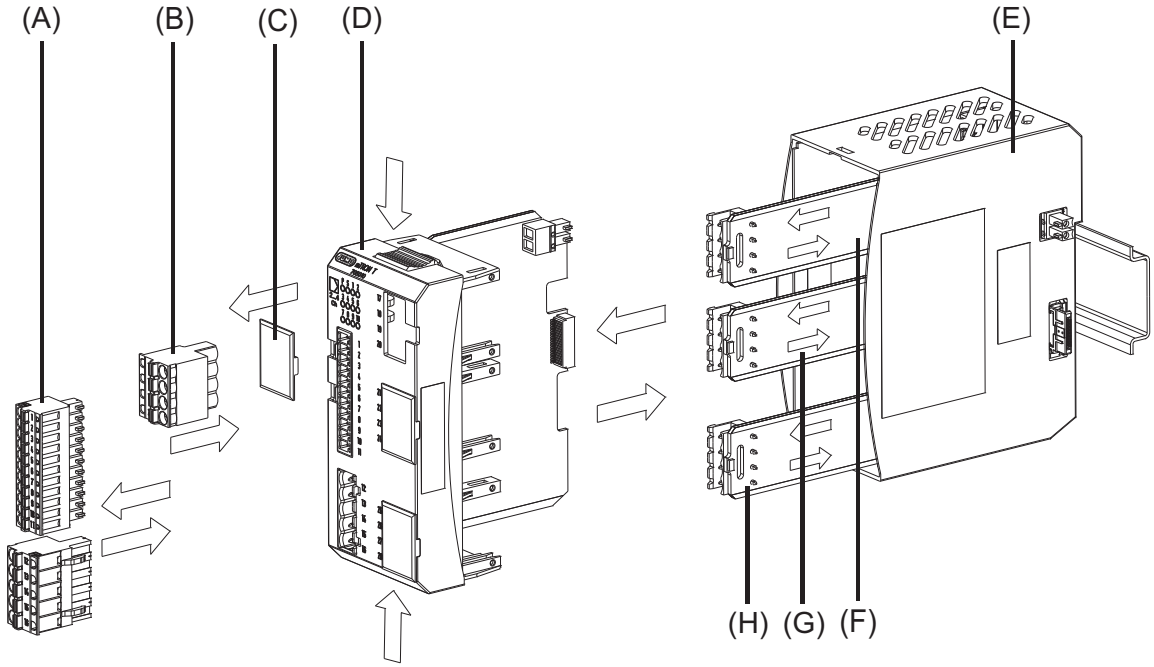
Module	Code (order code)	Part no.	For use in expansion slot
Analog input (universal) – without approval according to DIN EN 14597 and without DNV approval 	1	00776489	1 (F), 2 (G)
Analog input (universal) 	1	00569497	1 (F), 2 (G)
Relay (changeover contact) 	2	00569498	1 (F), 2 (G), 3 (H)

10 Retrofitting inputs/outputs

Module	Code (order code)	Part no.	For use in expansion slot
2 relays (N/O contacts with common pole) 	3	00569499	1 (F), 2 (G), 3 (H)
Analog output (configurable) 	4	00569500	1 (F), 2 (G), 3 (H)
2 digital inputs DC 0/24 V 	5	00569501	1 (F), 2 (G), 3 (H)
Solid state relay 1 A 	6	00569502	1 (F), 2 (G), 3 (H)
2 open-collector outputs 	7	00569503	1 (F), 2 (G), 3 (H)

NOTE!
For modules that have already been fitted **ex-works**, the type designation on the nameplate of the module insert indicates the module type and the expansion slot.
If further information relating to this is required, it can be found in the "Identifying the device version" section in operating manual B 705010.0 or installation instructions B 705010.4. (The installation instructions are included in the scope of delivery of the multichannel controller module.)

Overview diagram



Shutting down the system and removing the module insert from the case

Step	Activity
1	Shut down the system and disconnect it from the voltage supply.
2	Pull off all wired terminal strips (A) toward the front.
3	Push in the grooved surfaces at the top and bottom of the module insert (D) and remove the module insert from the case (E).
4	Remove the cover plate (C) of the relevant expansion slot (illustrated here for slot 1).

