

Operating Instructions

Proline t-mass I 500

Thermal mass 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 Center will supply you with current information and updates to these instructions.

Table of contents

1	About this document	6	5.2	Mounting the measuring device	28
1.1	Document function	6	5.2.1	Required tool	28
1.2	Symbols	6	5.2.2	Preparing the measuring device	28
1.2.1	Safety symbols	6	5.2.3	Mounting the measuring device	28
1.2.2	Electrical symbols	6	5.2.4	Mounting the transmitter housing: Proline 500 – digital	30
1.2.3	Communication-specific symbols	6	5.3	Post-installation check	32
1.2.4	Tool symbols	7			
1.2.5	Symbols for certain types of information	7	6	Electrical connection	33
1.2.6	Symbols in graphics	7	6.1	Electrical safety	33
1.3	Documentation	8	6.2	Connection requirements	33
1.3.1	Document function	8	6.2.1	Required tools	33
1.4	Registered trademarks	8	6.2.2	Requirements for connection cable	33
2	Safety instructions	9	6.2.3	Terminal assignment	37
2.1	Requirements for the personnel	9	6.2.4	Shielding and grounding	38
2.2	Intended use	9	6.2.5	Preparing the measuring device	38
2.3	Workplace safety	10	6.3	Connecting the measuring device: Proline 500 – digital	39
2.4	Operational safety	10	6.3.1	Connecting the connecting cable	39
2.5	Product safety	10	6.3.2	Connecting the signal cable and the supply voltage cable	42
2.6	IT security	11	6.4	Potential equalization	43
2.7	Device-specific IT security	11	6.4.1	Requirements	43
2.7.1	Protecting access via hardware write protection	11	6.5	Special connection instructions	44
2.7.2	Protecting access via a password	11	6.5.1	Connection examples	44
2.7.3	Access via web server	12	6.6	Hardware settings	46
2.7.4	Access via service interface (CDI- RJ45)	13	6.6.1	Setting the device address	46
3	Product description	14	6.6.2	Activating the terminating resistor	47
3.1	Product design	14	6.7	Ensuring the degree of protection	48
3.1.1	Proline 500 – digital	14	6.7.1	Degree of protection IP68, Type 6P enclosure, with "Cust-potted" option	49
3.1.2	Proline 500	14	6.8	Post-connection check	49
4	Incoming acceptance and product identification	15	7	Operation options	50
4.1	Incoming acceptance	15	7.1	Overview of operation options	50
4.2	Product identification	15	7.2	Structure and function of the operating menu	51
4.2.1	Transmitter nameplate	16	7.2.1	Structure of the operating menu	51
4.2.2	Sensor nameplate	17	7.2.2	Operating philosophy	52
4.2.3	Symbols on the device	17	7.3	Access to operating menu via local display	53
4.3	Storage and transport	18	7.3.1	Operational display	53
4.3.1	Storage conditions	18	7.3.2	Navigation view	55
4.3.2	Transporting the product	18	7.3.3	Editing view	57
4.3.3	Packaging disposal	18	7.3.4	Operating elements	59
5	Mounting	19	7.3.5	Opening the context menu	59
5.1	Mounting requirements	19	7.3.6	Navigating and selecting from list	61
5.1.1	Installation position	19	7.3.7	Calling the parameter directly	61
5.1.2	Environment and process requirements	25	7.3.8	Calling up help text	62
5.1.3	Special mounting instructions	27	7.3.9	Changing the parameters	62
			7.3.10	User roles and related access authorization	63
			7.3.11	Disabling write protection via access code	63

7.3.12	Enabling and disabling the keypad lock	64	9.5.6	Using parameters for device administration	117
7.4	Access to operating menu via web browser ...	64	9.5.7	In-situ adjustment	118
7.4.1	Function range	64	9.6	Configuration management	125
7.4.2	Requirements	65	9.6.1	Function scope of the "Configuration management" parameter	125
7.4.3	Establishing a connection	66	9.7	Simulation	126
7.4.4	Logging on	68	9.8	Protecting settings from unauthorized access	128
7.4.5	User interface	69	9.8.1	Write protection via access code ...	128
7.4.6	Disabling the Web server	70	9.8.2	Write protection via write protection switch	130
7.4.7	Logging out	70			
7.5	Access to the operating menu via the operating tool	71	10	Operation	132
7.5.1	Connecting the operating tool	71	10.1	Reading off the device locking status	132
7.5.2	FieldCare	73	10.2	Adjusting the operating language	132
7.5.3	DeviceCare	74	10.3	Configuring the display	132
8	System integration	75	10.4	Reading off measured values	132
8.1	Overview of device description files	75	10.4.1	Process variables	133
8.1.1	Current version data for the device ...	75	10.4.2	System values	134
8.1.2	Operating tools	75	10.4.3	"Totalizer" submenu	134
8.2	Compatibility with earlier model	75	10.4.4	"Input values" submenu	135
8.3	Modbus RS485 information	76	10.4.5	Output values	136
8.3.1	Function codes	76	10.5	Adapting the measuring device to the process conditions	138
8.3.2	Register information	77	10.6	Performing a totalizer reset	138
8.3.3	Response time	77	10.6.1	Function scope of "Control Totalizer" parameter	139
8.3.4	Data types	77	10.6.2	Function range of "Reset all totalizers" parameter	139
8.3.5	Byte transmission sequence	78	10.7	Displaying data logging	139
8.3.6	Modbus data map	78	11	Diagnostics and troubleshooting ..	142
9	Commissioning	81	11.1	General troubleshooting	142
9.1	Post-mounting and post-connection check ...	81	11.2	Diagnostic information via light emitting diodes	144
9.2	Switching on the measuring device	81	11.2.1	Transmitter	144
9.3	Setting the operating language	81	11.2.2	Sensor connection housing	145
9.4	Configuring the measuring device	82	11.3	Diagnostic information on local display	146
9.4.1	Defining the tag name	83	11.3.1	Diagnostic message	146
9.4.2	Configuring the measurement mode ..	83	11.3.2	Calling up remedial measures	148
9.4.3	Configuring reference conditions	87	11.4	Diagnostic information in the web browser ..	148
9.4.4	Sensor adjustment	88	11.4.1	Diagnostic options	148
9.4.5	Setting the system units	89	11.4.2	Calling up remedy information	149
9.4.6	Configuring the communication interface	91	11.5	Diagnostic information in FieldCare or DeviceCare	149
9.4.7	Displaying the I/O configuration	92	11.5.1	Diagnostic options	149
9.4.8	Configuring the current input	93	11.5.2	Calling up remedy information	150
9.4.9	Configuring the status input	94	11.6	Diagnostic information via communication interface	151
9.4.10	Configuring the current output	95	11.6.1	Reading out diagnostic information	151
9.4.11	Configuring the pulse/frequency/switch output	98	11.6.2	Configuring error response mode ...	151
9.4.12	Configuring the relay output	104	11.7	Adapting the diagnostic information	151
9.4.13	Configuring the local display	105	11.7.1	Adapting the diagnostic behavior ...	151
9.4.14	Configuring the low flow cut off	108	11.8	Overview of diagnostic information	152
9.5	Advanced settings	109	11.9	Pending diagnostic events	155
9.5.1	Using the parameter to enter the access code	109	11.10	Diagnostic list	156
9.5.2	Configuring the totalizer	109	11.11	Event logbook	156
9.5.3	Carrying out additional display configurations	111	11.11.1	Reading out the event logbook	156
9.5.4	WLAN configuration	114			
9.5.5	Configuration management	115			

11.11.2	Filtering the event logbook	157
11.11.3	Overview of information events	157
11.12	Resetting the measuring device	159
11.12.1	Function range of "Device reset" parameter	159
11.13	Device information	159
11.14	Firmware history	160
12	Maintenance	161
12.1	Maintenance tasks	161
12.1.1	Exterior cleaning	161
12.1.2	Sensing element cleaning	161
12.1.3	Recalibration	162
12.2	Measuring and test equipment	162
12.3	Endress+Hauser services	162
13	Repair	163
13.1	General information	163
13.1.1	Repair and conversion concept	163
13.1.2	Notes for repair and conversion	163
13.2	Spare parts	163
13.3	Endress+Hauser services	163
13.4	Return	163
13.5	Disposal	164
13.5.1	Removing the measuring device	164
13.5.2	Disposing of the measuring device . .	164
14	Accessories	165
14.1	Device-specific accessories	165
14.1.1	For the transmitter	165
14.1.2	For the sensor	166
14.2	Communication-specific accessories	167
14.3	Service-specific accessories	168
14.4	System components	169
15	Technical data	170
15.1	Application	170
15.2	Function and system design	170
15.3	Input	171
15.4	Output	176
15.5	Power supply	181
15.6	Performance characteristics	183
15.7	Mounting	184
15.8	Environment	184
15.9	Process	187
15.10	Mechanical construction	188
15.11	Display and user interface	192
15.12	Certificates and approvals	196
15.13	Application packages	199
15.14	Accessories	200
15.15	Documentation	200
Index		202

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.

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
	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.
	LED Light emitting diode is off.

Symbol	Meaning
	LED Light emitting diode is on.
	LED Light emitting diode is flashing.

