Valid as of version 01.06.zz (Device firmware) Products Solutions

Services

# Operating Instructions **Proline Promass U 500**

Coriolis flowmeter Modbus RS485







- Make sure the document is stored in a safe place such that it is always available when working on or with the device.
- To avoid danger to individuals or the facility, read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser sales organization will supply you with current information and updates to this manual.

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# 1 About this document

#### 1.1 Document function

These Operating Instructions contain all the information required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

# 1.2 Symbols

#### 1.2.1 Safety symbols

#### **⚠** DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

#### **▲** WARNING

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

#### **A** CAUTION

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

#### NOTICE

This symbol contains information on procedures and other facts which do not result in personal injury.

#### 1.2.2 Electrical symbols

Symbol	Meaning	
===	Direct current	
~	Alternating current	
$\sim$	Direct current and alternating current	
≐	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.	
	Potential equalization connection (PE: protective earth) Ground terminals that must be connected to ground prior to establishing any other connections.	
	The ground terminals are located on the interior and exterior of the device:  Interior ground terminal: potential equalization is connected to the supply network.  Exterior ground terminal: device is connected to the plant grounding system.	

#### 1.2.3 Communication-specific symbols

Symbol	Meaning	
Wireless Local Area Network (WLAN) Communication via a wireless, local network.		
•	<b>LED</b> Light emitting diode is off.	

Symbol	Meaning
<u>-</u>	<b>LED</b> Light emitting diode is on.
	<b>LED</b> Light emitting diode is flashing.

# 1.2.4 Tool symbols

Symbol	Meaning
Torx screwdriver	
06	Phillips head screwdriver
Open-ended wrench	

# 1.2.5 Symbols for certain types of information

Symbol	Meaning
<b>✓</b>	Permitted Procedures, processes or actions that are permitted.
<b>✓</b> ✓	Preferred Procedures, processes or actions that are preferred.
X	Forbidden Procedures, processes or actions that are forbidden.
i	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
<b>•</b>	Notice or individual step to be observed
1., 2., 3	Series of steps
L	Result of a step
?	Help in the event of a problem
	Visual inspection

# 1.2.6 Symbols in graphics

Symbol	Meaning
1, 2, 3,	Item numbers
1., 2., 3.,	Series of steps
A, B, C,	Views
A-A, B-B, C-C,	Sections
≋ <b>→</b>	Flow direction

#### 1.3 **Documentation**



For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- Endress+Hauser Operations app: Enter serial number from nameplate or scan matrix code on nameplate.

The following documentation may be available depending on the device version ordered:

Document type	Purpose and content of the document
Technical Information (TI)	Planning aid for your device The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	Guide that takes you quickly to the 1st measured value The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	Your reference document These Operating Instructions contain all the information that is required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	Reference for your parameters The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

#### 1.4 Registered trademarks

#### **Modbus**®

Registered trademark of SCHNEIDER AUTOMATION, INC.

# 2 Safety instructions

# 2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ► Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ► Are authorized by the plant owner/operator.
- ► Are familiar with federal/national regulations.
- ▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- ► Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

#### 2.2 Intended use

#### Application and media

The measuring device described in this manual is intended only for the flow measurement of liquids.

To ensure that the measuring device remains in proper condition for the operation time:

- ▶ Only use the measuring device in full compliance with the data on the nameplate and the general conditions listed in the Operating Instructions and supplementary documentation.
- ▶ Use the measuring device only for media to which the process-wetted materials are sufficiently resistant.
- ▶ Keep within the specified pressure and temperature range.
- ► Keep within the specified ambient temperature range.
- ► Protect the measuring device permanently against corrosion from environmental influences.

#### Incorrect use

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

#### **A** WARNING

#### Danger of breakage due to corrosive or abrasive fluids and ambient conditions!

- ▶ Verify the compatibility of the process fluid with the sensor material.
- ▶ Ensure the resistance of all fluid-wetted materials in the process.
- ▶ Keep within the specified pressure and temperature range.

#### NOTICE

#### Verification for borderline cases:

► For special fluids and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-wetted materials, but does not accept any warranty or liability as minute changes in the temperature, concentration or level of contamination in the process can alter the corrosion resistance properties.

# 2.3 Workplace safety

When working on and with the device:

▶ Wear the required personal protective equipment as per national regulations.

# 2.4 Operational safety

Damage to the device!

- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ► The operator is responsible for the interference-free operation of the device.

#### Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!

▶ If modifications are nevertheless required, consult with the manufacturer.

#### Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

# 2.5 Product safety

This measuring device is designed in accordance with good engineering practice 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.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity. The manufacturer confirms this by affixing the CE mark to the device..

# 2.6 IT security

Our warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

# 2.7 Device-specific IT security

The device offers a range of specific functions to support protective measures on the operator's side. These functions can be configured by the user and guarantee greater inoperation safety if used correctly. The following list provides an overview of the most important functions:

Function/interface	Factory setting	Recommendation
Write protection via hardware write protection switch $\Rightarrow  riangleq 11$	Not enabled	On an individual basis following risk assessment
Access code (also applies to web server login or FieldCare connection) → 🖺 11	Not enabled (0000)	Assign a customized access code during commissioning

Function/interface	Factory setting	Recommendation
WLAN (order option in display module)	Enabled	On an individual basis following risk assessment
WLAN security mode	Enabled (WPA2- PSK)	Do not change
WLAN passphrase (Password) → 🖺 11	Serial number	Assign an individual WLAN passphrase during commissioning
WLAN mode	Access point	On an individual basis following risk assessment
Web server → 🗎 12	Enabled	On an individual basis following risk assessment
CDI-RJ45 service interface → 🖺 12	_	On an individual basis following risk assessment

#### 2.7.1 Protecting access via hardware write protection

Write access to the parameters of the device via the local display, web browser or operating tool (e.g. FieldCare, DeviceCare) can be disabled via a write protection switch (DIP switch on the main electronics module). When hardware write protection is enabled, only read access to the parameters is possible.

#### 2.7.2 Protecting access via a password

Different passwords are available to protect write access to the device parameters or access to the device via the WLAN interface.

- User-specific access code
   Protect write access to the device parameters via the local display, web browser or operating tool (e.g. FieldCare, DeviceCare). Access authorization is clearly regulated through the use of a user-specific access code.
- WLAN passphrase The network key protects a connection between an operating unit (e.g. notebook or tablet) and the device via the WLAN interface which can be ordered as an option.
- Infrastructure mode
   When the device is operated in infrastructure mode, the WLAN passphrase corresponds to the WLAN passphrase configured on the operator side.

#### User-specific access code

Write access to the device parameters via the local display, web browser or operating tool (e.g. FieldCare, DeviceCare) can be protected by the modifiable, user-specific access code  $(\rightarrow \cong 142)$ .

When the device is delivered, the device does not have an access code and is equivalent to 0000 (open).

#### WLAN passphrase: Operation as WLAN access point

When the device is delivered, the network key is pre-defined depending on the device. It can be changed via the **WLAN settings** submenu in the **WLAN passphrase** parameter  $(\rightarrow \implies 135)$ .

#### Infrastructure mode

A connection between the device and WLAN access point is protected by means of an SSID and passphrase on the system side. Please contact the relevant system administrator for access.

#### General notes on the use of passwords

- The access code and network key supplied with the device should be changed during commissioning for safety reasons.
- Follow the general rules for generating a secure password when defining and managing the access code and network kev.
- The user is responsible for the management and careful handling of the access code and network kev.
- For information on configuring the access code or on what to do if you lose the password, for example, see "Write protection via access code"  $\rightarrow \implies 142$ .

#### 2.7.3 Access via web server

The integrated web server can be used to operate and configure the device via a web browser  $\rightarrow \blacksquare$  59. The connection is established via the service interface (CDI-RI45) or the WLAN interface.

The web server is enabled when the device is delivered. The web server can be disabled via the **Web server functionality** parameter if necessary (e.g., after commissioning).

The device and status information can be hidden on the login page. This prevents unauthorized access to the information.



Detailed information on the device parameters: "Description of device parameters" document.

#### 2.7.4 Access via service interface (CDI-RJ45)

The device can be connected to a network via the service interface (CDI-RJ45). Devicespecific functions quarantee the secure operation of the device in a network.

The use of relevant industrial standards and quidelines that have been defined by national and international safety committees, such as IEC/ISA62443 or the IEEE, is recommended. This includes organizational security measures such as the assignment of access authorization as well as technical measures such as network segmentation.

# **3** Product description

The measuring system consists of a transmitter, a sensor and a disposable measuring tube.

- The device is available for front panel mounting:
   The transmitter and sensor are mounted physically separate from each other and are attached to each other via connecting cables.
- The device is available in a table-top version:
   The transmitter and sensor form a mechanical unit.

# 3.1 Product design

#### 3.1.1 **Proline 500 – digital**

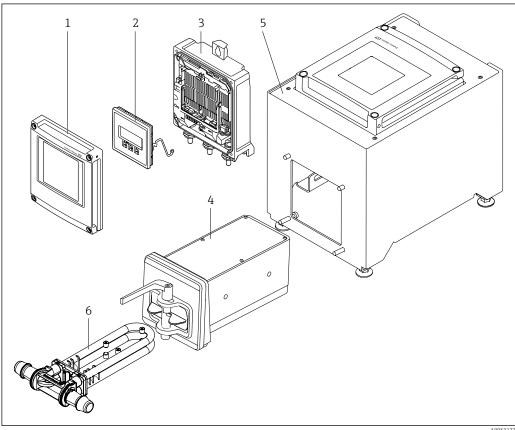
Signal transmission: digital

For use in clean rooms.

As the electronics are located in the sensor, the device is ideal:

For simple transmitter replacement.

Not sensitive to external EMC interference.



 $\blacksquare$  1 Important components of a measuring device

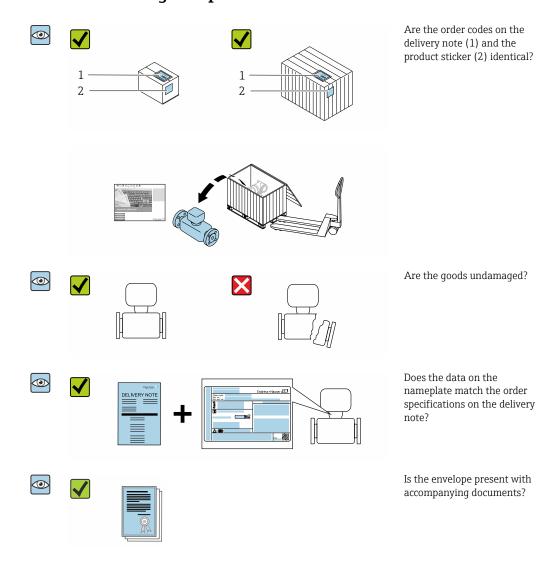
- 1 Electronics compartment cover
- 2 Display module
- 3 Transmitter housing
- 4 Sensor with integrated ISEM electronics
- 5 Table version with integrated transmitter
- 6 Disposable measuring tube

Endress+Hauser 13

A005317

# 4 Incoming acceptance and product identification

# 4.1 Incoming acceptance



- The disposable is not part of the device delivery and must be ordered separately.
- If one of the conditions is not satisfied, contact your Endress+Hauser Sales Center.
   The Technical Documentation is available via the Internet or via the Endress+Hauser Operations app: Product identification → 15.

# 4.2 Product identification

The device can be identified in the following ways:

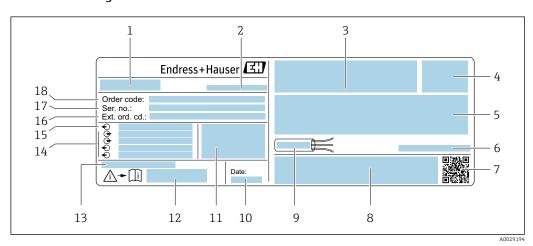
- Nameplate
- Order code with details of the device features on the delivery note
- Enter the serial numbers from the nameplates in the *Device Viewer* (www.endress.com/deviceviewer): all the information about the device is displayed.
- Enter the serial numbers from the nameplates into the *Endress+Hauser Operations app* or scan the DataMatrix code on the nameplate with the *Endress+Hauser Operations app*: all the information about the device is displayed.

For an overview of the scope of the associated Technical Documentation, refer to the following:

- The "Additional standard device documentation" and "Supplementary device-dependent documentation" sections
- The *Device Viewer*: Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations app*: Enter the serial number from the nameplate or scan the DataMatrix code on the nameplate.

#### 4.2.1 Transmitter nameplate

#### Proline 500 - digital

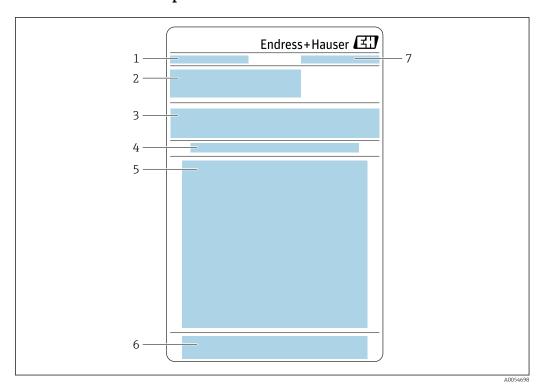


■ 2 Example of a transmitter nameplate

1 Name of the transmitter

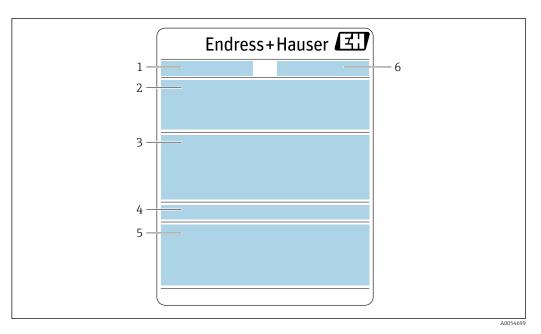
- 2 Manufacturer address/certificate holder
- 3 Space for approvals
- 4 Degree of protection
- 5 Electrical connection data: available inputs and outputs
- 6 Allowable ambient temperature  $(T_a)$
- 7 2-D matrix code
- 8 Space for approvals and certificates: e.g. CE mark, RCM tick
- 9 Permitted temperature range for cable
- 10 Date of manufacture: year-month
- 11 Firmware version (FW) and device revision (Dev. rev.) from the factory
- 12 Document number of safety-related supplementary documentation
- 13 Space for additional information in the case of special products
- 14 Available inputs and outputs, supply voltage
- 15 Electrical connection data: supply voltage
- 16 Extended order code (Ext. ord. cd.)
- 17 Serial number (Ser. no.)
- 18 Order code

#### 4.2.2 Sensor nameplate



- Designation
- 2 Order code, serial number, extended order code (Ext. ord. cd.)
- 3
- Material list, product information
  Installing/removing the disposable measuring tube
- *Instructions: Installing/removing the disposable measuring tube*
- CE mark + approvals
- Manufacturer address/certificate holder

16



1 Designation

- 2 Order code, serial number, extended order code (Ext. ord. cd.)
- 3 Material list, product information
- 4 Degree of protection
- 5 CE mark + approvals
- 6 Manufacturer address/certificate holder

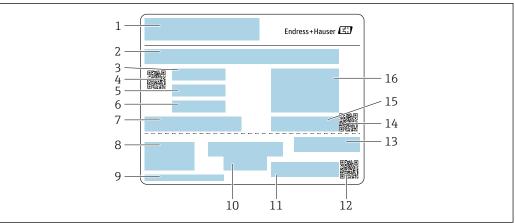
# Order code

The measuring device is reordered using the order code.

#### Extended order code

- The device type (product root) and basic specifications (mandatory features) are always listed.
- Of the optional specifications (optional features), only the safety and approvalrelated specifications are listed (e.g. LA). If other optional specifications are also ordered, these are indicated collectively using the # placeholder symbol (e.g. #LA#).
- If the ordered optional specifications do not include any safety and approval-related specifications, they are indicated by the + placeholder symbol (e.g. XXXXXX-ABCDE +).

# 4.2.3 Disposable measuring tube nameplate



A0054484

- 1 Designation
- 2 Material list
- 3 LOT number
- 4 Matrix code with LOT/material number
- 5 Date 1
- 6 Date 2 + 2 years
- 7 Manufacture details
- 8 References to Operating Instructions
- 9 Manufacturer address/certificate holder
- 10 Storage information
- 11 Order code + material number
- 12 Matrix code with DK8014-xx/material number
- 13 CE mark + approvals
- 14 Matrix code with serial number
- 15 Serial number
- 16 Product image

# 4.2.4 Symbols on the device

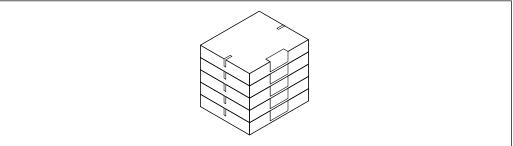
Symbol	Meaning
$\triangle$	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury. Please consult the documentation for the measuring device to discover the type of potential danger and measures to avoid it.
(i	Reference to documentation Refers to the corresponding device documentation.
	Protective ground connection A terminal that must be connected to the ground prior to establishing any other connections.

# 5 Storage and transport

# 5.1 Storage conditions

Observe the following notes for storage:

- ► Store in the original packaging to ensure protection from shock.
- ▶ Protect from direct sunlight. Avoid unacceptably high surface temperatures.
- ► Store in a dry and dust-free place.
- ▶ Do not store outdoors.
- ► Stack a maximum of 6 disposable measuring tubes in the cardboard packaging.
- ▶ Do not store the disposable measuring tubes for more than 2 years.



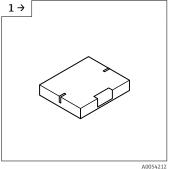
A0054168

Storage temperature → 🖺 238

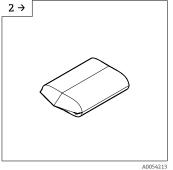
# 5.2 Transporting the product

Transport the measuring device to the measuring point in the original packaging.

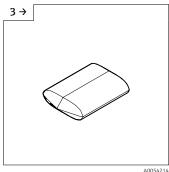
## 5.2.1 Transporting the disposable measuring tube



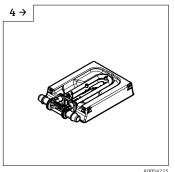
 Transport from the warehouse to the airlock in the box.

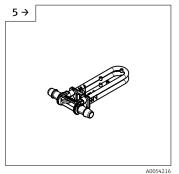


 Remove the box before the first airlock.

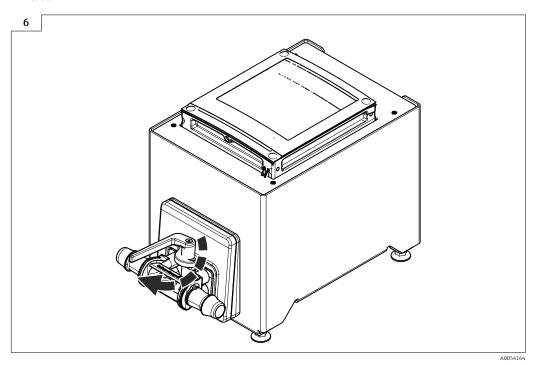


Remove the first plastic packaging inside the airlock.





- ► Remove the last plastic packaging in the clean room.
- ▶ If the disposable measuring tube is integrated into an assembly prior to commissioning, the stability packaging must remain in place to protect the measuring tube.
- Remove the disposable measuring tube from the stability packaging and secure it in the sensor immediately.



▶ Replacing the disposable measuring tube  $\rightarrow$  🖺 25

# 5.3 Packaging disposal

All packaging materials are environmentally friendly and 100% recyclable:

- Outer packaging of device Stretch wrap made of polymer in accordance with EU Directive 2002/95/EC (RoHS)
- Packaging
  - Wood crate treated in accordance with ISPM 15 standard, confirmed by IPPC logo
  - Cardboard box in accordance with European packaging guideline 94/62/EC, recyclability confirmed by Resy symbol
- Transport material and fastening fixtures
  - Disposable plastic pallet
  - Plastic straps
  - Plastic adhesive strips
- Filler material Paper pads

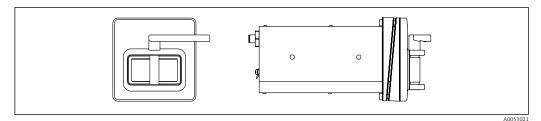
# 6 Installation

# 6.1 Installation requirements

# 6.1.1 Installation position

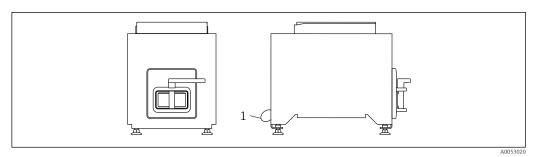
#### Installation point

Front panel mounting



■ 3 Order code for "Device version", option NA "Front panel mounting"

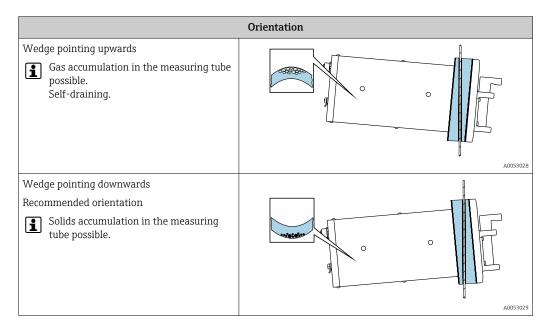
#### Table version



■ 4 Order code for "Device version", option NE "Table version"

1 Secure the device to the table with the supplied cable through the hole on the back.

#### Orientation



#### 6.1.2 Environmental and process requirements

#### Ambient temperature range

<b>Measuring device</b> +5 to +40 °C (+41 to +104 °F)	
Readability of the local display	-20 to +60 °C (-4 to +140 °F) The readability of the display may be impaired at temperatures outside the temperature range.

Dependency of ambient temperature on medium temperature  $\rightarrow \triangleq 239$ 

#### **Vibrations**

The operational reliability of the measuring system is not affected by plant vibrations.

#### **6.1.3** Special installation instructions

#### Drainability

When installed with the wedge pointing upwards, the measuring tubes can be drained completely and protected against buildup.

#### Sterility

#### **Biotech**

#### Zero verification and zero adjustment

During commissioning, the two components (sensor and disposable measuring tube) are combined into a single unit for the first time. The use of automated Heartbeat Verification during commissioning not only confirms the validity of the factory calibration of the disposable measuring tube but also verifies the entire flowmeter, including the sensor, the transmitter, and the installed disposable component, within a defined scope of testing.

Key parameters, such as the calibration factor of the disposable measuring tube and other device information determined during factory calibration, must remain unchanged. Commissioning also includes performing a zero-point adjustment of the installed measuring instrument filled with liquid to compensate for manufacturing tolerances of the sensor.

This results in an updated zero point, which may deviate from the original zero point specified on the factory calibration certificate and is subsequently documented in the Heartbeat Technology verification report.

To achieve the highest possible measurement accuracy at low flow rates, the installation must protect the sensor from mechanical stresses during operation.

To get a representative zero point, ensure that:

- any flow in the device is prevented during the adjustment
- the process conditions (e.g. pressure, temperature) are stable and representative

Verification and adjustment cannot be performed if the following process conditions are present:

- Gas pockets
   Ensure that the system has been sufficiently flushed with the medium. Repeated flushing can help to eliminate gas pockets.
- Thermal circulation
  In the event of temperature differences (e.g. between the measuring tube inlet and outlet section), induced flow can occur even if the valves are closed due to thermal circulation in the device
- Leaks at the valves
   If the valves are not leak-tight, flow is not sufficiently prevented when determining the zero point

If these conditions cannot be avoided, it is advisable to keep the factory setting for the zero point.

# 6.2 Installing the device

#### 6.2.1 Required tools

#### For sensor

For process connections: Use a suitable mounting tool.

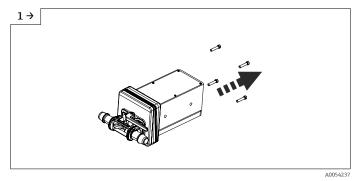
#### 6.2.2 Preparing the measuring instrument

▶ Remove all remaining transport packaging.

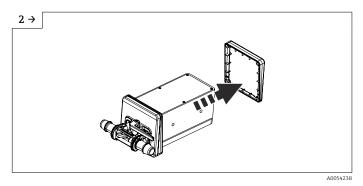
#### 6.2.3 Mounting the measuring device

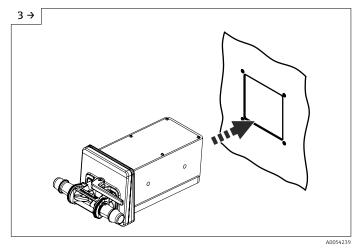
- Order code for "Device version", option NE "Table version"
   This version is completely mounted.
- Order code for "Device version", option NA "Front panel mounting" This version is mounted in a front panel.
- The sensor is designed for the following sheet thicknesses:
  - 3mm
  - 5mm
  - 7mm

Mount the sensor in the front panel.

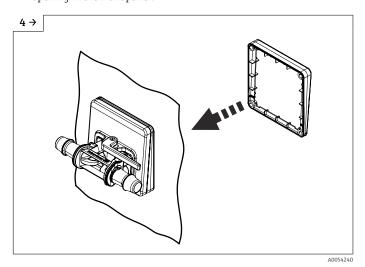


▶ Remove the screws.

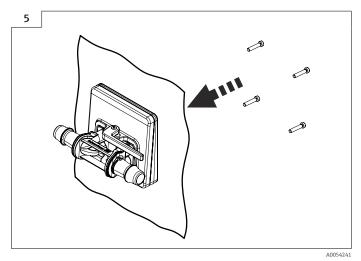




► Push the sensor with the wedge (to the outside) into the prepared opening in the front panel.



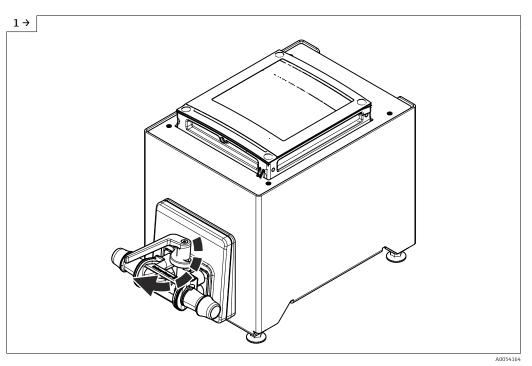
 $\,\blacktriangleright\,\,$  Slide the wedge over the sensor from the inside.



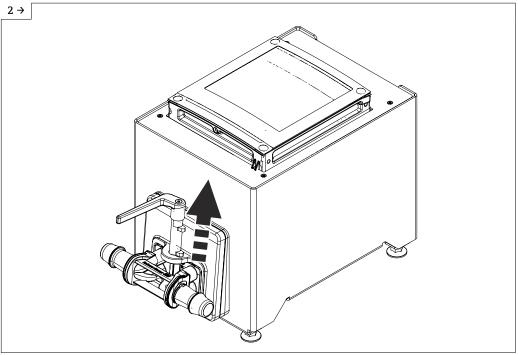
► Screw the sensor to the wedges.

# 6.2.4 Replacing the disposable measuring tube

The device version, option NE table version must be attached to the table with the stand.

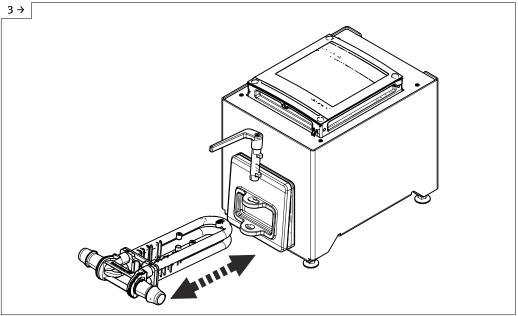


► Open the lever.



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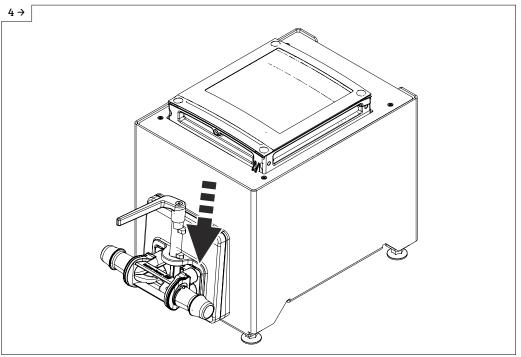
▶ Pull up the lever.



A0054166

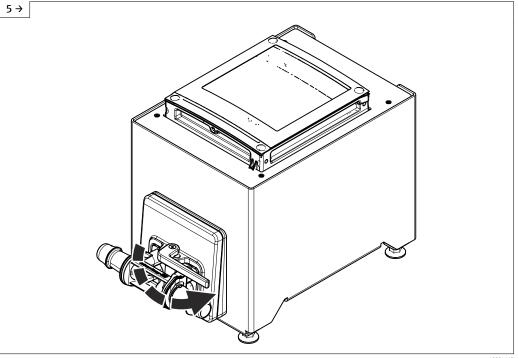
- Remove the disposable measuring tube. Wait until this diagnostic message appears: Sensor unknown. Insert the disposable measuring tube.

26



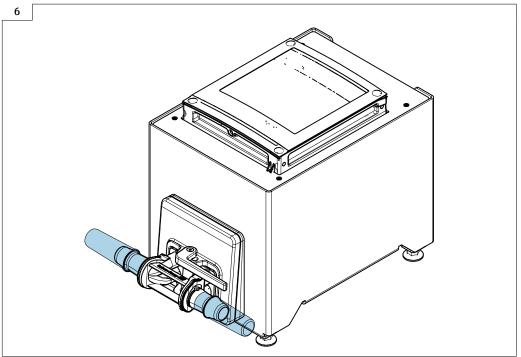
A0054685

▶ Lower the lever.



A0054163

- ► Turn the lever to the limit stop.
- After inserting the disposable measuring tube, this diagnostic message appears on the display after 30 seconds at the latest: Device initialization active.
- Heartbeat Verification and zero point adjustment are performed automatically. This diagnostic message is displayed during this time: Device initialization active.
- Heartbeat Verification and zero point adjustment have been performed: No diagnostic message is displayed.



A0056826

- Fill the system with liquid (density:  $800 \text{ to } 1500 \text{ kg/m}^3 \text{ (} 1764 \text{ to } 3307 \text{ lb/cf)}\text{)}.$
- Prevent any flow.
- ▶ Repeated flushing can help to eliminate gas pockets.
- ► Re-initialize the device: On the display Expert → Sensor → Disposable component → Commissioning, using Modbus Register 26321-1 or Profinet.
- ► Heartbeat Verification and zero point adjustment are performed. This diagnostic message is displayed during this time: Device initialization active.
- ▶ Heartbeat Verification and zero point adjustment have been performed: No diagnostic message is displayed.
- ▶ Download the Heartbeat Technology verification report: for detailed information on data management, see the Operating Instructions for the device
- ► The device is now operational.

#### 6.2.5 Mounting the transmitter housing: Proline 500 – digital

#### **A** CAUTION

#### Ambient temperature too high!

Danger of electronics overheating and housing deformation.

► Do not exceed the permitted maximum ambient temperature.

#### **A** CAUTION

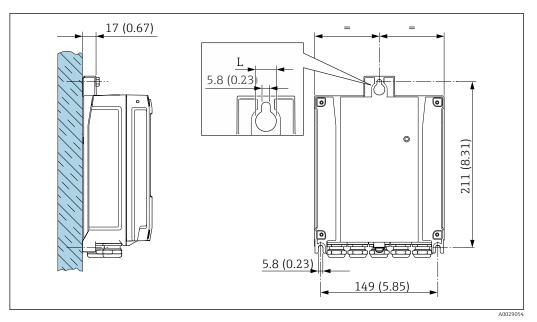
#### Excessive force can damage the housing!

► Avoid excessive mechanical stress.

#### Wall mounting

Required tools:

Drill with drill bit Ø 6.0 mm



■ 5 Engineering unit mm (in)

L Depends on order code for "Transmitter housing"

Order code for "Transmitter housing" Option  $\bf A$ , aluminum, coated: L = 14 mm (0.55 in)

- 1. Drill the holes.
- 2. Insert wall plugs into the drilled holes.
- 3. Screw in the fixing screws slightly.
- 4. Fit the transmitter housing over the fixing screws and mount in place.
- 5. Tighten the fixing screws.

# 6.3 Post-installation check

Is the device undamaged (visual inspection)?			
Does the measuring instrument correspond to the measuring point specifications?  For example:  Process temperature →  239  Pressure (refer to the "Pressure-temperature ratings" section of the "Technical Information" document).  Ambient temperature  Measuring range			
Has the correct orientation for the sensor been selected?  According to sensor type According to medium temperature According to medium properties (outgassing, with entrained solids)			
Does the arrow on the process connection match the direction of flow of the medium?			
Is the tag name and labeling correct (visual inspection)?			
Is the securing screw firmly tightened?			

#### 7 Electrical connection

#### **▲** WARNING

Live parts! Incorrect work performed on the electrical connections can result in an electric shock.

- ► Set up a disconnecting device (switch or power-circuit breaker) to easily disconnect the device from the supply voltage.
- ► In addition to the device fuse, include an overcurrent protection unit with max. 10 A in the plant installation.

# 7.1 Electrical safety

In accordance with applicable national regulations.

# 7.2 Connecting requirements

#### 7.2.1 Required tools

- For cable entries: use appropriate tool
- Wire stripper
- When using stranded cables: crimper for wire end ferrule
- For removing cables from terminal: flat blade screwdriver ≤ 3 mm (0.12 in)

#### 7.2.2 Requirements for connection cable

The connecting cables provided by the customer must fulfill the following requirements.

#### Protective grounding cable for the outer ground terminal

Conductor cross-section < 2.1 mm<sup>2</sup> (14 AWG)

The use of a cable lug enables the connection of larger cross-sections.

The grounding impedance must be less than 2  $\Omega$ .

#### Permitted temperature range

- The installation guidelines that apply in the country of installation must be observed.
- The cables must be suitable for the minimum and maximum temperatures to be expected.

#### Power supply cable (incl. conductor for the inner ground terminal)

Standard installation cable is sufficient.

#### Signal cable

For custody transfer, all signal lines must be shielded cables (tinned copper braiding, optical coverage  $\geq$  85 %). The cable shield must be connected on both sides.

Ethernet-APL

Shielded twisted-pair cable. Cable type A is recommended.

See https://www.profibus.com Ethernet-APL White Paper "

Modbus RS485

Shielded twisted-pair cable.



See https://modbus.org "MODBUS over Serial Line Specification and Implementation

Current output 0 /4 to 20 mA (excluding HART)

Standard installation cable is sufficient.

Pulse /frequency /switch output

Standard installation cable is sufficient.

Relay output

Standard installation cable is sufficient.

Current input 4 to 20 mA

Standard installation cable is sufficient.

Status input

Standard installation cable is sufficient.

#### Cable diameter

- Cable glands supplied:  $M20 \times 1.5$  with cable Ø 6 to 12 mm (0.24 to 0.47 in)
- Spring-loaded terminals: Suitable for strands and strands with ferrules. Conductor cross-section 0.2 to 2.5 mm<sup>2</sup> (24 to 12 AWG).

#### Choice of connecting cable between the transmitter and sensor

A: Connecting cable between sensor and transmitter: Proline 500 – digital Standard cable

A standard cable with the following specifications can be used as the connecting cable.

Design	2x2 cores (twisted pairs); stranded CU wires with common shield			
Shield	Tin-plated copper braid, optical cover ≥ 85 %			
Loop resistance	Power supply line (+, –): maximum 10 Ω			
Cable length	Maximum 300 m (900 ft), see the following table.			
Device plug, side 1	M12 socket, 5-pin, A-coded.			
Device plug, side 2	M12 plug, 5-pin, A-coded.			
Pins 1+2	Connected cores as twisted pair.			
Pins 3+4	Connected cores as twisted pair.			

Cross-section	Cable length [max.]		
0.34 mm <sup>2</sup> (AWG 22)	80 m (240 ft)		
0.50 mm <sup>2</sup> (AWG 20)	120 m (360 ft)		
0.75 mm <sup>2</sup> (AWG 18)	180 m (540 ft)		
1.00 mm <sup>2</sup> (AWG 17)	240 m (720 ft)		
1.50 mm <sup>2</sup> (AWG 15)	300 m (900 ft)		

#### connecting cable

Design	$2 \times 2 \times 0.34 \text{ mm}^2$ PUR cable with common shield	
Flame resistance	According to DIN EN 60332-1-2 (60 seconds)	
Oil resistance	According to DIN EN 60811-2-1 (for 168h at 90°C)	
Shield	Tin-plated copper braid	
Continuous operating temperature	When mounted in a fixed position: $-40$ to $+105$ °C ( $-40$ to $+221$ °F); when cable can move freely: $-25$ to $+105$ °C ( $-13$ to $+221$ °F)	
Available cable lengths	Fixed: 2 m (6 ft), 5 m (15 ft), 10 m (30 ft)	
Device plug, side 1	M12 socket, 5-pin, A-coded	
Device plug, side 2	M12 plug, 5-pin, A-coded	

#### 7.2.3 Terminal assignment

#### Transmitter: supply voltage, input/outputs

The terminal assignment of the inputs and outputs depends on the individual order version of the device. The device-specific terminal assignment is documented on an adhesive label in the terminal cover.

Supply	Supply voltage Input/output 1		Input/	output 2	Input/output 3		Input/output 4		
1 (+)	2 (-)	26 (B)	27 (A)	24 (+)	25 (-)	22 (+)	23 (-)	20 (+)	21 (-)
		Device-specific terminal assignment: adhesive label in terminal cover.							

#### Transmitter and sensor connection housing: connecting cable

The sensor and transmitter, which are mounted in separate locations, are interconnected by a connecting cable. The cable is connected via the sensor connection housing and the transmitter housing.

#### 7.2.4 Shielding and grounding

#### Shielding and grounding concept

- 1. Maintain electromagnetic compatibility (EMC).
- 2. Take explosion protection into consideration.
- 3. Pay attention to the protection of persons.
- 4. Comply with national installation regulations and guidelines.
- 5. Observe cable specifications.
- 6. Keep the stripped and twisted lengths of cable shield to the ground terminal as short as possible.
- 7. Shield cables fully.

#### Grounding of the cable shield

#### NOTICE

In systems without potential matching, the multiple grounding of the cable shield causes mains frequency equalizing currents!

Damage to the bus cable shield.

- ► Only ground the bus cable shield to either the local ground or the protective ground at one end.
- ▶ Insulate the shield that is not connected.

To comply with EMC requirements:

- 1. Ensure the cable shield is grounded to the potential matching line at multiple points.
- 2. Connect every local ground terminal to the potential matching line.

#### 7.2.5 Preparing the measuring device

Carry out the steps in the following order:

- 1. Mount the sensor and transmitter.
- 2. Sensor connection housing: Connect connecting cable.
- 3. Transmitter: Connect connecting cable.
- 4. Transmitter: Connect signal cable and cable for supply voltage.

#### NOTICE

#### Insufficient sealing of the housing!

Operational reliability of the measuring device could be compromised.

- ▶ Use suitable cable glands corresponding to the degree of protection.
- 1. Remove dummy plug if present.
- 2. If the measuring device is supplied without cable glands: Provide suitable cable gland for corresponding connecting cable.
- 3. If the measuring device is supplied with cable glands: Observe requirements for connecting cables  $\rightarrow \triangleq 30$ .

# 7.3 Connecting the device: Proline 500 – digital

#### NOTICE

#### An incorrect connection compromises electrical safety!

- ► Only properly trained specialist staff may perform electrical connection work.
- ▶ Observe applicable federal/national installation codes and regulations.
- ► Comply with local workplace safety regulations.
- ► Always connect the protective ground cable ⊕ before connecting additional cables.

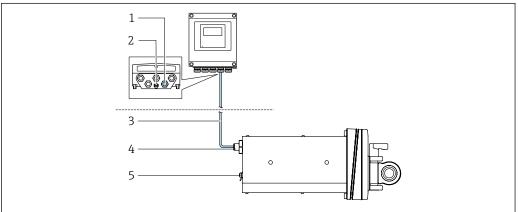
## 7.3.1 Fitting the connecting cable

#### **WARNING**

#### Risk of damaging electronic components!

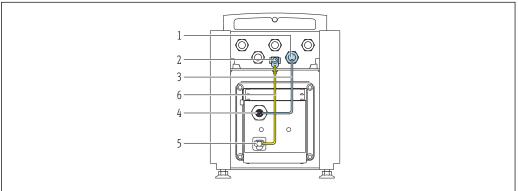
- ► Connect the sensor and transmitter to the same potential equalization.
- ▶ Only connect the sensor to a transmitter with the same serial number.

#### Connection of connecting cable: Proline 500 - digital



A005306

- 6 Order code for "Device version", option NA "Front panel mounting"
- 1 M12 socket for connecting the connecting cable on the transmitter housing
- 2 Terminal connection for potential equalization (PE)
- 3 Connecting cable with M12 plug and M12 socket
- 4 M12 plug for connecting the connecting cable on the sensor
- 5 Terminal connection for potential equalization (PE)



A005374

■ 7 Order code for "Device version", option NE "Table version"

- 1 M12 socket for connecting the connecting cable on the transmitter housing
- 2 Terminal connection for potential equalization (PE)
- 3 Connecting cable with M12 plug and M12 socket
- 4 M12 plug for connecting the connecting cable on the sensor
- 5 Terminal connection for potential equalization (PE)
- 6 Fixed connection between the potential equalization (PE)

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#### Pin assignment, device plug

#### Connection on transmitter

1	Pin	Color 1)	Assignment		Connection to terminal	
	1	Brown	+	Supply voltage	61	
4 0 0 0 2 5	2	White	-	Supply voltage	62	
	3	Blue	А	ISEM communication	64	
	4	Black	В	ISEM Communication	63	
A0053073	5	_		_	_	
		Coding		Plug/socket		
	А			Socket		

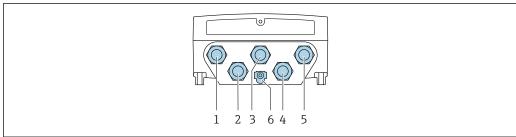
#### 1) Cable colors of connecting cable

#### Connection on sensor

2	Pin	Color 1)		Assignment
	1	Brown	+	Supply voltage
3 0 0 1	2	White	-	Supply voltage
5	3	Blue	Α	ISEM communication
	4	Black	В	ISEM Communication
	5	-		_
	Coding			Plug/socket
	A			Plug

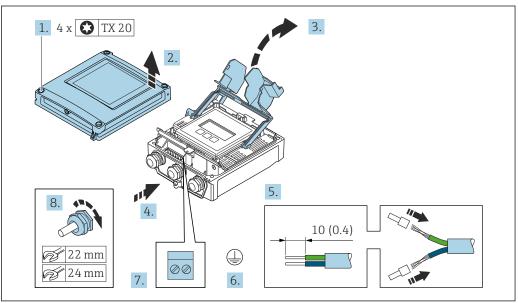
1) Cable colors of connecting cable

# 7.3.2 Connecting the signal cable and the supply voltage cable



A002820

- 1 Terminal connection for supply voltage
- 2 Terminal connection for signal transmission, input/output
- 3 Terminal connection for signal transmission, input/output
- 4 Terminal connection for connecting cable between sensor and transmitter
- 5 Terminal connection for signal transmission, input/output; optional: connection for external WLAN antenna
- 6 Protective earth (PE)



A0029597

- 1. Loosen the 4 fixing screws on the housing cover.
- 2. Open the housing cover.
- 3. Fold open the terminal cover.
- 4. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
- 5. Strip the cable and cable ends. In the case of stranded cables, fit ferrules.
- 6. Connect the protective ground.
- 7. Connect the cable according to the terminal assignment.
  - ► **Signal cable terminal assignment:** The device-specific terminal assignment is documented on an adhesive label in the terminal cover.

**Supply voltage terminal assignment:** Adhesive label in the terminal cover or  $\Rightarrow \implies 32$ .

- 8. Firmly tighten the cable glands.
  - ► This concludes the cable connection process.
- 9. Close the terminal cover.
- 10. Close the housing cover.

### **WARNING**

Housing degree of protection may be voided due to insufficient sealing of the housing.

► Screw in the screw without using any lubricant.

#### NOTICE

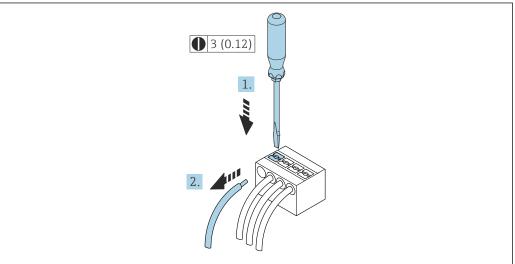
### Excessive tightening torque applied to the fixing screws!

