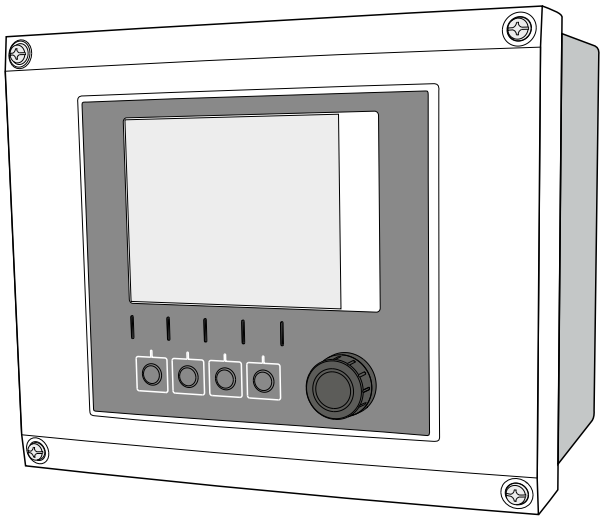
BA00444C/07/EN/24.19
71431516
2019-01-31

Valid as of version
01.06.08

Operating Instructions
Liquiline CM442/CM444/CM448

Universal four-wire multichannel controller
Field device



Endress+Hauser
People for Process Automation

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1 About this document

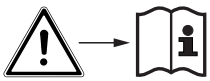
1.1 Warnings

Structure of information	Meaning
DANGER **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **will** result in a fatal or serious injury.
WARNING **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **can** result in a fatal or serious injury.
CAUTION **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** If necessary, Consequences of non-compliance (if applicable) ▶ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols

Symbol	Meaning
	Additional information, tips
	Permitted or recommended
	Not permitted or not recommended
	Reference to device documentation
	Reference to page
	Reference to graphic
	Result of a step

1.3 Symbols at the device

Symbol	Meaning
	Reference to device documentation

1.4 Documentation

The following instructions complement these Operating Instructions and are available on the product pages on the internet:

- Brief Operating Instructions Liquiline CM44x, KA01159C
- Operating Instructions Memosens, BA01245C
  - Software description for Memosens inputs
  - Calibration of Memosens sensors
  - Sensor-specific diagnostics and troubleshooting
- Operating Instructions for HART communication, BA00486C
  - Onsite settings and installation instructions for HART
  - Description of HART driver
- Guidelines for communication via fieldbus and web server
  - HART, SD01187C
  - PROFIBUS, SD01188C
  - Modbus, SD01189C
  - Web server, SD01190C
  - EtherNet/IP, SD01293C

2 Basic safety instructions

2.1 Requirements for personnel

- Installation, commissioning, operation and maintenance of the measuring system may be carried out only by specially trained technical personnel.
- The technical personnel must be authorized by the plant operator to carry out the specified activities.
- The electrical connection may be performed only by an electrical technician.
- The technical personnel must have read and understood these Operating Instructions and must follow the instructions contained therein.
- Faults at the measuring point may only be rectified by authorized and specially trained personnel.

Repairs not described in the Operating Instructions provided must be carried out only directly at the manufacturer's site or by the service organization.

2.2 Designated use

2.2.1 Non-hazardous atmosphere

Liquiline CM44x is a multichannel controller for connecting digital sensors with Memosens technology in non-hazardous environments.

The device is designed for use in the following applications:
- Water and wastewater
- Power stations
- Chemical industry
- Other industrial applications

2.2.2 Hazardous environment in accordance with cCSAus Class I Div. 2

▶ Please pay attention to the control drawing and specified operating conditions in the appendix of this manual and follow the instructions.

2.2.3 Non-designated use

Use of the device for any purpose other than that described, poses a threat to the safety of people and of the entire measuring system and is therefore not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

2.3 Workplace safety

As the user, you are responsible for complying with the following safety conditions:
- Installation guidelines
- Local standards and regulations
- Regulations for explosion protection

Electromagnetic compatibility
- The product has been tested for electromagnetic compatibility in accordance with the applicable European standards for industrial applications.
- The electromagnetic compatibility indicated applies only to a product that has been connected in accordance with these Operating Instructions.

2.4 Operational safety

Before commissioning the entire measuring point:

1. Verify that all connections are correct.
2. Ensure that electrical cables and hose connections are undamaged.
3. Do not operate damaged products, and protect them against unintentional operation.
4. Label damaged products as defective.

During operation:

- If faults cannot be rectified:
  products must be taken out of service and protected against unintentional operation.

⚠ CAUTION

Cleaning not switched off during calibration or maintenance activities
Risk of injury due to medium or cleaning agent!

- If a cleaning system is connected, switch it off before removing a sensor from the medium.
- If you wish to check the cleaning function and have therefore not switched off the cleaning system, wear protective clothing, goggles and gloves or take other appropriate measures.

2.5 Product safety

2.5.1 State of the art

The product is designed to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. The relevant regulations and European standards have been observed.

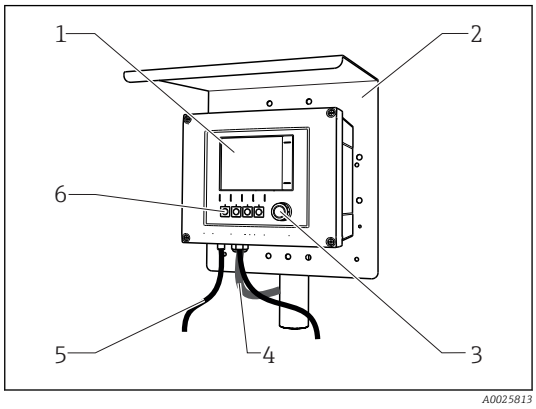
2.5.2 IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings.

IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

3 Device description

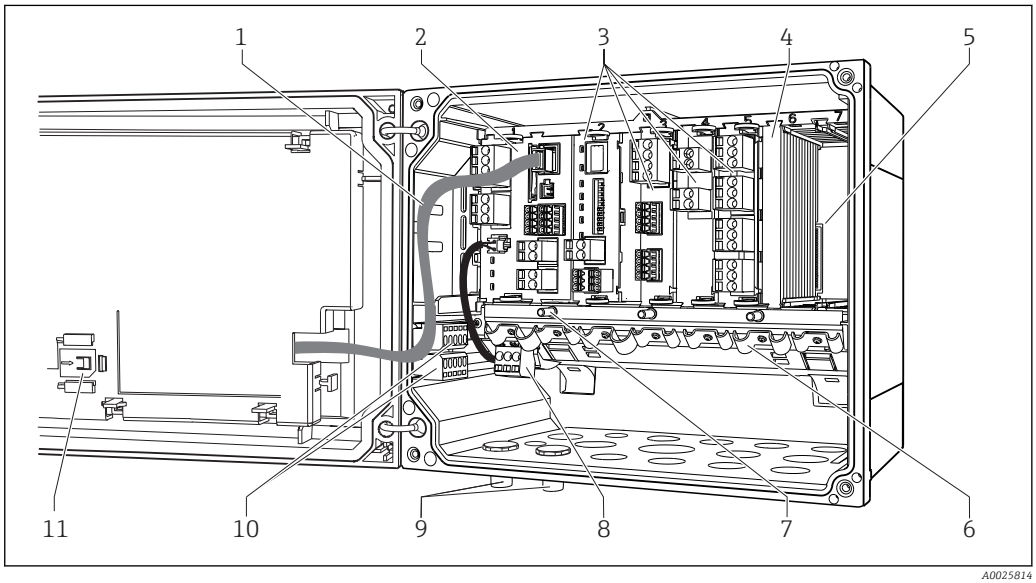
3.1 Housing closed



1 *Mounted on a post*

1 *Display*
2 *Weather protection cover (optional)*
3 *Navigator*
4 *Sensor cable or current output cable*
5 *Power supply cable*
6 *Soft keys, assignment depends on menu*

3.2 Housing open

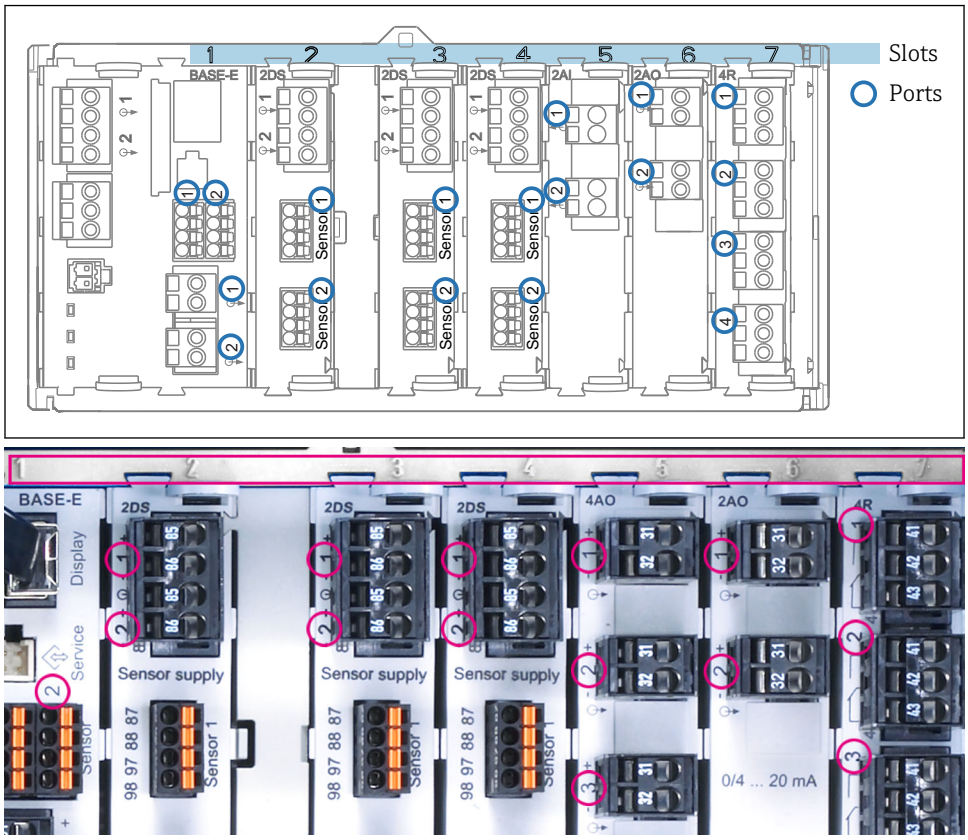


2 *Example of a four-channel device with an open display cover (without wiring)*

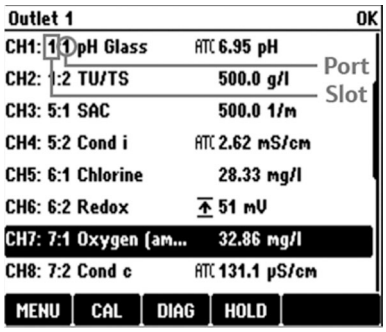
1	*Display cable*	7	*Threaded bolt for protective ground connection*
2	*Basic module*	8	*Extension power unit with internal cable*
3	*Extension modules (optional)*	9	*M12 connectors for sensor connection (optional)*
4	*Shock protection, dummy cover and end cover*	10	*Distributor terminals for user-defined use* [1)]
5	*Extension backplane*	11	*Storage slot for SD card*
6	*Cable mounting rail*		

1) Example: you want to loop the signal from the alarm relay to a siren and a lamp. The terminals on the alarm relay only accommodate one cable. Route the signal from the alarm relay to a terminal on the distributor block. The block's terminals are all interconnected. You therefore have 3 additional terminals on this block from where you can carry the signal forward to the consumer (siren, lamp etc.). The signal can be multiplied in this way.

3.3 Slot and port assignment



3 *Slot and port assignment of the hardware modules*



4 *Slot and port assignment on the display*

- Inputs are assigned to measuring channels in the ascending order of the slots and ports.
  Adjacent example:
  "CH1: 1:1 pH glass" means:
  Channel 1 (CH1) is slot 1 (basic module) : Port 1 (input 1), pH glass sensor
- Outputs and relays are named according to their function, e.g. "current output", and are displayed with the slot and port numbers in ascending order

3.4 Terminal diagram

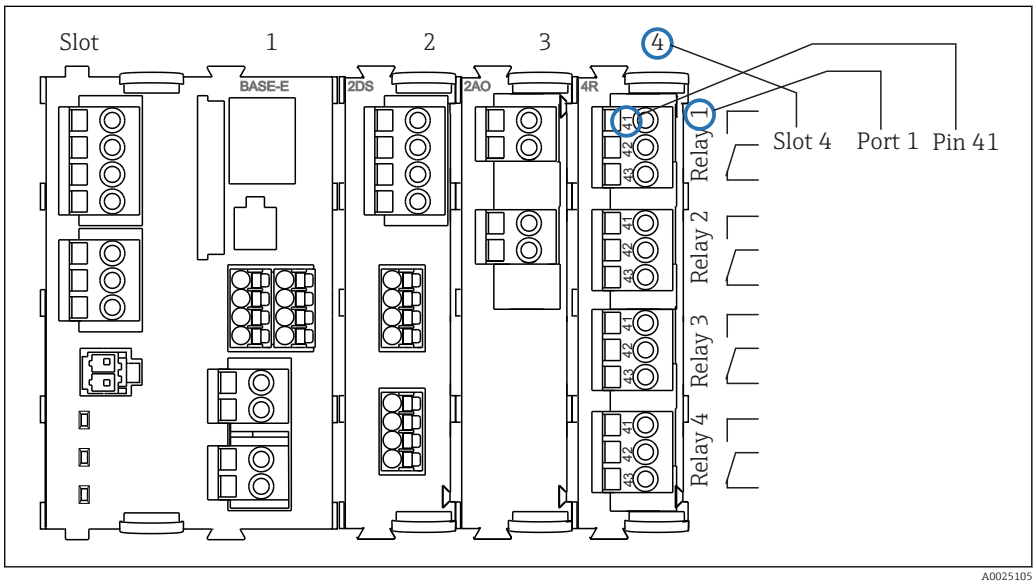
The unique terminal name is derived from:

Slot no. : Port no. : Terminal

Example, NO contact of a relay

Device with 4 inputs for digital sensors, 4 current outputs and 4 relays

- Base module BASE-E (contains 2 sensor inputs, 2 current outputs)
- 2DS module (2 sensor inputs)
- 2AO module (2 current outputs)
- 4R module (4 relays)



5 *Creating a terminal diagram using the example of the NO contact (terminal 41) of a relay*

4 Incoming acceptance and product identification

4.1 Incoming acceptance

1. Verify that the packaging is undamaged.
   ↳ Notify the supplier of any damage to the packaging.
   Keep the damaged packaging until the issue has been resolved.
2. Verify that the contents are undamaged.
   ↳ Notify the supplier of any damage to the delivery contents.
   Keep the damaged goods until the issue has been resolved.
3. Check that the delivery is complete and nothing is missing.
   ↳ Compare the shipping documents with your order.
4. Pack the product for storage and transportation in such a way that it is protected against impact and moisture.
   ↳ The original packaging offers the best protection.
   Make sure to comply with the permitted ambient conditions.

If you have any questions, please contact your supplier or your local Sales Center.

4.2 Product identification

4.2.1 Nameplate

The nameplate provides you with the following information on your device:
- Manufacturer identification
- Order code
- Extended order code
- Serial number
- Firmware version
- Ambient and process conditions
- Input and output values
- Activation codes
- Safety information and warnings

▶ Compare the information on the nameplate with the order.

4.2.2 Product identification

Product page

www.endress.com/cm442

www.endress.com/cm444

www.endress.com/cm448

Interpreting the order code

The order code and serial number of your product can be found in the following locations:
- On the nameplate
- In the delivery papers

Obtaining information on the product

1. Go to www.endress.com.

2. Call up the site search (magnifying glass).
3. Enter a valid serial number.
4. Search.
   ↳ The product structure is displayed in a popup window.
5. Click on the product image in the popup window.
   ↳ A new window (**Device Viewer**) opens. All of the information relating to your device is displayed in this window as well as the product documentation.

Manufacturer's address

Endress+Hauser Conducta GmbH+Co. KG
Dieselstraße 24
D-70839 Gerlingen

4.3 Scope of delivery

The scope of delivery comprises:
- 1 multichannel controller in the version ordered
- 1 mounting plate
- 1 wiring label (attached at the factory to the inside of the display cover)
- 1 printed copy of the Brief Operating Instructions in the language ordered

▶ If you have any queries:
Please contact your supplier or local sales center.

4.4 Certificates and approvals

4.4.1 CE mark

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EU directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.

4.4.2 EAC

The product has been certified according to guidelines TP TC 004/2011 and TP TC 020/2011 which apply in the European Economic Area (EEA). The EAC conformity mark is affixed to the product.

4.4.3 cCSAus

The device has been certified with regard to its electrical safety and for NI Class I Div. 2 cCSAus explosion-proof environments. It meets the requirements in accordance with:
- CLASS 2252 06 - Process Control Equipment
- CLASS 2252 86 - Process Control Equipment - Certified to US Standards
- CLASS 2258 03 - Process Control Equipment - Intrinsically Safe and Non-incendive Systems - For Hazardous Locations
- CLASS 2258 83 - Process Control Equipment - Intrinsically Safe and Non-incendive Systems - For Hazardous Locations - Certified to US Standards
- FM3600
- FM3611
- FM3810
- ANSI/ISA NEMA250
- IEC 60529
- CAN/CSA-C22.2 No. 0

- CAN/CSA C22.2 No. 94
- CSA Std. C22.2 No. 213
- CAN/CSA-C22.2 No. 61010-1
- CAN/CSA-C22.2 No. 60529
- UL/ANSI/ISA 61010-1
- ANSI - ISA 12 12 01

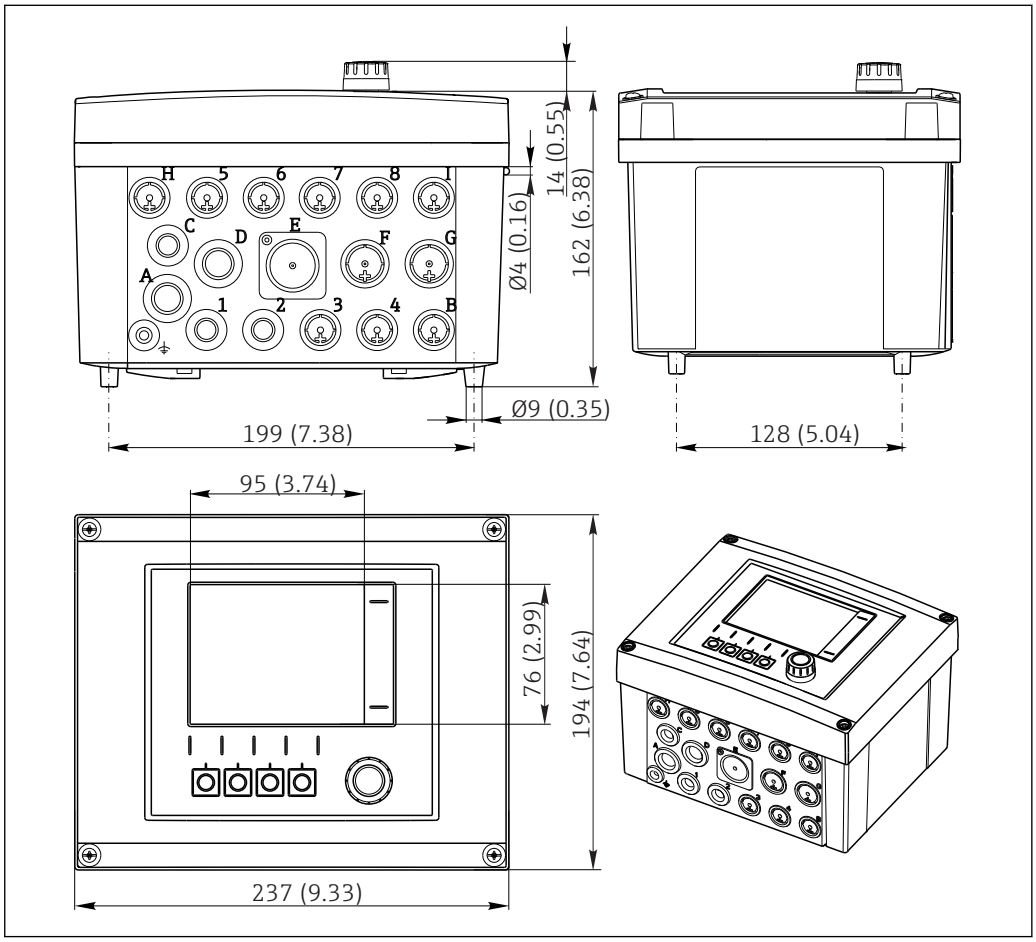
4.4.4 MCERTS

CM442 only
The device has been assessed by Sira Certification Service and complies with "MCERTS Performance Standards for Continuous Water Monitoring Equipment, Part 2: online analysers, Version 3.1, dated August 2010"; Certificate No.: Sira MC140246/01.

5 Installation

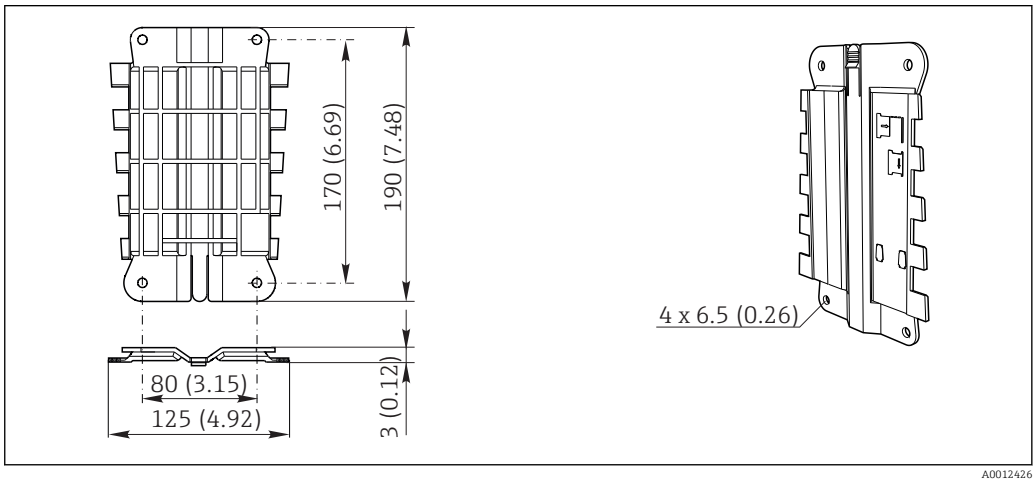
5.1 Installation conditions

5.1.1 Dimensions



6 *Dimensions of field housing in mm (inch)*

5.1.2 Mounting plate



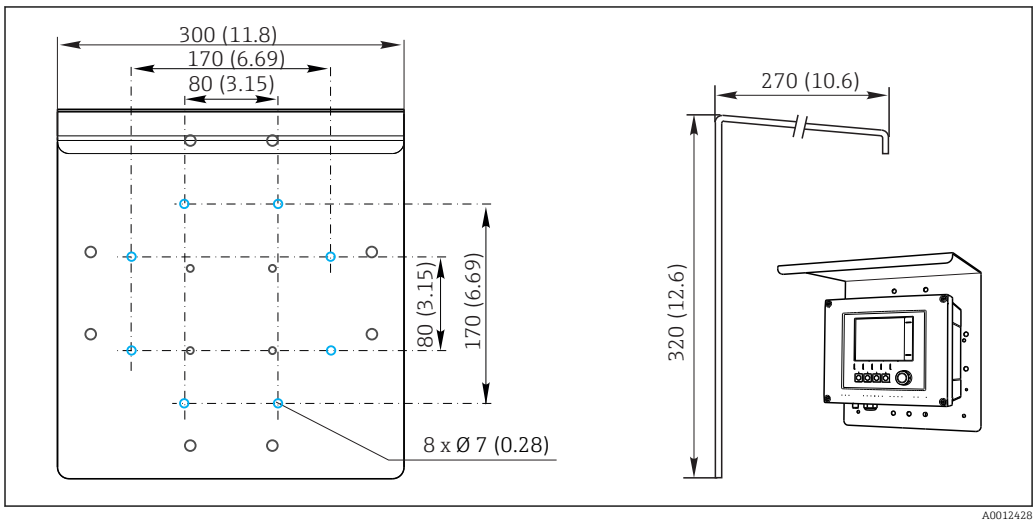
7 *Mounting plate, dimensions in mm (in)*

5.1.3 Protective cover

NOTICE

Effect of climatic conditions (rain, snow, direct sunlight etc.)
Impaired operation to complete transmitter failure are possible!

- Always use the weather protection cover (accessory) when installing the device outdoors.

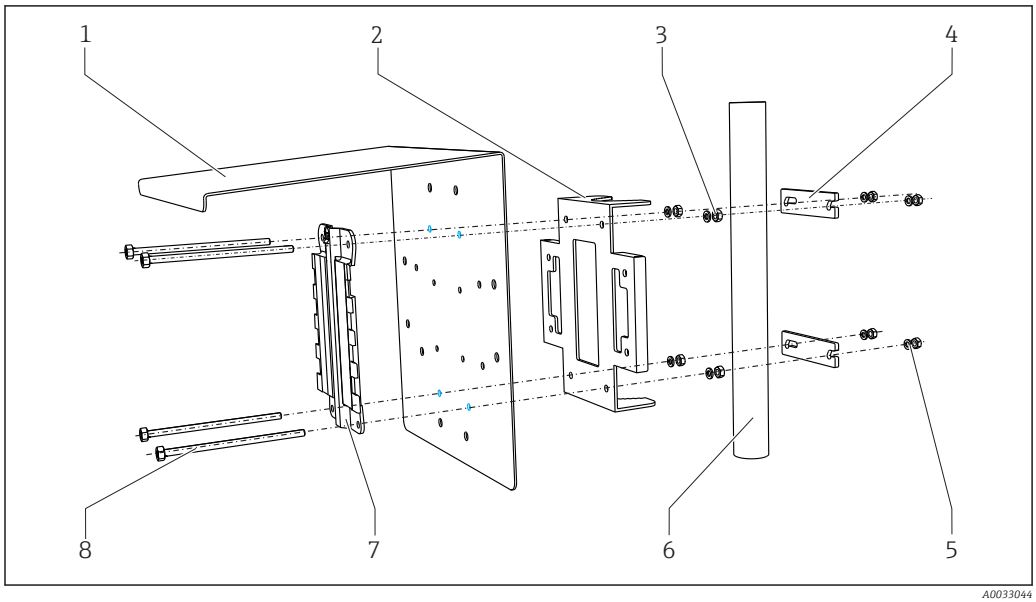


8 *Dimensions in mm (in)*

5.2 Mounting the measuring device

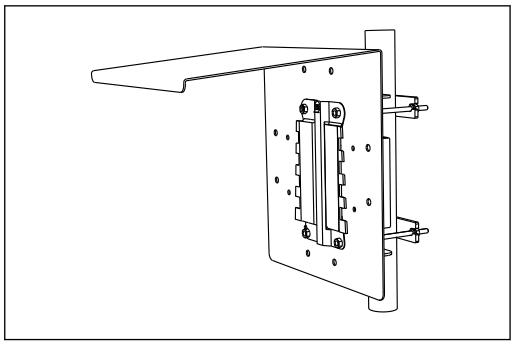
5.2.1 Post mounting

You require the post mounting kit (optional) to mount the unit on a pipe, post or railing (square or circular, clamping range 20 to 61 mm (0.79 to 2.40")).

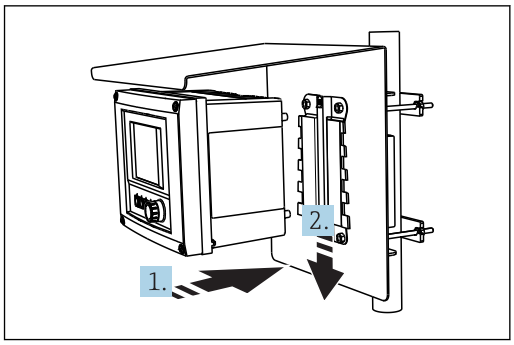


9 *Post mounting*

1	*Weather protection cover (optional)*	5	*Spring washers and nuts (post mounting kit)*
2	*Post mounting plate (post mounting kit)*	6	*Pipe or railing (circular/square)*
3	*Spring washers and nuts (post mounting kit)*	7	*Mounting plate*
4	*Pipe clamps (post mounting kit)*	8	*Threaded rods (post mounting kit)*



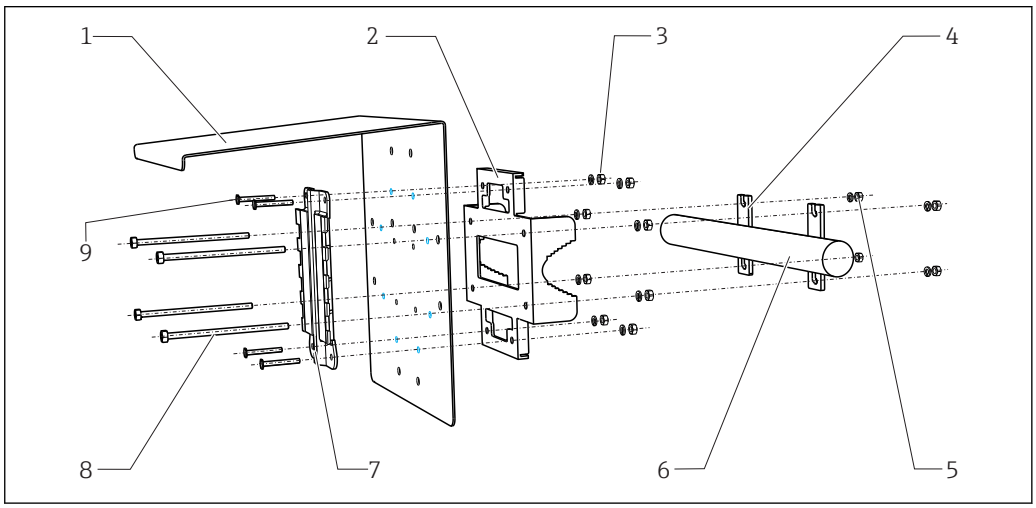
10 *Post mounting*



11 *Attach the device and click it into place*

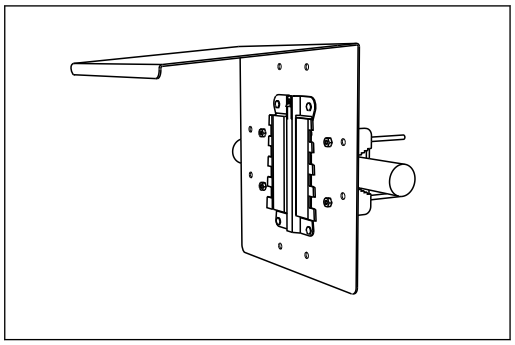
1. Place the device on the mounting plate.
2. Slide the device downwards in the guide on the mounting rail until it clicks into place.

5.2.2 Rail mounting

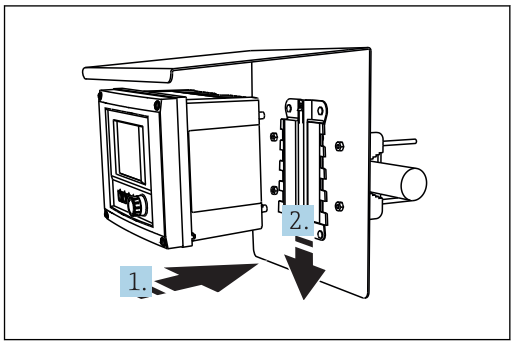


12 *Rail mounting*

1	*Weather protection cover (optional)*	6	*Pipe or railing (circular/square)*
2	*Post mounting plate (post mounting kit)*	7	*Mounting plate*
3	*Spring washers and nuts (post mounting kit)*	8	*Threaded rods (post mounting kit)*
4	*Pipe clamps (post mounting kit)*	9	*Screws (post mounting kit)*
5	*Spring washers and nuts (post mounting kit)*		



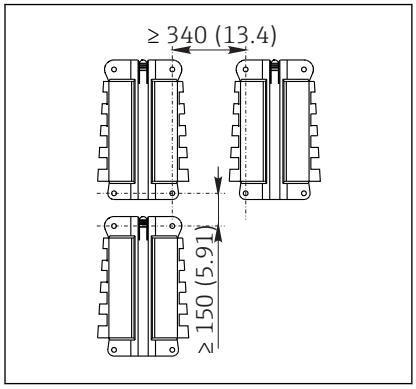
13 *Rail mounting*



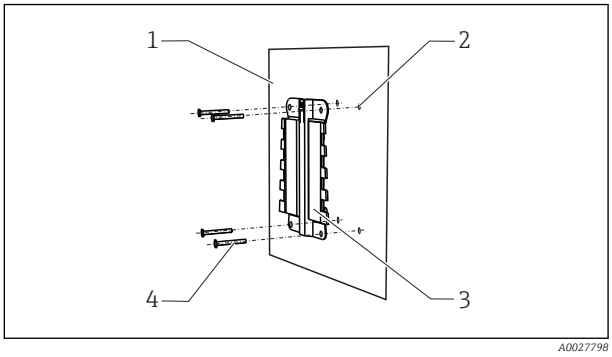
14 *Attach the device and click it into place*

1. Place the device on the mounting plate.
2. Slide the device downwards in the guide on the mounting rail until it clicks into place.

5.2.3 Wall mounting



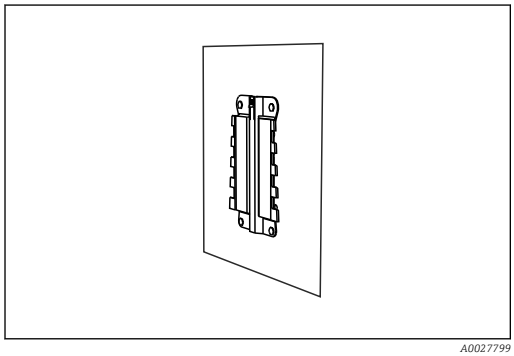
15 *Installation clearance in mm (in)*



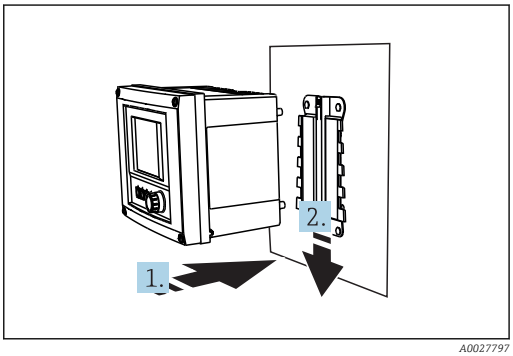
16 *Wall mounting*

1 *Wall*
2 *4 drill holes* [1]
3 *Mounting plate*
4 *Screws Ø 6 mm (not part of scope of supply)*

[1] *The size of the drill holes depends on the wall plugs used. The wall plugs and screws must be provided by the customer.*



17 *Wall mounting*



18 *Attach the device and click it into place*

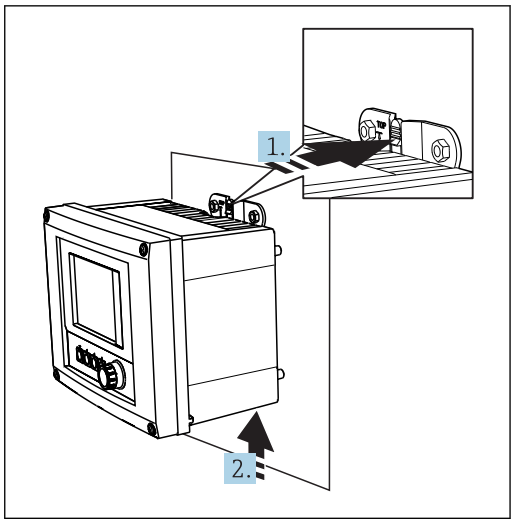
1. Place the device on the mounting plate.
2. Slide the device downwards in the guide on the mounting rail until it clicks into place.

5.2.4 Disassembly (for conversion, cleaning etc.)

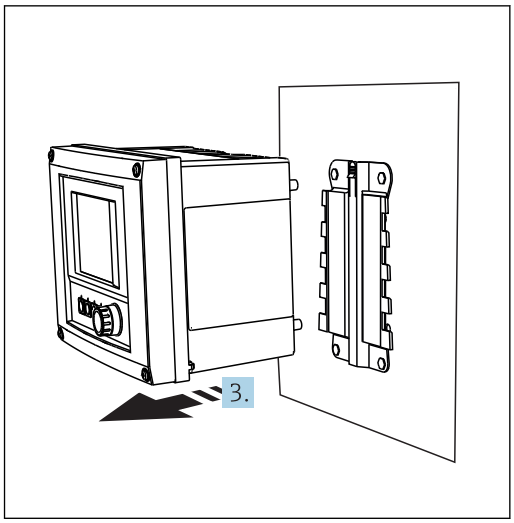
NOTICE

The device can be damaged if dropped

▶ When pushing the housing out of the holder, secure the housing to prevent it from falling. If possible, ask a second person to help you.



19 *Disassembling*



20 *Disassembling*

1. Hold down the latch.
2. Push up the device to remove it from the holder.
3. Remove the device towards the front.

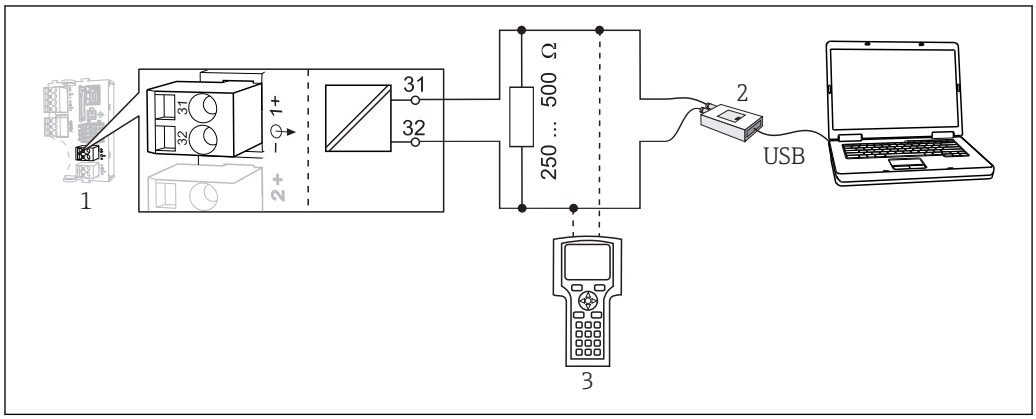
5.3 Post-installation check

1. After installation, check the transmitter for damage.
2. Check whether the transmitter is protected against precipitation and direct sunlight (e.g. by the weather protection cover).