1.2.4 Tool symbols

Symbol	Meaning
	Torx screwdriver
	Phillips head screwdriver
	Open-ended wrench

1.2.5 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps
	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
	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections
	Hazardous area

Symbol	Meaning
	Safe area (non-hazardous area)
	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.

1.3.1 Document function

The following documentation may be available depending on the 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 The Operating Instructions contain all the information that is required in the various phases of the life cycle 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.
Safety Instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. The Safety Instructions are an integral part of the Operating Instructions.  Information on the Safety Instructions (XA) relevant to the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral 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 gases.

Depending on the version ordered, the measuring device can also measure potentially explosive, flammable, poisonous and oxidizing media.

Measuring devices for use in hazardous areas or where the process pressures pose an increased risk, are marked specifically on the nameplate.

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

- ▶ Use the measuring device only for media to which the process-wetted materials are sufficiently resistant.
- ▶ Keep within the specified pressure and temperature range.
- ▶ 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.
- ▶ Check the nameplate to verify if the device ordered can be put to its intended use in the hazardous area (e.g. explosion protection, pressure equipment safety).
- ▶ If the ambient temperature of the measuring device is outside the atmospheric range, it is absolutely essential to comply with the relevant basic conditions as specified →  8 in the device documentation.
- ▶ 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.

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.

⚠ WARNING**Injury from sensor being ejected!**

- ▶ The sensor gland should be opened only when in an unpressurized state.

NOTICE**Penetration of dust and moisture when the transmitter housing is opened.**

- ▶ Only open the transmitter housing briefly, ensuring that no dust or moisture enters the housing.

Residual risks**⚠ CAUTION****The electronics and the medium may cause the surfaces to heat up or freeze. Risk of burns or frostbite!**

- ▶ Mount suitable touch protection.

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 in-operation 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 →  11	Not enabled	On an individual basis following risk assessment
Access code (also applies to web server login or FieldCare connection) →  12	Not enabled (0000)	Assign a customized access code during commissioning
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) →  12	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 →  13	–	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.

Hardware write protection is disabled when the device is delivered →  130.

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 (→  128).

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

A connection between an operating unit (e.g. notebook or tablet) and the device via the WLAN interface (→  72), which can be ordered as an optional extra, is protected by the network key. The WLAN authentication of the network key complies with the IEEE 802.11 standard.

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 (→  115).

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 key.
- The user is responsible for the management and careful handling of the access code and network key.
- 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" →  128.

2.7.3 Access via web server

The integrated web server can be used to operate and configure the device via a web browser →  64. The connection is established via the service interface (CDI-RJ45) 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.



For detailed information on device parameters, see:
"Description of Device Parameters" document (**Verweisziel existiert nicht, aber @y.link.required=true**).

2.7.4 Access via service interface (CDI-RJ45)

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

The use of relevant industrial standards and guidelines 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 and a sensor. The transmitter and sensor are mounted in physically separate locations. They are interconnected by connecting cables.

3.1 Product design

3.1.1 Proline 500 – digital

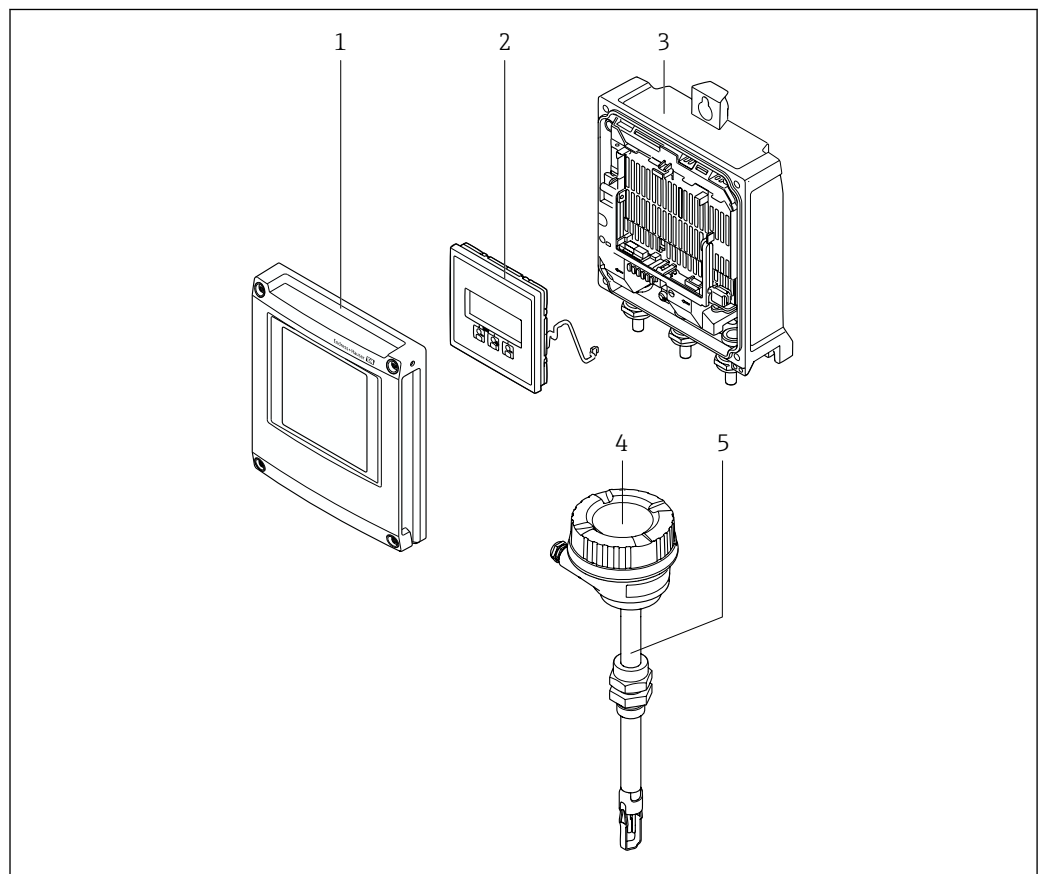
Signal transmission: digital

Order code for "Integrated ISEM electronics", option **A** "Sensor"

For use in applications not required to meet special requirements due to ambient or operating conditions.

As the electronics are located in the sensor, the device is ideal:
For simple transmitter replacement.

- A standard cable can be used as the connecting cable.
- Not sensitive to external EMC interference.



- 1 Electronics compartment cover
- 2 Display module
- 3 Transmitter housing
- 4 Sensor connection housing with integrated ISEM electronics: connecting cable connection
- 5 Sensor

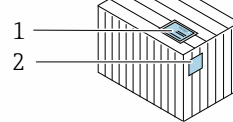
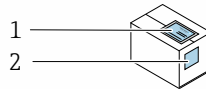
3.1.2 Proline 500

Signal transmission: analog

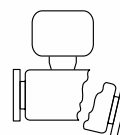
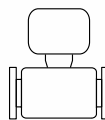
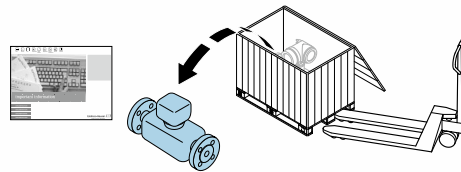
Order code for "Integrated ISEM electronics", option **B** "Transmitter"

4 Incoming acceptance and product identification

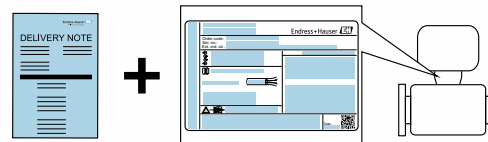
4.1 Incoming acceptance



Are the order codes on the delivery note (1) and the product sticker (2) identical?



Are the goods undamaged?



Does the data on the nameplate match the order specifications on the delivery note?



Is the envelope present with accompanying documents?



- 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 → 16.

4.2 Product identification

The following options are available for identification of the device:

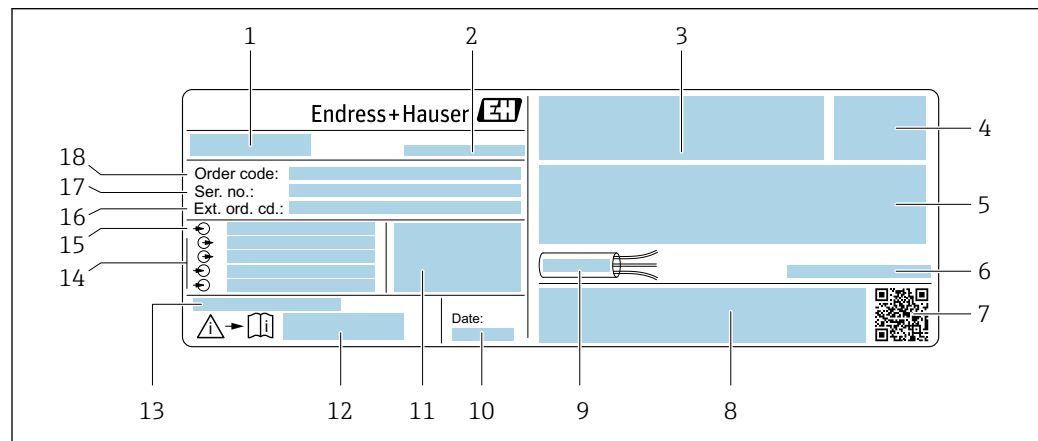
- Nameplate
- Order code with details of the device features on the delivery note
- Enter the serial numbers from the nameplates in the *Device Viewer* (www.endress.com/deviceviewer): all the information about the device is displayed.
- Enter the serial numbers from the nameplates into the *Endress+Hauser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