Risk of damaging the plastic transmitter.

- ► Tighten the fixing screws as per the tightening torque: 2.5 Nm (1.8 lbf ft)
- 11. Tighten the 4 fixing screws on the housing cover.

### Removing a cable

To remove a cable from the terminal:



A002959

- 8 Engineering unit mm (in)
- 1. Use a flat-blade screwdriver to press down on the slot between the two terminal holes.
- 2. Remove the cable end from the terminal.

## 7.4 Potential equalization

## 7.4.1 Requirements

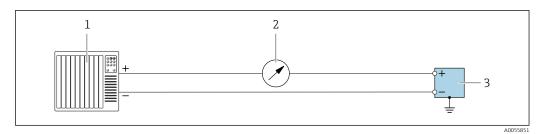
For potential equalization:

- Pay attention to in-house grounding concepts
- Take account of operating conditions, such as the pipe material and grounding
- Connect the medium, sensor and transmitter to the same electric potential
- For the "device version" order code NE "table top" option, the sensor and transmitter are internally wired
- Use a ground cable with a minimum cross-section of 6 mm<sup>2</sup> (10 AWG) and a cable lug for potential equalization connections

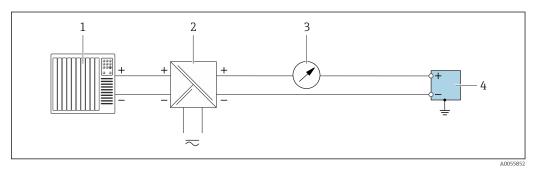
## 7.5 Special connection instructions

## 7.5.1 Connection examples

## Current output 4 to 20 mA (without HART)



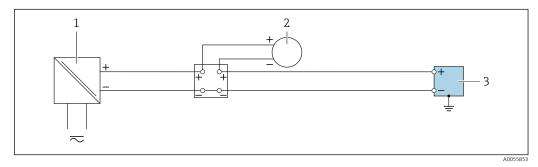
- 9 Connection example for 4 to 20 mA current output (active)
- 1 Automation system with current input (e.g. PLC)
- 2 Optional additional display unit: Observe maximum load
- 3 Flowmeter with current output (active)



■ 10 Connection example for 4 to 20 mA current output (passive)

- 1 Automation system with current input (e.g. PLC)
- 2 Power supply
- 3 Optional additional display unit: Observe maximum load
- 4 Transmitter with current output (passive)

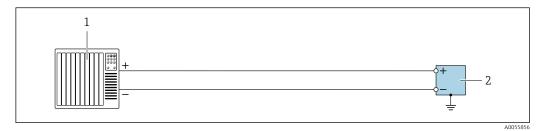
### Current input 4 to 20 mA



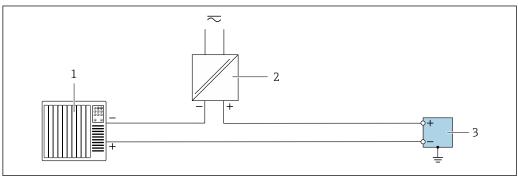
 $\blacksquare$  11 Connection example for 4 to 20 mA current input

- 1 Power supply
- 2 External measuring instrument with 4 to 20 mA passive current output. e.g. pressure or temperature)
- 3 Transmitter with 4 to 20 mA current input

## Pulse output/frequency output/switch output

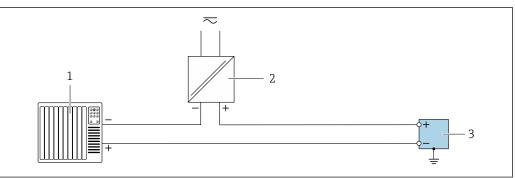


- Connection example for pulse output/frequency output/switch output (active)
- Automation system with pulse input/frequency input/switch input (e.g. PLC)
- Transmitter with pulse output/frequency output/switch output (active)



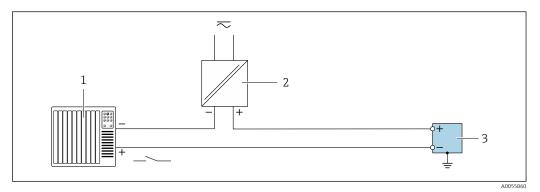
- **■** 13 Connection example for pulse output/frequency output/switch output (passive)
- Automation system with pulse input/frequency input/switch input (e.g. PLC)
- 2 Power supply
- 3 Transmitter with pulse output/frequency output/switch output (passive)

## Relay output



- **■** 14 Connection example for relay output
- Automation system with switch input (e.g. PLC)
- 2 Power supply
- *Transmitter with relay output*

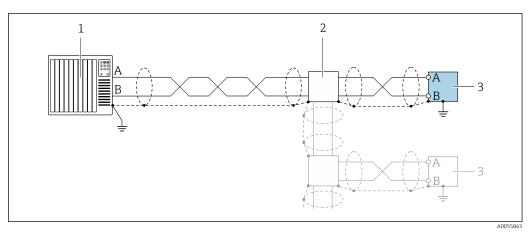
### Status input



■ 15 Connection example for status input

- 1 Automation system with switch output passive e.g. PLC)
- 2 Power supply
- 3 Transmitter with status input

#### Modbus RS485



■ 16 Connection example for Modbus RS485

- 1 Automation system with Modbus master (e.g. PLC)
- Optional distribution box
- 3 Transmitter with Modbus RS485

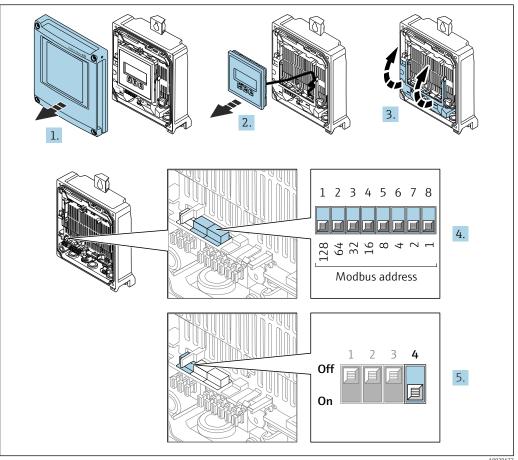
# 7.6 Hardware settings

## 7.6.1 Setting the device address

The device address must always be configured for a Modbus slave. The valid device addresses are in the range from 1 to 247. Each address may only be assigned once in a Modbus RS485 network. If an address is not configured correctly, the measuring device is not recognized by the Modbus master. All measuring devices are delivered from the factory with the device address 247 and with the "software addressing" address mode.

### Proline 500 - digital transmitter

Hardware addressing



- 1. Open the housing cover.
- 2. Remove the display module.
- 3. Fold open the terminal cover.
- 4. Set the desired device address using the DIP switches.
- 5. To switch addressing from software addressing to hardware addressing: set the DIP switch to **On**.
  - ► The change of device address takes effect after 10 seconds.

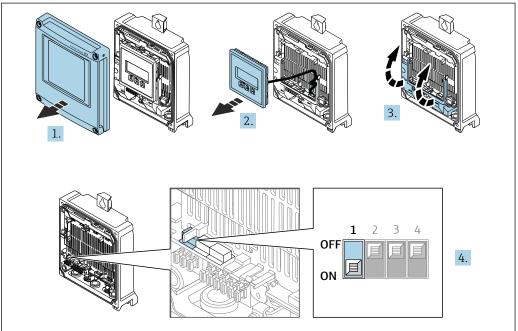
## Software addressing

- To switch addressing from hardware addressing to software addressing: set the DIP switch to Off.
  - The device address configured in the **Device address** parameter takes effect after 10 seconds.

#### 7.6.2 Activating the terminating resistor

To avoid incorrect communication transmission caused by impedance mismatch, terminate the Modbus RS485 cable correctly at the start and end of the bus segment.

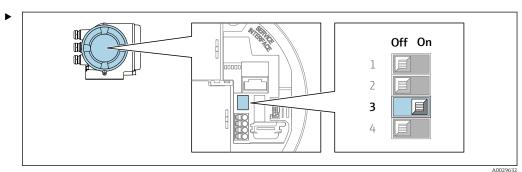
### Proline 500 - digital transmitter



A0029675

- 1. Open the housing cover.
- 2. Remove the display module.
- 3. Fold open the terminal cover.
- 4. Switch DIP switch no. 3 to **On**.

### Proline 500 transmitter



Switch DIP switch no. 3 to **On**.

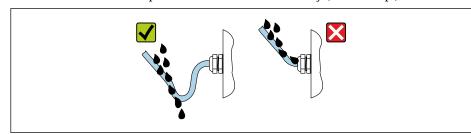
# 7.7 Ensuring the degree of protection

The measuring instrument fulfills all the requirements for the degree of protection IP66/67, Type 4X enclosure.

To guarantee the degree of protection IP66/67, Type 4X enclosure, carry out the following steps after the electrical connection:

- 1. Check that the housing seals are clean and fitted correctly.
- 2. Dry, clean or replace the seals if necessary.
- 3. Tighten all housing screws and screw covers.
- 4. Firmly tighten the cable glands.

5. To ensure that moisture does not enter the cable entry:
Route the cable so that it loops down before the cable entry ("water trap").



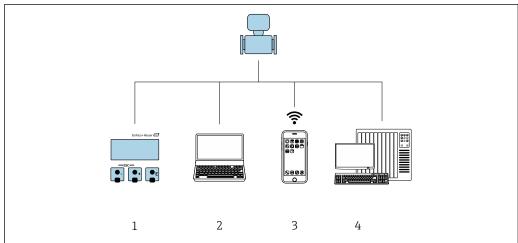
6. The cable glands supplied do not ensure housing protection when not in use. They must therefore be replaced by dummy plugs corresponding to the housing protection.

## 7.8 Post-connection check

Are the device and cable undamaged (visual inspection)?	
Is the protective earthing established correctly?	
Do the cables used comply with the requirements ?	
Are the installed cables strain-relieved and securely routed?	
Are all cable glands installed, securely tightened and leak-tight? Cable run with "water trap" → 🖺 42?	
Is the terminal assignment correct ?	
Are dummy plugs inserted in unused cable entries and have transportation plugs been replaced with dummy plugs?	

# **8** Operation options

## 8.1 Overview of operation options

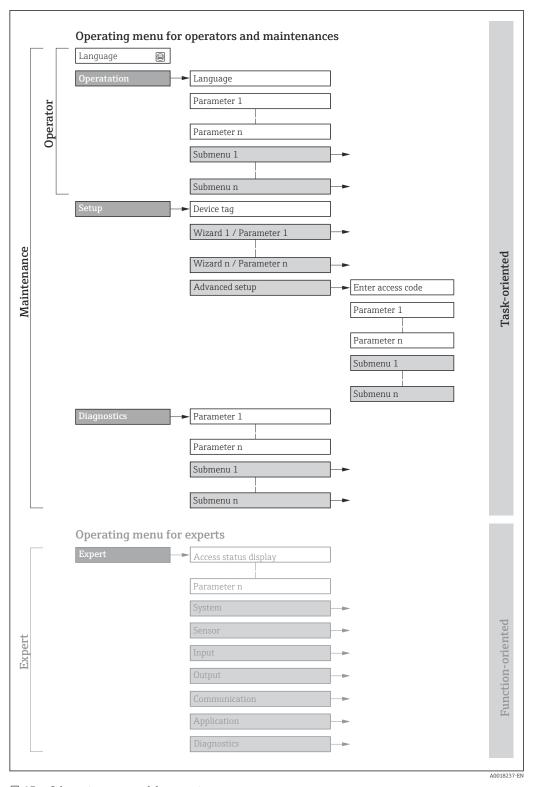


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- 1 Local operation via display module
- 2 Computer with Web browser (e.g. Internet Explorer) or with operating tool (e.g. FieldCare, DeviceCare, AMS Device Manager, SIMATIC PDM)
- 3 Mobile handheld terminal with SmartBlue App
- 4 Automation system (e.g. PLC)

## 8.2 Structure and function of the operating menu

## 8.2.1 Structure of the operating menu



 $\blacksquare$  17 Schematic structure of the operating menu

## 8.2.2 Operating philosophy

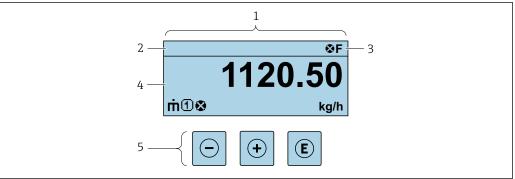
The individual parts of the operating menu are assigned to certain user roles (e.g. operator, maintenance etc.). Each user role contains typical tasks within the device life cycle.

Menu/pa	arameter	User role and tasks	Content/meaning
Language	Task- oriented	Role "Operator", "Maintenance" Tasks during operation: Configuration of the operational	<ul> <li>Defining the operating language</li> <li>Defining the Web server operating language</li> <li>Resetting and controlling totalizers</li> </ul>
Operation		display • Reading measured values	<ul> <li>Configuration of the operational display (e.g. display format, display contrast)</li> <li>Resetting and controlling totalizers</li> </ul>
Setup		"Maintenance" role Commissioning: Configuration of the measurement Configuration of the inputs and outputs Configuration of the communication interface	Wizards for fast commissioning:  Configuring the system units  Configuration of the communication interface  Definition of the medium  Displaying the I/O configuration  Configuring the inputs  Configuring the outputs  Configuration of the operational display  Configuring the low flow cut off  Configuring partial and empty pipe detection  Advanced setup  For more customized configuration of the measurement (adaptation to special measuring conditions)  Configuration of totalizers  Configuration of WLAN settings  Administration (define access code, reset measuring device)
Diagnostics		"Maintenance" role Troubleshooting: Diagnostics and elimination of process and device errors Measured value simulation	Contains all parameters for error detection and analyzing process and device errors:  Diagnostic list Contains up to 5 currently pending diagnostic messages.  Event logbook Contains event messages that have occurred.  Device information Contains information for identifying the device  Measured values Contains all current measured values.  Data logging submenu with the "Extended HistoROM" order option Storage and visualization of measured values  Heartbeat Technology Verification of device functionality on request and documentation of verification results  Simulation Used to simulate measured values or output values.

Menu/pa	arameter	User role and tasks	Content/meaning
Expert	Function- oriented	Tasks that require detailed knowledge of the function of the device:  Commissioning measurements under difficult conditions  Optimal adaptation of the measurement to difficult conditions  Detailed configuration of the communication interface  Error diagnostics in difficult cases	Contains all of the device parameters and allows direct access to these by means of an access code. The structure of this menu is based on the function blocks of the device:  System Contains all higher-level device parameters that do not affect measurement or measured value communication  Sensor Configuration of the measurement.  Input Configuration of the status input  Output Configuration of the analog current outputs as well as the pulse/frequency and switch output  Communication Configuration of the digital communication interface and the Web server  Application Configuration of the functions that go beyond the actual measurement (e.g. totalizer)  Diagnostics Error detection and analysis of process and device errors and for device simulation and Heartbeat Technology.

## 8.3 Access to operating menu via local display

## 8.3.1 Operational display



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- 1 Operational display
- 2 Device tag
- 3 Status area
- 4 Display range for measured values (up to 4 lines)
- 5 Operating elements  $\rightarrow \triangleq 54$

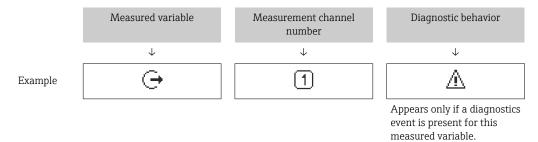
### Status area

The following symbols appear in the status area of the operational display at the top right:

- Status signals → 🗎 204
  - **F**: Failure
  - **C**: Function check
  - **S**: Out of specification
  - M: Maintenance required
- Diagnostic behavior → 🖺 205
  - 🐼: Alarm
  - <u></u> : Warning
- 🛱: Locking (the device is locked via the hardware )
- ←: Communication (communication via remote operation is active)

## Display area

In the display area, each measured value is prefaced by certain symbol types for further description:



#### Measured variables

Symbol	Meaning
ṁ	Mass flow
Ü	<ul><li>Volume flow</li><li>Corrected volume flow</li></ul>
P	<ul><li>Density</li><li>Reference density</li></ul>
4	Temperature

The number and display format of the measured variables can be configured via the **Format display** parameter ( $\Rightarrow \triangleq 109$ ).

### Totalizer

Symbol	Meaning
Σ	Totalizer  The measurement channel number indicates which of the three totalizers is displayed.

### Output

Symbol	Meaning
<b>(-)</b>	Output  The measurement channel number indicates which of the outputs is displayed.

### Input

Symbol	Meaning
€	Status input

## Measurement channel numbers

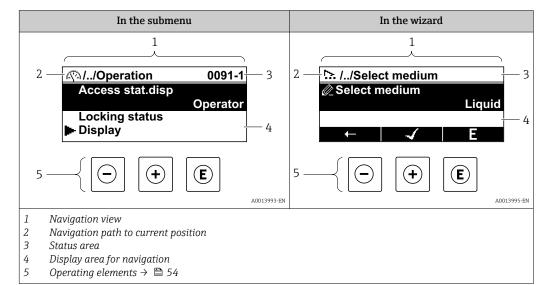
Symbol	Meaning
14	Measurement channel 1 to 4
	The measurement channel number is displayed only if more than one channel is present for the same measured variable type (e.g. totalizer 1 to 3).

## Diagnostic behavior

Symbol	Meaning
8	Alarm  Measurement is interrupted.  Signal outputs and totalizers assume the defined alarm condition.  A diagnostic message is generated.
Δ	<ul> <li>Warning</li> <li>Measurement is resumed.</li> <li>The signal outputs and totalizers are not affected.</li> <li>A diagnostic message is generated.</li> </ul>

The diagnostic behavior pertains to a diagnostic event that is relevant to the displayed measured variable.

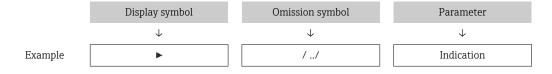
## 8.3.2 Navigation view



### Navigation path

The navigation path to the current position is displayed at the top left in the navigation view and consists of the following elements:

- The display symbol for the menu/submenu (►) or the wizard (►).
- An omission symbol (/ ../) for operating menu levels in between.
- Name of the current submenu, wizard or parameter



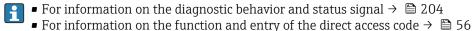
For more information about the icons in the menu, refer to the "Display area" section  $\Rightarrow \triangleq 50$ 

#### Status area

The following appears in the status area of the navigation view in the top right corner:

- In the submenu
  - The direct access code to the parameter (e.g., 0022-1)
  - If a diagnostic event is present, the diagnostic behavior and status signal
- In the wizard

If a diagnostic event is present, the diagnostic behavior and status signal



### Display area

#### Menus

Symbol	Meaning
P	Operation Is displayed: In the menu next to the "Operation" selection At the left in the navigation path in the Operation menu

۶	Setup Is displayed: In the menu next to the "Setup" selection At the left in the navigation path in the Setup menu
્ય	Diagnosis Is displayed: ■ In the menu next to the "Diagnostics" selection ■ At the left in the navigation path in the Diagnostics menu
₹.	Expert Is displayed: In the menu next to the "Expert" selection At the left in the navigation path in the Expert menu

## Submenus, wizards, parameters

Symbol	Meaning
•	Submenu
55.	Wizards
Ø.	Parameters within a wizard  No display symbol exists for parameters in submenus.

## Locking procedure

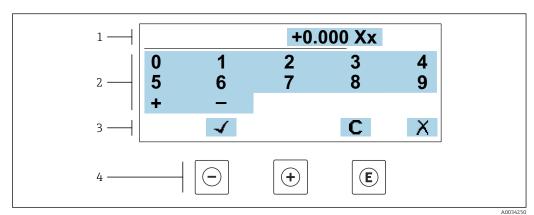
Symbol	Meaning	
û	Parameter locked When displayed in front of a parameter name, indicates that the parameter is locked.  By a user-specific access code  By the hardware write protection switch	

## Wizards

Symbol	Meaning
<b>—</b>	Switches to the previous parameter.
✓	Confirms the parameter value and switches to the next parameter.
Е	Opens the editing view of the parameter.

#### 8.3.3 **Editing view**

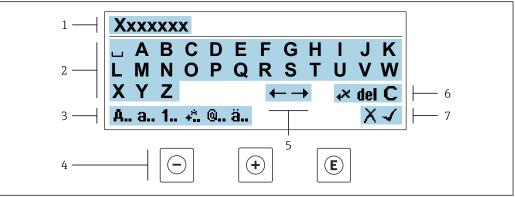
#### Numeric editor



■ 18 For entering values in parameters (e.g. limit values)

- 1 Entry display area
- 2 Input screen
- 3 Confirm, delete or reject entry
- Operating elements

#### Text editor



- For entering text in parameters (e.g. device tag)
- 1 Entry display area
- 2 Current input screen
- 3 Change input screen
- Operating elements
- Move entry position 5
- 6 Delete entry
- Reject or confirm entry

*Using the operating elements in the editing view* 

Operating key	Meaning
	Minus key Move the entry position to the left.
+	Plus key Move the entry position to the right.

Operating key	Meaning
E	<ul> <li>Enter key</li> <li>Pressing the key briefly confirms your selection.</li> <li>Pressing the key for 2 s confirms your entry.</li> </ul>
-++	Escape key combination (press keys simultaneously) Close the editing view without accepting a change.

## *Input screens*

Symbol	Meaning
А	Upper case
a	Lower case
1	Numbers
+*	Punctuation marks and special characters: = + - * / $^2$ $^3$ $^1$ /4 $^1$ /2 $^3$ /4 ( ) [ ] < > { }
<b>@</b>	Punctuation marks and special characters: ' " ` ^ . , ; : ? ! % $\mu$ ° $\in$ \$ £ ¥ § @ # / \ I ~ & _
ä	Umlauts and accents

## Controlling data entries

Symbol	Meaning	
←→	Move entry position	
X	Reject entry	
-√	Confirm entry	
ν,	Delete character immediately to the left of the entry position	
del	Delete character immediately to the right of the entry position	
С	Clear all the characters entered	

## 8.3.4 Operating elements

Operating key	Meaning		
	Minus key In menu, submenu Moves the selection bar upwards in a picklist In wizards Goes to previous parameter In the text and numeric editor Move the entry position to the left.		
<b>(+)</b>	Plus key In menu, submenu Moves the selection bar downwards in a picklist In wizards Goes to the next parameter In the text and numeric editor Move the entry position to the right.		
Œ	<ul> <li>Enter key</li> <li>In the operational display</li> <li>Pressing the key briefly opens the operating menu.</li> <li>In menu, submenu</li> <li>Pressing the key briefly: <ul> <li>Opens the selected menu, submenu or parameter.</li> <li>Starts the wizard.</li> <li>If help text is open, closes the help text of the parameter.</li> </ul> </li> <li>Pressing the key for 2 s in a parameter: <ul> <li>If present, opens the help text for the function of the parameter.</li> </ul> </li> <li>In wizards</li> <li>Opens the editing view of the parameter and confirms the parameter value</li> <li>In the text and numeric editor</li> <li>Pressing the key briefly confirms your selection.</li> <li>Pressing the key for 2 s confirms your entry.</li> </ul>		
(a) + (+)	Escape key combination (press keys simultaneously)  In menu, submenu  Pressing the key briefly: Exits the current menu level and takes you to the next higher level. If help text is open, closes the help text of the parameter. Pressing the key for 2 s returns you to the operational display ("home position").  In wizards Exits the wizard and takes you to the next higher level  In the text and numeric editor Exits the Editing view without applying the changes.		
-+E	<ul> <li>Minus/Enter key combination (press and hold down the keys simultaneously)</li> <li>If keypad lock is active:     Pressing the key for 3 s deactivates the keypad lock.</li> <li>If keypad lock is not active:     Pressing the key for 3 s opens the context menu including the option for activating the keypad lock.</li> </ul>		

## 8.3.5 Opening the context menu

Using the context menu, the user can call up the following menus quickly and directly from the operational display:

- Setup
- Data backup
- Simulation

## Calling up and closing the context menu

The user is in the operational display.

- 1. Press the  $\Box$  and  $\Box$  keys for longer than 3 seconds.
  - └ The context menu opens.



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- 2. Press = + ± simultaneously.
  - ightharpoonup The context menu is closed and the operational display appears.

### Calling up the menu via the context menu

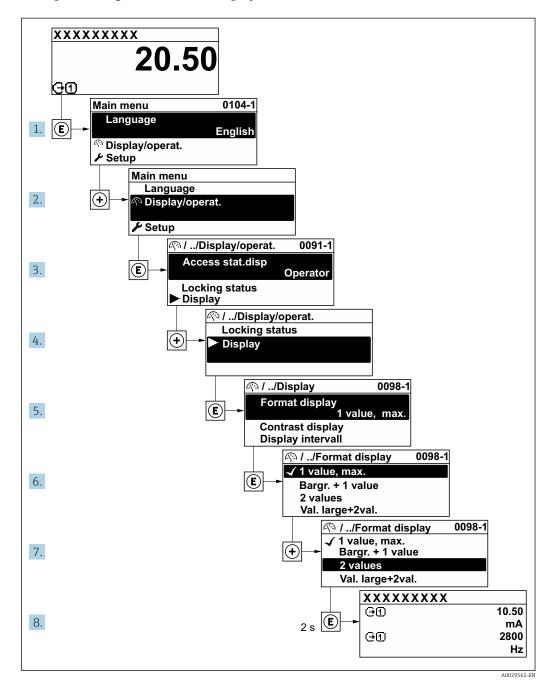
- 1. Open the context menu.
- 2. Press ± to navigate to the desired menu.
- 3. Press 🗉 to confirm the selection.
  - ► The selected menu opens.

### 8.3.6 Navigating and selecting from list

Different operating elements are used to navigate through the operating menu. The navigation path is displayed on the left in the header. Icons are displayed in front of the individual menus. These icons are also shown in the header during navigation.

For an explanation of the navigation view with symbols and operating elements  $\Rightarrow \stackrel{\triangle}{=} 50$ 

Example: Setting the number of displayed measured values to "2 values"



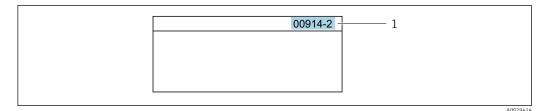
## 8.3.7 Calling the parameter directly

A parameter number is assigned to every parameter to be able to access a parameter directly via the onsite display. Entering this access code in the **Direct access** parameter calls up the desired parameter directly.

### Navigation path

Expert → Direct access

The direct access code consists of a 5-digit number (at maximum) and the channel number, which identifies the channel of a process variable: e.g. 00914-2. In the navigation view, this appears on the right-hand side in the header of the selected parameter.



1 Direct access code

Note the following when entering the direct access code:

- The leading zeros in the direct access code do not have to be entered. Example: Enter "914" instead of "00914"
- If no channel number is entered, channel 1 is opened automatically.
   Example: Enter 00914 → Assign process variable parameter
- If a different channel is opened: Enter the direct access code with the corresponding channel number.

Example: Enter **00914-2** → **Assign process variable** parameter

For the direct access codes of the individual parameters, see the "Description of Device Parameters" document for the device

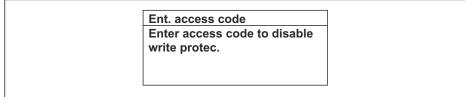
### 8.3.8 Calling up help text

Help text is available for some parameters and can be called up from the navigation view. The help text provides a brief explanation of the parameter function and thereby supports swift and safe commissioning.

#### Calling up and closing the help text

The user is in the navigation view and the selection bar is on a parameter.

- 1. Press E for 2 s.
  - ► The help text for the selected parameter opens.



A0014002-E

- 20 Example: Help text for parameter "Enter access code"
- 2. Press  $\Box$  +  $\pm$  simultaneously.
  - ► The help text is closed.

## 8.3.9 Changing the parameters

Parameters can be changed via the numeric editor or text editor.

- Numeric editor: Change values in a parameter, e.g. specifications for limit values.
- Text editor: Enter text in a parameter, e.g. tag name.

A message is displayed if the value entered is outside the permitted value range.

Ent. access code Invalid or out of range input value Min:0 Max:9999

A0014049-E

For a description of the editing view - consisting of the text editor and numeric editor - with symbols  $\rightarrow \implies 52$ , for a description of the operating elements  $\rightarrow \implies 54$ 

## 8.3.10 User roles and related access authorization

### Defining access authorization for user roles

An access code is not yet defined when the device is delivered from the factory. Access authorization (read and write access) to the device is not restricted and corresponds to the "Maintenance" user role.

- ▶ Define the access code.
  - The "Operator" user role is redefined in addition to the "Maintenance" user role. Access authorization differs for the two user roles.

Access authorization to parameters: "Maintenance" user role

Access code status	Read access	Write access
An access code has not yet been defined (factory setting).	V	V
After an access code has been defined.	V	<b>✓</b> 1)

1) The user only has write access after entering the access code.

Access authorization to parameters: "Operator" user role

Access code status	Read access	Write access
After an access code has been defined.	V	_ 1)

- Despite the defined access code, certain parameters can always be modified and thus are excluded from the write protection as they do not affect the measurement: write protection via access code → 

   □ 142
- The user role with which the user is currently logged on is indicated by the **Access status** parameter. Navigation path: Operation → Access status

### 8.3.11 Disabling write protection via access code

If the @-symbol appears on the local display in front of a parameter, the parameter is write-protected by a user-specific access code and its value cannot be changed at the moment using local operation > riangleq 142.

Parameter write protection via local operation can be disabled by entering the user-specific access code in the **Enter access code** parameter ( $\rightarrow \implies 117$ ) via the respective access option.

1. After you press E, the input prompt for the access code appears.

- 2. Enter the access code.
  - The \( \bar{\text{\alpha}}\) -symbol in front of the parameters disappears; all previously write-protected parameters are now re-enabled.

### 8.3.12 Enabling and disabling the keypad lock

The keypad lock makes it possible to block access to the entire operating menu via local operation. As a result, it is no longer possible to navigate through the operating menu or change the values of individual parameters. Users can only read the measured values on the operational display.

The keypad lock is switched on and off via the context menu.

### Switching on the keypad lock

- The keypad lock is switched on automatically:
  - If the device has not been operated via the display for > 1 minute.
  - Each time the device is restarted.

### To activate the keylock manually:

- 1. The device is in the measured value display.

  Press the □ and □ keys for 3 seconds.
  - ► A context menu appears.
- 2. In the context menu select the **Keylock on** option.
  - ► The keypad lock is switched on.
- If the user attempts to access the operating menu while the keypad lock is active, the **Keylock on** message appears.

### Switching off the keypad lock

- ► The keypad lock is switched on. Press the □ and © keys for 3 seconds.
  - ► The keypad lock is switched off.

## 8.4 Access to operating menu via web browser

### 8.4.1 Function range

With the integrated web server, the device can be operated and configured via a web browser service interface (CDI-RJ45) or WLAN interface. The structure of the operating menu is the same as for the local display. In addition to the measured values, status information on the device is displayed and can be used to monitor device health. Furthermore the device data can be managed and the network parameters can be configured.

A device that has a WLAN interface (can be ordered as an option) is required for the WLAN connection: order code for "Display; operation", option G "4-line, illuminated; touch control + WLAN". The device acts as an Access Point and enables communication by computer or a mobile handheld terminal.

For additional information on the web server, see the Special Documentation for the device. → 🗎 247

## 8.4.2 Requirements

## Computer hardware

Hardware	Interface		
	CDI-RJ45	WLAN	
Interface	The computer must have a RJ45 interface. <sup>1)</sup>	The operating unit must have a WLAN interface.	
Connection	Standard Ethernet cable	Connection via Wireless LAN.	
Screen	Recommended size: ≥12" (depends on the screen resolution)		

<sup>1)</sup> Recommended cable: CAT5e, CAT6 or CAT7, with shielded plug (e.g. YAMAICHI product; part no. Y-ConProfixPlug63/Prod. ID: 82-006660)

## Computer software

Software	Interface		
	CDI-RJ45	WLAN	
Recommended operating systems	<ul> <li>Microsoft Windows 8 or higher.</li> <li>Mobile operating systems: <ul> <li>iOS</li> <li>Android</li> </ul> </li> <li>Microsoft Windows XP and Windows 7 is supported.</li> </ul>		
Web browsers supported	<ul> <li>Microsoft Internet Explorer 8 or higher</li> <li>Microsoft Edge</li> <li>Mozilla Firefox</li> <li>Google Chrome</li> <li>Safari</li> </ul>		

## Computer settings

Settings	Interface		
	CDI-RJ45	WLAN	
User rights	Appropriate user rights (e.g. administrator rights) for TCP/IP and proxy server settings are necessary (e.g. for adjusting the IP address, subnet mask etc.).		
Proxy server settings of the web browser	The web browser setting <i>Use a proxy server for your LAN</i> must be <b>disabled</b> .		
JavaScript	JavaScript must be enabled.	JavaScript must be enabled.	
	If JavaScript cannot be enabled: Enter http://192.168.1.212/servlet/ basic.html in the address bar of the web browser. A fully functional but simplified version of the operating menu structure starts in the web browser.	The WLAN display requires JavaScript support.	
	When installing a new firmware version: To enable correct data display, clear the temporary memory (cache) under Internet options in the web browser.		
Network connections	Only use the active network connections to the measuring device.		
	Switch off all other network connections such as WLAN for example.	Switch off all other network connections.	

### Measuring device: Via CDI-RJ45 service interface

Device	CDI-RJ45 service interface	
Measuring device	The measuring device has an RJ45 interface.	
Web server	Web server must be enabled; factory setting: ON	
	For information on enabling the Web server $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	

### Measuring device: via WLAN interface

Device	WLAN interface
Measuring device	The measuring device has a WLAN antenna:  Transmitter with integrated WLAN antenna Transmitter with external WLAN antenna
Web server	Web server and WLAN must be enabled; factory setting: ON  For information on enabling the Web server →   65

## 8.4.3 Connecting the device

### Via service interface (CDI-RJ45)

Preparing the measuring device

Proline 500 - digital

- 1. Loosen the 4 fixing screws on the housing cover.
- 2. Open the housing cover.
- 3. The location of the connection socket depends on the measuring device and the communication protocol.

Connect the computer to the RJ45 plug via the standard Ethernet cable .

### Proline 500

- 1. Depending on the housing version:

  Loosen the securing clamp or fixing screw of the housing cover.
- 2. Depending on the housing version: Unscrew or open the housing cover.
- 3. Connect the computer to the RJ45 plug via the standard Ethernet cable.

*Configuring the Internet protocol of the computer* 

The following information refers to the default Ethernet settings of the device.

IP address of the device: 192.168.1.212 (factory setting)

- 1. Switch on the measuring device.
- 2. Connect the computer to the RJ45 plug via the standard Ethernet cable  $\rightarrow \triangleq 66$ .
- 3. If a 2nd network card is not used, close all the applications on the notebook.
  - Applications requiring Internet or a network, such as e-mail, SAP applications, Internet or Windows Explorer.
- 4. Close any open Internet browsers.
- 5. Configure the properties of the Internet protocol (TCP/IP) as defined in the table:

IP address	192.168.1.XXX; for XXX all numerical sequences except: 0, 212 and 255 $\rightarrow$ e.g. 192.168.1.213
Subnet mask 255.255.255.0	
Default gateway	192.168.1.212 or leave cells empty

#### Via WLAN interface

Configuring the Internet protocol of the mobile terminal

### **NOTICE**

### If the WLAN connection is lost during the configuration, settings made may be lost.

▶ Make sure that the WLAN connection is not disconnected while configuring the device.

### NOTICE

### Note the following to avoid a network conflict:

- ► Avoid accessing the measuring device simultaneously from the same mobile terminal via the service interface (CDI-RI45) and the WLAN interface.
- ▶ Only activate one service interface (CDI-RJ45 or WLAN interface).
- ▶ If simultaneous communication is necessary: configure different IP address ranges, e.g. 192.168.0.1 (WLAN interface) and 192.168.1.212 (CDI-RJ45 service interface).

Preparing the mobile terminal

► Enable WLAN on the mobile terminal.

Establishing a WLAN connection from the mobile terminal to the measuring device

- 1. In the WLAN settings of the mobile terminal: Select the measuring device using the SSID (e.g. EH\_\_500\_A802000).
- 2. If necessary, select the WPA2 encryption method.
- 3. Enter the password:

Serial number of the measuring device ex-works (e.g. L100A802000).

- The LED on the display module flashes. It is now possible to operate the measuring device with the web browser, FieldCare or DeviceCare.
- 🚹 The serial number can be found on the nameplate.
- To ensure the safe and swift assignment of the WLAN network to the measuring point, it is advisable to change the SSID name. It should be possible to clearly assign the new SSID name to the measuring point (e.g. tag name) because it is displayed as the WLAN network.

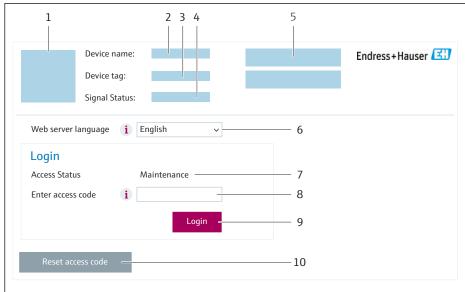
Terminating the WLAN connection

► After configuring the device: Terminate the WLAN connection between the mobile terminal and measuring device.

### Starting the web browser

1. Start the web browser on the computer.

- 2. Enter the IP address of the web server in the address line of the web browser: 192.168.1.212
  - ► The login page appears.



A00E2670

- 1 Picture of device
- 2 Device name
- 3 Device tag
- 4 Status signal
- 5 Current measured values
- 6 Operating language
- 7 User role
- 8 Access code
- 9 Login
- 10 Reset access code (→ 🖺 137)
- If a login page does not appear, or if the page is incomplete  $\rightarrow \stackrel{\triangle}{=} 201$

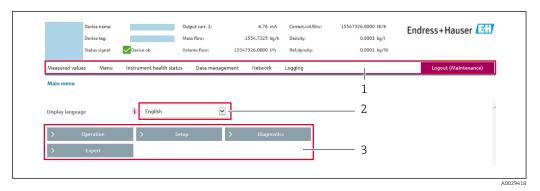
## 8.4.4 Logging on

- 1. Select the preferred operating language for the Web browser.
- 2. Enter the user-specific access code.
- 3. Press **OK** to confirm your entry.

Access code 0000 (factory setting); can be changed by customer

If no action is performed for 10 minutes, the Web browser automatically returns to the login page.

## 8.4.5 User interface



- 1 Function row
- 2 Local display language
- 3 Navigation area

### Header

The following information appears in the header:

- Device name
- Device tag
- Device status with status signal  $\rightarrow$   $\stackrel{\triangle}{=}$  207
- Current measured values

### **Function row**

Functions	Meaning		
Measured values	Displays the measured values of the device		
Menu	<ul> <li>Access to the operating menu from the measuring device</li> <li>The structure of the operating menu is the same as for the local display</li> <li>Detailed information on the operating menu structure: Description of Device</li> <li>Parameters</li> </ul>		
Device status	Displays the diagnostic messages currently pending, listed in order of priority		
Data management	Data exchange between computer and measuring device:  Device configuration:  Load settings from the device (XML format, save configuration)  Save settings to the device (XML format, restore configuration)  Logbook - Export Event logbook (.csv file)  Documents - Export documents:  Export backup data record (.csv file, create documentation of the measuring point configuration)  Verification report (PDF file, only available with the "Heartbeat Verification" application package)  Firmware update - Flashing a firmware version		
Network	Configuration and checking of all the parameters required for establishing the connection to the measuring device:  Network settings (e.g. IP address, MAC address)  Device information (e.g. serial number, firmware version)		
Logout	End the operation and call up the login page		

### Navigation area

The menus, the associated submenus and parameters can be selected in the navigation area.

### Working area

Depending on the selected function and the related submenus, various actions can be performed in this area:

- Configuring parameters
- Reading measured values
- Calling up help text
- Starting an upload/download

## 8.4.6 Disabling the Web server

The Web server of the measuring device can be switched on and off as required using the **Web server functionality** parameter.

#### **Navigation**

"Expert" menu  $\rightarrow$  Communication  $\rightarrow$  Web server

#### Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Web server functionality	Switch the Web server on and off.	<ul><li>Off</li><li>HTML Off</li><li>On</li></ul>	On

### Function scope of the "Web server functionality" parameter

Option	Description	
Off	<ul><li>The Web server is completely disabled.</li><li>Port 80 is locked.</li></ul>	
HTML Off	The HTML version of the Web server is not available.	
On	<ul> <li>The complete Web server functionality is available.</li> <li>JavaScript is used.</li> <li>The password is transferred in an encrypted state.</li> <li>Any change to the password is also transferred in an encrypted state.</li> </ul>	

### Enabling the Web server

If the Web server is disabled it can only be re-enabled with the **Web server functionality** parameter via the following operating options:

- Via local display
- Via Bedientool "FieldCare"
- Via "DeviceCare" operating tool

### 8.4.7 Logging out

- Before logging out, perform a data backup via the **Data management** function (upload configuration from device) if necessary.
- 1. Select the **Logout** entry in the function row.
  - ► The home page with the Login box appears.
- 2. Close the Web browser.
- 3. If no longer needed:

Reset the modified properties of the Internet protocol (TCP/IP)  $\rightarrow$   $\bigcirc$  61.

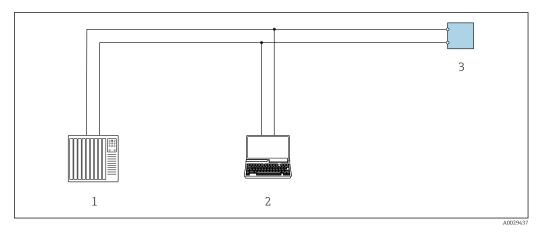
## 8.5 Access to the operating menu via the operating tool

The structure of the operating menu in the operating tools is the same as for operation via the local display.

## 8.5.1 Connecting the operating tool

### Via Modbus RS485 protocol

This communication interface is available in device versions with a Modbus RS485 output.



 $\blacksquare$  21 Options for remote operation via Modbus RS485 protocol (active)

- 1 Control system (e.g. PLC)
- 2 Computer with web browser (e.g. Microsoft Edge) to access the integrated device web server or with operating tool (e.g. FieldCare, DeviceCare) with COM DTM "CDI Communication TCP/IP" or Modbus DTM
- 3 Transmitter

### Service interface

Via service interface (CDI-RJ45)

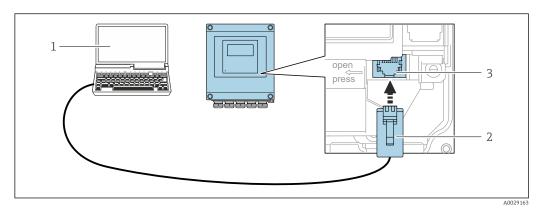
A point-to-point connection can be established to configure the device onsite. With the housing open, the connection is established directly via the service interface (CDI-RJ45) of the device.

An adapter for the RJ45 to the M12 plug is optionally available:

Order code for "Accessories", option NB: "Adapter RJ45 M12 (service interface)"

The adapter connects the service interface (CDI-RJ45) to an M12 plug mounted in the cable entry. The connection to the service interface can be established via an M12 plug without opening the device.