6 Electrical connection

6.1 Connection conditions

6.1.1 Via HART (e.g. using HART modem and FieldCare)

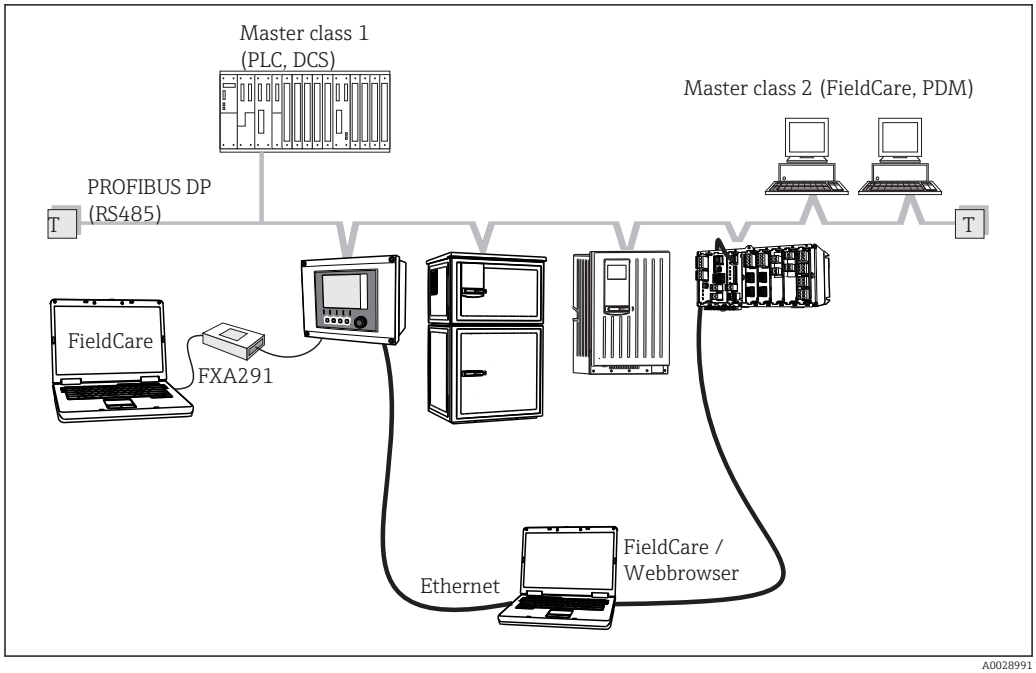


21 HART using modem

1 Device module Base L, H or E: current output 1 with HART
2 HART modem for connection to PC, e.g. Commubox FXA191 (RS232) or FXA195 [1] (USB)
3 HART handheld terminal

[1] Switch position "on" (substitutes the resistor)

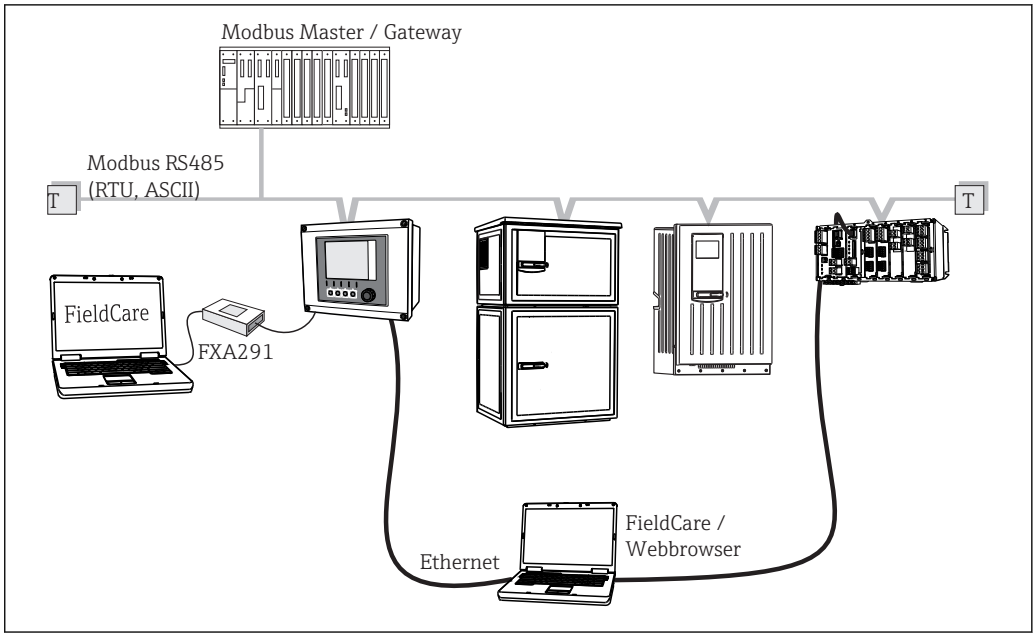
6.1.2 Via PROFIBUS DP



22 PROFIBUS DP

T Terminating resistor

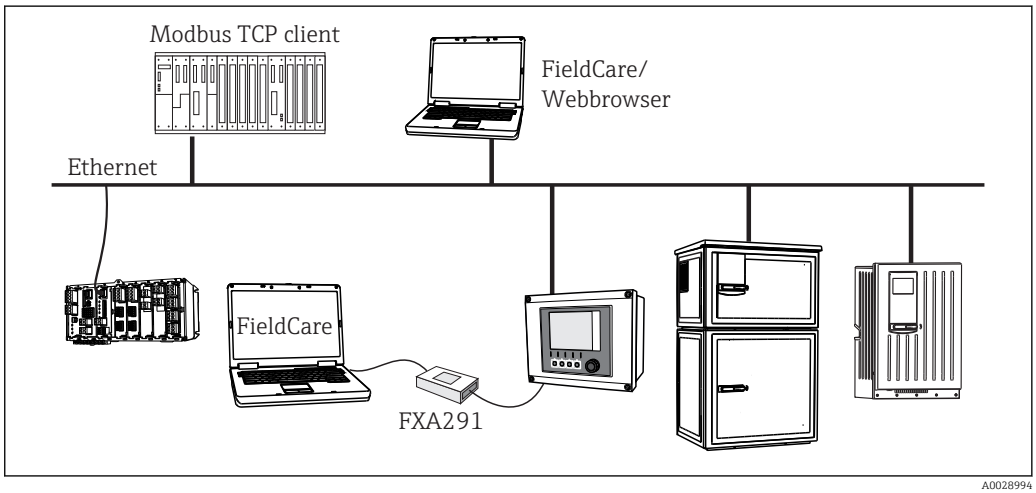
6.1.3 Via Modbus RS485



23 *Modbus RS485*

T Terminating resistor

6.1.4 Via Ethernet/Web server/Modbus TCP/EtherNet/IP



24 *Modbus TCP and/or EtherNet/IP*

6.2 Connecting the measuring device

WARNING

Device is live!

Incorrect connection may result in injury or death!

- The electrical connection may be performed only by an electrical technician.
- The electrical technician must have read and understood these Operating Instructions and must follow the instructions contained therein.
- **Prior** to commencing connection work, ensure that no voltage is present on any cable.

NOTICE

The device does not have a power switch!

- Provide a protected circuit breaker in the vicinity of the device at the place of installation.
- The circuit breaker must be a switch or power switch, and must be labeled as the circuit breaker for the device.
- At the supply point, the power supply must be isolated from dangerous live cables by double or reinforced insulation in the case of devices with a 24 V supply voltage.

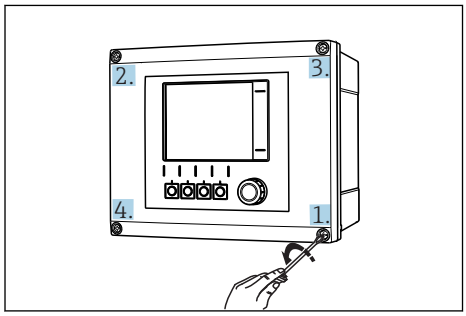
6.2.1 Open the housing

NOTICE

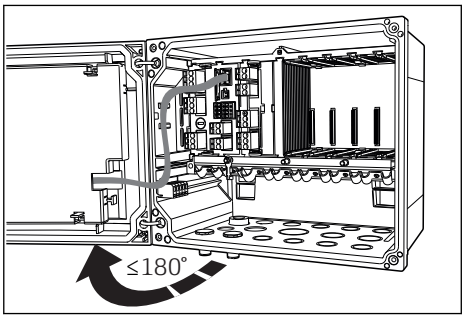
Pointed or sharp tools

If unsuitable tools are used, they can scratch the housing or damage the seal, and thus have a negative impact on the leak-tightness of the housing!

- Do not use any sharp or pointed objects, such as a knife, to open the housing.
- Only use a suitable Phillips screwdriver.



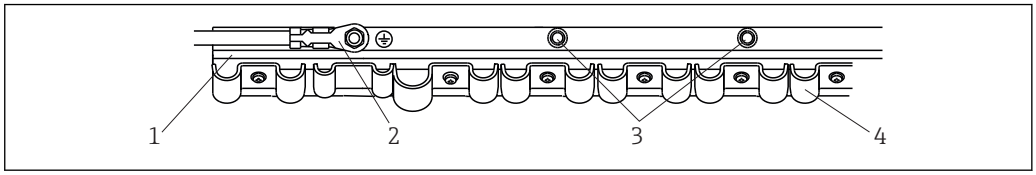
25 *Releasing housing screws in a diagonally opposite sequence with Phillips screwdriver*



26 *Opening display cover, max. opening angle 180 ° (depends on installation position)*

1. Release the housing screws on a step-by-step basis. Start with any screw of your choice. Then release the screw diagonally opposite this screw etc.
2. To close the housing: tighten the screws in a similar step-by-step, diagonally opposite sequence.

6.2.2 Cable mounting rail



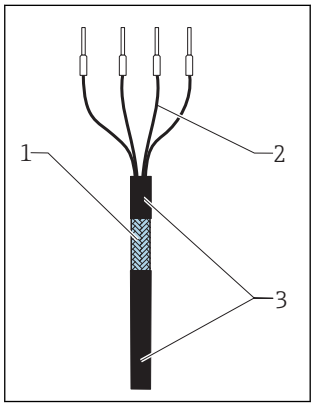
27 Cable mounting rail and associated function

1 Cable mounting rail
2 Threaded bolt (protective ground connection, central grounding point)
3 Additional threaded bolts for ground connections
4 Cable clamps (fixing and grounding the sensor cables)

6.2.3 Connecting the cable shield

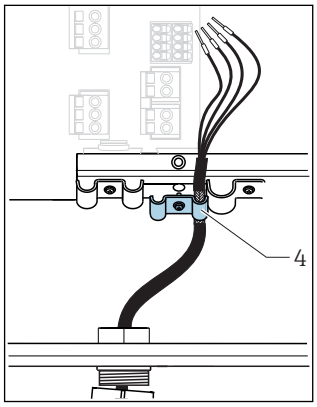
If possible, only use terminated original cables. The sensor, fieldbus and ethernet cables must be shielded.

Cable sample (does not necessarily correspond to the original cable supplied)



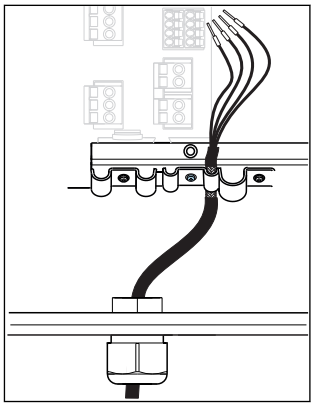
28 Terminated cable

1 Outer shield (exposed)
2 Cable cores with ferrules
3 Cable sheath (insulation)



29 Inserting the cable

4 Grounding clip



30 Tighten screw (2 Nm)

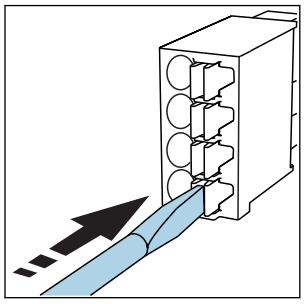
The cable shield is grounded using the grounding clamp. [1)]

1) Please note the instructions in the "Ensuring the degree of protection" section. (→ 39)

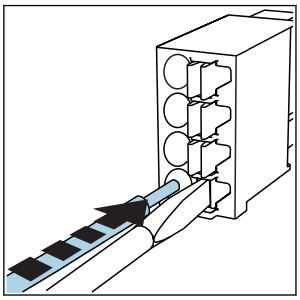
1. Release a suitable cable gland on the bottom of the housing and remove the dummy plug.
2. Making sure the gland is facing the right direction, thread the gland onto the cable end and pull the cable through the entry and into the housing.
3. Route the cable in the housing in such a way that the **exposed** cable shield fits into one of the cable clamps and the cable cores can be easily routed as far as the connection plug on the electronics module.
4. Open the cable clamp and clamp the cable in place. Then tighten the screw of the cable clamp again.
5. Connect cable cores as per the wiring diagram.
6. Tighten the cable gland from outside.

6.2.4 Cable terminals

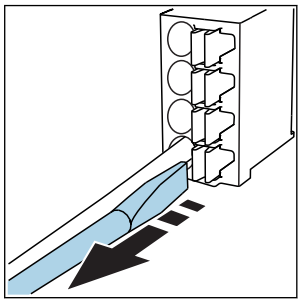
Plug-in terminals for Memosens and PROFIBUS/RS485 connections



▶ Press the screwdriver against the clip (opens the terminal).



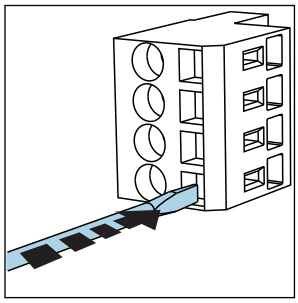
▶ Insert the cable until the limit stop.



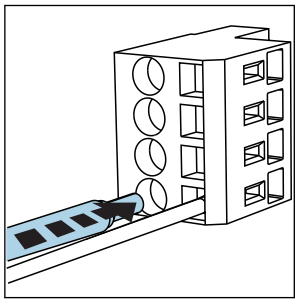
▶ Remove the screwdriver (closes the terminal).

After connection, make sure that every cable end is securely in place. Terminated cable ends, in particular, tend to come loose easily if they have not been correctly inserted as far as the limit stop.

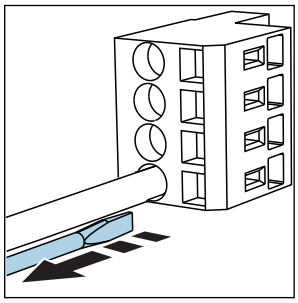
All other plug-in terminals



▶ Press the screwdriver against the clip (opens the terminal).

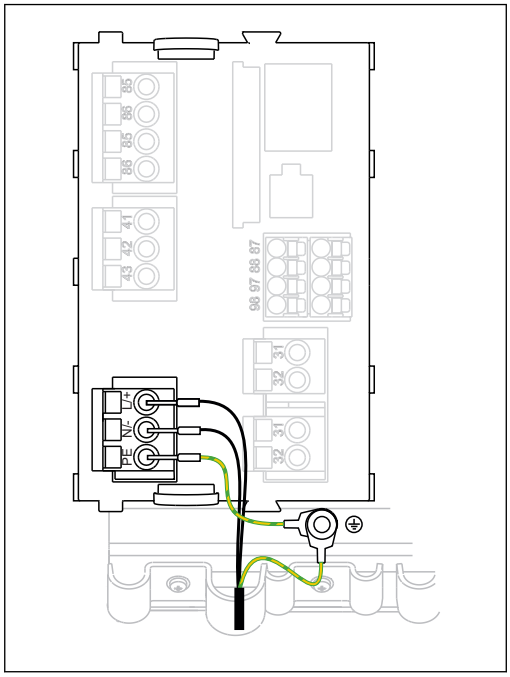


▶ Insert the cable until the limit stop.

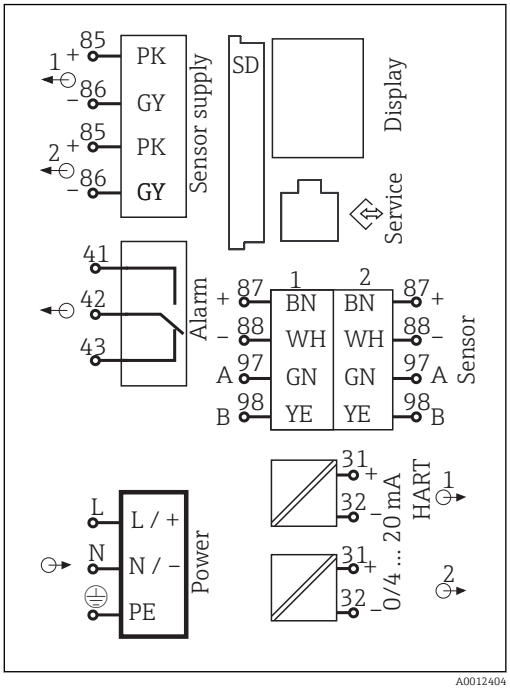


▶ Remove the screwdriver (closes the terminal).

6.2.5 Connecting the supply voltage for the CM442



31 *Connecting power supply on the BASE-H or -L*

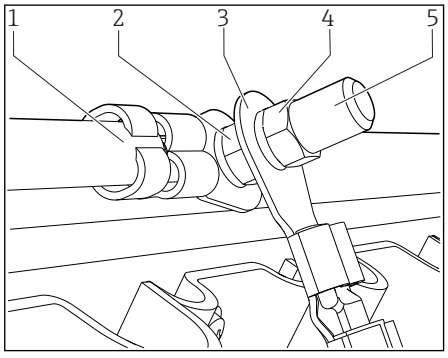


32 *Overall wiring diagram for BASE-H or -L*

H Power unit 100 to 230 VAC
L Power unit 24 VAC or 24 VDC

Connecting the supply voltage

1. Route the power supply cable into the housing through the suitable cable entry.
2. Step 2 applies **only to the 100 to 230 V AC power unit**.
   Connect the protective ground of the power unit to the threaded bolt specially provided on the cable mounting rail.
3. Protective ground or grounding provided by customer **(absolutely essential for 24 V power unit, additionally recommended for 100 to 230 V AC power unit)**: Provide a ground cable (min. 0.75 mm² (corresponding to 18 AWG))[1]! Guide the ground cable also through the cable entry and connect it to the threaded bolt on the cable mounting rail.
4. Connect the cable cores L and N (100 to 230 V AC) or + and - (24 V DC) to the plug-in terminals on the power unit in accordance with the wiring diagram.



1 Protective ground of power unit
2 Serrated washer and nut
3 Protective ground / ground cable, provided by customer (min. 0.75 mm² (≙ 18 AWG)) 1)
4 Serrated washer and nut
5 Mounting bolts

33 *Protective ground or grounding connection*

1) For a fuse with a rating of 10 A. For a fuse with a rating of 16 A, the protective ground / ground cable must have a cross-sectional area of at least 1.5 mm² (≙ 14 AWG).

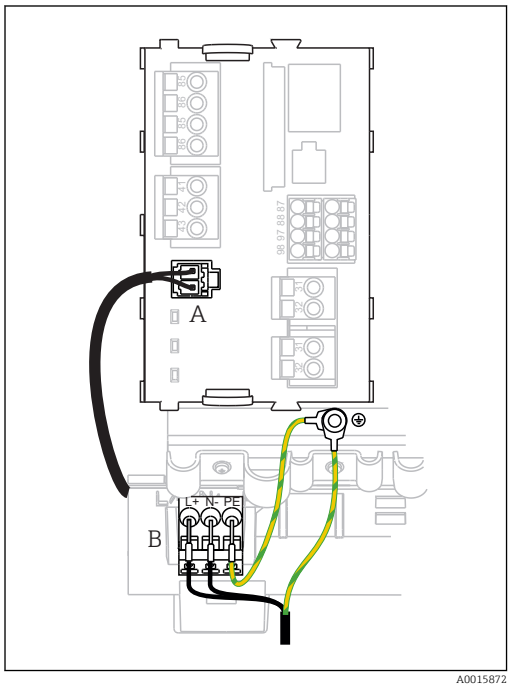
NOTICE

Protective ground/ground cable with end sleeve or open cable lug

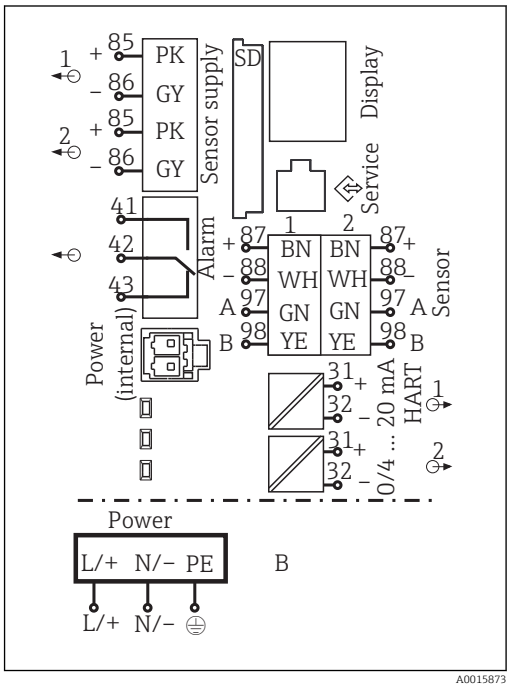
The cable can become loose. Loss of the protective function!

- ▶ To connect the protective ground or ground cable to the threaded bolt, only use a cable with a closed cable lug as per DIN 46211, 46225, form A.
- ▶ Never connect the protective ground or ground cable to the threaded bolt with an end sleeve or an open cable lug!

6.2.6 Connecting the supply voltage for the CM444 and the CM448



34 *Power supply connection on the BASE-E*

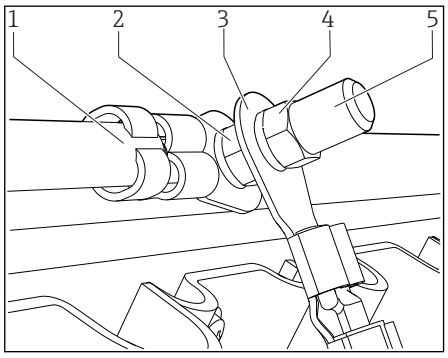


35 *Overall wiring diagram BASE-E and extension power unit (B)*

A Internal power supply cable
B Extension power unit

Connecting the supply voltage

1. Route the power supply cable into the housing through the suitable cable entry.
2. Step 2 applies **only to the 100 to 230 V AC power unit**.
   Connect the protective ground of the power unit to the threaded bolt specially provided on the cable mounting rail.
3. Protective ground or grounding provided by customer **(absolutely essential for 24 V power unit, additionally recommended for 100 to 230 V AC power unit)**: Provide a ground cable (min. 0.75 mm^2 (corresponding to 18 AWG))[1]! Guide the ground cable also through the cable entry and connect it to the threaded bolt on the cable mounting rail.
4. Connect the cable cores L and N (100 to 230 V AC) or + and - (24 V DC) to the plug-in terminals on the power unit in accordance with the wiring diagram.



1 *Protective ground of power unit*
2 *Serrated washer and nut*
3 *Protective ground / ground cable, provided by customer (min. 0.75 mm² (≙ 18 AWG))* [1)]
4 *Serrated washer and nut*
5 *Mounting bolts*

36 *Protective ground or grounding connection*

1) For a fuse with a rating of 10 A. For a fuse with a rating of 16 A, the protective ground / ground cable must have a cross-sectional area of at least 1.5 mm² (≙ 14 AWG).

NOTICE

Protective ground/ground cable with end sleeve or open cable lug

The cable can become loose. Loss of the protective function!

- To connect the protective ground or ground cable to the threaded bolt, only use a cable with a closed cable lug as per DIN 46211, 46225, form A.
- Never connect the protective ground or ground cable to the threaded bolt with an end sleeve or an open cable lug!

6.3 Connecting the sensors

6.3.1 Sensor types with Memosens protocol

Sensors with Memosens protocol

Sensor types	Sensor cable	Sensors
Digital sensors **without** additional internal power supply	With plug-in connection and inductive signal transmission	▪ pH sensors ▪ ORP sensors ▪ Combined sensors ▪ Oxygen sensors (amperometric and optical) ▪ Conductivity sensors with conductive measurement of conductivity ▪ Chlorine sensors (disinfection)
	Fixed cable	Conductivity sensors with inductive measurement of conductivity
Digital sensors with additional internal power supply	Fixed cable	▪ Turbidity sensors ▪ Sensors for interface measurement ▪ Sensors for measuring the spectral absorption coefficient (SAC) ▪ Nitrate sensors ▪ Optical oxygen sensors ▪ Ion-sensitive sensors

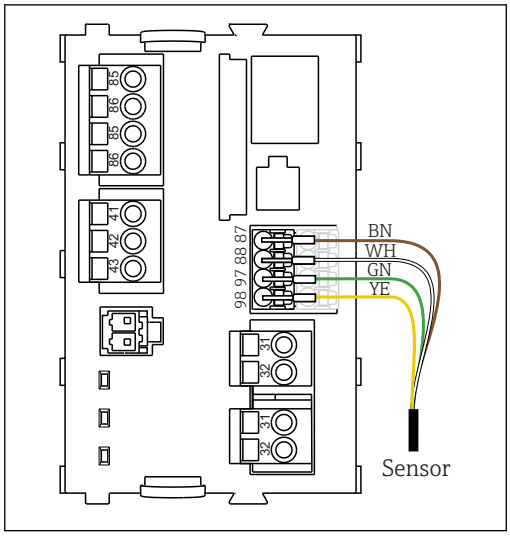
The following rule applies if connecting CUS71D sensors:
- CM442
  - Only one CUS71D is possible; an additional sensor is not permitted.
  - The second sensor input may also not be used for another type of sensor.
- CM444
  No restrictions. All the sensor inputs can be used as required.
- CM448
  - If a CUS71D is connected, the number of sensor inputs that can be used is limited to a maximum of 4.
  - Of these, all 4 inputs can be used for CUS71D sensors.
  - Every combination of CUS71D and other sensors is possible, provided that the total number of connected sensors does not exceed 4.

6.3.2 Connecting the sensors

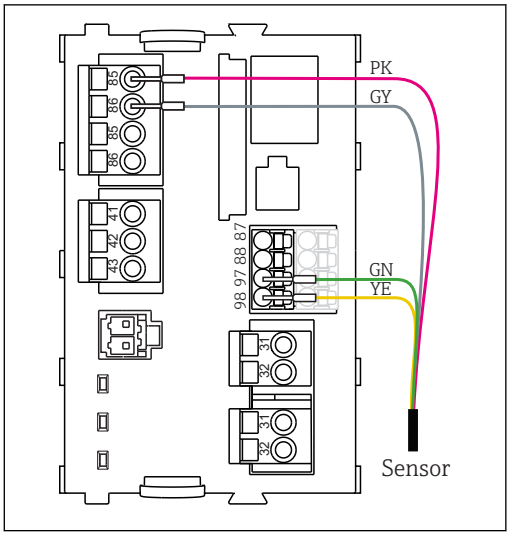
Types of connection
- Direct connection of sensor cable to terminal connector of the sensor module 2DS or of base module L, H or E (→ 37 ff.)
- Optional: Sensor cable plug connected to the M12 sensor socket on the underside of the device
  With this type of connection, the device is already wired at the factory (→ 40).

1. Sensor cable connected directly
   Connect the sensor cable to the Memosens terminal connector of the sensor module 2DS or of base module L, H or E.
2. When connecting via M12 connector
   Connect the sensor connector to an M12 sensor socket which has been previously installed or is supplied on delivery.

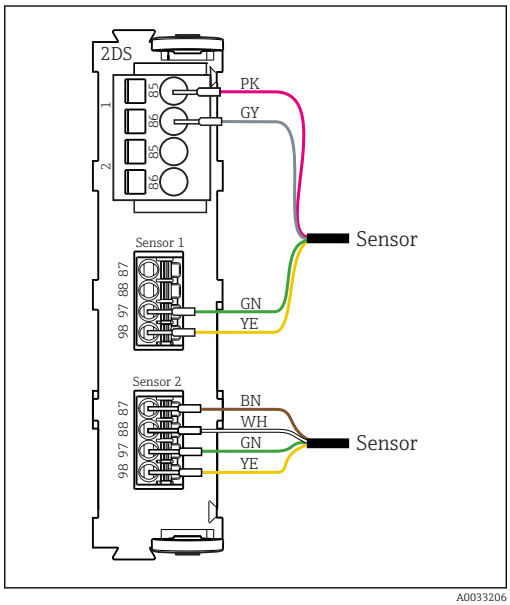
Sensor cable connected directly



37 *sensors without additional supply voltage*

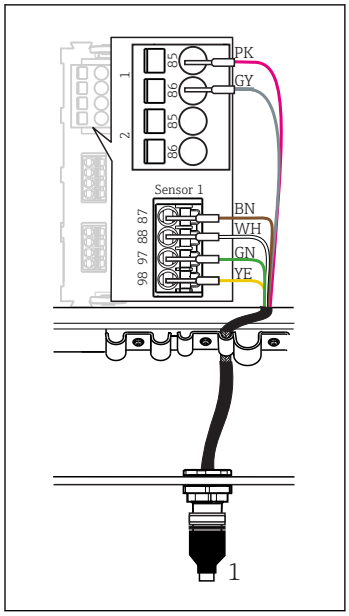


38 *sensors with additional supply voltage*



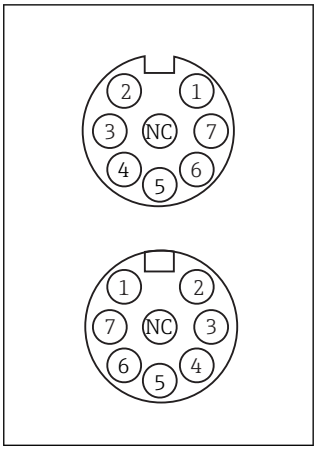
39 *sensors with and without additional supply voltage at sensor module 2DS*

connection via M12 plug-in connection



40 M12 plug-in connection (e.g. at sensor module)

1 Sensor cable with M12 connector



41 M12 assignment Top: socket Bottom: connector (top view in each case)

1 PK (24 V)
2 GY (Ground 24 V)
3 BN (3 V)
4 WH (Ground 3 V)
5 GN (Memosens)
6 YE (Memosens)
7, NC Not connected

Device versions with a pre-installed M12 socket are ready-wired upon delivery.

Version without a pre-installed M12 socket

1. Insert an M12 socket (accessory) into a suitable opening in the base of the housing.
2. Connect the cable to a Memosens terminal as per the wiring diagram.

Connecting the sensor

- Plug the connector of the sensor cable (→ 40item 1) directly into the M12 socket.

Please note the following:
- The internal device wiring is always the same regardless of what kind of sensor you connect to the M12 socket (plug&play).
- The signal or power supply cables are assigned in the sensor head in such a way that the PK and GY power supply cables are either used (e.g. optical sensors) or not (e.g. pH or ORP sensors).

6.4 Connecting additional inputs, outputs or relays

WARNING

Module not covered

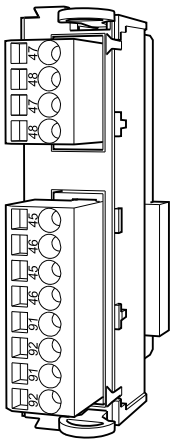
No shock protection. Danger of electric shock!

- Change or extend the hardware: always fill the slots from left to right. Do not leave any gaps.
- If all of the slots are not occupied: always insert a dummy cover or end cover in the slot to the right of the last module(→ 2, 9). This ensures that the unit is shock-protected.
- Always ensure shock protection is guaranteed particularly in the case of relay modules (2R, 4R, AOR).

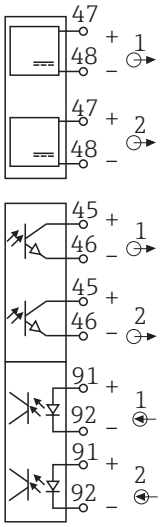
- If additional shields are required, connect them with PE centrally in the control cabinet via terminal blocks supplied by the customer.

6.4.1 Digital inputs and outputs

DIO module



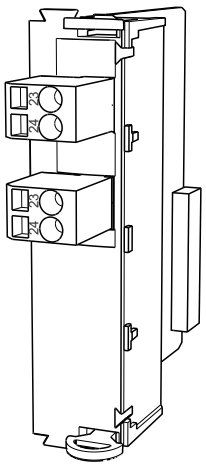
42 Module



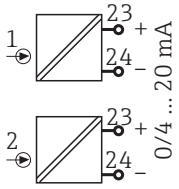
43 Wiring diagram

6.4.2 Current inputs

Module 2AI

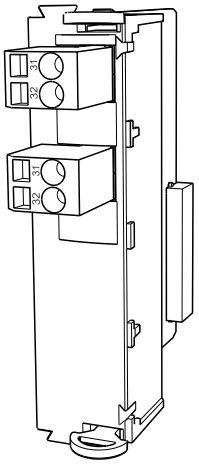
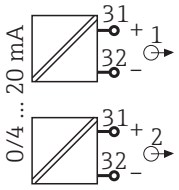
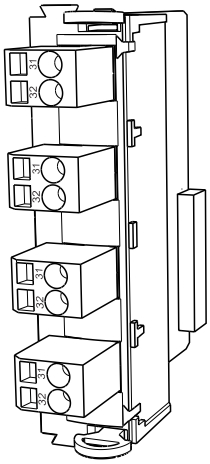
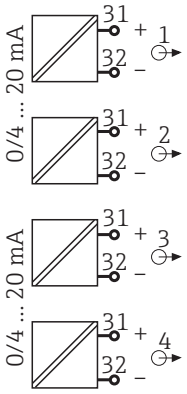


44 Module

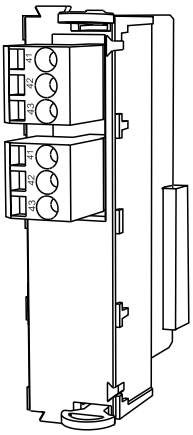
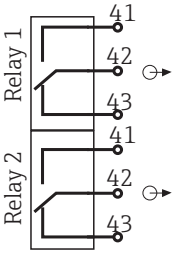
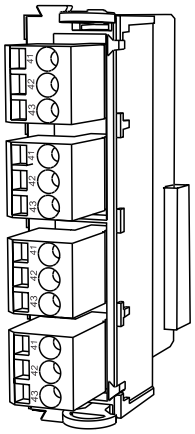
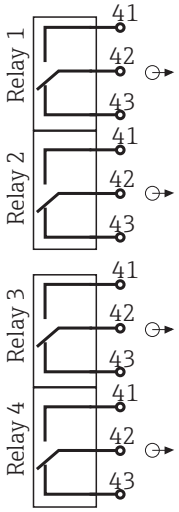


45 Wiring diagram

6.4.3 Current outputs

2AO		4AO	
			
46 Module	47 Wiring diagram	48 Module	49 Wiring diagram

6.4.4 Relay

Module 2R		Module 4R	
			
50 Module	51 Wiring diagram	52 Module	53 Wiring diagram

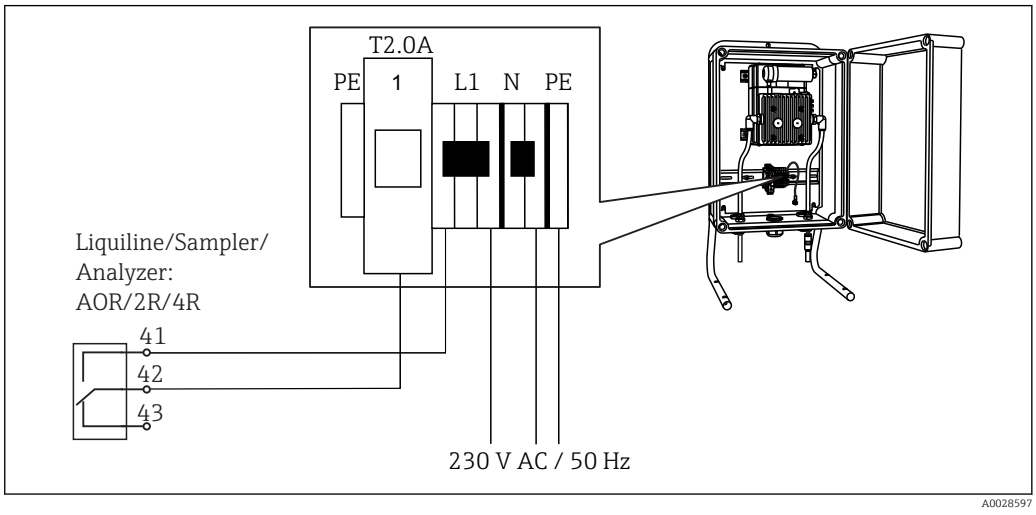
Example: Connecting the cleaning unit 71072583 for CAS40D

NOTICE

Power consumption too high for the Liquiline alarm relay!

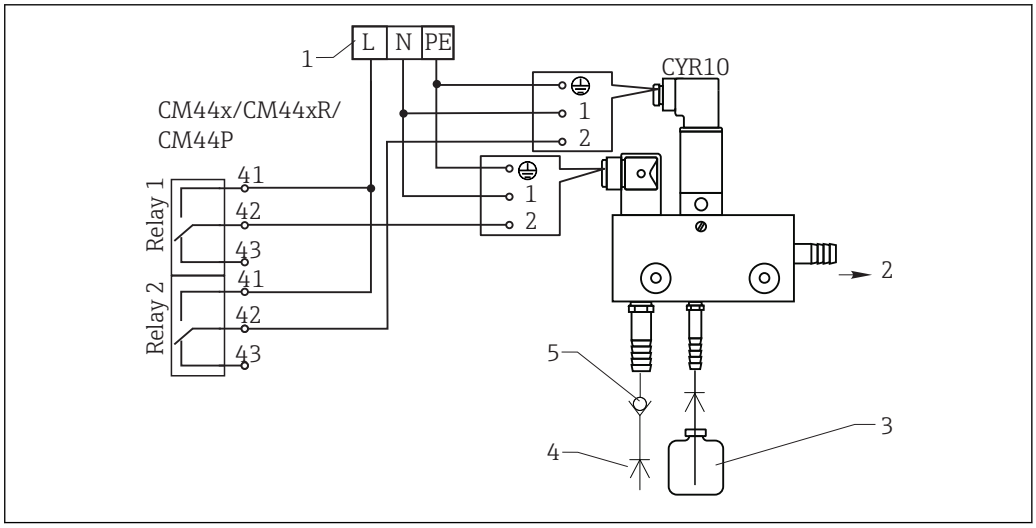
Can cause irreparable damage to the base module

- Connect the cleaning unit only to terminals of an additional module (AOR, 2R or 4R), **not** to the alarm relay of the base module.