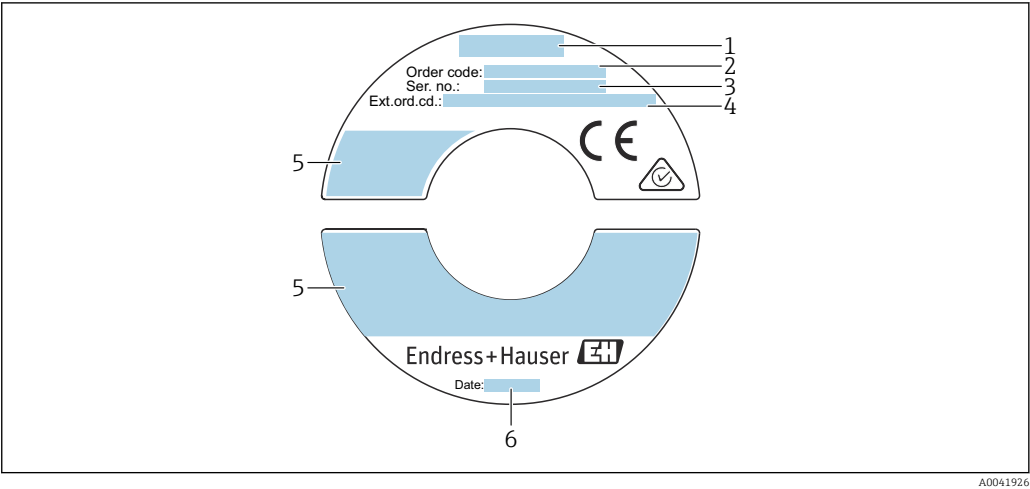


A0029194

1 Example of a transmitter nameplate

- 1 Name of the transmitter
- 2 Manufacturer address/certificate holder
- 3 Space for approvals: use in hazardous areas
- 4 Degree of protection
- 5 Electrical connection data: available inputs and outputs
- 6 Permitted 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
- 17 Serial number
- 18 Order code

4.2.2 Sensor nameplate



2 Example of sensor nameplate

- 1 Name of sensor
- 2 Order code
- 3 Serial number
- 4 Extended order code
- 5 Flow; length of sensor; pressure rating; nominal pressure; system pressure; medium temperature range; permitted ambient temperature range (T_a); explosion protection approval information, Pressure Equipment Directive and degree of protection
- 6 Date of manufacture: year-month

i 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 approval-related 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 Symbols on the device

Symbol	Meaning
	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.
	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.

4.3 Storage and transport

4.3.1 Storage conditions

Observe the following notes for storage:

- ▶ Store in the original packaging to ensure protection from shock.
- ▶ Do not remove protective covers or protective caps installed on process connections. They prevent mechanical damage to the sealing surfaces and contamination in the measuring tube.
- ▶ Protect from direct sunlight. Avoid unacceptably high surface temperatures.
- ▶ Select a storage location that excludes the possibility of condensation forming on the measuring device. Fungi and bacteria can damage the liner.
- ▶ Store in a dry and dust-free place.
- ▶ Do not store outdoors.

Storage temperature →  185

4.3.2 Transporting the product

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



Do not remove protection caps. They prevent mechanical damage.

4.3.3 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

5 Mounting

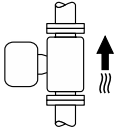
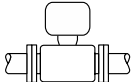
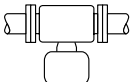
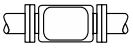
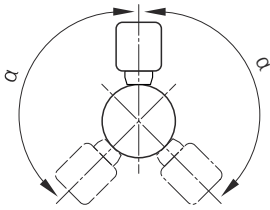
5.1 Mounting requirements

- The recommended inlet and outlet specifications must be observed.
- The piping system and the device must be installed according to good engineering practice.
- Ensure the correct alignment and orientation of the sensor.
- Take measures to avoid or prevent condensation (e.g. condensation trap, thermal insulation etc.).
- Observe the maximum permissible ambient temperatures and medium temperature range.
- Install the measuring device in a shady location or use a weather protection cover.
- For mechanical reasons and to protect the pipe, support is recommended for heavy sensors (e.g. with a hot-tap retractable assembly).

5.1.1 Installation position

Orientation

The direction of flow must match the direction of the arrow on the sensor. In the case of the bidirectional sensor, the arrow points in the positive direction. When performing bidirectional measurement, the sensing element must be installed with an accuracy of 3°.

Orientation		Recommendation
Vertical orientation	 A0015591	✓ ¹⁾
Horizontal orientation, transmitter head up	 A0015589	✓✓
Horizontal orientation, transmitter head down	 A0015590	✓ ²⁾
Horizontal orientation, transmitter head at side	 A0015592	✓
Inclined orientation, transmitter head down	 A0015773	✓ ²⁾

- 1) In the case of saturated or impure gases, vertical orientation is preferred in order to minimize condensation or contamination. For bidirectional sensors, select horizontal orientation.
- 2) Select inclined orientation ($\alpha = \text{approx. } 135^\circ$) for very wet or water-saturated gas (e.g. digester gas, undried compressed air), or if deposits or condensate are constantly present.

Pipes

The measuring device must be professionally installed, and the following points must be observed:

- Weld pipes professionally.
- Use seals of the correct size.
- Align flanges and seals correctly.
- Remove protection cap from sensing element.
- Following installation, the pipe must be free from dirt and particles in order to avoid damage to the sensors.
- For further information → ISO standard 14511.

Sensor selection and arrangement

The minimum length of the sensor can be determined using the Endress+Hauser Applicator program (version 10.00 or higher) or with the calculation formula below.

The minimum length of the sensor is determined by the necessary insertion depth. The calculated necessary insertion depth must be within the adjusting range of the selected insertion version.

Insertion depth

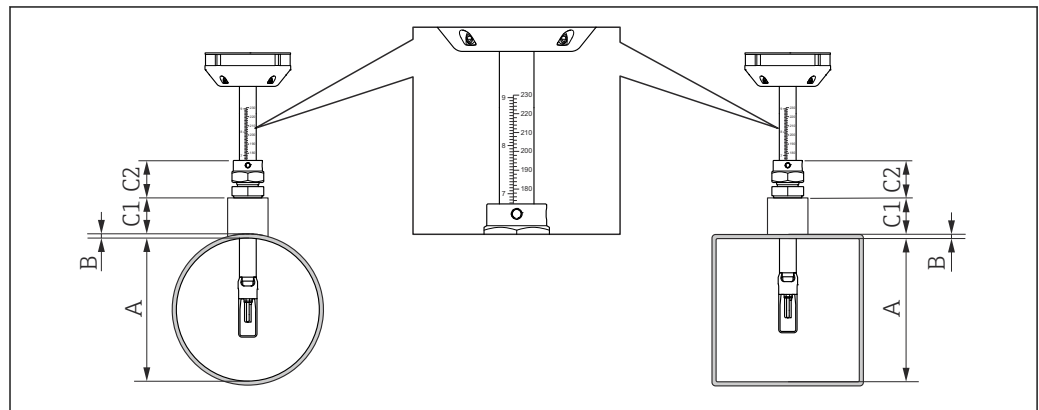
The minimum length of the insertion version can be determined using the Endress+Hauser Applicator program or with the calculation formula below. The calculated necessary insertion depth must be within the adjusting range of the selected insertion version.

NOTICE

Metal ferrules undergo plastic deformation during the initial installation.

As a result the insertion depth is fixed after initial installation and the ferrules can no longer be replaced.

- Pay attention to information on preconditions and on determining the insertion depth.
- Check the insertion depth closely before tightening the ferrules.



A0039548

3 Determine the dimensions A, B, C1 and C2

A In the case of a circular pipe: the pipe internal diameter (DN); in the case of a duct: the inner dimension

B Thickness of pipe wall or of duct wall

C1 Mounting kit

C2 Sensor's compression fitting

Calculating the insertion depth

$$\text{Insertion depth} = (0.3 \cdot A) + B + (C1 + C2)$$



The insertion depth must be at least 100mm.

*Determining dimensions C1 and C2**If only Endress+Hauser mounting bosses are used*

Mounting boss 1" NPT	C1 + C2 = 112 mm (4.409 in)
Mounting boss G1"	C1 + C2 = 106 mm (4.173 in)
Mounting boss ¾" NPT	C1 + C2 = 108 mm (4.252 in)
Mounting boss G¾"	C1 + C2 = 105 mm (4.134 in)



If a cold/hot tap is used, use dimension "L" →  188 instead of "C1".



Use Applicator to determine dimensions C1 and C2 if using other E+H mounting kits (e.g. cold/hot taps).