### *Proline* 500 – digital transmitter



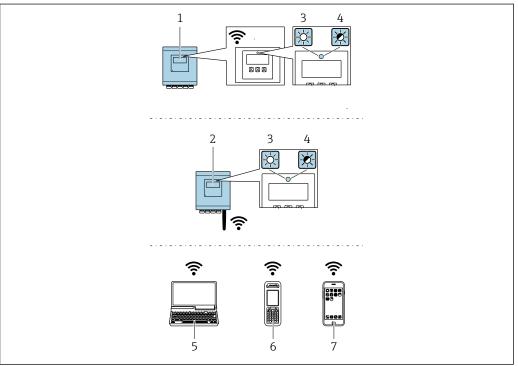
■ 22 Connection via service interface (CDI-RJ45)

- 1 Computer with web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated web server or with "FieldCare" operating tool, "DeviceCare" with COM DTM "CDI Communication TCP/IP" or Modbus DTM
- 2 Standard Ethernet connecting cable with RJ45 plug
- 3 Service interface (CDI-RJ45) of the measuring device with access to the integrated Web server

### Via WLAN interface

The optional WLAN interface is available on the following device version:

Order code for "Display; operation", option G "4-line, illuminated; touch control + WLAN"



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- 1 Transmitter with integrated WLAN antenna
- 2 Transmitter with external WLAN antenna
- 3 LED lit constantly: WLAN reception is enabled on measuring device
- 4 LED flashing: WLAN connection established between operating unit and measuring device
- 5 Computer with WLAN interface and web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device web server or with operating tool (e.g. FieldCare, DeviceCare)
- 6 Mobile handheld terminal with WLAN interface and web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device web server or operating tool (e.g. FieldCare, DeviceCare)

7 Smart phone or tablet (e.g. Field Xpert SMT70)

Function	WLAN: IEEE 802.11 b/g (2.4 GHz)	
Encryption	WPA2-PSK AES-128 (in accordance with IEEE 802.11i)	
Configurable WLAN channels	1 to 11	
Degree of protection	IP67	
Available antennas	<ul> <li>Internal antenna</li> <li>External antenna (optional)         In the event of poor transmission/reception conditions at the place of installation.     </li> <li>Only 1 antenna is active at any one time!</li> </ul>	
Range	<ul> <li>Internal antenna: typically 10 m (32 ft)</li> <li>External antenna: typically 50 m (164 ft)</li> </ul>	
Materials (external antenna)	<ul> <li>Antenna: ASA plastic (acrylonitrile styrene acrylate) and nickel-plated brass</li> <li>Adapter: Stainless steel and nickel-plated brass</li> <li>Cable: Polyethylene</li> <li>Plug: Nickel-plated brass</li> <li>Angle bracket: Stainless steel</li> </ul>	

Configuring the Internet protocol of the mobile terminal

#### NOTICE

If the WLAN connection is lost during the configuration, settings made may be lost.

▶ Make sure that the WLAN connection is not disconnected while configuring the device.

### NOTICE

#### Note the following to avoid a network conflict:

- ► Avoid accessing the measuring device simultaneously from the same mobile terminal via the service interface (CDI-RJ45) and the WLAN interface.
- Only activate one service interface (CDI-RJ45 or WLAN interface).
- ▶ If simultaneous communication is necessary: configure different IP address ranges, e.g. 192.168.0.1 (WLAN interface) and 192.168.1.212 (CDI-RJ45 service interface).

### Preparing the mobile terminal

► Enable WLAN on the mobile terminal.

Establishing a WLAN connection from the mobile terminal to the measuring device

- 1. In the WLAN settings of the mobile terminal: Select the measuring device using the SSID (e.g. EH\_\_500\_A802000).
- 2. If necessary, select the WPA2 encryption method.
- 3. Enter the password:

Serial number of the measuring device ex-works (e.g. L100A802000).

- The LED on the display module flashes. It is now possible to operate the measuring device with the web browser, FieldCare or DeviceCare.
- The serial number can be found on the nameplate.
- To ensure the safe and swift assignment of the WLAN network to the measuring point, it is advisable to change the SSID name. It should be possible to clearly assign the new SSID name to the measuring point (e.g. tag name) because it is displayed as the WLAN network.

### *Terminating the WLAN connection*

► After configuring the device:

Terminate the WLAN connection between the mobile terminal and measuring device.

### 8.5.2 FieldCare

#### **Function range**

FDT-based (Field Device Technology) plant asset management tool from Endress+Hauser. It can configure all smart field units in a system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.

#### Access is via:

- CDI-RJ45 service interface → 🗎 66
- WLAN interface → 🗎 67

### Typical functions:

- Transmitter parameter configuration
- Loading and saving of device data (upload/download)
- Documentation of the measuring point
- Visualization of the measured value memory (line recorder) and event logbook



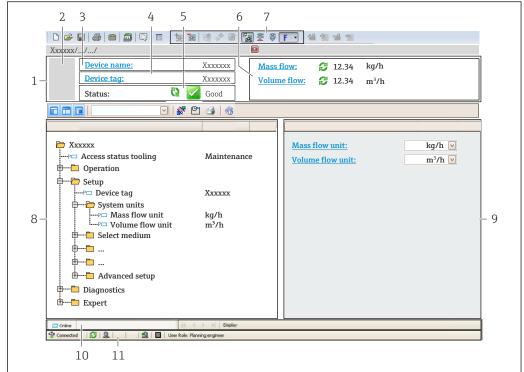
- Operating Instructions BA00027S
- Operating Instructions BA00059S
- Source for device description files  $\rightarrow \Box 71$

### Establishing a connection



- Operating Instructions BA00027S
- Operating Instructions BA00059S

### User interface



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- 1 Header
- 2 Picture of device
- 3 Device name
- 4 Device tag
- 5 Status area with status signal → 🗎 207
- 6 Display area for current measured values
- 7 Editing toolbar with additional functions such as save/load, event list and create documentation
- 8 Navigation area with operating menu structure
- 9 Work area
- 10 Action area
- 11 Status area

### 8.5.3 DeviceCare

### Function range

Tool for connecting and configuring Endress+Hauser field devices.

The fastest way to configure Endress+Hauser field devices is with the dedicated "DeviceCare" tool. Together with the device type managers (DTMs) it presents a convenient, comprehensive solution.

Innovation brochure INO1047S

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# 9 System integration

## 9.1 Overview of device description files

### 9.1.1 Current version data for the device

Firmware version	01.06.zz	<ul> <li>On the title page of the manual</li> <li>On the transmitter nameplate</li> <li>Firmware version         Diagnostics → Device information → Firmware version     </li> </ul>
Release date of firmware version	08.2022	

## 9.1.2 Operating tools

The suitable device description file for the individual operating tools is listed in the table below, along with information on where the file can be acquired.

Operating tool via service interface (CDI) or Modbus interface	Sources for obtaining device descriptions
FieldCare	<ul> <li>www.endress.com → Downloads area</li> <li>USB stick (contact Endress+Hauser)</li> <li>DVD (contact Endress+Hauser)</li> </ul>
DeviceCare	<ul> <li>www.endress.com → Downloads area</li> <li>CD-ROM (contact Endress+Hauser)</li> <li>DVD (contact Endress+Hauser)</li> </ul>

# 9.2 Compatibility with previous model

If the device is replaced, the measuring device Promass 500 supports the compatibility of the Modbus registers for the process variables and the diagnostic information with the previous model Promass 83. It is not necessary to change the engineering parameters in the automation system.

Compatible Modbus registers: process variables

Process variable	Compatible Modbus registers
Mass flow	2007
Volume flow	2009
Corrected volume flow	2011
Density	2013
Reference density	2015
Temperature	2017
Totalizer 1	2610
Totalizer 2	2810
Totalizer 3	3010

## Compatible Modbus registers: diagnostic information

Diagnostic information	Compatible Modbus registers	
Diagnostic code (data type: String), e.g. F270	6821	
Diagnostic number (data type: Integer), e.g. 270	6859	

## 9.3 Modbus RS485 information

## 9.3.1 Function codes

Function codes are used to define which read or write action is carried out via the Modbus protocol. The measuring device supports the following function codes:

Code	Name	Description	Application
03	Read holding register	Master reads one or more Modbus registers from the device.  A maximum of 125 consecutive registers can be read with 1 telegram: 1 register = 2 bytes  The measuring device does not make a distinction between function codes 03 and 04; these codes therefore yield the same result.	Read device parameters with read and write access Example: Read mass flow
04	Read input register	Master reads one or more Modbus registers from the device.  A maximum of 125 consecutive registers can be read with 1 telegram: 1 register = 2 bytes  The measuring device does not make a distinction between function codes 03 and 04; these codes therefore yield the same result.	Read device parameters with read access Example: Read totalizer value
06	Write single registers	Master writes a new value to <b>one</b> Modbus register of the measuring device.  Use function code 16 to write multiple registers with just 1 telegram.	Write only 1 device parameter Example: reset totalizer
08	Diagnostics	Master checks the communication connection to the measuring device.  The following "Diagnostics codes" are supported: ■ Sub-function 00 = Return query data (loopback test) ■ Sub-function 02 = Return diagnostics register	

Code	Name	Description	Application
16	Write multiple registers	Master writes a new value to multiple Modbus registers of the device. A maximum of 120 consecutive registers can be written with 1 telegram.	Write multiple device parameters  Example:  Mass flow unit  Mass unit
		If the required device parameters are not available as a group, yet must nevertheless be addressed with a single telegram, use Modbus data map → 🖺 74	
23	Read/Write multiple registers	Master reads and writes a maximum of 118 Modbus registers of the measuring device simultaneously with 1 telegram. Write access is executed <b>before</b> read access.	Write and read multiple device parameters  Example:  Read mass flow  Reset totalizer

Broadcast messages are only allowed with function codes 06, 16 and 23.

#### 9.3.2 **Register information**



For an overview of device parameters with their respective Modbus register information, please refer to the "Modbus RS485 register information" section in the 

#### 9.3.3 Response time

Response time of the measuring device to the request telegram of the Modbus master: typically 3 to 5 ms

#### 9.3.4 Data types

The measuring device supports the following data types:

<b>FLOAT</b> (floating point number IEEE 754) Data length = 4 bytes (2 registers)					
Byte 3	Byte 2 Byte 1 Byte 0				
SEEEEEE EMMMMMM MMMMMMM MMMMMMMM					
S = sign, E = exponent, M = mantissa					

INTEGER Data length = 2 bytes (1 register)	
Byte 1	Byte 0
Most significant byte (MSB)	Least significant byte (LSB)

<b>STRING</b> Data length = depends on the device parameter, e.g. presentation of a device parameter with a data length = 1 bytes (9 registers)				meter with a data length = 18
Byte 17 Byte 16 Byte 1 Byte 0				
Most significant byte (MSB)				Least significant byte (LSB)

## 9.3.5 Byte transmission sequence

Byte addressing, i.e. the transmission sequence of the bytes, is not specified in the Modbus specification. For this reason, it is important to coordinate or match the addressing method between the master and slave during commissioning. This can be configured in the measuring device using the **Byte order** parameter.

The bytes are transmitted depending on the selection in the **Byte order** parameter:

FLOAT						
	Sequence	Sequence				
Options	1.	2.	3.	4.		
1-0-3-2*	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM)		
0 - 1 - 2 - 3	Byte 0 (MMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 2 (EMMMMMMM)	Byte 3 (SEEEEEEE)		
2 - 3 - 0 - 1	Byte 2 (EMMMMMMM)	Byte 3 (SEEEEEEE)	Byte 0 (MMMMMMM)	Byte 1 (MMMMMMM)		
3 - 2 - 1 - 0	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)		
* = factory settin	* = factory setting, S = sign, E = exponent, M = mantissa					

INTEGER			
	Sequence		
Options	1.	2.	
1-0-3-2* 3-2-1-0	Byte 1 (MSB)	Byte 0 (LSB)	
0-1-2-3 2-3-0-1	Byte 0 (LSB)	Byte 1 (MSB)	
* = factory setting, MSB = most significant byte, LSB = least significant byte			

STRING Presentation taking the example of a device parameter with a data length of 18 bytes.						
	Sequence	Sequence				
Options	1.	2.		17.	18.	
1-0-3-2* 3-2-1-0	Byte 17 (MSB)	Byte 16		Byte 1	Byte 0 (LSB)	
0 - 1 - 2 - 3       Byte 16       Byte 17        Byte 0       Byte 1         2 - 3 - 0 - 1       (MSB)       (LSB)						
* = factory setting, MSB = most significant byte, LSB = least significant byte						

## 9.3.6 Modbus data map

#### Function of the Modbus data map

The device offers a special memory area, the Modbus data map (for a maximum of 16 device parameters), to allow users to call up multiple device parameters via Modbus RS485 and not only individual device parameters or a group of consecutive device parameters.

Grouping of device parameters is flexible and the Modbus master can read or write to the entire data block simultaneously with a single request telegram.

#### Structure of the Modbus data map

The Modbus data map consists of two data sets:

- Scan list: Configuration area
   The device parameters to be grouped are defined in a list by entering their Modbus RS485 register addresses in the list.
- Data area

The measuring device reads out the register addresses entered in the scan list cyclically and writes the associated device data (values) to the data area.



#### Scan list configuration

For configuration, the Modbus RS485 register addresses of the device parameters to be grouped must be entered in the scan list. Please note the following basic requirements of the scan list:

Max. entries	16 device parameters
Supported device parameters	Only parameters with the following characteristics are supported:  Access type: read or write access Data type: float or integer

Configuration of the scan list via FieldCare or DeviceCare

Carried out using the operating menu of the measuring device: Expert  $\rightarrow$  Communication  $\rightarrow$  Modbus data map  $\rightarrow$  Scan list register 0 to 15

Scan list	
No.	Configuration register
0	Scan list register 0
15	Scan list register 15

Configuration of the scan list via Modbus RS485

Carried out using register addresses 5001 - 5016

Scan list	Scan list				
No.	Modbus RS485 register	Data type	Configuration register		
0	5001	Integer	Scan list register 0		
		Integer			
15	5016	Integer	Scan list register 15		

#### Reading out data via Modbus RS485

The Modbus master accesses the data area of the Modbus data map to read out the current values of the device parameters defined in the scan list.

Master access to data area	Via register addresses 5051-5081

Data area					
Device parameter value	Modbus RS485	Modbus RS485 register		Access**	
	Start register	End register (Float only)			
Value of scan list register 0	5051	5052	Integer/float	read/write	
Value of scan list register 1	5053	5054	Integer/float	read/write	
Value of scan list register					
Value of scan list register 15	5081	5082	Integer/float	read/write	

<sup>\*</sup>Data type depends on the device parameters entered in the scan list.

\*\* Data access depends on the device parameters entered in the scan list. If the device parameter entered supports read and write access, the parameter can also be accessed via the data area.

#### 10 Commissioning

#### 10.1 Post-mounting and post-connection check

Before commissioning the device:

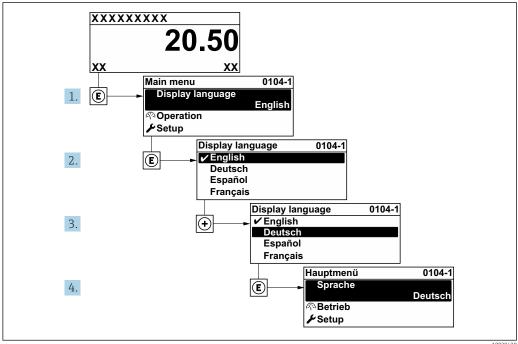
- ▶ Make sure that the post-installation and post-connection checks have been performed successfully.
- Checklist for "Post-installation" check → 🗎 29
- Checklist for "Post-connection" check → 🗎 43

#### 10.2 Switching on the measuring device

- ▶ Switch on the device upon successful completion of the post-mounting and postconnection check.
  - ► After a successful startup, the local display switches automatically from the startup display to the operational display.
- If nothing appears on the local display or if a diagnostic message is displayed, refer to the section on "Diagnostics and troubleshooting"  $\rightarrow \square$  200.

#### 10.3 Setting the operating language

Factory setting: English or ordered local language



■ 23 Taking the example of the local display

#### 10.4 Initializing the measuring instrument

- 1. Fill the system with liquid (density:  $800 \text{ to } 1500 \text{ kg/m}^3 (1764 \text{ to } 3307 \text{ lb/cf})$ ).
- 2. Prevent any flow.
- 3. Repeated flushing can help to eliminate gas pockets.

- 4. Perform device initialization: Expert → Sensor → Disposable component → Commissioning, Modbus register 26321-1 or Profinet.
- 5. Heartbeat Verification and zero point adjustment are performed. This diagnostic message is displayed during this time: Device initialization active.
- 6. Heartbeat Verification and zero point adjustment have been performed: No diagnostic message is displayed.

The measuring instrument is initialized.

#### **Navigation**

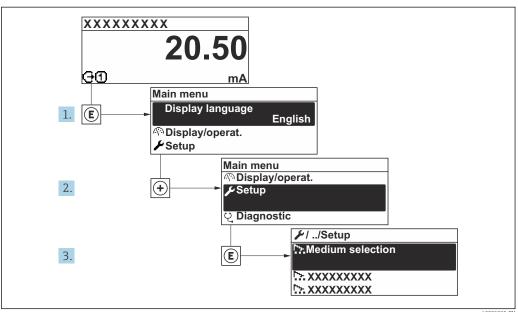
"Expert" menu → Sensor → Disposable component

#### Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Commissioning	Start commissioning of the sensor manually if does not start automatically.	<ul><li>Start</li><li>Busy</li><li>Done</li><li>Not done</li></ul>	Not done

# 10.5 Configuring the device

The **Setup** menu with its guided wizards contains all the parameters needed for standard operation.



A0032222-EN

 $\blacksquare$  24 Navigation to "Setup" menu using the example of the local display

The number of submenus and parameters can vary depending on the device version. Certain submenus and parameters in these submenus are not described in the Operating Instructions. Instead a description is provided in the Special Documentation for the device ("Supplementary documentation").

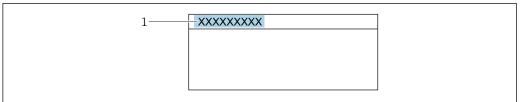
**≯** Setup

Device tag

► System units	→ 🖺 80	
<b>▶</b> Communication	→ 🖺 82	
▶ Medium selection	→ 🖺 84	
► I/O configuration	→ 🖺 84	
► Current input 1 to n	→ 🗎 85	
► Status input 1 to n	→ 🗎 86	
► Current output 1 to n	→ 🗎 87	
► Pulse/frequency/switch output 1 to n	→ 🗎 92	
▶ Relay output 1 to n	→ 🖺 103	
▶ Double pulse output	→ 🖺 106	
▶ Display	→ 🖺 107	
► Low flow cut off	→ 🗎 114	
▶ Partially filled pipe detection	→ 🖺 115	
► Advanced setup	→ 🖺 116	

# 10.5.1 Defining the tag name

To enable fast identification of the measuring point within the system, you can enter a unique designation using the **Device tag** parameter and thus change the factory setting.



A002942

- $\blacksquare$  25 Header of the operational display with tag name
- 1 Tag name
- Enter the tag name in the "FieldCare" operating tool  $\rightarrow \triangleq 70$

#### Navigation

"Setup" menu  $\rightarrow$  Device tag

Parameter	Description	User entry	Factory setting
Device tag	31	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /).	Promag

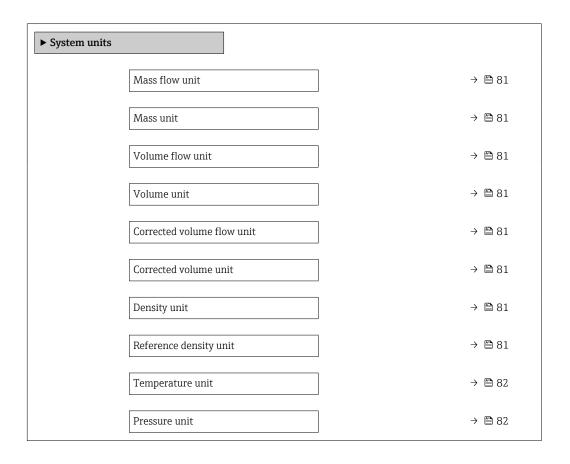
## 10.5.2 Setting the system units

In the **System units** submenu the units of all the measured values can be set.

The number of submenus and parameters can vary depending on the device version. Certain submenus and parameters in these submenus are not described in the Operating Instructions. Instead a description is provided in the Special Documentation for the device ("Supplementary documentation").

#### Navigation

"Setup" menu  $\rightarrow$  System units



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Parameter	Description	Selection	Factory setting
Mass flow unit	Select mass flow unit.  Effect  The selected unit applies to:  Output  Low flow cut off  Simulation process variable	Unit choose list	kg/h
Mass unit	Select mass unit.	Unit choose list	Country-specific: • kg • lb
Volume flow unit	Select volume flow unit.  Effect  The selected unit applies to:  Output  Low flow cut off Simulation process variable	Unit choose list	1/h
Volume unit	Select volume unit.	Unit choose list	Country-specific:  l gal (us)
Corrected volume flow unit	Select corrected volume flow unit.  Effect  The selected unit applies to:  Corrected volume flow parameter $(\rightarrow \cong 147)$	Unit choose list	NI/h
Corrected volume unit	Select corrected volume unit.	Unit choose list	Country-specific:  NI Sft³
Density unit	Select density unit.  Effect  The selected unit applies to:  Output  Simulation process variable  Density adjustment (Expert menu)	Unit choose list	kg/l
Reference density unit	Select reference density unit.	Unit choose list	kg/Nl
Density 2 unit	Select second density unit.	Unit choose list	Country-specific:  • kg/l  • lb/ft <sup>3</sup>

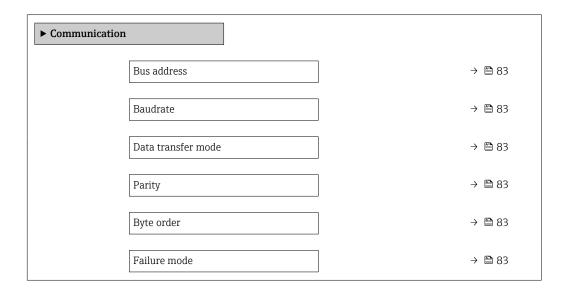
Parameter	Description	Selection	Factory setting
Temperature unit	Select temperature unit.  Effect  The selected unit applies to:  • Electronic temperature parameter (6053)  • Maximum value parameter (6051)  • Minimum value parameter (6052)  • External temperature parameter (6080)  • Maximum value parameter (6108)  • Minimum value parameter (6109)  • Maximum value parameter (6029)  • Minimum value parameter (6030)  • Reference temperature parameter (1816)  • Temperature parameter	Unit choose list	Country-specific:  ■ °C  ■ °F
Pressure unit	Select process pressure unit.  Effect  The unit is taken from:  ■ Pressure value parameter (→ 🖺 84)  ■ External pressure parameter (→ 🖺 84)  ■ Pressure value	Unit choose list	bar

# 10.5.3 Configuring the communication interface

The **Communication** submenu guides you systematically through all the parameters that have to be configured for selecting and setting the communication interface.

#### **Navigation**

"Setup" menu  $\rightarrow$  Communication



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Parameter	Description	User entry / Selection	Factory setting
Bus address	Enter device address.	1 to 247	247
Baudrate	Define data transfer speed.	<ul> <li>1200 BAUD</li> <li>2400 BAUD</li> <li>4800 BAUD</li> <li>9600 BAUD</li> <li>19200 BAUD</li> <li>38400 BAUD</li> <li>57600 BAUD</li> <li>115200 BAUD</li> </ul>	19200 BAUD
Data transfer mode	Select data transfer mode.	• ASCII • RTU	RTU
Parity	Select parity bits.	Picklist ASCII option:  • 0 = Even option  • 1 = Odd option  Picklist RTU option:  • 0 = Even option  • 1 = Odd option  • 2 = None / 1 stop bit option  • 3 = None / 2 stop bits option	Even
Byte order	Select byte transmission sequence.	<ul> <li>0-1-2-3</li> <li>3-2-1-0</li> <li>1-0-3-2</li> <li>2-3-0-1</li> </ul>	1-0-3-2
Failure mode	Select measured value output behavior when a diagnostic message occurs via Modbus communication.  NaN <sup>1)</sup>	<ul><li>NaN value</li><li>Last valid value</li></ul>	NaN value

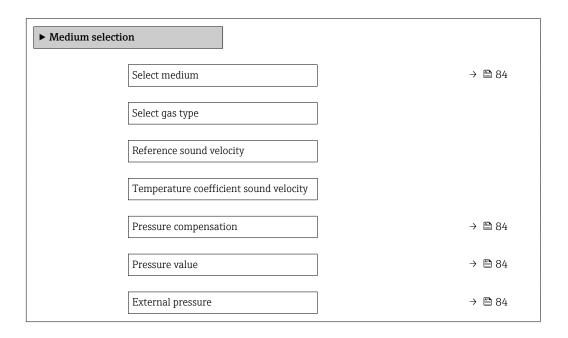
1) Not a Number

# 10.5.4 Selecting and setting the medium

The **Select medium** wizard submenu contains parameters that must be configured in order to select and set the medium.

#### Navigation

"Setup" menu  $\rightarrow$  Medium selection



#### Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Select medium	-	Use this function to select the type of medium: "Gas" or "Liquid". Select the "Other" option in exceptional cases in order to enter the properties of the medium manually (e.g. for highly compressive liquids such as sulfuric acid).	<ul><li>Liquid</li><li>Gas</li></ul>	Liquid
Pressure compensation	-	Select pressure compensation type.	<ul> <li>Off</li> <li>Fixed value</li> <li>External value</li> <li>Current input 1*</li> <li>Current input 2*</li> <li>Current input 3*</li> </ul>	Off
Pressure value	In the <b>Pressure compensation</b> parameter, the <b>Fixed value</b> option is selected.	Enter process pressure to be used for pressure correction.	Positive floating- point number	1.01325 bar
External pressure	In the Pressure compensation parameter, the External value option or the Current input 1n option is selected.	Shows the external process pressure value.		-

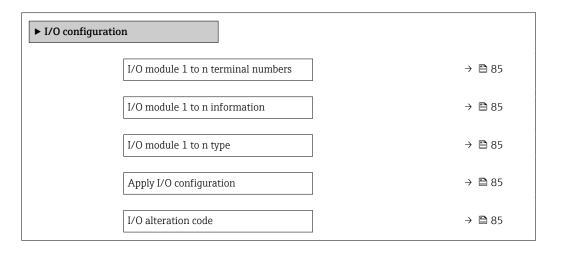
Visibility depends on order options or device settings

## 10.5.5 Displaying the I/O configuration

The **I/O configuration** submenu guides the user systematically through all the parameters in which the configuration of the I/O modules is displayed.

#### Navigation

"Setup" menu  $\rightarrow$  I/O configuration



#### Parameter overview with brief description

Parameter	Description	User interface / Selection / User entry	Factory setting
I/O module 1 to n terminal numbers	Shows the terminal numbers used by the I/O module.	<ul> <li>Not used</li> <li>26-27 (I/O 1)</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)*</li> </ul>	-
I/O module 1 to n information	Shows information of the plugged I/O module.	<ul><li>Not plugged</li><li>Invalid</li><li>Not configurable</li><li>Configurable</li><li>MODBUS</li></ul>	-
I/O module 1 to n type	Shows the I/O module type.	<ul> <li>Off</li> <li>Current output*</li> <li>Current input*</li> <li>Status input*</li> <li>Pulse/frequency/switch output*</li> <li>Double pulse output*</li> <li>Relay output*</li> </ul>	Off
Apply I/O configuration	Apply parameterization of the freely configurable I/O module.	■ No ■ Yes	No
I/O alteration code	Enter the code in order to change the I/O configuration.	Positive integer	0

<sup>\*</sup> Visibility depends on order options or device settings

# 10.5.6 Configuring the current input

The **"Current input" wizard** guides the user systematically through all the parameters that have to be set for configuring the current input.

## Navigation

"Setup" menu → Current input

► Current input 1 to n	
Terminal number	→ 🖺 86
Signal mode	
0/4 mA value	→ 🖺 86
20 mA value	→ 🖺 86
Current span	→ 🖺 86
Failure mode	→ 🖺 86
Failure value	→ 🖺 86

## Parameter overview with brief description

Parameter	Prerequisite	Description	User interface / User entry / Selection	Factory setting
Terminal number	-	Shows the terminal numbers used by the current input module.	<ul> <li>Not used</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)*</li> </ul>	-
0/4 mA value	-	Enter 4 mA value.	Signed floating-point number	0
20 mA value	-	Enter 20 mA value.	Signed floating-point number	Depends on country and nominal diameter
Current span	-	Select current range for process value output and upper/lower level for alarm signal.	■ 420 mA (4 20.5 mA) ■ 420 mA NAMUR (3.820.5 mA) ■ 420 mA US (3.920.8 mA) ■ 020 mA (0 20.5 mA)	Country-specific:  420 mA NAMUR (3.820.5 mA)  420 mA US (3.920.8 mA)
Failure mode	-	Define input behavior in alarm condition.	<ul><li>Alarm</li><li>Last valid value</li><li>Defined value</li></ul>	Alarm
Failure value	In the <b>Failure mode</b> parameter, the <b>Defined value</b> option is selected.	Enter value to be used by the device if input value from external device is missing.	Signed floating-point number	0

<sup>\*</sup> Visibility depends on order options or device settings

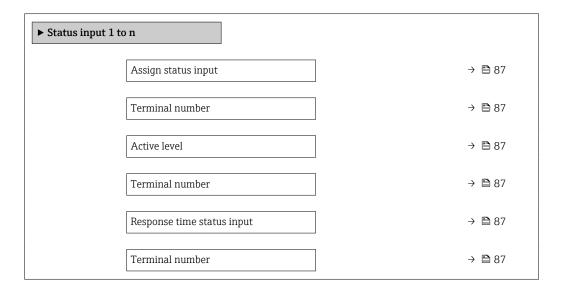
# 10.5.7 Configuring the status input

The **Status input** submenu guides the user systematically through all the parameters that have to be set for configuring the status input.

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#### Navigation

"Setup" menu  $\rightarrow$  Status input 1 to n



#### Parameter overview with brief description

Parameter	Description	Selection / User interface / User entry	Factory setting
Assign status input	Select function for the status input.	<ul> <li>Off</li> <li>Reset totalizer 1</li> <li>Reset totalizer 2</li> <li>Reset totalizer 3</li> <li>Reset all totalizers</li> <li>Flow override</li> <li>Zero point adjustment</li> </ul>	Off
Terminal number	Shows the terminal numbers used by the status input module.	<ul> <li>Not used</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)*</li> </ul>	-
Active level	Define input signal level at which the assigned function is triggered.	■ High ■ Low	High
Response time status input	Define the minimum amount of time the input signal level must be present before the selected function is triggered.	5 to 200 ms	50 ms

<sup>\*</sup> Visibility depends on order options or device settings

## 10.5.8 Configuring the current output

The **Current output** wizard guides you systematically through all the parameters that have to be set for configuring the current output.

#### Navigation

"Setup" menu → Current output



Signal mode		<u> </u>	₽ 🖺 88
Assign current out	out 1 to n	<u>;</u>	₽ 189
Current span		·	₽ 190
0/4 mA value		<u> </u>	∙ 🖺 90
20 mA value		<u> </u>	₽ 90
Fixed current		- -	∙ 🖺 90
Damping output 1	to n	· ]	• 🖺 91
Failure mode			• 🖺 91
Failure current		· }	₽ 1 91

Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
Terminal number	-	Shows the terminal numbers used by the current output module.	<ul> <li>Not used</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)*</li> </ul>	-
Signal mode	-	Select the signal mode for the current output.	<ul><li>Active*</li><li>Passive*</li></ul>	Active

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Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
Assign current output 1 to n		Select process variable for current output.	• Off* • Mass flow • Volume flow • Corrected volume flow* • Target mass flow * • Carrier mass flow * • Carrier volume flow* • Carrier volume flow * • Carrier corrected volume flow * • Carrier corrected volume flow * • Density • Reference density alternative * • GSV flow alternative * • NSV flow alternative * • NSV flow alternative * • Oil density * • Water cut * • Oil density * • Water cut * • Oil rorrected volume flow * • Water volume flow * • Water volume flow * • Water corrected volume flow * • Water corrected volume flow * • Temp. • Concentration * • Dynamic viscosity * • Temp. • Compensated dynamic viscosity * • Temp. • Compensated kinematic viscosity * • Temp. • Compensated dynamic viscosity * • Temp. • Compensated compensated contains to the compensated contains to the compensated contains the contains the compensated contains the compensated contains the compensated contains the contains the compensated contains the co	Mass flow

Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
			Oscillation damping 0* Oscillation damping 1* Oscillation damping fluctuation 0* Oscillation damping fluctuation 1* Signal asymmetry* Exciter current 0* Exciter current 1* HBSI* Pressure* Application specific output 0* Application specific output 1* Index inhomogeneous medium Index suspended bubbles*	
Current span	-	Select current range for process value output and upper/lower level for alarm signal.	<ul> <li>420 mA NAMUR (3.820.5 mA)</li> <li>420 mA US (3.920.8 mA)</li> <li>420 mA (4 20.5 mA)</li> <li>020 mA (0 20.5 mA)</li> <li>Fixed current</li> </ul>	Depends on country:  420 mA NAMUR (3.820.5 mA)  420 mA US (3.920.8 mA)
0/4 mA value	In <b>Current span</b> parameter (→ 🗎 90), one of the following options is selected:  • 420 mA NAMUR (3.820.5 mA)  • 420 mA US (3.920.8 mA)  • 420 mA (4 20.5 mA)  • 020 mA (0 20.5 mA)	Enter 4 mA value.	Signed floating-point number	Depends on country:  • 0 kg/h  • 0 lb/min
20 mA value	In <b>Current span</b> parameter (→ 🗎 90), one of the following options is selected:  • 420 mA NAMUR (3.820.5 mA)  • 420 mA US (3.920.8 mA)  • 420 mA (4 20.5 mA)  • 020 mA (0 20.5 mA)	Enter 20 mA value.	Signed floating-point number	Depends on country and nominal diameter
Fixed current	The <b>Fixed current</b> option is selected in the <b>Current span</b> parameter (→ 🖺 90).	Defines the fixed output current.	0 to 22.5 mA	22.5 mA

Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
Damping output 1 to n	A process variable is selected in the <b>Assign current output</b> parameter (→ ■ 89) and one of the following options is selected in the <b>Current span</b> parameter (→ ■ 90):  • 420 mA NAMUR (3.820.5 mA)  • 420 mA US (3.920.8 mA)  • 420 mA (4 20.5 mA)  • 020 mA (0 20.5 mA)	Set reaction time for output signal to fluctuations in the measured value.	0.0 to 999.9 s	1.0 s
Failure mode	A process variable is selected in the <b>Assign current output</b> parameter (→	Define output behavior in alarm condition.	<ul> <li>Min.</li> <li>Max.</li> <li>Last valid value</li> <li>Actual value</li> <li>Defined value</li> </ul>	Max.
Failure current	The <b>Defined value</b> option is selected in the <b>Failure mode</b> parameter.	Enter current output value in alarm condition.	0 to 22.5 mA	22.5 mA

Visibility depends on order options or device settings

# 10.5.9 Configuring the pulse/frequency/switch output

The **Pulse/frequency/switch output** wizard guides you systematically through all the parameters that can be set for configuring the selected output type.

#### Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Pulse/frequency/switch output



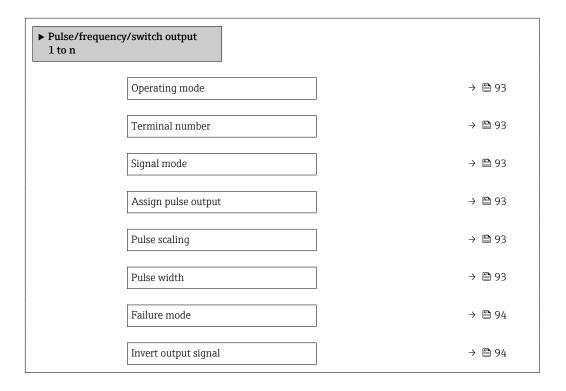
#### Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Operating mode	Define the output as a pulse, frequency or switch output.	<ul><li>Pulse</li><li>Frequency</li><li>Switch</li></ul>	Pulse

#### Configuring the pulse output

#### **Navigation**

"Setup" menu → Pulse/frequency/switch output



Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Operating mode	-	Define the output as a pulse, frequency or switch output.	<ul><li>Pulse</li><li>Frequency</li><li>Switch</li></ul>	Pulse
Terminal number	-	Shows the terminal numbers used by the PFS output module.	<ul> <li>Not used</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)*</li> </ul>	-
Signal mode	-	Select the signal mode for the PFS output.	<ul><li>Passive</li><li>Active</li><li>Passive NAMUR</li></ul>	Passive
Assign pulse output 1 to n	The <b>Pulse</b> option is selected in <b>Operating mode</b> parameter.	Select process variable for pulse output.	Off     Mass flow     Volume flow     Corrected volume flow*     Target mass flow*     Carrier mass flow*     Carrier volume flow*     Carrier volume flow*     Carrier corrected volume flow*     Carrier corrected volume flow*     Carrier to rorected volume flow*     Carrier corrected volume flow*     Carrier corrected volume flow*     Casv flow alternative*     NSV flow alternative     NSV flow alternative     S&W volume flow*     Oil mass flow*     Water mass flow     Oil volume flow*     Oil corrected volume flow*     Water corrected volume flow*      Water corrected volume flow*	Off
Pulse scaling	The <b>Pulse</b> option is selected in the <b>Operating mode</b> parameter (→ 🗎 92) and a process variable is selected in the <b>Assign pulse output</b> parameter (→ 🖺 93).	Enter quantity for measured value at which a pulse is output.	Positive floating point number	Depends on country and nominal diameter
Pulse width	The <b>Pulse</b> option is selected in the <b>Operating mode</b> parameter (→ 🖺 92) and a process variable is selected in the <b>Assign pulse output</b> parameter (→ 🖺 93).	Define time width of the output pulse.	0.05 to 2 000 ms	100 ms

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Failure mode	The <b>Pulse</b> option is selected in the <b>Operating mode</b> parameter (→ 🖺 92) and a process variable is selected in the <b>Assign pulse output</b> parameter (→ 🖺 93).	Define output behavior in alarm condition.	<ul><li>Actual value</li><li>No pulses</li></ul>	No pulses
Invert output signal	_	Invert the output signal.	<ul><li>No</li><li>Yes</li></ul>	No

Visibility depends on order options or device settings

# Configuring the frequency output

# Navigation

"Setup" menu → Pulse/frequency/switch output

➤ Pulse/frequen 1 to n	cy/switch output	
	Operating mode	→ 🖺 95
	Terminal number	→ 🖺 95
	Signal mode	→ 🖺 95
	Assign frequency output	→ 🖺 96
	Minimum frequency value	→ 🖺 98
	Maximum frequency value	→ 🖺 98
	Measuring value at minimum frequency	→ 🖺 98
	Measuring value at maximum frequency	→ 🖺 98
	Failure mode	→ 🖺 98
	Failure frequency	→ 🖺 99
	Invert output signal	→ 🖺 99

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Operating mode	-	Define the output as a pulse, frequency or switch output.	<ul><li>Pulse</li><li>Frequency</li><li>Switch</li></ul>	Pulse
Terminal number	-	Shows the terminal numbers used by the PFS output module.	<ul> <li>Not used</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)*</li> </ul>	-
Signal mode	-	Select the signal mode for the PFS output.	<ul><li>Passive</li><li>Active</li><li>Passive NAMUR</li></ul>	Passive

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Assign frequency output	The <b>Frequency</b> option is selected in <b>Operating mode</b> parameter (→ □ 92).	Select process variable for frequency output.	Off Mass flow Volume flow Corrected volume flow* Density Reference density alternative* GSV flow GSV flow alternative* NSV flow alternative NSV flow alternative S&W volume flow Water cut Oil density Water density Oil mass flow Oil volume flow Water volume flow Vater corrected volume flow Vater corrected volume flow Temp. compensated dynamic viscosity Temp. compensated kinematic viscosity Temp. compensated kinematic viscosity Temp. compensated dynamic viscosity Temp. compensated dynamic viscosity Temp. compensated kinematic viscosity Temp. compensated dynamic viscosity Temp. compensated kinematic viscosity Temp. compensated dynamic viscosity Temp. compensated kinematic viscosity Temp. compensated coscillation frequency 1 Oscillation amplitude 1 Frequency fluctuation 1* Oscillation damping 1 Oscillation damping 1 Oscillation damping 1 Carrier mass flow Target volume flow Carrier rorected volume flow Carrier rorected volume flow Carrier corrected	Off

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
	rielequisite	Description	interface / User	ractory Setting
			<ul> <li>Oscillation frequency 1 *</li> <li>Oscillation amplitude 1 *</li> <li>Frequency fluctuation 0 *</li> </ul>	
			<ul> <li>Oscillation amplitude 0 *</li> </ul>	

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
			Oscillation amplitude 1*     Frequency fluctuation 1*     Oscillation damping 1*     Oscillation damping fluctuation 1*     Signal asymmetry Electronic temperature     Index inhomogeneous medium     Index suspended bubbles*	
Minimum frequency value	The <b>Frequency</b> option is selected in the <b>Operating mode</b> parameter ( $\rightarrow \implies 92$ ) and a process variable is selected in the <b>Assign frequency output</b> parameter ( $\rightarrow \implies 96$ ).	Enter minimum frequency.	0.0 to 10 000.0 Hz	0.0 Hz
Maximum frequency value	The <b>Frequency</b> option is selected in the <b>Operating mode</b> parameter ( $\rightarrow \implies 92$ ) and a process variable is selected in the <b>Assign frequency output</b> parameter ( $\rightarrow \implies 96$ ).	Enter maximum frequency.	0.0 to 10 000.0 Hz	10 000.0 Hz
Measuring value at minimum frequency	The <b>Frequency</b> option is selected in the <b>Operating mode</b> parameter ( $\rightarrow \implies 92$ ) and a process variable is selected in the <b>Assign frequency output</b> parameter ( $\rightarrow \implies 96$ ).	Enter measured value for minmum frequency.	Signed floating-point number	Depends on country and nominal diameter
Measuring value at maximum frequency	The <b>Frequency</b> option is selected in the <b>Operating mode</b> parameter ( $\rightarrow \stackrel{\triangle}{=} 92$ ) and a process variable is selected in the <b>Assign frequency output</b> parameter ( $\rightarrow \stackrel{\triangle}{=} 96$ ).	Enter measured value for maximum frequency.	Signed floating-point number	Depends on country and nominal diameter
Failure mode	The <b>Frequency</b> option is selected in the <b>Operating mode</b> parameter (→ 🗎 92) and a process variable is selected in the <b>Assign frequency output</b> parameter (→ 🖺 96).	Define output behavior in alarm condition.	<ul><li>Actual value</li><li>Defined value</li><li>0 Hz</li></ul>	0 Hz

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Failure frequency	In the <b>Operating mode</b> parameter (→ □ 92), the <b>Frequency</b> option is selected, in the <b>Assign frequency output</b> parameter (→ □ 96) a process variable is selected, and in the <b>Failure mode</b> parameter, the <b>Defined value</b> option is selected.	Enter frequency output value in alarm condition.	0.0 to 12 500.0 Hz	0.0 Hz
Invert output signal	_	Invert the output signal.	<ul><li>No</li><li>Yes</li></ul>	No

<sup>\*</sup> Visibility depends on order options or device settings

# Configuring the switch output

# Navigation

"Setup" menu → Pulse/frequency/switch output

► Pulse/frequence 1 to n	cy/switch output	
	Operating mode	→ 🖺 100
	Terminal number	→ 🖺 100
	Signal mode	→ 🖺 100
	Switch output function	→ 🖺 101
	Assign diagnostic behavior	→ 🖺 101
	Assign limit	→ 🖺 102
	Assign flow direction check	→ 🖺 103
	Assign status	→ 🖺 103
	Switch-on value	→ 🖺 103
	Switch-off value	→ 🖺 103
	Switch-on delay	→ 🖺 103
	Switch-off delay	→ 🖺 103
	Failure mode	→ 🖺 103
	Invert output signal	→ 🖺 103

## Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Operating mode	-	Define the output as a pulse, frequency or switch output.	<ul><li>Pulse</li><li>Frequency</li><li>Switch</li></ul>	Pulse
Terminal number	-	Shows the terminal numbers used by the PFS output module.	<ul> <li>Not used</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)*</li> </ul>	-
Signal mode	-	Select the signal mode for the PFS output.	<ul><li>Passive</li><li>Active</li><li>Passive NAMUR</li></ul>	Passive

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Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Switch output function	The <b>Switch</b> option is selected in the <b>Operating mode</b> parameter.	Select function for switch output.	<ul> <li>Off</li> <li>On</li> <li>Diagnostic behavior</li> <li>Limit</li> <li>Flow direction check</li> <li>Status</li> </ul>	Off
Assign diagnostic behavior	<ul> <li>In the Operating mode parameter, the Switch option is selected.</li> <li>In the Switch output function parameter, the Diagnostic behavior option is selected.</li> </ul>	Select diagnostic behavior for switch output.	<ul><li>Alarm</li><li>Alarm or warning</li><li>Warning</li></ul>	Alarm

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Assign limit	■ The Switch option is selected in Operating mode parameter.  ■ The Limit option is selected in Switch output function parameter.	Select process variable for limit function.	Mass flow Volume flow Corrected volume flow* Target mass flow Target volume flow Carrier mass flow Target volume flow Carrier corrected volume flow Target corrected volume flow Carrier corrected volume flow Carrier corrected volume flow Density Reference density alternative GSV flow GSV flow alternative NSV flow alternative NSV flow valternative S&W volume flow Water cut Oil density Water density Oil mass flow Water was flow Vater volume flow Water volume flow Water corrected volume flow Water corrected volume flow Concentration Kinematic viscosity Concentration Kinematic viscosity Temp. compensated dynamic viscosity Temp. compensated vincentration Kinematic viscosity Temp. compensated dynamic viscosity	Mass flow

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Assign flow direction check	<ul> <li>The Switch option is selected in the Operating mode parameter.</li> <li>The Flow direction check option is selected in the Switch output function parameter.</li> </ul>	Select process variable for flow direction monitoring.		Mass flow
Assign status	<ul> <li>The Switch option is selected in Operating mode parameter.</li> <li>The Status option is selected in Switch output function parameter.</li> </ul>	Select device status for switch output.	<ul><li>Partially filled pipe detection</li><li>Low flow cut off</li></ul>	Partially filled pipe detection
Switch-on value	<ul> <li>The Switch option is selected in the Operating mode parameter.</li> <li>The Limit option is selected in the Switch output function parameter.</li> </ul>	Enter measured value for the switch-on point.	Signed floating-point number	Depends on country:  • 0 kg/h  • 0 lb/min
Switch-off value	<ul> <li>The Switch option is selected in the Operating mode parameter.</li> <li>The Limit option is selected in the Switch output function parameter.</li> </ul>	Enter measured value for the switch-off point.	Signed floating-point number	Depends on country:  • 0 kg/h  • 0 lb/min
Switch-on delay	<ul> <li>The Switch option is selected in the Operating mode parameter.</li> <li>The Limit option is selected in the Switch output function parameter.</li> </ul>	Define delay for the switch-on of status output.	0.0 to 100.0 s	0.0 s
Switch-off delay	<ul> <li>The Switch option is selected in the Operating mode parameter.</li> <li>The Limit option is selected in the Switch output function parameter.</li> </ul>	Define delay for the switch-off of status output.	0.0 to 100.0 s	0.0 s
Failure mode	-	Define output behavior in alarm condition.	<ul><li>Actual status</li><li>Open</li><li>Closed</li></ul>	Open
Invert output signal	-	Invert the output signal.	■ No ■ Yes	No

 $<sup>^{\</sup>star}$  Visibility depends on order options or device settings

# 10.5.10 Configuring the relay output

The **Relay output** wizard guides the user systematically through all the parameters that have to be set for configuring the relay output.