54 *Connecting the cleaning unit for CAS40D*

Example: Connecting the Chemoclean CYR10 injector cleaning unit

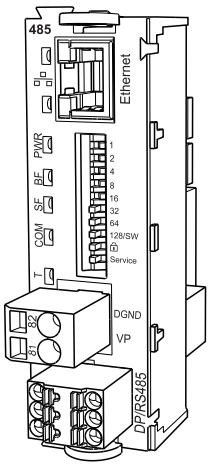


55 *Connecting the CYR10 injector cleaning unit*

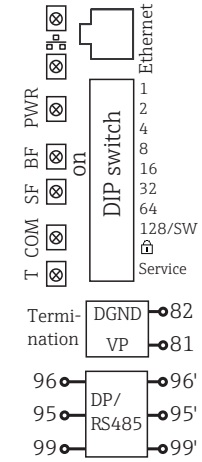
1 *External power supply*
2 *Cleaner to spray head*
3 *Container with cleaner*
4 *Motive water 2 to 12 bar (30 to 180 psi)*
5 *Backflow valve (to be provided by the customer)*

6.5 Connecting digital communication

6.5.1 Module 485



56 *Module*



57 *Wiring diagram*

Terminal	PROFIBUS DP	Modbus RS485
95	A	B
96	B	A
99	Not connected	C
82	DGND	DGND
81	VP	VP

LEDs on front of module

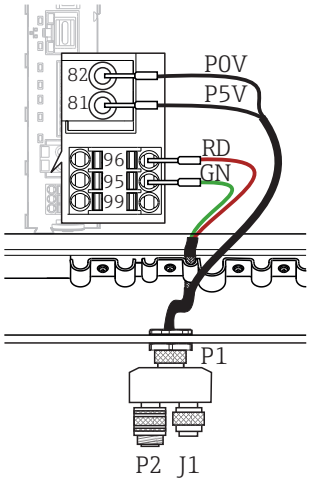
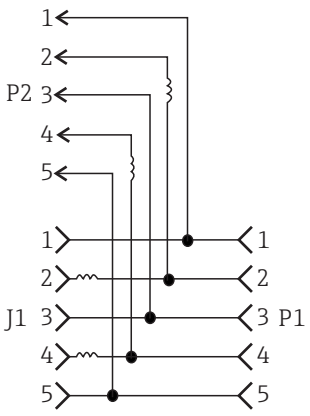
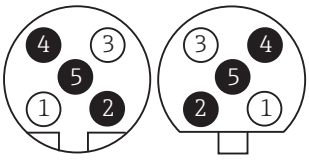
LED	Designation	Color	Description
RJ45	LNK/ACT	GN	▪ Off = Connection is not active ▪ On = Connection is active ▪ Flashing = Data transmission
RJ45	10/100	YE	▪ Off = Transmission rate 10 MBit/s ▪ On = Transmission rate 100 MBit/s
PWR	Power	GN	Supply voltage is applied and module is initialized
BF	Bus failure	RD	Bus failure
SF	System failure	RD	Device error
COM	Communication	YE	Modbus message sent or received
T	Bus termination	YE	▪ Off = No termination ▪ On = Termination is used

DIP switches on front of module

DIP	Factory setting	Assignment
1-128	ON	Bus address (→ "Commissioning/communication")
🔓	OFF	Write protection: "ON" = configuration not possible via the bus, only via local operation
Service	OFF	If the switch is set to **"ON"** , the user settings for Ethernet addressing are saved and connection settings programmed into the device at the factory are activated: IP address=192.168.1.212, Subnet mask=255.255.255.0, Gateway=0.0.0.0, DHCP=Off. If the switch is set to **"OFF"** , the saved user settings are reactivated.

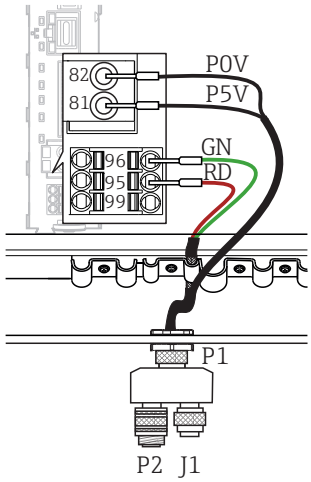
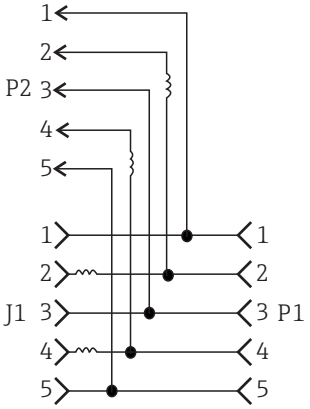
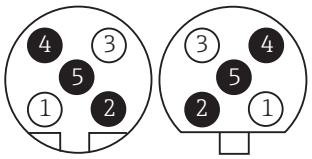
6.5.2 Connection via M12 connector

PROFIBUS DP

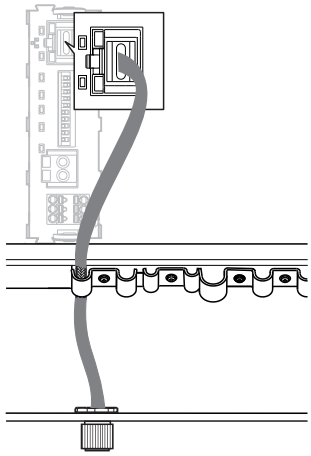
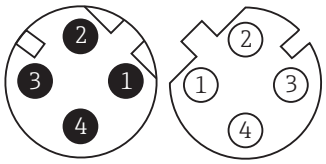
M12 Y-section	Wiring in M12 Y section	Pin assignment in connector and socket
		
58 *M12 connection*	59 *Wiring*	60 *Connector (left) and socket (right)* *1 P5V, 5 V power supply for external terminating resistor* *2 A* *3 P0V, reference potential for P5V* *4 B* *5 n.c., not connected* * *Shielding*

When using the M12 Y-section, the maximum data transfer rate is limited to 1.5 MBit/s. For direct wiring, the maximum data transfer rate is 12 MBit/s.

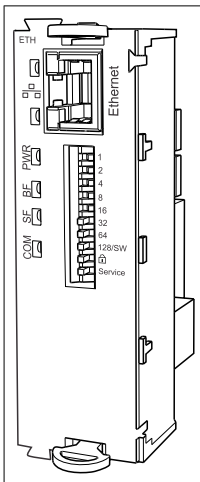
Modbus RS485

M12 Y-section	Wiring in M12 Y section	Pin assignment in connector and socket
 61 M12 connection	 62 Wiring	 63 Connector (left) and socket (right) 1 P5V, 5 V power supply for external terminating resistor 2 A 3 P0V, reference potential for P5V 4 B 5 n.c., not connected * Shielding

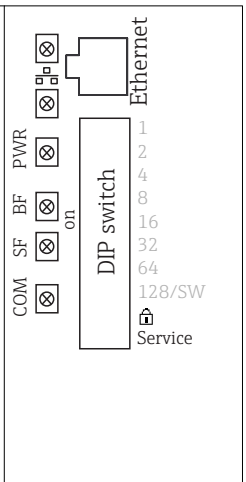
Ethernet, Web server

Internal connection	Pin assignment in connector and socket
 64 Ethernet socket	 65 Connector (left) and socket (right) 1 Tx+ 2 Rx+ 3 Tx- 4 Rx- Shielding (thread)

6.5.3 Module ETH



66 *Module*



67 *Wiring diagram*

LEDs on front of module

LED	Designation	Color	Description
RJ45	LNK/ACT	GN	▪ Off = Connection is not active ▪ On = Connection is active ▪ Flashing = Data transmission
RJ45	10/100	YE	▪ Off = Transmission rate 10 MBit/s ▪ On = Transmission rate 100 MBit/s
PWR	Power	GN	Supply voltage is applied and module is initialized
BF	Bus failure	RD	Not used
SF	System failure	RD	Device error
COM	Communication	YE	Modbus message sent or received

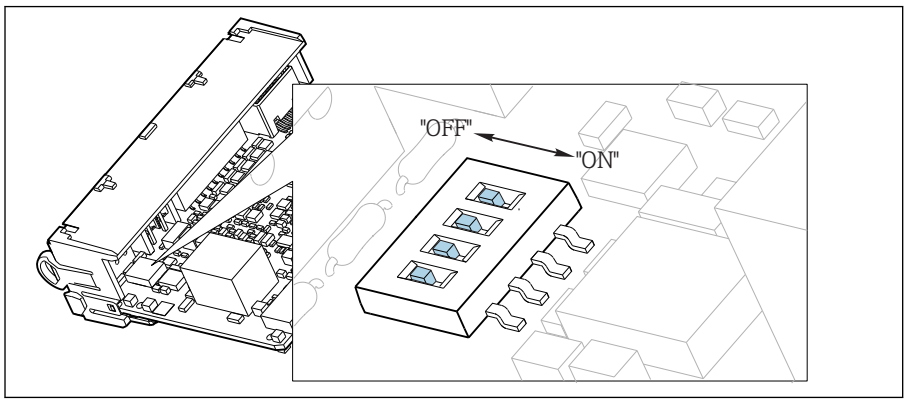
DIP switches on front of module

DIP	Factory setting	Assignment
1-128	ON	Bus address (→ "Commissioning/communication")
🔓	OFF	Write protection: "ON" = configuration not possible via the bus, only via local operation
Service	OFF	If the switch is set to **"ON"** , the user settings for Ethernet addressing are saved and connection settings programmed into the device at the factory are activated: IP address=192.168.1.212, Subnet mask=255.255.255.0, Gateway=0.0.0.0, DHCP=Off. If the switch is set to **"OFF"** , the saved user settings are reactivated.

6.5.4 Bus termination

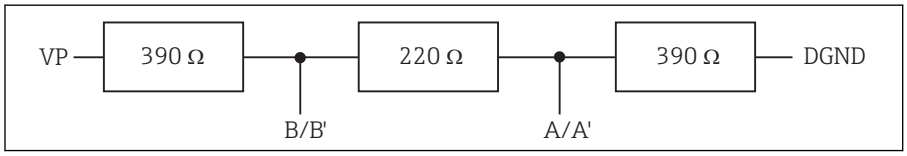
There are 2 ways to terminate the bus:

1. Internal termination (via DIP switch on module board)



68 *DIP switch for internal termination*

- Using a suitable tool such as a tweezer, move all four DIP switches to the "ON" position.
  - The internal termination is used.



69 *Structure of internal termination*

2. External termination

Leave the DIP switches on the module board in the "OFF" position (factory setting).

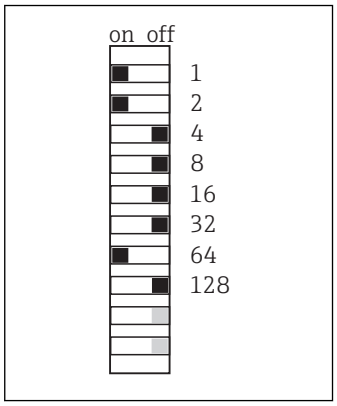
- Connect the external termination to terminals 81 and 82 on the front of module 485 for 5-V power supply.
  - The external termination is used.

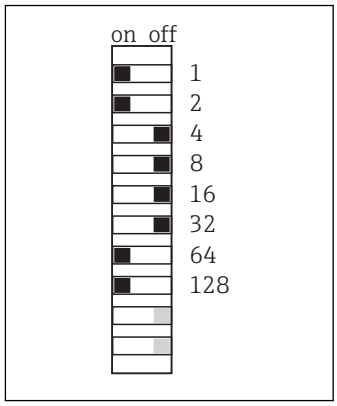
6.6 Hardware settings

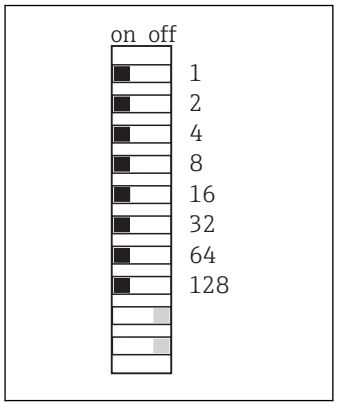
Setting the bus address

1. Open the housing.
2. Set the desired bus address via the DIP switches of module 485.

For PROFIBUS DP, valid bus addresses are anything between 1 and 126, and anything between 1 and 247 for Modbus. If you configure an invalid address, software addressing is automatically enabled via the local configuration or via the fieldbus.







70 Valid PROFIBUS address 67 *71 Valid Modbus address 195* *72 Invalid address 255* [1]

[1] Order configuration, software addressing is active, software address configured at the factory: PROFIBUS 126, Modbus 247

6.7 Ensuring the degree of protection

Only the mechanical and electrical connections which are described in these instructions and which are necessary for the required, designated use, may be carried out on the device delivered.

▶ Exercise care when carrying out the work.

Individual types of protection permitted for this product (impermeability (IP), electrical safety, EMC interference immunity, Ex protection) can no longer be guaranteed if, for example :

- Covers are left off
- Different power units to the ones supplied are used
- Cable glands are not sufficiently tightened (must be tightened with 2 Nm (1.5 lbf ft) for the permitted level of IP protection)
- Unsuitable cable diameters are used for the cable glands
- Modules are not fully secured
- The display is not fully secured (risk of moisture entering due to inadequate sealing)
- Loose or insufficiently tightened cables/cable ends
- Conductive cable strands are left in the device

6.8 Post-connection check

⚠ WARNING

Connection errors

The safety of people and of the measuring point is at risk! The manufacturer does not accept any responsibility for errors that result from failure to comply with the instructions in this manual.

- Put the device into operation only if you can answer **yes** to **all** the following questions.

Instrument status and specifications

- Are the device and all the cables free from damage on the outside?

Electrical connection

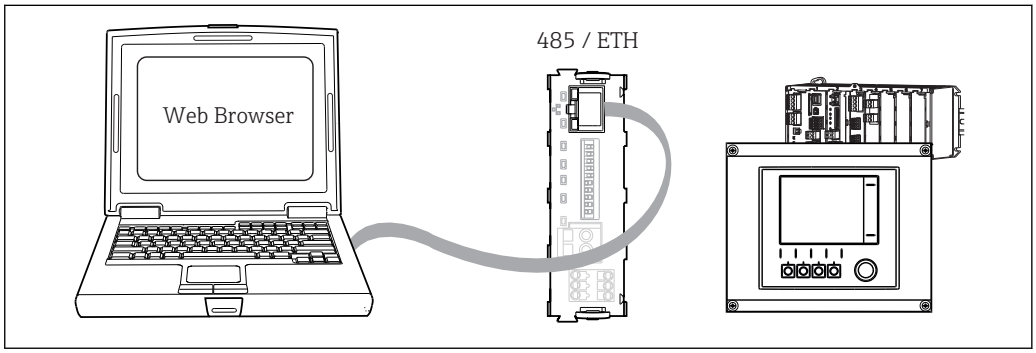
- Are the mounted cables strain relieved?
- Are the cables routed without loops and cross-overs?
- Are the signal cables correctly connected as per the wiring diagram?
- Have all the other connections been established correctly?
- Are unused connection wires connected to the protective ground connection?
- Are all plug-in terminals securely engaged?
- Are all the connection wires securely positioned in the cable terminals?
- Are all cable entries mounted, tightened and leak-tight?
- Does the supply voltage match the voltage indicated on the nameplate?

7 System integration

7.1 Web server

7.1.1 Connection

- Connect the computer's communication cable to the RJ45 port of module 485 or module ETH.



73 *Web server/Ethernet connection*

7.1.2 Establishing the data connection

To ensure that your device has a valid IP address, you must disable the **DHCP** parameter in the Ethernet settings. (**Menu/Setup/General settings/Extended setup/Ethernet/Settings**)

You can then set the IP address in the same menu.

1. Start your PC.
2. First, configure a manual IP address in the network connection settings of the operating system.

Example: Microsoft Windows 7

3. In the Control Panel, go to the Network and Sharing Center. You should see an active "Local Area Connection" link.
4. Select the "Local Area Connection" link.
5. In the pop-up window select the "Properties" button.
6. Double-click "Internet Protocol Version 4 (TCP/IPv4)".
7. Select "Use the following IP Address".
8. Enter the desired IP address. This address must be in the same subnetwork as the IP address of the device, e.g.:
   ↳ IP address for Liquiline: 192.168.1.212 (as configured previously)
   IP address for PC: 192.168.1.213.
9. Start the internet browser.
10. If you use a proxy server to connect to the Internet:
    Disable the proxy (browser settings under "Connections/LAN settings").
11. Enter the IP address of your device in the address bar (192.168.1.212 in the example).
    ↳ The system takes a few moments to establish the connection and then the CM44 web server starts. You might be asked for a password. The factory setting is "admin" for the user name and "admin" for the password.

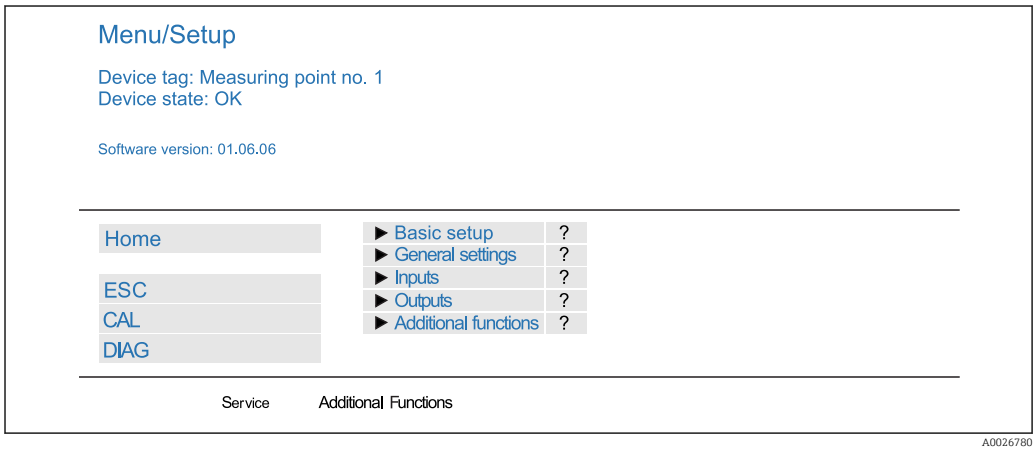
12. Enter the following address(es) to download logbooks:
    ↳ 192.168.1.212/logbooks_csv.fhtml (for logbooks in CSV format)
    192.168.1.212/logbooks_fdm.fhtml (for logbooks in FDM format)

Downloads in FDM format can be securely transmitted, saved and visualized with Endress+Hauser's "Field Data Manager Software".

(→ www.endress.com/ms20)

7.1.3 Operation

The menu structure of the web server corresponds to the onsite operation.



74 *Example of web server (menu/language=English)*

- Clicking a menu name or a function corresponds to pressing the navigator.
- You can make your settings conveniently via the computer keyboard.

Instead of using an Internet browser, you can also use FieldCare for configuration via ethernet. The ethernet DTM required for this is an integral part of the "Endress +Hauser Interface Device DTM Library".

Download: https://portal.endress.com/webdownload/FieldCareDownloadGUI/

7.1.4 Heartbeat verification

You can also start Heartbeat verification via the web server. This has the advantage that you can view the results directly in the browser and can avoid using an SD card.

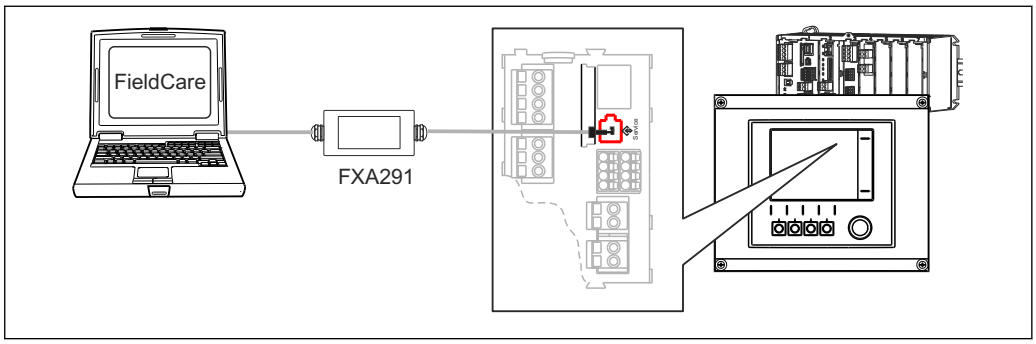
1. Open the menu: **Diagnostics/Systemtest/Heartbeat**.
2. ▷**Perform verification**.
3. Either ▶**Verification results** (quick display and export to SD card) or **Additional Functions** (additional menu below the lower limit line → 74).
4. **Additional Functions/Heartbeat**: select the language of the pdf file.
   ↳ The verification report is displayed in the browser and can be printed out, saved as a pdf file, etc.

7.2 Service interface

You can connect the device to a computer via the service interface and configure it using "FieldCare" . Furthermore, configurations can also be saved, transferred and documented.

7.2.1 Connection

1. Connect the service connector to the interface on the Liquiline base module and connect it to the Commubox.
2. Connect the Commubox via the USB connection to the computer on which FieldCare is installed.



75 *Connection overview*

7.2.2 Establishing the data connection

1. Start FieldCare.
2. Establish a connection to the Commubox. To do so, select the "CDI Communication FXA291" ComDTM.
3. Then select the "Liquiline CM44x" DTM and start configuration.

You can now start online configuration via the DTM.

Online configuration competes with onsite operation, i. e. each of the two options blocks the other one. On both sides it is possible to take away access from the other side.

7.2.3 Operation

- In the DTM the menu structure corresponds to the onsite operation. The functions of the Liquiline soft keys are found in the main window on the left.
- Clicking a menu name or a function corresponds to pressing the navigator.
- You can make your settings conveniently via the computer keyboard.
- You can use FieldCare to save logbooks, make backups of configurations and transfer configurations to other devices.
- You can also print out configurations or save them as PDFs.

7.3 Fieldbuses

7.3.1 HART

You can communicate using the HART protocol via current output 1.

1. Connect the HART modem or HART handheld terminal to current output 1 (communication load 230 - 500 Ohm).
2. Establish a connection via your HART device.
3. Operate the Liquiline via the HART device. To do so, follow the instructions in the manual.

More detailed information on HART communication is provided on the product pages on the Internet (→ BA00486C).

7.3.2 PROFIBUS DP

With the fieldbus module 485 and the appropriate device version, you can communicate via PROFIBUS DP.

- Connect the PROFIBUS data cable to the terminals of the fieldbus module as described (→ 34).

For detailed information on "PROFIBUS communication", see product pages on the internet (→ SD01188C).

7.3.3 Modbus

With the fieldbus module 485 and the appropriate device version, you can communicate via Modbus RS485 or Modbus TCP.

For Modbus TCP, you can use the ETH module as an alternative to module 485.

The RTU and ASCII protocols are available when connecting via Modbus RS485. You can switch to ASCII on the device.

- Connect the Modbus data cable to the terminals of the fieldbus module (RS 485) or to the RJ45 (TCP) port as described.

For detailed information on "Modbus communication", see product pages on the internet (→ SD01189C).

7.3.4 EtherNet/IP

With the fieldbus module 485 or the ETH module and the appropriate device version, you can communicate via EtherNet/IP.

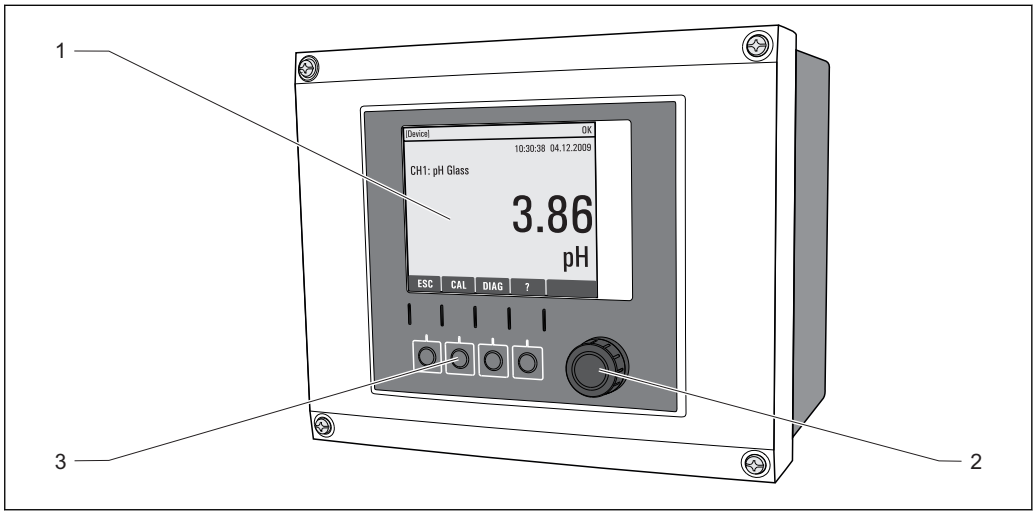
- Connect the EtherNet/IP data cable to the RJ45 socket of module 485 or ETH.

For detailed information on "EtherNet/IP communication", see product pages on the internet (→ SD01293C).

8 Operation options

8.1 Overview

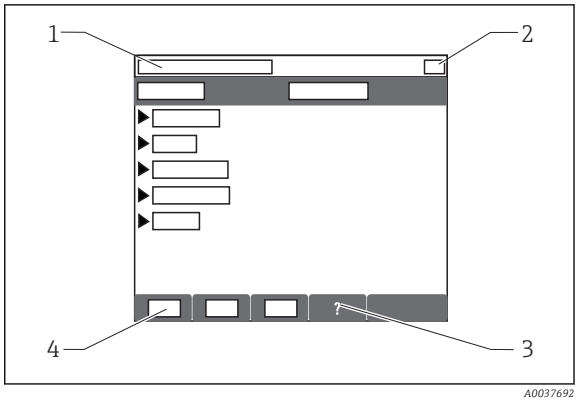
8.1.1 Display and operating elements



76 Overview of operation

1 Display (with red display background in alarm condition)
2 Navigator (jog/shuttle and press/hold function)
3 Soft keys (function depends on menu)

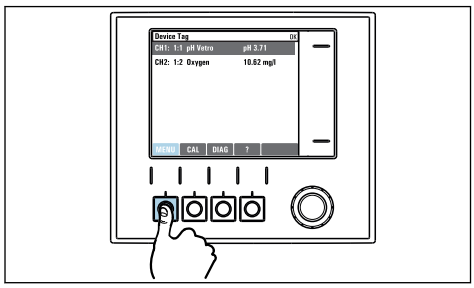
8.1.2 Display



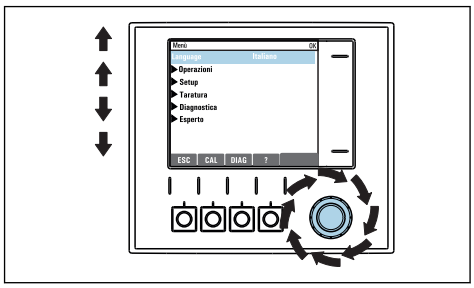
1 Menu path and/or device designation
2 Status display
3 Help if available
4 Assignment of the soft keys

8.2 Access to the operating menu via the local display

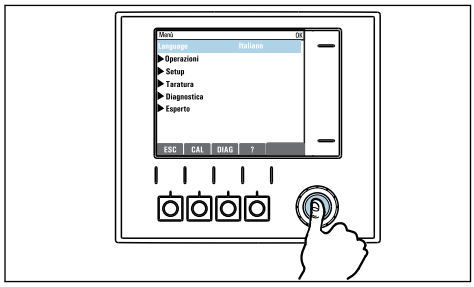
8.2.1 Operating concept



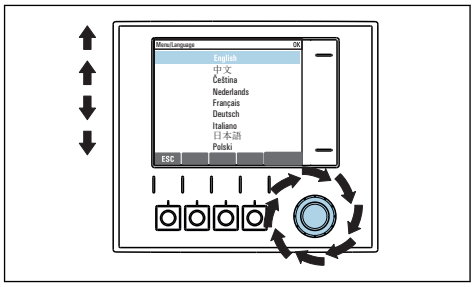
▶ Pressing the soft key: selecting the menu directly



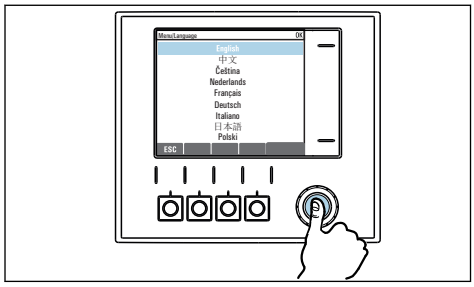
▶ Turning the navigator: moving the cursor in the menu



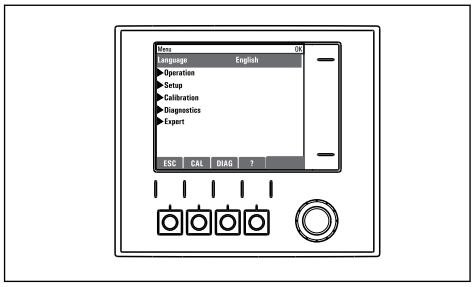
▶ Pressing the navigator: launching a function



▶ Turning the navigator: selecting a value (e.g. from a list)



▶ Pressing the navigator: accepting the new value



↳ New setting is accepted

8.2.2 Locking or unlocking operating keys

Locking operating keys

1. Press the navigator for longer than 2 s.
   ↳ A context menu for locking the operating keys is displayed.
   You have the choice of locking the keys with or without password protection. "With password" means that you can only unlock the keys again by entering the correct password. Set this password here: **Menu/Setup/General settings/Extended setup/Data management/Change lock password**.

2. Select whether to lock keys with or without a password.
   ↳ The keys are locked. No more entries can be made. In the soft key bar, you will see the symbol.

The password is 0000 when the device is delivered from the factory. **Make sure to note down any changes to the password,** as otherwise you will not be able to unlock the keypad yourself.

Unlocking operating keys

1. Press the navigator for longer than 2 s.
   ↳ A context menu for unlocking the operating keys is displayed.
2. **Key unlock** .
   ↳ The keys are unlocked immediately if you did not choose to lock with a password. Otherwise you are asked to enter your password.
3. Only if keypad is password-protected: enter the right password.
   ↳ The keys are unlocked. It is possible to access the entire onsite operation again. The symbol is no longer visible on the display.

8.3 Configuration options

8.3.1 Display only

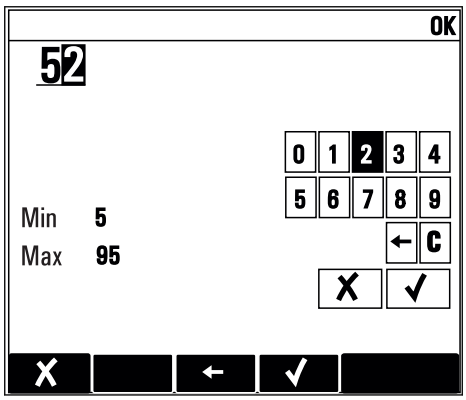
- You can only read the values but cannot change them.
- Typical read-only values are: sensor data and system information
- Example: **Menu/Setup/Inputs/../Sensor type**

8.3.2 Picklists

- You receive a list of options. In a few cases, these also appear in the form of multiple choice boxes.
- Usually you just select one option; in rare instances you select one or more options.
- Example: **Menu/Setup/General settings/Temperature unit**

8.3.3 Numerical values

- You are changing a variable.
- The maximum and minimum values for this variable are shown on the display.
- Configure a value within these limits.
- Example: **Menu/Operation/Display/Contrast**

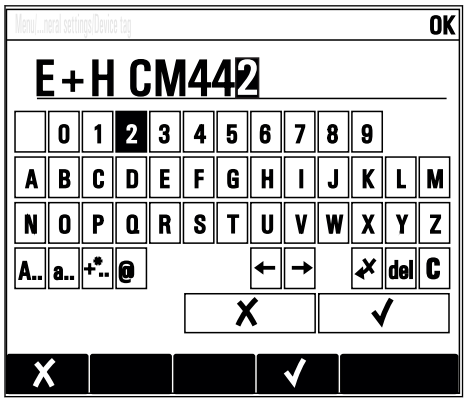


8.3.4 Actions

- You trigger an action with the appropriate function.
- You know that the item in question is an action if it is preceded by the following symbol: ▷
- Examples of typical actions include:
  - Deleting log entries
  - Saving or loading configurations
  - Triggering cleaning programs
- Example: **Diagnostics/Logbooks/Configuration logbook/Delete all entries**

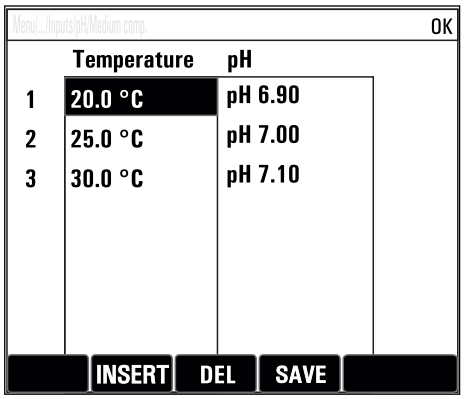
8.3.5 Free text

- You are assigning an individual designation.
- Enter a text. You can use the characters in the editor for this purpose (upper-case and lower-case letters, numbers and special characters).
- Using the soft keys, you can:
  - Cancel your entries without saving the data (✗)
  - Delete the character in front of the cursor (✗)
  - Move the cursor back one position (←)
  - Finish your entries and save (✓)
- Example: **Menu/Setup/General settings/Device tag**



8.3.6 Tables

- Tables are needed to map mathematical functions .
- You edit a table by navigating through rows and columns with the navigator and changing the values of the cells.
- You only edit the numerical values. The controller automatically takes care of the engineering units.
- You can add lines to the table (**INSERT**) or delete lines from the table (**DEL**).
- Afterwards, you save the table (**SAVE**).
- You can also cancel your entries any time using the ✗ soft key.
- Example: **Menu**/**Setup**/**Inputs**/pH/**Medium comp.**



9 Commissioning

9.1 Function check

⚠ WARNING

Incorrect connection, incorrect supply voltage

Safety risks for staff and device malfunctions!

- ▶ Check that all connections have been established correctly in accordance with the wiring diagram.
- ▶ Ensure that the supply voltage matches the voltage indicated on the nameplate.

Saving the configuration settings as a screenshot

Via the local display , you can take screenshots at any time and save them to an SD card.

1. Insert an SD card into the SD card slot in the base module.
2. Press the navigator button for at least 3 seconds.
3. In the context menu, select the **Screenshot** item.
   ↳ The current screen is saved as a bitmap file to the SD card in the "Screenshots" folder.

9.2 Power up

During the device startup phase, the relays and current outputs have an undefined status for a few seconds prior to initialization. Watch out for possible effects on any actuators which may be connected.

9.2.1 Setting the operating language

Configuring the language

If you have not already done so, close the housing cover and screw the device closed.

1. Switch on the supply voltage.
   ↳ Wait for the initialization to finish.
2. Press the soft key **MENU** . Set your language in the top menu item.
   ↳ The device can now be operated in your chosen language.

9.2.2 Display behavior

Menu/Operation/Display		
Function	**Options**	**Info**
Contrast	5 to 95 % **Factory setting** 50 %	Adjust the screen settings to suit your working environment. **Backlight** = **Automatic** The backlighting is switched off automatically after a short time if a button is not pressed. It switches back on again as soon as you press the navigator button. **Backlight** = **On** The backlighting does not switch off automatically.
Backlight	**Selection** ▪ On ▪ Off ▪ Automatic **Factory setting** Automatic	
Screen rotation	**Selection** ▪ Manual ▪ Automatic **Factory setting** Manual	If **Automatic** is selected, the single-channel measured value display switches from one channel to the next every second.

9.3 User definable screens

Menu/Operation/User definable screens		
Function	**Options**	**Info**
▶ Meas. screen 1 … 6		You can create 6 measuring screens of your own and give them a name. The functions are identical for all 6 measuring screens.
Meas. screen	**Selection** ▪ On ▪ Off **Factory setting** Off	Once you have defined your own measuring screen, you can switch it on here. You can find the new screen under **User definable screens**.
Label	Customized text, 20 characters	Name of the measuring screen Appears in the status bar of the display.
Number of lines	1 to 8 **Factory setting** 8	Specify the number of measured values displayed.
▶ Line 1 … 8	**User interface** Label	Specify the content of **Label** in the submenu of each line.
Source of data	**Selection** ▪ None ▪ See list in "Info" column **Factory setting** None	▶ Select a source of data. You can choose from the following: ▪ Sensor inputs ▪ Heartbeat diagnostics of sensor inputs ▪ Controller ▪ Current inputs ▪ Fieldbus signals ▪ Mathematical functions ▪ Binary inputs and outputs ▪ Current outputs ▪ Relay ▪ Measuring range switching
Measured value **Source of data** *is an input*	**Selection** Depends on the input **Factory setting** None	You can display different main, secondary and raw measured values depending on the type of input. No options can be selected for outputs here.

Menu/Operation/User definable screens		
Function	**Options**	**Info**
Actuator type **Source of data** *is a controller*	**Selection** ▪ None ▪ Bipolar ▪ Unipolar- ▪ Unipolar+ **Factory setting** None	For more information on controllers and manipulated variables: → 🖹 71.
Label	Customized text, 20 characters	User-defined name for the parameter to be displayed
▷ Set label to "%0V" [1]	Action	If you perform this action you accept the parameter name that is automatically suggested. Your own parameter name (**Label**) is lost!

1) "%0V" here stands for text that depends on the context. This text is generated automatically by the software and inserted in place of %0V. In the simplest situations, the generated text could be the name of the measuring channel, for example.

9.4 Basic setup

Making basic settings

1. Switch to the **Setup/Basic setup** menu.
   ↳ Make the following settings.
2. **Device tag**: Give your device any name of your choice (max. 32 characters).
3. **Set date**: Correct the set date if necessary.
4. **Set time**: Correct the set time if necessary.
   ↳ For quick commissioning, you can ignore the additional settings for outputs, relays etc. You can make these settings later in the specific menus.
5. To return to the measuring mode: press the soft key for **ESC** for at least one second.
   ↳ Your controller now works with your basic settings. The sensors connected use the factory settings of the sensor type in question and the individual calibration settings that were last saved.

If you wish to configure your most important input and output parameters in the **Basic setup** :

► Configure the current outputs, relays, limit switches, controllers, device diagnostics and cleaning cycles with the submenus which follow the time setting.

10 Operation

10.1 Display

10.1.1 Soft keys in the measurement mode

On the bottom row of the display you can find four soft keys in the measuring screens:
- With **MENU**, **CAL** and **DIAG** take you directly to the specific software menu.
- With **HOLD** you can activate an immediate, general hold for sensors. This also sets all the linked outputs, controllers and cleaning cycles to HOLD. Any sensor cleaning programs that are currently running are interrupted. However, you can also start manual sensor cleaning when a hold is active.

10.1.2 Measuring mode

There are different display modes: (press the navigator button to change the mode)
- (1) Overview of all the inputs and outputs
- (2) Main measured value of an input or output or the status of a relay
- (3) Main and secondary measured value of a sensor input
- (4) All measured values of a sensor input
- (5) **Only for interface measurement:**
  Graphic display of the separation zone

There are also submenus:
- (6) User-defined screens
  Choice of previously configured screens (→ 51)
- (7) Heartbeat diagnostics
  Quick overview of the health of the device and of each connected sensor that supports Heartbeat technology

Changing to display modes (2) - (5)

▶ Turn the navigator.
  ↳ The display changes from channel to channel.