Retrofitting the module

Step	Activity
1	Select the expansion slot: slot 1 (F), slot 2 (G), or slot 3 (H). The diagram shows the expansion slots with modules already fitted.
2	Align the module (as shown in the diagram) and insert it carefully into the guide rails inside the case (E) until the connector engages.

Inserting the module insert into the case and starting up the system

Step	Activity
1	Hold the module insert (D) at the grooved surfaces on the top and bottom and insert the module insert into the case (E). When doing so, ensure that the board of the module insert slides into the guide rails of the case. Also ensure that the board of the retrofitted module slides into the guide rail of the module insert (D).

Step	Activity
2	Attach terminal strip (B) to the contacts of the retrofitted module and attach the label with the terminal numbers to the terminal strip. When doing so, ensure that the numbering on the terminal strip matches the numbering on the front panel of the module insert.
3	Reattach all wired terminal strips (A). Restart the system.
4	Configure the retrofitted inputs or outputs with the setup program or multifunction panel. Do not perform wiring until this is complete.
5	Test the correct function of the whole plant under supervision.

NOTE!
When inserting the module insert, ensure that the snap holders (under the grooved surfaces) audibly snap into place.

CAUTION!
If a retrofitted module is removed again, an opening is left in the front panel of the module insert.
Protection type IP20 is no longer guaranteed in this case.
To avoid this situation, the cover plate that was removed during the retrofit must be refitted at the opening. The cover plate should be retained for this reason.

11.1 Technical data

11.1.1 Analog inputs

General information

Number (standard version)	2 (input 1 and 2)
Optional number (option slot 1 to 3)	2 (input 3 and 4)
A/D converter	Dynamic resolution up to 16 bit

Thermocouples

Designation	Standard	Measuring range	Measuring accuracy[a]	Ambient temperature influence
Fe-CuNi “L”		-200 to +900 °C	≤ 0.1 % from -100 °C	300 ppm/K
Fe-CuNi “J”	DIN EN 60584	-200 to +1200 °C	≤ 0.1 % from -100 °C	300 ppm/K
Cu-CuNi “U”		-200 to +600 °C	≤ 0.1 % from -130 °C	300 ppm/K
Cu-CuNi “T”	DIN EN 60584	-200 to +400 °C	≤ 0.1 % from -150 °C	300 ppm/K
NiCr-Ni “K”	DIN EN 60584	-200 to +1372 °C	≤ 0.1 % from -80 °C	300 ppm/K
NiCr-CuNi “E”	DIN EN 60584	-200 to +1000 °C	≤ 0.1 % from -80 °C	300 ppm/K
NiCrSi-NiSi “N”	DIN EN 60584	-100 to +1300 °C	≤ 0.1 % from -80 °C	300 ppm/K
Pt10Rh-Pt “S”	DIN EN 60584	-50 to 1768 °C	≤ 0.15 % from 20 °C	300 ppm/K
Pt13Rh-Pt “R”	DIN EN 60584	-50 to 1768 °C	≤ 0.15 % from 50 °C	300 ppm/K
Pt30Rh-Pt6Rh “B”	DIN EN 60584	0 to 1820 °C	≤ 0.15 % from 400 °C	300 ppm/K
W5Re-W26Re “C”		0 to 2320 °C	≤ 0.15 % from 500 °C	300 ppm/K
W3Re-W25Re “D”		0 to 2495 °C	≤ 0.15 % from 500 °C	300 ppm/K
W3Re-W26Re		0 to 2400 °C	≤ 0.15 % from 500 °C	300 ppm/K
Chromel-Copel	GOST 8.585-2001	-200 to +800 °C	≤ 0.15 % from -80 °C	300 ppm/K
Chromel-Alumel	GOST 8.585-2001	-200 to +1372 °C	≤ 0.1 % from -80 °C	300 ppm/K
PLII (Platinel II)		0 to 1395 °C	≤ 0.1 % from -80 °C	300 ppm/K
Linear		0 to 75 mV	≤ 0.1 %	300 ppm/K
Cold junction		Pt100 internal		
Cold junction accuracy		± 1 K		

[a] The accuracy values refer to the maximum measuring range. Smaller measuring ranges lead to reduced linearization accuracy.