If not exclusively using Endress+Hauser mounting bosses

C1	Length of pipe connection used
C2 (compression fitting with 1" NPT thread)	52 mm (2.047 in)
C2 (compression fitting with G1" thread)	46 mm (1.811 in)
C2 (compression fitting with ¾" NPT thread)	48 mm (1.889 in)
C2 (compression fitting with G¾" thread)	45 mm (1.772 in)

Selecting the length of the insertion version

Select the length of the insertion version using the calculated insertion depth and the following table. The insertion depth must be within the adjusting range of the insertion version.

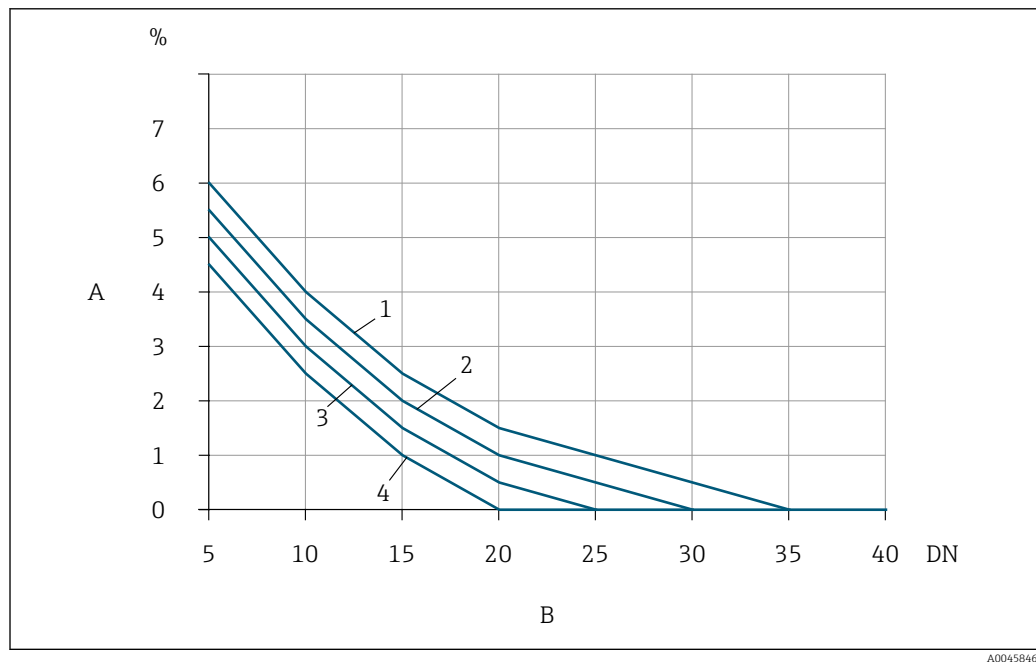
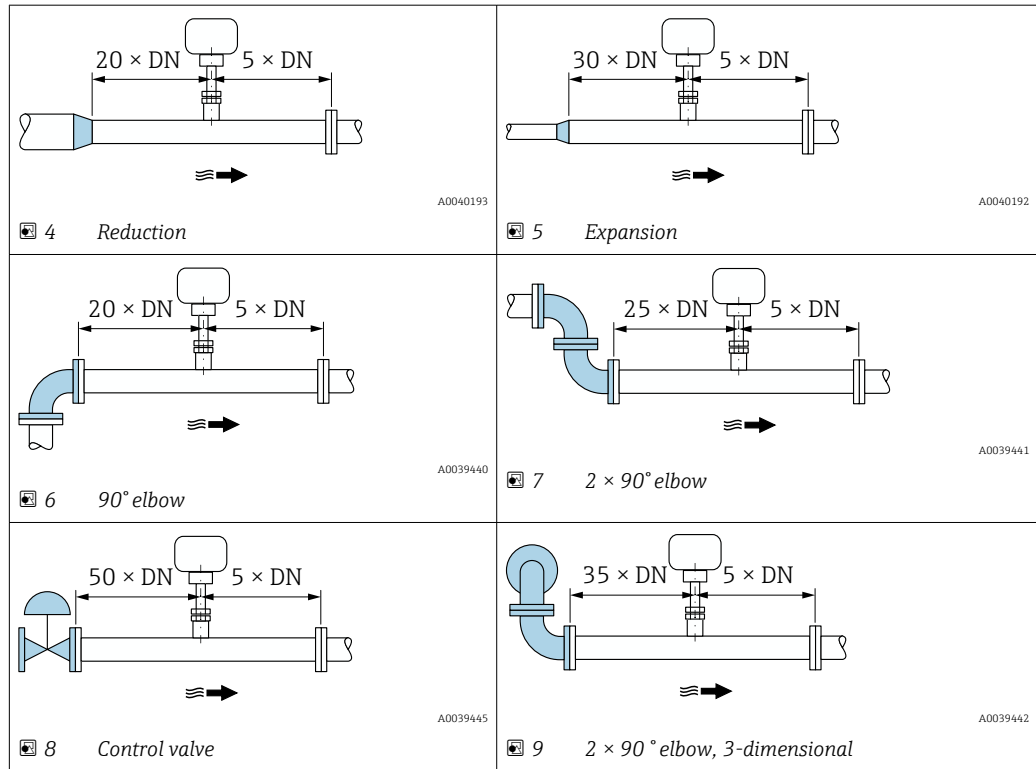
Length of insertion tube		Adjusting range (insertion depth)	
[mm]	[in]	[mm]	[in]
235	9	100 to 235	3.9 to 9.3
335	13	100 to 335	3.9 to 13.2
435	17	100 to 435	3.9 to 17.1
608	24	100 to 608	3.9 to 23.9

Inlet and outlet runs

A fully developed flow profile is a requirement for optimal thermal flow measurement.

To achieve the best possible measuring performance, observe the following inlet and outlet runs at the very minimum.

- In the case of bidirectional sensors, also observe the recommended inlet run in the opposite direction.
- If several flow disturbances are present, use flow conditioners.
- Use flow conditioners if it is not possible to observe the required inlet runs.
- In the case of control valves, the amount of disturbance depends on the valve type and opening degree. The recommended inlet run for control valves is $50 \times \text{DN}$.
- In the case of very light gases (helium, hydrogen), the recommended inlet run must be doubled.



10 The additional measured error to be expected without flow conditioners depending on the disturbance type and inlet run

- A Additional measured error (%)
 B Inlet run (DN)
 1 2 x 90° elbow, 3-dimensional
 2 Expansion
 3 2 x 90° elbow
 4 Reduction or 90° elbow

Flow conditioner

Use flow conditioners if it is not possible to observe the required inlet runs. Flow conditioners improve the flow profile and therefore reduce the necessary inlet runs.

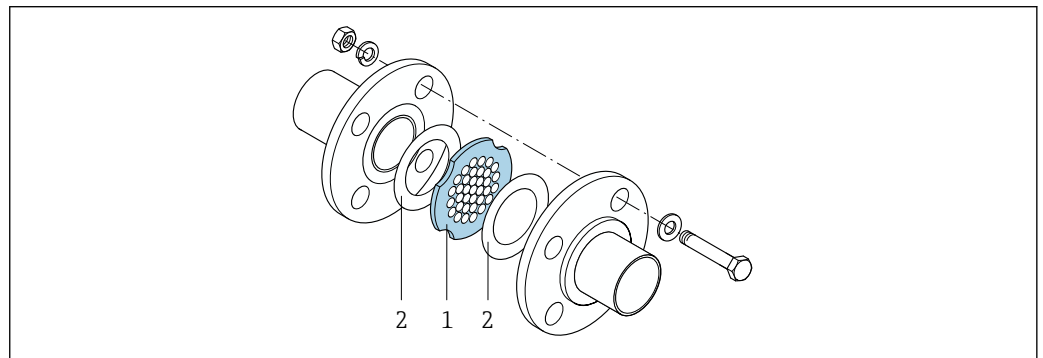
Mount the flow conditioner in flow direction in front of the measuring device.

Available in the following flange standards:

- ASME B16.5 Cl. 150/Cl. 300
- EN 1092-1 PN10/PN16/PN25/PN40
- JIS B2220 10K/20K

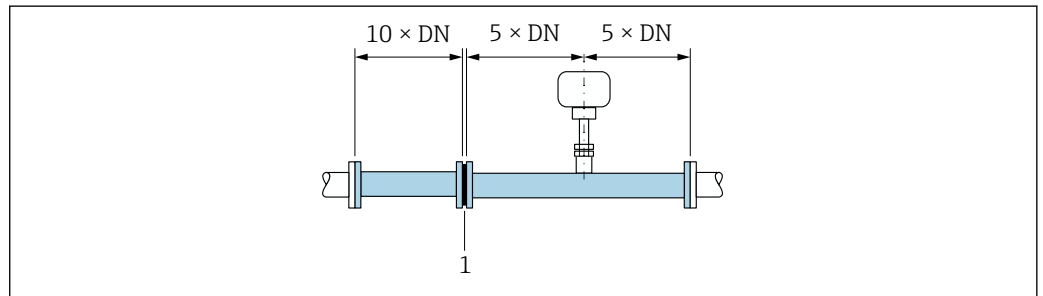
Available in the following line sizes:

- DN 80 (3")
- DN 100 (4")
- DN 150 (6")
- DN 200 (8")
- DN 250 (10")
- DN 300 (12")