Sensor type	Main value	Main / secondary measured value	All values
pH, glass	pH value	pH value, temperature	**Main value**, **Raw value**, **Temperature**, **Glass Impedance**
Combined sensor pH and ORP	pH value or ORP or rH value	pH value or ORP or rH value, temperature	**Main value**, **Raw value**, **Temperature**, **Glass Impedance**
pH, ISFET	pH value	pH value, temperature	**Main value**, **Raw value**, **Temperature**
ORP	ORP	ORP, temperature	**Main value**, **Raw value**, **Offset**, **Temperature**
Conductivity, measured inductively	Conductivity, concentration	Conductivity, concentration, temperature	**Main value**, **Raw value**, **Temperature**
Conductivity, measured conductively	Conductivity, resistivity, concentration	Conductivity, resistivity, concentration, temperature	**Main value**, **Raw value**, **Temperature**
Oxygen, optical and amperometric	Oxygen	Oxygen, temperature	**Partial pressure**, **Saturation** , **Concentration**, **Temperature**
Disinfection	Chlorine or chlorine dioxide (depending on the sensor)	Chlorine or chlorine dioxide, temperature	**Main value**, **Raw value**, **Temperature**

Sensor type	Main value	Main / secondary measured value	All values
Nitrate	Nitrate	Nitrate, temperature	**Main value**, **Raw value**, **Temperature**
Turbidity	Turbidity	Turbidity, temperature	**Main value**, **Raw value**, **Temperature**
Spectral absorption coefficient (SAC)	SAC	SAC, temperature	**Main value**, **Raw value**, **Temperature**
Sludge level	Turbidity	Turbidity, temperature	**Main value**, **Raw value**, **Temperature**
Ammonium, ion-selective	Ammonium	Ammonium, temperature	**Main value**, **Raw value**, **Temperature**
Nitrate, ion-selective	Nitrate	Nitrate, temperature	**Main value**, **Raw value**, **Temperature**
Potassium, ion-selective	Potassium	Potassium, temperature	**Main value**, **Raw value**, **Temperature**
Interface measurement	UIS	UIS	**Main value**, **Raw value**, **Temperature** Separation zone (graphic)

Heartbeat diagnostics
(optional or with additional activation code)
- Heartbeat diagnostics screen with graphic indicators for the health of the device and sensor and with a maintenance or (sensor-dependent) calibration timer
- Heartbeat status information on the health of the device and the condition of the sensor → 📄 55
  - ☺: Sensor/device condition or maintenance timer > 20 %; no action is required
  - 😐: Sensor/device condition or maintenance timer > 5 ≤ 20 %, maintenance not yet urgent but should be scheduled
  - ☹: Sensor/device condition or maintenance timer < 5 %, maintenance is recommended
- The Heartbeat sensor condition is the assessment of the calibration results and the sensor diagnostic functions.

An unhappy smiley can be due to the calibration result, the measured value status or to the operating hours limit having been exceeded. These limits can be configured in the sensor setup in a way that adapts the Heartbeat diagnostics to the application.

Heartbeat and NAMUR category
The Heartbeat status indicates the sensor or device condition while the NAMUR categories (F, C, M, S) assess the reliability of the measured value. The two conditions can correlate but do not have to.
- **Example 1**
  - The number of remaining cleaning cycles for the sensor reaches 20% of the defined maximum number. The Heartbeat symbol changes from ☺ to 😐. The measured value is still reliable so the NAMUR status signal does not change.
  - If the maximum number of cleaning cycles is exceeded, the Heartbeat symbol changes from 😐 to ☹. While the measured value can still be reliable, the NAMUR status signal changes to M (maintenance required).
- **Example 2**
  The sensor breaks. The Heartbeat status changes immediately from ☺ to ☹ and the NAMUR status signal also changes immediately to F (failure).

10.1.3 Device status

Icons on the display alert you to special device states.

Icon	Location	Description
F	Header bar	Diagnostic message "Failure"
M	Header bar	Diagnostic message "Maintenance request"
C	Header bar	Diagnostic message "Check"
S	Header bar	Diagnostic message "Out of specification"
⇆	Header bar	Fieldbus or TCP/IP communication active
⧗	Header bar	Hold active (for sensors)
⧗	At measured value	Hold for the actuator (current output, limit switch etc.) is active
⍐	At measured value [1]	An offset has been added to the measured value
⊗	At measured value	Measured value in "Bad" or "Alarm" state
ATC	At measured value	Automatic temperature compensation active (for sensors)
MTC	At measured value	Manual temperature compensation active (for sensors)
SIM	Header bar	Simulation mode active or Memocheck SIM connected
SIM	At measured value	The measured value is influenced by a simulated value
SIM	At measured value	The displayed measured value is simulated (for sensors)
☺	After the channel number	Heartbeat diagnostics: condition of sensor is good
☹	After the channel number	Heartbeat diagnostics: condition of sensor is bad
😐	After the channel number	Heartbeat diagnostics: condition of sensor is OK
◹	Header bar	Controller is active

1) Only pH or ORP measurement

If two or more diagnostic messages occur simultaneously, only the icon for the message with the highest priority is shown on the display (for the order of priority according to NAMUR, → 🖹 112).

10.1.4 Assignment views

Assignment views, e.g. **Channel assignment view**, appear as the last function in many sections of the menu. You can use this function to see which actuators or functions are connected to an input or output. The assignments appear in hierarchical order.

10.2 General settings

10.2.1 Basic settings

Menu/Setup/General settings		
Function	**Options**	**Info**
Device tag	Customized text, 32 characters	▶ Select any name for your controller, e.g. use the TAG name.
Temperature unit	**Selection** ▪ °C ▪ °F ▪ K **Factory setting** °C	

Menu/Setup/General settings		
Function	**Options**	**Info**
Current output range	**Selection** ▪ 0..20 mA ▪ 4..20 mA **Factory setting** 4..20 mA	In accordance with Namur NE43, the linear range is from 3.8 to 20.5 mA (**4..20 mA**) or from 0 to 20.5 mA (**0..20 mA**). If the range is exceeded or undershot, the current value stops at the range limit and a diagnostic message (460 or 461) is output.
Error current	0.0 to 23.0 mA **Factory setting** 22.5 mA	The function meets NAMUR NE43. ▶ Set the current value that should be output at the current outputs in the event of an error.
The value for **Error current** should be outside the measuring range. If you decided that your **Current output range** = **0..20 mA** you should set an error current between 20.1 and 23 mA. If the **Current output range** = **4..20 mA** you could also define a value < 4 mA as the error current. The device allows an error current within the measuring range. In such instances pay attention to any effects this may have on your process.		
Alarm delay	0 to 9999 s **Factory setting** 0 s	The software displays only the errors that are present longer than the set delay time. This makes it possible to suppress messages that only occur briefly and are caused by normal process-specific fluctuations.
Device hold	**Selection** ▪ Disabled ▪ Enabled **Factory setting** Disabled	You can enable an immediate, general hold (for sensors) here. The function acts in the same way as the **HOLD** soft key in the screens.

10.2.2 Date and time

Menu/Setup/General settings/Date/Time		
Function	**Options**	**Info**
Set date	Depends on the format	Editing mode: Day (two-digit): 01 to 31 Month (two-digit): 01 to 12 Year (four-digit): 1970 to 2106
Set time	Depends on the format	Editing mode: hh (hour): 00 to 23 / 0 am to 12 pm mm (minutes): 00 to 59 ss (seconds): 00 to 59

Menu/Setup/General settings/Date/Time		
Function	**Options**	**Info**
▶ Extended setup		
Date format	**Selection** ▪ DD.MM.YYYY ▪ YYYY-MM-DD ▪ MM-DD-YYYY **Factory setting** DD.MM.YYYY	▶ Select a date format.
Time format	**Selection** ▪ hh:mm am (12h) ▪ hh:mm (24h) ▪ hh:mm:ss (24h) **Factory setting** hh:mm:ss (24h)	▶ Choose between 12-hour display or 24-hour display. Seconds can also be displayed with the latter version.
Time zone	**Selection** ▪ None ▪ Choice of 35 time zones **Factory setting** None	**None** = Greenwich Mean Time (London).
DST	**Selection** ▪ Off ▪ Europe ▪ USA ▪ Manual **Factory setting** Off	The controller adapts the summertime/normal time changeover automatically if you choose European or American daylight saving time. Manual means that you can specify the start and end of daylight saving time yourself. Here, two additional submenus are displayed in which you specify the changeover date and time.

10.2.3 Hold settings

Menu/Setup/General settings/Hold settings		
Function	**Options**	**Info**
Settings automatic Hold		
Hold release time	0 to 600 s **Factory setting** 0 s	The hold status is maintained for the duration of the delay time when you switch to the measuring mode.
Setup menu	**Selection** ▪ Disabled ▪ Enabled **Factory setting** Disabled	▶ Decide whether the device outputs should switch to the defined hold state when the particular menu is opened.
Diagnostics menu		
Calibration active	**Factory setting** Enabled	

If a device-specific hold status is activated, any cleaning previously started is interrupted. When a hold is active you can only start manual cleaning.

10.2.4 Logbooks

Logbooks record the following events:
- Calibration/adjustment events
- Operator events
- Diagnostic events

You define how the logbooks should store the data.

In addition, you can also define individual data logbooks .

1. Assign the logbook name.
2. Select the measured value to be recorded.
3. Set the recording rate (**Scan time**).
   ↳ You can set the recording rate individually for every data logbook.

Further information on the logbooks: → 118.

Menu/Setup/General settings/Logbooks		
Function	**Options**	**Info**
Logbook ident	Customized text, 16 characters	Part of the file name when exporting a logbook
Event logbook	**Selection** ▪ Off ▪ Ring buffer ▪ Fill up buffer **Factory setting** Ring buffer	All diagnostic messages are recorded **Ring buffer** If the memory is full, the most recent entry automatically overwrites the oldest entry. **Fill up buffer** If the memory is full, there is an overflow,i. e. you cannot store any new values. The controller displays a corresponding diagnostic message. The memory then has to be cleared manually.
▶ Overflow warnings **Event logbook** = **Fill up buffer**		
Calibration logbook Diagnostic logbook Configuration logbook	**Selection** ▪ Off ▪ On **Factory setting** Off	▸ Decide whether you want to receive a diagnostic message if the fill buffer of the relevant logbook overflows.
▶ Data logbooks		
▶ New		You can create a maximum of 8 data logbooks.
Logbook name	Customized text, 20 characters	
Source of data	**Selection** ▪ Sensor inputs ▪ Heartbeat signals ▪ Controller ▪ Current inputs ▪ Fieldbus signals ▪ Binary inputs ▪ Mathematical functions **Factory setting** None	▸ Select a data source for the logbook entries. You can choose from the following: ▪ Connected sensors ▪ Available controllers ▪ Current inputs ▪ Fieldbus signals ▪ Binary input signals ▪ Mathematical functions
Measured value	**Selection** depend on **Source of data** **Factory setting** None	You can record different measured values depending on the data source.

Menu/Setup/General settings/Logbooks		
Function	**Options**	**Info**
Scan time	0:00:01 to 1:00:00 **Factory setting** 0:01:00	Minimum time interval between two entries Format: H:MM:SS
Data logbook	**Selection** ▪ Ring buffer ▪ Fill up buffer **Factory setting** Ring buffer	**Ring buffer** If the memory is full, the most recent entry automatically overwrites the oldest entry. **Fill up buffer** If the memory is full, there is an overflow,i. e. no new values can be saved. The controller displays a corresponding diagnostic message. The memory then has to be cleared manually.
Overflow warnings **Event logbook** = **Fill up buffer**	**Selection** ▪ Off ▪ On **Factory setting** Off	▶ Decide whether you want to receive a diagnostic message if the fill buffer of the relevant logbook overflows.
▷ Add another logbook	Action	Only if you want to create another data logbook immediately. You add a new data logbook at a later date using **New** .
▷ Finished	Action	This allows you to exit the menu **New**.
▷ Start/stop simultaneously	Action	Appears if you have created more than one data logbook. With one mouse click, you can start or stop recording all the data logbooks.
▶ Logbook name		The name of this submenu is based on the name of the logbook and only appears once you have created a logbook.
This menu appears several times if you have several data logbooks.		
Source of data	Read only	This is for information purposes only. If you want to record another value, delete this logbook and create a new data logbook.
Measured value		
Log time left **Event logbook** = **Fill up buffer**	Read only	Displays the days, hours and minutes remaining until the logbook is full.
Log size **Event logbook** = **Fill up buffer**	Read only	Displays the number of entries remaining until the logbook is full.
Logbook name	Customized text, 20 characters	You can change the name here again.
Scan time	0:00:01 to 1:00:00 **Factory setting** 0:01:00	As above Minimum time interval between two entries Format: H:MM:SS
Data logbook	**Selection** ▪ Ring buffer ▪ Fill up buffer **Factory setting** Ring buffer	**Ring buffer** If the memory is full, the most recent entry automatically overwrites the oldest entry. **Fill up buffer** If the memory is full, there is an overflow, i. e. no new values can be saved. The controller displays a corresponding diagnostic message. The memory then has to be cleared manually.
Overflow warnings **Event logbook** = **Fill up buffer**	**Selection** ▪ Off ▪ On **Factory setting** Off	▶ Decide whether you want to receive a diagnostic message if the fill buffer of the relevant logbook overflows.

Menu/Setup/General settings/Logbooks		
Function	**Options**	**Info**
▶ Line plotter		Menu to define the graphic display
Axes	**Selection** ▪ Off ▪ On **Factory setting** On	Should the axes (x, y) be displayed (**On**) or not (**Off**)?
Orientation	**Selection** ▪ Horizontal ▪ Vertical **Factory setting** Horizontal	You can choose whether the value curves should be displayed from left to right (**Horizontal**) or from top to bottom (**Vertical**). If you want to display two data logbooks simultaneously, make sure that both logbooks have the same settings here.
X-Description Y-Description Grids Pitches	**Selection** ▪ Off ▪ On **Factory setting** On	▶ Decide whether a description should be displayed for the axes and whether gridlines should be shown. In addition, you can also decide whether pitches should be displayed.
X Pitch/Grid distance Y Pitch/Grid distance	10 to 50% **Factory setting** 10 %	▶ Determine the pitch.
▷ Remove	Action	This action removes the data logbook. Any data that have not been saved are lost.

Example: New data logbook (Setup/General settings/Logbooks/Data logbooks/New)

1. Make the settings:

- Logbook name
  Assign a name. Example: "01".
- Source of data
  Select a data source. Example: Sensor connected to channel 1 (CH1).
- Measured value
  Select the measured value to be recorded. Example: pH value.
- Scan time
  Specify the time interval between two logbook entries.
- Data logbook
  Activate the logbook: specify the data storage method.

2. Run the .../**Finished**: action.
   ↳ The device shows the new logbook in the list of data logbooks.
3. Select data logbook "01".
   ↳ Additional display: **Log time left**.
4. Only for **Fill up buffer**:
   Choose **Overflow warning**: **On** or **Off**.
   ↳ **On**: The device displays a diagnostic message in the event of memory overflow.
5. Submenu **Line plotter**: Specify the type of graphic representation.

10.2.5 Advanced setup

Diagnostics settings

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then can you make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	You can deactivate or reactivate a diagnostic message here. Deactivating means: ▪ No error message in the measuring mode ▪ No error current at the current output
Error current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether an error current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the error current is output at all the current outputs. In the event of channel-specific errors, the error current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether you want to change a status signal assignment for your application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	You can use this function to select an output to which the diagnostic message should be assigned. Before being able to assign the message to an output you must first configure a relay output to **Diagnostics** . (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set the **Operating mode** to **as assigned** .)
An alarm relay is always available, regardless of the device version. Other relays are optional.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. You can define the cleaning programs under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Here you can find more information on the diagnostic message and instructions on how to resolve the problem.

HART bus address

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/General settings/Extended setup/HART		
Function	**Options**	**Info**
Bus address	0 to 63 **Factory setting** 0	You can change the device address to integrate several HART devices in a single network (Multidrop mode).

If you reset the device to the factory settings (**Diagnostics/Reset/Factory default**), the bus address is not reset. Your setting is retained.

PROFIBUS DP

Menu/Setup/General settings/Extended setup/PROFIBUS		
Function	**Options**	**Info**
Enable	**Selection** ▪ Off ▪ On **Factory setting** On	You can switch off communication at this point. The software can then only be accessed via local operation.
Termination	Read only	If the device is the last in the bus, you can terminate via the hardware. → 🖹 38
Bus address	1 to 125	If you have addressed the bus via hardware (DIP switches on the module, → 🖹 38), you can only read the address here. If an invalid address is set via the hardware, you have to assign a valid address for your device either here or via the bus.
Ident number	**Selection** ▪ Automatic ▪ PA-Profile 3.02 (9760) ▪ Liquiline CM44x (155D) ▪ Manufacturer specific **Factory setting** Automatic	

Modbus

Menu/Setup/General settings/Extended setup/Modbus		
Function	**Options**	**Info**
Enable	**Selection** ▪ Off ▪ On **Factory setting** On	You can switch off communication at this point. The software can then only be accessed via local operation.
Termination	Read only	If the device is the last in the bus, you can terminate via the hardware. → 🖹 38

Menu/Setup/General settings/Extended setup/Modbus		
Function	**Options**	**Info**
Settings		
Transmission Mode	**Selection** ▪ TCP ▪ RTU ▪ ASCII **Factory setting** (Modbus-RS485 only) RTU	The transmission mode is displayed depending on the version ordered. In the case of RS485 transmission, you can choose between **RTU** and **ASCII** . There are no choices for Modbus-TCP.
Baudrate *Modbus-RS485 only*	**Selection** ▪ 1200 ▪ 2400 ▪ 4800 ▪ 9600 ▪ 19200 ▪ 38400 ▪ 57600 ▪ 115200 **Factory setting** 19200	
Parity *Modbus-RS485 only*	**Selection** ▪ Even (1 Stopbit) ▪ Odd (1 Stopbit) ▪ None (2 Stopbit) **Factory setting** Even (1 Stopbit)	
Byte order	**Selection** ▪ 1-0-3-2 ▪ 0-1-2-3 ▪ 2-3-0-1 ▪ 3-2-1-0 **Factory setting** 1-0-3-2	
Watchdog	0 to 999 s **Factory setting** 5 s	If no data transmission takes place for longer than the time set, this is an indicator that communication has been interrupted. After this time, input values received via the Modbus are considered to be invalid.

Web server

Menu/Setup/General settings/Extended setup/Webserver		
Function	**Options**	**Info**
Webserver	**Selection** ▪ Off ▪ On **Factory setting** On	You can switch off communication at this point. The software can then only be accessed via local operation.
Webserver TCP Port 80	Read only	The Transmission Control Protocol (TCP) is an arrangement (protocol) as to how data should be exchanged between computers. A port is a part of an address which assigns data segments to a network protocol.
Webserver login	**Selection** ▪ Off ▪ On **Factory setting** On	You can switch user administration on and off at this point. This makes it possible to create multiple users with password access.

Menu/Setup/General settings/Extended setup/Webserver		
Function	**Options**	**Info**
User administration		
List of users already created	View/edit	You can change user names or passwords or delete users. A user is already created at the factory: "admin" with password "admin".
New user:		
Name	Free text	**Create new user** 1. **INSERT** . 2. Assign any name to the new user. 3. Select a password for the user. 4. Confirm password. ↳ You can now change the password at any time.
Enter new user password	Free text	
Confirm new user password	Free text	
Change user password	Free text	

EtherNet/IP

Menu/Setup/General settings/Extended setup/Ethernet		
Function	**Options**	**Info**
Enable	**Selection** ▪ Off ▪ On **Factory setting** On	You can switch off communication at this point. The software can then only be accessed via local operation.
Settings		
Link settings	**Selection** ▪ Auto negotiation ▪ 10MBps Half duplex ▪ 10MBps Full duplex ▪ 100MBps Half duplex ▪ 100MBps Full duplex **Factory setting** Auto negotiation	Transmission methods of the communication channels ▪ Full duplex: Data can be transmitted and received simultaneously. ▪ Half-duplex: Data can be transmitted and received on an alternating basis only, i.e. not simultaneously.
DHCP	**Selection** ▪ Off ▪ On **Factory setting** On	The Dynamic Host Configuration Protocol (DHCP) makes it possible to assign the network configuration to clients via a server. With DHCP, it is possible to automatically integrate the device into an existing network without the need for manual configuration. Normally only the automatic assignment of the IP address must be configured at the client. During startup, the IP address, the netmask and the gateway are retrieved from a DHCP server. Do you want to assign the IP address of the device manually? If so, you must set **DHCP** = **Off** .
IP-Address	xxx.xxx.xxx.xxx	An IP address is an address in computer networks which are based on the Internet protocol (IP). You can only set the IP address if **DHCP** is switched off.

Menu/Setup/General settings/Extended setup/Ethernet		
Function	**Options**	**Info**
Netmask	xxx.xxx.xxx.xxx	On the basis of the IP address of a device, the netmask specifies which IP addresses this device searches for in its own network and which addresses it could access in other networks via a router. It therefore divides the IP address into a network part (network prefix) and a device part. The network part must be identical for all devices in the individual network, and the device part must be different for every device within the network.
Gateway	x.x.x.x	A gateway (protocol converter) enables communication between networks that are based on completely different protocols.
Service switch	Read only	
MAC-Address	Read only	The MAC address (Media Access Control address) is the hardware address of every individual network adapter which is used to uniquely identify the device in a computer network.
EtherNetIP Port 44818	Read only	A port is a part of an address which assigns data segments to a network protocol.

Accepting settings

Have you changed settings manually, such as the IP address?

- Before you leave the **Ethernet** menu:
  SAVE Select , to apply your settings.
  - In the **DIAG/System information** menu you can check whether the new settings are used.

Data management

Firmware update

Please contact your local sales office for information on firmware updates available for your controller and its compatibility with earlier versions.

The **current firmware version** can be found at: **Menu/Diagnostics/System information/**.

- Back up your current setup and your logbooks to an SD card.

To install a firmware update, you must have the update available on an SD card.

1. Insert the SD card into the controller card reader.
2. Go to **Menu/Setup/General settings/Extended setup/Data management/ Firmware update** .
   - The update files on the SD card are displayed.
3. Select the desired update and select yes when asked the following:

   The current firmware will be overwritten.
   After this the device will reboot.
   Do you want to proceed?

   - The firmware is loaded and the device is then started with the new firmware.

Saving the setup

Saving a setup offers the following advantages, among others :
- Copying settings for other devices
- Quick and easy switching between various setups, e. g. for different user groups or for recurring sensor type changes
- Restoring a tried-and-tested setup, e. g. if you have changed a lot of settings and no longer know what the original settings were

1. Insert the SD card into the controller card reader.
2. Go to **Menu/Setup/General settings/Extended setup/Data management/Save setup** .
3. **Name**: Assign a file name.
4. Then select **Save** .
   ↳ If you have already assigned the file name, you will be asked whether you want to overwrite the existing setup.
5. Use **OK** to confirm or cancel and assign a new file name.
   ↳ Your setup is stored on the SD card and you can upload it quickly to the device at a later date.

Loading the setup

When you load a setup, the current configuration is overwritten.

1. Insert the SD card into the controller card reader. A setup must have been saved to the SD card.
2. Go to **Menu/Setup/General settings/Extended setup/Data management/Load setup** .
   ↳ A list of all the setups on the SD card is displayed.
   An error message is displayed if there is no valid setup on the card.
3. Select the desired setup.
   ↳ A warning is displayed:

   The current parameters will be overwritten and the device will reboot.
   Warning: Please note that cleaning and controller programs can be active.
   Do you want to proceed?
4. Use **OK** to confirm or cancel.
   ↳ If you select **OK** to confirm, the device restarts with the desired setup.

Exporting the setup

Exporting a setup offers the following advantages, among others:
- Export in XML format with a stylesheet for formatted display in an XML-compatible application, such as . Microsoft Internet Explorer
- Importing the data (drag and drop the XML file into a browser window)

1. Insert the SD card into the controller card reader.
2. Go to **Menu/Setup/General settings/Extended setup/Data management/Export setup** .
3. **Name**: Assign a file name.
4. Then select **Export** .
   ↳ If you have already assigned the file name, you will be asked whether you want to overwrite the existing setup.

5. Use **OK** to confirm or cancel and assign a new file name.
   ↳ Your setup is saved on the SD card in the "Device" folder.

You cannot upload the exported setup to the device again. You must use the **Save setup** . This is the only way you can save a setup to an SD card and reload it later on or upload it to other devices.

Activation code

You require activation codes for:
- Additional functions, e. g. fieldbus communication
- Firmware upgrades
- Modifications, e. g. deactivation of fieldbus protocols

If your original device has activation codes, these can be found on the internal nameplate. The corresponding device functions are activated at the factory. You only require the codes if servicing the device or deactivating fieldbus protocols.

1. Enter activation code: **Menu/Setup/General settings/Extended setup/Data management/Activation code**.
2. Confirm your entry.
   ↳ The new hardware or software function is activated and can be configured.

Functions that are enabled by an activation code:

Function	Activation code beginning with
Second Memosens input (CM442 only)	062...
Deactivation of fieldbus when 485 or ETH module is removed [1]	0B0...
Two current outputs (BASE-E module only)	081...
HART	0B1...
PROFIBUS PA	0B2...
PROFIBUS DP	0B3...
Modbus TCP	0B4...
Modbus RS485	0B5...
EtherNet/IP	0B6...
Measuring range switching, set 1	211...
Measuring range switching, set 2 [2]	212...
Feedforward control	220...
Chemoclean Plus	25...
Configure the mathematical function **Cation exchanger capacity**	301...
Heartbeat monitoring	2D1...
Heartbeat verification	2E1...

1) The device displays an error message if you remove the 485 or ETH module with the fieldbus protocol activated. You must now enter the activation code on the inside nameplate. The fieldbus is only deactivated once you do this. Afterwards you must enter the appropriate activation code to activate current outputs of the base module. Additional current outputs (CM444R and CM448R only) are activated as soon as the corresponding module is used.
2) When you order the "Measuring range switching" option, you receive two activation codes. Enter both in order to have two sets for measuring range switching.

Change password

You can lock the operating keys with a password (access the context menu by pressing the navigator for longer). The keys can then only be enabled by entering the right password.

You can set the password to lock the keys here: **Menu/Setup/General settings/Extended setup/Data management/Change lock password**.

1. Enter the current password (factory setting 0000).
   ↳ Enter new lock password
2. Enter a new password.
   ↳ Confirm new lock password
3. Enter the new password again.
   ↳ The lock password has been changed successfully.

Press the navigator for longer to return to the measuring mode.

10.3 Current inputs

The input can be used as the data source for limit switches and logbooks, for example. Furthermore, external values can be made available as set points for controllers.

Menu/Setup/Inputs/Current input x:y [1]		
Function	**Options**	**Info**
Mode	**Selection** ▪ Off ▪ 0 - 20mA ▪ 4 - 20mA **Factory setting** 4 - 20mA	▶ Select the same current range as in the data source (connected device).
Input mode	**Selection** ▪ Flow rate ▪ Parameter ▪ Current **Factory setting** Current	▶ Select the input variable.
Meas. value format	**Selection** ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** #.#	▶ Specify the number of decimal places.
Parameter name **Input mode** = **Parameter**	Customized text, 16 characters	▶ Assign a useful name, e.g. the parameter name that the data source also uses.
Unit of measure **Input mode** = **Parameter**	Customized text, 16 characters	You cannot choose the unit from a list. If you want to use a unit, you must enter it here as customized text.
Lower range value **Input mode** = **Parameter**	-20.0 ... **Upper range value** <unit of measure> **Factory setting** 0.0 <engineering unit>	▶ Enter the measuring range. The lower and upper range values are assigned to the 0 or 4 mA value and the 20 mA value respectively. The system uses the engineering unit which you entered beforehand.
Upper range value **Input mode** = **Parameter**	**Lower range value** to 10000.0 <engineering unit> **Factory setting** 10.0 <engineering unit>	
Damping	0 to 60 s **Factory setting** 0 s	The damping causes a floating average curve of the measured values over the time specified.

1) x:y = slot no. : input number

10.4 Outputs

10.4.1 Current outputs

The basic version of the device always has two current outputs.

You can configure additional current outputs with extension modules.

Setting the current output range

▶ **Menu/Setup/General settings**: select **0..20 mA** or **4..20 mA**.

Menu/Setup/Outputs/Current output x:y [1]		
Function	**Options**	**Info**
Current output	**Selection** ▪ Off ▪ On **Factory setting** Off	Use this function to activate or deactivate a variable being output at the current output
Source of data	**Selection** ▪ None ▪ Connected inputs ▪ Controller **Factory setting** None	The sources of data on offer depend on your device version. The all the sensors and controllers connected to inputs are available for selection.
Measured value	**Selection** ▪ None ▪ Depends on the **Source of data** **Factory setting** None	The measured value you can select depends on the option selected under **Source of data** .
The list of the dependent measured values can be found in the **Measured value** *depending on the* **Source of data**→ 🖹 69. Apart from measured values from connected sensors, you can also select a controller as the data source. The best way to do so is by using the **Additional functions**menu. Here, you can select and configure the current output for outputting the controlled variable.		
Range lower value Range upper value	Range of adjustment and factory settings depending on the **Measured value**	You can output the entire measuring range or just some of it at the current output. To do so, specify the upper and lower range values in accordance with your requirements.
Hold behavior	**Selection** ▪ Freeze ▪ Fixed value ▪ None **Factory setting** Depends on the channel:output	**Freeze** The device freezes the last current value. **Fixed value** You define a fixed current value that is output at the output. **None** A hold does not affect this current output.
Hold current **Hold behavior** = **Fixed value**	0.0 to 23.0 mA **Factory setting** 22.0 mA	▶ Specify which current should be output at this current output in the hold state.

1) x:y = slot: output number

Measured value *depending on the* Source of data

Source of data	Measured value
pH Glass pH ISFET	**Selection** ▪ Raw value mV ▪ pH ▪ Temperature

Source of data	Measured value
ORP	**Selection** ▪ Temperature ▪ ORP mV ▪ ORP %
Oxygen (amp.) Oxygen (opt.)	**Selection** ▪ Temperature ▪ Partial pressure ▪ Concentration liquid ▪ Saturation ▪ Raw value nA *(only* **Oxygen (amp.)***)* ▪ Raw value µs *(only* **Oxygen (opt.)***)*
Cond i Cond c Cond c 4-pol	**Selection** ▪ Temperature ▪ Conductivity ▪ Resistance *(only* **Cond c***)* ▪ Concentration *(only* **Cond i** *and* **Cond c 4-pol***)*
Disinfection	**Selection** ▪ Temperature ▪ Sensor current ▪ Concentration
ISE	**Selection** ▪ Temperature ▪ pH ▪ Ammonium ▪ Nitrate ▪ Potassium ▪ Chloride
TU/TS TU	**Selection** ▪ Temperature ▪ Turbidity g/l *(only* **TU/TS***)* ▪ Turbidity FNU *(only* **TU/TS***)* ▪ Turbidity Formazine *(only* **TU***)* ▪ Turbidity solid *(only* **TU***)*
Nitrate	**Selection** ▪ Temperature ▪ NO3 ▪ NO3-N
Ultrasonic interface	**Selection** ▪ Temperature ▪ Interface ▪ Turbidity
SAC	**Selection** ▪ Temperature ▪ SAC ▪ Transm. ▪ Absorption ▪ COD ▪ BOD

Source of data	Measured value
Controller 1	**Selection** ▪ Bipolar *(only for current outputs)* ▪ Unipolar+ ▪ Unipolar-
Controller 2	
Mathematical functions	All the mathematical functions can also be used as a data source and the calculated value can be used as the measured value.

Outputting the controller manipulated variable via the current output
Unipolar+ Assign to the output to which an actuator that can increase the measured value is connected. **Unipolar-** Assign to the output to which an actuator that can decrease the measured value is connected.
To output the manipulated variable of a two-sided controller, positive manipulated variables and negative manipulated variables generally have to be output to different actuators, as most actuators are able to influence the process in one direction only (not in both). For this purpose, the instrument splits the bipolar manipulated variable y into two unipolar manipulated variables, y+ and y-.
Only the two unipolar manipulated variable parts are available for selection for outputting to modulated relays. If outputting the values via a current output, you also have the possibility of outputting the bipolar manipulated variable y to one current output only (split range).

10.4.2 Alarm relay and optional relays

The basic version of the device always has one alarm relay. Additional relays are also available depending on the version of the device.

The following functions can be output via a relay:
- Limit switch status
- Controller manipulated variable for controlling an actuator
- Diagnostic messages
- Status of a cleaning function in order to control a pump or a valve

You can assign a relay to multiple inputs in order to clean several sensors with just one cleaning unit, for example.

Menu/Setup/Outputs/Alarm relay or relay at channel no.		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ Limit switch ▪ Controller ▪ Diagnostics ▪ Cleaning (sensor) **Factory setting** ▪ Alarm relays: Diagnostics ▪ Other relays: Off	The following functions depend on the option selected. These versions are illustrated individually in the following sections to provide a clearer understanding of the options. **Function** = **Off** Switches off the relay function and means no further settings are required.

Outputting the status of a limit switch

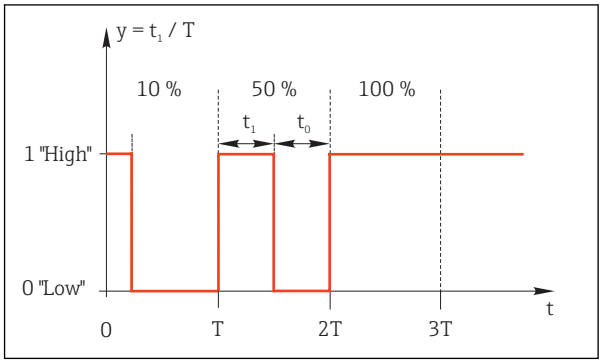
Function = Limit switch		
Function	**Options**	**Info**
Source of data	**Selection** Limit switch 1 ... 8 **Factory setting** None	Select the limit switch via which the status of the relay is to be output. The limit switches are configured in the menu: **Setup/Additional functions/Limit switches**. Use the softkeys **ALL** and **NONE** to select or deselect all the limit switches in one go.

Outputting the manipulated variable of a controller

To output a controller manipulated variable via a relay, the relay is modulated. The relay is energized (pulse, t_1) and is then de-energized (interval, t_0).

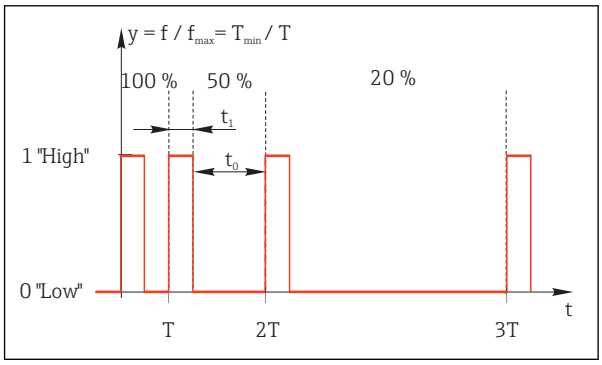
Function = Controller		
Function	**Options**	**Info**
Source of data	**Selection** ▪ None ▪ Controller 1 ▪ Controller 2 **Factory setting** None	▶ Select the controller that should act as the data source.
Operating mode	**Selection** ▪ PWM ▪ PFM **Factory setting** PWM	PWM=pulse width modulation PFM=pulse frequency modulation

1. **PWM** (pulse width modulation):
   The duty cycle is varied within a period **T** ($T=t_1+t_0$). The cycle duration remains constant.



77 *Typical application: solenoid valve*

2. **PFM** (pulse frequency modulation):
   Here, pulses of a constant length (t_1) are output and the interval between the pulses varies (t_0). At a maximum frequency, $t_1 = t_0$.



78 *Typical application: dosing pump*

Function = Controller		
Function	**Options**	**Info**
Actuator type	**Selection** ▪ None ▪ Unipolar(-) ▪ Unipolar(+) **Factory setting** None	Here you specify what part of the controller should power the relay. **Unipolar(+)** is the part of the manipulated variable which the controller uses to increase the process value (e. g. for heating purposes). On the other hand, select **Unipolar(-)** if you want to connect an actuator to the relay that causes the controlled variable to drop (e. g. for cooling purposes).
Cycle duration **Operating mode** = **PWM**	**Shortest turn-on time** to 999.0 s **Factory setting** 10.0 s	▶ Specify the cycle duration within which the duty cycle should be varied (only PWM).
The settings for **Cycle duration** and **Shortest turn-on time** mutually affect one another. The following applies **Cycle duration** ≥ **Shortest turn-on time**.		
Shortest turn-on time **Operating mode** = **PWM**	0.3 s to **Cycle duration** **Factory setting** 0.3 s	Pulses that are shorter than this limit value are not output in order to conserve the actuator.
Maximum frequency **Operating mode** = **PFM**	1 to 180 min^{-1} **Factory setting** 60 min^{-1}	Maximum number of pulses per minute The controller calculates the pulse duration based on this setting.

Outputting diagnostic messages via the relay

If a relay is defined as a diagnostic relay (**Function** = **Diagnostics**), it works in the **"fail-safe mode"**.
This means that the relay is always energized ("normally closed", n.c.) in the basic state if an error is not present. In this way it can also indicate a drop in voltage, for example.
The alarm relay always works in the failsafe mode.

You can output two categories of diagnostic messages via the relay:
- Diagnostic messages from one of the 4 Namur classes → 🖹 112
- Diagnostic messages which you have individually assigned to the relay output

A message is individually assigned to the relay output at 2 specific points in the menu:
- **Menu/Setup/General settings/Extended setup/Diagnostics settings/Diag. behavior** (device-specific messages)
- **Menu/Setup/Inputs/**<Sensor>**/Extended setup/Diagnostics settings/Diag. behavior** (sensor-specific messages)

Before being able to assign the relay output to a special message in **Diag. behavior** you must first configure **Outputs**/Relay x:y or **/Alarm relay/Function** = **Diagnostics** .

Function = Diagnostics		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ as assigned ▪ Namur M ▪ Namur S ▪ Namur C ▪ Namur F **Factory setting** as assigned	**as assigned** If this option is selected, the diagnostic messages which you have individually assigned to the relay are output via the relay. **Namur M** ... **Namur F** If you decided to use one of the Namur classes, all the messages that are assigned to the individual class are output via the relay. You can also change the Namur class assignment for every diagnostic message. (**Menu/Setup/General settings/Extended setup/Diagnostics settings/Diag. behavior** or **Menu/Setup/Inputs/**<Sensor>**/Extended setup/Diagnostics settings/Diag. behavior**)
Attributed diagnostic messages **Operating mode** = **as assigned**	Read only	All the messages assigned to the relay output appear on the display. You do not have the option of editing the information here.

Outputting the status of a cleaning function

Function = Cleaning		
Function	**Options**	**Info**
Assignments	**Options** ▪ None ▪ Depends on the type of cleaning **Factory setting** None	Here you can specify how a cleaning function should be displayed for the relay. Depending on the cleaning program selected (**Menu/Setup/Additional functions/Cleaning**) you can choose from the following: ▪ **Cleaning type** = **Standard clean** **Cleaning 1 - Water**, **Cleaning 2 - Water**, **Cleaning 3 - Water**, **Cleaning 4 - Water** ▪ **Cleaning type** = **Chemoclean** **Cleaning 1 - Water**, **Cleaning 1 - Cleaner**, **Cleaning 2 - Water**, **Cleaning 2 - Cleaner**, **Cleaning 3 - Water**, **Cleaning 3 - Cleaner**, **Cleaning 4 - Water**, **Cleaning 4 - Cleaner** ▪ **Cleaning type** = **Chemoclean Plus** 4x **Cleaning 1 - %0V**, 4x **Cleaning 2 - %0V** [1]

1) %0V is variable text which you can assign in **Menu/Setup/Additional functions/Cleaning/Chemoclean Plus/Output label 1 ... 4** .