#### Navigation

"Setup" menu  $\rightarrow$  Relay output 1 to n



Relay output function		→ 🖺 104
Assign flow direction check		→ 🖺 104
Assign limit		→ 🖺 105
Assign diagnostic behavior		→ 🗎 106
Assign status	]	→ 🖺 106
Switch-off value		→ 🖺 106
Switch-off delay		→ 🖺 106
Switch-on value	]	→ 🗎 106
Switch-on delay	]	→ 🗎 106
Failure mode		→ 🖺 106
Switch status		→ 🖺 106
Powerless relay status		→ 🖺 106

Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
Terminal number	-	Shows the terminal numbers used by the relay output module.	<ul> <li>Not used</li> <li>24-25 (I/O 2)</li> <li>22-23 (I/O 3)</li> <li>20-21 (I/O 4)</li> </ul>	-
Relay output function	-	Select the function for the relay output.	<ul> <li>Closed</li> <li>Open</li> <li>Diagnostic behavior</li> <li>Limit</li> <li>Flow direction check</li> <li>Digital Output</li> </ul>	Closed
Assign flow direction check	The Flow direction check option is selected in the Relay output function parameter.	Select process variable for flow direction monitoring.		Mass flow

Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
Assign limit	The Limit option is selected in Relay output function parameter.	Select process variable for limit function.	Mass flow Volume flow Corrected volume flow* Target mass flow* Carrier mass flow Target volume flow* Carrier volume flow* Carrier corrected volume flow Service density Reference density alternative GSV flow GSV flow Alternative NSV flow NSV flow SSW volume flow* Vater cut Oil density Vater density Vater volume flow Vater volume flow Vater cut Coil corrected volume flow Vater cut Coil corrected volume flow Vater density Coil corrected volume flow Vater volume flow Totalizer 1 Totalizer 1 Totalizer 1 Totalizer 1 Totalizer 2 Totalizer 3 Oscillation damping Pressure Application specific output 0 Application specific output 1 Index inhomogeneous medium Index suspended bubbles*	Mass flow

Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
Assign diagnostic behavior	In the Relay output function parameter, the Diagnostic behavior option is selected.	Select diagnostic behavior for switch output.	<ul><li>Alarm</li><li>Alarm or warning</li><li>Warning</li></ul>	Alarm
Assign status	In the <b>Relay output function</b> parameter, the <b>Digital Output</b> option is selected.	Select device status for switch output.	<ul><li>Partially filled pipe detection</li><li>Low flow cut off</li></ul>	Partially filled pipe detection
Switch-off value	The <b>Limit</b> option is selected in the <b>Relay output function</b> parameter.	Enter measured value for the switch-off point.	Signed floating-point number	Depends on country:  Okg/h Olb/min
Switch-off delay	In the <b>Relay output function</b> parameter, the <b>Limit</b> option is selected.	Define delay for the switch-off of status output.	0.0 to 100.0 s	0.0 s
Switch-on value	The <b>Limit</b> option is selected in the <b>Relay output function</b> parameter.	Enter measured value for the switch-on point.	Signed floating-point number	Depends on country:  Okg/h Olb/min
Switch-on delay	In the <b>Relay output function</b> parameter, the <b>Limit</b> option is selected.	Define delay for the switch-on of status output.	0.0 to 100.0 s	0.0 s
Failure mode	-	Define output behavior in alarm condition.	<ul><li>Actual status</li><li>Open</li><li>Closed</li></ul>	Open
Switch status	-	Shows the current relay switch status.	<ul><li>Open</li><li>Closed</li></ul>	-
Powerless relay status	-	Select quietscent state for relay.	<ul><li>Open</li><li>Closed</li></ul>	Open

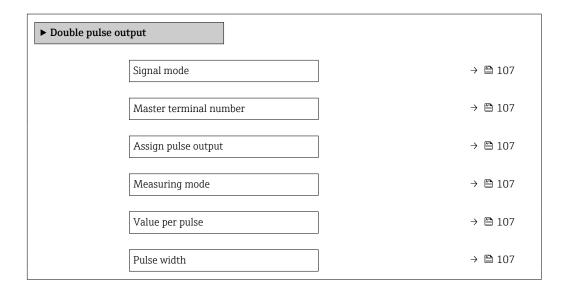
Visibility depends on order options or device settings

## 10.5.11 Configuring the double pulse output

The **Double pulse output** submenu guides the user systematically through all the parameters that have to be set for configuring the double pulse output.

#### Navigation

"Setup" menu → Double pulse output



106

Failure mode	→ 🖺 107
Invert output signal	→ 🖺 107

Parameter	Description	Selection / User interface / User entry	Factory setting
Signal mode	Select the signal mode for the double pulse output.	<ul><li>Passive</li><li>Active</li><li>Passive NAMUR</li></ul>	Passive
Master terminal number	Shows the terminal numbers used by the master of the double pulse output module.	<ul><li>Not used</li><li>24-25 (I/O 2)</li><li>22-23 (I/O 3)</li></ul>	-
Assign pulse output 1	Select process variable for pulse output.	Off Mass flow Volume flow Corrected volume flow* Target mass flow* Carrier mass flow* Target volume flow* Carrier volume flow* Target corrected volume flow* Carrier corrected volume flow* GSV flow* GSV flow alternative* NSV flow alternative* S&W volume flow* Oil mass flow* Water mass flow* Oil volume flow* Oil corrected volume flow* Water corrected volume flow* Water corrected volume flow*	Off
Measuring mode	Select measuring mode for pulse output.	<ul> <li>Forward flow</li> <li>Forward/Reverse flow</li> <li>Reverse flow</li> <li>Reverse flow compensation</li> </ul>	Forward flow
Value per pulse	Enter measured value at which a pulse is output.	Signed floating-point number	Depends on country and nominal diameter
Pulse width	Define time width of the output pulse.	0.5 to 2 000 ms	0.5 ms
Failure mode	Define output behavior in alarm condition.	<ul><li>Actual value</li><li>No pulses</li></ul>	No pulses
Invert output signal	Invert the output signal.	■ No ■ Yes	No

<sup>\*</sup> Visibility depends on order options or device settings

# 10.5.12 Configuring the local display

The **Display** wizard guides you systematically through all the parameters that can configured for configuring the local display.

Navigation
"Setup" menu → Display

► Display	
Format display	→ 🖺 109
Value 1 display	→ 🖺 110
0% bargraph value 1	→ 🖺 112
100% bargraph value 1	→ 🖺 112
Value 2 display	→ 🖺 112
Value 3 display	→ 🖺 112
0% bargraph value 3	→ 🖺 112
100% bargraph value 3	→ 🖺 113
Value 4 display	→ 🖺 113

# Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Format display	A local display is provided.	Select how measured values are shown on the display.	<ul> <li>1 value, max. size</li> <li>1 bargraph + 1</li> <li>value</li> <li>2 values</li> <li>1 value large + 2</li> <li>values</li> <li>4 values</li> </ul>	1 value, max. size

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Value 1 display	A local display is provided.	Select the measured value that is shown on the local display.	Mass flow Volume flow Corrected volume flow* Density Reference density alternative GSV flow alternative NSV flow NSV flow alternative S&W volume flow Water cut Oil density Vater density Oil rolume flow Water volume flow Vater volume flow Water corrected volume flow Water corrected volume flow Water corrected volume flow Water corrected volume flow The individed density average Weighted density average Weighted temperature average Wighted temperature average Temp. Compensated dynamic viscosity Temp. Compensated dynamic viscosity Temp. Compensated dynamic viscosity Temp. Compensated Wighted temperature viscosity Temp. Compensated Carrier pipe temperature Coscillation damping 1 Coscillation damping 1 Coscillation damping 1 Current output 2 Current output 4 Pressure Totalizer 2 Totalizer 3 Concentration Target mass flow Carrier mass flow Carrier mass flow	Mass flow

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
			<ul> <li>Target volume flow *</li> <li>Carrier volume</li> </ul>	
			flow *  Target corrected	
			volume flow * Carrier corrected volume flow *	
			Reference density alternative *	
			GSV flow *	
			alternative * ■ NSV flow *	
			<ul> <li>NSV flow alternative *</li> <li>S&amp;W volume flow *</li> </ul>	
			<ul> <li>Water cut *</li> <li>Oil density *</li> </ul>	
			<ul><li>Water density*</li><li>Oil mass flow*</li></ul>	
			<ul><li>Water mass flow *</li><li>Oil volume flow *</li></ul>	
			<ul> <li>Water volume flow *</li> <li>Oil corrected</li> </ul>	
			volume flow *  Water corrected	
			volume flow *  • Weighted density	
			average * ■ Weighted	
			temperature average *  Dynamic viscosity *	
			<ul> <li>Kinematic viscosity viscosity viscosity</li> </ul>	
			■ Temp. compensated	
			dynamic viscosity *  Temp.	
			compensated kinematic viscosity *	
			<ul> <li>Carrier pipe temperature *</li> </ul>	
			<ul> <li>Oscillation frequency 1 *</li> </ul>	
			<ul> <li>Oscillation amplitude 1*</li> <li>Frequency</li> </ul>	
			fluctuation 1 *  • Oscillation	
			damping 1 *  • Oscillation	
			damping fluctuation 1 * Exciter current 1 *	
			Current output 1 * Current output 2 *	
			<ul><li>Current output 4*</li><li>Index</li></ul>	
			inhomogeneous medium	
			<ul><li>Application specific output 0*</li><li>Application</li></ul>	
			specific output 1 *	

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
			■ HBSI* ■ Exciter current 0 ■ Oscillation damping 0 ■ Oscillation damping 1 ■ Oscillation damping fluctuation 0* ■ Oscillation frequency 0 ■ Oscillation frequency 1 ■ Oscillation amplitude 1* ■ Frequency fluctuation 0* ■ Oscillation amplitude 0 ■ Oscillation amplitude 1* ■ Frequency fluctuation 1 ■ Frequency fluctuation 1 ■ Oscillation amplitude 1 ■ Frequency fluctuation 1 ■ Oscillation damping 1 ■ Oscillation damping fluctuation 1 ■ Signal asymmetry ■ Electronic temperature ■ Oscillation frequency 1 ■ Oscillation amplitude 1 ■ Frequency fluctuation 1 ■ Signal asymmetry ■ Electronic temperature ■ Oscillation damping fluctuation 1 ■ Oscillation amplitude 1 ■ Frequency fluctuation 1 ■ Coscillation damping 1 ■ Oscillation damping 1 ■ Oscillation damping 1 ■ Oscillation damping 1 ■ Current output 2 ■ Current output 3 ■ Index suspended bubbles*	
0% bargraph value 1	A local display is provided.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific:  Okg/h  Olb/min
100% bargraph value 1	A local display is provided.	Enter 100% value for bar graph display.	Signed floating-point number	Depends on country and nominal diameter
Value 2 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→   110)	None
Value 3 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→ 🖺 110)	None
0% bargraph value 3	A selection was made in the <b>Value 3 display</b> parameter.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific:  Okg/h Olb/min

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
100% bargraph value 3	A selection was made in the Value 3 display parameter.	Enter 100% value for bar graph display.	Signed floating-point number	0
Value 4 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→ 🖺 110)	None
Value 5 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→ 🖺 110)	None
Value 6 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→ 🖺 110)	None
Value 7 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→ 🖺 110)	None
Value 8 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→ 🖺 110)	None

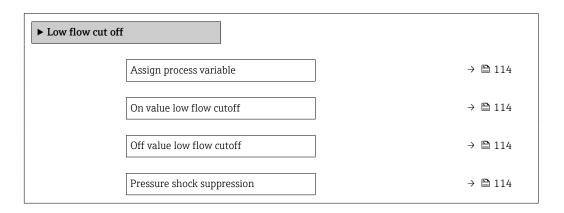
<sup>\*</sup> Visibility depends on order options or device settings

# 10.5.13 Configuring the low flow cut off

The **Low flow cut off** wizard systematically guides the user through all the parameters that must be set to configure low flow cut off.

### Navigation

"Setup" menu  $\rightarrow$  Low flow cut off



## Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Assign process variable	-	Select process variable for low flow cut off.	<ul> <li>Off</li> <li>Mass flow</li> <li>Volume flow</li> <li>Corrected volume flow*</li> </ul>	Mass flow
On value low flow cutoff	A process variable is selected in the <b>Assign process variable</b> parameter ( $\rightarrow \blacksquare 114$ ).	Enter on value for low flow cut off.	Positive floating- point number	Depends on country and nominal diameter
Off value low flow cutoff	A process variable is selected in the <b>Assign process variable</b> parameter ( $\rightarrow \implies 114$ ).	Enter off value for low flow cut off.	0 to 100.0 %	50 %
Pressure shock suppression	A process variable is selected in the <b>Assign process variable</b> parameter ( $\rightarrow \implies 114$ ).	Enter time frame for signal suppression (= active pressure shock suppression).	0 to 100 s	0 s

<sup>\*</sup> Visibility depends on order options or device settings

# 10.5.14 Configuring partially filled pipe detection

The **Partial filled pipe detection** wizard guides you systematically through all parameters that have to be set for configuring the monitoring of the pipe filling.

## Navigation

"Setup" menu  $\rightarrow$  Partially filled pipe detection

▶ Partially filled pipe detection	
Assign process variable	→ 🖺 115
Low value partial filled pipe detection	→ 🖺 115
High value partial filled pipe detection	→ 🖺 115
Response time part. filled pipe detect.	→ 🖺 115

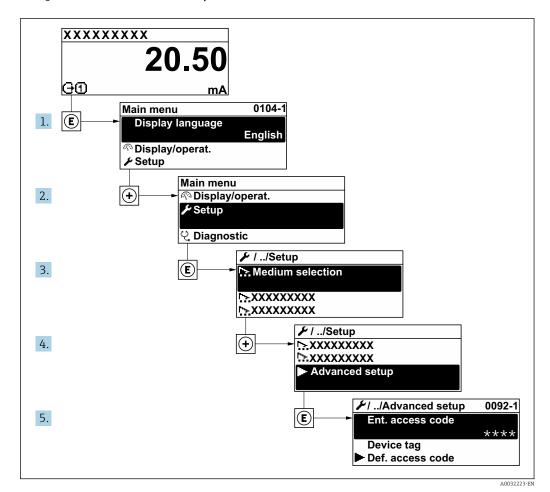
# Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Assign process variable	_	Select process variable for partially filled pipe detection.	<ul><li>Off</li><li>Density</li><li>Reference density</li></ul>	Density
Low value partial filled pipe detection	A process variable is selected in the <b>Assign process variable</b> parameter ( $\rightarrow \implies 115$ ).	Enter lower limit value for deactivating partialy filled pipe detection.	Signed floating-point number	Depends on country:  200 kg/m³  12.5 lb/ft³
High value partial filled pipe detection	A process variable is selected in the <b>Assign process variable</b> parameter ( $\rightarrow \implies 115$ ).	Enter upper limit value for deactivating partialy filled pipe detection.	Signed floating-point number	Depends on country:  • 6 000 kg/m <sup>3</sup> • 374.6 lb/ft <sup>3</sup>
Response time part. filled pipe detect.	A process variable is selected in the <b>Assign process variable</b> parameter ( $\Rightarrow  riangleq  riangl$	Use this function to enter the minimum time (hold time) the signal must be present before diagnostic message S962 "Pipe only partly filled" is triggered in the event of a partially filled or empty measuring pipe.	0 to 100 s	1s

# 10.6 Advanced settings

The **Advanced setup** submenu with its submenus contains parameters for specific settings.

Navigation to the "Advanced setup" submenu



The number of submenus and parameters can vary depending on the device version and the available application packages. These submenus and their parameters are explained in the Special Documentation for the device and not in Operating Instructions.

## Navigation

"Setup" menu → Advanced setup

➤ Advanced setup	
Enter access code	→ 🖺 117
► Calculated values	→ 🖺 117
► Sensor adjustment	→ 🖺 118

► Totalizer 1 to n	→ 🖺 124
► Display	→ 🖺 127
► WLAN settings	→ 🖺 134
► Configuration backup	→ 🖺 135
► Administration	→ 🖺 136

## 10.6.1 Using the parameter to enter the access code

#### Navigation

"Setup" menu → Advanced setup

### Parameter overview with brief description

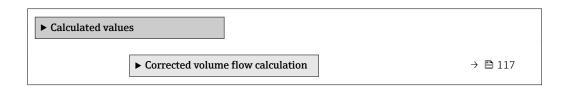
Parameter	Description	User entry
Enter access code	1 1	Max. 16-digit character string comprising numbers, letters and special characters

## 10.6.2 Calculated process variables

The **Calculated values** submenu contains parameters for calculating the corrected volume flow.

#### Navigation

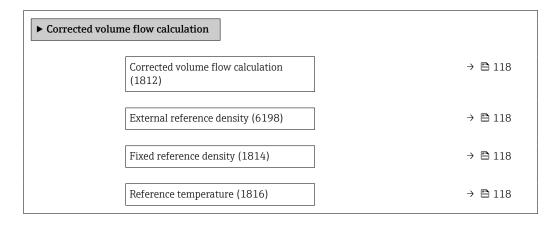
"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Calculated values



#### "Corrected volume flow calculation" submenu

#### Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Calculated values  $\rightarrow$  Corrected volume flow calculation



Linear expansion coefficient (1817)  $\Rightarrow \ \ \, \implies \ \, 118$  Square expansion coefficient (1818)  $\Rightarrow \ \ \, \implies \ \, 118$ 

## Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Corrected volume flow calculation	-	Select reference density for calculating the corrected volume flow.	<ul> <li>Fixed reference density</li> <li>Calculated reference density</li> <li>Current input 1*</li> <li>Current input 2*</li> <li>Current input 3*</li> </ul>	Calculated reference density
External reference density	In the Corrected volume flow calculation parameter, the External reference density option is selected.	Shows external reference density.	Floating point number with sign	-
Fixed reference density	The Fixed reference density option is selected in the Corrected volume flow calculation parameter parameter.	Enter fixed value for reference density.	Positive floating- point number	1 kg/Nl
Reference temperature	The Calculated reference density option is selected in the Corrected volume flow calculation parameter parameter.	Enter reference temperature for calculating the reference density.	-273.15 to 99999 °C	Country-specific:  • +20 °C  • +68 °F
Linear expansion coefficient	The Calculated reference density option is selected in the Corrected volume flow calculation parameter parameter.	Enter linear, medium-specific expansion coefficient for calculating the reference density.	Signed floating-point number	0.0 1/K
Square expansion coefficient	The Calculated reference density option is selected in the Corrected volume flow calculation parameter parameter.	For media with a non-linear expansion pattern: enter the quadratic, medium-specific expansion coefficient for calculating the reference density.	Signed floating-point number	0.0 1/K <sup>2</sup>

<sup>\*</sup> Visibility depends on order options or device settings

## 10.6.3 Carrying out a sensor adjustment

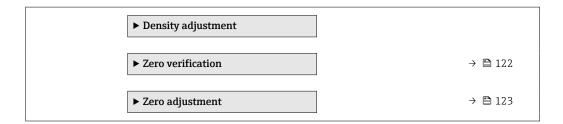
The **Sensor adjustment** submenu contains parameters that pertain to the functionality of the sensor.

### Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Sensor adjustment

► Sensor adjustment

Installation direction → 🖺 119



#### Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Installation direction	Set sign of flow direction to match the direction of the arrow on the sensor.	<ul><li>Flow in arrow direction</li><li>Flow against arrow direction</li></ul>	Flow in arrow direction

#### Density adjustment

With density adjustment, a high level of accuracy is achieved only at the point of adjustment and at the relevant density and temperature. However, the accuracy of a density adjustment is only ever as good as the quality of the reference measuring data provided. Therefore it is not a substitute for special density calibration.

#### Performing density adjustment

- Note the following before performing the adjustment:
  - A density adjustment only makes sense if there is little variation in the operating conditions and the density adjustment is performed under the operating conditions.
  - The density adjustment scales the internally computed density value with a userspecific slope and offset.
  - A 1-point or 2-point density adjustment can be performed.
  - For a 2-point density adjustment, there must be a difference of at least 0.2 kg/l between the two target density values.
  - The reference media must be gas-free or pressurized so that any gas they contain is compressed.
  - The reference density measurements must be performed at the same medium temperature that prevails in the process, as otherwise the density adjustment will not be accurate.
  - The correction resulting from the density adjustment can be deleted with the **Restore original** option.

#### "1 point adjustment" option

- 1. In the **Density adjustment mode** parameter, select the **1 point adjustment** option and confirm.
- 2. In the **Density setpoint 1** parameter, enter the density value and confirm.
  - In the **Execute density adjustment** parameter the following options are now available:

Ok

**Measure density 1** option Restore original

- 3. Select the **Measure density 1** option and confirm.
- 4. Select the **Calculate** option and confirm.

If the adjustment was completed successfully, the **Density adjustment factor** parameter and the **Density adjustment offset** parameter and the values calculated for them are shown on the display.

## "2 point adjustment" option

- 1. In the **Density adjustment mode** parameter, select the **2 point adjustment** option and confirm.
- 2. In the **Density setpoint 1** parameter, enter the density value and confirm.
- 3. In the **Density setpoint 2** parameter, enter the density value and confirm.
  - In the **Execute density adjustment** parameter the following options are now available:

Ok

Measure density 1

Restore original

- 4. Select the **Measure density 1** option and confirm.
  - ► In the **Execute density adjustment** parameter the following options are now available:

Ok

Measure density 2

Restore original

- 5. Select the **Measure density 2** option and confirm.
  - In the **Execute density adjustment** parameter the following options are now available:

Ok

Calculate

Cancel

6. Select the **Calculate** option and confirm.

If the **Density adjust failure** option is displayed in the **Execute density adjustment** parameter, call up the options and select the **Cancel** option. The density adjustment is canceled and can be repeated.

#### **Navigation**

"Expert" menu → Sensor → Sensor adjustment → Density adjustment

► Density adjustment	
Density adjustment mode	→ 🖺 121
Density setpoint 1	→ 🖺 121
Density setpoint 2	→ 🖺 121
Execute density adjustment	→ 🖺 121
Progress	→ 🖺 121
Density adjustment factor	→ 🗎 121
Density adjustment offset	→ 🖺 121

#### Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Density adjustment mode	-	Select the method for field density adjustment to correct the factory setting.	<ul><li>1 point adjustment</li><li>2 point adjustment</li></ul>	1 point adjustment
Density setpoint 1	-	Enter density for the first reference media.	The entry depends on the unit selected in the <b>Density unit</b> parameter (0555).	1 kg/l
Density setpoint 2	In the <b>Density adjustment mode</b> parameter, the <b>2 point adjustment</b> option is selected.	Enter density for the second reference media.	The entry depends on the unit selected in the <b>Density unit</b> parameter (0555).	1 kg/l
Execute density adjustment	-	Select the next step to be performed for the density adjustment.	<ul> <li>Cancel *</li> <li>Busy *</li> <li>Ok *</li> <li>Density adjust failure *</li> <li>Measure density 1 *</li> <li>Measure density 2 *</li> <li>Calculate *</li> <li>Restore original *</li> </ul>	Ok
Progress	-	Shows the progress of the process.	0 to 100 %	-
Density adjustment factor	-	Shows the calculated correction factor for the density.	Signed floating-point number	1
Density adjustment offset	-	Showsthe calculated correction offset for the density.	Signed floating-point number	0

<sup>\*</sup> Visibility depends on order options or device settings

#### Zero verification and zero adjustment

All measuring instruments are calibrated in accordance with state-of-the-art technology. Calibration takes place under reference conditions  $\Rightarrow \triangleq 235$ .

During commissioning, the two components (sensor and disposable measuring tube) are combined into a single unit for the first time. The use of automated Heartbeat Verification during commissioning not only confirms the validity of the factory calibration of the disposable measuring tube but also verifies the entire flowmeter, including the sensor, the transmitter, and the installed disposable component, within a defined scope of testing.

Key parameters, such as the calibration factor of the disposable measuring tube and other device information determined during factory calibration, must remain unchanged. Commissioning also includes performing a zero-point adjustment of the installed measuring instrument filled with liquid to compensate for manufacturing tolerances of the sensor.

This results in an updated zero point, which may deviate from the original zero point specified on the factory calibration certificate and is subsequently documented in the Heartbeat Technology verification report.

To achieve the highest possible measurement accuracy at low flow rates, the installation must protect the sensor from mechanical stresses during operation.

To get a representative zero point, ensure that:

- any flow in the device is prevented during the adjustment
- the process conditions (e.g. pressure, temperature) are stable and representative

Zero verification and zero adjustment cannot be performed if the following process conditions are present:

- lacktriangle Gas pockets
  - Ensure that the system has been sufficiently flushed with the medium. Repeated flushing can help to eliminate gas pockets.
- Thermal circulation
  - In the event of temperature differences (e.g. between the measuring tube inlet and outlet section), induced flow can occur even if the valves are closed due to thermal circulation in the device
- Leaks at the valves
  - If the valves are not leak-tight, flow is not sufficiently prevented when determining the zero point

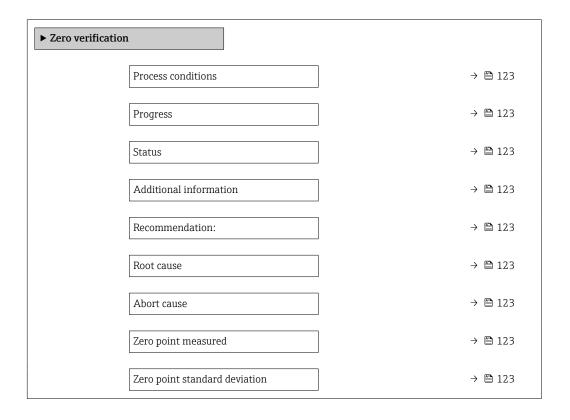
If these conditions cannot be avoided, it is advisable to keep the factory setting for the zero point.

Zero point verification

The zero point can be verified with the **Zero verification** wizard.

#### **Navigation**

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Sensor adjustment  $\rightarrow$  Zero verification



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## Parameter overview with brief description

Parameter	Description	Selection / User interface	Factory setting
Process conditions	Ensure process conditions as follows.	<ul> <li>Tubes are completely filled</li> <li>Process operational pressure applied</li> <li>No-flow conditions (closed valves)</li> <li>Process and ambient temperatures stable</li> </ul>	-
Progress	Shows the progress of the process.	0 to 100 %	-
Zero point adjustment status	Shows the status of the zero point adjustment.	<ul><li>Busy</li><li>Zero point adjust failure</li><li>Ok</li></ul>	-
Additional information	Indicate whether to display additional information.	• Hide • Show	Hide
Recommendation:	Indicates whether an adjustment is recommended. Only recommended if the measured zero point deviates significantly from the current zero point.	<ul><li>Do not adjust zero point</li><li>Adjust zero point</li></ul>	-
Abort cause	Indicates why the wizard was aborted.	Check process conditions!     A technical issue has occurred	-
Root cause	Shows the diagnostic and remedy.	<ul> <li>Zero point too high. Ensure no-flow.</li> <li>Zero point is unstable.         Ensure no-flow.     </li> <li>Fluctuation high. Avoid 2-phase medium.</li> </ul>	-
Zero point measured	Shows the zero point measured for the adjustment.	Signed floating-point number	-
Zero point standard deviation	Shows the standard deviation of the zero point measured.	Positive floating-point number	_

# Zero adjust

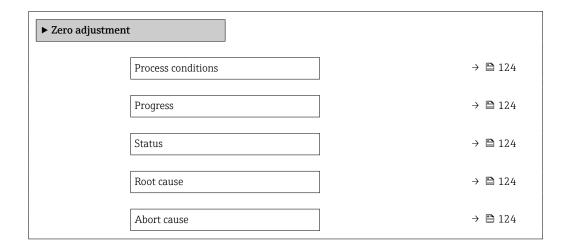
The zero point can be adjusted with the **Zero adjustment** wizard.



- A zero point verification should be performed before a zero adjustment.
- The zero point can also be adjusted manually: Expert → Sensor → Calibration

#### **Navigation**

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Sensor adjustment  $\rightarrow$  Zero adjustment



Root cause	→ 🖺 124
Reliability of measured zero point	→ 🖺 124
Additional information	→ 🖺 124
Reliability of measured zero point	→ 🖺 124
Zero point measured	→ 🖺 124
Zero point standard deviation	→ 🖺 124
Select action	→ 🖺 124

# Parameter overview with brief description

Parameter	Description	Selection / User interface	Factory setting
Process conditions	Ensure process conditions as follows.	<ul> <li>Tubes are completely filled</li> <li>Process operational pressure applied</li> <li>No-flow conditions (closed valves)</li> <li>Process and ambient temperatures stable</li> </ul>	-
Progress	Shows the progress of the process.	0 to 100 %	-
Zero point adjustment status	Shows the status of the zero point adjustment.	<ul><li>Busy</li><li>Zero point adjust failure</li><li>Ok</li></ul>	-
Abort cause	Indicates why the wizard was aborted.	Check process conditions!     A technical issue has occurred	-
Root cause	Shows the diagnostic and remedy.	<ul> <li>Zero point too high. Ensure no-flow.</li> <li>Zero point is unstable.         Ensure no-flow.     </li> <li>Fluctuation high. Avoid 2-phase medium.</li> </ul>	-
Reliability of measured zero point	Indicates the reliability of the zero point measured.	<ul><li>Not done</li><li>Good</li><li>Uncertain</li></ul>	-
Additional information	Indicate whether to display additional information.	<ul><li>Hide</li><li>Show</li></ul>	Hide
Zero point measured	Shows the zero point measured for the adjustment.	Signed floating-point number	-
Zero point standard deviation	Shows the standard deviation of the zero point measured.	Positive floating-point number	-
Select action	Select the zero point value to apply.	<ul> <li>Keep current zero point</li> <li>Apply zero point measured</li> <li>Apply factory zero point*</li> </ul>	Keep current zero point

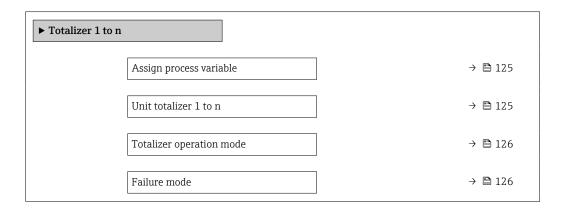
<sup>\*</sup> Visibility depends on order options or device settings

# 10.6.4 Configuring the totalizer

In the **"Totalizer 1 to n" submenu**, you can configure the specific totalizer.

## Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Totalizer 1 to n



# Parameter overview with brief description

Parameter	Prerequisite	Description	Selection	Factory setting
Assign process variable		Select process variable for totalizer.	■ Off ■ Mass flow ■ Volume flow ■ Corrected volume flow* ■ Target mass flow* ■ Carrier mass flow * ■ Target volume flow* ■ Carrier volume flow* ■ Carrier corrected volume flow ■ Carrier volume flow ■ GSV flow ■ GSV flow ■ GSV flow ■ Iternative ■ NSV flow ■ NSV flow ■ NSV flow ■ NSV flow ■ laternative ■ S&W volume flow* ■ Oil mass flow ■ Oil volume flow ■ Water volume flow ■ Water volume flow ■ Water corrected volume flow	Mass flow
Unit totalizer 1 to n	A process variable is selected in the <b>Assign process variable</b> parameter (→ 🖺 125) of the <b>Totalizer 1 to n</b> submenu.	Select process variable totalizer unit.	Unit choose list	Depends on country:  • kg • lb

Parameter	Prerequisite	Description	Selection	Factory setting
Totalizer operation mode	A process variable is selected in the <b>Assign process variable</b> parameter ( $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	Select totalizer calculation mode.	<ul><li>Net flow total</li><li>Forward flow total</li><li>Reverse flow total</li></ul>	Net flow total
Failure mode	A process variable is selected in the <b>Assign process variable</b> parameter ( $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	Define totalizer behavior in alarm condition.	<ul><li>Stop</li><li>Actual value</li><li>Last valid value</li></ul>	Stop

<sup>\*</sup> Visibility depends on order options or device settings

# 10.6.5 Carrying out additional display configurations

In the  $\bf Display$  submenu you can set all the parameters associated with the configuration of the local display.

## Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Display

	128
Value 1 display	129
value 1 display	
0% bargraph value 1 →	131
100% bargraph value 1	131
Decimal places 1	₽ 131
Value 2 display →	₽ 131
Decimal places 2	132
Value 3 display →	132
0% bargraph value 3	132
100% bargraph value 3	132
Decimal places 3	132
Value 4 display	132
Decimal places 4	132
Display language	133
Display interval	133
Display damping -	133
Header	133
Header text	133
Separator	134
Backlight	134

# Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Format display	A local display is provided.	Select how measured values are shown on the display.	<ul> <li>1 value, max. size</li> <li>1 bargraph + 1</li> <li>value</li> <li>2 values</li> <li>1 value large + 2</li> <li>values</li> <li>4 values</li> </ul>	1 value, max. size

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Value 1 display	A local display is provided.	Select the measured value that is shown on the local display.	Mass flow Volume flow Corrected volume flow* Density Reference density alternative* GSV flow GSV flow alternative* NSV flow NSV flow alternative* S&W volume flow* Water cut* Oil density Uater mass flow Oil volume flow* Water volume flow* Oil corrected volume flow Water corrected volume flow Water corrected volume flow Weighted density average* Weighted temperature average* Weighted temperature average* Dynamic viscosity* Kinematic viscosity* Temp. compensated dynamic viscosity Temp. compensated volume flow* Temp. compensated volume	Mass flow

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
			■ Target volume flow *	
			<ul> <li>Carrier volume</li> </ul>	
			flow *  Target corrected	
			volume flow *	
			<ul> <li>Carrier corrected volume flow *</li> </ul>	
			Reference density	
			alternative *	
			<ul><li>GSV flow *</li><li>GSV flow</li></ul>	
			alternative *	
			<ul><li>NSV flow*</li><li>NSV flow</li></ul>	
			alternative *	
			<ul><li>S&amp;W volume flow *</li><li>Water cut *</li></ul>	
			<ul> <li>Oil density *</li> </ul>	
			<ul><li>Water density *</li></ul>	
			<ul><li>Oil mass flow *</li><li>Water mass flow *</li></ul>	
			<ul> <li>Oil volume flow *</li> </ul>	
			<ul> <li>Water volume flow *</li> </ul>	
			<ul> <li>Oil corrected</li> </ul>	
			volume flow *  Water corrected	
			volume flow *	
			<ul> <li>Weighted density average *</li> </ul>	
			<ul><li>Weighted</li></ul>	
			temperature	
			average * Dynamic viscosity *	
			<ul> <li>Kinematic</li> </ul>	
			viscosity * Temp.	
			compensated	
			dynamic viscosity * Temp.	
			compensated	
			kinematic	
			viscosity * Carrier pipe	
			temperature *	
			<ul> <li>Oscillation frequency 1 *</li> </ul>	
			<ul> <li>Oscillation</li> </ul>	
			amplitude 1 * • Frequency	
			fluctuation 1 *	
			<ul> <li>Oscillation damping 1 *</li> </ul>	
			<ul> <li>Oscillation</li> </ul>	
			damping fluctuation 1 *	
			<ul> <li>Exciter current 1 *</li> </ul>	
			<ul> <li>Current output 1 *</li> </ul>	
			<ul><li>Current output 2 *</li><li>Current output 4 *</li></ul>	
			■ Index	
			inhomogeneous medium	
			<ul> <li>Application</li> </ul>	
			specific output 0 *  • Application	
			specific output 1 *	
			specific output 1	

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
			■ HBSI* ■ Exciter current 0 ■ Oscillation damping 0 ■ Oscillation damping 1* ■ Oscillation damping fluctuation 0* ■ Oscillation frequency 0 ■ Oscillation frequency 1* ■ Oscillation amplitude 1* ■ Frequency fluctuation 0* ■ Oscillation amplitude 0 ■ Oscillation amplitude 1 ■ Frequency fluctuation 1 ■ Frequency fluctuation 1 ■ Oscillation damping 1 ■ Oscillation damping 1 ■ Oscillation damping fluctuation 1* ■ Signal asymmetry ■ Electronic temperature ■ Oscillation frequency 1 ■ Oscillation frequency 1 ■ Oscillation amplitude 1 ■ Frequency fluctuation 1 ■ Coscillation frequency 1 ■ Oscillation damping 3 ■ Index suspended bubbles	
0% bargraph value 1	A local display is provided.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific:  0 kg/h 0 lb/min
100% bargraph value 1	A local display is provided.	Enter 100% value for bar graph display.	Signed floating-point number	Depends on country and nominal diameter
Decimal places 1	A measured value is specified in the <b>Value 1 display</b> parameter.	Select the number of decimal places for the display value.	• x • x.x • x.xx • x.xxx • x.xxx	x.xx
Value 2 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display  parameter  (→ 🖺 110)	None

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Decimal places 2	A measured value is specified in the <b>Value 2 display</b> parameter.	Select the number of decimal places for the display value.	• X • X.X • X.XX • X.XXX • X.XXXX	x.xx
Value 3 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display  parameter  (→   110)	None
0% bargraph value 3	A selection was made in the <b>Value 3 display</b> parameter.	Enter 0% value for bar graph display.	Signed floating-point number	Country-specific:  0 kg/h 0 lb/min
100% bargraph value 3	A selection was made in the <b>Value 3 display</b> parameter.	Enter 100% value for bar graph display.	Signed floating-point number	0
Decimal places 3	A measured value is specified in the <b>Value 3 display</b> parameter.	Select the number of decimal places for the display value.	<ul><li>X</li><li>X.X</li><li>X.XX</li><li>X.XXX</li><li>X.XXX</li></ul>	x.xx
Value 4 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter (→   110)	None
Decimal places 4	A measured value is specified in the <b>Value 4 display</b> parameter.	Select the number of decimal places for the display value.	• X • X.X • X.XX • X.XXX	x.xx
Value 5 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display  parameter  (→ 🖺 110)	None
0% bargraph value 5	An option was selected in the <b>Value 5 display</b> parameter.	Enter 0% value for bar graph display.	Signed floating-point number	Depends on country:  Okg/h Olb/min
100% bargraph value 5	An option was selected in the <b>Value 5 display</b> parameter.	Enter 100% value for bar graph display.	Signed floating-point number	0
Decimal places 5	A measured value is specified in the <b>Value 5 display</b> parameter.	Select the number of decimal places for the display value.	X     X.X     X.XX     X.XXX     X.XXXX     X.XXXXX     X.XXXXX	x.xx
Value 6 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display  parameter  (→   110)	None
Decimal places 6	A measured value is specified in the <b>Value 6 display</b> parameter.	Select the number of decimal places for the display value.	X     X.X     X.XX     X.XXX     X.XXXX     X.XXXXX     X.XXXXX	x.xx
Value 7 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display parameter ( > 110)	None

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
0% bargraph value 7	An option was selected in the <b>Value 7 display</b> parameter.	Enter 0% value for bar graph display.	Signed floating-point number	Depends on country:  Okg/h Olb/min
100% bargraph value 7	An option was selected in the <b>Value 7 display</b> parameter.	Enter 100% value for bar graph display.	Signed floating-point number	0
Decimal places 7	A measured value is specified in the <b>Value 7 display</b> parameter.	Select the number of decimal places for the display value.  • x • x.x • x.xx • x.xxx • x.xxxx • x.xxxxx • x.xxxxx • x.xxxxx		x.xx
Value 8 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see  Value 1 display  parameter  (→   110)	None
Decimal places 8	A measured value is specified in the <b>Value 8 display</b> parameter.	Select the number of decimal places for the display value.	X     X.X     X.XX     X.XXX     X.XXXX     X.XXXXX     X.XXXXX	x.xx
Display language	A local display is provided.	Set display language.	English     Deutsch     Français     Español     Italiano     Nederlands     Portuguesa     Polski     pyсский язык (Russian)     Svenska     Türkçe     中文 (Chinese)     日本語 (Japanese)     한국어 (Korean)     tiếng Việt (Vietnamese)     čeština (Czech)	English (alternatively, the ordered language is preset in the device)
Display interval	A local display is provided.	Set time measured values are shown on display if display alternates between values.	1 to 10 s	5 s
Display damping	A local display is provided.	Set display reaction time to fluctuations in the measured value.	0.0 to 999.9 s	0.0 s
Header	A local display is provided.	Select header contents on local display.	<ul><li>Device tag</li><li>Free text</li></ul>	Device tag
Header text	The <b>Free text</b> option is selected in the <b>Header</b> parameter.	Enter display header text.	Max. 12 characters, such as letters, numbers or special characters (e.g. @, %, /)	

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Separator	A local display is provided.	Select decimal separator for displaying numerical values.	<ul><li>. (point)</li><li>, (comma)</li></ul>	. (point)
Backlight	One of the following conditions is met:  Order code for "Display; operation", option F "4-line, illum.; touch control"  Order code for "Display; operation", option G "4-line, illum.; touch control +WLAN"	Switch the local display backlight on and off.	<ul><li>Disable</li><li>Enable</li></ul>	Enable

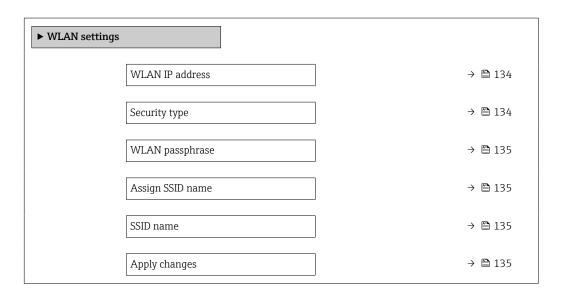
<sup>\*</sup> Visibility depends on order options or device settings

# 10.6.6 WLAN configuration

The **WLAN Settings** submenu guides the user systematically through all the parameters that have to be set for the WLAN configuration.