A0039538

- 1 Flow conditioner
2 Seal



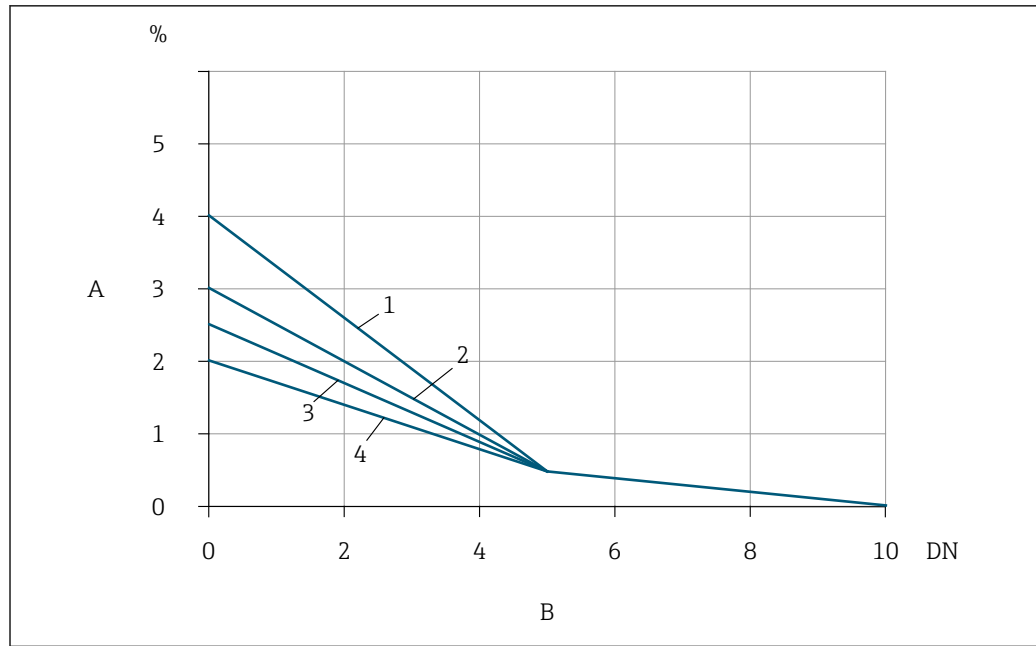
A0039424

11 Recommended inlet and outlet runs when using a flow conditioner

- 1 Flow conditioner



In the case of bidirectional sensors, also observe the inlet run in the opposite direction.



A0039508

12 The additional measured error to be expected with flow conditioners depending on the disturbance type and inlet run

- A Additional measured error (%)
 B Inlet runs upstream of the flow conditioner (DN)
 1 $2 \times 90^\circ$ elbow, 3-dimensional
 2 Expansion
 3 $2 \times 90^\circ$ elbow
 4 Reduction or 90° elbow

The pressure loss for flow conditioners is calculated as follows: $\Delta p \text{ [mbar]} = 0.0085 \cdot \rho \text{ [kg/m}^3] \cdot v^2 \text{ [m/s]}$

Example of air

$p = 10 \text{ bar abs.}$

$t = 25^\circ\text{C} \rightarrow \rho = 11.71 \text{ kg/m}^3$

$v = 10 \text{ m/s}$

$\Delta p = 0.0085 \cdot 11.71 \cdot 10^2 = 9.95 \text{ mbar}$

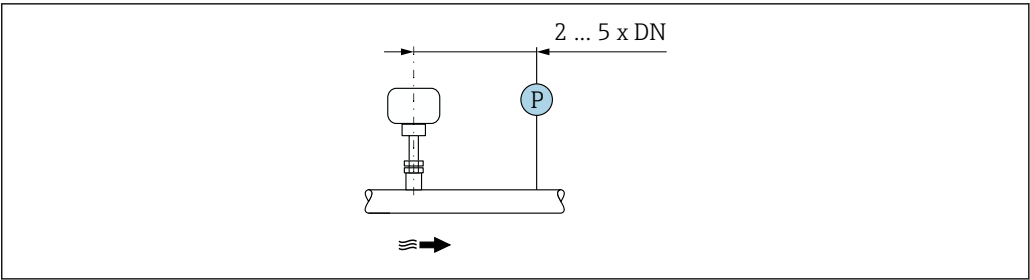
ρ : density of the process medium

v : average flow velocity

abs. = absolute

Outlet runs with pressure measuring points

Install the pressure measuring point downstream of the measuring system. This prevents the pressure transmitter from potentially affecting the flow in the measuring point.

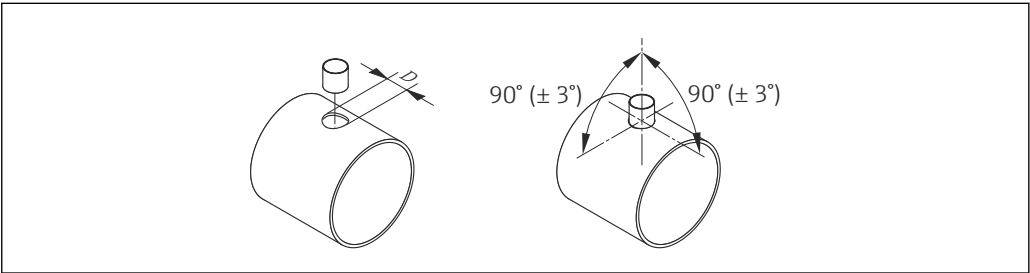


A0039447

13 Installation of a pressure measuring point (P = pressure transmitter)

Installation conditions for nipples

i Suitable support brackets must be used if installing in rectangular air ducts (or pipes with thin walls).



A0040684

D $\varnothing 31.0 \pm 0.5 \text{ mm}$ (1.22 $\pm$ 0.019 in)

5.1.2 Environment and process requirements

Ambient temperature range

Measuring device	■ -40 to +60 °C (-40 to +140 °F) ■ Order code for "Test, certificate", option JP: -50 to +60 °C (-58 to +140 °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.

NOTICE

Danger of overheating

- Ensure that the temperature at the lower end of the transmitter housing does not exceed 80 °C (176 °F).
- Ensure that sufficient convection takes place at the transmitter neck.
- When using in potentially explosive atmospheres, observe the information in the device-specific Ex documentation. For detailed information on the temperature tables, see the separate document entitled "Safety Instructions" (XA) for the device.
- Ensure that a sufficiently large area of the transmitter neck remains exposed. The uncovered part serves as a radiator and protects the electronics from overheating and excessive cooling.
- If operating outdoors:
Avoid direct sunlight, particularly in warm climatic regions.

i You can order a weather protection cover from Endress+Hauser → 165.

System pressure

Pressure-reducing valves and some compressor systems can generate significant process pressure variations that can distort the flow profile. This can produce an additional measured error. Suitable measures must be taken to reduce these pressure pulses, such as:

- The use of expansion tanks
- The use of inlet diffusers
- Positioning the measuring device further downstream

To avoid pulsating flow and contamination from oil/dirt in compressed air applications, it is recommended to install the measuring device downstream of filter, drying and storage devices. Do not install the measuring device directly after the compressor.

Thermal insulation

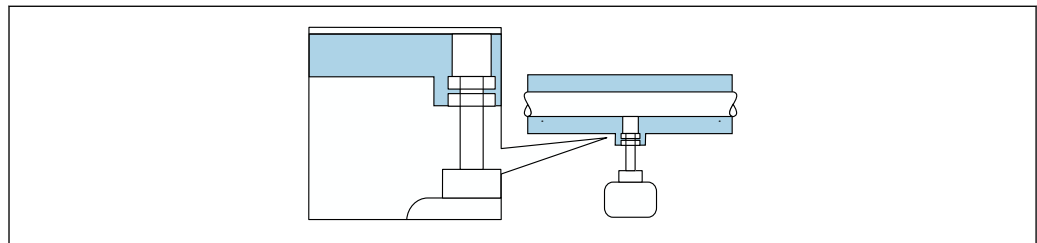
In the case of some fluids, it is important to keep the heat radiated from the sensor to the transmitter to a low level. A wide range of materials can be used for the required insulation.

If the gas is very wet or saturated with water (e.g. digester gas), the pipe and the sensor housing should be insulated, and heated where necessary, to prevent water droplets condensing on the sensing element.

NOTICE

Electronics overheating on account of thermal insulation!

- ▶ Recommended orientation: horizontal orientation, sensor connection housing pointing downwards.
- ▶ Do not insulate the sensor connection housing.
- ▶ Maximum permissible temperature at the lower end of the sensor connection housing: 80 °C (176 °F)
- ▶ Thermal insulation with not isolated extended neck: We recommend that you do not insulate the extended neck in order to ensure optimum dissipation of heat.



A0039420

14 Thermal insulation with not isolated extended neck

Heating

NOTICE

Electronics can overheat due to elevated ambient temperature!

- ▶ Observe maximum permitted ambient temperature for the transmitter.
- ▶ Depending on the medium temperature, take the device orientation requirements into account.

NOTICE

Electronics overheating on account of thermal insulation!