10.4.3 HART

Specify which device variables should be output via HART communication.

You can define a maximum of 16 device variables.

1. Specify the data source.
   ↳ You can choose from sensor inputs and controllers.
2. Select the measured value to be output.
3. Specify the behavior in "Hold" status. (Configuration options of **Source of data**, **Measured value** and **Hold behavior**) → 69

Please note that if you select **Hold behavior** = **Freeze** , the system not only flags the status but also actually "freezes" the measured value.

More information is provided in:

Operating Instructions "HART Communication", BA00486C

10.4.4 PROFIBUS DP

Device variables (device → PROFIBUS)

Here you can specify which process values should be mapped to the PROFIBUS function blocks and are thereby available for transmission via PROFIBUS communication.

You can define a maximum of 16 device variables (AI Blocks).

1. Define the data source.
   ↳ You can choose from sensor inputs, current inputs and mathematical functions.
2. Choose the measured value to be transmitted.
3. Define how the device should behave in the hold state. (Configuration options of **Source of data**, **Measured value** and **Hold behavior**) → 69

Please note that if you select **Hold behavior** = **Freeze** , the system not only flags the status but also actually "freezes" the measured value.

In addition, you can define 8 binary variables (DI Blocks):

1. Define the data source.
2. Select the limit switch or relay whose status is to be transmitted.

PROFIBUS variables (PROFIBUS → device)

A maximum of 4 analog (AO) and 8 digital (DO) PROFIBUS variables are available as measured values in the controller, limit switch or current output menus.

Example: Using an AO or DO value as the set point for the controller

Menu/Setup/Additional functions/Controller 1

1. In the specified menu, define PROFIBUS as the data source.
2. Select the desired analog output (AO) or digital output (DO) as the measured value.

Further information on "PROFIBUS" can be found in the Guideline for Communication via PROFIBUS, SD01188C

10.4.5 Modbus RS485 and Modbus TCP

Specify which process values should be output via Modbus RS485 Communication or via Modbus TCP.

In the case of Modbus RS485, you can switch between the RTU and the ASCII protocol.

You can define a maximum of 16 device variables.

1. Define the data source.
   ↳ You can choose from sensor inputs and controllers.
2. Select the measured value to be output.
3. Define how the device should behave in the hold state. (Configuration options of **Source of data**, **Measured value** and **Hold behavior**) → 69

Please note that if you select **Hold behavior** = **Freeze** , the system not only flags the status but also actually "freezes" the measured value.

Further information on "Modbus" can be found in the Guideline for Communication via Modbus, SD01189C

10.4.6 EtherNet/IP

Specify which process values should be output via EtherNet/IP communication.

You can define a maximum of 16 analog device variables (AI).

1. Define the data source.
   ↳ You can choose from sensor inputs and controllers.
2. Select the measured value to be output.
3. Define how the device should behave in the hold state. (Configuration options of **Source of data**, **Measured value** and **Hold behavior**) → 69
4. In the case of controllers, also specify the type of manipulated variable.

Please note that if you select **Hold behavior** = **Freeze** , the system not only flags the status but also actually "freezes" the measured value.

In addition you can define digital device variables (DI):

- Define the data source.
  ↳ You can choose from relays, binary inputs and limit switches.

For further information on "EtherNet/IP", see the Guideline for Communication via EtherNet/IP, SD01293C

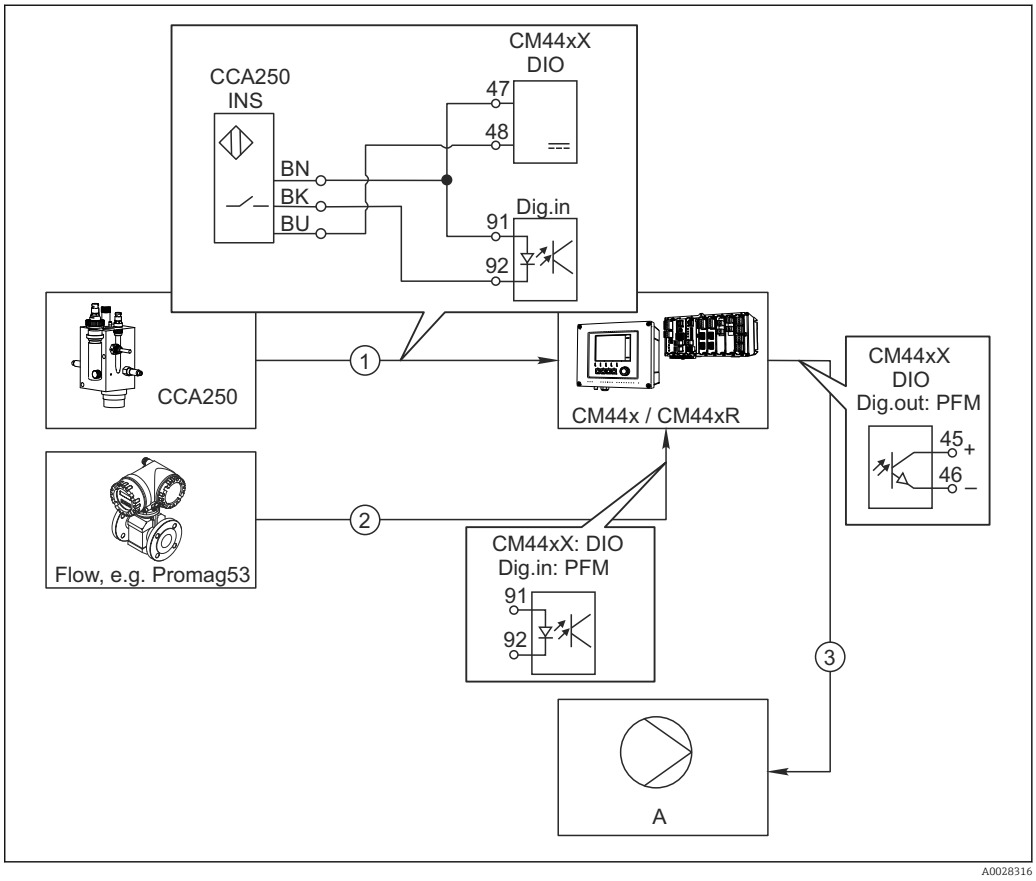
10.5 Binary inputs and outputs

Hardware options, such as the "DIO" module with 2 digital inputs and 2 digital outputs or fieldbus module "485" enable the following:

- Via a digital input signal
  - measuring range switching for conductivity (upgrade code required, → 142)
  - switching between different calibration datasets in the case of optical sensors
  - external hold
  - a cleaning interval to be triggered
  - PID controller switch-on/switch-off, e.g. via the proximity switch of the CCA250
  - the use of the input as an "analog input" for pulse-frequency modulation (PFM)
- Via a digital output signal
  - diagnostic states, point level switches, or similar states transmitted statically (similar to a relay)
  - the dynamic transmission (comparable to a non-wearing "analog output") of PFM signals, e.g. to control dosing pumps

10.5.1 Application examples

Chlorine regulation with feedforward control



79 *Example of chlorine control with feedforward control*

1 *Connection of the inductive proximity switch INS of CCA250 to the digital input of the DIO module*
2 *Connection of the signal from a flowmeter to the digital input of the DIO module*
3 *Activation of a (pulse) dosing pump via the digital output of the DIO module*
A *Dosing pump*

Utilize the advantage of the effectively wear-free control with binary outputs versus a control system with relay. With pulse frequency modulation (PFM), it is possible to achieve virtually continuous dosing using a dosing pump with higher input frequency.

1. Connect the INS proximity switch of the CCA250 assembly to a digital input of the DIO module (e.g. slot 6, port 1).
2. In the software, configure a controller and as the source select the binary input (e.g.**Binary input 1**) to which the proximity switch is connected. (**Menu/Additional functions/Controllers/Controller 1/Controller Enable** = **Binary input 1**)
3. **Signal type**: For the selected input, select the factory setting (**Static signal**).
4. Connect the measured value of a flowmeter to the second input of the DIO module (e.g. slot 6, port 2).
5. **Signal type**: for this input, select **PFM** . (**Menu/Inputs/Binary input 6:2/Signal type** = **PFM**)
6. **Input mode**: select the corresponding measured value (**Flow rate**).
   ↳ You can now use the input you have just configured as the disturbance variable for your controller [1)].

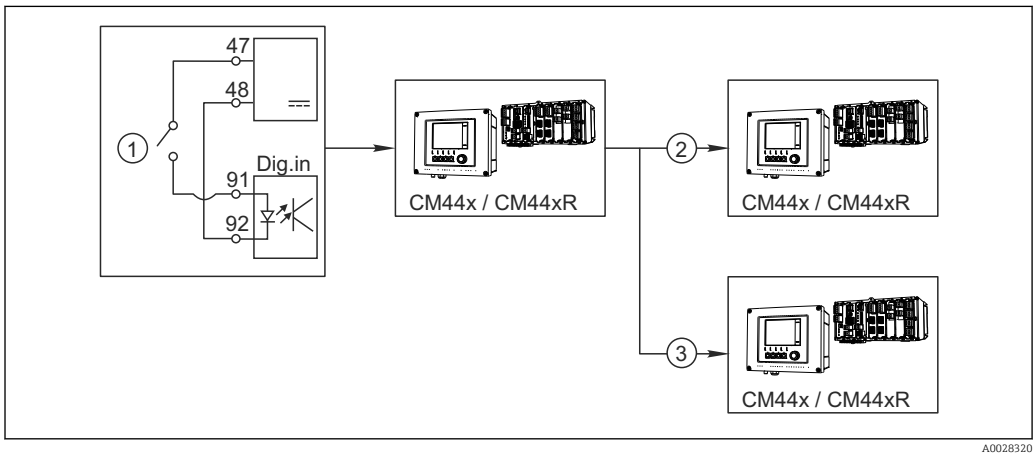
1) An activation code, Order No. 71211288, is necessary for the "feedforward control" function.

7. **Disturbance variable**: in the controller menu, select the binary input to which you have connected the flow measured value. (**Menu/Additional functions/Controllers/Controller 1/Disturbance variable/Source of data** = **Binary input 6:2** and **Measured value** = **PFM value**)
8. You can activate a dosing pump through PFM via a digital output of the DIO module. Connect the pump to an output of the DIO module (e.g. slot 6, port 1) and select the following settings in the menu: **Menu/Outputs/Binary output 6:1/Signal type** = **PFM** and **Source of data** = **Controller 1**.

Take the direction of action of your dosing into account. Select the correct parameter (**Actuator type** = **Unipolar+** or **Unipolar-**).

You must make additional settings in the controller menu to fully customize the control to suit your process conditions.

CM44x as the cleaning master



80 Example of a central cleaning control

1 External cleaning trigger at the binary input
2 Transferring the external hold over binary output to other measuring devices without connected cleaning functions
3 Transferring the cleaning trigger over a binary output to other self-cleaning measuring points

1. An external trigger actuates a cleaning operation at the master.
   A cleaning unit is connected via a relay or a binary output, for example.
2. The cleaning trigger is transferred to another device via a binary output. This does not have its own connected cleaning unit, but its sensors are installed in the medium affected by cleaning the master and are set to hold by the trigger.
3. The trigger is transferred via an additional binary output to another device, whose connected sensors have their own cleaning units. The signal can be used to simultaneously activate a self-cleaning with the master.

10.5.2 Binary input configuration

Menu/Setup/Inputs/Binary input x:y [1]		
Function	**Options**	**Info**
Binary input	**Selection** ▪ Off ▪ On **Factory setting** On	Switches the input on/off
Signal type	**Selection** ▪ Static signal ▪ PFM **Factory setting** Static signal	▶ Select the signal type. **Static signal** Use this setting to read out the position of, for example, an on/off switch, an inductive proximity switch or a PLC binary output. Signal application: for measuring range switching, acceptance of an external hold, as a cleaning trigger or for controller activation **PFM** The PFM setting produces a pulse-frequency-modulated signal that is subsequently available on the device as a quasi-continuous process value. Example: Measuring signal of a flowmeter
Signal type = **Static signal**		
Signal level	**Selection** ▪ Low ▪ High **Factory setting** High	Specifies which input signal levels should activate, for example, measuring range switching or a cleaning. **Low** Input signals between 0 and 5 V DC **High** Input signals between 11 and 30 V DC
Signal type = **PFM**		
Max. frequency	100.00 to 1000.00 Hz **Factory setting** 1000.00 Hz	Maximum frequency of the PFM input signal Is to equal the maximum possible upper limit of the measuring range. If the value selected is too small, higher frequencies will not be detected. If the value is too large, on the other hand, the resolution for small frequencies will be relatively inexact.
Meas. value format	**Selection** ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** #.##	▶ Specify the number of decimal places.

Menu/Setup/Inputs/Binary input x:y [1]		
Function	**Options**	**Info**
Input mode	**Selection** ▪ Frequency ▪ Parameter ▪ Flow rate **Factory setting** Frequency	**Frequency** Display in Hz in the measuring menu **Parameter** You subsequently determine the parameter name and unit. These are then displayed in the measuring menu. **Flow rate** For connecting a flowmeter
Parameter name **Input mode** = **Parameter**	Customized text, 16 characters	▶ Define a name for the parameter, e.g. "Pressure".
Unit of measure **Input mode** = **Parameter**	Customized text, 16 characters	▶ Specify the unit for your parameter, e.g. "hPa".
Flow rate unit **Input mode** = **Flow rate**	**Selection** ▪ l/s ▪ l/h ▪ m^3/s ▪ m^3/h ▪ cfs ▪ cfd ▪ mgd **Factory setting** l/s	▶ Define the unit for the flow. **cfs** = cubic feet per second **cfd** = cubic feet per day **mgd** = mega gallon per day
Lower range value **Input mode** = **Parameter** *or* **Flow rate**	-2000.00 to 0.00 **Factory setting** 0.00	The start of measuring range corresponds to a frequency of 0 Hz. Your previously defined unit is additionally displayed.
Upper range value **Input mode** = **Parameter** *or* **Flow rate**	0.00 to 10000.00 **Factory setting** 0.00	The end of measuring range corresponds to the maximum frequency defined above. Your previously defined unit is additionally displayed.
Damping	0 to 60 s **Factory setting** 0 s	The damping causes a floating average curve of the measured values over the time specified.

1) x:y = slot no. : input number

10.5.3 Configuration of binary outputs

Menu/Setup/Outputs/Binary output x:y [1]		
Function	**Options**	**Info**
Binary output	**Selection** ▪ Off ▪ On **Factory setting** On	Switches the output on/off
Signal type	**Selection** ▪ Static signal ▪ PFM **Factory setting** Static signal	▶ Select the signal type. **Static signal** Comparable to a relay: output of a diagnostic status or a limit switch **PFM** You can output a measured value, e. g. the chlorine value or the manipulated variable of a controller. It functions as a "wear-free" switching contact that can be used to activate a dosing pump, for example.

Menu/Setup/Outputs/Binary output x:y [1]		
Function	**Options**	**Info**
Signal type = **Static signal**		
Function	**Selection** ▪ None ▪ Limit switches ▪ Diagnostics message ▪ Cleaning **Factory setting** None	Source for the outputted switching state The following functions depend on the option selected. **Function** = **None** Switches off the function. There are no other settings.
Assignments **Function** = **Cleaning**	**Multiple selection** ▪ **Cleaning 1 - Water** ... ▪ Cleaning 4 - Cleaner	Here you can decide which binary outputs should be used for activating the valves and pumps. Here you concretely assign a control signal to the binary output for the cleaner/water dosing of a cleaning program. You can define cleaning programs under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Data sources **Function** = **Limit switches**	**Multiple selection** Limit switch 1 ... 8	▶ Select the limit switches that should be output via the binary output. Configuration of the limit switches: **Menu**/**Setup**/**Additional functions**/**Limit switches**.
Operating mode **Function** = **Diagnostics message**	**Selection** ▪ as assigned ▪ Namur M ▪ Namur S ▪ Namur C ▪ Namur F **Factory setting** as assigned	**as assigned** With this selection, the diagnosis messages are transmitted over the binary output that you individually allocated to it. **Namur M ... F** When you choose one of the Namur classes, all messages allocated to that respective class are output. You can change the Namur class assignment for every diagnostic message → 🖹 113.
Signal type = **PFM**		
Max. frequency	1.00 to 1000.00 Hz **Factory setting** 1000.00 Hz	Maximum frequency of the PFM output signal Is to equal the maximum possible upper limit of the measuring range.
Meas. value format	**Selection** ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** #.##	▶ Specify the number of decimal places.

Menu/Setup/Outputs/Binary output x:y [1]		
Function	**Options**	**Info**
Source of data	**Selection** ▪ None ▪ Sensor inputs ▪ Binary inputs ▪ Controller ▪ Fieldbus signals ▪ Mathematical functions **Factory setting** None	Source, whose value should be read out as a frequency over the binary output.
Measuring value **Source of data** ≠ *Controller*	**Selection** Depends on: Source of data	▶ Choose the measured value which should be output as the frequency via the binary output.
Actuator type **Source of data** = *Controller*	**Selection** ▪ None ▪ Bipolar ▪ Unipolar+ ▪ Unipolar- **Factory setting** None	▶ Determines which controller component the connected actuator, e. g. the dosing pump, should trigger. **Bipolar** "Split range" **Unipolar+** Part of the manipulated variable that the controller uses to increase the process value **Unipolar-** For connected actuators that decrease the controlled variable
Hold behavior	**Selection** ▪ Freeze ▪ Fixed value ▪ None **Factory setting** None	**Freeze** The device freezes the last value. **Fixed value** You define a fixed current value that is transmitted at the output. **None** A hold does not affect this output.
Hold value **Hold behavior** = **Fixed value**	0 to 100 % **Factory setting** 0 %	
Error behavior	**Selection** ▪ Freeze ▪ Fixed value **Factory setting** Fixed value	**Freeze** The device freezes the last value. **Fixed value** You define a fixed current value that is transmitted at the output.
Error value **Error behavior** = **Fixed value**	0 to 100 % **Factory setting** 0 %	

1) x:y = slot no. : input number

10.6 Additional functions

10.6.1 Limit switches

There are different ways to configure a limit switch:
- Assigning a switch-on and switch-off point
- Assigning a switch-on and switch-off delay for a relay
- Setting an alarm threshold and also outputting an error message
- Starting a cleaning function

Menu/Setup/Additional functions/Limit switches/Limit switch 1 … 8		
Function	**Options**	**Info**
Source of data	**Selection** ▪ None ▪ Sensor inputs ▪ Binary inputs ▪ Controller ▪ Fieldbus signals ▪ Mathematical functions ▪ MRS set 1 … 2 **Factory setting** None	▶ Specify the input or output which is to be the data source for the limit switch. The sources of data on offer depend on your device version. You can choose from connected sensors, binary inputs, fieldbus signals, mathematical functions, controllers and sets for measuring range switching.
Measuring value	**Selection** Depends on: Source of data	▶ Select the measured value, see the following table.

Measured value *depending on the* **Source of data**

Source of data	Measured value
pH Glass pH ISFET	**Selection** ▪ Raw value mV ▪ pH ▪ Temperature
ORP	**Selection** ▪ Temperature ▪ ORP mV ▪ ORP %
Oxygen (amp.) Oxygen (opt.)	**Selection** ▪ Temperature ▪ Partial pressure ▪ Concentration liquid ▪ Saturation ▪ Raw value nA *(only* **Oxygen (amp.)***)* ▪ Raw value µs *(only* **Oxygen (opt.)***)*
Cond i Cond c Cond c 4-pol	**Selection** ▪ Temperature ▪ Conductivity ▪ Resistance *(only* **Cond c***)* ▪ Concentration *(only* **Cond i** *and* **Cond c 4-pol***)*
Disinfection	**Selection** ▪ Temperature ▪ Sensor current ▪ Concentration
ISE	**Selection** ▪ Temperature ▪ pH ▪ Ammonium ▪ Nitrate ▪ Potassium ▪ Chloride

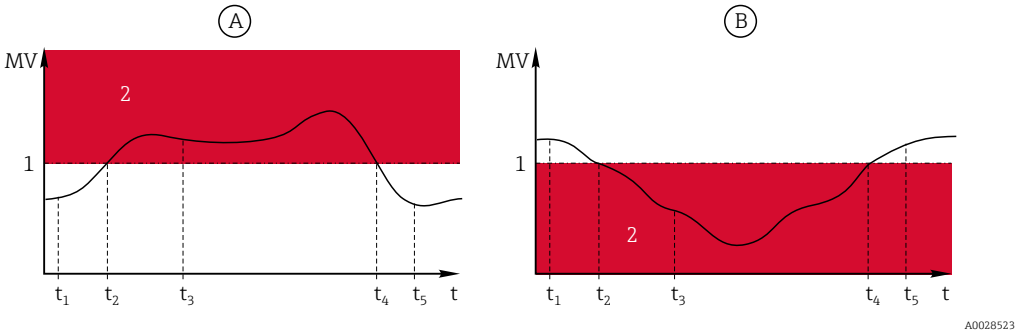
Source of data	Measured value
TU/TS	**Selection** ▪ Temperature ▪ Turbidity g/l *(only* **TU/TS***)* ▪ Turbidity FNU *(only* **TU/TS***)* ▪ Turbidity Formazine *(only* **TU***)* ▪ Turbidity solid *(only* **TU***)*
TU	
Nitrate	**Selection** ▪ Temperature ▪ NO3 ▪ NO3-N
Ultrasonic interface	**Selection** ▪ Temperature ▪ Interface ▪ Turbidity
SAC	**Selection** ▪ Temperature ▪ SAC ▪ Transm. ▪ Absorption ▪ COD ▪ BOD
Controller 1	**Selection** ▪ Bipolar *(only for current outputs)* ▪ Unipolar+ ▪ Unipolar-
Controller 2	
Mathematical functions	All the mathematical functions can also be used as a data source and the calculated value can be used as the measured value.

You can monitor the manipulated variable by assigning the controller manipulated variable to a limit switch (e. g. configure a dosing time alarm).

Menu/Setup/Additional functions/Limit switches/Limit switch 1 … 8		
Function	**Options**	**Info**
Cleaning program	**Selection** ▪ None ▪ Cleaning 1 … 4 **Factory setting** None	Use this function to choose which cleaning instance should start when the limit switch is active.
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Activating/deactivating the limit switch
Operating mode	**Selection** ▪ Above limit check ▪ Below limit check ▪ In range check ▪ Out of range check ▪ Change rate **Factory setting** Above limit check	Type of limit value monitoring: ▪ Limit value overshoot or undershoot→ 81 ▪ Measured value within or outside a range → 82 ▪ Rate of change → 84

Menu/Setup/Additional functions/Limit switches/Limit switch 1 … 8

Function	Options	Info
Limit value	Settings depend on the measured value	**Operating mode** = **Above limit check** *or* **Below limit check**

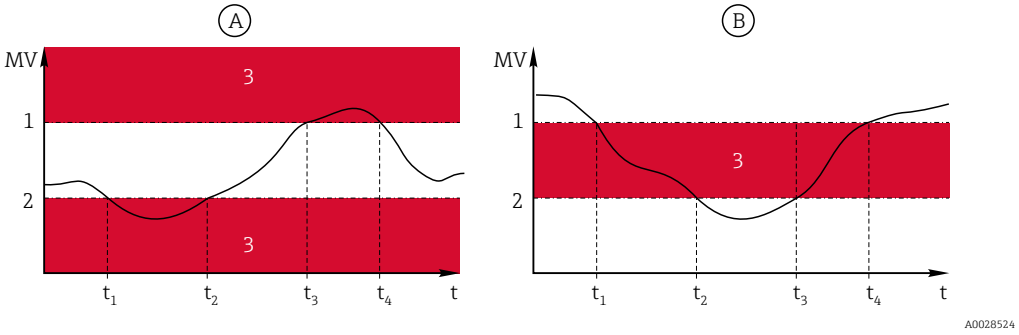


81 Exceeding (A) and undershooting (B) a limit value (without hysteresis and switch-on delay)

1 Limit value
2 Alarm range
$t_{1,3,5}$ No action
$t_{2,4}$ An event is generated

- If the measured values (MV) are increasing, the relay contact is closed when the on-value is exceeded (**Limit value** + **Hysteresis**) and the start delay (**Start delay**) has elapsed.
- If the measured values are decreasing, the relay contact is reset when the off-value is undershot (**Limit value** - **Hysteresis**) and following the drop-out delay (**Switch off delay**).

Range lower value	Settings depend on the measured value	**Operating mode** = **Out of range check** *or* **In range check**
Range upper value		

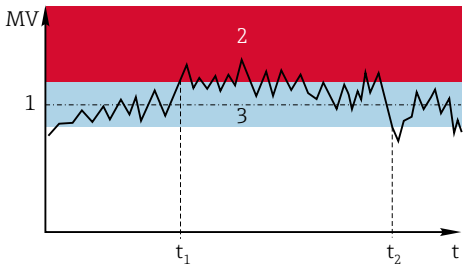


82 Range monitoring outside (A) and within (B) a range (without hysteresis and switch-on delay)

1 End of range
2 Start of range
3 Alarm range
t_{1-4} An event is generated

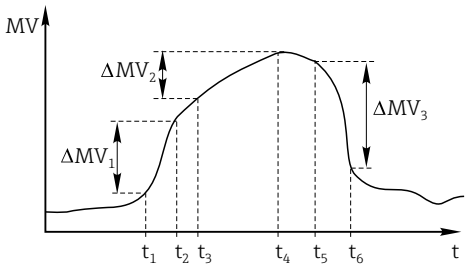
- If the measured values (MV) are increasing, the relay contact is closed when the on-value is exceeded (**Range lower value** + **Hysteresis**) and the start delay (**Start delay**) has elapsed.
- If the measured values are decreasing, the relay contact is reset when the off-value is undershot (**Range upper value** - **Hysteresis**) and following the drop-out delay (**Switch off delay**).

Menu/Setup/Additional functions/Limit switches/Limit switch 1 ... 8		
Function	**Options**	**Info**
Hysteresis	Settings depend on the measured value	**Operating mode** ≠ **Change rate** The hysteresis is needed to ensure a stable switching behavior. The device software adds or subtracts the value set here to/from the limit value (**Limit value**, **Range lower value** or **Range upper value**). This results in double the **Hysteresis**value for the hysteresis range around the limit value. An event is then only generated if the measured value (MV) completely passes through the hysteresis range.
Start delay **Operating mode** ≠ **Change rate**	0 to 9999 s **Factory setting** 0 s	Synonyms: pick-up and drop-out delay
Switch off delay **Operating mode** ≠ **Change rate**		
Delta value	Settings depend on the measured value	**Operating mode** = **Change rate** The slope of the measured value (MV) is monitored in this mode. An event is generated if, in the given timeframe (**Delta time**), the measured value increases or decreases by more than the specified value (**Delta value**). No further event is generated if the value continues to experience such a steep increase or decrease. If the slope is back below the limit value, the alarm status is reset after a preset time (**Auto Confirm**). Events are triggered by the following conditions in the example given: t_2 - t_1 < **Delta time** and ΔMV1 > **Delta value** t_4 - t_3 >**Auto Confirm** and ΔMV2 < **Delta value** t_6 - t_5 < **Delta time** and ΔMV3 > **Delta value**
Delta time	00:01 to 23:59 **Factory setting** 01:00	
Auto Confirm	00:01 to 23:59 **Factory setting** 00:01	



83 Hysteresis taking the example of limit value overshoot

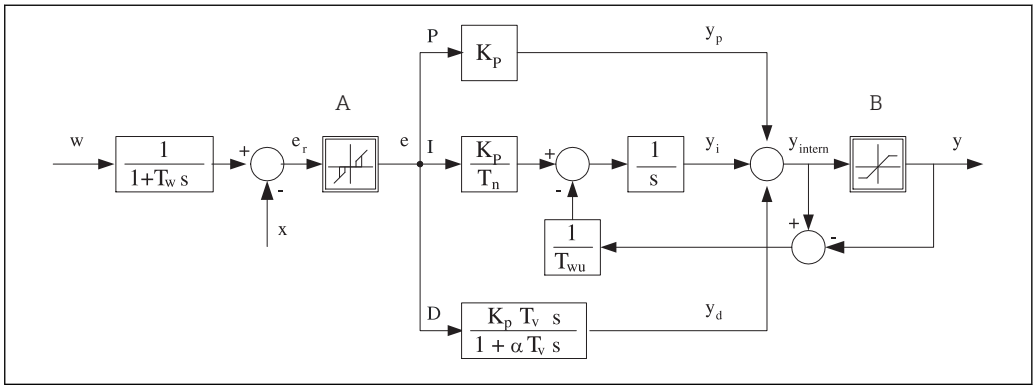
1 Limit value
2 Alarm range
3 Hysteresis range
$t_{1,2}$ An event is generated



84 Rate of change

10.6.2 Controller

Controller structure in Laplace representation



85 *Block diagram of the controller structure*

A	*Neutral zone*	*I*	*Integral value*
B	*Output limiting*	*D*	*Derivative value*
K_p	*Gain (P-value)*	αT_V	*Damping time constant with α = 0 to 1*
T_n	*Integral action time (I-value)*	*e*	*Control deviation*
T_v	*Derivative action time (D-value)*	*w*	*Set point*
T_w	*Time constant for set point damping*	*x*	*Controlled variable*
T_{wu}	*Time constant for anti-windup feedback*	*y*	*Manipulated variable*
P	*Proportional value*		

The controller structure of the device comprises set point damping at the input to prevent erratic changes in the manipulated variable if the set point changes. The difference between the set point w and the controlled variable (measured value) X results in the control deviation which is filtered by a neutral zone.

The neutral zone is used to suppress control deviations (e) that are too small. The control deviation thus filtered is now fed to the actual PID controller which divides into 3 parts based on the P (proportional), I (integral) and D (derivative) values (top-down). The integral section (middle) also comprises an anti-windup mechanism for limiting the integrator. A low-pass filter is added to the D-section to damp hard D-terms in the manipulated variable. The sum of the 3 sections results in the internal controller manipulated variable which is limited according to the settings (for PID-2s to -100% to +100%).

The graphic does not illustrate a downstream filter for limiting the rate of change of the manipulated variable (can be configured in the menu in **Max y change rate**).

In the menu do not configure the gain K_p. Instead configure the reciprocal value, the proportional band X_p ($K_p=1/X_p$).

Configuration

Make the following decisions to configure a controller:
- (1) What type of process can your process be assigned to? → **Process type**
- (2) Should it be possible to influence the measured variable (controlled variable) in one direction or in both directions? One-sided or two-sided controller, → **Controller type**
- (3) What should be the controlled variable (sensor, measured value)? → **Controlled variable**
- (4) Do you have a disturbance variable that should be active at the controller output? → **Disturbance variable**

- (5) Specify the parameters for the controller:
  - Set point, → **Setpoint**
  - Neutral zone, → **Xn**
  - Proportional band, → **Xp**
  - Integral action time (I-value), → **Tn**
  - Derivative action time (D-value), → **Tv**
- (6) What should the controller do in the event of a hold (measured error, sensor replacement, cleaning etc.)?
  - Pause or continue with dosing? →**Hold behavior/Manipulated Variable**
  - At the end of a hold, continue or restart the control loop (affects I-value)? →**Hold behavior/State**
- (7) How should the actuator be triggered?
  - **Unipolar+**: assign this setting to the output for an actuator which can increase the measured value.
  - **Unipolar-**: assign this setting to the output for an actuator which can decrease the measured value.
  - **Bipolar**: select this setting if you want to output the manipulated variable via one current output only (split range).
- (8) Configure the outputs and switch on the controller.

Menu/Setup/Additional functions/Controller 1 … 2		
Function	**Options**	**Info**
Control	**Selection** ▪ Off ▪ Automatic ▪ Manual mode **Factory setting** Off	▶ First configure the controller and leave the switch at the factory setting (**Off**). Once you have made all the settings, you can assign the controller to an output and switch it on.
▶ Manual mode		
y	-100 to 100 % **Factory setting** 0 %	▶ Specify the manipulated variable that should be output in manual mode.
y Actual output	Read only	Manipulated variable actually output.
Setpoint		Current set point
x		Current measured value
Disturbance variable		Current measured value of disturbance variable
Norm. disturb. value		
Name	Free text	▶ Give the controller a name so you can identify it later on.
Controller Enable	**Selection** ▪ None ▪ Binary inputs ▪ Limit switches ▪ Fieldbus variables **Factory setting** None	In connection with the DIO module, you can select a binary input signal, e. g.from an inductive proximity switch, as a source for enabling the controller.
Setup Level	**Selection** ▪ Standard ▪ Advanced **Factory setting** Standard	Changes the number of parameters that can be configured. → **Parameters** → 🖹 92 **Standard**: If you choose this, the other controller parameters are active nevertheless. The factory settings are used. These suffice in most cases.

Menu/Setup/Additional functions/Controller 1 … 2

Function	Options	Info
Process type	**Selection** ▪ Inline ▪ Batch **Factory setting** Inline	▶ Decide what type of process best describes your particular process.

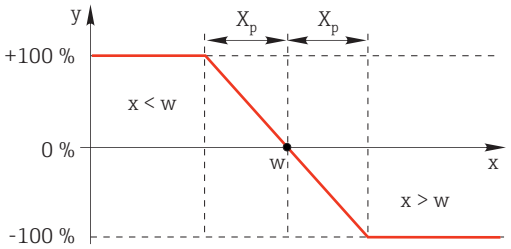
Batch process
The medium is in a closed system.
The task of the control system is to dose in such a way that the measured value (controlled variable) changes from its start value to its target value. No more dosing is needed once the set point has been reached and the system is stable. If the target value is overshot, a two-sided control system can compensate for this. In the case of 2-sided batch control systems, a neutral zone is used/configured to suppress oscillations around the set point.

In-line process
In an in-line process, the control system works with the medium flowing by in the process.
Here, the controller has the task of using the manipulated variable to set a mixture ratio between the medium and dosing agent such that the resulting measured variable corresponds to the set point. The properties and volume of the medium flow can change at any time and the controller has to react to these changes on a continuous basis. If the flow rate and medium remain constant, the manipulated variable can also assume a fixed value once the process has settled. Since the control process is never "finished" here, this type of control is also referred to as continuous control.

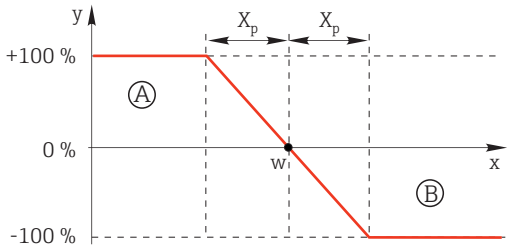
A mixture of both process types can often be found in practice: the semi-batch process. Depending on the ratio between the flow and the container volume, this arrangement behaves either like a batch process or an in-line process.

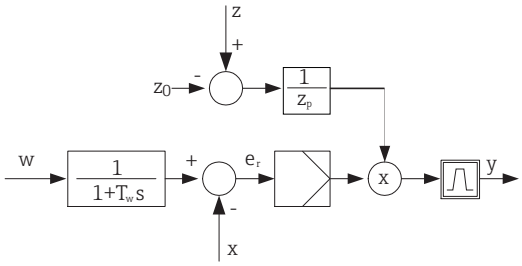
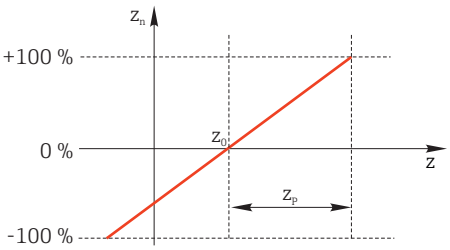
Controller type	**Selection** ▪ PID 1-sided ▪ PID 2-sided **Factory setting** PID 2-sided	Depending on which actuator you have connected, you influence the process in only one direction (e.g . heating) or in both directions (e. g. heating and cooling).

A 2-sided controller can output a manipulated variable in the range from -100 % to +100 %, i. e. the manipulated variable is bipolar. The manipulated variable is positive if the controller should increase the process value. In the case of a pure P-controller, this means that the value of the controlled variable x is smaller than the set point w. On the other hand, the manipulated variable is negative if the process value should be decreased. The value for x is greater than the set point w.



86 *Relationship y = (w-x)/X_p*

Menu/Setup/Additional functions/Controller 1 ... 2		
Function	**Options**	**Info**
Effective direction **Controller type** = **PID 1-sided**	**Selection** ▪ Direct ▪ Reverse **Factory setting** Reverse	In what direction should the controller influence the measured value? ▪ The measured value should increase as a result of dosing (e. g. heating) → **Reverse** ▪ The measured value should decrease as a result of dosing (e. g. cooling) → **Direct**
A 1-sided controller has a unipolar manipulated variable, i. e. it can only influence the process in one direction. **Reverse**: If the controller should increase the process value, set this as the direction of action. The controller becomes active when the process value is too small (range A). **Direct**: With this direction of action, the controller acts as a "downwards controller". It becomes active when the process value (e. g. the temperature) is too high (range B).  87 *Red: overlap between the curves of the two 1-sided controllers.*		
▶ Controlled variable		
Source of data	**Selection** ▪ None ▪ Sensor inputs ▪ Current inputs ▪ Fieldbus signals ▪ Binary inputs ▪ Mathematical functions **Factory setting** None	▶ Specify the input or output which should be the source of data for the controlled variable.
Measured value	**Selection** Depends on **Source of data** **Factory setting** None	▶ Specify the measured value that should be your controlled variable. You can use different measured values depending on the data source. → 82
▶ Setpoint		Target value of the controlled variable This menu is not displayed if you selected a fieldbus as the source (**Source of data** = fieldbus).
Setpoint	Range of adjustment and factory setting depending on the **Source of data**	▶ Specify the target value for the controlled variable.
Tw **Setup Level** = **Advanced**	0.0 to 999.9 s **Factory setting** 2.0 s	Time constant for the set point damping filter
▶ Disturbance variable		optional, activation code necessary

Menu/Setup/Additional functions/Controller 1 ... 2		
Function	**Options**	**Info**
In the case of "flowing medium" (in-line) controls, the flow rate may not be constant. In some circumstances, strong fluctuations are possible. In the case of a settled control system in which the flow rate is suddenly halved, it is desirable that the dosed quantity from the controller is also directly halved. In order to achieve this type of "flow-rate-proportional" dosing, this task is not left to the I-component of the controller, but rather one enters the (to be measured) flow rate as disturbance variable z multiplicative at the controller output.  Strictly speaking, feedforward control involves an open-loop control system, since its effect is not measured directly. That means that the feed flow is directed exclusively forward. Hence the designation "feedforward control". For the additive feedforward control that is alternatively available in the device, the (standardized) disturbance variable is added to the controller manipulated variable. This enables you to set up a type of variable base load dosing. The standardization of the disturbance variable is required both for multiplicative and for additive feedforward control and is done using parameters Z_0 (zero point) and Z_p (proportional band): $z_n = (z - z_0)/z_p$  **Example** Flowmeter with measuring range 0 to 200 m^3/ h The controller would currently dose 100% without feedforward control. The feedforward control should be configured such that at z = 200m^3/h, the controller still doses at 100% (z_n = 1). If the flow rate drops, the dosing rate should be reduced, and at a flow rate of less than 4 m^3/h, dosing should stop entirely (z_n = 0). → Select the zero point z_0 = 4 m^3/h and the proportional band Z_p= 196 m^3/h.		
Function	**Selection** ▪ Off ▪ Multiply ▪ Add **Factory setting** Off	Selecting multiplicative or additive feedforward control
Source of data	**Selection** ▪ None ▪ Sensor inputs ▪ Current inputs ▪ Fieldbus signals ▪ Binary inputs ▪ Mathematical functions **Factory setting** None	▶ Specify the input which should be the source of data for the disturbance variable.