### Navigation

"Setup" menu → Advanced setup → WLAN settings



## Parameter overview with brief description

Parameter	Prerequisite	Description	User entry / Selection	Factory setting
WLAN IP address	-	Enter IP address of the WLAN interface of the device.	4 octet: 0 to 255 (in the particular octet)	192.168.1.212
Network security	_	Select the security type of the WLAN network.	<ul> <li>Unsecured</li> <li>WPA2-PSK</li> <li>EAP-PEAP with MSCHAPv2*</li> <li>EAP-PEAP MSCHAPv2 no server authentic.*</li> <li>EAP-TLS*</li> </ul>	WPA2-PSK

Parameter	Prerequisite	Description	User entry / Selection	Factory setting
WLAN passphrase	The WPA2-PSK option is selected in the Security type parameter.	Enter the network key (8 to 32 characters).  The network key supplied with the device should be changed during commissioning for security reasons.	8 to 32-digit character string comprising numbers, letters and special characters (without spaces)	Serial number of the measuring device (e.g. L100A802000)
Assign SSID name	-	Select which name will be used for SSID: device tag or user-defined name.	<ul><li>Device tag</li><li>User-defined</li></ul>	User-defined
SSID name	<ul> <li>The User-defined option is selected in the Assign SSID name parameter.</li> <li>The WLAN access point option is selected in the WLAN mode parameter.</li> </ul>	Enter the user-defined SSID name (max. 32 characters).  The user-defined SSID name may only be assigned once. If the SSID name is assigned more than once, the devices can interfere with one another.	Max. 32-digit character string comprising numbers, letters and special characters	
Apply changes	-	Use changed WLAN settings.	<ul><li>Cancel</li><li>Ok</li></ul>	Cancel

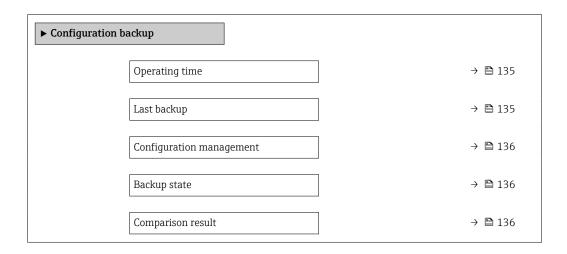
<sup>\*</sup> Visibility depends on order options or device settings

# 10.6.7 Configuration management

After commissioning, you can save the current device configurationor restore the previous device configuration. The device configuration is managed via the **Configuration management** parameter.

## Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Configuration backup



## Parameter overview with brief description

Parameter	Description	User interface / Selection	Factory setting
Operating time	Indicates how long the device has been in operation.	Days (d), hours (h), minutes (m) and seconds (s)	_
Last backup	Shows when the last data backup was saved to HistoROM backup.	Days (d), hours (h), minutes (m) and seconds (s)	-

Parameter	Description	User interface / Selection	Factory setting
Configuration management	Select action for managing the device data in the HistoROM backup.	<ul> <li>Cancel</li> <li>Execute backup</li> <li>Restore*</li> <li>Compare*</li> <li>Clear backup data</li> </ul>	Cancel
Backup state	Shows the current status of data saving or restoring.	<ul> <li>None</li> <li>Backup in progress</li> <li>Restoring in progress</li> <li>Delete in progress</li> <li>Compare in progress</li> <li>Restoring failed</li> <li>Backup failed</li> </ul>	None
Comparison result	Comparison of current device data with HistoROM backup.	<ul> <li>Settings identical</li> <li>Settings not identical</li> <li>No backup available</li> <li>Backup settings corrupt</li> <li>Check not done</li> <li>Dataset incompatible</li> </ul>	Check not done

<sup>\*</sup> Visibility depends on order options or device settings

## Function range of "Configuration management" parameter

Options	Description
Cancel	No action is executed and the user exits the parameter.
Execute backup	A backup copy of the current device configuration is saved from the HistoROM backup to the memory of the device. The backup copy includes the transmitter data of the device.
Restore	The last backup copy of the device configuration is restored from the display module from the device memory to the device's HistoROM backup. The backup copy includes the transmitter data of the device.
Compare	The device configuration saved in the device memory is compared with the current device configuration of the HistoROM backup.
Clear backup data	The backup copy of the device configuration is deleted from the memory of the device.

# HistoROM backup

A HistoROM is a "non-volatile" device memory in the form of an EEPROM.

While this action is in progress, the configuration cannot be edited via the local display and a message on the processing status appears on the display.

# 10.6.8 Using parameters for device administration

The **Administration** submenu systematically guides the user through all the parameters that can be used for device administration purposes.

#### Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Administration

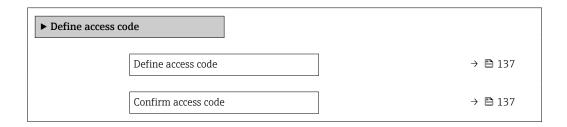


► Reset access code	→ 🖺 137
Device reset	→ 🖺 138

## Using the parameter to define the access code

### Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Administration  $\rightarrow$  Define access code



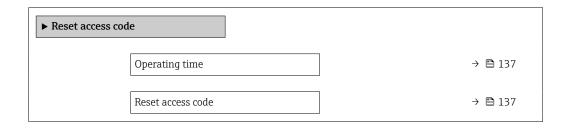
### Parameter overview with brief description

Parameter	Description	User entry
Define access code	Restrict write-access to parameters to protect the configuration of the device against unintentional changes.	Max. 16-digit character string comprising numbers, letters and special characters
Confirm access code	Confirm the entered access code.	Max. 16-digit character string comprising numbers, letters and special characters

## Using the parameter to reset the access code

### Navigation

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Administration  $\rightarrow$  Reset access code



### Parameter overview with brief description

Parameter	Description	User interface / User entry	Factory setting
Operating time	Indicates how long the device has been in operation.	Days (d), hours (h), minutes (m) and seconds (s)	-
Reset access code	Reset access code to factory settings.  For a reset code, contact your Endress+Hauser service organization.  The reset code can only be entered via:  Web browser  DeviceCare, FieldCare (via CDI-RJ45 service interface)  Fieldbus	Character string comprising numbers, letters and special characters	0x00

## Using the parameter to reset the device

## **Navigation**

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Administration

### Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Device reset	Reset the device configuration - either entirely or in part - to a defined state.	<ul> <li>Cancel</li> <li>To delivery settings</li> <li>Restart device</li> <li>Restore S-DAT backup *</li> </ul>	Cancel

Visibility depends on order options or device settings

# 10.7 Simulation

Via the **Simulation** submenu, it is possible to simulate various process variables in the process and the device alarm mode and verify downstream signal chains (switching valves or closed-control loops). The simulation can be performed without a real measurement (no flow of medium through the device).

#### **Navigation**

"Diagnostics" menu  $\rightarrow$  Simulation

<b>▶</b> Simulation	
Assign simulation process variab	ole → 🖺 140
Process variable value	→ 🖺 140
Current input 1 to n simulation	→ 🗎 141
Value current input 1 to n	→ 🗎 141
Status input simulation 1 to n	→ 🗎 141
Input signal level 1 to n	→ 🗎 141
Current output 1 to n simulation	→ 🗎 140
Value current output 1 to n	→ 🖺 140
Frequency output simulation 1 t	o n → 🖺 140
Frequency value 1 to n	→ 🗎 141
Pulse output simulation 1 to n	→ 🗎 141
Pulse value 1 to n	→ 🖺 141

Switch output simulation 1 to n	→ 🖺 141
Switch status 1 to n	→ 🖺 141
Relay output 1 to n simulation	→ 🖺 141
Switch status 1 to n	→ 🖺 141
Pulse output simulation	→ 🖺 141
Pulse value	→ 🖺 141
Device alarm simulation	→ 🖺 141
Diagnostic event category	→ 🖺 141
Diagnostic event simulation	→ 🖺 141

# Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Assign simulation process variable		Select a process variable for the simulation process that is activated.	Off     Mass flow     Volume flow     Corrected volume flow*     Target mass flow*     Carrier mass flow*     Carrier volume flow*     Carrier volume flow*     Carrier corrected volume flow*     Carrier corrected volume flow*     Carrier corrected volume flow*     Carrier corrected volume flow*     Density     Reference density alternative*     GSV flow     alternative*     NSV flow     NSV flow     NSV flow     Insolution flow*     Water cut*     Oil density*     Water density*     Water density*     Water mass flow*     Water mass flow*     Water volume flow*     Water volume flow*     Water corrected volume flow*     Water corrected volume flow*     Water corrected volume flow*     Temperature     Dynamic viscosity*     Temp.     compensated dynamic viscosity*     Temp.     compensated kinematic viscosity*     Temp.     compensated kinematic viscosity*     Concentration*	Off
Process variable value	A process variable is selected in the <b>Assign simulation process variable</b> parameter (→   140).	Enter the simulation value for the selected process variable.	Depends on the process variable selected	0
Current output 1 to n simulation	-	Switch the simulation of the current output on and off.	Off On	Off
Value current output 1 to n	In the <b>Current output 1 to n simulation</b> parameter, the <b>On</b> option is selected.	Enter the current value for simulation.	3.59 to 22.5 mA	3.59 mA
Frequency output simulation 1 to n	In the <b>Operating mode</b> parameter, the <b>Frequency</b> option is selected.	Switch the simulation of the frequency output on and off.	• Off • On	Off

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Frequency value 1 to n	In the <b>Frequency output simulation 1 to n</b> parameter, the <b>On</b> option is selected.	Enter the frequency value for the simulation.	0.0 to 12 500.0 Hz	0.0 Hz
Pulse output simulation 1 to n	In the <b>Operating mode</b> parameter, the <b>Pulse</b> option is selected.	Set and switch off the pulse output simulation.  For Fixed value option: Pulse width parameter (→   93) defines the pulse width of the pulses output.	<ul><li>Off</li><li>Fixed value</li><li>Down-counting value</li></ul>	Off
Pulse value 1 to n	In the <b>Pulse output simulation 1 to n</b> parameter, the <b>Down-counting value</b> option is selected.	Enter the number of pulses for simulation.	0 to 65 535	0
Switch output simulation 1 to n	In the <b>Operating mode</b> parameter, the <b>Switch</b> option is selected.	Switch the simulation of the switch output on and off.	• Off • On	Off
Switch status 1 to n	-	Select the status of the status output for the simulation.	<ul><li>Open</li><li>Closed</li></ul>	Open
Relay output 1 to n simulation	-	Switch simulation of the relay output on and off.	Off On	Off
Switch status 1 to n	The <b>On</b> option is selected in the <b>Switch output simulation 1 to n</b> parameter parameter.	Select status of the relay output for the simulation.	<ul><li>Open</li><li>Closed</li></ul>	Open
Pulse output simulation	-	Set and switch off the pulse output simulation.  For Fixed value option: Pulse width parameter defines the pulse width of the pulses output.	<ul><li>Off</li><li>Fixed value</li><li>Down-counting value</li></ul>	Off
Pulse value	In the <b>Pulse output simulation</b> parameter, the <b>Down-counting value</b> option is selected.	Set and switch off the pulse output simulation.	0 to 65 535	0
Device alarm simulation	-	Switch the device alarm on and off.	Off On	Off
Diagnostic event category	-	Select a diagnostic event category.	<ul><li>Sensor</li><li>Electronics</li><li>Configuration</li><li>Process</li></ul>	Process
Diagnostic event simulation	-	Select a diagnostic event to simulate this event.	<ul> <li>Off</li> <li>Diagnostic event picklist (depends on the category selected)</li> </ul>	Off
Current input 1 to n simulation	-	Switch simulation of the current input on and off.	Off On	Off
Value current input 1 to n	In the <b>Current input 1 to n simulation</b> parameter, the <b>On</b> option is selected.	Enter the current value for simulation.	0 to 22.5 mA	0 mA
Status input simulation 1 to n	-	Switch simulation of the status input on and off.	Off On	Off
Input signal level 1 to n	In the <b>Status input simulation</b> parameter, the <b>On</b> option is selected.	Select the signal level for the simulation of the status input.	■ High ■ Low	High

<sup>\*</sup> Visibility depends on order options or device settings

# 10.8 Protecting settings from unauthorized access

The following write protection options exist in order to protect the configuration of the measuring device from unintentional modification:

## 10.8.1 Write protection via access code

The effects of the user-specific access code are as follows:

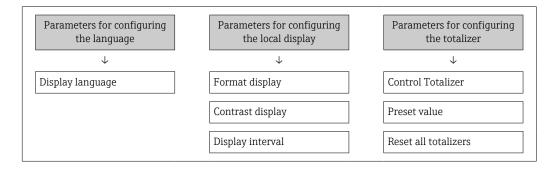
- Via local operation, the parameters for the measuring device configuration are writeprotected and their values can no longer be changed.
- Device access is protected via the Web browser, as are the parameters for the measuring device configuration.
- Device access is protected via FieldCare or DeviceCare (via CDI-RJ45 service interface), as are the parameters for the measuring device configuration.

#### Defining the access code via the local display

- 1. Navigate to the **Define access code** parameter ( $\Rightarrow \triangleq 137$ ).
- 2. Maximum of 16-digit character string comprising numbers, letters and special characters as the access code.
- 3. Enter the access code again in the **Confirm access code** parameter ( $\rightarrow \implies 137$ ) to confirm.
  - ► The 🗈 symbol appears in front of all write-protected parameters.
- - If the access code is lost: Resetting the access code  $\rightarrow \triangleq 143$ .
  - The user role with which the user is currently logged in is displayed in **Access** status parameter.
    - Navigation path: Operation → Access status
    - User roles and their access rights  $\rightarrow \triangleq 58$
- The device automatically locks the write-protected parameters again if a key is not pressed for 10 minutes in the navigation and editing view.
- The device locks the write-protected parameters automatically after 60 s if the user skips back to the operational display mode from the navigation and editing view.

#### Parameters which can always be modified via the local display

Certain parameters that do not affect the measurement are excepted from parameter write protection via the local display. Despite the user-specific access code, they can always be modified, even if the other parameters are locked.



#### Defining the access code via the web browser

1. Navigate to the **Define access code** parameter ( $\rightarrow \triangleq 137$ ).

- 2. Define a 16-digit (max.) numeric code as the access code.
- 3. Enter the access code again in the **Confirm access code** parameter ( $\rightarrow \implies 137$ ) to confirm.
  - ► The web browser switches to the login page.
- $\blacksquare$  Disabling parameter write protection via access code  $\rightarrow$   $\blacksquare$  58.
  - If the access code is lost: Resetting the access code  $\Rightarrow \triangleq 143$ .
  - The Access status parameter shows which user role the user is currently logged in with.
    - Navigation path: Operation → Access status
    - User roles and their access rights  $\rightarrow \triangleq 58$

If no action is performed for 10 minutes, the web browser automatically returns to the login page.

#### Resetting the access code

If you misplace the user-specific access code, it is possible to reset the code to the factory setting. A reset code must be entered for this purpose. The user-specific access code can then be defined again afterwards.

Via Web browser, FieldCare, DeviceCare (via CDI-RJ45 service interface), fieldbus

- You can only obtain a reset code from your local Endress+Hauser service organization. The code must be calculated explicitly for every device.
- 1. Note down the serial number of the device.
- 2. Read off the **Operating time** parameter.
- 3. Contact the local Endress+Hauser service organization and tell them the serial number and the operating time.
  - Get the calculated reset code.
- 4. Enter the reset code in the **Reset access code** parameter ( $\rightarrow \triangleq 137$ ).
  - The access code has been reset to the factory setting **0000**. It can be redefined  $\rightarrow \boxminus 142$ .
- For IT security reasons, the calculated reset code is only valid for 96 hours from the specified operating time and for the specific serial number. If you cannot return to the device within 96 hours, you should either increase the operating time you read out by a few days or switch off the device.

#### 10.8.2 Write protection via write protection switch

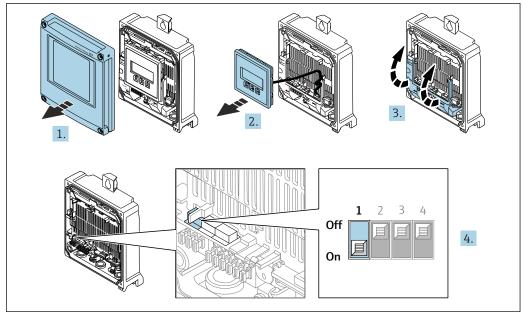
Unlike parameter write protection via a user-specific access code, this allows the user to lock write access to the entire operating menu - apart from the **"Contrast display"** parameter.

The parameter values are now read only and cannot be edited any more (exception "Contrast display" parameter):

- Via local display
- Via MODBUS RS485 protocol

## Proline 500 - digital

#### Enable/disable write protection



A002967

- 1. Open the housing cover.
- 2. Remove the display module.
- 3. Fold open the terminal cover.

### 4. Enable or disable write protection:

Setting the write protection (WP) switch on the main electronics module to the **ON** position enables hardware write protection/setting to **OFF** (factory setting) disables hardware write protection.

In the Locking status parameter, the Hardware locked option is displayed
 → ■ 145. When hardware write protection is enabled, the ® symbol appears in the header of the measured value display and in the navigation view in front of the parameters.



A002942

- 5. Insert the display module.
- 6. Close the housing cover.

### 7. NOTICE

# Excessive tightening torque applied to the fixing screws!

Risk of damaging the plastic transmitter.

► Tighten the fixing screws as per the tightening torque: 2.5 Nm (1.8 lbf ft)

Tighten the fixing screws.

### Operation 11

### 11.1 Reading off the device locking status

Device active write protection: Locking status parameter

Operation → Locking status

Function scope of the "Locking status" parameter

Options	Description
None	The access authorization displayed in the <b>Access status</b> parameter applies → 🖺 58. Only appears on local display.
Hardware locked	The DIP switch for hardware locking is activated on the PCB board. This locks write access to the parameters (e.g. via local display or operating tool) $\rightarrow$ $\  \   \  \   \   \   \   \   \$
Temporarily locked	Write access to the parameters is temporarily locked on account of internal processes running in the device (e.g. data upload/download, reset, etc.). Once the internal processing has been completed, the parameters can be changed once again.

### 11.2 Adjusting the operating language



Petailed information:

- To configure the operating language → 🗎 77
- For information on the operating languages supported by the measuring device → 🖺 240

### 11.3 Configuring the display

Detailed information:

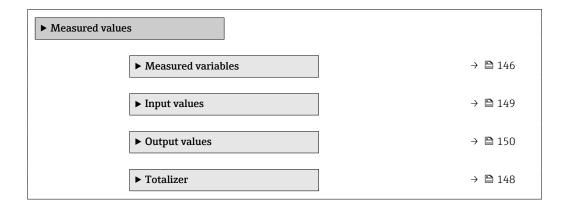
- On the advanced settings for the local display  $\rightarrow \implies 127$

### 11.4 Reading the measured values

With the **Measured values** submenu, it is possible to read all the measured values.

### **Navigation**

"Diagnostics" menu → Measured values

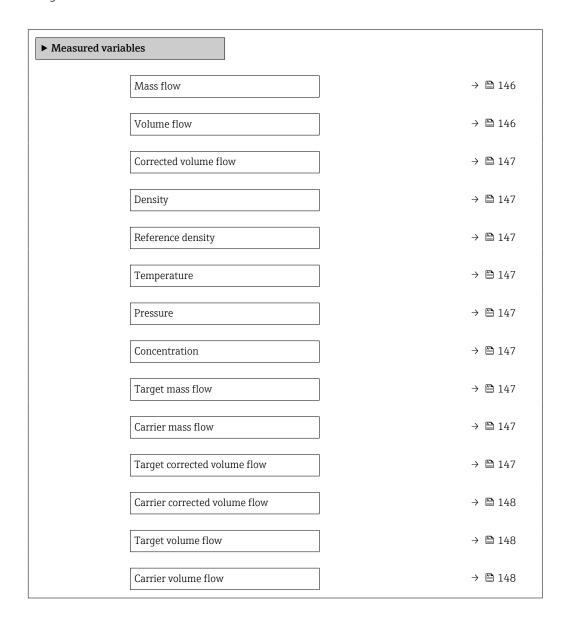


### 11.4.1 "Measured variables" submenu

The **Measured variables** submenu contains all the parameters needed to display the current measured values for each process variable.

### Navigation

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Measured variables



### Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Mass flow	-	Displays the mass flow that is currently measured.	Signed floating-point number
		Dependency The unit is taken from: Mass flow unit parameter (→ ■ 81)	
Volume flow	-	Displays the volume flow that is currently calculated.	Signed floating-point number
		Dependency The unit is taken from the Volume flow unit parameter ( $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	

Parameter	Prerequisite	Description	User interface
Corrected volume flow	-	Displays the corrected volume flow that is currently calculated.  Dependency The unit is taken from: Corrected volume flow unit parameter (→   81)	Signed floating-point number
Density	-	Shows the density currently measured. Dependency The unit is taken from the <b>Density unit</b> parameter $(\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	Signed floating-point number
Reference density	-	Displays the reference density that is currently calculated.  Dependency The unit is taken from: Reference density unit parameter (→ ≅ 81)	Signed floating-point number
Temperature	-	Shows the medium temperature currently measured.  Dependency The unit is taken from: Temperature unit parameter (→ 🖺 82)	Signed floating-point number
Pressure value	-	Displays either a fixed or external pressure value.  Dependency The unit is taken from the Pressure unit parameter (→   82).	Signed floating-point number
Concentration	For the following order code: Order code for "Application package", option ED "Concentration"  The software options currently enabled are displayed in the Software option overview parameter.	Displays the concentration that is currently calculated.  Dependency The unit is taken from the Concentration unit parameter.	Signed floating-point number
Target mass flow	With the following conditions: Order code for "Application package", option ED "Concentration"  The software options currently enabled are displayed in the Software option overview parameter.	Displays the mass flow that is currently measured for the target medium.  Dependency The unit is taken from: Mass flow unit parameter (→ 🖺 81)	Signed floating-point number
Carrier mass flow	With the following conditions: Order code for "Application package", option ED "Concentration"  The software options currently enabled are displayed in the Software option overview parameter.	Displays the mass flow of the carrier medium that is currently measured.  Dependency The unit is taken from: Mass flow unit parameter (→ ■ 81)	Signed floating-point number
Target corrected volume flow	With the following conditions:  Order code for "Application package", option ED "Concentration"  The Ethanol in water option or %mass / %volume option is selected in the Liquid type parameter.  The software options currently enabled are displayed in the Software option overview parameter.	Displays the corrected volume flow that is currently measured for the target fluid.  Dependency The unit is taken from the Volume flow unit parameter (→   81).	Signed floating-point number

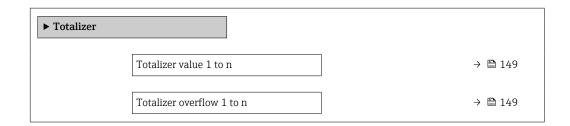
Parameter	Prerequisite	Description	User interface
Carrier corrected volume flow	With the following conditions:  Order code for "Application package", option ED "Concentration"  In the Liquid type parameter, the Ethanol in water option or %mass / %volume option is selected.  The software options currently enabled are displayed in the Software option overview parameter.	Displays the corrected volume flow currently measured for the carrier fluid.  Dependency The unit is taken from the Volume flow unit parameter (→ 🖺 81).	Signed floating-point number
Target volume flow	With the following conditions:  Order code for "Application package", option ED "Concentration"  The Ethanol in water option or %mass / %volume option is selected in the Liquid type parameter.  The %vol option is selected in the Concentration unit parameter.  The software options currently enabled are displayed in the Software option overview parameter.	Displays the volume flow currently measured for the target medium. Dependency  The unit is taken from the Volume flow unit parameter ( $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	Signed floating-point number
Carrier volume flow	With the following conditions:  Order code for "Application package", option ED "Concentration"  The Ethanol in water option or %mass / %volume option is selected in the Liquid type parameter.  The %vol option is selected in the Concentration unit parameter.  The software options currently enabled are displayed in the Software option overview parameter.	Displays the volume flow currently measured for the carrier medium.  Dependency The unit is taken from the Volume flow unit parameter (→ 🖺 81).	Signed floating-point number

### 11.4.2 "Totalizer" submenu

The **Totalizer** submenu contains all the parameters needed to display the current measured values for every totalizer.

### Navigation

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Totalizer



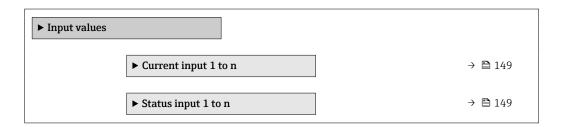
Parameter	Prerequisite	Description	User interface
Totalizer value 1 to n	A process variable is selected in the <b>Assign process variable</b> parameter (→ 🖺 125) of the <b>Totalizer 1 to n</b> submenu.	Displays the current totalizer counter value.	Signed floating-point number
Totalizer overflow 1 to n	A process variable is selected in the <b>Assign process variable</b> parameter (→ 🖺 125) of the <b>Totalizer 1 to n</b> submenu.	Displays the current totalizer overflow.	Integer with sign

### 11.4.3 "Input values" submenu

The **Input values** submenu guides you systematically to the individual input values.

### Navigation

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Input values

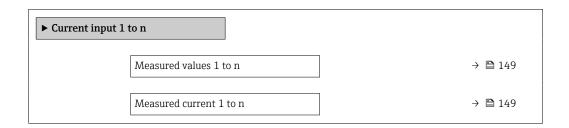


### Input values of current input

The **Current input 1 to n** submenu contains all the parameters needed to display the current measured values for every current input.

### **Navigation**

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Input values  $\rightarrow$  Current input 1 to n



### Parameter overview with brief description

Parameter	Description	User interface
Measured values 1 to n	Displays the current input value.	Signed floating-point number
Measured current 1 to n	Displays the current value of the current input.	0 to 22.5 mA

### Input values of status input

The **Status input 1 to n** submenu contains all the parameters needed to display the current measured values for every status input.

### **Navigation**

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Input values  $\rightarrow$  Status input 1 to n



### Parameter overview with brief description

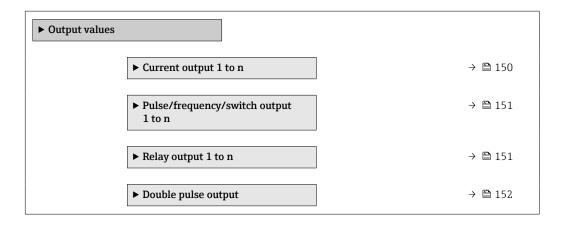
Parameter	Description	User interface
Value status input	Shows the current input signal level.	■ High ■ Low

### 11.4.4 Output values

The **Output values** submenu contains all the parameters needed to display the current measured values for every output.

### Navigation

"Diagnostics" menu → Measured values → Output values

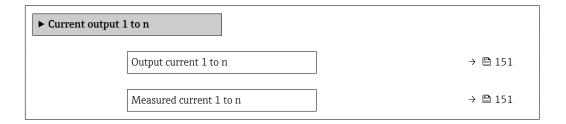


### Output values of current output

The **Value current output** submenu contains all the parameters needed to display the current measured values for every current output.

### Navigation

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Output values  $\rightarrow$  Value current output 1 to n



150

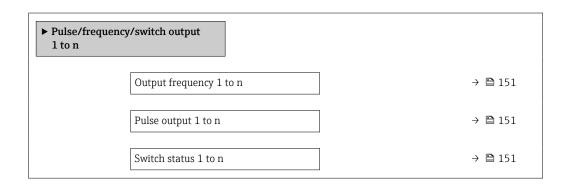
Parameter	Description	User interface
Output current 1	Displays the current value currently calculated for the current output.	3.59 to 22.5 mA
Measured current	Displays the current value currently measured for the current output.	0 to 30 mA

### Output values for pulse/frequency/switch output

The **Pulse/frequency/switch output 1 to n** submenu contains all the parameters needed to display the current measured values for every pulse/frequency/switch output.

### Navigation

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Output values  $\rightarrow$  Pulse/frequency/switch output 1 to n



### Parameter overview with brief description

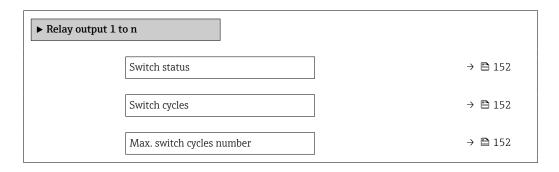
Parameter	Prerequisite	Description	User interface
Output frequency 1 to n	In the <b>Operating mode</b> parameter, the <b>Frequency</b> option is selected.	Displays the value currently measured for the frequency output.	0.0 to 12 500.0 Hz
Pulse output 1 to n	The <b>Pulse</b> option is selected in the <b>Operating mode</b> parameter parameter.	Displays the pulse frequency currently output.	Positive floating-point number
Switch status 1 to n	The <b>Switch</b> option is selected in the <b>Operating mode</b> parameter.	Displays the current switch output status.	■ Open ■ Closed

### Output values for relay output

The **Relay output 1 to n** submenu contains all the parameters needed to display the current measured values for every relay output.

### Navigation

"Diagnostics" menu  $\rightarrow$  Measured values  $\rightarrow$  Output values  $\rightarrow$  Relay output 1 to n



Parameter	Description	User interface
Switch status	Shows the current relay switch status.	<ul><li>Open</li><li>Closed</li></ul>
Switch cycles	Shows number of all performed switch cycles.	Positive integer
Max. switch cycles number	Shows the maximal number of guaranteed switch cycles.	Positive integer

### Output values for double pulse output

The **Double pulse output** submenu contains all the parameters needed to display the current measured values for every double pulse output.

### **Navigation**

"Diagnostics" menu → Measured values → Output values → Double pulse output



### Parameter overview with brief description

Parameter	Description	User interface
Pulse output	Shows the currently output pulse frequency.	Positive floating-point number

# 11.5 Adapting the measuring device to the process conditions

The following are available for this purpose:

- Basic settings using the **Setup** menu ( $\rightarrow$   $\stackrel{\triangle}{=}$  78)
- Advanced settings using the **Advanced setup** submenu (→ 🖺 116)

# 11.6 Performing a totalizer reset

The totalizers are reset in the **Operation** submenu:

- Control Totalizer
- Reset all totalizers

### **Navigation**

"Operation" menu → Totalizer handling



Totalizer value 1 to n	→ 🖺 153
Reset all totalizers	→ 🖺 153

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Control Totalizer 1 to n	A process variable is selected in the <b>Assign process variable</b> parameter (→ 🖺 125) of the <b>Totalizer 1 to n</b> submenu.	Control totalizer value.	<ul> <li>Totalize</li> <li>Reset + hold *</li> <li>Preset + hold *</li> <li>Reset + totalize</li> <li>Preset + totalize *</li> <li>Hold *</li> </ul>	Totalize
Preset value 1 to n	A process variable is selected in the <b>Assign process variable</b> parameter (→ 🖺 125) of the <b>Totalizer 1 to n</b> submenu.	Specify start value for totalizer.  Dependency  The unit of the selected process variable is defined in the Unit totalizer parameter (→   125) for the totalizer.	Signed floating-point number	Depends on country:  Okg Olb
Totalizer value	A process variable is selected in the <b>Assign process variable</b> parameter (→ 🖺 125) of the <b>Totalizer 1 to n</b> submenu.	Displays the current totalizer counter value.	Signed floating-point number	-
Reset all totalizers	_	Reset all totalizers to 0 and start.	<ul><li>Cancel</li><li>Reset + totalize</li></ul>	Cancel

<sup>\*</sup> Visibility depends on order options or device settings

# 11.6.1 Function scope of "Control Totalizer" parameter

Options	Description
Totalize	The totalizer is started or continues running.
Reset + hold	The totaling process is stopped and the totalizer is reset to 0.
Preset + hold <sup>1)</sup>	The totaling process is stopped and the totalizer is set to its defined start value from the <b>Preset value</b> parameter.
Reset + totalize	The totalizer is reset to 0 and the totaling process is restarted.
Preset + totalize 1)	The totalizer is set to the defined start value in the <b>Preset value</b> parameter and the totaling process is restarted.
Hold	Totalizing is stopped.

<sup>1)</sup> Visible depending on the order options or device settings

# 11.6.2 Function range of "Reset all totalizers" parameter

Options	Description
Cancel	No action is executed and the user exits the parameter.
Reset + totalize	Resets all totalizers to 0 and restarts the totaling process. This deletes all the previously aggregated flow values.

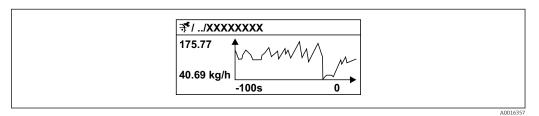
# 11.7 Displaying the measured value history

The **Extended HistoROM** application package must be enabled in the device (order option) for the **Data logging** submenu to appear. This contains all the parameters for the measured value history.

- Pata logging is also available via:
  - Plant Asset Management Tool FieldCare → 🖺 69.
  - Web browser

### **Function range**

- A total of 1000 measured values can be stored
- 4 logging channels
- Adjustable logging interval for data logging
- Measured value trend for each logging channel displayed in the form of a chart



■ 26 Chart of a measured value trend

- x-axis: depending on the number of channels selected displays 250 to 1000 measured values of a process variable.
- y-axis: displays the approximate measured value span and constantly adapts this to the ongoing measurement.
- If the length of the logging interval or the assignment of the process variables to the channels is changed, the content of the data logging is deleted.

### Navigation

"Diagnostics" menu → Data logging

► Data logg	ing	
	Assign channel 1	→ 🖺 156
	Assign channel 2	→ 🖺 158
	Assign channel 3	→ 🖺 158
	Assign channel 4	→ 🖺 158
	Logging interval	→ 🖺 158
	Clear logging data	→ 🖺 158
	Data logging	→ 🖺 158
	Logging delay	→ 🖺 159
	Data logging control	→ 🖺 159

Data logging status	→ 🖺 159
Entire logging duration	→ 🖺 159
▶ Display channel 1	
▶ Display channel 2	
▶ Display channel 3	
▶ Display channel 4	

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Assign channel 1	The Extended HistoROM application package is available.	Assign process variable to logging channel.	■ Off ■ Mass flow ■ Volume flow ■ Corrected volume flow* ■ Density ■ Reference density alternative* ■ GSV flow ■ GSV flow ■ Iternative* ■ NSV flow ■ Iternative* ■ NSV flow ■ Iternative* ■ S&W volume flow* ■ Water cut* ■ Oil density* ■ Water density* ■ Oil mass flow ■ Water wolume flow* ■ Water volume flow* ■ Water volume flow ■ Water volume flow ■ Temp. ■ Compensated dynamic viscosity* ■ Temp. ■ compensated kinematic viscosity* ■ Temp. ■ Compensated kinematic viscosity* ■ Temp. ■ Compensated dynamic viscosity ■ Temp. ■ Compensated kinematic viscosity ■ Temp. ■ Compensated Compensated ki	Off

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
			damping 0 • Oscillation	

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
			<ul> <li>Oscillation damping fluctuation 0*</li> <li>Oscillation frequency 0</li> <li>Oscillation frequency 1*</li> <li>Oscillation amplitude*</li> <li>Frequency fluctuation 0*</li> <li>Oscillation amplitude 1*</li> <li>Frequency fluctuation 1</li> <li>Oscillation damping 1*</li> <li>Oscillation damping 1</li> <li>Oscillation damping fluctuation 1*</li> <li>Signal asymmetry</li> <li>Electronic temperature</li> <li>Index suspended bubbles*</li> </ul>	
Assign channel 2	The Extended HistoROM application package is available.  The software options currently enabled are displayed in the Software option overview parameter.	Assign a process variable to logging channel.	For the picklist, see Assign channel 1 parameter (→ 🖺 156)	Off
Assign channel 3	The Extended HistoROM application package is available.  The software options currently enabled are displayed in the Software option overview parameter.	Assign a process variable to logging channel.	For the picklist, see  Assign channel 1 parameter (→ 🖺 156)	Off
Assign channel 4	The Extended HistoROM application package is available.  The software options currently enabled are displayed in the Software option overview parameter.	Assign a process variable to logging channel.	For the picklist, see  Assign channel 1 parameter (→ 🖺 156)	Off
Logging interval	The <b>Extended HistoROM</b> application package is available.	Define the logging interval for data logging. This value defines the time interval between the individual data points in the memory.	0.1 to 3 600.0 s	1.0 s
Clear logging data	The <b>Extended HistoROM</b> application package is available.	Clear the entire logging data.	Cancel Clear data	Cancel
Data logging	-	Select the type of data logging.	<ul><li>Overwriting</li><li>Not overwriting</li></ul>	Overwriting

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Logging delay	In the <b>Data logging</b> parameter, the <b>Not overwriting</b> option is selected.	Enter the time delay for measured value logging.	0 to 999 h	0 h
Data logging control	In the <b>Data logging</b> parameter, the <b>Not overwriting</b> option is selected.	Start and stop measured value logging.	<ul><li>None</li><li>Delete + start</li><li>Stop</li></ul>	None
Data logging status	In the <b>Data logging</b> parameter, the <b>Not overwriting</b> option is selected.	Displays the measured value logging status.	<ul><li>Done</li><li>Delay active</li><li>Active</li><li>Stopped</li></ul>	Done
Entire logging duration	In the <b>Data logging</b> parameter, the <b>Not overwriting</b> option is selected.	Displays the total logging duration.	Positive floating- point number	0 s

Visibility depends on order options or device settings

### 11.8 **Gas Fraction Handler**

The Gas Fraction Handler improves measurement stability and repeatability in the event of two-phase media and provides valuable diagnostic information for the process.

The function continuously checks for the presence of gas bubbles in liquids or droplets in gases, as this second phase influences the output values for flow and density.

In the case of two-phase media, the Gas Fraction Handler stabilizes the output values and enables better readability for operators and easier interpretation by the distributed control system. The level of smoothing is adjusted according to the severity of the disturbances introduced by the second phase. In the case of single-phase media, the Gas Fraction Handler does not have any influence on the output values.

Possible options in the Gas Fraction Handler parameter:

- Off: Disables the Gas Fraction Handler. When a second phase is present, large fluctuations in the values output for flow and density will occur.
- Moderate: Use for applications with low levels or intermittent levels of second phase.
- Powerful: Use for applications with very significant levels of second phase.

The Gas Fraction Handler is cumulative to any fixed damping constants applied to flow and density that are set elsewhere in the instrument parameterization.



For detailed information on the parameter descriptions of the Gas Fraction Handler, see the Special Documentation for the device  $\rightarrow \triangleq 247$ 

#### "Measurement mode" submenu 11.8.1

### **Navigation**

"Expert" menu → Sensor → Measurement mode

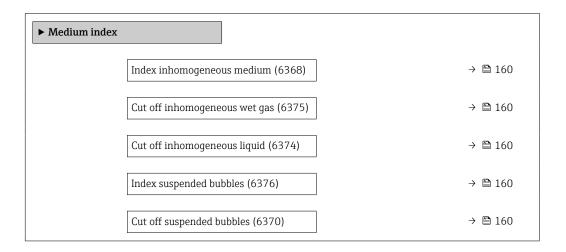


Parameter	Description	Selection	Factory setting
Gas Fraction Handler	Activates the Gas Fraction Handler function for two phase media.	<ul><li>Off</li><li>Moderate</li><li>Powerful</li></ul>	Off

# 11.8.2 "Medium index" submenu

### Navigation

"Expert" menu  $\rightarrow$  Application  $\rightarrow$  Medium index



### Parameter overview with brief description

Parameter	Prerequisite	Description	User interface / User entry	Factory setting
Index inhomogeneous medium	-	Shows the degree of inhomogeneity of the medium.	Signed floating-point number	-
Cut off inhomogeneous wet gas	-	Enter cut off value for wet gas applications. Below this value the Index inhomogeneous medium is set to 0.	Positive floating- point number	0.25
Cut off inhomogeneous liquid	-	Enter cut off value for liquid applications. Below this value the Index inhomogeneous medium is set to 0.	Positive floating- point number	0.05
Index suspended bubbles	The diagnostic index is only available for Promass Q.	Shows the relative amount of suspended bubbles in the medium.	Signed floating-point number	-
Cut off suspended bubbles	The parameter is only available for Promass Q.	Enter the cut off value for suspended bubbles. Below this value the 'Index for suspended bubbles' is set to 0.	Positive floating- point number	0.05

# 11.9 Heartbeat Verification + Monitoring

### 11.9.1 Product features

Heartbeat Technology offers diagnostic functionality through continuous self-monitoring, the transmission of additional measured variables to an external Condition Monitoring system and the in-situ verification of measuring devices in the application.

The test scope achieved using these diagnostic and verification tests is expressed as the **total test coverage** (TTC). The TTC is calculated using the following formula for random errors (calculation based on FMEDA as per IEC 61508):

$$TTC = (\lambda_{TOT} - \lambda_{du}) / \lambda_{TOT}$$

 $\lambda_{TOT}$ : Rate of all theoretically possible failures

 $\lambda_{du}$ : Rate of undetected dangerous failures

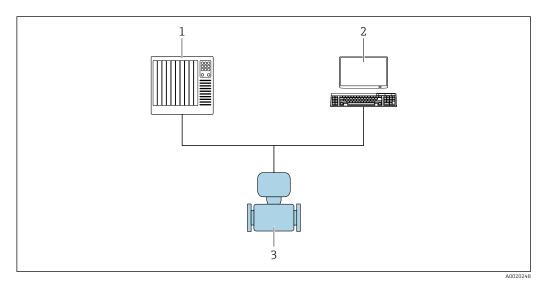
Only the dangerous undetected failures that are not captured by the device diagnostics can falsify the measured value that is output or interrupt the output of measured values.

Heartbeat Technology checks the device function within the specified measuring tolerance with a defined TTC. The defined TTC is indicated in the product-specific TÜV certificate (TÜV = Technical Inspection Association).

- The current value for the TTC depends on the configuration and integration of the measuring device. It is determined under the following basic conditions:
  - Simulation operation not active
  - Error behavior, current output set to Minimum alarm or Maximum alarm and evaluation unit recognizes both alarms
  - Settings for diagnostic behavior correspond to factory settings

### 11.9.2 System integration

The **Heartbeat Technology** features are available via the local display module and the digital interfaces. The features can be used via an asset management system and also via the automation infrastructure (e.g. PLC).



■ 27 General screen layout

- 1 PLC
- 2 Asset management system
- 3 Measuring device

# 1 2 4 3 Wellesten

### Performing the verification and creating a verification report

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- 1 Local display
- 2 Web browser
- 3 FieldCare
- 4 Data memory in the measuring device
- 5 Verification report

### Run **Heartbeat Verification** via one of the following interfaces:

- System integration interface of a higher-level system
- Local display
- WLAN interface
- CDI-RJ45 service interface (CDI: Common Data Interface)

The device must be accessed externally from a higher-level system via the system integration interface in order to start a verification and signal the verification result (Passed or Failed). It is not possible to start the verification via an external status signal and relay the results to a higher-level system via the status output.

The detailed results of the verification (8 data records) are saved in the device and provided in the form of a verification report.

Verification reports can be generated with the help of the device DTM, web server integrated in the measuring device or Endress+Hauser's FieldCare plant asset management software.

With the Flow Verification DTM, FieldCare also offers the possibility of data management and of archiving the verification results to create traceable documentation.

The Flow Verification DTM also enables trend analysis – i.e. the ability to monitor, compare and track the verification results of all the verifications performed on the device. This can be used for evaluation purposes, for example to extend recalibration intervals.

Data exchange can take place automatically or be triggered by a user.

### Integration in the PLC system

The verification function integrated in the measuring device can be activated by a control system and the results checked.

For further information on "System integration", see the Operating Instructions (documentation code)

Performing verification Start Check Status Performing verification Status is Repeat Not done as needed Status is **Done** Check Result Verification results Result is Passed Result is Failed Application specific Device behavior as expected standard operating procedure

The following procedure must be implemented for this purpose:

Verification result: The overall verification result is indicated in the **Overall result** parameter. Depending on the result, different application-specific measures must be performed by system routines; e.g. a "Maintenance Required" alert is triggered if the result is **Failed**.

### Data availability for the user

The data from the **Heartbeat Monitoring** function and the **Heartbeat Verification** function can be made available in different ways.

### Device

### **Heartbeat Monitoring**

The user can read the monitoring measured variables in the operating menu.

### Heartbeat Verification

- Start verification.
- Read out the last verification result.

Asset management system

### **Heartbeat Monitoring**

Configuration of the monitoring function: specify which monitoring parameters are output continuously via the system integration interface.

### **Heartbeat Verification**

- $\mbox{-}\hspace{-0.05in}$  Start verification in the operating menu.
- Read out, archive and document the verification results including detailed results with flow verification DTM and devices DTM.

### PLC system

### **Heartbeat Monitoring**

Configuration of the monitoring function: specify which monitoring parameters are output continuously via the system integration interface.

### Heartbeat Verification

- Start verification.
- The user can read the verification result (pass/fail) in the system.

### Data management

The results of a **Heartbeat Verification** are saved as a non-volatile parameter set in the measuring device memory:

- Availability of 8 storage locations for parameter data sets
- New verification results overwrite old data following the FIFO 1) principle

The results can be documented in the form of a verification report using the web server integrated in the measuring device the Endress+Hauser FieldCare asset management software and Netilion Health.