- ▶ Recommended orientation: horizontal orientation, sensor connection housing pointing downwards.
- ▶ Do not insulate the sensor connection housing.
- ▶ Maximum permissible temperature at the lower end of the sensor connection housing: 80 °C (176 °F)
- ▶ Thermal insulation with extended neck free: We recommend that you do not insulate the extended neck in order to ensure optimum dissipation of heat.

NOTICE**Danger of overheating when heating**

- ▶ Ensure that the temperature at the lower end of the transmitter housing does not exceed 80 °C (176 °F).
- ▶ Ensure that sufficient convection takes place at the transmitter neck.
- ▶ When using in potentially explosive atmospheres, observe the information in the device-specific Ex documentation. For detailed information on the temperature tables, see the separate document entitled "Safety Instructions" (XA) for the device.
- ▶ Ensure that a sufficiently large area of the transmitter neck remains exposed. The uncovered part serves as a radiator and protects the electronics from overheating and excessive cooling.

Heating options

If a fluid requires that no heat loss should occur at the sensor, users can avail of the following heating options:

- Electrical heating, e.g. with electric band heaters
- Via pipes carrying hot water or steam

Vibrations**NOTICE****Strong vibrations can damage the measuring device.**

Can result in damage to the measuring device or the fastening units.

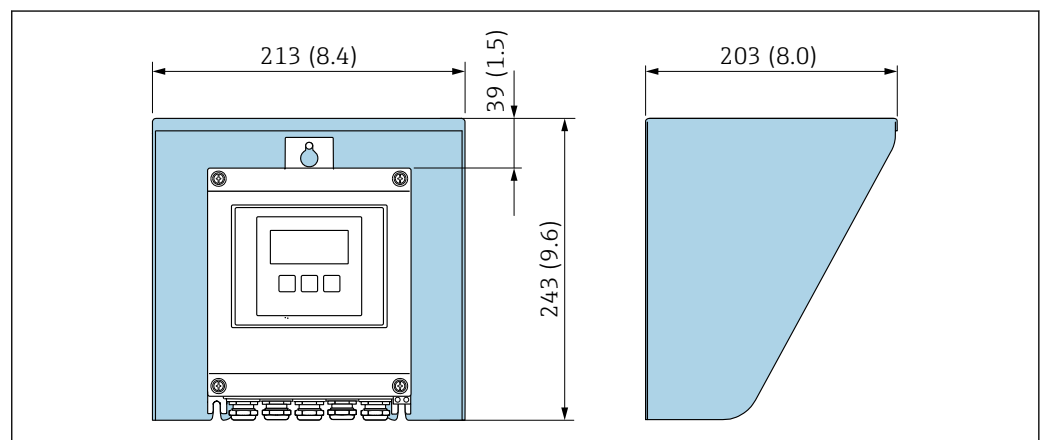
- ▶ Pay attention to information on the vibration and shock resistance → 📖 185

5.1.3 Special mounting instructions**Zero adjust**

All measuring devices are calibrated in accordance with state-of-the-art technology. Calibration takes place under reference conditions. Therefore, a zero adjustment in the field is generally not required.

Experience shows that zero adjustment is advisable only in special cases:

- If strict measuring accuracy requirements apply.
- Under extreme process or operating conditions, e.g., very high process temperatures or light gases (helium, hydrogen).

Weather protection cover

📖 15 Weather protection cover for Proline 500; engineering unit mm (in)

A0029552

5.2 Mounting the measuring device

5.2.1 Required tool

For sensor

Sensor's compression fitting: appropriate mounting tool.

5.2.2 Preparing the measuring device

1. Remove all remaining transport packaging.
2. Remove any protective covers or protective caps present from the sensor.
3. Remove stick-on label on the electronics compartment cover.

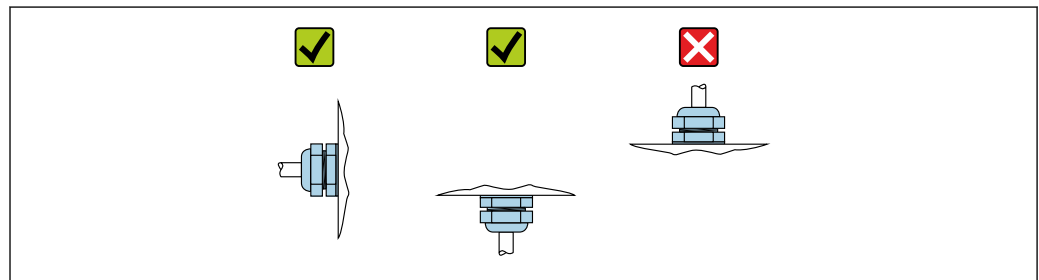
5.2.3 Mounting the measuring device

⚠ WARNING

Danger due to improper process sealing!

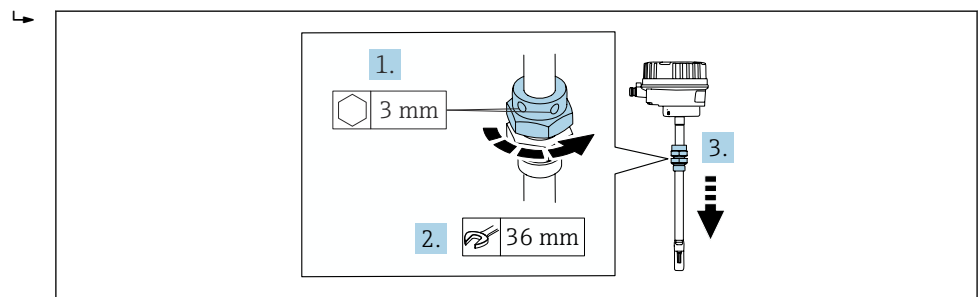
- ▶ Ensure that the seals are clean and undamaged.
- ▶ Ensure that the correct sealing material is used (e.g. Teflon tape for NPT compression fitting).
- ▶ Secure the seals correctly.

Install the measuring device or turn the transmitter housing so that the cable entries do not point upwards.



A0029263

1. Weld in the mounting boss in accordance with the requirements.
2. Loosen the union nut (1) and push down the compression fitting (2).

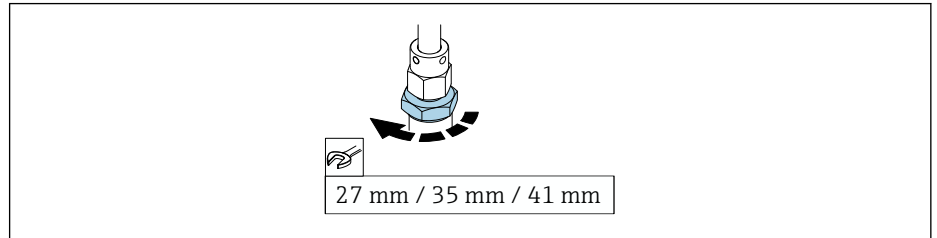


A0041023

3. NOTICE**Damage to the sensing element!**

- Make sure the sensing elements do not hit against anything.

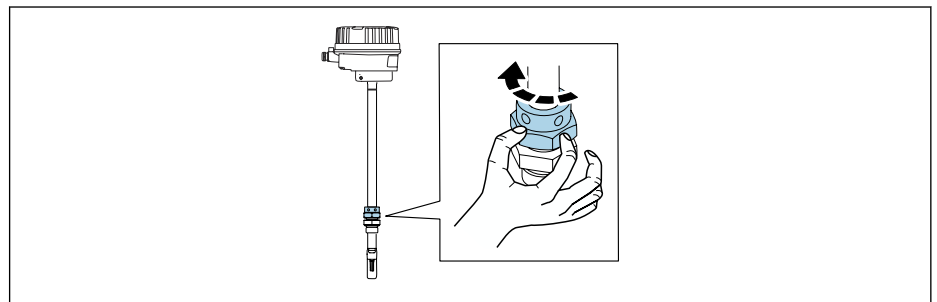
Using a wrench (27 mm / 35 mm / 41 mm), tighten the bottom nut of the compression fitting to the end stop.



A0036810

- Now read off the previously calculated insertion depth from the scale and insert the sensor until this value is at the same height as the upper end of the compression fitting.

- Tighten the union nut by hand. It should still be possible to move the sensor slightly.

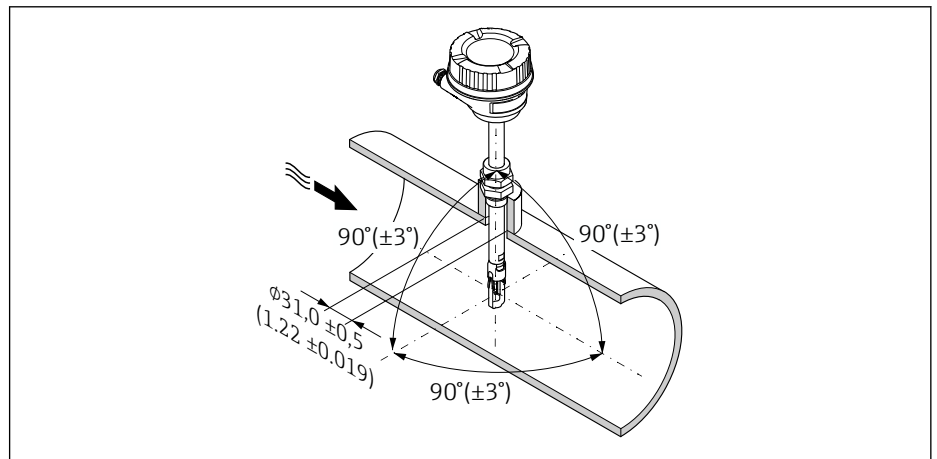


A0041025

- Align the sensor with the flow direction.