Menu/Setup/Additional functions/Controller 1 ... 2

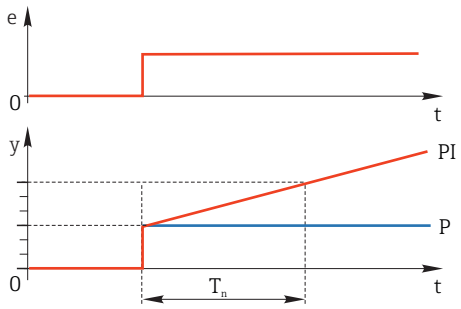
Function	Options	Info
Measured value	**Selection** Depends on **Source of data** **Factory setting** None	▶ Specify the measured value that should be your disturbance variable. You can use different measured values depending on the data source. → 🖹 82
Zp	Range of adjustment depending on the selection of the measured value	Proportional band -->
Z0		Zero point
▶ Parameters		

The Liquiline PID controller has been implemented in the serial structural form, i. e. it has the following parameters:
- Integral action time T_n
- Derivative action time T_v
- Proportional band X_p

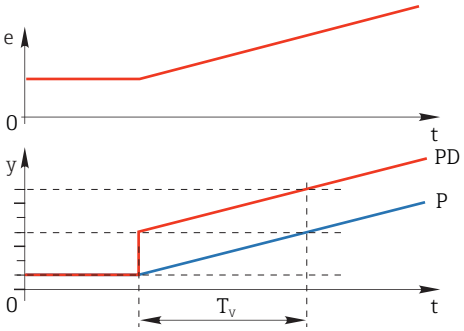
Setup Level = **Advanced**: With this setup level, you can also configure the following:
- Time constant T_{wu}
- Time constant α
- Width of the neutral zone X_n
- Width of the hysteresis range of the neutral zone X_{hyst}
- Clock time of the controller

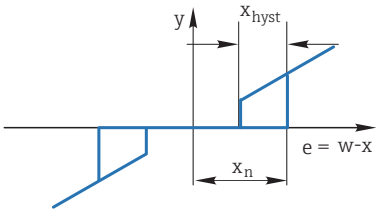
Tn	0.0 to 9999.0 s **Factory setting** 0.0 s	The integral action time specifies the effect of the I-value If **Tn** > 0 the following applies: **Clock** < **Twu** < 0.5(**Tn** + **Tv**)

The integral action time is the time needed in a step-function response to achieve a change in the manipulated variable - as a result of the I effect - which has the same magnitude as the P-value.



e = control deviation, e=w-x (set point controlled variable)

Menu/Setup/Additional functions/Controller 1 … 2		
Function	**Options**	**Info**
Twu	0.1 to 999.9 s **Factory setting** 20.0 s	Time constant for anti-windup feedback The lower the value the greater the integrator inhibition. Exercise extreme caution when making changes. **Clock** < **Twu** < 0.5(**Tn** + **Tv**)
Tv	0.1 to 999.9 s **Factory setting** 0.0 s	The derivative action time specifies the effect of the D-value
The derivative action time is the time by which the ramp response of a PD controller reaches a specific value of the manipulated variable at an earlier stage than it would solely as a result of its P-value.  		
alpha	0.0 to 1.0 **Factory setting** 0.3	Affects the additional damping filter of the D-controller. The time constant is calculated from $\alpha \cdot T_v$.
Process balance **Controller type** = **PID 2-sided**	**Selection** ▪ Symmetric ▪ Asymmetric **Factory setting** Symmetric	**Symmetric** There is only one control gain and this applies for both sides of the process. **Asymmetric** You can set the control gain individually for both sides of the process.
Xp **Process balance** = **Symmetric**	Range of adjustment and factory setting depending on the **Source of data**	Proportional band, reciprocal value of the proportional gain K_p As soon as controlled variable x deviates more than x_p from the set point w, manipulated variable y reaches 100%.
Xp Low **Process balance** = **Asymmetric**	Range of adjustment and factory setting depending on the **Source of data**	x_p for y < 0 (manipulated variable < 0)
Xp High **Process balance** = **Asymmetric**		x_p for y > 0 (manipulated variable > 0)
Xn	Range of adjustment and factory setting depending on the **Source of data**	Tolerance range about the set point that prevents minor oscillations about the set point if using two-sided control loops.
XN Low **Process balance** = **Asymmetric**	Range of adjustment and factory setting depending on the **Source of data**	x_n for x < w (controlled variable < set point)
XN High **Process balance** = **Asymmetric**		x_n for x > w (controlled variable > set point)

Menu/Setup/Additional functions/Controller 1 ... 2		
Function	**Options**	**Info**
XHyst	0.0 to 99.9 % **Factory setting** 0.0 %	Width of the hysteresis range of the neutral zone, relative component of x_n
 The graphic illustrates the manipulated variable (with a pure P-controller) over the control deviation e (set point minus controlled variable). Very low control deviations are set to zero. Control deviations > x_n are processed "in the normal way". Via x_{hyst} it is possible to configure a hysteresis to suppress oscillations at the edges.		
Clock	0.333 to 100.000 s **Factory setting** 1.000 s	**Expert setting** Only change the clock time of the controller if you know exactly what you are doing. **Clock** < **Twu** < 0.5(**Tn** + **Tv**)
Max y change rate	0.00 to 1.00 **Factory setting** 0.40	Limits the change of the output variable A value of 0.5 permits a maximum manipulated variable change of 50 % within one second.
▶ Exception behavior		Hold=measured value is no longer reliable
Manipulated Variable	**Selection** ▪ Freeze ▪ Fixed value **Factory setting** Freeze	How should the controller react to a measured value that is no longer reliable? **Freeze** The manipulated variable is frozen at the current value **Fixed value** Manipulated variable is set to 0 (no dosing)
State	**Selection** ▪ Freeze ▪ Reset **Factory setting** Freeze	Internal controller status **Freeze** No change **Reset** After a hold, the control system starts from scratch, and settling time takes place again.
Hold as exception	**Selection** ▪ All ▪ None **Factory setting** All	▶ Select: Should the hold trigger the previously selected exception behaviour, or should it be ignored?
▶ Outputs		Goes to the menu **Outputs** → 🖹 69
▶ Controller assignment view		Shows an overview of the inputs and outputs used

10.6.3 Cleaning programs

⚠ CAUTION

Cleaning not switched off during calibration or maintenance activities

Risk of injury due to medium or cleaning agent!

- ▶ If a cleaning system is connected, switch it off before removing a sensor from the medium.
- ▶ If you wish to check the cleaning function and have therefore not switched off the cleaning system, wear protective clothing, goggles and gloves or take other appropriate measures.

Cleaning types

The user can choose from the following cleaning types:
- Standard clean
- Chemoclean
- Chemoclean Plus

State of cleaning: Indicates whether the cleaning program is active or not. This is for information purposes only.

Selecting the cleaning type

1. **Menu/Setup/Additional functions/Cleaning**: Select a cleaning program.
   ↳ You can configure 4 different types of cleaning which you can assign individually to the inputs.
2. **Cleaning type**: For each cleaning program decide which type of cleaning should be performed.

Standard cleaning

Standard cleaning involves cleaning a sensor with compressed air, for instance, as performed with the ion-selective sensor CAS40D (connection of cleaning unit for → 33CAS40D)

Menu/Setup/Additional functions/Cleaning/Cleaning 1 ... 4/Standard clean		
Function	**Options**	**Info**
Cleaning time	5 to 600 s **Factory setting** 10 s	Cleaning duration The cleaning duration and interval depend on the process and sensor. ▶ Determine the variables empirically or based on experience.

▶ Define the cleaning cycle→ 97.

Chemoclean

An example is the use of the CYR10 injector unit to clean pH glass sensors. (CYR10 connection → 33)

Menu/Setup/Additional functions/Cleaning/Cleaning 1 ... 4/Chemoclean		
Function	**Options**	**Info**
Cleaning time	0 to 900 s **Factory setting** 5 s	Cleaning duration
Prerinse time	0 to 900 s **Factory setting** 0 s	The cleaning duration, pre-rinse and post-rinse times and the interval depend on the process and sensor. Determine the variables empirically or based on experience.
Postrinse time		

Chemoclean Plus

An example is the use of the CYR10 injector unit to clean pH glass sensors. (CYR10 connection → 🖹 33)

Menu/Setup/Additional functions/Cleaning/Cleaning 1 … 4/Chemoclean Plus/ChemoCleanPlus setup		
Function	**Options**	**Info**
Cleaning steps setup	Table to create a time program	You define a maximum of 30 program steps which should be performed one after the other. For each step enter the duration [s] and the state (0 = "off", 1 = "on") of each relay or output. You can specify the number and name of the outputs further down in the menu. See below for an example of programming.
Failsafe step setup	Table view	▶ In the table specify the states that the relays or outputs should assume in the event of an error.
Limit contacts	0 to 2	▶ Select the number of digital input signals (e. g. from limit position switches of the retractable assembly).
Limit contact 1 … 2	**Selection** ▪ Binary inputs ▪ Fieldbus signals	▶ Define the signal source for each limit position switch.
Outputs	0 to 4	▶ Select the number of outputs that actuators, such as valves or pumps, should activate.
Output label 1 … 4	Free text	You can assign a meaningful name to each output, e. g. "assembly", "cleaner 1", "cleaner 2", etc.

Programming example: regular cleaning with water and 2 cleaning agents

Limit switch	Duration [s]	Assembly CPA87x	Water	Cleaner 1	Cleaner 2
ES1 1	5	1	1	0	0
ES2 1	5	1	1	0	0
0	30	1	1	0	0
0	5	1	1	1	0
0	60	1	0	0	0
0	30	1	1	0	0
0	5	1	1	0	1
0	60	1	0	0	0
0	30	1	1	0	0
ES1 0	5	0	1	0	0
ES2 0	5	0	1	0	0
0	5	0	0	0	0

The pneumatic retractable assembly, e.g. CPA87x, is activated by compressed air via a two-way valve. As a result, the assembly assumes either the "Measure" position (sensor in medium) or the "Service" position (sensor in rinse chamber). Media such as water or cleaning agents are supplied via valves or pumps. Here there are two states: 0 (= "off" or "closed") and 1 (= "on" or "open").

The hardware required for "Chemoclean Plus", such as control valves, pumps, compressed air supply, media supply etc., must be provided by the customer.

Defining the cleaning cycle

Menu/Setup/Additional functions/Cleaning/Cleaning 1 … 4		
Function	**Options**	**Info**
Cleaning cycle	**Selection** ▪ Off ▪ Interval ▪ Weekly program **Factory setting** Weekly program	▶ Choose from a cleaning routine that is restarted at set intervals and a user-definable weekly program.
Cleaning interval **Cleaning cycle** = **Interval**	0-00:01 to 07-00:00 (D-hh:mm) **Factory setting** 1-00:00	The interval value can be between 1 minute and 7 days. Example: You have set the value "1-00:00". Each day, the cleaning cycle starts at the same time you started the first cleaning cycle.
Daily event times **Cleaning cycle** = **Weekly program**	00:00 to 23:59 (HH:MM)	1. Define up to 6 times (**Event time 1 … 6**). ↳ You can then choose from these for each day of the week. 2. Choose individually for each day of the week which of the 6 times should be used for a cleaning routine on this particular day. This allows you to create weekly programs that are perfectly adapted to suit your process.
Weekdays **Cleaning cycle** = **Weekly program**	**Selection** **Monday** … **Sunday**	

Other settings and manual cleaning

Menu/Setup/Additional functions/Cleaning/Cleaning 1 … 4		
Function	**Options**	**Info**
Start signal	**Selection** ▪ None ▪ Fieldbus signals ▪ Signals of digital or analog inputs **Factory setting** None	In addition to cyclic cleaning, you can also use an input signal to start event-controlled cleaning. ▶ Choose the trigger for such a cleaning process here. Interval and weekly programs are executed as normal, i. e. conflicts can occur. Priority is given to the cleaning program that was the first to be started.
Hold	**Selection** ▪ Off ▪ On **Factory setting** On	▶ Decide whether there should be a hold during the cleaning process. This hold affects the inputs to which this cleaning process is assigned.
▷ Start single	Action	Start an individual cleaning process with the selected parameters. If cyclical cleaning is enabled, there are times in which it is not possible to manually start the process.
▷ **Stop** or **Stop Failsafe**	Action	End the cleaning process (cyclically or manually)
▶ Outputs		Goes to the menu **Outputs** → 🖹 69
▶ Cleaning program assignment view		Shows an overview of the cleaning processes

10.6.4 Mathematical functions

In addition to "real" process values, which are provided by connected physical sensors or analog inputs, mathematical functions can be used to calculate a maximum of 6 "virtual" process values.

The "virtual" process values can be:
- Output via a current output or a fieldbus
- Used as a controlled variable
- Assigned as a measured variable to a limit switch
- Used as a measured variable to trigger cleaning
- Displayed in user-defined measuring menus

Difference

You can subtract the measured values of two sensors and use the result to detect incorrect measurements, for example.

To calculate a difference, you must use two measured values with the same engineering unit.

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Difference		
Function	**Options**	**Info**
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Y1	The options depend on the sensors connected	Select the sensors and the measured variables that should act as the minuend (**Y1**) or subtrahend (**Y2**).
Measured value		
Y2		
Measured value		
Difference value	Read only	View this value in a user-defined measuring screen or output the value via the current output.
▶ Mathematical function assignment view		Overview of the configured functions

Redundancy

Use this function to monitor two or three sensors with redundant measurements. The arithmetic average of the two closest measured values is calculated and output as the redundancy value.

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Redundancy		
Function	**Options**	**Info**
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Y1	The options depend on the sensors connected	You can select a maximum of 3 different types of sensor that output the same measured value. **Example for temperature redundancy** You have a pH sensor and an oxygen sensor at inputs 1 and 2. Select the pH sensor as **Y1** and the oxygen sensor as **Y2** item. **Measured value**: In each case **Temperature** item.
Measured value		
Y2		
Measured value		
Y3 (optional)		
Measured value		

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Redundancy		
Function	**Options**	**Info**
Deviation control	**Selection** ▪ Off ▪ On **Factory setting** Off	You can monitor the redundancy. Specify an absolute limit value that must not be exceeded.
Deviation limit	Depends on the selected measured value	
Redundancy	Read only	View this value in a user-defined measuring screen or output the value via the current output.
▶ Mathematical function assignment view		Overview of the configured functions

rH value

To calculate the rH value, a pH sensor and an ORP sensor must be connected. It is irrelevant whether you are using a pH glass sensor, an ISFET sensor or the pH electrode of an ISE sensor.

Instead of the mathematical functions, you can also connect a combined pH/ORP sensor.

▶ Set the main measured value simply to rH (**Setup**/).

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = rH calculation		
Function	**Options**	**Info**
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
pH source	Connected pH sensor	Set the input for the pH sensor and the input for the ORP sensor. Measured value interrogation is obsolete as you must select pH or ORP mV.
ORP source	Connected ORP sensor	
Calculated rH	Read only	View this value in a user-defined measuring screen or output the value via the current output.
▶ Mathematical function assignment view		Overview of the configured functions

Degassed conductivity

Carbon dioxide from the air can be a contributing factor to the conductivity of a medium. The degassed conductivity is the conductivity of the medium excluding the conductivity caused by carbon dioxide.

Advantages of using degassed conductivity taking the example of a power station:
- The conductivity caused by corrosion products or contamination in the feed water is determined as soon as the turbines are started. The system excludes the initially high conductivity values resulting from the ingress of air.
- If carbon dioxide is regarded as non-corrosive, the live steam can be directed to the turbine far earlier during startup.
- If the conductivity value increases during normal operation, it is possible to immediately determine an ingress of coolant or air by calculating the degassed conductivity.

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Degassed conductivity		
Function	**Options**	**Info**
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Cation conductivity	Connected conductivity sensor	**Cation conductivity** is the sensor downstream from the cation exchanger and upstream from the "degassing module", **Degassed conductivity** is the sensor at the outlet of the degassing module. Measured value interrogation is obsolete as you can only choose conductivity.
Degassed conductivity	Connected conductivity sensor	
CO2 concentration	Read only	View this value in a user-defined measuring screen or output the value via the current output.
▶ Mathematical function assignment view		Overview of the configured functions

Dual conductivity

You can subtract two conductivity values and use the result to monitor the efficiency of an ion exchanger, for example.

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Dual conductivity		
Function	**Options**	**Info**
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Inlet	The options depend on the sensors connected	Select the sensors that should act as the minuend (**Inlet**, e. g. sensor upstream from ion exchanger) or subtrahend (**Outlet**, e. g. sensor downstream from ion exchanger).
Measured value		
Outlet		
Measured value		
Main value format	**Selection** ▪ Auto ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** Auto	Specify the number of decimal places.
Cond. unit	**Selection** ▪ Auto ▪ µS/cm ▪ mS/cm ▪ S/cm ▪ µS/m ▪ mS/m ▪ S/m **Factory setting** Auto	
Dual conductivity	Read only	View this value in a user-defined measuring screen or output the value via the current output.
▶ Mathematical function assignment view		Overview of the configured functions

Calculated pH value

The pH value can be calculated from the measured values of two conductivity sensors under certain conditions. Areas of application include power stations, steam generators and boiler feedwater.

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = pH calculation from conductivity		
Function	**Options**	**Info**
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Method	**Selection** ▪ NaOH ▪ NH3 ▪ LiOH **Factory setting** NaOH	The calculation is performed on the basis of Guideline VGB-R-450L of the Technical Association of Large Power Plant Operators (Verband der Großkesselbetreiber, (VGB)). **NaOH** $pH = 11 + \log \{(\kappa_v - 1/3\ \kappa_h)/273\}$ **NH3** $pH = 11 + \log \{(\kappa_v - 1/3\ \kappa_h)/243\}$ **LiOH** $pH = 11 + \log \{(\kappa_v - 1/3\ \kappa_h)/228\}$ κ_v ... **Inlet** ... direct conductivity κ_h ... **Outlet** ... acid conductivity
Inlet Measured value Outlet Measured value	The options depend on the sensors connected	**Inlet** Sensor upstream from the cation exchanger, "direct conductivity" **Outlet** Sensor downstream from the cation exchanger, "acid conductivity" The choice of measured value is obsolete since it must always be **Conductivity** .
Calculated pH	Read only	View this value in a user-defined measuring screen or output the value via the current output.
▶ Mathematical function assignment view		Overview of the configured functions

Cation exchanger capacity (optional, with activation code)

Cation exchangers are used to monitor the water/steam circuit for inorganic contamination. The cation exchangers eliminate the disruptive influence of alkalizing agents, such as ammonium hydroxide or caustic soda, which are added to the boiler feedwater.

The service life of cation exchangers depends on:
- The type of alkalizing agent
- The concentration of the alkalizing agent
- The amount of contamination in the medium
- The capacity of the cation exchanger (efficiency of the resin)

To ensure the smooth operation of power stations, it is important to continuously monitor the exchange column load. When a user-defined remaining capacity is reached, the transmitter displays a diagnostic message so that the ion exchange column can be replaced or regenerated in good time.

The calculation of the remaining capacity depends on the following factors:
- Flow rate
- Volume of the exchanger
- Salinity of the water at the exchanger inlet
- Total volume capacity of the resin
- Degree of efficiency of the exchanger

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Cation exchanger capacity		
Function	**Options**	**Info**
Cond IEX output	Read only	
Cond IEX input		
Flow rate		
Remaining capacity		
Remaining op. time		
Time until %0B [1)]		
▶ Configuration		
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Unit of volume	**Selection** ▪ l ▪ gal **Factory setting** l	
Exchanger volume	0.0 to 99999 **Factory setting** 0.0	Volume of the cation exchanger Unit depending on the option selected in **Unit of volume**
TVC Resin	0.0 to 99999 **eq/l** or **eq/gal** **Factory setting** 0.0 **eq/l**	TVC = total volume capacity Unit as equivalent per **Unit of volume**
Resin efficiency	1.0 to 100.0 % **Factory setting** 100.0 %	For information on the resin efficiency, refer to the data provided by the manufacturer of the resin used.
Set remaining capacity	**Selection** ▪ Yes ▪ No **Factory setting** No	Before you start monitoring, specify the remaining capacity of the exchanger resin. This value makes allowances for the re-use of resin that has already been used. If a value is not entered manually, 100 % is taken as the initial value for calculating the current remaining capacity.
Remaining capacity **Set remaining capacity** = **Yes**	0.0 to 100.0 % **Factory setting** 0.0 %	
Warning limit	1.0 to 100.0 % **Factory setting** 20.0 %	Specify the remaining capacity at which the transmitter should display a diagnostic message.

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Cation exchanger capacity		
Function	**Options**	**Info**
Cond IEX input	Connected conductivity sensor	Select the conductivity sensor upstream from the inlet of the exchanger column.
Cond IEX output	Connected conductivity sensor	Select the conductivity sensor downstream from the outlet of the exchanger column.
Max cond at IEX output	0.0 to 99999 µS/cm **Factory setting** 0.0 µS/cm	Here, enter the maximum value that the acid conductivity may have at the outlet of the cation exchanger. The transmitter displays a diagnostic message if this value is exceeded.
Flow rate type	**Selection** ▪ Source value ▪ Fixed value **Factory setting** Source value	**Source value** You have connected the measured value of a flowmeter via a current input or a binary input. **Fixed value** Manual entry of a fixed flow rate
Flow rate	**Selection** ▪ None ▪ Current inputs ▪ Binary inputs **Factory setting** None	Specify the input at which you have connected and configured the measured value of a flowmeter (**Menu**/**Setup**/**Inputs**).
Fixed value **Flow rate type** = **Fixed value**	Free text	Specify the fixed flow value which you have read on an external flowmeter, for example.
Min flow rate	0.0 to 99999 l/h **Factory setting** 0.0 l/h	
Max flow rate		
▶ Mathematical function assignment view		Overview of the configured functions

1) %0B is a variable whose value depends on the configuration. The configured value is displayed, e.g. 20%.

Formula (optional, with activation code)

With the formula editor, it is possible to calculate a new value from a maximum of 3 measured values. A wide range of mathematical and logical (Boolean) operations are available for this purpose.

The Liquiline firmware offers you a powerful mathematics tool with the formula editor. You are responsible for the feasibility of your formula, and therefore for the feasibility of the result.

Symbol	Operation	Type of operands	Type of result	Example
+	Addition	Numerical	Numerical	A+2
-	Subtraction	Numerical	Numerical	100-B
*	Multiplication	Numerical	Numerical	A*C
Select /	Division	Numerical	Numerical	B/100
^	Power	Numerical	Numerical	A^5
²	Square	Numerical	Numerical	A^2
³	Cube	Numerical	Numerical	B^3
SIN	Sine	Numerical	Numerical	SIN(A)
COS	Cosine	Numerical	Numerical	COS(B)
EXP	Exponential function e^x	Numerical	Numerical	EXP(A)
LN	Natural logarithm	Numerical	Numerical	LN(B)

Symbol	Operation	Type of operands	Type of result	Example
LOG	Decadic logarithm	Numerical	Numerical	LOG(A)
MAX	Maximum of two values	Numerical	Numerical	MAX(A,B)
MIN	Minimum of two values	Numerical	Numerical	MIN(20,B)
ABS	Absolute value	Numerical	Numerical	ABS(C)
NUM	Boolean → numerical conversion	Boolean	Numerical	NUM(A)
=	Equals	Boolean	Boolean	A=B
<>	Not equal to	Boolean	Boolean	A<>B
>	Greater than	Numerical	Boolean	B>5.6
<	Less than	Numerical	Boolean	A<C
OR	Disjunction	Boolean	Boolean	B OR C
AND	Conjunction	Boolean	Boolean	A AND B
XOR	Exclusive disjunction	Boolean	Boolean	B XOR C
NOT	Negation	Boolean	Boolean	NOT A

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Formula		
Function	**Options**	**Info**
Calculation	**Selection** ▪ Off ▪ On **Factory setting** Off	On/off switch for the function
Source A … C	**Selection** Select source **Factory setting** None	You can use all the sensor inputs, binary and analog inputs, mathematical functions, limit switches, fieldbus signals, controllers and data records for measuring range switching as the source for measured values. 1. Choose a maximum of three sources (A, B and C) for measured values. 2. For each source, choose the measured value to be calculated. ↳ All available signals - depending on the selected source - are possible measured values. 3. Enter the formula. 4. Switch on the calculation. ↳ The current measured values A, B and C as well as the result of the calculation using the formula are displayed.
Measured value	**Selection** Depends on the source	
A … C	The current measured value is displayed	
Formula	Free text	Table → 🖹 103 Make sure the exact notation is used (upper case). Blank spaces before and after mathematical characters are irrelevant. Note the operator precedence, i.e. multiplication and division take precedence over addition and subtraction. Use parentheses if necessary.

Menu/Setup/Additional functions/Mathematical functions/MF1 to 6/Mode = Formula		
Function	**Options**	**Info**
Result unit	Free text	You may enter a unit for the calculated value if desired.
Result format	**Selection** ▪ # ▪ #.# ▪ #.## ▪ #.### ▪ #.#### **Factory setting** #.##	Select the number of decimal places.
Result numeric	Read only	Current, calculated value
▶ Mathematical function assignment view		Overview of the configured functions

Example: 2-point chlorine regulator with volume flow monitoring

A relay output activates a dosing pump. The pump should switch on when the following 3 conditions are met:
- (1) There is flow
- (2) The volume flow is above a defined value
- (3) The concentration of chlorine drops below a defined value

1. Connect a binary input signal from an "INS" point level switch of the CCA250 assembly to the DIO module.
2. Connect an analog input signal of a volume flow meter to the AI module.
3. Connect the chlorine sensor.
4. Configure the mathematical function **Formula** : **Source A** = DIO binary input, **Source B** = AI current input, **Source C** = input **Disinfection**.
   ↳ Formula:
   A AND (B > 3) AND (C < 0.9)
   (where 3 is the lower limit value of the volume flow and 0.9 is the lower limit value of the chlorine concentration)
5. Configure the relay output with the mathematical function **Formula** and connect the dosing pump to the corresponding relay.

The pump is switched on if all 3 conditions are met. If one of the conditions is no longer met, the pump is switched off again.

ⓘ Instead of outputting the result of the formula directly to a relay, you can also connect a limit switch in between in order to attenuate the output signal via a switch-on and switch-off delay.

Example: Load-based control

The load - i.e. the product of the concentration and volume flow - is needed for the dosage of precipitants, for instance.

1. Connect the input signal of a phosphate analyzer to the AI module.
2. Connect an analog input signal of a volume flow meter to the AI module.
3. Configure the mathematical function **Formula** : **Source A** = phosphate input signal and **Source B** = volume flow input signal.
   ↳ Formula:
   A*B*x
   (where x is an application-specific proportionality factor)
4. Select this formula as the source e.g. of the current output or of a modulated binary output.

5. Connect the valve or pump.

10.6.5 Measuring range switching

A measuring range switching (MRS) configuration includes the following options for each of the four binary input states:
- Operating mode (conductivity or concentration)
- Concentration table
- Temperature compensation
- Current output turndown
- Limit switch range

An MRS set is assigned to a channel and switched on. The measuring range configuration selected via the binary inputs is now applied instead of the normal configuration of the linked sensor channel. For current outputs and limit switches to be controlled by the MRS, they must be linked to the MRS set, not to the measuring channel.
Current outputs and limit switches can be linked to an MRS set. This MRS set gives you the measured value and the associated turn down (current outputs) or the range for limit value monitoring (limit switches).
A limit switch connected to an MRS set always uses the **Out of range check**mode. Consequently, it switches when the value is outside the configured range.
If a current output or limit switch is connected to an MRS set, the turndown, monitoring range and limit switch mode can no longer be configured manually. Therefore, these options are hidden in the menus (current outputs and limit switch).

Programming example: CIP cleaning in a brewery

	Beer	**Water**	**Alkali**	**Acid**
Binary input 1	0	0	1	1
Binary input 1	0	1	0	1
	Measuring range 00	Measuring range 01	Measuring range 10	Measuring range 11
Operating mode	Conductivity	Conductivity	Concentration	Concentration
Conc. Table	-	-	NaOH 0..15%	User table 1
Compensation	User table 1	Linear	-	-
Current output				
Range lower value	1.00 mS/cm	0.1 mS/cm	0.50 %	0.50 %
Range upper value	3.00 mS/cm	0.8 mS/cm	5.00 %	1.50 %
Limit switches				
Range lower value	2.3 mS/cm	0.5 mS/cm	2.00 %	1.30 %
Range upper value	2.5 mS/cm	0.7 mS/cm	2.10 %	1.40 %

Menu/Setup/Additional functions/Measuring range switch		
Function	**Options**	**Info**
▶ MRS set 1 … 2		If you enter both activation codes, you have two independent parameter sets available for measuring range switching. The submenus are the same for both sets.
MRS	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Sensor	**Selection** ▪ None ▪ Connected conductivity sensors **Factory setting** None	This function can be used on conductivity sensors only.
Binary input 1 … 2	**Selection** ▪ None ▪ Binary inputs ▪ Fieldbus signals ▪ Limit switches **Factory setting** None	Source of the switching signal, can be selected for input 1 and 2 in each case
▶ Measuring range 00 … 11		Select the MRSs; a maximum of 4 are possible. The submenus are identical for each and thus are displayed only once.
Operating mode	**Selection** ▪ Conductivity ▪ Concentration ▪ TDS ▪ Resistance **Factory setting** Conductivity	Selection depends on the sensor used: ▪ Inductive sensor and conductive four-pin sensor – Conductivity – Concentration – TDS ▪ Conductive sensor – Conductivity – Resistance – TDS
Conc. Table **Operating mode** = **Concentration**	**Selection** ▪ NaOH 0..15% ▪ NaOH 25..50% ▪ HCl 0..20% ▪ HNO3 0..25% ▪ HNO3 24..30% ▪ H2SO4 0..28% ▪ H2SO4 93..100% ▪ H3PO4 0..40% ▪ NaCl 0..26% ▪ User table 1 … 4 **Factory setting** NaOH 0..15%	Concentration tables saved at the factory: ▪ NaOH: 0 to 15%, 0 to 100 °C (32 to 212 °F) ▪ NaOH: 25 to 50%, 2 to 80 °C (36 to 176 °F) ▪ HCl: 0 to 20%, 0 to 65 °C (32 to 149 °F) ▪ HNO3: 0 to 25%, 2 to 80 °C (36 to 176 °F) ▪ H2SO4: 0 to 28%, 0 to 100 °C (32 to 212 °F) ▪ H2SO4: 40 to 80%, 0 to 100 °C (32 to 212 °F) ▪ H2SO4: 93 to 100%, 0 to 100 °C (32 to 212 °F) ▪ H3PO4: 0 to 40%, 2 to 80 °C (36 to 176 °F) ▪ NaCl: 0 to 26%, 2 to 80 °C (36 to 176 °F)
Compensation **Operating mode** = **Conductivity**	**Selection** ▪ None ▪ Linear ▪ NaCl (IEC 746-3) ▪ Water ISO7888 (20°C) ▪ Water ISO7888 (25°C) ▪ UPW NaCl ▪ UPW HCl ▪ User table 1 … 4 **Factory setting** Linear	Various methods are available to compensate for the temperature dependency. Depending on your process, decide which type of compensation you want to use. Alternatively, you can also select **None** and thus measure uncompensated conductivity.

Menu/Setup/Additional functions/Measuring range switch		
Function	**Options**	**Info**
▶ Current output		
Range lower unit	Depends on the **Operating mode**	Units are only queried for **Operating mode** = **Conductivity** . The other units are pre-defined and cannot be modified. ▪ Conductivity **S/m**, **mS/cm**, **µS/cm**, **S/cm**, **µS/m**, **mS/m** ▪ Concentration % ▪ TDS ppm ▪ Resistance Ωcm
Range lower value		
Range upper unit		
Range upper value		
▶ Limit switches		
Range lower unit	Depends on the **Operating mode**	Units are only queried for **Operating mode** = **Conductivity** . The other units are pre-defined and cannot be modified. ▪ Conductivity **S/m**, **mS/cm**, **µS/cm**, **S/cm**, **µS/m**, **mS/m** ▪ Concentration % ▪ TDS ppm ▪ Resistance Ωcm
Range lower value		
Range upper unit		
Range upper value		

10.6.6 Diagnostic modules

Here you can configure a maximum of 8 individual diagnostic messages.

A diagnostic module has the following properties:
- The feed source can be configured like a binary output (relay, digital output).
- You can choose whether the diagnostic message should be output at a high level or low level.
- You decide which error category (Namur class) should be assigned to the message.
- You can define a customized text to be output as the diagnostic message text.

In addition you can switch off the factory diagnostic code for limit switches. This allows you to:
- Use the limit switch on a purely functional basis (without a message)
- Configure application-specific message texts
- Control diagnostic modules directly by a digital signal or via a limit switch output (enables the use of switch-on/switch-off delay, for example).

Menu/Setup/Additional functions/Diagnostic modules		
Function	**Options**	**Info**
▶ Diagnostic module 1 (961) … 8 (968)		
Source of data	**Selection** ▪ None ▪ Fieldbus signals ▪ Binary inputs ▪ Limit switches **Factory setting** None	Specify the input which should be the source of data for the diagnostic message.
Measured value	**Selection** depend on **Source of data** **Factory setting** None	Specify the measured value that should trigger the diagnostic message. You can use different measured values depending on the data source. → 🖹 82

Menu/Setup/Additional functions/Diagnostic modules		
Function	**Options**	**Info**
Active low	**Selection** ▪ Off ▪ On **Factory setting** On	**On**: The output value is equal to the inverse output value.
Short text	Free text	Give the diagnostic message a name.
▶ Diagnostic module assignment view		Shows an overview of the diagnostic modules used.

11 Calibration

- Sensors with Memosens protocol are calibrated at the factory.
- Users must decide whether the process conditions present require calibration during initial commissioning.
- Additional calibration is not required in many standard applications.
- Calibrate the sensors at sensible intervals depending on the process.

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12 Diagnostics and troubleshooting

12.1 General troubleshooting

The transmitter continuously monitors its functions itself.

If a diagnostic message occurs, the display alternates between the diagnostic message and the measured value in the measuring mode.

The color of the display background changes to red if a diagnostic message for error category "F" occurs.

12.1.1 Troubleshooting

A diagnostic message appears on the display or via the fieldbus , measured values are not plausible, or you identify a fault.

1. See the Diagnostics menu for details on the diagnostic message.
   ↳ Follow the instructions to rectify the problem.
2. If this does not help, search for the diagnostic message under "Overview of diagnostic information"(→ 114) in these Operating Instructions. Use the message number as a search criterion. Ignore the letters indicating the Namur error category.
   ↳ Follow the troubleshooting instructions provided in the last column of the error tables.
3. If the measured values are implausible, the local display is faulty or you encounter other problems, search for the faults under "Process errors without messages" (→ Operating Instructions Memosens, BA01245C) or "Device-specific errors" (→ 111).
   ↳ Follow the recommended measures.
4. Contact the Service Department if you cannot rectify the error yourself, citing only the error number.

12.1.2 Process errors without messages

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12.1.3 Device-specific errors

Problem	Possible cause	Tests and/or remedial measures
Dark display	No supply voltage	Check if supply voltage applied.
	Base module defective	Replace base module
Values appear on display but: ▪ Display does not change and / or ▪ Device cannot be operated	Module not wired correctly	Check modules and wiring.
	Impermissible operating system condition	Switch off device and switch it on again.
Implausible measured values	Inputs defective	First perform tests and take measures as outlined in "Process-specific errors" section Measuring input test: ▸ Connect the emocheck Sim CYP03D to the input and use it to check the function of the input.

Problem	Possible cause	Tests and/or remedial measures
Current output, incorrect current value	Incorrect adjustment	▶ Check with integrated current simulation, connect mA meter directly to current output.
	Load too large	
	Shunt / short to ground in current loop	
No current output signal	Base module defective	▶ Check with integrated current simulation, connect mA meter directly to current output.

12.2 Diagnostic information on the local display

Up-to-date diagnostic events are displayed along with their status category, diagnostic code and short text. Clicking on the navigator lets you retrieve more information and tips on remedial measures.

12.3 Diagnostic information via web browser

The same information as for the local display is available via the web server.

12.4 Diagnostic information via fieldbus

Diagnostic events, status signals and more information are transmitted according to the definitions and technical capability of the respective fieldbus systems.

12.5 Adapting the diagnostic information

12.5.1 Classification of diagnostic messages

In the **DIAG/Diagnostics list** menu you can find more detailed information on the current diagnostic messages displayed.

In accordance with Namur specification NE 107, the diagnostic messages are characterized by:

- Message number
- Error category (letter in front of the message number)
  - **F** = (Failure) a malfunction has been detected
    The measured value of the affected channel is no longer reliable. The cause of the malfunction is to be found in the measuring point. Any control system connected should be set to manual mode.
  - **C** = (Function check), (no error)
    Maintenance work is being performed on the device. Wait until the work has been completed.
  - **S** = (Out of specification), the measuring point is being operated outside its specification
    Operation is still possible. However, you run the risk of increased wear, shorter operating life or lower measurement accuracy. The cause of the problem is to be found outside the measuring point.
  - **M** = (Maintenance required), action should be taken as soon as possible
    The device still measures correctly. Immediate measures are not necessary. However, proper maintenance efforts would prevent a possible malfunction in the future.
- Message text

If you contact the Service Department, please cite the message number only. Since you can individually change the assignment of an error to an error category, the Service Department cannot use this information.

12.5.2 Adapting the diagnostic behavior

All the diagnostic messages are assigned to specific error categories at the factory. Since other settings might be preferred depending on the application, error categories and the effect errors have on the measuring point can be configured individually. Furthermore, every diagnostic message can be disabled.

Example

Diagnostic message 531 **Logbook full**appears on the display. You want to change this message so that an error is not shown on the display for example.

1. **Menu/Setup/General settings/Extended setup/Diagnostics settings/Diag. behavior** .
2. Select the diagnostics message and press the navigator button.
3. Decide: (a) Should the message be deactivated? (**Diagnostics message** = **Off**)
   (b) Do you want to change the error category?(**Status signal**)
   (c) Should an error current be output? (**Error current** = **On**)
   (d) Do you want to trigger a cleaning program? (**Cleaning program**)
4. Example: You deactivate the message.
   ↳ The message is no longer displayed. In the **DIAG** menu, the message appears as **Past message**.