FieldCare also offers additional capabilities with the Flow Verification DTM:

- Archiving of verification results
- Export of data from these archives
- Trend analysis of verification results (line recorder function)

Data management via Web browser

Thanks to the integrated web server, the device can be operated and configured and a **Heartbeat Verification** performed. The results of the verification can be displayed and a verification report can be created.

Printing a verification report

A verification report is created in PDF format.

Prerequisite: A verification has already been performed.

User interface in the Web browser following login:



A0031439

- 1. Click the navigation buttons **Data management** → **Documents** → **Verification** report.
  - ► The input area for downloading verification reports is displayed.
- 2. Enter the necessary information in the **Plant operator** and **Location** fields.
  - The information entered here appears in the verification report.
- 3. Select the result data set.
  - → A result data set is indicated as a time stamp in the drop-down list. If no verification has been performed, the message "No result data set" is displayed here.
- 4. Click **Upload**.
  - ► The Web server generates a verification report in PDF format.

Data management via device DTM

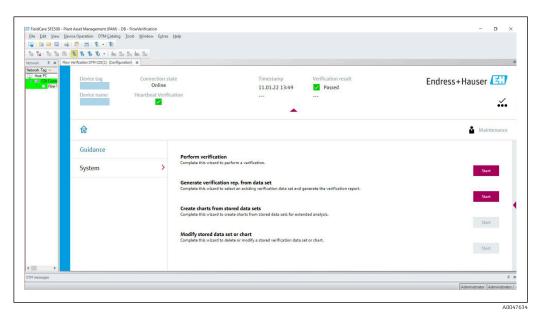
Thanks to the device DTM the device can be operated and a **Heartbeat Verification** performed. The results of the verification can be displayed and a verification report can be created.

1) First In – First Out

Data management via Flow Verification DTM

The Flow Verification DTM allows you to perform a **Heartbeat Verification**. The results of the verification can be displayed and a verification report can be created.

The Flow Verification DTM offers advanced capabilities for managing and visualizing the results.

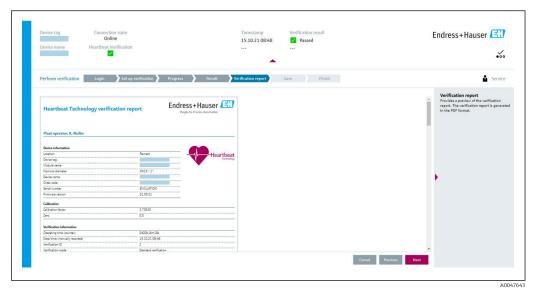


28 "Flow Verification DTM" home page in FieldCare SFE500

A wizard guides the user through four different processes step by step with help text.

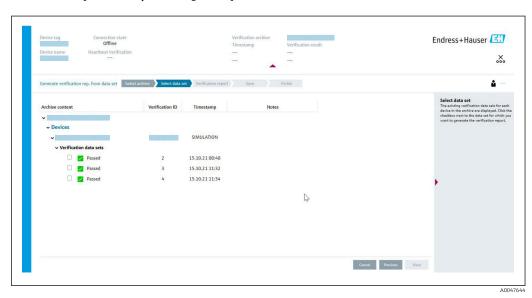
Entry point	Process description
Perform verification  Online connection to the device required.	Perform verification and generate a verification report.
Generate verification report using a verification data set  ■ from the device (online)  ■ from archive (offline)	Select the existing verification data set and create the verification report.
Create charts for selected diagnostic parameters from stored verification data sets	Create charts for selected diagnostic parameters from archived verification data sets for the purpose of advanced analysis and trending.
Maintain stored verification data sets or chart templates	Delete or modify archived verification data sets or chart templates.

### Perform verification



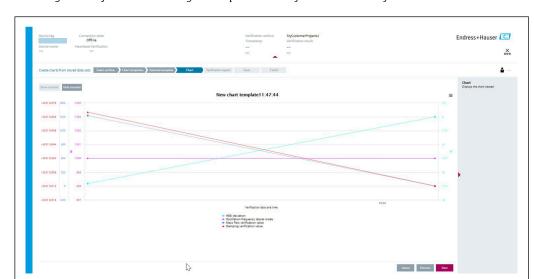
- $\blacksquare$  29 Example: Verification report displayed after verification has been performed
- Online connection to the device required.

Generate verification report using a verification data set



- $\blacksquare$  30 Example: Generating verification report using a verification data set
- Read the verification data set from
  Device: Online connection to device required.
  - Archive: Offline operation sufficient.

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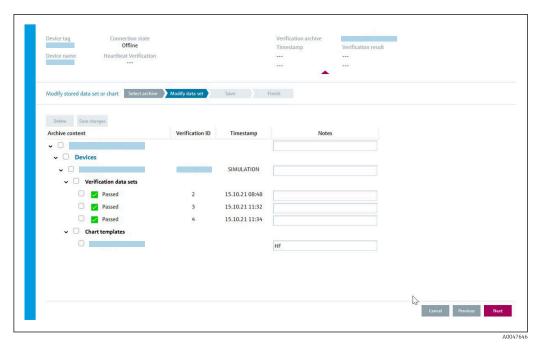


Creating charts for selected diagnostic parameters from stored verification data sets

Example: Create charts you have edited yourself for selected diagnostic parameters from stored verification data sets

You can create your own templates.

Maintaining stored verification data sets or chart templates



32 Example: Deleting or modifying stored verification data sets or chart templates

### 11.9.3 Heartbeat Verification

Heartbeat Verification checks the device function within the specified measuring tolerance on demand. The result of the verification is "Passed" or "Failed".

The verification data are saved in the device and optionally archived on a PC with the Asset Management Software DeviceCare or FieldCare on a PC. Based on this data, a verification report is generated automatically to ensure that traceable documentation of the verification results is available.

Heartbeat Technology offers two options for performing Heartbeat Verification:

- standard verification → 170
   Verification is performed by the device without manual checking of external measured variables.
- Extended verification → 173
   Verification includes the entry of external measured variables.

### Performance characteristics

**Heartbeat Verification** is performed on demand and supplements permanent self-monitoring with additional checks .

The standard verification also checks the following analog inputs and outputs:

- 4 to 20 mA current output, active and passive
- Pulse/frequency output, active and passive
- 4 to 20 mA current input, active and passive
- Double pulse output, active and passive
- Relay output

The extended verification supports a check of the following output modules by means of simulation and measurement using external measuring equipment:

- 4 to 20 mA current output, active and passive
- Pulse/frequency output, active and passive
- **Heartbeat Verification** does not check the digital inputs and outputs and does not issue a result for this.

The test is based on reference values that are incorporated in the measuring device, traceable from the factory and redundant in the device. **Heartbeat Verification** confirms on demand the device function with the total test coverage (TTC).

Assessed by an independent body: **Heartbeat Technology** meets the requirements for traceable verification according to DIN EN ISO 9001:2015, Clause 7.1.5.2 a Measurement traceability. According to the standard, the user is responsible for specifying the verification interval in accordance with requirements.

### Commissioning

The configuration (factory reference) required as part of **Heartbeat Verification** is recorded during calibration at the factory and permanently stored in the measuring device.

When verification is performed in the application, the current measuring device situation is compared with this factory reference.

The results are saved as an initial situation in the measuring device life cycle up until the 8th verification. From the 9th verification onwards, a printout of the verification reports or an upload of the data using the Flow Verification DTM is recommended to avoid losing the data from the previous verifications.

### Recording reference data

It is possible to manually record reference data relating to the operator and the location. These reference data appear on the verification report.

Operation continues while the reference data are being recorded.

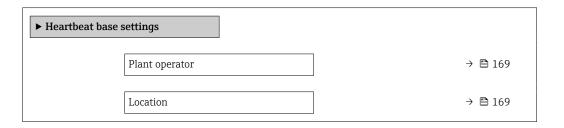
### **Navigation**

"Setup" menu  $\rightarrow$  Advanced setup  $\rightarrow$  Heartbeat setup  $\rightarrow$  Heartbeat base settings

168

### Navigation

"Expert" menu → Diagnostics → Heartbeat Technology → Heartbeat base settings



### Parameter overview with brief description

Parameter	Description	User entry
Plant operator	Enter the plant operator.	Max. 32 characters such as letters, numbers or special characters (e.g. @, %, /)
Location	Enter the location.	Max. 32 characters such as letters, numbers or special characters (e.g. @, %, /)

### Operation

Initial verification

▶ When commissioning the measuring device:

Perform an initial verification so you can save the results as an initial situation in the measuring device life cycle. As of the 9th verification, printing the verification reports or uploading the data using the Flow Verification DTM is recommended.

Initial verification can be performed in 2 ways:

- Standard verification → 🖺 170
- Extended verification → 🗎 173

Device behavior and interpretation

Result is "Passed"

All test results are within the specifications.

If the calibration factor and the zero point match the factory settings, there is a high degree of certainty that the measuring device complies with the specification for flow and density.

Verification generally delivers the result Passed in most applications.

Result is "Failed"

One or more test results are outside the specifications.

If the result of the verification is "Failed", take the following measures:

- 1. Establish defined and stable process conditions.
  - Ensure a constant process temperature.

    Avoid wet gases, two-phase mixtures, pulsating flow, pressure shock and very high flow rates.
- 2. Repeat verification.
  - Repeat verification "Passed"

    If the result of the second verification is "Passed", the result of the first verification can be ignored. In order to identify possible deviations, compare the current process conditions with the process conditions of a previous verification.

If the result of the verification is "Failed" again, take the following measures:

- 1. Take remedial action on the basis of the verification results and the diagnostic information of the measuring device.
  - The cause of the error can be narrowed down by identifying the test group with a "Failed" verification.
- 2. Provide Endress+Hauser Service with the verification result with the current process conditions.
- 3. Check the calibration or calibrate the measuring device.
  - The calibration has the advantage that the "as found" measuring device state is recorded and the actual measured error is determined.

### Standard verification

Standard verification is performed automatically by the device and without manual checking of external measured variables.

### Diagnostic behavior

The device signals that standard verification is being performed:  $\triangle$ C302 Device verification in progress diagnostic message

- Factory setting for diagnostic behavior: warning
- The device continues to measure.
- The signal outputs and totalizers are not affected.
- Test duration: approx. 60 seconds.
- The diagnostic behavior can be changed by the user if necessary: Expert → System → Diagnostic handling → Diagnostic behavior If Alarm is selected as the diagnostic behavior, the output of measured values is interrupted in the event of an error and the signal outputs and totalizers adopt the defined alarm condition.
  - A category is assigned to the relevant diagnostic message of the outputs in the Diagnostic configuration submenu.

Expert  $\rightarrow$  Communication  $\rightarrow$  Diagnostic configuration If the device does not have outputs, they are output as an error. To prevent an error from being output, assign the **No effect (N)** option to any outputs that are not present on the device.

For detailed information on diagnostics and troubleshooting and for diagnostics information and associated remedial measures, see the Operating Instructions .

Performing standard verification

### Before verification starts

The date and time are saved with the current operating time and the verification results and also appear in the verification report.

The **Year** parameter, **Month**, **Day**, **Hour**, **AM/PM** and **Minute** are used to manually record the data at the time of verification.

1. Enter date and time.

### Select the verification mode

2. In the **Verification mode** parameter, select the **Standard verification** option.

### Starting the verification test

- 3. In the **Start verification** parameter, select the **Start** option.
  - While the verification is being performed, the progress of the verification is indicated as a % (bar graph indicator) in the **Progress** parameter.

Displaying the verification status and result

The current status of standard verification is displayed in the **Status** parameter  $(\rightarrow \implies 173)$ :

Done

The verification test is finished.

Busy

The verification test is running.

■ Not done

A verification has not yet been performed on this measuring device.

Failed

A precondition for performing the verification has not been met, the verification cannot start (e.g. due to unstable process parameters)  $\rightarrow \triangleq 169$ .

The result of the verification is displayed in the **Overall result** parameter ( $\rightarrow \triangleq 173$ ):

Passed

All the verification tests were successful.

Not done

A verification has not yet been performed on this measuring device.

Failed

One or more verification tests were not successful  $\rightarrow \triangleq 169$ .

- i
- The overall result of the last verification can always be accessed in the menu.
- Navigation:

Diagnostics  $\rightarrow$  Heartbeat Technology  $\rightarrow$  Verification results

- Detailed information on the verification result (test groups and test status) are shown in the verification report in addition to the overall verification result
   → ≅ 184.
- If the device does not pass the verification, the results are saved nonetheless and indicated in the verification report.
- This helps users to perform a targeted search for the cause of the error  $\rightarrow$  🗎 169.

"Performing verification" submenu

### **Navigation**

"Diagnostics" menu → Heartbeat Technology → Performing verification

▶ Performing veri	fication	
	Year	→ 🗎 172
	Month	→ 🖺 172
	Day	→ 🖺 172
	Hour	→ 🖺 172
	AM/PM	→ 🖺 172
	Minute	→ 🖺 172
	Verification mode	→ 🗎 172
	External device information	→ 🖺 179
	Start verification	→ 🗎 172

Progress	→ 🖺 173
Measured values	→ 🖺 180
Output values	→ 🗎 180
Status	→ 🗎 173
Overall result	→ 🗎 173

Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Year	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 1): enter the year verification is performed.	9 to 99	10
Month	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 2): enter the month verification is performed.	<ul> <li>January</li> <li>February</li> <li>March</li> <li>April</li> <li>May</li> <li>June</li> <li>July</li> <li>August</li> <li>September</li> <li>October</li> <li>November</li> <li>December</li> </ul>	January
Day	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 3): enter the day verification is performed.	1 to 31 d	1 d
Hour	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 4): enter the hour verification is performed.	0 to 23 h	12 h
AM/PM	Can be edited if Heartbeat Verification is not active.  The dd.mm.yy hh:mm am/pm option or the mm/dd/yy hh:mm am/pm option is selected in the Date/ time format parameter (2812).	Entry for date and time (field 5): enter the morning or afternoon.	• AM • PM	AM
Minute	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 6): enter the minute verification is performed.	0 to 59 min	0 min
Verification mode	Can be edited if Heartbeat Verification is not active.	Select the verification mode. Standard verification Verification is performed automatically by the device and without manual checking of external measured variables.	<ul><li>Internal verification</li><li>External verification</li></ul>	Internal verification
Start verification	-	Start the verification. Start the verification with the Start option.	<ul><li>Cancel</li><li>Start</li></ul>	Cancel

Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Progress	-	Shows the progress of the process.	0 to 100 %	-
Status	-	Displays the current status of the verification.	<ul><li>Done</li><li>Busy</li><li>Failed</li><li>Not done</li></ul>	-
Overall result	-	Displays the overall result of the verification.  Detailed description of the classification of the results: → 183	<ul><li>Passed</li><li>Not done</li><li>Failed</li></ul>	Not done

### Extended verification

Permanently predefined output signals, which do not represent the current measured value, are simulated during extended verification of the outputs. To measure the simulated signals, it may be necessary to set the higher-level process control system to a safe state beforehand. In order to perform a verification, the pulse/frequency/switch output must be enabled and assigned to a measured variable.

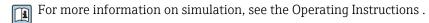
### Extended verification measured variables

Output current (current output)

- Simulation of the measured values for every output physically present on the device
- Simulation "Low value" and "High value"
- Measurement of the two values
- Entry of the two measured values in the verification screen

Output frequency (pulse/frequency output)

- Simulation of the measured values for every output physically present on the device
- Simulation value pulse output: Simulated frequency depending on the pulse width configured
- Simulation value frequency output: Maximum frequency



### Measuring equipment requirements

### Recommendations for the measuring equipment

DC current measuring uncertainty	±0.2 %
DC current resolution	10 μΑ
DC voltage measuring uncertainty	±0.1 %
DC voltage resolution	1 mV
Frequency measuring uncertainty	±0.1 %
Frequency resolution	1 Hz
Temperature coefficient	0.0075 %/°C

Connecting the measuring equipment in the measuring circuit

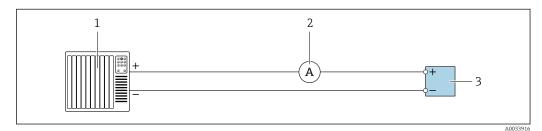
Determining the terminal assignment for the outputs

The terminal assignment depends on the specific device version.

To determine the device-specific terminal assignment:

- See the adhesive label in the terminal cover
- Check the operating menu via the local display, Web browser or operating tool
  - Setup  $\rightarrow$  I/O configuration  $\rightarrow$  I/O module 1 to n terminal numbers
  - Expert  $\rightarrow$  I/O configuration  $\rightarrow$  I/O module 1 to n terminal numbers
- For detailed information on terminal assignment, see the Operating Instructions for the device

### Active current output



■ 33 Extended verification of the active current output

- 1 Automation system with current input (e.g. PLC)
- 2 Ammeter
- 3 Transmitter

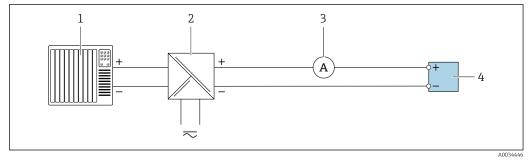
Extended verification of the active current output

► Connect the ammeter to the transmitter by looping it in series into the circuit.

If the automation system is switched off, the measuring circuit may be interrupted as a result. It is then not possible to perform a measurement. If this is the case, proceed as follows:

- 1. Disconnect the output cables of the current output (+/-) from the automation system.
- 2. Short the output cables of the current output (+ / -).
- 3. Connect the ammeter to the transmitter by looping it in series into the circuit.

### Passive current output



■ 34 Extended verification of the passive current output

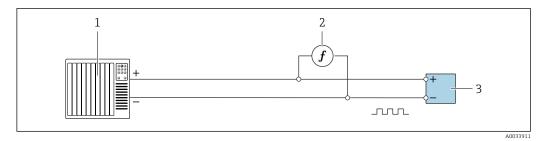
- 1 Automation system with current input (e.g. PLC)
- 2 Power supply unit
- 3 Ammeter
- 4 Transmitter

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Extended verification of the passive current output

- 1. Connect the ammeter to the transmitter by looping it in series into the circuit.
- 2. Connect the power supply unit.

Active pulse/frequency/switch output



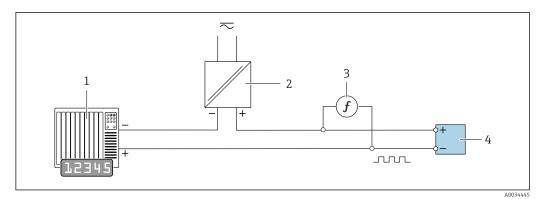
 $label{eq:balance} 
label{eq:balance} 
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label{eq:balance} Extended verification of the active pulse/frequency output$ 

- 1 Automation system with pulse/frequency input (e.g. PLC)
- 2 Frequency meter
- 3 Transmitter

Extended verification of the active pulse/frequency output

 Connect the frequency meter in parallel to the pulse/frequency output of the transmitter

Passive pulse/frequency/switch output



■ 36 Extended verification of the passive pulse/frequency output

- Automation system with pulse/frequency input (e.g. PLC)
- 2 Power supply unit
- 3 Frequency meter
- 4 Transmitter

Extended verification of the passive pulse/frequency output

- 1. Connect the power supply unit
- 2. Connect the frequency meter in parallel to the pulse/frequency output of the transmitter

### Diagnostic behavior

A diagnostic event signals that the extended verification is being performed:

The screen alternates between the status signal "C" (Function Check) and the operational display:

Verification is currently active in the device.

 Different diagnostic behaviors, along with the relevant diagnostic codes, can be displayed depending on the device version.

The output selected under the **Start verification** parameter is displayed in all cases, however:

Output 1...n low value option, Output 1...n high value option

Diagnostic code	Diagnostic behavior	Options in Start verification
C491	Current output 1 to n simulation active	Output 1n low value Output 1n high value
C492	Simulation frequency output 1 to n active	Frequency output 1n
C493	Simulation pulse output 1 to n active	Pulse output 1n
C302	<b>△C302 Device verification in progress</b>	

An extended verification (simulation mode) may be started only if the process plant is not in the automatic mode.

If the **Start** option is selected in the **Start verification** parameter, the following diagnostic event is output on the display (second part of the external verification):  $\triangle$ **C302 Device verification in progress** diagnostic message

- Factory setting for diagnostic behavior: warning
- The device continues to measure.
- The totalizers are not affected.
- Test duration (all outputs switched on): approx. 60 seconds.
- i
- The diagnostic behavior can be changed by the user if necessary: Expert → System → Diagnostic handling → Diagnostic behavior If **Alarm** is selected as the diagnostic behavior, the output of measured values is interrupted in the event of an error and the signal outputs and totalizers adopt the defined alarm condition.
- A category is assigned to the relevant diagnostic message of the outputs in the **Diagnostic configuration** submenu.

Expert  $\rightarrow$  Communication  $\rightarrow$  Diagnostic configuration If the device does not have outputs, they are output as an error. To prevent an error from being output, assign the **No effect (N)** option to any outputs that are not present on the device.

For detailed information on diagnostics and troubleshooting and for diagnostics information and associated remedial measures, see the Operating Instructions .

### Performing extended verification

A full standard verification is performed in the course of the verification. The validity of the entered and measured values of the outputs is checked. Additional standard verification of the outputs does not take place.

### NOTICE

If the electrical connections have not been established and the ammeter is not looped in during verification, extended verification is not possible.

- ► Establish the electrical connection before starting the extended verification.
- ▶ Loop in ammeter before extended verification starts.

### Before verification starts

The date and time are saved with the current operating time and the verification results and also appear in the verification report.

The **Year** parameter, **Month, Day, Hour, AM/PM and Minute** are used to manually record the data at the time of verification.

1. Enter date and time.

### Select the verification mode

2. In the **Verification mode** parameter, select the **Extended verification** option.

### Further parameter settings

- 3. In the **External device information** parameter, enter a unique ID (e.g. serial number) of the measuring equipment used (max. 32 characters).
- 4. In the **Start verification** parameter, select one of the options available (e.g. the **Output 1 low value** option).
- 5. In the **Measured values** parameter, enter the value shown on the external measuring equipment.
- 6. Repeat steps 4 and 5 until all the output options are checked.
- 7. Adhere to the sequence indicated and enter the measured values.

The duration of the process and number of outputs depend on the device configuration, on whether the output is switched on and on whether the output is active or passive.

The value displayed in the **Output values** parameter ( $\rightarrow \implies 180$ ) shows the value simulated by the device at the selected output  $\rightarrow \implies 174$ 

### Starting the verification test

- 8. In the **Start verification** parameter, select the **Start** option.
  - While the verification is being performed, the progress of the verification is indicated as a % (bar graph indicator) in the **Progress** parameter.

Displaying the verification status and result

The current status of standard verification is displayed in the **Status** parameter  $(\rightarrow \implies 173)$ :

Done

The verification test is finished.

Busy

The verification test is running.

■ Not done

A verification has not yet been performed on this measuring device.

Failed

A precondition for performing the verification has not been met, the verification cannot start (e.g. due to unstable process parameters)  $\rightarrow \triangleq 169$ .

The result of the verification is displayed in the **Overall result** parameter ( $\Rightarrow \implies 173$ ):

Passed

All the verification tests were successful.

Not done

A verification has not yet been performed on this measuring device.

Failed

One or more verification tests were not successful  $\rightarrow \triangleq 169$ .

- i
- The overall result of the last verification can always be accessed in the menu.
- Navigation:

Diagnostics → Heartbeat Technology → Verification results

- Detailed information on the verification result (test groups and test status) are shown in the verification report in addition to the overall verification result
   → ■ 184.
- If the device does not pass the verification, the results are saved nonetheless and indicated in the verification report.
- This helps users to perform a targeted search for the cause of the error  $\rightarrow$   $\stackrel{\triangle}{=}$  169.

"Performing verification" submenu

### Navigation

"Diagnostics" menu → Heartbeat Technology → Performing verification

▶ Performing veri	fication	
	Year	→ 🖺 179
	Month	→ 🖺 179
	Day	→ 🖺 179
	Hour	→ 🖺 179
	AM/PM	→ 🖺 179
	Minute	→ 🖺 179
	Verification mode	→ 🖺 179
	External device information	→ 🖺 179
	Start verification	→ 🖺 180
	Progress	→ 🖺 180
	Measured values	→ 🖺 180
	Output values	→ 🖺 180
	Status	→ 🖺 181
	Overall result	→ 🖺 181

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Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Year	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 1): enter the year verification is performed.	9 to 99	10
Month	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 2): enter the month verification is performed.	<ul> <li>January</li> <li>February</li> <li>March</li> <li>April</li> <li>May</li> <li>June</li> <li>July</li> <li>August</li> <li>September</li> <li>October</li> <li>November</li> <li>December</li> </ul>	January
Day	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 3): enter the day verification is performed.	1 to 31 d	1 d
Hour	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 4): enter the hour verification is performed.	0 to 23 h	12 h
AM/PM	Can be edited if Heartbeat Verification is not active.  The dd.mm.yy hh:mm am/pm option or the mm/dd/yy hh:mm am/pm option is selected in the Date/time format parameter (2812).	Entry for date and time (field 5): enter the morning or afternoon.	■ AM ■ PM	AM
Minute	Can be edited if Heartbeat Verification is not active.	Entry for date and time (field 6): enter the minute verification is performed.	0 to 59 min	0 min
Verification mode	Can be edited if Heartbeat Verification is not active.	Select the verification mode. Extended verification Standard verification is extended by the additional entry of external measured variables: Measured values parameter.	<ul><li>Internal verification</li><li>External verification</li></ul>	Internal verification
External device information	With the following conditions:  The Extended verification option is selected in the Verification mode parameter.  Can be edited if Heartbeat Verification is not active.	Record measuring equipment for extended verification.	Free text entry	-

Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Start verification		Start the verification.  To carry out a complete verification, select the selection parameters individually. Once the external measured values have been recorded, verification is started using the Start option.	Cancel Output 1 low value * Output 1 high value * Output 2 low value * Output 2 high value * Output 3 low value * Output 4 low value * Output 4 figh value * Output 5 high value * Output 6 low value * Output 7 high value * Output 8 high value * Output 9 high value * Output 1 fight value * Frequency output 1 fight value * Frequency output 2 fight value 1 fight value 1 fight value 2 fight value 3 fight value 2 fight value 3 fight value 2 fight value 3 fight value 4 fight value	Cancel
Measured values	One of the following options is selected in the Start verification parameter (→ ≧ 172):  Output 1 low value  Output 1 high value  Output 2 low value  Output 3 low value  Output 3 low value  Output 4 low value  Putput 4 low value  Trequency output 1  Pulse output 1  Pulse output 2  Pulse output 2  Frequency output 3  Frequency output 3	Use this function to enter the measured values (actual values) for the external measured variables:.  Current output: Output current in [mA]  Pulse/frequency output: Output frequency in [Hz]	Signed floating-point number	0
Progress	-	Shows the progress of the process.	0 to 100 %	
Output values	-	Displays the simulated output values (target values) for the external measured variables:  Current output: Output current in [mA].  Pulse/frequency output: Output frequency in [Hz].	Signed floating-point number	-

Parameter	Prerequisite	Description	User entry / Selection / User interface	Factory setting
Status	-	Displays the current status of the verification.	<ul><li>Done</li><li>Busy</li><li>Failed</li><li>Not done</li></ul>	-
Overall result	-	Displays the overall result of the verification.  Detailed description of the classification of the results: →  183	<ul><li>Passed</li><li>Not done</li><li>Failed</li></ul>	Not done

Visibility depends on order options or device settings

### Verification results

Access to the verification results:

In the operating menu via the onsite display, operating tool or Web browser

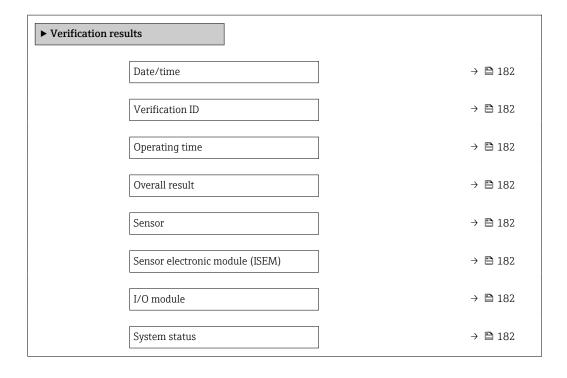
- Diagnostics → Heartbeat Technology → Verification results
- Expert → Diagnostics → Heartbeat Technology → Verification results

### Navigation

"Diagnostics" submenu  $\rightarrow$  Heartbeat  $\rightarrow$  Verification results

### Navigation

"Expert" menu  $\rightarrow$  Diagnostics  $\rightarrow$  Heartbeat  $\rightarrow$  Verification results



# Parameter overview with brief description

Parameter	Prerequisite	Description	User interface	Factory setting
Date/time	The verification has been performed.	Date and time.	dd.mmmm.yyyy; hh:mm	1 January 2010; 12:00
Verification ID	The verification has been performed.	Displays consecutive numbering of the verification results in the measuring device.	0 to 65 535	0
Operating time	The verification has been performed.	Indicates how long the device has been in operation up to the verification.	Days (d), hours (h), minutes (m), seconds (s)	-
Overall result	-	Displays the overall result of the verification.  ■ Detailed description of the classification of the results: → 🖺 183	<ul><li>Passed</li><li>Not done</li><li>Failed</li></ul>	Not done
Sensor	The <b>Failed</b> option was shown in the <b>Overall result</b> parameter.	Displays the result for the sensor.  Detailed description of the classification of the results: →  183	<ul><li>Passed</li><li>Not done</li><li>Failed</li></ul>	Not done
Sensor electronic module (ISEM)	The <b>Failed</b> option was shown in the <b>Overall result</b> parameter.	Displays the result for the sensor electronics module (ISEM).  Detailed description of the classification of the results: →  183	<ul><li>Passed</li><li>Not done</li><li>Failed</li></ul>	Not done
I/O module	The <b>Failed</b> option was shown in the <b>Overall result</b> parameter.	Displays the result for I/O module monitoring of the I/O module.  For current output: Accuracy of the current For pulse output: Accuracy of pulses  For frequency output: Accuracy of frequency Current input: Accuracy of the current  Double pulse output: Accuracy of the current Accuracy of the pulses Relay output: Number of switching cycles  Heartbeat Verification does not check the digital inputs and outputs and does not issue a result for this.  Detailed description of the classification of the results: →  183	<ul> <li>Passed</li> <li>Not done</li> <li>Not plugged</li> <li>Failed</li> </ul>	Not done
System status	The <b>Failed</b> option was shown in the <b>Overall result</b> parameter.	Displays the system condition. Tests the measuring device for active errors.  Detailed description of the classification of the results: →  183	<ul><li>Passed</li><li>Not done</li><li>Failed</li></ul>	Not done

## Classification of results

### Individual results

Result	Description	
Failed	At least one individual test in the test group was outside the specifications.	
Passed	All individual tests in the test group complied with the specifications. The result is also "Passed" if the result of an individual test is "Check not done" and the result of all other tests is "Passed".	
Not done	No test has been performed for this test group. For example, because this parameter is not available in the current device configuration.	
Not supported	The result is used for internal purposes.	
Not plugged	The result is displayed if no I/O module is plugged into the slot.	
Off	The result is displayed if a universal module is plugged into the slot and has not been configured.  This is equivalent to the slot in question being "deactivated".	

### Overall results

Result	Description	
Failed	At least one test group was outside the specifications.	
Passed	All verified test groups complied with the specifications (result "Passed"). The overall result is also "Passed" if the result for an individual test group is "Check not done" and the result for all other test groups is "Passed".	
Not done	No verification was performed for any of the test groups (result for all test groups is "Check not done").	

Heartbeat Verification confirms the device function within the specified measuring tolerance on demand. Based on redundant reference values in the device that are traceable from the factory, Heartbeat Technology meets the requirements of traceable verification in accordance with DIN EN ISO 9001:2015, Clause 7.1.5.2 a Measurement traceability. According to the standard, the user is responsible for specifying the verification interval in accordance with requirements.

### Test groups

Test group	Description
Sensor	Electrical components of the sensor (signals, circuits and cables)
HBSI	Electrical, electromechanical and mechanical components of the sensor, including the measuring tube
Sensor electronics module (ISEM)	Electronics module for activating and converting the sensor signals
I/O module	Results of the input and output modules installed on the measuring device
System condition	Test for active measuring device errors of "alarm"-type diagnostic behavior

- Test groups and individual tests → 🗎 184.
- The partial results for a test group (e.g. sensor) contain the result of several individual tests. All the individual tests must be passed for the partial result to pass.

The same applies to the overall verification result: All the partial results must pass for the overall verification result to pass. Information on the individual tests is provided in the verification report and in the partial results by test groups, which can be retrieved with the flow verification DTM.

### Limit values

### I/O module

Output; input	Standard verification	Extended verification
Current output 4 to 20 mA, active and passive	$\pm$ (100 $\mu$ A (offset) + 1 % of reading)	<ul><li>Lower value 4 mA: ±1 %</li><li>Upper value 20 mA: ±0.5 %</li></ul>
Pulse/frequency/switch output, active and passive	±0.05 %, with a 120 s cycle	<ul><li>Pulse: ±0.3 %</li><li>Frequency: ±0.3 %</li></ul>
Current input 4 to 20 mA, active and passive	■ -20 %: 24 V - 20 % = 19.2 V ■ Read back the supply voltage: >24 V - 20 % - 5 % = 18 V (min. 18 V applied)	-
Double pulse output, active and passive	±0.05 %, with a 120 s cycle	Only standard verification possible.
Relay output	The number of switching cycles depends on the hardware.	Only standard verification possible.

### Detailed verification results

Partial results by test groups and detailled verification results can be viewed in the verification report and retrieved using the flow verification DTM.

This also applies to the process conditions determined at the time of verification.

### Process conditions

To increase the comparability of the results, the process conditions that apply at the time of verification are recorded and documented as process conditions on the last page of the verification report.

Process conditions	Description
Mass flow verification value	Current measured value for mass flow
Density verification value	Current measured value for density
Damping verification value	Current measured value for measuring pipe damping
Process temperature verification value	Current measured value for medium temperature
Electronics temperature	Current measured value for the electronic temperature in the transmitter

### Individual test group results

The individual test group results listed below provide information on the results of the individual tests within a test group.

### Sensor

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
Inlet sensor coil	Condition of the inlet sensor coil: Intact/not intact (short-circuit/open circuit)	No value range Passed Failed	<ul> <li>Check connecting cable between sensor and transmitter</li> <li>Replace sensor</li> </ul>
Outlet sensor coil	Condition of the outlet sensor coil: Intact/not intact (short-circuit/open circuit)	No value range Passed Failed	<ul> <li>Check connecting cable between sensor and transmitter</li> <li>Replace sensor</li> </ul>
Measuring tube temperature sensor	Condition of the measuring tube temperature sensor: Intact/not intact (short-circuit/open circuit)	No value range Passed Failed	<ul> <li>Check connecting cable between sensor and transmitter</li> <li>Replace sensor</li> </ul>

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
Carrier tube temperature sensor	Condition of the carrier tube temperature sensor: Intact/not intact (short-circuit/open circuit)	No value range Passed Failed	<ul> <li>Check connecting cable between sensor and transmitter</li> <li>Replace sensor</li> </ul>
Sensor coil symmetry	Monitoring of the signal amplitude between the inlet and outlet sensor	No value range Passed Failed	Indication of mechanical damage or electronic interference  ➤ Check connecting cable between sensor and transmitter  ➤ Replace sensor
Lateral mode frequency	Monitoring of the oscillation frequency of the measuring tube/tubes	No value range Passed Failed	<ul> <li>Check whether the sensor is outside the operational range</li> <li>Check for damage on the measuring tube, e.g. as a result of corrosion</li> <li>Check connecting cable between sensor and transmitter</li> <li>Replace sensor</li> </ul>

# HBSI

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
HBSI	Monitoring of the relative change of the entire sensor, with all its electrical, mechanical and electromechanical components incorporated in the sensor housing (including the measuring tube, electrodynamic sensors, excitation system, cables etc.), in % of the reference value.	No value range Passed Failed	► Deviations of the HBSI value indicate corrosion, abrasion or other damage, such as shock/impact. If the result is "Failed", the sensor is seriously impaired and must be checked.

# Sensor electronics module (ISEM)

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
Supply voltage	Monitoring of the main supply voltage of the sensor electronics module Execution: Monitoring of the supply voltage for the sensor electronics module guarantees that the system is functioning correctly.	No value range Passed Failed	Sensor electronics module (ISEM) defective  ▶ Replace sensor electronics module (ISEM)
Zero point monitoring	Test of the entire signal path, amplitude and zero point.	No value range Passed Failed	Sensor electronics module (ISEM) defective  ▶ Replace sensor electronics module (ISEM)
Reference clock	Monitoring of the reference clock for flow and density measurement	No value range Passed Failed	Sensor electronics module (ISEM) defective  • Replace sensor electronics module (ISEM)
Reference temperature	Temperature measurement monitoring	No value range Passed Failed	Sensor electronics module (ISEM) defective  ▶ Replace sensor electronics module (ISEM)

# System condition

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
System condition	System condition monitoring	No value range Passed Failed Not done	Causes System error during verification  Corrective action  ► Check diagnostic event in the Event logbook submenu.

# I/O modules

Parameter/individual test	Description	Result/limit value	Interpretation/cause/remedial measures
Output 1 to n	Check of all the input and output modules installed at the measuring device	No value range ■ Passed ■ Failed ■ Not done Limit values → 🗎 184	Causes  ■ Output values out of specification ■ I/O modules defective  Measures  ► Check cabling. ► Check connections. ► Check load (current output). ► Replace the I/O module.

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### Verification report

The verification results can be documented via the web server, DeviceCare or FieldCare operating tools in the form of a verification report  $\Rightarrow \boxminus 164$ . The verification report is created on the basis of the data records saved in the measuring device after verification. As the verification results are automatically and uniquely identified with a verification ID and the operating time, they are suitable for the traceable documentation of the verification of measuring devices.

### First page: identification

Measuring point identification, identification of the verification results and confirmation of completion:

- Plant operator: customer reference
- Device information
  - Information on the place of operation (tag) and the current configuration of the measuring point
  - Management of the information in the device
  - Display on the verification report
- Calibration
  - Information on the calibration factor and zero point setting for the sensor
  - These values must correspond to those from the last calibration or repeat calibration in order to comply with factory specifications
- Verification information
  - The operating time and verification ID are used to uniquely assign the verification results for the traceable documentation of the verification
  - Storage and display of the manual date and time entry as well as the current operating time in the device
  - Verification mode: standard verification or extended verification
- Overall verification result:
  - Overall result of the verification "Passed": All the results have been "Passed"
  - Overall result of the verification "Failed": One or more individual results have been "Failed"

#### Second page: test results

Details on the individual results for all test groups:

- System operator
- Test groups → 🖺 184
  - Sensor
  - HBSI
  - System condition
  - I/O modules

# Third page (and subsequent pages, if applicable): measured values and visualization

Numerical values and graphic presentation of all the values recorded:

- System operator
- Test object
- Unit
- Current: measured value
- Min.: lower limit
- Max.: upper limit
- Visualization: graphic presentation of the measured value, within the lower and upper limits.

# Last page: process conditions

Information on the process conditions that applied during the verification:

- Flow
- Process temperature
- Electronics temperature
- Density
- Damping

As a prerequisite for the validity of the verification report, the **Heartbeat Verification** feature must be activated on the measuring device concerned and must have been

performed by an operator tasked to carry out this job by the customer. Alternatively, an Endress+Hauser service technician or a service provider authorized by Endress+Hauser can be tasked with performing the verification.

Individual test groups and description of individual tests:  $\rightarrow \, \stackrel{ riangle}{ riangle} \, 184$ 

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Interpreting and using the verification results

**Heartbeat Verification** uses the self-monitoring function of the Proline devices to check the measuring device functionality. During the verification process, the system checks whether the measuring device components comply with the factory specifications. Both the sensor and the electronics modules are included in the tests.

Compared to flow calibration, which assesses the flow measuring performance directly (primary measured variable), **Heartbeat Verification** checks the function of the measuring chain from the sensor to the outputs.

During this process, device-internal parameters that are correlated with flow measurement are checked (secondary measured variables, comparative values). The check is based on reference values that were recorded during the factory calibration.

If a verification is passed, this confirms that the comparative values checked are within the factory specification and that the measuring device is working correctly. At the same time, zero point and calibration factor of the sensor can be traced via the verification report. To ensure that the measuring device complies with the factory specification, these values must correspond to those of the last calibration or repeat calibration.



- Confirmation of compliance with the flow specification with 100 % test coverage can only be obtained by verifying the primary measured variable (flow) by means of recalibration or proving.
- **Heartbeat Verification** confirms on demand that the device is functioning within the specified measuring tolerance and the specified total test coverage TTC.

Recommended course of action if the result of a verification is "Failed"

If the result of a verification is **Failed**, it is advisable to begin by repeating the verification.

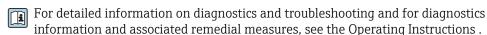
Ideally, ensure defined and stable process conditions in order to rule out process-specific influences as much as possible. When repeating the verification, it is advisable to compare the current process conditions to those of the previous verification in order to identify any deviations.



The process conditions for the previous verification are documented on the last page of the verification report or can be called up using the flow verification DTM  $\rightarrow \blacksquare$  184.

Additional remedial measures if the result of a verification is "Failed"

- Calibrate the measuring device
   The calibration has the advantage that the "as found" measuring device state is recorded and the actual measured error is determined.
- Direct remedial measures
   Take remedial action on the basis of the verification results and the diagnostic information of the measuring device. Narrow down the possible cause of the error by identifying the test group that **failed** the verification.



## 11.9.4 Heartbeat Monitoring

With Heartbeat Monitoring, additional measured values are output continuously and monitored in an external Condition Monitoring system so that changes to the measuring device and in the process can be detected at an early stage. The measured variables can be interpreted in a Condition Monitoring system. The information obtained in this way helps users to control measures concerning maintenance or process optimization. Possible applications of Condition Monitoring include the detection of the formation of build-up or wear as a result of corrosion.

### Commissioning

Assign the diagnostic parameters to the outputs for commissioning. After commissioning, the parameters are available at the outputs and in the case of digital communication they are generally available continuously.

## **Enabling or disabling Heartbeat Monitoring**

*Description of the monitoring parameters* 

The following diagnostic parameters can be assigned to the various outputs of the measuring device .

Some measured variables are only available if the **Heartbeat Verification + Monitoring** application package is enabled in the measuring device.

Measured variable	Description	Value range
Electronic temperature	Temperature of the electronics in the set system unit	-50 to +90 °C <sup>1)</sup>
Exciter current 0	Exciter current of the measuring tube/ tubes in mA	±100 mA
Frequency fluctuation 0	Fluctuation of the oscillation frequency of the measuring tube/s	1)
Oscillation damping fluctuation 0	Fluctuation of the mechanical damping of the measuring tube/s	1)
Oscillation amplitude 0	Relative mechanical oscillation amplitude of the measuring tube/tubes in % of the target value	0 to 100 %  Can be > 100% temporarily.
Oscillation frequency 0	Oscillation frequency of the measuring tube/tubes in Hz	1)
Oscillation damping 0	Mechanical damping of the measuring tubes/tube in A/m	0 to 100 000 <sup>1)</sup>
Signal asymmetry	Relative deviation of the signal amplitude between the inlet and outlet sensor in %	0 to 25 %
	Temperature of the sensor carrier tube in the set system unit	Depends on the medium temperature200 to +350 °C

1) Depends on the sensor type, version and nominal diameter

For information on using the parameters and interpreting the measurement results  $\Rightarrow \triangleq 192$ .

### HBSI monitoring

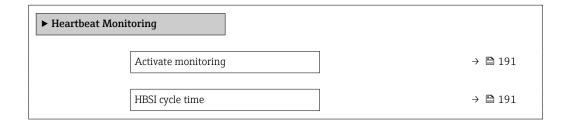
Enables monitoring of the **HBSI** parameter (Heartbeat Sensor Integrity). This parameter monitors the sensor (measuring tube, electrodynamic sensors, exciter system, cables etc.) for changes that can cause deviations in flow and density measurement.

HBSI Monitoring is periodically available for all other sensors. The function must be enabled during commissioning in order to use the additional measured variable.