- Pay attention to the direction of the arrow on the neck section of the sensor for the flow direction.

The maximum permitted deviation from the flow direction is 3°.



A0039512

16 Engineering unit: mm (in)

- Depending on the process connection:

Tighten union nut with x turns:

- For PEEK ferrules continue with Step 8.
- For metal ferrules continue with Step 9.

8. For PEEK ferrules:

Mounting for the first time: tighten union nut with 1¼ turns. Repeat mounting: tighten union nut with 1 turn.

↳ **Tip** If strong vibrations can be expected, tighten the union nut with 1½ turns when mounting for the first time.

9. For metal ferrules:

Mounting for the first time: tighten union nut with 1¼ turns. Repeat mounting: tighten union nut with ¼ turn.

10. Tighten both fixing screws again with a 3 mm (⅛ in) Allen screw with 4 Nm (2.95 lbf ft).

↳ It is now no longer possible to move the sensor.

11. Check the measuring point for leaks (max. process pressure).

5.2.4 Mounting the transmitter housing: Proline 500 – digital

⚠ CAUTION**Ambient temperature too high!**

Danger of electronics overheating and housing deformation.

- ▶ Do not exceed the permitted maximum ambient temperature .
- ▶ If operating outdoors: Avoid direct sunlight and exposure to weathering, particularly in warm climatic regions.

⚠ CAUTION**Excessive force can damage the housing!**

- ▶ Avoid excessive mechanical stress.

The transmitter can be mounted in the following ways:

- Post mounting
- Wall mounting

Pipe mounting

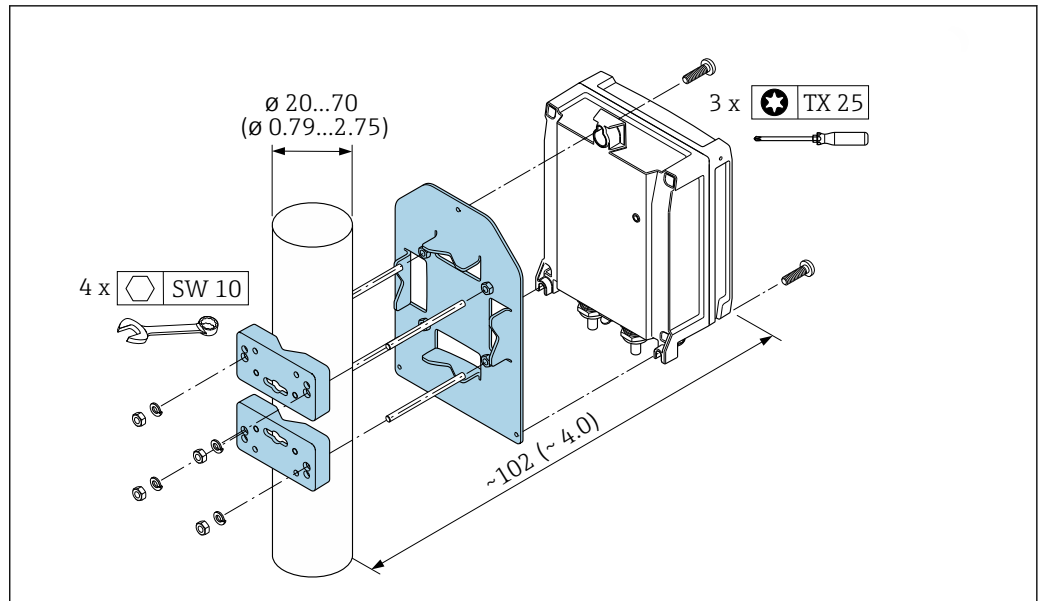
Required tools:

- Open-ended wrench AF 10
- Torx screwdriver TX 25

⚠ WARNING**Excessive tightening torque applied to the fixing screws!**

Risk of damaging the plastic transmitter.

- ▶ Tighten the fixing screws as per the tightening torque: 2 Nm (1.5 lbf ft)



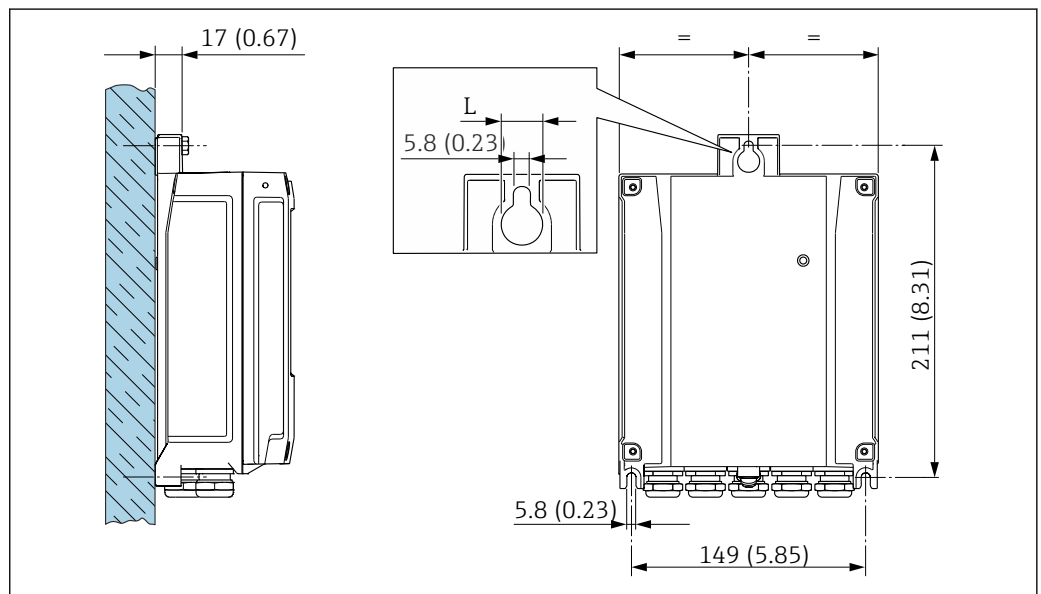
A0029051

17 Engineering unit mm (in)

Wall mounting

Required tools:

Drill with drill bit $\varnothing 6.0$ mm



A0029054

18 Engineering unit mm (in)

L Depends on order code for "Transmitter housing"

Order code for "Transmitter housing"

- Option A, aluminum, coated: L = 14 mm (0.55 in)
- Option D, polycarbonate: L = 13 mm (0.51 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.

5.3 Post-installation check

Is the device undamaged (visual inspection)?	☐
Does the measuring device conform to the measuring point specifications? For example: ■ Process temperature →  187 ■ Process pressure (refer to the "Pressure-temperature ratings" section of the "Technical Information" document) ■ Ambient temperature →  25 ■ Measuring range →  171	☐
Has the correct orientation been selected for the sensor →  19? ■ According to sensor type ■ According to medium properties ■ According to medium temperature ■ According to process pressure	☐
Does the arrow on the sensor match the actual direction of flow of the medium through the piping ?	☐
Have sufficient inlet and outlet runs been provided upstream and downstream of the measuring point →  21?	☐
Correct sensor insertion depth?	☐
Is the device adequately protected from precipitation and direct sunlight?	☐
Is the device protected against overheating?	☐
Is the device protected against excessive vibrations?	☐
Gas property checked (e.g. purity, dryness, cleanness)?	☐
Are the measuring point identification and labeling correct (visual inspection)?	☐
Are the securing screw and securing clamp tightened securely?	☐

6 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.

6.1 Electrical safety

In accordance with applicable national regulations.

6.2 Connection requirements

6.2.1 Required tools

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

6.2.2 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 $< 2.1 \text{ mm}^2$ (14 AWG)

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

The grounding impedance must be less than 2Ω .

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

Modbus RS485

The EIA/TIA-485 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	$< 30 \text{ pF/m}$
Wire cross-section	$> 0.34 \text{ mm}^2$ (22 AWG)

Cable type	Twisted pairs
Loop resistance	$\leq 110 \Omega/\text{km}$
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shield	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

Current output 0/4 to 20 mA

Standard installation cable is sufficient

Pulse /frequency /switch output

Standard installation cable is sufficient

Relay output

Standard installation cable is sufficient.