Possible settings

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/Run the ../Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then can you make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ Off ▪ On **Factory setting** Depends on the Diag. code	You can deactivate or reactivate a diagnostic message here. Deactivating means: ▪ No error message in the measuring mode ▪ No error current at the current output
Error current	**Selection** ▪ Off ▪ On **Factory setting** Depends on the Diag. code	Decide whether an error current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the error current is switched to all the current outputs. In the event of channel-specific errors, the error current is only switched to the current output in question.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the Diag. code	The messages are divided into different error categories in accordance with NAMUR NE 107. Decide whether you want to change a status signal assignment for your application.

Menu/Setup/Run the ../Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
Diag. output	**Selection** ▪ None ▪ Binary outputs ▪ Alarm relay ▪ Relay **Factory setting** None	You can use this function to select an output to which the diagnostic message should be assigned. An alarm relay is always available, regardless of the device version. Other relays are optional. Before you can assign the message to an output: Configure one of the output types mentioned as follows: **Menu**/**Setup**/**Outputs**/(**Alarm relay** or **Binary output** or **relay**)/**Function** = **Diagnostics** and **Operating mode** = **as assigned**.
Cleaning program	**Selection** ▪ None ▪ Cleaning 1 ... 4 **Factory setting** None	Decide whether the diagnostic message should trigger a cleaning program. You can define cleaning programs under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
▶ Detail information	Read only	Here you can find more information on the diagnostic message and instructions on how to resolve the problem.

12.6 Overview of diagnostic information

12.6.1 Device-specific, general diagnostic messages

No.	Message	Factory settings			Tests or remedial action
		S [1]	D [2]	F [3]	
202	Selftest active	F	On	Off	Wait for self-test to be finished
216	Hold active	C	On	Off	Output values and status of the channel are on hold
241	Firmware failure	F	On	On	Internal device error 1. Update the software 2. Contact the Service Department 3. Replace the backplane (Service)
242	Firmware incomp.	F	On	On	
243	Firmware failure	F	On	On	
261	Electronics module	F	On	On	Electronics module defective 1. Replace the module 2. Contact the Service Department
262	Module connection	F	On	On	Electronics module not communicating 1. Check the module , replace it if necessary 2. Contact the Service Department
263	Incomp. detected	F	On	On	Wrong kind of electronics module 1. Replace the module 2. Contact the Service Department
284	Firmware update	M	On	Off	Update completed successfully

No.	Message	Factory settings			Tests or remedial action
		S [1]	D [2]	F [3]	
285	Update error	F	On	On	Firmware update failed 1. Repeat 2. SD card error → use another card 3. Incorrect firmware → repeat with suitable firmware 4. Contact the Service Department
302	Battery low	M	On	Off	Buffer battery of real time clock is low The date and time are lost if the power is interrupted. ▶ Contact the Service Department (battery replacement)
304	Module data	F	On	On	At least 1 module has incorrect configuration data 1. Check the system information 2. Contact the Service Department
305	Power consumption	F	On	On	Total power consumption too high 1. Check installation 2. Remove sensors/modules
306	Software error	F	On	On	Internal firmware error ▶ Contact the Service Department
366	Module connection	F	On	On	No communication with the actuator module ▶ Check the internal connecting cable to the 1IF module
370	Internal voltage	F	On	On	Internal voltage outside the valid range ▶ Check supply voltage
373	Electronictemp. high	M	On	Off	High electronics temperature ▶ Check ambient temperature and energy consumption
374	Sensor check	F	On	Off	No measurement signal from sensor 1. Check sensor connection 2. Check sensor, replace if necessary
401	Factory reset	F	On	On	Factory reset is performed
403	Device verification	M	Off	Off	Device verification active, please wait
405	Service IP active	C	Off	Off	Service switch is switched on The device can be addressed at 192.168.1.212. ▶ Switch off the service switch to change to the saved IP settings
406	Param. active	C	Off	Off	▶ Wait for configuration to be finished
407	Diag. setup active	C	Off	Off	▶ Wait for maintenance to be finished
412	Writing backup	F	On	Off	▶ Wait for the write process to be finished
413	Reading backup	F	On	Off	▶ Wait
460	Output below limit	S	On	Off	Reasons ▪ Sensor in air ▪ Air pockets in assembly ▪ Sensor fouled ▪ Incorrect flow to sensor 1. Check sensor installation 2. Clean sensor 3. Adjust assignment of current outputs
461	Output above limit	S	On	Off	

No.	Message	Factory settings			Tests or remedial action
		S [1]	D [2]	F [3]	
502	No text catalog	F	On	On	▶ Contact the Service Department
503	Language change	M	On	Off	Language change failed ▶ Contact the Service Department
529	Diag. setup active	C	Off	Off	▶ Wait for maintenance to be finished.
530	Logbook at 80%	M	On	Off	1. Save the logbook to the SD card and then delete the logbook in the device 2. Set memory to ring memory 3. Deactivate logbook
531	Logbook full	M	On	Off	
532	License error	M	On	Off	▶ Contact the Service Department
540	Parameter save fail	M	On	Off	Storage of configuration has failed ▶ Repeat
541	Parameter load ok	M	On	Off	Configuration successfully loaded
542	Parameter load fail	M	On	Off	Loading of configuration has failed ▶ Repeat
543	Parameter load abort	M	On	Off	Configuration loading aborted
544	Parameter reset ok	M	On	Off	Factory default successful
545	Parameter reset fail	M	On	Off	Setting of device configuration to factory setting has failed
731	Leakage sensor	F	On	Off	Leak detected in the sample preparation system or analyzer 1. Check hoses and connections 2. Check solenoid valves 3. Check leakage sensor 4. Check the free outlet on the analyzer 5. Replace defective parts and, if necessary, reset the operating hours counters in the Diagnostics menu
906	Cat.exchanger failure	F	On	Off	Invalid values for conductivity or flow 1. Check for valid measured values in the menu of the mathematical function. 2. Check sensors. 3. Check minimum flow.
907	Cat.exchanger warning	S	On	Off	Limit values exceeded for conductivity or flow. Possible reasons: ▪ Resin depleted ▪ Blocked pipe ▶ Check application.
908	IEX capacity low	M	On	Off	The capacity of the exchange resin will soon be exhausted. ▶ Schedule resin regeneration or replacement.
909	IEX capacity exhausted	F	On	Off	The capacity of the exchange resin is exhausted. ▶ Regenerate or replace the resin.
910	Limit switch	S	On	Off	Limit switch activated
937	Controlled variable	S	On	Off	Controller input warning Status of the controller variable is not OK ▶ Check application

No.	Message	Factory settings			Tests or remedial action
		S [1]	D [2]	F [3]	
938	Controller setpoint	S	On	Off	Controller input warning Status of set point is not OK ▶ Check application
939	Control. disturbance	S	On	Off	Controller input warning Status of disturbance variable is not OK ▶ Check application
951 - 958	Hold active CH1 ..	C	On	Off	Output values and status of the channels are on hold. ▶ Wait until the hold is deactivated again.
961 - 968	Diagnostic module 1 (961) ... Diagnostic module 8 (968)	S	Off	Off	Diagnostic module is enabled
969	Modbus Watchdog	S	Off	Off	The device did not receive a Modbus telegram from the master within the specified time. The status of Modbus process values received is set to invalid
970	Curr. input overload	S	On	On	Current input overloaded The current input is switched off from 23 mA due to overload and reactivated automatically when a normal load is present.
971	Current Input low	S	On	On	Current input too low At 4 to 20 mA, the input current is less than the lower failure current. ▶ Check the input for short-circuiting
972	Curr. input > 20 mA	S	On	On	Current output range exceeded
973	Current Input < 4 mA	S	On	On	Current output range undershot
974	Diagnostics confirm.	C	Off	Off	User has acknowledged the message displayed in the measuring menu.
975	Device restart	C	Off	Off	Device reset
976	PFM value high	S	On	Off	Pulse frequency modulation: output signal exceeded/undershot. Measured value outside the specified range. ▪ Sensor in air ▪ Air pockets in assembly ▪ Incorrect flow to sensor ▪ Sensor fouled 1. Clean sensor 2. Check plausibility 3. Adjust the PFM configuration
977	PFM value low	S	On	Off	
978	ChemoClean Failsafe	S	On	On	No feedback signal detected within the configured period. 1. Check the application 2. Check the wiring 3. Extend the duration
990	Deviation limit	F	On	On	Redundancy: limit value of percentage deviation exceeded
991	CO2 conc. range	F	On	On	CO_2 concentration (degassed conductivity) outside the measuring range
992	pH calculation range	F	On	On	pH calculation outside the measuring range
993	rH calculation range	F	On	On	rH calculation outside the measuring range

No.	Message	Factory settings			Tests or remedial action
		S [1]	D [2]	F [3]	
994	Difference conduct.	F	On	On	Dual conductivity outside the measuring range
995	Mathematical error	S	On	On	Incorrect calculation result 1. Check the mathematical functions. 2. Check the input variables.

1) **Status signal**
2) **Diagnostic message**
3) **Error current**

12.6.2 Sensor-specific diagnostic messages

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12.7 Pending diagnostic messages

The Diagnostics menu contains all the information on the device status.

Furthermore, various service functions are available.

The following messages are directly displayed every time you enter the menu:
- **Most important message**
  Diagnostic message recorded with the highest criticality level
- **Past message**
  Diagnostic message whose cause is no longer present.

All the other functions in the Diagnostics menu are described in the following chapters.

12.8 Diagnostics list

All the current diagnostic messages are listed here.

A time stamp is available for each message. Furthermore, the user also sees the configuration and description of the message as saved in **Menu/Setup/General settings/ Extended setup/Diagnostics settings/Diag. behavior** .

12.9 Event logbook

12.9.1 Available logbooks

Types of logbooks
- Logbooks physically available (all apart from the overall logbook)
- Database view of all logbooks (=overall logbook)

Logbook	Visible in	Max. entries	Can be disabled [1])	Logbook can be deleted	Entries can be deleted	Can be exported
Overall logbook	All events	20000	Yes	No	Yes	No
Calibration logbook	Calibration events	75	(Yes)	No	Yes	Yes
Operation logbook	Configuration events	250	(Yes)	No	Yes	Yes
Diagnostics logbook	Diagnostic events	250	(Yes)	No	Yes	Yes
Version logbook	All events	50	No	No	No	Yes

Logbook	Visible in	Max. entries	Can be disabled [1])	Logbook can be deleted	Entries can be deleted	Can be exported
Hardware version logbook	All events	125	No	No	No	Yes
Data logbook for sensors (optional)	Data logbooks	150 000	Yes	Yes	Yes	Yes
Debugging logbook	Debug events (only accessible by entering the special service activation code)	1000	Yes	No	Yes	Yes

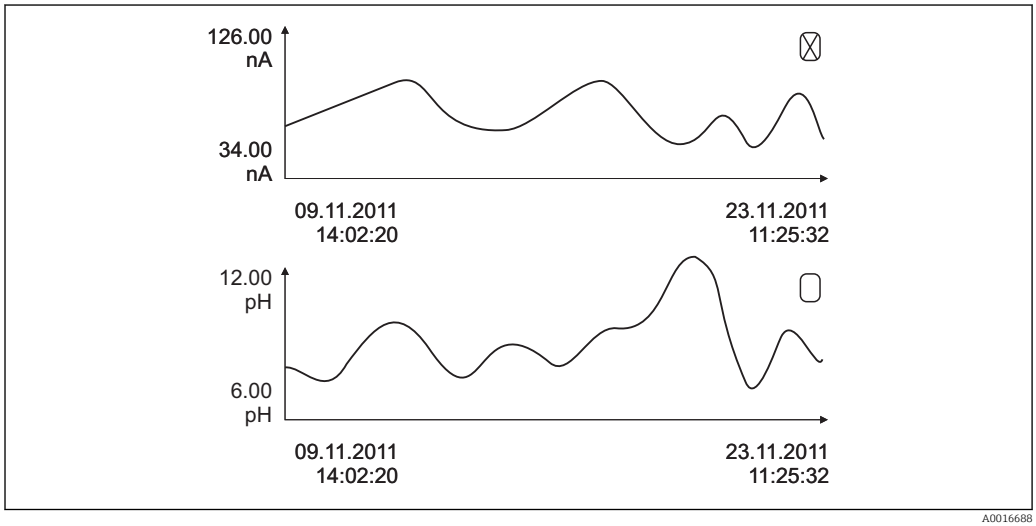
1) Data in brackets means this depends on the overall logbook

12.9.2 Menu Logbooks

DIAG/Logbooks		
Function	**Options**	**Info**
▶ All events		Chronological list of all the logbook entries, with information on the type of event
▶ Show	Events are displayed	Select a particular event to display more detailed information.
▶ Go to date	**User entry** ▪ Go to date ▪ Time	Use this function to go directly to a specific time in the list. In this way, you avoid having to scroll through all the information. The complete list is always visible, however.
▶ Calibration events		Chronological list of the calibration events
▶ Show	Events are displayed	Select a particular event to display more detailed information.
▶ Go to date	**User entry** ▪ Go to date ▪ Time	Use this function to go directly to a specific time in the list. In this way, you avoid having to scroll through all the information. The complete list is always visible, however.
▷ Delete all entries	Action	You can delete all the calibration logbook entries here.
▶ Configuration events		Chronological list of the configuration events
▶ Show	Events are displayed	Select a particular event to display more detailed information.
▶ Go to date	**User entry** ▪ Go to date ▪ Time	Use this function to go directly to a specific time in the list. In this way, you avoid having to scroll through all the information. The complete list is always visible, however.
▷ Delete all entries	Action	You can use this to delete all the operation logbook entries.
▶ Diagnostic events		Chronological list of the diagnostics events
▶ Show	Events are displayed	Select a particular event to display more detailed information.
▶ Go to date	**User entry** ▪ Go to date ▪ Time	Use this function to go directly to a specific time in the list. In this way, you avoid having to scroll through all the information. The complete list is always visible, however.
▷ Delete all entries	Action	You can use this to delete all the diagnostics logbook entries.

You can view your data logbook entries graphically on the display (**Show plot**).

You can also adapt the display to suit your individual requirements:
- Press the navigator button in the graphic display: you are given additional options such as the zoom function and x/y movement of the graph.
- Define the cursor: if you select this option, you can move along the graph with the navigator and view the logbook entry (data stamp/measured value) in text form for every point in the graph.
- Simultaneous display of two logbooks: **Select 2nd plot** and **Show plot**
  - A small cross marks the currently selected graph for which the zoom can be changed or a cursor used, for example.
  - In the context menu (press the navigator button), you can select the other graph. You can then apply the zoom function, a movement or a cursor to this graph.
  - Using the context menu, you can also select both graphs simultaneously. This enables you to use the zoom function on both graphs simultaneously, for example .



88 Simultaneous display of two graphs, the top one is "selected"

DIAG/Logbooks		
Function	**Options**	**Info**
▶ Data logbooks		Chronological list of the data logbook entries for sensors
Data logbook 1 ... 8 <Logbook name>		This submenu is available for each data logbook that you have set up and activated.
Source of data	Read only	Input or mathematical function is displayed
Measured value	Read only	Measured value being recorded is displayed
Log time left	Read only	Display of days, hours and minutes until logbook is full. ► Pay attention to the information on selecting the memory type in the **General settings/Logbooks**menu.
▶ Show	Events are displayed	Select a particular event to display more detailed information.
▶ Go to date	**User entry** ▪ Go to date ▪ Time	Use this function to go directly to a specific time in the list. In this way, you avoid having to scroll through all the information. The complete list is always visible, however.
▶ Show plot	Graphic display of the logbook entries	The entries are displayed according to your settings in the **General settings/Logbooks**.
Select 2nd plot	Select another data logbook	You can view a second logbook at the same time as the current one.

DIAG/Logbooks		
Function	**Options**	**Info**
▷ Delete all entries	Action	You can use this to delete all data logbook entries.
▶ Save logbooks		
File format	**Selection** ▪ CSV ▪ FDM	▶ Save the logbook in the preferred file format. You can then open the saved CSV file on the PC in MS Excel, for example, and make further edits here. [1]. You can import the FDM files into FieldCare and archive them so that they are tamper-proof.
▷ All data logbooks ▷ Data logbook 1 … 8 ▷ All event logbooks ▷ Calibration logbook ▷ Diagnostic logbook ▷ Configuration logbook ▷ HW version logbook ▷ Version logbook	Action, commences as soon as the option is selected	Use this function to save the logbook to an SD card. ▶ Save the logbook in the preferred file format. You can then open the saved CSV file on the PC in MS-Excel, for example, and make further edits here. You can import the FDM files into Fieldcare and archive them so they are tamper-proof.
The file name consists of **Logbook ident** (**Menu/Setup/General settings/Logbooks**), an abbreviation for the logbook and a time stamp.		

1) CSV files use international number formats and separators. Therefore they must be imported into MS Excel as external data with the correct format settings. If you double-click the file to open it, the data are only displayed correctly if MS Excel is installed with the US country setting.

12.10 Simulation

You can simulate values at inputs and outputs for testing purposes:
- Current values at current outputs
- Measured values at inputs
- Relay contact opening or closing

Only current values are simulated. Via the simulation function, it is not possible to calculate the totalized value for the flow or rainfall.

DIAG/Simulation		
Function	**Options**	**Info**
▶ Current output x:y		Simulation of an output current This menu appears once for each current output.
Simulation	**Selection** ▪ Off ▪ On **Factory setting** Off	If you simulate the value at the current output, this is indicated on the display by a simulation icon in front of the current value.
Current	2.4 to 23.0 mA **Factory setting** 4 mA	▶ Set the desired simulation value.

DIAG/Simulation		
Function	**Options**	**Info**
▶ Alarm relay ▶ Relay x:y		Simulation of a relay state This menu appears once for each relay.
Simulation	**Selection** ▪ Off ▪ On **Factory setting** Off	If you simulate the relay state, this is indicated on the display by a simulation icon in front of the relay display.
State	**Selection** ▪ Low ▪ High **Factory setting** Low	▶ Set the desired simulation value. The relay switches in accordance with your setting when you switch on the simulation. In the measured value display you see **On** (= **Low**) or **Off** (= **High**) for the simulated relay state.
▶ Meas. inputs		Simulation of a measured value (only for sensors) This menu appears once for each measuring input.
Channel : parameter		
Simulation	**Selection** ▪ Off ▪ On **Factory setting** Off	If you simulate the measured value, this is indicated on the display by a simulation icon in front of the measured value.
Main value	Depends on the sensor	▶ Set the desired simulation value.
Sim. temperature	**Selection** ▪ Off ▪ On **Factory setting** Off	If you simulate the temperature measured value, this is indicated on the display by a simulation icon in front of the temperature.
Temperature	-50.0 to +250.0 °C (-58.0 to 482.0 °F) **Factory setting** 20.0 °C (68.0 °F)	▶ Set the desired simulation value.

12.11 Device test

DIAG/Systemtest		
Function	**Options**	**Info**
▶ Power Supply	**Read only** ▪ Digital Supply 1: 1.2V ▪ Digital Supply 2: 3.3V ▪ Analog Supply: 12.5V ▪ Sensor Supply: 24V ▪ Temperature	Detailed list of power supply to instrument. The actual values can vary without a malfunction being present.
▶ Heartbeat		Heartbeat has no effect on the outputs and their status. You can start the verification at any time without affecting the measurement.
▶ Perform verification		Starts verification. 1. To save the results: **OK**. ↳ Results displayed (see below) 2. Ensure that the writable SD card is inserted in the device's card reader. **Export to SD-card**. ↳ Results are written to the SD card in the form of a PDF file. Display indicates if this was successful or not. 3. If export fails: Check SD card; use a different SD card if necessary. Check SD compartment on base module.
▷ Verification results		**Result display** ▪ Plant Operator Customized text, maximum 32 characters ▪ Location Customized text, maximum 32 characters ▪ Verification report Automatic time stamp ▪ Verification ID Automatic counter ▪ Overall result Passed or failed
▷ Export to SD-card		Export the verification report as a pdf file ▪ Detailed report on various device tests ▪ Input and output information ▪ Device information ▪ Sensor information The report is ready to be printed out and signed. You can file it immediately in an operations log, for example.

12.12 Resetting the measuring device

DIAG/Reset		
Function	**Options**	**Info**
▷ Device restart	**Selection** ▪ OK ▪ ESC	Restart and keep all the settings
▷ Factory default	**Selection** ▪ OK ▪ ESC	Restart with factory settings Settings that have not been saved are lost.

12.13 Device information

12.13.1 System information

DIAG/System information		
Function	**Options**	**Info**
Device tag	Read only	Individual device tag → **General settings**
Order code	Read only	You can order identical hardware with this code. This code changes on account of changes to the hardware and you can enter the new code you received from the manufacturer here [1].
To establish the version of your device, enter the order code into the search screen at the following address: www.endress.com/order-ident		
Orig. order code ext.	Read only	Complete order code for the original device, resulting from the product structure.
Current order code ext.	Read only	Current code, taking into account changes to the hardware. You must enter this code yourself.
Serial number	Read only	The serial number allows you to access device data and documentation on the Internet: www.endress.com/device-viewer
Software version	Read only	Current version
▶ HART *Only with the HART option*	Read only ▪ Bus address ▪ Unique address ▪ Manufacturer ID ▪ Device type ▪ Device revision ▪ Software revision	HART-specific information The unique address is linked to the serial number and is used to access devices in a Multidrop environment. Device and software version numbers are incremented as soon as changes have been made.
▶ Modbus *Only with the Modbus option*	Read only ▪ Enable ▪ Bus address ▪ Termination ▪ Modbus TCP Port 502	Modbus-specific information
▶ PROFIBUS *Only with the PROFIBUS option*	Read only ▪ Termination ▪ Bus address ▪ Ident number ▪ Baudrate ▪ DPV0 state ▪ DPV0 fault ▪ DPV0 master addr ▪ DPV0 WDT [ms]	Module status and other PROFIBUS-specific information
▶ Ethernet *Only with the Ethernet, EtherNet/IP, Modbus TCP, Modbus RS485 or PROFIBUS DP option*	Read only ▪ Enable ▪ Webserver ▪ Link settings ▪ DHCP ▪ IP-Address ▪ Netmask ▪ Gateway ▪ Service switch ▪ MAC-Address ▪ EtherNetIP Port 44818 ▪ Modbus TCP Port 502 ▪ Webserver TCP Port 80	Ethernet-specific information Display depends on the fieldbus protocol used.
▶ SD card	Read only ▪ Total ▪ Free memory	

DIAG/System information		
Function	**Options**	**Info**
▶ System modules		
Backplane	Read only ▪ Description ▪ Serial number ▪ Order code ▪ Hardware version ▪ Software version	This information is provided for every electronics module available. Specify the serial numbers and order codes when servicing, for example.
Base		
Display module		
Extension module 1 … 8		
▶ Sensors	Read only ▪ Description ▪ Serial number ▪ Order code ▪ Hardware version ▪ Software version	This information is provided for every sensor available. Specify the serial numbers and order codes when servicing, for example.
▶ Save system information		
▷ Save to SD card	File name assigned automatically (includes a time stamp)	The information is saved on the SD card in a "sysinfo" subfolder. The csv file can be read and edited in MS Excel, for example. This file can be used when servicing the device.
▶ Heartbeat operation		Heartbeat functions are only available with the appropriate device version or optional access code.
▶ Device	Read only ▪ Total operating time ▪ Counters since reset – Availability – Operating time – Time in failure – Number of failures – MTBF – MTTR ▪ ▷ Reset counters	**Availability** Percentage of time no error with the status signal F was pending (**Operating time** - **Time in failure**)*100% / **Operating time** **Time in failure** Total amount of time an error with the status signal F was pending **MTBF** Mean Time Between Failures (**Operating time** - **Time in failure**)/**Number of failures** **MTTR** Mean Time To Repair **Time in failure**/**Number of failures**

1) Provided you give the manufacturer all the information about changes to the hardware.

12.13.2 Sensor information

▶ Select the channel you want from the list of channels.

Information in the following categories is displayed:
- **Extreme values**
  Extreme conditions to which the sensor was previously exposed, e. g. min./max. temperatures [2)]
- **Operating time**
  Operating time of the sensor under defined extreme conditions
- **Calibration information**
  Calibration data of the last calibration
- **Sensor specifications**
  Measuring range limits for main measured value and temperature
- **General information**
  Information on sensor identification

2) Not available for all sensor types.

The specific data that are displayed depends on what sensor is connected.

12.14 Firmware history

Date	Version	Changes to firmware	Documentation
01/2019	01.06.08	Improvement ▪ Heartbeat verification no longer affects outputs ▪ Graphic display of Heartbeat status also in integrated web server ▪ Limit values for electrolyte depletion for amperometric oxygen sensors ▪ Limit values for CIP cycles for 4-pin conductivity sensors	BA00444C/07/EN/24.19 BA00486C/07/EN/02.13 BA01245C/07/EN/06.19
05/2018	01.06.06	Improvement ▪ New soft keys **ALL** and **NONE** in multiple selection editors ▪ Manual factor for CAS51D nitrate ▪ Calibration timer and validity revised for pH, conductivity, oxygen and disinfection ▪ Clear distinction between offset and 1-point calibration for pH ▪ Heartbeat verification report can now also be downloaded via the web server ▪ Better description of diagnostics code 013	BA00444C/07/EN/23.18 BA00486C/07/EN/02.13 BA01245C/07/EN/05.17
06/2017	01.06.04	Expansion ▪ Heartbeat Monitoring and Verification ▪ New mathematical function **Formula** ▪ New sensors: CUS50D and chlorine dioxide ▪ Calibration via EtherNet/IP ▪ pdf generator for Heartbeat ▪ Sample calibration CAS51D Improvement ▪ Changes to conductivity concentration tables ▪ Renaming of parameter chlorine → **Disinfection** ▪ Last active measuring screen restored after reboot ▪ Cap and electrolyte replacements are logged in the calibration logbook (oxygen, disinfection) ▪ Manual factor for nitrate	BA00444C/07/EN/20.17 BA00486C/07/EN/02.13 BA01245C/07/EN/05.17
12/2016	01.06.03	Expansion ▪ Sensor calibration via Modbus or EtherNet/IP: conductivity, oxygen, chlorine and turbidity ▪ Four-factor adjustment, SAC ▪ Flash meter, nitrate and SAC ▪ New sludge model CUS51D Improvement ▪ Local display can be locked via Modbus or EtherNet/IP ▪ The output status can also be recorded in the data logbook ▪ Name of Endress+Hauser pH buffer 9.18 changed to 9.22 ▪ CUS51D factor can be read out via fieldbus	BA00444C/07/EN/19.16 BA00486C/07/EN/02.13 BA01245C/07/EN/04.16
03/2016	01.06.00	Expansion ▪ Heartbeat verification ▪ User-configurable diagnostic modules ▪ Four-factor adjustment, SAC ▪ Offset calibration CUS71D ▪ New mathematical function, cation exchanger ▪ Configurable byte order for Modbus Improvement ▪ Sensor calibration validity check (adaptation to batch processes) ▪ pH-Offset can be saved in either the sensor or the transmitter (previously only possible in the transmitter) ▪ CUS71D screens (gain display, trend information) ▪ Modified menu texts	BA00444C/07/EN/19.16 BA00486C/07/EN/02.13 BA01245C/07/EN/03.16

Date	Version	Changes to firmware	Documentation
03/2015	01.05.02	Expansion ▪ Conductivity: – New sensor: CLS82D – Concentration always visible in measuring menus – Expansion of concentration tables ▪ Oxygen: New sensor: COS81D ▪ SAC, nitrate, turbidity: – Calibration settings adjusted – Adjustable flash rate (expert function) Improvement Menu corrections (functions, designations)	BA00444C/07/EN/18.15 BA00486C/07/EN/02.13 BA01245C/07/EN/02.15
12/2013	01.05.00	Expansion ▪ Chemoclean Plus ▪ Calendar function for cleaning ▪ Conductivity: – Measuring range switching also for conductive conductivity measurement – External temperature signal via current input ▪ Oxygen: – External pressure or temperature signals via current input – Connected conductivity sensor can be used to calculate the salinity. ▪ SAC, nitrate, turbidity: Calibration settings can be configured via fieldbus ▪ Channel-specific diagnostics codes for HOLD function ▪ Support for EtherNet/IP Improvement ▪ Web server login for managing multiple users ▪ Set point and PID parameters for controllers can be configured via fieldbus	BA00444C/07/EN/17.13 BA00486C/07/EN/02.13 BA01245C/07/EN/01.13
04/2013	01.04.00	Expansion ▪ Conductivity: – Measuring range switching – Temperature compensation ISO 7888 at 20 °C ▪ Support for DIO module – Triggering of an external hold – Triggering a cleaning – PID regulator enable/disable – PFM can be used as analog input – Limit switch signals via digital output ▪ Keylock with password protection ▪ PID regulator: disturbance variable feed forward is supported ▪ pH: – Icon for manual and automatic temperature compensation (ATC/MTC+MED) – Monitoring for the upper and lower limits of the glass SCS value can be switched on or off independently of each other ▪ ISE – Simultaneous calibration of two parameters – User-defined electrode type – Raw measured value for current output selectable – Timer for membrane replacement ▪ Logbooks remain intact after a firmware update Improvement ▪ PROFIBUS address range for Siemens-S7 moved to the lower area. ▪ Offset icon still only present for pH or ORP ▪ Turbidity: autoranging can be switched off ▪ Export print (xml): device also provides a stylesheet.	BA00444C/07/EN/16.13 BA00445C/07/EN/16.13 BA00450C/07/EN/16.13 BA00451C/07/EN/15.13 BA00486C/07/EN/01.11

Date	Version	Changes to firmware	Documentation
06/2012	01.03.01	Improvement ▪ Hold via soft key ▪ Global or channel-specific hold stops automatic cleaning. Manual cleaning can be started, however. ▪ Adapted factory settings	BA00444C/07/EN/15.12 BA00445C/07/EN/15.12 BA00450C/07/EN/15.12 BA00451C/07/EN/14.11 BA00486C/07/EN/01.11
12/2011	01.03.00	Expansion ▪ Max. 8 sensor channels supported ▪ Current inputs ▪ PROFIBUS DP supported incl. Profile 3.02 ▪ Modbus RTU (RS485) supported ▪ Modbus TCP supported ▪ Integrated web server supported via TCPIP (RJ45) ▪ USP/EP (United States Pharmacopoeia and European Pharmacopoeia) and TDS (Total Dissolved Solids) for conductivity ▪ Icon for "controller active" in measuring screen Improvement ▪ Controller hold via analog input ▪ Adapted factory settings ▪ SAC: factory calibration in the field incl. reset filter operation time and lamp change ▪ ISFET leakage visible in measuring screen ▪ Multiselect for limit switch and cleaning cycles	BA00444C/07/EN/14.11 BA00445C/07/EN/14.11 BA00450C/07/EN/14.11 BA00451C/07/EN/14.11 BA00486C/07/EN/01.11
12/2010	01.02.00	Expansion ▪ Support for additional sensors: – Chlorine – ISE – SAC – Interface ▪ HART Communication ▪ Mathematical functions Improvement ▪ Modified software structures ▪ Adapted factory settings ▪ User-defined measuring screens	BA444C/07/EN/13.10 BA445C/07/EN/13.10 BA450C/07/EN/13.10 BA451C/07/EN/13.10 BA00486C/07/EN/01.11
03/2010	01.00.00	Original firmware	BA444C/07/EN/03.10 BA445C/07/EN/03.10 BA450C/07/EN/03.10 BA451C/07/EN/03.10

WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

13 Maintenance

Effects on process and process control
- ▶ Take all the necessary precautions in time to ensure the operational safety and reliability of the entire measuring point.

The maintenance of the measuring point comprises:
- Calibration
- Cleaning the controller, assembly and sensor
- Checking the cables and connections.

⚠ WARNING

Process pressure and temperature, contamination, electrical voltage
Risk of serious or fatal injury
- ▶ If the sensor has to be removed during maintenance work, avoid hazards posed by pressure, temperature and contamination.
- ▶ Make sure the device is de-energized before you open it.
- ▶ Power can be supplied to switching contacts from separate circuits. De-energize these circuits before working on the terminals.

NOTICE

Electrostatic discharge (ESD)
Risk of damaging the electronic components
- ▶ Take personal protective measures to avoid ESD, such as discharging beforehand at PE or permanent grounding with a wrist strap.
- ▶ For your own safety, use only genuine spare parts. With genuine parts, the function, accuracy and reliability are also ensured after maintenance work.

13.1 Cleaning

13.1.1 Controller

- ▶ Clean the front of the housing using commercially available cleaning agents only.

The front of the housing is resistant to the following in accordance with DIN 42 115:
- Ethanol (for a short time)
- Diluted acids (max. 2% HCl)
- Diluted bases (max. 3% NaOH)
- Soap-based household cleaning agents

NOTICE

Cleaning agents not permitted
Damage to the housing surface or housing seal
- ▶ Never use concentrated mineral acids or alkaline solutions for cleaning.
- ▶ Never use organic cleaners such as acetone, benzyl alcohol, methanol, methylene chloride, xylene or concentrated glycerol cleaner.
- ▶ Never use high-pressure steam for cleaning.

13.1.2 Digital sensors

⚠ CAUTION

Cleaning not switched off during calibration or maintenance activities

Risk of injury due to medium or cleaning agent!

- ▶ If a cleaning system is connected, switch it off before removing a sensor from the medium.
- ▶ If you wish to check the cleaning function and have therefore not switched off the cleaning system, wear protective clothing, goggles and gloves or take other appropriate measures.

Replacing the sensor while ensuring measuring point availability

If an error occurs or the maintenance schedule stipulates that the sensor has to be replaced, use a new sensor, or a sensor that has been precalibrated in the laboratory.

- A sensor is calibrated in the laboratory under optimum external conditions, thereby ensuring better quality of measurement.
- You must perform onsite calibration if you use a sensor that is not precalibrated.

1. Remove the sensor that requires maintenance.
2. Install the new sensor.
   ↳ The sensor data are automatically accepted by the transmitter. A release code is not required.
   Measurement is resumed.
3. Take the used sensor back to the laboratory.
   ↳ In the laboratory you can get the sensor ready for reuse while ensuring the availability of the measuring point.

Prepare the sensor for reuse

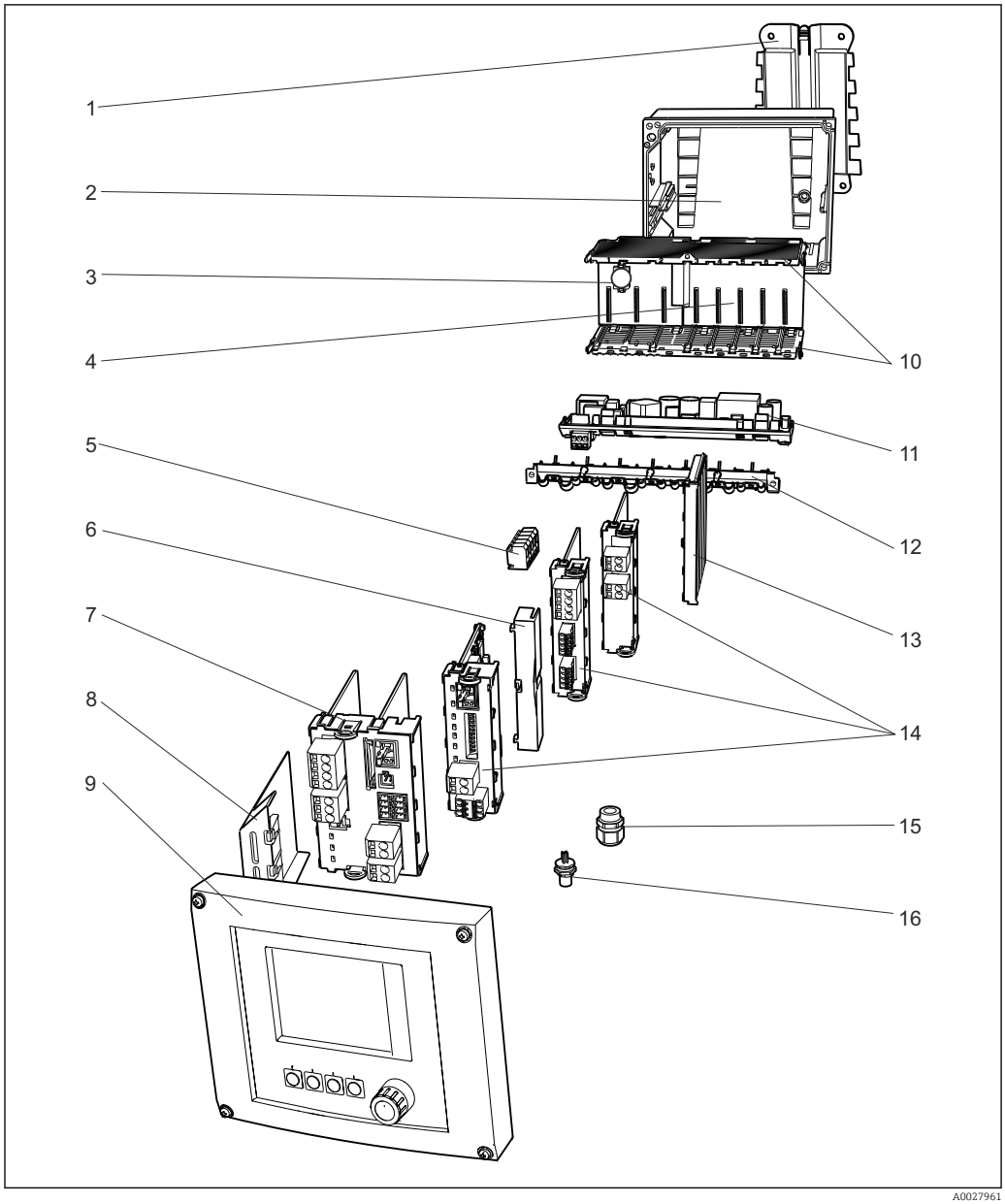
1. Clean sensor.
   ↳ For this purpose, use the cleaning agent specified in the sensor manual.
2. Inspect the sensor for cracks or other damage.
3. If no damage is found, regenerate the sensor. Where necessary, store the sensor in a regeneration solution (→ sensor manual).
4. Recalibrate the sensor for reuse.

13.1.3 Assemblies

Refer to the assembly operating manual for information on servicing and troubleshooting the assembly. The assembly operating manual describes the procedure for mounting and disassembling the assembly, replacing the sensors and seals, and contains information on the material resistance properties, as well as on spare parts and accessories.