RTD temperature probe

Designation	Standard	Measuring range	Measuring accuracy[a]	Ambient temperature influence
Pt100	DIN EN 60751	-200 to +850 °C		50 ppm/K
2-wire circuit			≤ 0.15 %	
3-wire/4-wire circuit			≤ 0.05 %	
Pt500	DIN EN 60751	-200 to +850 °C		50 ppm/K
2-wire circuit			≤ 0.30 %	
3-wire/4-wire circuit			≤ 0.15 %	

11 Appendix

Designation	Standard	Measuring range	Measuring accuracy[a]	Ambient temperature influence
Pt1000	DIN EN 60751	-200 to +850 °C		50 ppm/K
2-wire circuit			≤ 0.20 %	
3-wire/4-wire circuit			≤ 0.08 %	
Ni100	DIN 43760	-60 to +250 °C		50 ppm/K
2-wire circuit			≤ 0.36 %	
3-wire/4-wire circuit			≤ 0.24 %	
Pt100	JIS 1604	-200 to +650 °C		50 ppm/K
2-wire circuit			≤ 0.20 %	
3-wire/4-wire circuit			≤ 0.06 %	
Pt50	GOST 6651-94	-200 to +1100 °C		50 ppm/K
2-wire circuit			≤ 0.30 %	
3-wire/4-wire circuit			≤ 0.06 %	
Pt100	GOST 6651-94	-200 to +850 °C		50 ppm/K
2-wire circuit			≤ 0.15 %	
3-wire/4-wire circuit			≤ 0.05 %	
Cu50	GOST 6651-94	-50 to +200 °C		200 ppm/K
2-wire circuit			≤ 0.80 %	
3-wire/4-wire circuit			≤ 0.60 %	
Cu100	GOST 6651-94	-50 to +200 °C		200 ppm/K
2-wire circuit			≤ 0.80 %	
3-wire/4-wire circuit			≤ 0.50 %	
KTY11-6		-50 to +150 °C		50 ppm/K
2-wire circuit			≤ 1 %	
3-wire/4-wire circuit			≤ 0.24 %	
Sensor lead resistance		Max. 30 Ω per lead for 3-wire and 4-wire circuit Max. 10 Ω per lead for 2-wire circuit		
Measuring current		Pt100 approx. 250 µA, Pt500, and Pt1000 approx. 100 µA; not constant		
Lead compensation		Not required for 3-wire and 4-wire circuit. For a 2-wire circuit, lead compensation can be set in the software by correcting the actual value.		

[a] The accuracy values refer to the maximum measuring range. Smaller measuring ranges lead to reduced linearization accuracy.

Standard signals

Designation	Measuring range	Measuring accuracy[a]	Ambient temperature influence
Voltage Input resistance R_E > 500 kΩ Input resistance R_E > 100 kΩ	 DC 0(2) to 10 V DC 0 to 1 V	≤ 0.05 %	100 ppm/K
Current (voltage drop ≤ 2 V)	DC 0(4) to 20 mA	≤ 0.05 %	100 ppm/K
Heater current	AC 0 to 50 mA	≤ 20%	100 ppm/K
	DC 0 to 20 mA	≤ 1 %	100 ppm/K
Resistance transmitter	100 Ω to 4 kΩ	± 4 Ω	100 ppm/K
Resistance/potentiometer	100 Ω to 4 kΩ	± 4 Ω	100 ppm/K

[a] The accuracy values refer to the maximum measuring range. Smaller measuring ranges lead to reduced linearization accuracy.

Measuring circuit monitoring

In the event of an error the outputs move to a defined status.

Measuring element	Underrange	Overrange	Probe or lead short circuit	Probe or lead break
Thermocouple	Is detected	Is detected	Is not detected	Is detected
RTD temperature probe	Is detected	Is detected	Is detected	Is detected
Voltage 2 to 10 V 0 to 10 V 0 to 1 V	 Is detected Is detected Is detected	 Is detected Is detected Is detected	 Is detected Is not detected Is not detected	 Is detected Is not detected Is not detected
Current 4 to 20 mA 0 to 20 mA	 Is detected Is not detected	 Is detected Is detected	 Is detected Is not detected	 Is detected Is not detected
Heater current	Is detected	Is detected	Is not detected	Is not detected
Resistance transmitter	Is detected	Is detected	Is not detected	Is detected
Resistance/potentiometer	Is detected	Is detected	Is detected	Is detected