Enabling and disabling HBSI Monitoring

### **Navigation**

"Setup" menu → Advanced setup → Heartbeat setup → Heartbeat Monitoring



# Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Activate monitoring	-	Activate monitoring to enable cyclic transmission of the HBSI measured value.	Time-controlled HBSI	On
HBSI cycle time	In the Activate monitoring parameter, the Time-controlled HBSI option is selected.	This parameter can be used to set the cycle time for determining the HBSI measured value.	0.5 to 4320 h	12 h

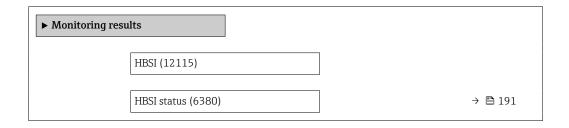
*Displaying the monitoring results* 

The current value of the **HBSI** parameter is continuously displayed in the Expert menu.

In the case of measuring devices with a local display, the value can also be configured as a display value.

### **Navigation**

"Diagnostics" submenu  $\rightarrow$  Heartbeat  $\rightarrow$  Monitoring results



## Parameter overview with brief description

Parameter	Description	User interface	Factory setting
HBSI	Displays the relative change of the entire sensor, with all its electrical, mechanical and electromechanical components incorporated in the sensor housing (including the measuring tube, electrodynamic pick-ups, excitation system, cables etc.), in % of the reference value.	-100.0 to 100.0 %	_
HBSI status	Shows the status of the HBSI value. Uncertain or Bad: Due to difficult process conditions over a long time no HBSI value could be determined.	<ul><li>Good</li><li>Uncertain</li><li>Bad</li></ul>	Uncertain

Configuration of the outputs and local display

Example: Configuring the current output

### Select the monitoring measured variable for current output

1. Prerequisite:

Setup  $\rightarrow$  I/O configuration

- Configurable I/O module displays the I/O module type parameter with Current output option
- 2. Setup  $\rightarrow$  Current output
- 3. Select the monitoring measured variable for the current output in the **Assign current output** parameter

### **Navigation**

"Setup" menu → Current output → Assign current output

Example: Configuring the local display

### Select the measured value that is shown on the local display

- 1. Setup → Display → Value 1 display
- 2. Select the measured value.

# Operation

The benefits of **Heartbeat Monitoring** are in direct correlation with the recorded data selection and their interpretation. Good data interpretation is critical for deciding whether a problem has occurred and when and how maintenance should be scheduled or performed (good knowledge of the application is required). The elimination of process effects that cause misleading warnings or interpretation must also be ensured. For this reason it is important to compare the recorded data against a process reference.

With Heartbeat Monitoring it is possible to output additional monitoring-specific measured values for monitoring in an external Condition Monitoring system during continuous operation.

Condition Monitoring focuses on measured variables that indicate a change in the performance of the device brought about by process-specific influences. There are two difference categories of process-specific influences:

- Temporary process-specific influences that impact the measuring function directly and therefore result in a higher level of measuring uncertainty than would normally be expected (e.g. measurement of multiphase fluids). These process-specific influences generally do not affect the integrity of the device but do impact measuring performance temporarily.
- Process-specific influences that only impact the integrity of the sensor over the medium term but that also bring about a gradual change in the measuring performance (e.g. abrasion, corrosion or buildup in the sensor). These influences also affect the integrity of the device on the long term.

Devices with **Heartbeat Monitoring** offer a range of parameters that are particularly suitable for monitoring specific, application-related influences:

- Buildup in the sensor
- Corrosive or abrasive fluids
- Multi-phase fluids (gas content in liquid fluids)
- Wet gases
- Applications in which the sensor is exposed to a programmed amount of wear.

The results of condition monitoring must always be interpreted in the context of the application.

Possible interpretation of the monitoring parameters

This section describes the interpretation of certain monitoring parameters in connection with the process and the application.

Monitoring parameter	Possible reasons for deviation
Mass flow	If the mass flow can be kept constant and can be repeated, a deviation from the reference indicates a zero point shift.
Density	A deviation from the reference may be caused by a change in the resonance frequency of the measuring tube, e.g. due to coating/buildup in the measuring tube, corrosion or abrasion.
Reference density	The reference density values can be interpreted in the same way as the density values. If it is not possible to keep the liquid temperature entirely constant, you can analyze the reference density (density at a constant temperature, e.g. at 20 $^{\circ}$ C) instead of the density. Make sure that the parameters required for calculating the reference density have been configured correctly.
Temperature	Use this diagnostics parameter to monitor the process temperature.
Oscillation damping	A deviation from the reference state can be caused by a change in the measuring tube damping, e.g. by mechanical changes (formation of coating or buildup, fouling).
Signal asymmetry	A deviation is an indicator of abrasion or corrosion.
Frequency fluctuation	A deviation in the frequency fluctuation is an indicator of rapidly changing process conditions, e.g. gas content in a liquid medium or moisture in gaseous media.
Tube damping fluctuation	A deviation in the tube damping fluctuation is an indicator of rapidly changing process conditions, e.g. gas content in a liquid medium.
HBSI	A deviation in the HBSI indicates a change of the entire sensor, with all its electrical, mechanical and electromechanical components incorporated in the sensor housing (including the measuring tube, electrodynamic pick-ups, excitation system, cables etc.).
	<ul> <li>In the event of deposits/buildup, fouling in the sensor:         or         In the event of abrasion or corrosion in the sensor:         Inspect the sensor, clean the measuring tube if necessary</li> <li>In case of mechanical damage or aging of sensor and excitation coils:         Replace the sensor</li> </ul>
Electronic temperature	Indication of high ambient temperatures or heat transfer from the process, e.g. due to installation conditions (incorrect insulation of the pipework).

Description of typical applications

Coating or deposit buildup in the measuring tube

If it emerges that the process causes coating/build-up in the measuring tubes of the measuring device, **Heartbeat Monitoring** can be used for this application.

### Relevant monitoring parameters:

Oscillation damping

Oscillation damping is a number that defines the ratio of the exciter current to the oscillation amplitude of the tubes. Coating or deposit buildup in the measuring tube have a significant influence on this value. Note: Medium viscosity and entrained gas in liquid media can also influence the Oscillation damping .

HBSI

In the case of Promass I, the **HBSI** parameter is also suitable for detecting deposits and the formation of buildup in the measuring tube. The shift from the baseline value depends on whether the buildup forming on the measuring tube is soft or hard.

Density

Mechanical changes to the tubes cause a shift in the resonance frequency. The formation of buildup and deposits reduces the resonance frequency. This causes the measured density value to increase compared to the reference value. Note: A reliable comparison with the reference value requires a reference condition, i.e. a medium of known density or an empty measuring tube.

Corrosion or abrasion in the measuring tube

If there is evidence or the suspicion that the process is causing corrosion or abrasion in the measuring tubes of the measuring device, **Heartbeat Monitoring** can be used for this application.

Relevant monitoring parameters:

HBSI

An increase in the **HBSI** parameter is a clear indication of increased wear of the sensor due to corrosion or abrasion.

Sensor asymmetry

Corrosion or abrasion is rarely constant over the entire length of the measuring tube. Abrasion often occurs at the inlet, i.e. in areas of higher fluid velocity. Corrosion attacks the weak points of a measuring system and occurs at welds (flow splitters etc.). Changes to the sensor asymmetry can be caused by corrosion and abrasion in the Coriolis sensor.

Density

Mechanical changes to the tubes cause a shift in the resonance frequency. If the density has changed in relation to the reference value, this can indicate eroded or corroded measuring tubes. Note: A reliable comparison with the reference value requires a reference condition, i.e. a medium of known density or an empty measuring tube.

Application with multiphase fluids

If there is evidence or the suspicion that multiphase conditions are present in the process, **Heartbeat Monitoring** can be used for the following applications:

- Air entrained in liquids
- Wet gas

Relevant monitoring parameters:

Frequency fluctuation

If the process is stopped or if constant process conditions are present, a value close to 0 can be expected. An increase in the current value in applications involving liquids is an indicator of gas content in the fluid. In applications with gaseous fluids, the Frequency fluctuation is a good indicator of wet gas, as the fluctuation in the frequency indicates that a fluid is not homogeneous.

Oscillation damping and Oscillation damping fluctuation

An increase in oscillation damping coupled with a rapid change in Oscillation damping is an indicator of multiphase conditions in the process (particularly gas content in liquid fluids), as these conditions cause increased damping in the measuring tube. The changes in the Oscillation damping are caused by the changing gas concentration and distribution of the gas in the liquid.

# 11.9.5 Modbus RS485 register information

#### **Notes**

Structure of the register information

The individual parts of a parameter description are described in the following section:

Navigation: navigation	Navigation: navigation path to the parameter						
Parameter	Register	Data type	Access type	User interface/ Selection/User entry	→ 🖺		
Name of parameter	Indicated in decimal numerical format	<ul> <li>Float length =         4 byte     </li> <li>Integer length =         2 byte     </li> <li>String length,         depending on         parameter     </li> </ul>	Possible type of access to parameter:  Read access via function codes 03, 04 or 23  Write access via function codes 06, 16 or 23	Options List of the individual options for the parameter Option 1 Option 2 Option 3 (+)  (+) = Factory setting depends on country, order options or device settings  User entry Specific value or input range for the parameter	Page number information and cross-reference to the standard parameter description		

# **NOTICE**

If non-volatile device parameters are modified via the MODBUS RS485 function codes 06, 16 or 23, the change is saved in the EEPROM of the measuring device.

The number of writes to the EEPROM is technically restricted to a maximum of 1 million.

- ► Make sure to comply with this limit since, if it is exceeded, data loss and measuring device failure will result.
- ▶ Avoid constantly writing non-volatile device parameters via the MODBUS RS485.

### Address model

The Modbus RS485 register addresses of the measuring device are implemented in accordance with the "Modbus Applications Protocol Specification V1.1".

In addition, systems are used that work with the register address model "Modicon Modbus Protocol Reference Guide (PI-MBUS-300 Rev. J)".

Depending on the function code used, a number is added at the start of the register address with this specification:

- "3"  $\rightarrow$  "Read" access
- "4"  $\rightarrow$  "Write" access

Function code	Access type	Register in accordance with "Modbus Applications Protocol Specification"	Register in accordance with "Modicon Modbus Protocol Reference Guide"
03 04 23	Read	XXXX Example: mass flow = 2007	3XXXX Example: mass flow = 32007
06 16 23	Write	XXXX Example: reset totalizer = 6401	4XXXX Example: reset totalizer = 46401

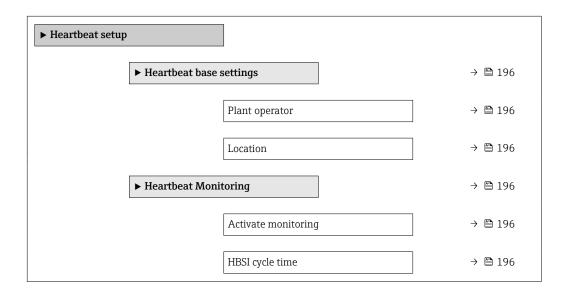
## Overview of the Heartbeat operating menu

The following tables provide an overview of the structure of the Heartbeat Technology operating menu along with the parameters. The page reference indicates where the associated description of the submenu or parameter can be found.

"Heartbeat setup" submenu

### Navigation

"Setup" menu → Advanced setup → Heartbeat setup



Register information

"Heartbeat base settings" submenu

Navigation: Heartbeat setup → Heartbeat base settings					
Parameter	Register	Data type	Access	Selection / User entry / User interface	→ 🖺
Plant operator	3414 to 3429	String	Read / Write	Max. 32 characters such as letters, numbers or special characters (e.g. @, %, /)	169
Location	3430 to 3445	String	Read / Write	Max. 32 characters such as letters, numbers or special characters (e.g. @, %, /)	169

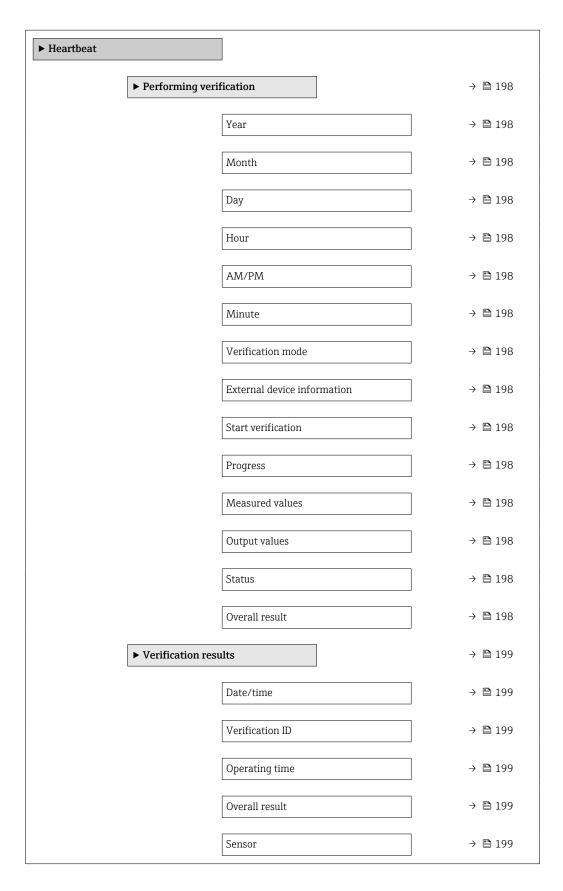
### "Heartbeat Monitoring" submenu

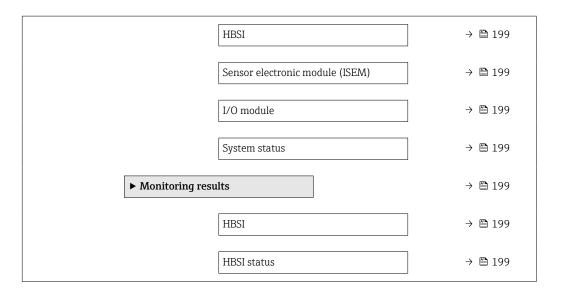
Navigation: Heartbeat setup → Heartbeat Monitoring					
Parameter	Register	Data type	Access	Selection / User entry / User interface	→ 🖺
Activate monitoring	2088	Integer	Read / Write	2 = Time-controlled HBSI	191
HBSI cycle time	28625 to 28626	Float	Read / Write	0.5 to 4320 h	191

### "Heartbeat" submenu

### Navigation

"Heartbeat" submenu





Register information
"Performing verification" submenu

Navigation: Heartbeat → Perfor	ming verification				
Parameter	Register	Data type	Access	Selection / User entry / User interface	→ 🖺
Year	2495	Integer	Read / Write	9 to 99	172
Month	2494	Integer	Read / Write	0 = January 1 = February 2 = March 3 = April 4 = May 5 = June 6 = July 7 = August 8 = September 9 = October 10 = November 11 = December	172
Day	2493	Integer	Read / Write	1 to 31 d	172
Hour	2492	Integer	Read / Write	0 to 23 h	172
AM/PM	2496	Integer	Read / Write	<b>0 = AM</b> 1 = PM	172
Minute	2467	Integer	Read / Write	0 to 59 min	172
Verification mode	2366	Integer	Read / Write	<b>0 = Internal verification</b> 1 = External verification	172
External device information	20493 to 20508	String	Read / Write	Free text entry	179
Start verification	2270	Integer	Read / Write	0 = Cancel 1 = Start	172
Progress	6797	Integer	Read	0 to 100 %	121
Measured values	5512 to 5513	Float	Read / Write	Signed floating-point number	180
Output values	5516 to 5517	Float	Read	Signed floating-point number	180
Status	2079	Integer	Read	0 = Failed 1 = Done 3 = Not done 8 = Busy	173
Overall result	2355	Integer	Read	0 = Failed 2 = Passed 3 = Not done	173

198

# "Verification results" submenu

Navigation: Heartbeat → Verificat	ion results				
Parameter	Register	Data type	Access	Selection / User entry / User interface	→ 🖺
Date/time	2372 to 2381	String	Read	dd.mmmm.yyyy; hh:mm	182
Verification ID	2315	Integer	Read	0 to 65 535	182
Operating time	3346	String	Read	Days (d), hours (h), minutes (m), seconds (s)	182
Overall result	2355	Integer	Read	0 = Failed 2 = Passed 3 = Not done	173
Sensor	2384	Integer	Read	0 = Failed 2 = Passed <b>3 = Not done</b>	182
HBSI		Integer	Read		
Sensor electronic module (ISEM)	2385	Integer	Read	0 = Failed 2 = Passed 3 = Not done	182
I/O module	2386	Integer	Read	0 = Failed 2 = Passed <b>3 = Not done</b> 254 = Not plugged	182
System status	5790	Integer	Read	0 = Failed 2 = Passed <b>3 = Not done</b>	182

# "Monitoring results" submenu

Navigation: Heartbeat → Monitoring results						
Parameter	Register	Data type	Access	Selection / User entry / User interface	→ 🖺	
HBSI		Float	Read			
HBSI status	34882	Integer	Read	0 = Bad 64 = Uncertain 128 = Good	191	

# 12 Diagnostics and troubleshooting

# 12.1 General troubleshooting

# For local display

Error	Possible causes	Remedial action
Local display is dark, but signal output is within the valid range	The cable of the display module is not plugged in correctly.	Insert the plug correctly into the main electronics module and display module.
Local display dark and no output signals	Supply voltage does not match the voltage specified on the nameplate.	Apply the correct supply voltage $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $
Local display dark and no output signals	Supply voltage has incorrect polarity.	Reverse polarity of supply voltage.
Local display dark and no output signals	No contact between connecting cables and terminals.	Ensure electrical contact between the cable and the terminal.
Local display dark and no output signals	<ul> <li>Terminals are not plugged into the I/O electronics module correctly.</li> <li>Terminals are not plugged into the main electronics module correctly.</li> </ul>	Check terminals.
Local display dark and no output signals	<ul><li>I/O electronics module is defective.</li><li>Main electronics module is defective.</li></ul>	Order spare part → 🗎 222.
Local display dark and no output signals	The connector between the main electronics module and display module is not plugged in correctly.	Check the connection and correct if necessary.
Local display cannot be read, but signal output is within the valid range	Display is set too bright or too dark.	■ Set the display brighter by simultaneously pressing
Local display is dark, but signal output is within the valid range	Display module is defective.	Order spare part → 🖺 222.
Backlighting of local display is red	Diagnostic event with "Alarm" diagnostic behavior has occurred.	Take remedial measures → 🖺 210
Text on local display appears in a language that cannot be understood.	The selected operating language cannot be understood.	1. Press □ + □ for 2 s ("home position"). 2. Press □. 3. Configure the required language in the Display language parameter (→ □ 133).
Message on local display: "Communication Error" "Check Electronics"	Communication between the display module and the electronics is interrupted.	<ul> <li>Check the cable and the connector between the main electronics module and display module.</li> <li>Order spare part →   222.</li> </ul>

# For output signals

Error	Possible causes	Remedial action
Signal output outside the valid range	Main electronics module is defective.	Order spare part → 🖺 222.
Device shows correct value on local display, but signal output is incorrect, though in the valid range.	Parameter configuration error	Check and adjust parameter configuration.
Device measures incorrectly.	Configuration error or device is operated outside the application.	Check and correct parameter configuration.     Observe limit values specified in the "Technical Data".  "Technical Data".

### For access

Error	Possible causes	Remedial action
Write access to parameter not possible.	Hardware write protection is enabled.	Set the write protection switch on the main electronics module to the <b>OFF</b> position → 🗎 143.
Write access to parameter not possible.	Current user role has limited access authorization.	<ol> <li>Check user role →          □ 58.</li> <li>Enter correct customer-specific access code →          □ 58.</li> </ol>
Connection via Modbus RS485 is not possible.	Modbus RS485 bus cable is connected incorrectly.	Check the terminal assignment $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $
Connection via Modbus RS485 is not possible.	Modbus RS485 cable is incorrectly terminated.	Check the terminating resistor $\rightarrow \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $
Connection via Modbus RS485 is not possible.	Settings for the communication interface are incorrect.	Check the Modbus RS485 configuration  → 🖺 82.
Connection to the web server is not possible.	Web server is disabled.	Use the "FieldCare" or "DeviceCare" operating tool to check if the web server of the device is enabled and enable if necessary → 🖺 65.
	The Ethernet interface is incorrectly configured on the PC.	Check the properties of the Internet protocol (TCP/IP) → 🖺 61.      Check the network settings with the IT manager.
Connection to the web server is not possible.	The IP address is incorrectly configured on the PC.	Check the IP address: 192.168.1.212 → 🖺 61
Connection to the web server is not possible.	WLAN access data are incorrect.	<ul> <li>Check WLAN network status.</li> <li>Log on to the device again using WLAN access data.</li> <li>Check that WLAN is enabled for the device and operating device →</li></ul>
	WLAN communication is disabled.	-
It is not possible to connect to the web server, FieldCare or DeviceCare.	WLAN network is not available.	<ul> <li>Check whether WLAN reception is available:         LED on the display module lights up in blue.</li> <li>Check if the WLAN connection is enabled:         LED on display module flashes blue.</li> <li>Switch on instrument function.</li> </ul>
No network connection or unstable network connection.	WLAN network is weak.	<ul> <li>Operating device outside of receiving range: Check the network status on the operating device.</li> <li>To improve network performance, use an external WLAN antenna.</li> </ul>
	Parallel WLAN and Ethernet communication.	<ul> <li>Check network settings.</li> <li>Temporarily enable only the WLAN as an interface.</li> </ul>
Web browser is frozen and no further operation possible.	Data transfer is active.	Wait until data transfer or current action is finished.
	Connection lost	<ul> <li>Check cable connection and power supply.</li> <li>Refresh web browser and restart if necessary.</li> </ul>
The web browser contents are difficult to read or incomplete.	The web browser version used is not the best option.	<ul> <li>▶ Use correct web browser version →  60.</li> <li>▶ Empty the web browser cache.</li> <li>▶ Restart the web browser.</li> </ul>
	Unsuitable view settings.	Change the font size/display ratio of the Web browser.
No contents displayed in the web browser or contents incomplete.	<ul><li> JavaScript is not enabled.</li><li> JavaScript cannot be enabled.</li></ul>	<ul> <li>Enable JavaScript.</li> <li>Enter http://XXX.XXX.X.X.XX/servlet/basic.html as the IP address.</li> </ul>

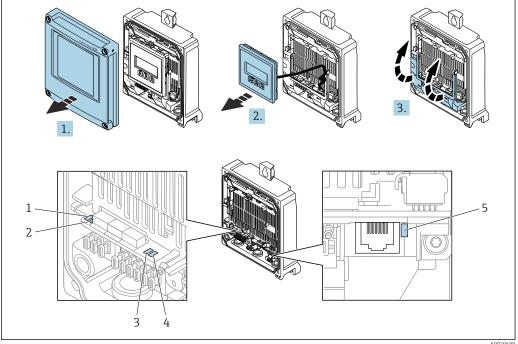
Error	Possible causes	Remedial action
Operation with FieldCare or DeviceCare not possible via CDI-RJ45 service interface (port 8000).	Firewall of the PC or network prevents communication.	Depending on the settings of the firewall used on the PC or in the network, the firewall must be disabled or adjusted for FieldCare/DeviceCare access.
Flashing of firmware with FieldCare or DeviceCare not possible via CDI-RJ45 service interface (port 8000 or TFTP ports).	Firewall of the PC or network prevents communication.	Depending on the settings of the firewall used on the PC or in the network, the firewall must be disabled or adjusted for FieldCare/DeviceCare access.

#### Diagnostic information via light emitting diodes 12.2

#### 12.2.1 **Transmitter**

# Proline 500 - digital

Different LEDs in the transmitter provide information on the device status.



- 1 Supply voltage
- 2 Device status
- 3 Not used
- CommunicationService interface (CDI) active
- 1. Open the housing cover.
- Remove the display module.
- 3. Fold open the terminal cover.

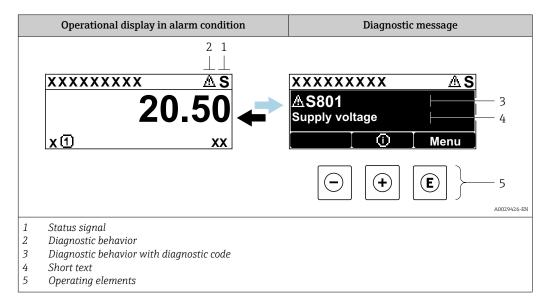
LED		Color	Meaning
1	Supply voltage	Off	Supply voltage is off or too low.
		Green	Supply voltage is OK.
2 Device status (normal operation)		Off	Firmware error
		Green	Device status is OK.

LED		Color	Meaning
		Flashing green	Device is not configured.
		Flashing red	A diagnostic event with "Warning" diagnostic behavior has occurred.
		Red	A diagnostic event with "Alarm" diagnostic behavior has occurred.
		Flashing red or green	The device restarts.
2 Device status (during start-up)		Flashes red slowly	If > 30 seconds: problem with the boot loader.
		Flashes red quickly	If > 30 seconds: compatibility problem when reading the firmware.
3	Not used	-	-
4	Communication	Off	Communication not active.
		White	Communication active.
5	Service interface (CDI)	Off	Not connected or no connection established.
		Yellow	Connected and connection established.
		Flashing yellow	Service interface active.

# 12.3 Diagnostic information on local display

# 12.3.1 Diagnostic message

Faults detected by the self-monitoring system of the measuring device are displayed as a diagnostic message in alternation with the operational display.



If two or more diagnostic events are pending simultaneously, only the message of the diagnostic event with the highest priority is shown.

- Other diagnostic events that have occurred can be displayed in the **Diagnostics** menu:
  - Via parameter → 🖺 214
  - Via submenus  $\rightarrow$  🖺 215

### Status signals

The status signals provide information on the state and reliability of the device by categorizing the cause of the diagnostic information (diagnostic event).

The status signals are categorized according to VDI/VDE 2650 and NAMUR Recommendation NE 107: F = Failure, C = Function Check, S = Out of Specification, M = Maintenance Required

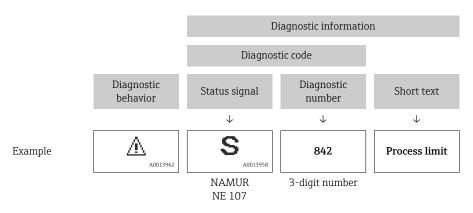
Symbol	Meaning
F	Failure A device error has occurred. The measured value is no longer valid.
С	<b>Function check</b> The device is in service mode (e.g. during a simulation).
S	Out of specification The device is being operated: Outside its technical specification limits (e.g. outside the process temperature range)
М	Maintenance required Maintenance is required. The measured value remains valid.

## Diagnostic behavior

Symbol	Meaning
*	<ul> <li>Alarm</li> <li>Measurement is interrupted.</li> <li>Signal outputs and totalizers assume the defined alarm condition.</li> <li>A diagnostic message is generated.</li> </ul>
Δ	<ul> <li>Warning</li> <li>Measurement is resumed.</li> <li>The signal outputs and totalizers are not affected.</li> <li>A diagnostic message is generated.</li> </ul>

### Diagnostic information

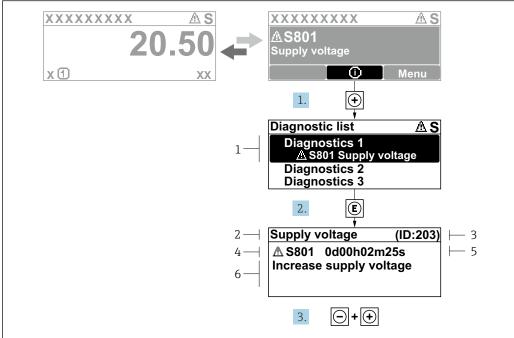
The fault can be identified using the diagnostic information. The short text helps you by providing information about the fault. In addition, the corresponding symbol for the diagnostic behavior is displayed in front of the diagnostic information on the local display.



# Operating elements

Operating key	Meaning
<b>(+)</b>	Plus key In menu, submenu Opens the message about the remedial measures.
E	Enter key In menu, submenu Opens the operating menu.

## 12.3.2 Calling up remedial measures



A0029431-EN

- 37 Message for remedial measures
- 1 Diagnostic information
- 2 Short text
- 3 Service ID
- 4 Diagnostic behavior with diagnostic code
- 5 Operation time when error occurred
- 6 Remedial measures
- 1. The user is in the diagnostic message.

Press ± (① symbol).

- The **Diagnostic list** submenu opens.
- 2. Select the desired diagnostic event with  $\pm$  or  $\Box$  and press  $\Box$ .
  - └ The message about the remedial measures opens.
- 3. Press  $\Box$  +  $\pm$  simultaneously.
  - ► The message about the remedial measures closes.

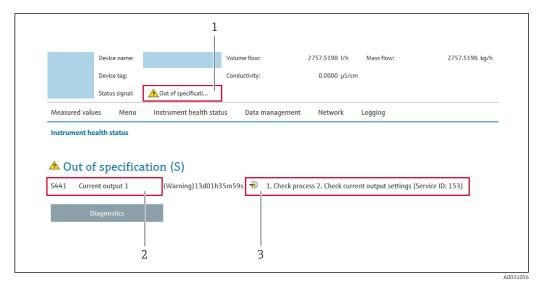
The user is in the **Diagnostics** menu at an entry for a diagnostics event, e.g. in the **Diagnostic list** submenu or **Previous diagnostics** parameter.

- 1. Press E.
  - ► The message for the remedial measures for the selected diagnostic event opens.
- 2. Press  $\Box$  +  $\pm$  simultaneously.
  - ► The message for the remedial measures closes.

# 12.4 Diagnostic information in the web browser

### 12.4.1 Diagnostic options

Any faults detected by the measuring device are displayed in the Web browser on the home page once the user has logged on.



- 1 Status area with status signal
- 2 Diagnostic information
- 3 Remedial measures with service ID
- In addition, diagnostic events which have occurred can be shown in the **Diagnostics** menu:

  - Via submenu  $\rightarrow$  🗎 215

### Status signals

The status signals provide information on the state and reliability of the device by categorizing the cause of the diagnostic information (diagnostic event).

Symbol	Meaning
8	Failure A device error has occurred. The measured value is no longer valid.
V	Function check The device is in service mode (e.g. during a simulation).
<u>^</u> ?	Out of specification The device is being operated: Outside its technical specification limits (e.g. outside the process temperature range)
<b>&amp;</b>	Maintenance required Maintenance is required. The measured value remains valid.

The status signals are categorized in accordance with VDI/VDE 2650 and NAMUR Recommendation NE 107.

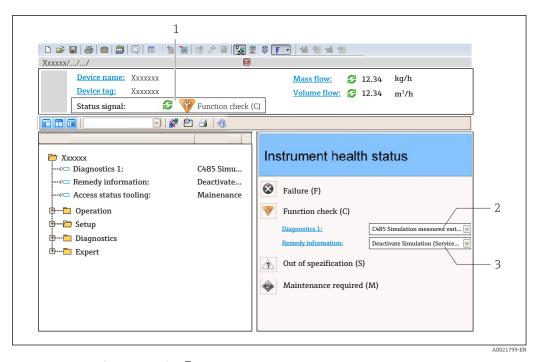
# 12.4.2 Calling up remedy information

Remedy information is provided for every diagnostic event to ensure that problems can be rectified quickly. These measures are displayed in red along with the diagnostic event and the related diagnostic information.

# 12.5 Diagnostic information in FieldCare or DeviceCare

# 12.5.1 Diagnostic options

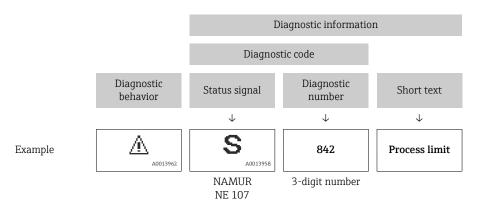
Any faults detected by the measuring device are displayed on the home page of the operating tool once the connection has been established.



- 1 Status area with status signal  $\rightarrow \triangleq 204$
- *2 Diagnostic information* → 🖺 *205*
- 3 Remedial measures with service ID
- In addition, diagnostic events which have occurred can be shown in the **Diagnostics** menu:
  - Via parameter  $\rightarrow$  🗎 214
  - Via submenu  $\rightarrow \stackrel{\cdot}{\blacksquare} 215$

### Diagnostic information

The fault can be identified using the diagnostic information. The short text helps you by providing information about the fault. In addition, the corresponding symbol for the diagnostic behavior is displayed in front of the diagnostic information on the local display.



# 12.5.2 Calling up remedy information

Remedy information is provided for every diagnostic event to ensure that problems can be rectified quickly:

- On the home page Remedy information is displayed in a separate field below the diagnostics information.
- In the **Diagnostics** menu
   Remedy information can be called up in the working area of the user interface.

The user is in the **Diagnostics** menu.

- 1. Call up the desired parameter.
- 2. On the right in the working area, mouse over the parameter.
  - ► A tool tip with remedy information for the diagnostic event appears.

# 12.6 Diagnostic information via communication interface

# 12.6.1 Reading out diagnostic information

Diagnostic information can be read out via Modbus RS485 register addresses.

- Via register address **6821** (data type = string): diagnosis code, e.g. F270
- Via register address **6859** (data type = integer): diagnosis number, e.g. 270
- For an overview of diagnostic events with diagnosis number and diagnosis code  $\rightarrow \stackrel{\cong}{=} 210$

# 12.6.2 Configuring error response mode

The error response mode for Modbus RS485 communication can be configured in the **Communication** submenu using 2 parameters.

### Navigation path

Setup → Communication

Parameter overview with brief description

Parameter	Meaning	Options	Factory setting
Failure mode	Select measured value output behavior when a diagnostic message occurs via Modbus communication.  The effect of this parameter depends on the option selected in the Assign diagnostic behavior parameter.	<ul> <li>NaN value</li> <li>Last valid value</li> <li>NaN = not a number</li> </ul>	NaN value

# 12.7 Adapting the diagnostic information

# 12.7.1 Adapting the diagnostic behavior

Each item of diagnostic information is assigned a specific diagnostic behavior at the factory. The user can change this assignment for specific diagnostic information in the **Diagnostic behavior** submenu.

Expert  $\rightarrow$  System  $\rightarrow$  Diagnostic handling  $\rightarrow$  Diagnostic behavior

You can assign the following options to the diagnostic number as the diagnostic behavior:

Options	Description
Alarm	The device stops measurement. The measured value output via Modbus RS485 and the totalizers assume the defined alarm condition. A diagnostic message is generated. The background lighting changes to red.
Warning	The device continues to measure. The measured value output via Modbus RS485 and the totalizers are not affected. A diagnostic message is generated.

Options	Description
Logbook entry only	The device continues to measure. The diagnostic message is only displayed in the <b>Event logbook</b> submenu ( <b>Event list</b> submenu) and is not displayed in alternating sequence with the operational display.
Off	The diagnostic event is ignored, and no diagnostic message is generated or entered.

# 12.8 Overview of diagnostic information

In the case of some items of diagnostic information, the diagnostic behavior can be changed. Adapting the diagnostic information  $\rightarrow \cong 209$ 

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of	sensor			
022	Temperature sensor defective	Check or replace sensor electronic module (ISEM)     If available: Check connection cable between sensor and transmitter     Replace sensor	F	Alarm
046	Sensor limit exceeded	Inspect sensor     Check process condition	S	Warning 1)
062	Sensor connection faulty	Check or replace sensor electronic module (ISEM)     If available: Check connection cable between sensor and transmitter     Replace sensor	F	Alarm
063	Exciter current faulty	Check or replace sensor electronic module (ISEM)     If available: Check connection cable between sensor and transmitter     Replace sensor	S	Alarm
082	Data storage	Check module connections     Change electronic modules	F	Alarm
083	Memory content	Restart device     Restore HistoROM S-DAT backup     (Device reset' parameter)     Replace HistoROM S-DAT	F	Alarm
140	Sensor signal asymmetrical	Check or replace sensor electronic module (ISEM)     If available: Check connection cable between sensor and transmitter     Replace sensor	S	Alarm 1)
144	Measurement error too high	Check or change sensor     Check process conditions	F	Alarm 1)
Diagnostic of	electronic		'	
201	Device failure	Restart device	F	Alarm
242	Software incompatible	Check software     Flash or change main electronics module	F	Alarm
252	Modules incompatible	Check electronic modules     Check if correct modules are available (e.g. NEx, Ex)     Replace electronic modules	F	Alarm
252	Modules incompatible	Check if correct electronic modul is plugged     Replace electronic module	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
262	Sensor electronic connection faulty	Check or replace connection cable between sensor electronic module (ISEM) and main electronics     Check or replace ISEM or main electronics	F	Alarm
270	Main electronic failure	Change main electronic module	F	Alarm
271	Main electronic failure	Restart device     Change main electronic module	F	Alarm
272	Main electronic failure	Restart device	F	Alarm
273	Main electronic failure	Change electronic	F	Alarm
275	I/O module 1 to n defective	Change I/O module	F	Alarm
276	I/O module 1 to n faulty	Restart device     Change I/O module	F	Alarm
283	Memory content	Reset device	F	Alarm
283	Memory content	Restart device	F	Alarm
302	Device verification active	Device verification active, please wait.	С	Warning
303	I/O 1 to n configuration changed	Apply I/O module configuration     (parameter 'Apply I/O     configuration')     Afterwards reload device     description and check wiring	M	Warning
311	Electronic failure	Do not reset device     Contact service	M	Warning
332	Writing in HistoROM backup failed	Replace user interface board Ex d/XP: replace transmitter	F	Alarm
361	I/O module 1 to n faulty	Restart device     Check electronic modules     Change I/O Modul or main electronics	F	Alarm
372	Sensor electronic (ISEM) faulty	Restart device     Check if failure recurs     Replace sensor electronic module (ISEM)	F	Alarm
373	Sensor electronic (ISEM) faulty	Transfer data or reset device	F	Alarm
374	Sensor electronic (ISEM) faulty	Restart device     Check if failure recurs     Replace sensor electronic module (ISEM)	S	Warning <sup>1)</sup>
375	I/O- 1 to n communication failed	Restart device     Check if failure recurs     Replace module rack inclusive electronic modules	F	Alarm
378	Supply voltage ISEM faulty	Check supply voltage to the ISEM	F	Alarm
382	Data storage	Insert T-DAT     Replace T-DAT	F	Alarm
383	Memory content	Restart device     Delete T-DAT via 'Reset device'     parameter     Replace T-DAT	F	Alarm
387	HistoROM data faulty	Contact service organization	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of	configuration			
330	Flash file invalid	Update firmware of device     Restart device	M	Warning
331	Firmware update failed	Update firmware of device     Restart device	F	Warning
410	Data transfer	Check connection     Retry data transfer	F	Alarm
412	Processing download	Download active, please wait	С	Warning
431	Trim 1 to n	Carry out trim	С	Warning
437	Configuration incompatible	Restart device	F	Alarm
438	Dataset	Check data set file     Check device configuration     Up- and download new configuration	М	Warning
441	Current output 1 to n	Check process     Check current output settings	S	Warning 1)
442	Frequency output 1 to n	1. Check process	S	Warning 1)
442	Frequency output 1 to n	2. Check frequency output settings	S	Warning
443	Pulse output 1 to n	Check process     Check pulse output settings	S	Warning 1)
444	Current input 1 to n	Check process     Check current input settings	S	Warning 1)
453	Flow override	Deactivate flow override	С	Warning
484	Failure mode simulation	Deactivate simulation	С	Alarm
485	Measured variable simulation	Deactivate simulation	С	Warning
486	Current input 1 to n simulation	Deactivate simulation	С	Warning
491	Current output 1 to n simulation	Deactivate simulation	С	Warning
492	Simulation frequency output 1 to n	Deactivate simulation frequency output	С	Warning
493	Simulation pulse output 1 to n	Deactivate simulation pulse output	С	Warning
494	Switch output simulation 1 to n	Deactivate simulation switch output	С	Warning
495	Diagnostic event simulation	Deactivate simulation	С	Warning
496	Status input simulation	Deactivate simulation status input	С	Warning
502	CT activation/ deactivation failed	Follow the sequence of the custody transfer activation/deactivation: First authorized user login, then set the DIP switch on the main electonic module	С	Warning
520	I/O 1 to n hardware configuration invalid	Check I/O hardware configuration     Replace wrong I/O module     Plug the module of double pulse output on correct slot	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
528	Concentration calculation not possible	Out of valid range of the selected calculation algorithm  1. Check concentration settings 2. Check measured values, e.g. density or temperature	S	Alarm
529	Concentration calculation not accurate	Out of valid range of the selected calculation algorithm  1. Check concentration settings 2. Check measured values, e.g. density or temperature	S	Warning
537	Configuration	Check IP addresses in network     Change IP address	F	Warning
540	Custody transfer mode failed	Power off device and toggle DIP switch     Deactivate custody transfer mode     Reactivate custody transfer mode     Check electronic components	F	Alarm
543	Double pulse output	Check process     Check pulse output settings	S	Warning
593	Double pulse output simulation	Deactivate simulation pulse output	С	Warning
594	Relay output simulation	Deactivate simulation switch output	С	Warning
599	Custody transfer logbook full	Deactivate custody transfer mode     Clear custody transfer logbook (all 30 entries)     Activate custody transfer mode	F	Warning
Diagnostic of p	process			
803	Current loop	Check wiring     Change I/O module	F	Alarm
830	Sensor temperature too high	Reduce ambient temp. around the sensor housing	S	Warning 1)
831	Sensor temperature too low	Increase ambient temp. around the sensor housing	S	Warning 1)
832	Electronic temperature too high	Reduce ambient temperature	S	Warning 1)
833	Electronic temperature too low	Increase ambient temperature	S	Warning 1)
834	Process temperature too high	Reduce process temperature	S	Warning 1)
835	Process temperature too low	Increase process temperature	S	Warning 1)
842	Process limit	Low flow cut off active!  1. Check low flow cut off configuration	S	Warning 1)
862	Partly filled pipe	Check for gas in process     Adjust detection limits	S	Warning 1)
882	Input signal	Check input configuration     Check external device or process conditions	F	Alarm
910	Tubes not oscillating	Check electronic     Inspect sensor	F	Alarm
912	Medium inhomogeneous	Check process cond.     Increase system pressure	S	Warning 1)

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
913	Medium unsuitable	Check process conditions     Check electronic modules or sensor	S	Warning 1)
941	API temperature out of specification	Check process temperature with selected API commodity group     Check API related parameters	S	Warning 1)
942	API density out of specification	Check process density with selected     API commodity group     Check API related parameters	S	Warning <sup>1)</sup>
943	API pressure out of specification	Check process pressure with selected API commodity group     Check API related parameters	S	Warning <sup>1)</sup>
944	Monitoring failed	Check process conditions for Heartbeat Monitoring	S	Warning 1)
948	Oscillation damping too high	Check process conditions	S	Warning 1)

1) Diagnostic behavior can be changed.

# 12.9 Pending diagnostic events

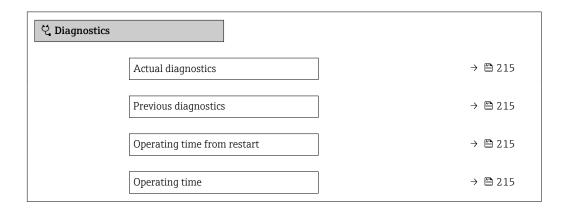
The **Diagnostics** menu allows the user to view the current diagnostic event and the previous diagnostic event separately.

- To call up the measures to rectify a diagnostic event:
  - Via local display → 
    206
    - Via web browser → 

      207
    - Via "FieldCare" operating tool → 🗎 208
    - Via "DeviceCare" operating tool → 🖺 208
- Other pending diagnostic events can be displayed in the **Diagnostic list** submenu  $\rightarrow \stackrel{\square}{=} 215$ .

### **Navigation**

"Diagnostics" menu



### Parameter overview with brief description

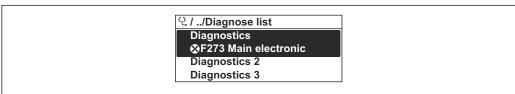
Parameter	Prerequisite	Description	User interface
Actual diagnostics	A diagnostic event has occurred.	Shows the current occured diagnostic event along with its diagnostic information.	Symbol for diagnostic behavior, diagnostic code and short message.
		If two or more messages occur simultaneously, the message with the highest priority is shown on the display.	
Previous diagnostics	Two diagnostic events have already occurred.	Shows the diagnostic event that occurred prior to the current diagnostic event along with its diagnostic information.	Symbol for diagnostic behavior, diagnostic code and short message.
Operating time from restart	-	Shows the time the device has been in operation since the last device restart.	Days (d), hours (h), minutes (m) and seconds (s)
Operating time	-	Indicates how long the device has been in operation.	Days (d), hours (h), minutes (m) and seconds (s)

# 12.10 Diagnostics list

Up to 5 currently pending diagnostic events can be displayed in the **Diagnostic list** submenu along with the associated diagnostic information. If more than 5 diagnostic events are pending, the events with the highest priority are shown on the display.