14 Repairs

14.1 Spare parts



89 Spare parts: You can find the names of spare parts and their order numbers in the following table.

Item	Kit	Order no.
1	Kit CM44x: mounting plate ▪ Mounting plate ▪ Instructions for spare parts kit CM44x	71101763
2	Kit CM44x: housing base of field housing ▪ Housing base of field housing ▪ Cable mounting rail with double clamps and screws (item 12) ▪ Instructions for spare parts kit CM44x	71101734
3	Kit CM44x/CM44xR: electronics module backplane ▪ Backplane complete ▪ To be replaced only by Endress+Hauser Service	71101457

Item	Kit	Order no.
4	Kit CM44x/CM44xR: electronics module extension backplane ▪ Extension backplane complete ▪ To be replaced only by Endress+Hauser Service	71141366
5	Kit CM44x: power distribution terminals N+L ▪ Power distribution terminals ▪ Instructions for spare parts kit CM44x	71101461
6, 13	Kit CM44x: end covers and blanking covers 5 pcs. each	71107455
7, 8	Kit CM442: base module BASE-L 24V AC/DC ▪ Base module 24V AC/DC complete ▪ End cover (item 8) ▪ Instructions for spare parts kit CM44x	71100607
	Kit CM442: base module BASE-H 230V AC ▪ Base module 230V AC, complete ▪ End cover (item 8) ▪ Instructions for spare parts kit CM44x	71100611
	Kit CM444/CM448: base module BASE-E ▪ Base module, complete ▪ End cover (item 8) ▪ Connecting cable to connect to the power unit ▪ Instructions for spare parts kit CM44x	71141336
	Kit CM44x: terminal set, base module	71107452
9	Kit CM44x: cover KS field housing cpl. with display ▪ Cover KS field housing cpl. with display ▪ Display cable ▪ Instructions for spare parts kit CM44x	71104106
10, 12	Kit CM44x: internal housing parts, mechanical ▪ Insert side panels (item 10) ▪ Cable mounting rail with double clamps and screws (item 12) ▪ Instructions for spare parts kit CM44x	71101765
11	Kit CM444/CM448: expansion power unit ▪ EPS-H or EPS-L expansion power unit ▪ Instructions for spare parts kit CM44x	On request
No graphic	Kit CM44x: connecting cable, power unit ▪ To connect to base module BASE-E ▪ Instructions for spare parts kit CM44x	71155580

Item	Kit	Order no.
14	Kit CM44x/ CM44xR: extension module AOR (2 relays + 2 current outputs) ▪ Extension module AOR, complete ▪ Instructions for spare parts kit CM44x	71111053
	Kit CM44x/CM44xR: terminal set, extension module AOR	71107453
	Kit CM44x/CM44xR: extension module 2R (2 relays) ▪ Extension module 2R complete ▪ Instructions for spare parts kit CM44x	71125375
	Kit CM44x/CM44xR: extension module 4R (4 relays) ▪ Extension module 4R complete ▪ Instructions for spare parts kit CM44x	71125376
	Kit CM44x/CM44xR: terminal set, extension module 2R, 4R	71155581
	Kit CM44x/CM44xR: extension module 2AO (2 x 0/4 to 20 mA) ▪ Extension module 2AO complete ▪ Instructions for spare parts kit CM44x	71135632
	Kit CM44x/CM44xR: extension module 4AO (4 x 0/4 to 20 mA) ▪ Extension module 4AO complete ▪ Instructions for spare parts kit CM44x	71135633
	Kit CM44x/CM44xR: terminal set, extension module 2AO, 4AO	71155582
	Kit CM44x/CM44xR: extension module DIO (2 x digital input, digital output in each case) ▪ Extension module DIO, complete ▪ Instructions for spare parts kit CM44x	71135638
	Kit CM44x/CM44xR: terminal set, extension module DIO	71219784
	Kit CM44x/CM44xR: extension module 2DS (2 x digital sensor) ▪ Extension module 2DS complete ▪ Instructions for spare parts kit CM44x	71135631
	Kit CM44x/CM44xR: extension module 2AI (2 x analog input 0/4 to 20 mA) ▪ Extension module 2AI complete ▪ Instructions for spare parts kit CM44x	71135639
	Kit CM44x/CM44xR: extension module 485 (Ethernet configuration) ▪ Extension module 485 complete ▪ With activation code extendable to PROFIBUS DP or Modbus RS 485 or Modbus TCP or EtherNet/IP ▪ Instructions for spare parts kit CM44x	71135634
	Kit CM44x/CM44xR: terminal set for extension module 2AI, 485	71155583
15	Kit CM44x: set of 6 glands, metric ▪ Accessories kit, M cable glands ▪ Instructions for spare parts kit CM44x	71101768
	Kit CM44x: set of 6 glands, NPT ▪ Accessories kit, NPT cable glands ▪ Instructions for spare parts kit CM44x	71101770
	Kit CM44x: set of 6 glands, G ▪ Accessories kit, G cable glands ▪ Instructions for spare parts kit CM44x	71101771
16	M12 built-in socket 6-pin, complete with cables	71107456
No graphic	Kit CM44x: field housing display cable ▪ Display cable ▪ Instructions for spare parts kit CM44x	71101762
No graphic	Kit CM44x: dummy plug for cable bushing 6 pieces	71104942
No graphic	Kit CM44x: set of hinges 10 pieces	71107454
No graphic	CDI plug-in connector with counter nut M20x1.5	51517507

14.2 Return

The product must be returned if repairs or a factory calibration are required, or if the wrong product was ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium.

To ensure the swift, safe and professional return of the device:

- Refer to the website www.endress.com/support/return-material for information on the procedure and conditions for returning devices.

14.3 Disposal

The device contains electronic components. The product must be disposed of as electronic waste.

- Observe the local regulations.

Always dispose of batteries in accordance with local regulations on battery disposal.

15 Accessories

The following are the most important accessories available at the time this documentation was issued.

▶ For accessories not listed here, please contact your Service or Sales Center.

15.1 Protective cover

CYY101
- Weather protection cover for field devices
- Absolutely essential for field installation
- Material: stainless steel 1.4301 (AISI 304)
- Order No. CYY101-A

15.2 Post mounting kit

Post mounting kit CM44x
- For securing the field housing to horizontal and vertical posts and pipes
- Order No. 71096920

15.3 Measuring cable

Memosens data cable CYK10
- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10

Technical Information TI00118C

Memosens data cable CYK11
- Extension cable for digital sensors with Memosens protocol
- Product Configurator on the product page: www.endress.com/cyk11

Technical Information TI00118C

15.4 Sensors

15.4.1 Glass electrodes

Orbisint CPS11D
- pH sensor for process technology
- Optional SIL version for connecting to SIL transmitter
- With dirt-repellent PTFE diaphragm
- Product Configurator on the product page: www.endress.com/cps11d

Technical Information TI00028C

Memosens CPS31D
- pH electrode with gel-filled reference system with ceramic diaphragm
- Product Configurator on the product page: www.endress.com/cps31d

Technical Information TI00030C

Ceraliquid CPS41D
- pH electrode with ceramic junction and KCl liquid electrolyte
- Product Configurator on the product page: www.endress.com/cps41d

Technical Information TI00079C

Ceragel CPS71D
- pH electrode with reference system including ion trap
- Product Configurator on the product page: www.endress.com/cps71d

Technical Information TI00245C

Memosens CPS171D
- pH electrode for bio-fermenters with digital Memosens technology
- Product Configurator on the product page: www.endress.com/cps171d

Technical Information TI01254C

Orbipore CPS91D
- pH electrode with open aperture for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps91d

Technical Information TI00375C

Orbipac CPF81D
- Compact pH sensor for installation or immersion operation
- In industrial water and wastewater
- Product Configurator on the product page: www.endress.com/cpf81d

Technical Information TI00191C

15.4.2 Enamel pH electrodes

Ceramax CPS341D
- pH electrode with pH-sensitive enamel
- Meets highest demands of measuring accuracy, pressure, temperature, sterility and durability
- Product Configurator on the product page: www.endress.com/cps341d

Technical Information TI00468C

15.4.3 ORP sensors

Orbisint CPS12D
- ORP sensor for process technology
- Product Configurator on the product page: www.endress.com/cps12d

Technical Information TI00367C

Ceraliquid CPS42D
- ORP electrode with ceramic junction and KCl liquid electrolyte
- Product Configurator on the product page: www.endress.com/cps42d

Technical Information TI00373C

Ceragel CPS72D
- ORP electrode with reference system including ion trap
- Product Configurator on the product page: www.endress.com/cps72d

Technical Information TI00374C

Orbipac CPF82D
- Compact ORP sensor for installation or immersion operation in process water and wastewater
- Product Configurator on the product page: www.endress.com/cpf82d

Technical Information TI00191C

Orbipore CPS92D
- ORP electrode with open aperture for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps92d

Technical Information TI00435C

15.4.4 pH ISFET sensors

Tophit CPS441D
- Sterilizable ISFET sensor for low-conductivity media
- Liquid KCl electrolyte
- Product Configurator on the product page: www.endress.com/cps441d

Technical Information TI00352C

Tophit CPS471D
- Sterilizable and autoclavable ISFET sensor for food and pharmaceutics, process engineering
- Water treatment and biotechnology
- Product Configurator on the product page: www.endress.com/cps471d

Technical Information TI00283C

Tophit CPS491D
- ISFET sensor with open aperture for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps491d

Technical Information TI00377C

15.4.5 pH and ORP combined sensors

Memosens CPS16D
- Combined pH/ORP sensor for process technology
- With dirt-repellent PTFE diaphragm
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cps16D

Technical Information TI00503C

Memosens CPS76D
- Combined pH/ORP sensor for process technology
- Hygienic and sterile applications
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cps76d

Technical Information TI00506C

Memosens CPS96D
- Combined pH/ORP sensor for chemical processes
- With poison-resistant reference with ion trap
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cps96d

Technical Information TI00507C

15.4.6 Conductivity sensors with inductive measurement of conductivity

Indumax CLS50D
- High-durability inductive conductivity sensor
- For standard and hazardous area applications
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cls50d

Technical Information TI00182C

Indumax H CLS54D
- Inductive conductivity sensor
- With certified, hygienic design for foodstuffs, beverages, pharmaceuticals and biotechnology
- Product Configurator on the product page: www.endress.com/cls54d

Technical Information TI00508C

15.4.7 Conductivity sensors with conductive measurement of conductivity

Condumax CLS15D
- Conductive conductivity sensor
- For pure water, ultrapure water and hazardous area applications
- Product Configurator on the product page: www.endress.com/CLS15d

Technical Information TI00109C

Condumax CLS16D
- Hygienic, conductive conductivity sensor
- For pure water, ultrapure water and Ex applications
- With EHEDG and 3A approval
- Product Configurator on the product page: www.endress.com/CLS16d

Technical Information TI00227C

Condumax CLS21D
- Two-electrode sensor in plug-in head version version
- Product Configurator on the product page: www.endress.com/CLS21d

Technical Information TI00085C

Memosens CLS82D
- Four-electrode sensor
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cls82d

Technical Information TI01188C

15.4.8 Oxygen sensors

Oxymax COS22D
- Sterilizable sensor for dissolved oxygen
- With Memosens technology or as an analog sensor
- Product Configurator on the product page: www.endress.com/cos22d

Technical Information TI00446C

Oxymax COS51D
- Amperometric sensor for dissolved oxygen
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cos51d

Technical Information TI00413C

Oxymax COS61D
- Optical oxygen sensor for drinking water and industrial water measurement
- Measuring principle: quenching
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cos61d

Technical Information TI00387C

Memosens COS81D
- Sterilizable, optical sensor for dissolved oxygen
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cos81d

Technical Information TI01201C

15.4.9 Disinfection sensors

CCS142D
- Membrane-covered amperometric sensor for free chlorine
- Measuring range 0.01 to 20 mg/l
- With Memosens technology
- Product Configurator on the product page: www.endress.com/ccs142d

Technical Information TI00419C

15.4.10 Ion-selective sensors

ISEmax CAS40D
- Ion selective sensors
- Product Configurator on the product page: www.endress.com/cas40d

Technical Information TI00491C

15.4.11 Turbidity sensors

Turbimax CUS51D
- For nephelometric measurements of turbidity and solids in wastewater
- 4-beam scattered light method
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus51d

Technical Information TI00461C

Turbimax CUS52D
- Hygienic Memosens sensor for turbidity measurement in drinking water, process water and in utilities
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus52d

Technical Information TI01136C

15.4.12 SAC and nitrate sensors

Viomax CAS51D
- SAC and nitrate measurement in drinking water and wastewater
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cas51d

Technical Information TI00459C

15.4.13 Interface measurement

Turbimax CUS71D
- Immersion sensor for interface measurement
- Ultrasonic interface sensor
- Product Configurator on the product page: www.endress.com/cus71d

Technical Information TI00490C

15.5 Additional functionality

15.5.1 Hardware extension modules

Kit, extension module AOR
- 2 x relay, 2 x 0/4 to 20 mA analog output
- Order No. 71111053

Kit, extension module 2R
- 2 x relay
- Order No. 71125375

Kit, extension module 4R
- 4 x relay
- Order No. 71125376

Kit, extension module 2AO
- 2 x 0/4 to 20 mA analog output
- Order No. 71135632

Kit, extension module 4AO
- 4 x analog output 0/4 to 20 mA
- Order No. 71135633

Kit, extension module 2DS
- 2 x digital sensor, Memosens
- Order No. 71135631

Kit, extension module 2AI
- 2 x 0/4 to 20 mA analog input
- Order No. 71135639

Kit, extension module DIO
- 2 x digital input
- 2 x digital output
- Auxiliary voltage supply for digital output
- Order No. 71135638

Kit, extension module 485
- Ethernet configuration
- Can be extended to PROFIBUS DP or Modbus RS485 or Modbus TCP or EtherNet/IP. This requires an additional activation code which can be ordered separately.
- Order No. 71135634

Kit, extension module ETH
- Ethernet configuration
- Can be extended to Modbus TCP or EtherNet/IP. This requires an additional activation code which can be ordered separately.
- Order No. 71279810

Upgrade kit, extension module 485 with PROFIBUS DP
- Extension module 485
- PROFIBUS DP (+ Ethernet configuration)
- Order No. 71140888

Upgrade kit, extension module 485 with Modbus RS485
- Extension module 485
- Modbus RS485 (+ Ethernet configuration)
- Order No. 71140889

Upgrade kit, extension module 485 with Modbus TCP
- Extension module 485
- Modbus TCP (+ Ethernet configuration)
- Order No. 71140890

Upgrade kit, extension module 485 with EtherNet/IP
- Extension module 485
- EtherNet/IP (+ Ethernet configuration)
- Order No. 71219868

Upgrade kit, extension module ETH with Modbus TCP
- Extension module ETH
- Modbus TCP (+ Ethernet configuration)
- Order No. 71279809

Upgrade kit, extension module ETH with EtherNet/IP
- Extension module ETH
- EtherNet/IP (+ Ethernet configuration)
- Order No. 71279812

Kit CM442: upgrade kit to CM444/CM448
- Extension power supply unit 100 to 230 V AC and extension backplane
- Base module BASE-E
- You must quote the serial number of the device when ordering the kit.
- Order No. 71135644

Kit CM442: upgrade kit to CM444/CM448
- Extension power supply unit 24 V DC and extension backplane
- Base module BASE-E
- You must quote the serial number of the device when ordering the kit.
- Order No. 71211434

15.5.2 Firmware and activation codes

SD card with Liquiline firmware
- Industrial Flash Drive, 1 GB
- Order No. 71127100

You must quote the serial number of the device when ordering the activation code.

Activation code for digital HART communication
Order No. 71128428

Activation code for PROFIBUS DP
Order No. 71135635

Activation code for Modbus RS485
Order No. 71135636

Activation code for Modbus TCP for module 485
Order No. 71135637

Activation code for EtherNet/IP for module 485
Order No. 71219871

Activation code for Modbus TCP for module ETH
Order No. 71279813

Activation code for EtherNet/IP for module ETH
Order No. 71279830

Kit CM442: activation code for 2nd digital sensor input
Order No. 71114663

Kit CM444/CM448: upgrade code for 2 x 0/4 to 20 mA for BASE-E
Order No. 71140891

Activation code for feedforward control
- Requires current input or fieldbus communication
- Order No. 71211288

Activation code for measuring range switch
- Requires digital inputs or fieldbus communication
- Order No. 71211289

Activation code for ChemocleanPlus
- Requires relays or digital outputs or fieldbus communication and optional digital inputs
- Order No. 71239104

Activation code for Heartbeat Verification and Monitoring
Order No. 71367524

Activation code for ion exchanger operating time
- Mathematical function
- Order No. 71367531

Activation code for mathematics
- Formula editor
- Order No. 71367541

Activation code for remote calibration interface
Order No. 71367542

15.6 Software

Memobase Plus CYZ71D
- PC software to support laboratory calibration
- Visualization and documentation of sensor management
- Sensor calibrations stored in database
- Product Configurator on the product page: www.endress.com/cyz71d

Technical Information TI00502C

Field Data Manager Software MS20
- PC software for central data management
- Visualization of series of measurements and logbook events
- SQL database for secure data storage

15.7 Other accessories

15.7.1 SD card

- Industrial Flash Drive, 1 GB
- Weight: 2 g
- Order No. 71110815

15.7.2 Cable glands

Kit CM44x: gland M
- Set, 6 pieces
- Order No. 71101768

Kit CM44x: gland NPT
- Set, 6 pieces
- Order No. 71101770

Kit CM44x: gland G
- Set, 6 pieces
- Order No. 71101771

Kit CM44x: dummy plug for cable gland
- Set, 6 pieces
- Order No. 71104942

15.7.3 M12 built-in socket and cable junction with Velcro strip

Kit CM42/CM442/CM444/CM448: external CDI socket
- Socket with terminated connecting cables and counter nut
- Order No. 51517507

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for digital sensors
- Pre-terminated
- Order No. 71107456

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for PROFIBUS DP/Modbus RS485
- B-coded, pre-terminated
- Order No. 71140892

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for Ethernet
- D-coded, pre-terminated
- Order No. 71140893

Kit: external CDI socket, complete
- Retrofit kit for CDI interface, with terminated connecting cables
- Order No. 51517507

Cable junction with Velcro strip
- 4 pieces, for sensor cable
- Order No. 71092051

15.7.4 Communication-specific accessories

Commubox FXA191
- Intrinsically safe HART communication with FieldCare via the RS232C interface
- Transforms HART signals on RS 232C interface

Technical Information TI00237F

Commubox FXA195
Intrinsically safe HART communication with FieldCare via the USB port

Technical Information TI00404F

Commubox FXA291
Connects the CDI interface of measuring devices with the USB port of the computer or laptop

Technical Information TI00405C

Wireless HART adapter SWA70
- Wireless device connection
- Easily integrated, offers data protection and transmission safety, can be operated in parallel with other wireless networks, minimum cabling complexity

Technical Information TI00061S

Fieldgate FXA320
Gateway for the remote interrogation of 4-20 mA measuring devices via a Web browser

Technical Information TI00025S

FieldXpert SFX100
Compact, flexible and robust industrial handheld terminal for remote configuration and for obtaining measured values via the HART current output

Operating Instructions BA00060S

15.7.5 System components

RIA14, RIA16
- Field display unit for integration into 4-20 mA circuits
- RIA14 in flameproof metal enclosure

Technical Information TI00143R and TI00144R

RIA15
- Process display unit, Digital display unit for integration into 4-20 mA circuits
- Panel mounting
- With optional HART communication

Technical Information TI01043K

16 Technical data

16.1 Input

Measured variables	→ Documentation of the connected sensor
Measuring ranges	→ Documentation of the connected sensor
Types of input	▪ Digital sensor inputs for sensors with Memosens protocol ▪ Analog current inputs (optional) ▪ Digital inputs (optional)
Input signal	Depending on version: ▪ Max. 8 x binary sensor signal ▪ 2 x 0/4 to 20 mA (optional), passive, potentially isolated from one another and from the sensor inputs ▪ 0 to 30 V
Cable specification	**Cable type** Memosens data cable CYK10 or sensor fixed cable, each with cable end sleeves or M12 round-pin connector (optional) **Cable length** Max. 100 m (330 ft)

16.2 Digital inputs, passive

Electrical specification	▪ drawing power (passive) ▪ Galvanically isolated
Span	▪ High: 11 to 30 V DC ▪ Low: 0 to 5 V DC
Nominal input current	max. 8 mA
PFM function	Minimum pulse width: 500 µs (1 kHz)
Test voltage	500 V
Cable specification	Max. 2.5 mm^2 (14 AWG)

16.3 Current input, passive

Span	> 0 to 20 mA

Signal characteristic	Linear
Internal resistance	Non-linear
Test voltage	500 V

16.4 Output

Output signal

Depending on version:
- 2 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 4 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 6 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 8 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- Optional HART communication (only via current output 1:1)

HART	
Signal encoding	FSK ± 0.5 mA above current signal
Data transmission rate	1200 baud
Galvanic isolation	Yes
Load (communication resistor)	250 Ω

PROFIBUS DP/RS485	
Signal encoding	EIA/TIA-485, PROFIBUS DP-compliant acc. to IEC 61158
Data transmission rate	9.6 kBd, 19.2 kBd, 45.45kBd, 93.75 kBd, 187.5 kBd, 500 kBd, 1.5 MBd, 6 MBd, 12 MBd
Galvanic isolation	Yes
Connectors	Spring terminal (max. 1.5 mm), bridged internally (T-function), optional M12
Bus termination	Internal slide switch with LED display

Modbus RS485	
Signal encoding	EIA/TIA-485
Data transmission rate	2,400, 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200 baud
Galvanic isolation	Yes
Connectors	Spring terminal (max. 1.5 mm), bridged internally (T-function), optional M12
Bus termination	Internal slide switch with LED display

Ethernet and Modbus TCP	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	10/100 MBd
Galvanic isolation	Yes
Connection	RJ45, M12 optional
IP address	DHCP (default) or configuration via menu

EtherNet/IP	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	10/100 MBd
Galvanic isolation	Yes
Connection	RJ45, M12 optional (D-encoded)
IP address	DHCP (default) or configuration via menu

Signal on alarm

Adjustable, as per NAMUR Recommendation NE 43
- In measuring range 0 to 20 mA (HART is not available with this measuring range):
  Failure current from 0 to 23 mA
- In measuring range 4 to 20 mA:
  Failure current from 2.4 to 23 mA
- Factory setting for failure current for both measuring ranges:
  21.5 mA

Load

Max. 500 Ω

Linearization/transmission behavior

Linear

16.5 Digital outputs, passive

Electrical specification

- Passive
- Open collector, max. 30 V, 15 mA
- Maximum voltage drop 3 V

External power supply

When using an onsite auxiliary voltage supply and an onsite digital input:
Recommended minimum auxiliary voltage = 3 V + V_{IHmin}
(V_{IHmin} = minimum input voltage required (high-level input voltage)

PFM function

Minimum pulse width: 500 µs (1 kHz)

Auxiliary voltage

Electrical specification
- Galvanically isolated
- Unregulated, 24 V DC
- Max. 50 mA (per DIO module)

Test voltage

500 V

Cable specification	Max. 2.5 mm^2 (14 AWG)

16.6 Current outputs, active

Span	0 to 23 mA 2.4 to 23 mA for HART communication
Signal characteristic	Linear
Electrical specification	**Output voltage** Max. 24 V **Test voltage** 500 V
Cable specification	**Cable type** Recommended: shielded cable **Cable specification** Max. 2.5 mm^2 (14 AWG)

16.7 Relay outputs

Electrical specification

Relay types
- 1 single-pin changeover contact (alarm relay)
- 2 or 4 single-pin changeover contacts (optional with extension modules)

Maximum load
- Alarm relay: 0.5 A
- All other relays: 2.0 A

Relay switching capacity

Base module (Alarm relay)

Switching voltage	Load (max.)	Switching cycles (min.)
230 V AC, cosΦ = 0.8 to 1	0.1 A	700,000
	0.5 A	450,000
115 V AC, cosΦ = 0.8 to 1	0.1 A	1,000,000
	0.5 A	650,000
24 V DC, L/R = 0 to 1 ms	0.1 A	500,000
	0.5 A	350,000

Extension modules

Switching voltage	Load (max.)	Switching cycles (min.)
230 V AC, cosΦ = 0.8 to 1	0.1 A	700,000
	0.5 A	450,000
	2 A	120,000
115 V AC, cosΦ = 0.8 to 1	0.1 A	1,000,000
	0.5 A	650,000
	2 A	170,000
24 V DC, L/R = 0 to 1 ms	0.1 A	500,000
	0.5 A	350,000
	2 A	150,000

Cable specification

Max. 2.5 mm^2 (14 AWG)

16.8 Protocol-specific data

HART

Manufacturer ID	11_h
Device type	$155D_h$
Device revision	001_h
HART version	7.2
Device description files (DD/DTM)	www.endress.com/hart Device Integration Manager DIM
Device variables	16 user-definable and 16 predefined device variables, dynamic variables PV, SV, TV, QV
Supported features	PDM DD, AMS DD, DTM, Field Xpert DD

PROFIBUS DP

Manufacturer ID	11_h
Device type	$155D_h$
Profile version	3.02
GSD files	www.endress.com/profibus Device Integration Manager DIM
Output values	16 AI blocks, 8 DI blocks
Input variables	4 AO blocks, 8 DO blocks
Supported features	▪ 1 MSCY0 connection (cyclical communication, master class 1 to slave) ▪ 1 MSAC1 connection (acyclical communication, master class 1 to slave) ▪ 2 MSAC2 connections (acyclical communication, master class 2 to slave) ▪ Device lock: The device can be locked using the hardware or software. ▪ Addressing using DIL switches or software ▪ GSD, PDM DD, DTM

Modbus RS485

Protocol	RTU/ASCII
Function codes	03, 04, 06, 08, 16, 23
Broadcast support for function codes	06, 16, 23
Output data	16 measured values (value, unit, status), 8 digital values (value, status)
Input data	4 setpoints (value, unit, status), 8 digital values (value, status), diagnostic information
Supported features	Address can be configured using switch or software

Modbus TCP

TCP port	502
TCP connections	3
Protocol	TCP
Function codes	03, 04, 06, 08, 16, 23
Broadcast support for function codes	06, 16, 23
Output data	16 measured values (value, unit, status), 8 digital values (value, status)
Input data	4 setpoints (value, unit, status), 8 digital values (value, status), diagnostic information
Supported features	Address can be configured using DHCP or software

EtherNet/IP

Log	EtherNet/IP	
ODVA certification	Yes	
Device profile	Generic device (product type: 0x2B)	
Manufacturer ID	$0x049E_h$	
Device type ID	$0x109C_h$	
Polarity	Auto-MIDI-X	
Connections	CIP	12
	I/O	6
	Explicit message	6
	Multicast	3 consumers
Minimum RPI	100 ms (default)	
Maximum RPI	10000 ms	
System integration	EtherNet/IP	EDS
	Rockwell	Add-on-Profile Level 3, Faceplate for Factory Talk SE
IO data	Input (T → O)	Device status and diagnostic message with highest priority Measured values: ▪ 16 AI (analog input) + Status + Unit ▪ 8 DI (discrete input) + Status
	Output (O → T)	Actuating values: ▪ 4 A0 (analog output) + status + unit ▪ 8 DO (discrete output) + Status

Web server

The Web server enables full access to the device configuration, measured values, diagnostic messages, logbooks and service data via standard WiFi/WLAN/LAN/GSM or 3G routers with a user-defined IP address.

TCP port	80
Supported features	▪ Remote-controlled device configuration(1 session) ▪ Save/restore device configuration (via SD card) ▪ Logbook export (file formats: CSV, FDM) ▪ Access to Web server via DTM or Internet Explorer ▪ Login ▪ Web server can be switched off

16.9 Power supply

Supply voltage

CM442

Depending on version:

- 100 to 230 V AC, 50/60 Hz
  Maximum permitted fluctuation of mains supply voltage: ± 15 % of nominal voltage
- 24 V AC/DC, 50/60 Hz
  Maximum permitted fluctuation of mains supply voltage: + 20/- 15 % of nominal voltage

CM444 and CM448
Depending on the version,:
- 100 to 230 V AC, 50/60 Hz
  Maximum permitted fluctuation of mains supply voltage: ± 15 % of nominal voltage
- 24 V DC
  Maximum permitted fluctuation of mains supply voltage: + 20/- 15 % of nominal voltage

Power consumption

CM442
Depending on supply voltage
- 100 to 230 V AC and 24 V AC:
  Max. 55 VA
- 24 V DC:
  Max. 22 W

CM444 and CM448
Depending on supply voltage
- 100 to 230 V AC:
  Max. 73 VA
- 24 V DC:
  Max. 68 W

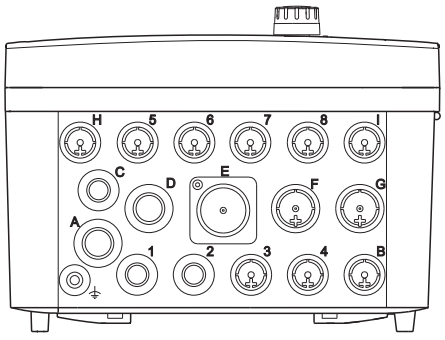
Fuse

Fuse not exchangeable

Overvoltage protection

Integrated overvoltage/lightning protection as per EN 61326
Protection category 1 and 3

Cable entries

Identification of the cable entry on housing base	Suitable gland
B, C, H, I, 1-8	M16x1.5 mm/NPT3/8"/G3/8
A, D, F, G	M20x1.5 mm/NPT1/2"/G1/2
E	-
⏚	M12x1.5 mm
 A0018025	**Recommended assignment** 1-8 Sensors 1-8 A Power supply B RS485 In or M12 DP/RS485 C Can be used freely D,F,G Current outputs and inputs, relays H Can be used freely I RS485 Out or M12 Ethernet E Do not use

Cable specification

Cable gland	Permitted cable diameter
M16x1.5 mm	4 to 8 mm (0.16 to 0.32")
M12x1.5 mm	2 to 5 mm (0.08 to 0.20")
M20x1.5 mm	6 to 12 mm (0.24 to 0.48")
NPT3/8"	4 to 8 mm (0.16 to 0.32")
G3/8	4 to 8 mm (0.16 to 0.32")
NPT1/2"	6 to 12 mm (0.24 to 0.48")
G1/2	7 to 12 mm (0.28 to 0.48")

Cable glands mounted at the factory are tightened with 2 Nm.

16.10 Performance characteristics

Response time

Current outputs
t_{90} = max. 500 ms for an increase from 0 to 20 mA

Current inputs
t_{90} = max. 330 ms for an increase from 0 to 20 mA

Digital inputs and outputs
t_{90} = max. 330 ms for an increase from low to high

Reference temperature

25 °C (77 °F)

Measured error for sensor inputs

→ Documentation of the connected sensor

Measured error for current inputs and outputs

Typical measured errors:
< 20 µA (with current values < 4 mA)
< 50 µA (with current values 4 to 20 mA)
at 25 °C (77 °F) each

Additional measured error depending on the temperature:
< 1.5 µA/K

Frequency tolerance of digital inputs and outputs

≤ 1%

Resolution of current inputs and outputs

< 5 µA

Repeatability

→ Documentation of the connected sensor

16.11 Environment

Ambient temperature range

CM442
–20 to 60 °C (0 to 140 °F)

CM444

- Generally –20 to 55 °C (0 to 130 °F), with the exception of packages under the second list item
- –20 to 50 °C (0 to 120 °F) for the following packages:
  - CM444-**M40A7FI******+...
  - CM444-**M40A7FK******+...
  - CM444-**N40A7FI******+...
  - CM444-**N40A7FK******+...
  - CM444-**M4AA5F4******+...
  - CM444-**M4AA5FF******+...
  - CM444-**M4AA5FH******+...
  - CM444-**M4AA5FI******+...
  - CM444-**M4AA5FK******+...
  - CM444-**M4AA5FM******+...
  - CM444-**M4BA5F4******+...
  - CM444-**M4BA5FF******+...
  - CM444-**M4BA5FH******+...
  - CM444-**M4BA5FI******+...
  - CM444-**M4BA5FK******+...
  - CM444-**M4BA5FM******+...
  - CM444-**M4DA5F4******+...
  - CM444-**M4DA5FF******+...
  - CM444-**M4DA5FH******+...
  - CM444-**M4DA5FI******+...
  - CM444-**M4DA5FK******+...
  - CM444-**M4DA5FM******+...

CM448

- Generally –20 to 55 °C (0 to 130 °F), with the exception of packages under the second list item
- –20 to 50 °C (0 to 120 °F) for the following packages:
  - CM448-***6AA******+...
  - CM448-***8A4******+...
  - CM448-***8A5******+...
  - CM448-**28A3******+...
  - CM448-**38A3******+...
  - CM448-**48A3******+...
  - CM448-**58A3******+...
  - CM448-**68A3******+...
  - CM448-**26A5******+...
  - CM448-**36A5******+...
  - CM448-**46A5******+...
  - CM448-**56A5******+...
  - CM448-**66A5******+...
  - CM448-**22A7******+...
  - CM448-**32A7******+...
  - CM448-**42A7******+...
  - CM448-**52A7******+...
  - CM448-**62A7******+...
  - CM448-**A6A5******+...
  - CM448-**A6A7******+...
  - CM448-**B6A5******+...
  - CM448-**B6A7******+...
  - CM448-**C6A5******+...
  - CM448-**C6A7******+...
  - CM448-**D6A5******+...
  - CM448-**D6A7******+...

Storage temperature	-40 to +80 °C (-40 to 175 °F)

Humidity	10 to 95 %, non-condensating
Degree of protection	IP 66/67, impermeability and corrosion resistance in accordance with NEMA TYPE 4X

Vibration resistance

Environmental tests
Vibration test based on DIN EN 60068-2, October 2008
Vibration test based on DIN EN 60654-3, August 1998

Post or pipe mounting

Frequency range	10 to 500 Hz (sinusoidal)	
Amplitude	10 to 57.5 Hz:	0.15 mm
	57.5 to 500 Hz:	2 g [1]
Test duration	10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./ min)	

Wall mounting

Frequency range	10 to 150 Hz (sinusoidal)	
Amplitude	10 to 12.9 Hz:	0.75 mm
	12.9 to 150 Hz:	0.5 g [1]
Test duration	10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./ min)	

1) g ... gravitational acceleration (1 g ≈ 9.81 m/s^2)

Electromagnetic compatibility	Interference emission and interference immunity as per EN 61326-1:2013, Class A for Industry
Electrical safety	IEC 61010-1, Class I equipment Low voltage: overvoltage category II Environment < 3000 m (< 9840 ft) above MSL
Degree of contamination	The product is suitable for pollution degree 4.
Pressure compensation to environment	Filter made of GORE-TEX used as pressure compensation element Ensures pressure compensation to environment and guarantees IP protection.

16.12 Mechanical construction

Dimensions	→ 15

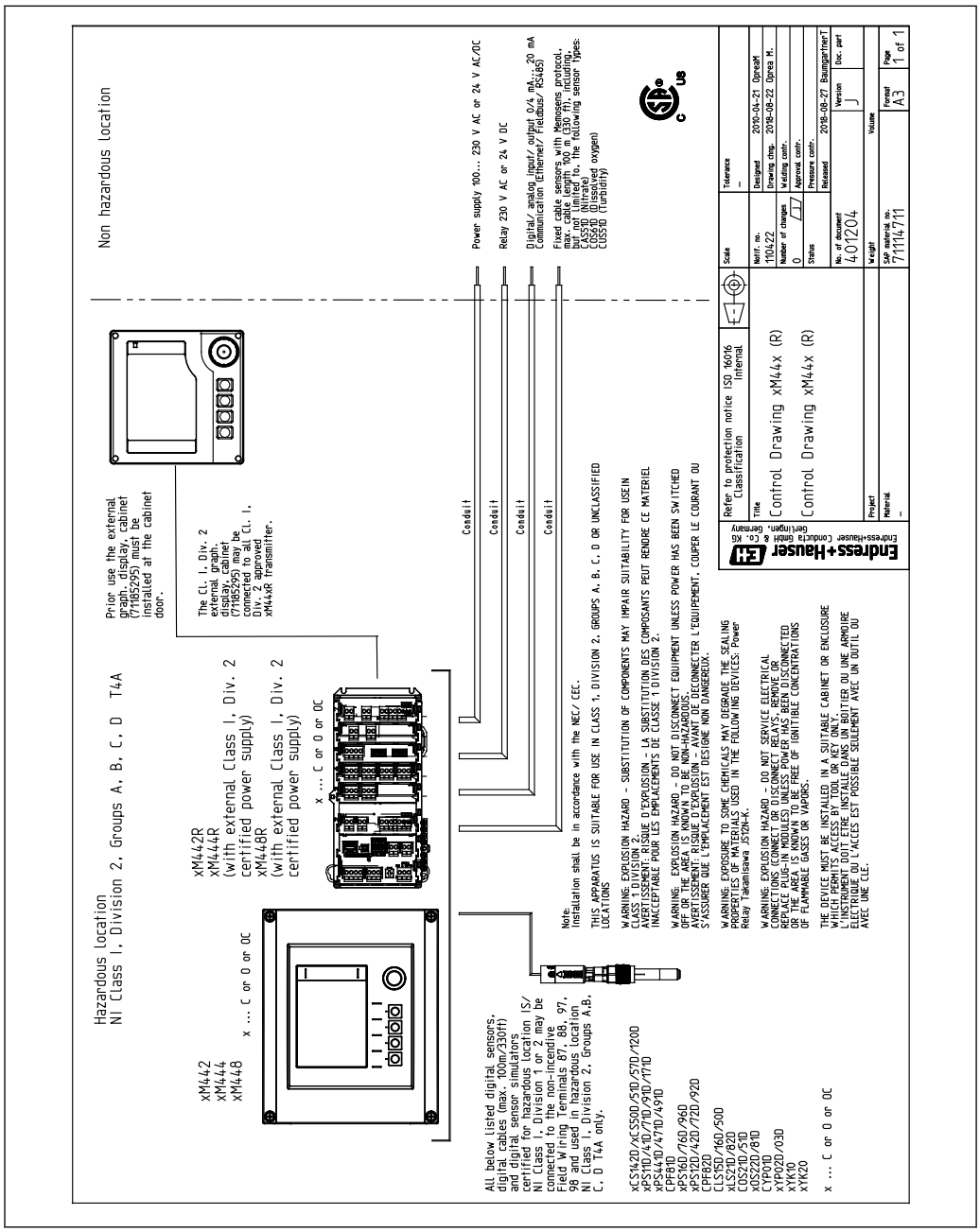
Weight	Complete device	Approx. 2.1 kg (4.63 lbs), depending on the version
	Individual module	Approx. 0.06 kg (0.13 lbs)
	SD card	Max. 5 g (0.17 oz)

Materials

Housing base	PC-FR
Display cover	PC-FR
Display foil and soft keys	PE
Housing seal	EPDM
Module side panels	PC-FR
Module covers	PBT GF30 FR
Cable mounting rail	PBT GF30 FR, stainless steel 1.4301 (AISI304)
Clamps	Stainless steel 1.4301 (AISI304)
Threaded fasteners	Stainless steel 1.4301 (AISI304)
Cable glands	Polyamide V0 as per UL94

17 Installation and operation in hazardous environment Class I Div. 2

Non-sparking device for use in specified hazardous environment in accordance with:
- Class I Div. 2
- Gas group A, B, C, D
- Temperature class T4A:
  - CM442: 0 °C (32 °F) < T_a < 60 °C (140 °F)
  - CM444/8: 0 °C (32 °F) < T_a < 55 °C (131 °F) or 50 °C (110 °F) for specific versions (→ 🖹 154)
- Control drawing: 401204
- Suitable for indoor and outdoor use according to NEMA 4X, IP66/67



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