11.1.2 Digital inputs

Number (standard version)	2 (input 1 and 2)
Optional number (option slot 1 to 3)	6 (input 5 to 10)
Input signal	DC 0/24 V (Input 1: Counting input up to 10 kHz) (PLC level; logical "0" = -3 to +5 V; logical "1" = +15 to +30 V)

11.1.3 Analog outputs

Per optional board (option slot 1 to 3)

1 analog output (configurable) (Output 1 to 3)	Load resistance R_{Load}	Accuracy	Ambient temperature influence
Voltage DC 0(2) to 10 V	≥ 500 Ω	± 0.25 %	± 150 ppm/K
Current DC 0(4) to 20 mA	≤ 500 Ω	± 0.25 %	± 150 ppm/K

Selectable output behavior in case of an error according to NAMUR recommendation NE 43 (for signal type 2 to 10 V and 4 to 20 mA).

The function of the analog output was confirmed during the tests according to DIN EN 14597.

11.1.4 Digital outputs

Standard version

2 relay outputs (N/O)	
Switching capacity	3A at AC 230V resistive load[a] 3A at DC 30V resistive load[a]
Contact life	150,000 operations at rated load / 350,000 operations at 1 A[a]
or	
2 logic outputs (to control external solid-state relays)	
Output signal	DC 0/15 V
Current	Max. 25 mA per output
(Output 3 and 4)	

[a] In the course of certification according to DIN EN 14597, 250,000 switching operations with 1 A at AC 230 V were carried out.

Per optional board (option slot 1 to 3)

1 relay output (changeover contact) Output 5, 7, and 9)	
Switching capacity	3A at AC 230V resistive load[a] 3A at DC 30V resistive load[a]
Contact life	350,000 operations at rated load / 750,000 operations at 1 A[a]
2 relay outputs (N/O contacts with common pole) (Output 5 to 10)	
Switching capacity	3A at AC 230V resistive load[a] 3A at DC 30V resistive load[a]
Contact life	150,000 operations at rated load / 350,000 operations at 1 A[a]
1 solid-state relay (Output 5, 7, and 9)	
Switching capacity	1 A at 230 V
Protection circuitry	Varistor

2 open-collector outputs (Output 5 to 10) Status logical "0” (transistor inhibited): Allowable voltage via switching transistor Maximum reverse current Status logical "1” (transistor switched): Maximum voltage via switching transistor Maximum current	 Min. 5 V, max. 30 V 0.1 mA ≤ 1.6 V 50 mA

[a] In the course of certification according to DIN EN 14597, 250,000 switching operations with 1 A at AC 230 V were carried out.

11.1.5 Controller

Controller types	Two-state controller, three-state controller, modulating controller, continuous controller, continuous controller with integrated actuator controller
Controller structures	P, PD, PI, PID
Sampling rate	50 ms, 100 ms, 150 ms, 200 ms, or 250 ms

11 Appendix

11.1.6 Electrical data

Voltage supply	
Connection	Lateral (feed via base unit or router module)
Voltage input	DC 24 V +25/-20 %
Residual ripple	5 %
Current consumption	Max. 300 mA (at DC 19.2 V)
Power consumption	Max. 6 W
Inputs and outputs (terminals 1 to 28)	
Connection	At the front (removable terminal strips with Push-In technology)
Conductor cross section on terminals 1 to 11	
Wire or strand without ferrule	Min. 0.14 mm^2, max. 1.5 mm^2
Strand with ferrule	Without plastic collar: Min. 0.25 mm^2, max. 1.5 mm^2 With plastic collar: Min. 0.25 mm^2, max. 0.5 mm^2
Stripping length on terminals 1 to 11	9 mm
Conductor cross section on terminals 12 to 28	
Wire or strand without ferrule	Min. 0.5 mm^2, max. 2.5 mm^2
Strand with ferrule	Min. 0.5 mm^2, max. 2.5 mm^2
2 x strand with twin ferrule with plastic collar	Min. 0.5 mm^2, max. 1.5 mm^2 (both strands with the same cross section)
Stripping length on terminals 12 to 28	10 mm
Electrical safety	Acc. to EN 61010-1:2020[a] Overvoltage category III, pollution degree 2
Electromagnetic compatibility	Acc. to EN 61326-1:2022[a]
Interference emission	Class A – only for industrial use –
Interference immunity	Industrial requirements[b]

[a] DIN EN 60730-1 in the course of certification according to DIN EN 14597

[b] During EMC interference, the measuring accuracy of the analog inputs may be reduced to +/- 1 %.