### Navigation path

Diagnostics → Diagnostic list



A0014006-EN

■ 38 Using the example of the local display



To call up the measures to rectify a diagnostic event:

- Via local display → 🖺 206
- Via "FieldCare" operating tool → 🗎 208

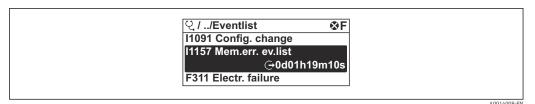
# 12.11 Event logbook

# 12.11.1 Reading out the event logbook

A chronological overview of the event messages that have occurred is provided in the Events list submenu.

## Navigation path

**Diagnostics** menu → **Event logbook** submenu → Events list



■ 39 Using the example of the local display

- A maximum of 20 event messages can be displayed in chronological order.
- If the **Extended HistoROM** application package (order option) is enabled in the device, the event list can contain up to 100 entries.

The event history includes entries for:

- Diagnostic events → 🖺 210
- Information events → 🖺 216

In addition to the operating time when the event occurred, each event is also assigned a symbol that indicates whether the event has occurred or is finished:

- Diagnostics event
  - ①: Occurrence of the event
  - 🕒: End of the event
- Information event
  - €: Occurrence of the event
- To call up the measures to rectify a diagnostic event:
  - Via local display → 

    206
  - Via web browser → 🖺 207

  - Via "DeviceCare" operating tool → 🗎 208
- ho For filtering the displayed event messages ho ho 216

# 12.11.2 Filtering the event logbook

Using the **Filter options** parameter you can define which category of event message is displayed in the **Events list** submenu.

### Navigation path

Diagnostics  $\rightarrow$  Event logbook  $\rightarrow$  Filter options

## Filter categories

- All
- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)
- Information (I)

### 12.11.3 Overview of information events

Unlike a diagnostic event, an information event is displayed in the event logbook only and not in the diagnostic list.

Info number	Info name
I1000	(Device ok)
I1079	Sensor changed
I1089	Power on
11090	Configuration reset
I1091	Configuration changed

Info number	Info name
I1092	HistoROM backup deleted
I1111	Density adjust failure
I1137	Electronic changed
I1151	History reset
I1155	Reset electronic temperature
I1156	Memory error trend
I1157	Memory error event list
I1209	Density adjustment ok
I1221	Zero point adjust failure
I1222	Zero point adjustment ok
I1256	Display: access status changed
I1278	I/O module restarted
I1335	Firmware changed
I1361	Web server: login failed
I1397	Fieldbus: access status changed
I1398	CDI: access status changed
I1444	Device verification passed
I1445	Device verification failed
I1447	Record application reference data
I1448	Application reference data recorded
I1449	Recording application ref. data failed
I1450	Monitoring off
I1451	Monitoring on
I1457	Measurement error verification failed
I1459	I/O module verification failed
I1460	HBSI verification failed
I1461	Sensor verification failed
I1462	Sensor electronic module verific. failed
I1512	Download started
I1513	Download finished
I1514	Upload started
I1515	Upload finished
I1517	Custody transfer active
I1518	Custody transfer inactive
I1618	I/O module 2 replaced
I1619	I/O module 3 replaced
I1621	I/O module 4 replaced
I1622	Calibration changed
I1624	Reset all totalizers
I1625	Write protection activated
I1626	Write protection deactivated
I1627	Web server: login successful
I1628	Display: login successful

Info number	Info name
I1629	CDI: login successful
I1631	Web server access changed
I1632	Display: login failed
I1633	CDI: login failed
I1634	Reset to factory settings
I1635	Reset to delivery settings
I1639	Max. switch cycles number reached
I1643	Custody transfer logbook cleared
I1649	Hardware write protection activated
I1650	Hardware write protection deactivated
I1651	Custody transfer parameter changed
I1712	New flash file received
I1725	Sensor electronic module (ISEM) changed
I1726	Configuration backup failed

# 12.12 Resetting the measuring device

The entire device configuration or some of the configuration can be reset to a defined state with the **Device reset** parameter ( $\Rightarrow \triangleq 138$ ).

# 12.12.1 Function range of "Device reset" parameter

Options	Description
Cancel	No action is executed and the user exits the parameter.
To delivery settings	Every parameter for which a customer-specific default setting was ordered is reset to the customer-specific value. All other parameters are reset to the factory setting.
Restart device	The restart resets every parameter with data stored in volatile memory (RAM) to the factory setting (e.g. measured value data). The device configuration remains unchanged.
Restore S-DAT backup	Restores the data that is saved on the S-DAT. Additional information: This function can be used to resolve the memory issue "083 Memory content inconsistent" or to restore the S-DAT data when a new S-DAT has been installed.  1 This option is displayed only in an alarm condition.

# 12.13 Device information

The **Device information** submenu contains all parameters that display different information for device identification.

### Navigation

"Diagnostics" menu  $\rightarrow$  Device information



	Serial number	→ 🖺 219
I	Firmware version	→ 🖺 219
I	Device name	→ 🖺 219
	Manufacturer	
	Order code	→ 🖺 219
I	Extended order code 1	→ 🖺 219
I	Extended order code 2	→ 🖺 219
	Extended order code 3	→ 🖺 219
[1	ENP version	→ 🖺 219

# Parameter overview with brief description

Parameter	Description	User interface	Factory setting
Device tag	Shows name of measuring point.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /).	Promass
Serial number	Shows the serial number of the measuring device.	Max. 11-digit character string comprising letters and numbers.	-
Firmware version	Shows the device firmware version installed.	Character string in the format xx.yy.zz	-
Device name	Shows the name of the transmitter.  The name can be found on the nameplate of the transmitter.	Character string comprising numbers, letters and special characters	-
Order code	Shows the device order code.	Character string composed of letters, numbers and certain punctuation marks (e.g. /).	-
Extended order code 1	Shows the 1st part of the extended order code.	Character string	-
Extended order code 2	Shows the 2nd part of the extended order code.  The extended order code can also be found on the nameplate of the sensor and transmitter in the "Ext. ord. cd." field.	Character string	-
Extended order code 3	Shows the 3rd part of the extended order code.  The extended order code can also be found on the nameplate of the sensor and transmitter in the "Ext. ord. cd." field.	Character string	_
ENP version	Shows the version of the electronic nameplate (ENP).	Character string	2.02.00

# 12.14 Firmware history

Release date	Firmware version	Order code for "Firmware version"	Firmware Changes	Documentation type	Documentation
08.2022	01.06.zz	Option 58	<ul> <li>New gas type: methane with hydrogen</li> <li>Eight display values on local display</li> <li>Zero point verification and zero adjustment wizard</li> <li>New density unit: "API</li> <li>New diagnostic parameters</li> <li>Additional languages for Heartbeat Technology Reports</li> </ul>	Operating Instructions	
09.2019	01.05.zz	Option 64	<ul> <li>Gas fraction handler Adaptive filter, gas entrainment index</li> <li>Application-specific input module</li> <li>Upgrading of the petroleum application package</li> </ul>	Operating Instructions	

- For the compatibility of the firmware version with the previous version, the installed device description files and operating tools, observe the information about the device in the "Manufacturer's information" document.
- The manufacturer's information is available:
  - $\blacksquare$  In the Download Area of the Endress+Hauser web site: www.endress.com  $\to$  Downloads
  - Specify the following details:
    - Product root: e.g. 85B
       The product root is the first part of the order code: see the nameplate on the device.
    - Text search: Manufacturer's information
    - Media type: Documentation Technical Documentation

# 12.15 Device history and compatibility

The device model is documented in the order code on the nameplate of the device (e.g. 8F3BXX-XXX....XXXA1-XXXXXX).

# 13 Maintenance

## 13.1 Maintenance work

No special maintenance work is required.

## 13.1.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing or the seals.

# 13.2 Measuring and test equipment

Endress+Hauser offers a variety of measuring and testing equipment, such as Netilion or device tests.

Your Endress+Hauser Sales Center can provide detailed information on the services.

List of some of the measuring and testing equipment:  $\rightarrow$   $\stackrel{\triangle}{=}$  225

### 13.3 Endress+Hauser services

Endress+Hauser offers a wide variety of services for maintenance such as, maintenance service or device tests.

Your Endress+Hauser Sales Center can provide detailed information on the services.

# 14 Repair

## 14.1 General notes

## 14.1.1 Repair and conversion concept

The Endress+Hauser repair and conversion concept provides for the following:

- The measuring devices have a modular design.
- Spare parts are grouped into logical kits with the associated Installation Instructions.
- Repairs are carried out by Endress+Hauser Service or by appropriately trained customers.
- Certified devices can only be converted to other certified devices by Endress+Hauser Service or at the factory.

### 14.1.2 Notes for repair and conversion

For repair and conversion of a measuring device, observe the following notes:

- ▶ Use only original Endress+Hauser spare parts.
- ► Carry out the repair according to the Installation Instructions.
- ▶ Observe the applicable standards, federal/national regulations, Ex documentation (XA) and certificates.
- ▶ Document all repairs and conversions and enter the details in Netilion Analytics.

# 14.2 Spare parts

Device Viewer (www.endress.com/deviceviewer):

All the spare parts for the measuring device, along with the order code, are listed here and can be ordered. If available, users can also download the associated Installation Instructions.

- Measuring device serial number:
  - Is located on the nameplate of the device.

### 14.3 Endress+Hauser services

Endress+Hauser offers a wide range of services.

Your Endress+Hauser Sales Center can provide detailed information on the services.

### 14.4 Return

The requirements for safe device return can vary depending on the device type and national legislation.

- 1. Refer to the web page for information: https://www.endress.com/support/return-material
  - ► Select the region.
- 2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

# 14.5 Disposal



If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

## 14.5.1 Removing the measuring device

1. Switch off the device.

### **WARNING**

### Danger to persons from process conditions!

- ▶ Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive media.
- 2. Carry out the mounting and connection steps from the "Mounting the measuring device" and "Connecting the measuring device" sections in reverse order. Observe the safety instructions.

### 14.5.2 Disposing of the measuring device

### **A** WARNING

### Danger to personnel and environment from fluids that are hazardous to health.

► Ensure that the measuring device and all cavities are free of fluid residues that are hazardous to health or the environment, e.g. substances that have permeated into crevices or diffused through plastic.

Observe the following notes during disposal:

- ▶ Observe valid federal/national regulations.
- ► Ensure proper separation and reuse of the device components.

### 14.5.3 Disposal of single-use measuring tube

Observe the following notes during disposal:

- ▶ Depending on the medium: autoclaving or incineration.
- ► Recycle steel part after autoclaving or incineration.

# 15 Accessories

Various accessories, which can be ordered with the device or subsequently from Endress +Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

# 15.1 Device-specific accessories

### 15.1.1 For the transmitter

Accessories	Description
Transmitter Proline 500 – digital	Transmitter for replacement or storage. Use the order code to define the following specifications:  Approvals  Output  Input  Display/operation  Housing  Software  Proline 500 – digital transmitter: Order number: 8X5BXX-*******A
External WLAN antenna	External WLAN antenna with 1.5 m (59.1 in) connecting cable and two angle brackets. Order code for "Accessory enclosed", option P8 "Wireless antenna wide area".  ■ The external WLAN antenna is not suitable for use in hygienic applications.  ■ Additional information regarding the WLAN interface → 🖺 67.  Order number: 71351317  Installation Instructions EA01238D
Connecting cable Proline 500 – digital Sensor – Transmitter	The connecting cable can be ordered directly with the measuring device (order code for "Cable, sensor connection) or as an accessory (order number DK8012).  The following cable lengths are available: order code for "Cable, sensor connection"  Option C: 2 m (6 ft)  Option J: 5 m (15 ft)  Option L: 10 m (30 ft)  Maximum possible cable length for a Proline 500 – digital connecting cable: 300 m (1000 ft)

## 15.1.2 For the sensor

Accessories	Description
Disposable measuring tube	Order number:  DN ½ ": DK8014-04SBOAADA2  DN ½ ": DK8014-06SBOAADA2  DN ½ ": DK8014-15SBOAADA2  DN 1": DK8014-25SBOAADA2

# 15.2 Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices:  Choice of measuring devices for industrial requirements  Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and accuracy.  Graphic illustration of the calculation results  Determination of the partial order code, administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.  Applicator is available:  Via the Internet: https://portal.endress.com/webapp/applicator
	As a downloadable DVD for local PC installation.
Netilion	lloT ecosystem: Unlock knowledge Endress+Hauser 's Netilion lloT ecosystem enables you to optimize your plant performance, digitize workflows, share knowledge and improve collaboration. Based on decades of experience in process automation, Endress+Hauser offers the process industry an lloT ecosystem that enables you to gain useful insights from data. This knowledge can be used to optimize processes, leading to higher plant availability, efficiency and reliability, and ultimately to a more profitable plant. www.netilion.endress.com
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.  Operating Instructions BA00027S and BA00059S
DeviceCare	Tool to connect and configure Endress+Hauser field devices.  Innovation brochure IN01047S

# 16 Technical data

# 16.1 Application

To ensure that the device remains in proper operating condition for its service life, use the measuring device only for media against which the process-wetted materials are sufficiently resistant.

# 16.2 Function and system design

Measuring principle

Mass flow measurement based on the Coriolis measuring principle

### Measuring system

The measuring system consists of a transmitter, a sensor and a disposable measuring tube.

- The device is available for front panel mounting:
   The transmitter and sensor are mounted physically separate from each other and are attached to each other via connecting cables.
- The device is available in a table-top version:
   The transmitter and sensor form a mechanical unit.

#### 16.3 Input

#### Measured variable

### Direct measured variables

- Mass flow
- Density
- Temperature

### Calculated measured variables

- Volume flow
- Corrected volume flow
- Reference density

### Measuring range

### Measuring range for liquids

Full scale value defined at 0.2 bar pressure loss.

DN		Measuring range full scal	e values $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$
[mm]	[in]	[kg/min]	[lb/min]
4	1/8	0 to 2	0 to 4.4
6	1/4	0 to 4.8	0 to 10.6
15	1/2	0 to 28.6	0 to 63.1
25	1	0 to 75	0 to 165.3

### Recommended measuring range



Flow limit  $\rightarrow \triangleq 239$ 

### Operable flow range

Over 1000:1.

Flow rates above the preset full scale value do not override the electronics unit, with the result that the totalizer values are registered correctly.

### Input signal

### External measured values

To increase the measurement accuracy of certain measured variables, the automation system can continuously write various measured values to the measuring instrument:

- pressure to increase measurement accuracy (Endress+Hauser recommends the use of a pressure measuring device for absolute pressure, e.g. Cerabar M or Cerabar S)
- Medium temperature to increase measurement accuracy

### Current input

The measured values are written from the automation system to the measuring device via 

### Digital communication

The measured values are written by the automation system via Modbus RS485.

### Current input 0/4 to 20 mA

Current input	0/4 to 20 mA (active/passive)
Current span	<ul><li>4 to 20 mA (active)</li><li>0/4 to 20 mA (passive)</li></ul>

Resolution	1 μΑ
Voltage drop	Typically: 0.6 to 2 V for 3.6 to 22 mA (passive)
Maximum input voltage	≤ 30 V (passive)
Open-circuit voltage	≤ 28.8 V (active)
Possible input variables	<ul><li>Pressure</li><li>Temperature</li><li>Density</li></ul>

## Status input

Maximum input values	<ul> <li>DC -3 to 30 V</li> <li>If status input is active (ON): R<sub>i</sub> &gt;3 kΩ</li> </ul>
Response time	Configurable: 5 to 200 ms
Input signal level	<ul> <li>Low signal: DC -3 to +5 V</li> <li>High signal: DC 12 to 30 V</li> </ul>
Assignable functions	<ul> <li>Off</li> <li>Reset the individual totalizers separately</li> <li>Reset all totalizers</li> <li>Flow override</li> </ul>

# 16.4 Output

# Output signal

## Modbus RS485

Physical interface	RS485 in accordance with EIA/TIA-485 standard
Terminating resistor	Integrated, can be activated via DIP switches

# Current output 4 to 20 mA

Signal mode	Can be set to: Active Passive
Current range	Can be set to:  4 to 20 mA NAMUR  4 to 20 mA US  4 to 20 mA  0 to 20 mA (only if the signal mode is active)  Fixed current
Maximum output values	22.5 mA
Open-circuit voltage	DC 28.8 V (active)
Maximum input voltage	DC 30 V (passive)
Load	0 to 700 Ω
Resolution	0.38 μΑ
Damping	Configurable: 0 to 999.9 s
Assignable measured variables	<ul> <li>Mass flow</li> <li>Volume flow</li> <li>Corrected volume flow</li> <li>Density</li> <li>Reference density</li> <li>Temperature</li> <li>Electronics temperature</li> <li>Oscillation frequency 0</li> <li>Oscillation damping 0</li> <li>Signal asymmetry</li> <li>Exciter current 0</li> <li>The range of options increases if the measuring device has one or more application packages.</li> </ul>

# Pulse/frequency/switch output

Function	Can be configured as pulse, frequency or switch output
Version	Open collector Can be set to: Active Passive Passive NAMUR
	Ex-i, passive
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Voltage drop	For 22.5 mA: ≤ DC 2 V
Pulse output	
Maximum input values	DC 30 V, 250 mA (passive)

Maximum output current	22.5 mA (active)
Open-circuit voltage	DC 28.8 V (active)
Pulse width	Configurable: 0.05 to 2 000 ms
Maximum pulse rate	10 000 Impulse/s
Pulse value	Configurable
Assignable measured variables	<ul><li>Mass flow</li><li>Volume flow</li><li>Corrected volume flow</li></ul>
	The range of options increases if the measuring device has one or more application packages.
Frequency output	
Maximum input values	DC 30 V, 250 mA (passive)
Maximum output current	22.5 mA (active)
Open-circuit voltage	DC 28.8 V (active)
Output frequency	Configurable: end value frequency 2 to $10000\text{Hz}(f_{max}=12500\text{Hz})$
Damping	Configurable: 0 to 999.9 s
Pulse/pause ratio	1:1
Assignable measured variables	<ul> <li>Mass flow</li> <li>Volume flow</li> <li>Corrected volume flow</li> <li>Density</li> <li>Reference density</li> <li>Temperature</li> <li>Electronics temperature</li> <li>Oscillation frequency 0</li> <li>Oscillation damping 0</li> <li>Signal asymmetry</li> <li>Exciter current 0</li> <li>The range of options increases if the measuring device has one or more application packages.</li> </ul>
Switch output	
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s
Number of switching cycles	Unlimited
Assignable functions	■ Disable ■ On ■ Diagnostic behavior ■ Limit ■ Mass flow ■ Volume flow ■ Corrected volume flow ■ Density ■ Reference density ■ Temperature ■ Totalizer 1-3 ■ Flow direction monitoring ■ Status ■ Partially filled pipe detection ■ Low flow cut off  ■ The range of options increases if the measuring device has one or more application packages.

## Double pulse output

Function	Double pulse
Version	Open collector
	Can be set to:  Active Passive Passive NAMUR
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Voltage drop	For 22.5 mA: ≤ DC 2 V
Output frequency	Configurable: 0 to 1000 Hz
Damping	Configurable: 0 to 999 s
Pulse/pause ratio	1:1
Assignable measured variables	<ul> <li>Mass flow</li> <li>Volume flow</li> <li>Corrected volume flow</li> <li>Density</li> <li>Reference density</li> <li>Temperature</li> <li>The range of options increases if the measuring device has one or more application packages.</li> </ul>

## Relay output

Function	Switch output
Version	Relay output, galvanically isolated
Switching behavior	Can be set to: NO (normally open), factory setting NC (normally closed)
Maximum switching capacity (passive)	<ul> <li>DC 30 V, 0.1 A</li> <li>AC 30 V, 0.5 A</li> </ul>
Assignable functions	<ul> <li>Disable</li> <li>On</li> <li>Diagnostic behavior</li> <li>Limit</li> <li>Mass flow</li> <li>Volume flow</li> <li>Corrected volume flow</li> <li>Density</li> <li>Reference density</li> <li>Temperature</li> <li>Totalizer 1-3</li> <li>Flow direction monitoring</li> <li>Status</li> <li>Partially filled pipe detection</li> <li>Low flow cut off</li> <li>The range of options increases if the measuring device has one or more application packages.</li> </ul>

# User-configurable input/output

 $\textbf{One} \ \text{specific input or output is assigned to a user-configurable input/output (configurable I/O) during device commissioning.}$ 

The following inputs and outputs are available for assignment:

- Choice of current output: 4 to 20 mA (active), 0/4 to 20 mA (passive)
- Pulse/frequency/switch output
- Choice of current input: 4 to 20 mA (active), 0/4 to 20 mA (passive)
- Status input

## Signal on alarm

Depending on the interface, failure information is displayed as follows:

### Modbus RS485

Failure mode	Choose from:
	NaN value instead of current value
	Last valid value

## Current output 0/4 to 20 mA

### 4 to 20 mA

Failure mode	Choose from:  4 to 20 mA in accordance with NAMUR recommendation NE 43  4 to 20 mA in accordance with US  Min. value: 3.59 mA  Max. value: 22.5 mA  Definable value between: 3.59 to 22.5 mA  Actual value  Last valid value
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### 0 to 20 mA

Failure mode	Choose from:
	■ Maximum alarm: 22 mA
	■ Definable value between: 0 to 20.5 mA

## Pulse/frequency/switch output

Pulse output	
Fault mode	Choose from:  Actual value  No pulses
Frequency output	
Fault mode	Choose from:  Actual value  O Hz  Definable value between: 2 to 12 500 Hz
Switch output	
Fault mode	Choose from:  Current status  Open  Closed

## Relay output

Failure mode	Choose from: Current status Open
	■ Closed

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## Local display

Plain text display With information on cause and remedial measures	
Backlight	Red lighting indicates a device error.



Status signal as per NAMUR recommendation NE 107

## Interface/protocol

- Via digital communication: Modbus RS485
- Via service interface
  - CDI-RJ45 service interface
  - WLAN interface

Plain text display	With information on cause and remedial measures
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### Web browser

Plain text display	With information on cause and remedial measures

## Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes			
	The following information is displayed depending on the device version:  Supply voltage active  Data transmission active  Device alarm/error has occurred			
	Diagnostic information via light emitting diodes →   202			

Low flow cut off

The switch points for low flow cut off are user-selectable.

Galvanic isolation

The outputs are galvanically isolated:

- from the power supply
- from one another
- from the potential equalization (PE) terminal

### Protocol-specific data

Protocol	Modbus Applications Protocol Specification V1.1		
Response times	<ul> <li>Direct data access: typically 25 to 50 ms</li> <li>Auto-scan buffer (data range): typically 3 to 5 ms</li> </ul>		
Device type	Slave		
Slave address range	1 to 247		
Broadcast address range	0		
Function codes	<ul> <li>03: Read holding register</li> <li>04: Read input register</li> <li>06: Write single registers</li> <li>08: Diagnostics</li> <li>16: Write multiple registers</li> <li>23: Read/write multiple registers</li> </ul>		

Broadcast messages	Supported by the following function codes:  O6: Write single registers  16: Write multiple registers  23: Read/write multiple registers
Supported baud rate	<ul> <li>1200 BAUD</li> <li>2400 BAUD</li> <li>4800 BAUD</li> <li>9600 BAUD</li> <li>19200 BAUD</li> <li>38400 BAUD</li> <li>57600 BAUD</li> <li>115200 BAUD</li> </ul>
Data transmission mode	■ ASCII ■ RTU
Data access	Each device parameter can be accessed via Modbus RS485.  For Modbus register information
System integration	Information regarding system integration → 🗎 72.  Modbus RS485 information Function codes Register information Response time Modbus data map

# 16.5 Power supply

Terminal assignment

→ 🖺 32

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Order code "Power supply"	Terminal voltage		Frequency range
Option I	DC 24 V	±20%	-
Option I	AC 100 to 240 V	-15+10%	50/60 Hz

### Power consumption

### Transmitter

Max. 10 W (active power)

switch-on current	Max. 36 A (<5 ms) as per NAMUR Recommendation NE 21
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### Current consumption

### Transmitter

- Max. 400 mA (24 V)
- Max. 200 mA (110 V, 50/60 Hz; 230 V, 50/60 Hz)

### Power supply failure

- Totalizers stop at the last value measured.
- Depending on the device version, the configuration is retained in the device memory or in the pluggable data memory (HistoROM DAT).
- Error messages (incl. total operated hours) are stored.

# Overcurrent protection element

The device must be operated with a dedicated circuit breaker, as it does not have an  $\mbox{ON/OFF}$  switch of its own.

- The circuit breaker must be easy to reach and labeled accordingly.
- Permitted nominal current of the circuit breaker: 2 A up to maximum 10 A.

Electrical connection	→ 🖺 34				
Potential equalization	→ 🗎 37				
Terminals		Spring-loaded terminals: Suitable for strands and strands with ferrules. Conductor cross-section 0.2 to 2.5 mm <sup>2</sup> (24 to 12 AWG).			
Cable entries	<ul> <li>Cable gland: M20 × 1.5 with cable</li> <li>Thread for cable entry:</li> <li>NPT ½"</li> <li>G ½"</li> <li>M20</li> </ul>	■ NPT ½" ■ G ½"			
Cable specification	→ 🖺 30				
Overvoltage protection	Mains voltage fluctuations	→ 🖺 234			
	Overvoltage category	Overvoltage category II			
	Short-term, temporary overvoltage	Between cable and ground up to 1200 V, for max. 5 s			
	Long-term, temporary overvoltage	Between cable and ground up to 500 V			

## 16.6 Performance characteristics

# Reference operating conditions

- Error limits based on ISO 11631
- Water
  - +15 to +45 °C (+59 to +113 °F)
  - 2 to 6 bar (29 to 87 psi)
- Data as indicated in the calibration protocol
- Accuracy based on accredited calibration rigs according to ISO 17025

Maximum measurement error

o.r. = of reading;  $1 \text{ g/cm}^3 = 1 \text{ kg/l}$ ; T = medium temperature

🚹 In non-condensing environment.

### Base accuracy

P Design fundamentals → 🗎 237

Mass flow and volume flow (liquids)

±0.5 % o.r.

**Temperature** 

±2.5 °C (±4.5 °F)

## Zero point stability

DN		Zero point stability		
[mm] [in]		[kg/min] [lb/min		
4	1/8	0.0006	0.00132	
6	1/4	0.0023	0.00507	
15	1/2	0.0082	0.01808	
25	1	0.0227	0.05004	

### Flow values

Flow values as turndown parameters depending on nominal diameter.

### SI units

DN	1:1	1:10	1:20	1:50	1:100	1:500
[mm]	[kg/h]	[kg/h]	[kg/h]	[kg/h]	[kg/h]	[kg/h]
4	450	45	22.5	9	4.5	0.9
6	1000	100	50	20	10	2
15	6500	650	325	130	65	13
25	18000	1800	900	360	180	36

### US units

DN	1:1	1:10	1:20	1:50	1:100	1:500
[inch]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]
1/8	16.54	1.654	0.827	0.331	0.165	0.033
1/4	36.75	3.675	1.838	0.735	0.368	0.074
1/2	238.9	23.89	11.95	4.778	2.389	0.478
1	661.5	66.15	33.08	13.23	6.615	1.323

## Accuracy of outputs

The outputs have the following base accuracy specifications.

Current output

Accuracy	±5 μA
----------	-------

Pulse/frequency output

o.r. = of reading

Repeatability

o.r. = of reading;  $1 \text{ g/cm}^3 = 1 \text{ kg/l}$ ; T = medium temperature

## Base repeatability

Mass flow and volume flow (liquids)

±0.25 % o.r.

Density (liquids)

- Basic accuracy: ±0.01 g/cm<sup>3</sup>
- Repeatability: ±0.005 g/cm<sup>3</sup>

**Temperature** 

±0.125 °C (±0.225 °F)

### Response time

The response time depends on the configuration (damping).

# Influence of ambient temperature

### **Current output**

Temperature coefficient	Max. 1 μA/°C

### Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.	
-------------------------	---	--

# Influence of medium temperature

### Mass flow

o.f.s. = of full scale value

If there is a difference between the temperature during zero adjustment and the process temperature, the additional measurement error of the sensors is typically  $\pm 0.0002$  %o.f.s./°C ( $\pm 0.0001$  % o.f.s./°F).

The influence is reduced when the zero adjustment is performed at process temperature.

### Density

Density performance is identical across the entire temperature range.

### **Temperature**

 $\pm 0.005 \cdot \text{T} \,^{\circ}\text{C} \, (\pm 0.005 \cdot (\text{T} - 32) \,^{\circ}\text{F})$ 

# Influence of medium pressure

A difference between the calibration pressure and process pressure does not affect accuracy.



A pressure of >0.2 bar is required for accurate measurement. Pressures lower than this can lead to incorrect measurement results due to cavitation and the formation of air bubbles.

### Design fundamentals

o.r. = of reading, o.f.s. = of full scale value

BaseAccu = base accuracy in % o.r., BaseRepeat = base repeatability in % o.r.

MeasValue = measured value; ZeroPoint = zero point stability

### Calculation of the maximum measured error as a function of the flow rate

Flow rate	Maximum measured error in % o.r.
$\geq \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$	± BaseAccu
A0021332	Augusti
$< \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$	± ZeroPoint MeasValue · 100
A0021333	A0021334

## Calculation of the maximum repeatability as a function of the flow rate

Flow rate	Maximum repeatability in % o.r.
$\geq \frac{\frac{1}{2} \cdot ZeroPoint}{BaseRepeat} \cdot 100$	± BaseRepeat
A0021335	A0021340
$<\frac{\frac{1}{2} \cdot ZeroPoint}{BaseRepeat} \cdot 100$	$\pm \frac{1}{2} \cdot \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$
A0021336	A0021337

# 16.7 Mounting

Mounting requirements

→ 🖺 21

## 16.8 Environment

Ambient temperature range	→ 🖺 22
Storage temperature	-40 to +70 °C (−40 to +158 °F)
Climate class	DIN EN 60068-2-38 (test Z/AD)
Relative humidity	The device is suitable for indoor use with a relative humidity of 5 to 40 %.
Operating height	According to EN 61010-1  ■ ≤ 2 000 m (6 562 ft)  > 2 000 m (6 562 ft) with additional overvoltage protection (e.g. Endress+Hauser HAW Series)

### Degree of protection

### Transmitter

- IP66/67, Type 4X enclosure, suitable for pollution degree 4
- When the housing is open: IP20, Type 1 enclosure, suitable for pollution degree 2
- Display module: IP20, Type 1 enclosure, suitable for pollution degree 2

### Sensor

- IP54
- When the housing is open: IP20

### External WLAN antenna

IP67

# Shock and vibration resistance

### Vibration sinusoidal, in accordance with IEC 60068-2-6

#### Sensor

- 2 to 8.4 Hz, 3.5 mm peak
- 8.4 to 2000 Hz, 1 g peak

### Transmitter

- 2 to 8.4 Hz, 7.5 mm peak
- 8.4 to 2000 Hz, 2 g peak

### Vibration broad-band random, according to IEC 60068-2-64

### Transmitter

- 10 to 200 Hz,  $0.01 \text{ g}^2/\text{Hz}$
- $\bullet$  200 to 2000 Hz, 0.003 g<sup>2</sup>/Hz
- Total: 2.70 g rms

### Shock half-sine, according to IEC 60068-2-27

Transmitter 6 ms 50 g

### Rough handling shocks according to IEC 60068-2-31

### Mechanical load

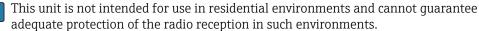
Transmitter housing, sensor and disposable measuring tube:

- Protect against mechanical effects, such as shock or impact
- Do not use as a ladder or climbing aid

# Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)
- As per IEC/EN 61000-6-2 and IEC/EN 61000-6-4

Details are provided in the Declaration of Conformity.



### 16.9 Process

Medium temperature range  $3 \text{ to } 60 \,^{\circ}\text{C} (37.4 \text{ to } 140 \,^{\circ}\text{F})$ 

Medium density 800 to 1500 kg/m<sup>3</sup> (1764 to 3307 lb/cf)

Medium pressure 6 bar (87 psi)

### Flow limit

Select the nominal diameter by optimizing between the required flow range and permissible pressure loss.

For an overview of the full scale values for the measuring range, see the "Measuring range" section  $\rightarrow \stackrel{\triangle}{=} 227$ 

- The minimum recommended full scale value is approx. 1/20 of the maximum full scale value
- In most applications, 20 to 50 % of the maximum full scale value can be considered ideal
- A low full scale value must be selected for abrasive media (such as liquids with entrained solids): flow velocity < 1 m/s (< 3 ft/s).
- To calculate the flow limit, use the *Applicator* sizing tool  $\rightarrow \triangle 225$

### Pressure loss

### 16.10 Mechanical construction

### Design, dimensions

For the dimensions and installation lengths of the device, see the "Technical Information" document, "Mechanical construction" section

#### Process connections

Hose connection nipple:

Covestro Makrolon Rx1805 polycarbonate

### Surface roughness

All data refer to parts in contact with the medium.

The following surface roughness categories can be ordered:

■ Steel:

Ra =  $0.76 \mu m$  (30  $\mu in$ ) Mechanically polished

■ Plastic:

 $Ra = 0.76 \mu m (30 \mu in)$ 

# 16.11 Operability

### Languages

Can be operated in the following languages:

- Via local operation
  - English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Korean, Vietnamese, Czech, Swedish
- Via web browser
  - English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Vietnamese, Czech, Swedish
- Via "FieldCare", "DeviceCare" operating tool: English, German, French, Spanish, Italian, Chinese, Japanese

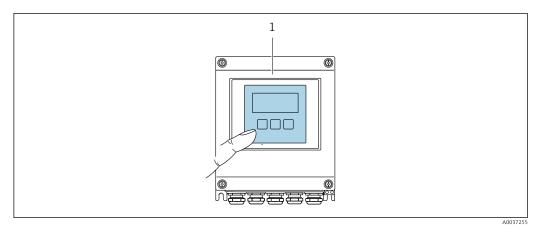
### Onsite operation

### Via display module

Features:

- Order code for "Display; operation", option F "4-line, illuminated, graphic display; touch control"
- Order code for "Display; operation", option G "4-line, illuminated, graphic display; touch control + WLAN"
- Information about WLAN interface  $\rightarrow \triangleq 67$

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40 Operation with touch control

1 Proline 500 – digital

### Display elements

- 4-line, illuminated, graphic display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured

### Operating elements

External operation via touch control (3 optical keys) without opening the housing:  $\boxdot$ ,  $\Box$ ,

Remote operation	→ 🗎 66
Service interface	→ 🖺 66

## Supported operating tools

Different operating tools can be used for local or remote access to the measuring device. Depending on the operating tool used, access is possible with different operating units and via a variety of interfaces.

Supported operating tools	Operating unit	Interface	Additional information
Web browser	Notebook, PC or tablet with Web browser	<ul><li>CDI-RJ45 service interface</li><li>WLAN interface</li></ul>	Special Documentation for device → 🖺 247
DeviceCare SFE100	Notebook, PC or tablet with Microsoft Windows system	<ul><li>CDI-RJ45 service interface</li><li>WLAN interface</li><li>Fieldbus protocol</li></ul>	→ 🖺 225
FieldCare SFE500	Notebook, PC or tablet with Microsoft Windows system	<ul><li>CDI-RJ45 service interface</li><li>WLAN interface</li><li>Fieldbus protocol</li></ul>	→ 🖺 225

Supported operating tools	Operating unit	Interface	Additional information
Field Xpert	SMT70/77/50	<ul> <li>All fieldbus protocols</li> <li>WLAN interface</li> <li>Bluetooth</li> <li>CDI-RJ45 service interface</li> </ul>	Operating Instructions BA01202S Device description files: Use update function of handheld terminal
SmartBlue app	Smartphone or tablet with iOs or Android	WLAN	→ 🖺 225

- Other operating tools based on FDT technology with a device driver such as DTM/iDTM or DD/EDD can be used for device operation. These operating tools are available from the individual manufacturers. Integration into the following operating tools, among others, is supported:
  - Field Device Manager (FDM) from Honeywell → www.process.honeywell.com
  - FieldMate from Yokogawa → www.yokogawa.com
  - PACTWare → www.pactware.com

The related device description files are available: www.endress.com → Download Area

#### Web server

With the integrated web server, the device can be operated and configured via a web browser service interface (CDI-RJ45) or WLAN interface. The structure of the operating menu is the same as for the local display. In addition to the measured values, status information on the device is displayed and can be used to monitor device health. Furthermore the device data can be managed and the network parameters can be configured.

A device that has a WLAN interface (can be ordered as an option) is required for the WLAN connection: order code for "Display; operation", option G "4-line, illuminated; touch control + WLAN". The device acts as an Access Point and enables communication by computer or a mobile handheld terminal.

### Supported functions

Data exchange between the operating unit (such as a notebook, for example,) and measuring device:

- Upload the configuration from the measuring device (XML format, configuration backup)
- Save the configuration to the measuring device (XML format, restore configuration)
- Export event list (.csv file)
- Export parameter settings (.csv file or PDF file, document the measuring point configuration)
- Export the Heartbeat verification report (PDF file, only available with the Heartbeat Verification application package)
- Flash firmware version for device firmware upgrade, for example
- Download driver for system integration
- Visualize up to 1000 saved measured values (only available with the Extended HistoROM application package)

HistoROM data management

The measuring device features HistoROM data management. HistoROM data management comprises both the storage and import/export of key device and process data, making operation and servicing far more reliable, secure and efficient.

When the device is delivered, the factory settings of the configuration data are stored as a backup in the device memory. This memory can be overwritten with an updated data record, for example after commissioning.

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### Additional information on the data storage concept

There are different types of data storage units in which device data are stored and used by the device:

	HistoROM backup	T-DAT	S-DAT
Available data	<ul> <li>Event logbook, e.g. diagnostic events</li> <li>Parameter data record backup</li> <li>Device firmware package</li> </ul>	<ul> <li>Measured value logging ("Extended HistoROM" order option)</li> <li>Current parameter data record (used by firmware at run time)</li> <li>Indicator (minimum/maximum values)</li> <li>Totalizer value</li> </ul>	<ul> <li>Sensor data: e.g. nominal diameter</li> <li>Serial number</li> <li>Calibration data</li> <li>Device configuration (e.g. SW options, fixed I/O or multi I/O)</li> </ul>
Storage location	Fixed on the user interface PC board in the connection compartment	Can be plugged into the user interface PC board in the connection compartment	In the sensor plug in the transmitter neck part

### Data backup

### **Automatic**

- The most important device data (sensor and transmitter) are automatically saved in the DAT modules
- If the transmitter or measuring device is replaced: once the T-DAT containing the previous device data has been exchanged, the new measuring device is ready for operation again immediately without any errors
- If the sensor is replaced: once the sensor has been replaced, new sensor data are transferred from the S-DAT in the measuring device and the measuring device is ready for operation again immediately without any errors
- If exchanging the electronics module (e.g. I/O electronics module): Once the electronics module has been replaced, the software of the module is compared against the current device firmware. The module software is upgraded or downgraded where necessary. The electronics module is available for use immediately afterwards and no compatibility problems occur.

### Manual

Additional parameter data record (complete parameter settings) in the integrated device memory HistoROM backup for:

- Data backup function
   Backup and subsequent restoration of a device configuration in the device memory
   HistoROM backup
- Data comparison function
   Comparison of the current device configuration with the device configuration saved in the device memory HistoROM backup

### Data transmission

### Manual

Transfer of a device configuration to another device using the export function of the specific operating tool, e.g. with FieldCare, DeviceCare or Web server: to duplicate the configuration or to store in an archive (e.g. for backup purposes)

### **Event list**

### **Automatic**

- Chronological display of up to 20 event messages in the events list
- If the Extended HistoROM application package (order option) is enabled: up to 100
  event messages are displayed in the events list along with a time stamp, plain text
  description and remedial measures
- The events list can be exported and displayed via a variety of interfaces and operating tools e.g. DeviceCare, FieldCare or Web server

### Data logging

### Manual

If the **Extended HistoROM** application package (order option) is enabled:

- Recording of 1 to 4 channels of up to 1000 measured values (up to 250 measured values per channel)
- User configurable recording interval
- Export the measured value log via a variety of interfaces and operating tools e.g.
   FieldCare, DeviceCare or web server

# 16.12 Certificates and approvals

Current certificates and approvals for the product are available at <a href="https://www.endress.com">www.endress.com</a> on the relevant product page:

- 1. Select the product using the filters and search field.
- 2. Open the product page.
- 3. Select **Downloads**.

### CE mark

The device meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

### UKCA marking

The device meets the legal requirements of the applicable UK regulations (Statutory Instruments). These are listed in the UKCA Declaration of Conformity along with the designated standards. By selecting the order option for UKCA marking, Endress+Hauser confirms a successful evaluation and testing of the device by affixing the UKCA mark.

Contact address Endress+Hauser UK:

Endress+Hauser Ltd.

Floats Road

Manchester M23 9NF

United Kingdom

www.uk.endress.com

## RCM marking

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

### Material certificate

- Bioburden
- Inorganic and organic residues
- Cytotoxicity growth inhibition
- Sensitization
- Systemic toxicity
- GC/MS fingerprints a. extraction
- Physico-chemical resistance
- Biocompatibility of plastics
- Hemolysis
- ISO Class 7 clean room
- Medical devices OM
- Conformities
- Ingredients for rubber parts
- Ingredients for plastic parts
- Medical packaging

- Gamma radiation
- O-ring standard
- FDA



A comprehensive listing of the serial number-specific disposable measuring tube can be found in the certificate of conformity for single-use requirements in the biopharmaceutical industry.

### Radio approval

The measuring device has radio approval.



For detailed information on the radio approval, see the Special Documentation → 🖺 247

### Additional certification

### CRN approval

Some device versions have CRN approval. A CRN-approved process connection with a CSA approval must be ordered for a CRN-approved device.

### Tests and certificates

## External standards and guidelines

■ EN 60529

Degrees of protection provided by enclosures (IP code)

■ IEC/EN 60068-2-6

Environmental influences: Test procedure - Test Fc: vibrate (sinusoidal).

■ IEC/EN 60068-2-31

Environmental influences: Test procedure - Test Ec: shocks due to rough handling, primarily for devices.

■ EN 61010-1

Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements

■ EN 61326-1/-2-3

EMC requirements for electrical equipment for measurement, control and laboratory use

■ NAMUR NE 21

Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment

■ NAMUR NE 32

Data retention in the event of a power failure in field and control instruments with microprocessors

■ NAMUR NE 43

Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.

■ NAMUR NE 53

Software of field devices and signal-processing devices with digital electronics

■ NAMUR NE 105

Specifications for integrating fieldbus devices in engineering tools for field devices

■ NAMUR NE 107

Self-monitoring and diagnosis of field devices

NAMUR NE 131

Requirements for field devices for standard applications

■ NAMUR NE 132

Coriolis mass meter

■ ETSI EN 300 328

Guidelines for 2.4 GHz radio components.

■ EN 301489

Electromagnetic compatibility and radio spectrum matters (ERM).

Animal Free (ADI)

# 16.13 Application packages

Many different application packages are available to enhance the functionality of the device. Such packages might be needed to address safety aspects or specific application requirements.

The application packages can be ordered with the device or subsequently from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Detailed information on the application packages: Special Documentation → 

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### 16.14 Accessories



Overview of accessories available to order → 🖺 224

# **16.15** Supplemental documentation

- For an overview of the scope of the associated Technical Documentation, refer to the following:
  - Device Viewer (www.endress.com/deviceviewer): Enter the serial number from the nameplate
  - Endress+Hauser Operations app: Enter serial number from nameplate or scan matrix code on nameplate.

Standard documentation

### Brief operating instructions

*Brief Operating Instructions for the sensor* 

Measuring instrument	Documentation code
Proline Promass U	KA01686D

### *Brief Operating Instructions for the transmitter*

Measuring device	Documentation code
Proline 500 – digital	KA01319D
Proline 500	KA01318D

### Technical information

Measuring device	Documentation code
------------------	--------------------

### Description of device parameters

Measuring instrument	Documentation code
Promass 500	GP01062D

Supplementary devicedependent documentation

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01614D
Radio approvals for WLAN interface for A309/A310 display module	SD01793D

## **Installation instructions**

Contents	Note
Installation instructions for spare part sets and accessories	<ul> <li>Access the overview of all the available spare part sets via <i>Device Viewer</i> →          <sup>1</sup> 222</li> <li>Accessories available for order with Installation Instructions →          <sup>2</sup> 224</li> </ul>

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