11.1.7 Case and ambient conditions

Case type	Plastic case for DIN rail mounting in the control cabinet (indoor use); DIN rail acc. to DIN EN 60715, 35 mm x 7.5 mm x 1 mm
Dimensions (W x H x D)	45 mm x 103.6 mm x 101.5 mm (without connection elements)
Weight (fully equipped)	Approx. 250 g
Protection type	IP20, acc. to DIN EN 60529
Ambient temperature range	-20 to +55 °C
Storage temperature range	-40 to +70 °C
Resistance to climatic conditions	Relative humidity ≤ 90 % annual average without condensation (climatic class 3K3 acc. to DIN EN 60721-3-3 with extended temperature and humidity range)
Site altitude	Up to 2000 m above sea level
Mechanical ambient conditions[a]	Classification acc. to DIN EN 60721-3-3, table 6, class 3M2

[a] Test conditions are listed in the System Descripton B 705000.8.

11.1.8 Approval/approval marks

Approval mark	Testing agency	Certificate/certification number	Inspection basis	Valid for
c UL us	Underwriters Laboratories	E201387	UL 61010-1 (3. Ed.), CAN/CSA-22.2 No. 61010-1 (3. Ed.)	all types
DNV GL	DNV GL	TAA000016N	Class Guideline DNVGL-CG-0339	all types; a power supply unit with DNV GL or GL type approval is required (e.g. type 705090)
DIN	DIN CERTCO	TR1257	DIN EN 14597	all types

产品组别 Product group: 705010	产品中有害物质的名称及含量 China EEP Hazardous Substances Information					
部件名称 Component Name						
	铅 （Pb）	汞 （Hg）	镉 （Cd）	六价铬 （Cr(VI)）	多溴联苯 （PBB）	多溴二苯醚 （PBDE）
外壳 Housing (Gehäuse)	○	○	○	○	○	○
过程连接 Process connection (Prozessanschluss)	○	○	○	○	○	○
螺母 Nuts (Mutter)	○	○	○	○	○	○
螺栓 Screw (Schraube)	○	○	○	○	○	○

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 is 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 materials' of the part is exceeded the limit of the GB/T 26572.

11.3 Certificate TR1257 (DIN CERTCO)

DIN CERTCO
Gesellschaft für Konformitätsbewertung mbH

CERTIFICATE

Certificate holder	**JUMO GmbH & Co. KG** **Moritz-Juchheim-Str. 1** **36039 Fulda** **GERMANY**
Product	Temperature control and limiting devices for heat generating systems
Type, Model	JUMO Mehrkanal-Reglermodul (705010)
Testing basis	DIN EN 14597:2015-02 Certification scheme Temperature control and limiting devices for heat generating systems (2009-01)
Mark of conformity	DIN Geprüft
Registration No.	TR1257
Valid until	2026-10-31
Right of use	This certificate entitles the holder to use the mark of conformity shown above in conjunction with the specified registration number. See annex for further information.

DAkkS Deutsche Akkreditierungsstelle D-ZE-11125-01-00

2021-11-02

Dipl.-Wi.-Ing. (FH) Sören Scholz
Head of Certification Body

GESELLSCHAFT FÜR KONFORMITÄTSBEWERTUNG MBH · DIN CERTCO

DIN

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DIN CERTCO
Gesellschaft für Konformitätsbewertung mbH

ANNEX

Certificate	TR1257 dated 2021-11-02
Technical Data	See technical data sheet to the above mentioned registration number at www.dincertco.tuv.com the Temperature control and limiting devices is suitable for - Temperature regulator (TR) with the modes of action 1.B
Testing laboratory/ Inspection body	TÜV SÜD Industrie Service GmbH Prüflabor für Kälte-, Klima- u. Wärmetechnik Ridlerstr. 65 80339 München GERMANY
Test report(s)	C-T 1648-00/21 dated 2021-10-12
Remark(s)	Based on the examination DIN EN IEC 60730-2-9:2021-01 DIN EN 60730-1:2012-10 DIN EN 60730-1:2017-05 DIN EN 60335-1:2012-10, paragraph 30

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