Current input 0/4 to 20 mA

Standard installation cable is sufficient

Status input

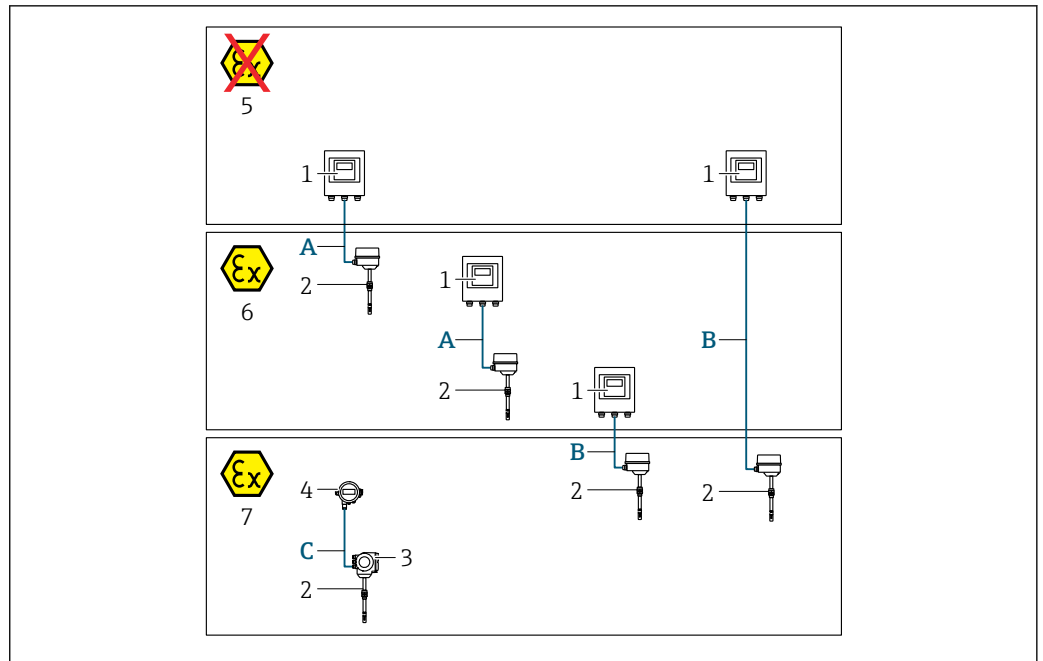
Standard installation cable is sufficient

Cable diameter

- Cable glands supplied:
M20 × 1.5 with cable $\varnothing$ 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 mm² (24 to 12 AWG).

Choice of connecting cable between the transmitter and sensor

Depends on the type of transmitter and the installation zones



A0042081

- 1 Proline 500 – digital transmitter
- 2 Sensor t-mass
- 3 Proline 300 transmitter
- 4 Remote display (DKX001)
- 5 Non-hazardous area
- 6 Hazardous area: Zone 2; Class I, Division 2
- 7 Hazardous area: Zone 1; Class I, Division 1
- A Standard cable to transmitter 500 – digital
Transmitter installed in the non-hazardous area or hazardous area: Zone 2; Class I, Division 2/sensor installed in the hazardous area: Zone 2; Class I, Division 2
- B Standard cable to transmitter 500 – digital → 36
Transmitter installed in the hazardous area: Zone 2; Class I, Division 2/sensor installed in the hazardous area: Zone 1; Class I, Division 1
- C Standard cable to remote display
Transmitter 300 and remote display installed in the hazardous area: Zone 1; Class I, Division 1



For applications with operation in Zone 1; Class 1, Division 1, we recommend the use of the compact version with the remote display. In this case, the display of the Proline 300 transmitter is a blind version without local operation.

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	4 cores; uninsulated stranded CU wires; with common shield
Shielding	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.

Cross-section	Cable length [max.]
0.34 mm ² (AWG 22)	80 m (240 ft)
0.50 mm ² (AWG 20)	120 m (360 ft)
0.75 mm ² (AWG 18)	180 m (540 ft)

Cross-section	Cable length [max.]
1.00 mm ² (AWG 17)	240 m (720 ft)
1.50 mm ² (AWG 15)	300 m (900 ft)

Optionally available connecting cable

Design	2 × 2 × 0.34 mm ² (AWG 22) PVC cable ¹⁾ with common shield (2 pairs, uninsulated stranded CU wires; pair-stranded)
Flame resistance	According to DIN EN 60332-1-2
Oil-resistance	According to DIN EN 60811-2-1
Shielding	Tin-plated copper braid, optical cover ≥ 85 %
Operating temperature	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)
Available cable length	Fixed: 20 m (60 ft); variable: up to maximum 50 m (150 ft)

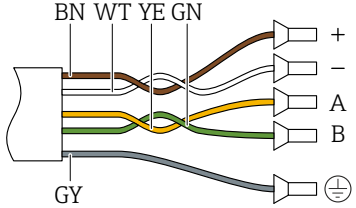
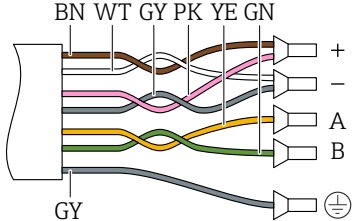
1) UV radiation can impair the cable outer sheath. Protect the cable from direct sunshine where possible.

B: 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	4, 6, 8 cores (2, 3, 4 pairs); uninsulated stranded CU wires; pair-stranded with common shield
Shielding	Tin-plated copper braid, optical cover ≥ 85 %
Capacitance C	Maximum 760 nF IIC, maximum 4.2 µF IIB
Inductance L	Maximum 26 µH IIC, maximum 104 µH IIB
Inductance/resistance ratio (L/R)	Maximum 8.9 µH/Ω IIC, maximum 35.6 µH/Ω IIB (e.g. according to IEC 60079-25)
Loop resistance	Power supply line (+, -): maximum 5 Ω
Cable length	Maximum 100 m (300 ft), see the following table.

Cross-section	Cable length [max.]	Termination
2 x 2 x 0.50 mm ² (AWG 20)	50 m (150 ft)	2 x 2 x 0.50 mm ² (AWG 20)  ■ +, - = 0.5 mm² ■ A, B = 0.5 mm²
3 x 2 x 0.50 mm ² (AWG 20)	100 m (300 ft)	3 x 2 x 0.50 mm ² (AWG 20)  ■ +, - = 1.0 mm² ■ A, B = 0.5 mm²

Optionally available connecting cable

Connecting cable for	Zone 1; Class I, Division 1
Standard cable	2 × 2 × 0.5 mm ² (AWG 20) PVC cable ¹⁾ with common shield (2 pairs, pair-stranded)
Flame resistance	According to DIN EN 60332-1-2
Oil-resistance	According to DIN EN 60811-2-1
Shielding	Tin-plated copper braid, optical cover ≥ 85 %
Operating temperature	When mounted in a fixed position: -50 to +105 °C (-58 to +221 °F); when cable can move freely: -25 to +105 °C (-13 to +221 °F)
Available cable length	Fixed: 20 m (60 ft); variable: up to maximum 50 m (150 ft)

1) UV radiation can impair the cable outer sheath. Protect the cable from direct sunshine where possible.

6.2.3 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 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.

Terminal assignment and connection of the connecting cable:

Proline 500 – digital →  39

6.2.4 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.

6.2.5 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 →  33.

6.3 Connecting the measuring device: Proline 500 – digital

NOTICE

An incorrect connection compromises electrical safety!

- ▶ Have electrical connection work carried out by appropriately trained specialists only.
- ▶ Observe applicable federal/national installation codes and regulations.
- ▶ Comply with local workplace safety regulations.
- ▶ Always connect the protective ground cable ⊕ before connecting additional cables.
- ▶ When using in potentially explosive atmospheres, observe the information in the device-specific Ex documentation.

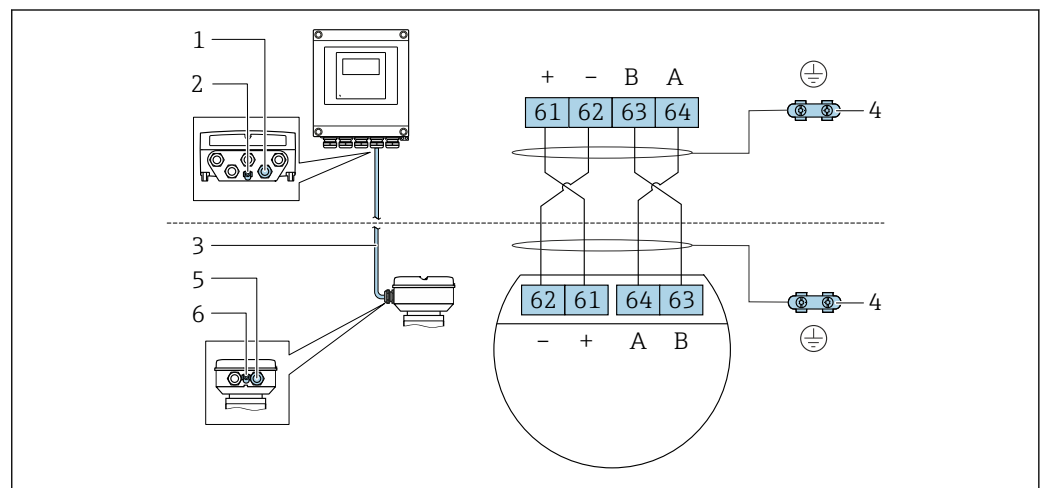
6.3.1 Connecting the connecting cable

⚠ 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.

Connecting cable terminal assignment



A0028198

- 1 Cable entry for cable on transmitter housing
- 2 Protective earth (PE)
- 3 Connecting cable ISEM communication
- 4 Grounding via ground connection; on device plug versions grounding is through the plug itself
- 5 Cable entry for cable or connection of device plug on sensor connection housing
- 6 Protective earth (PE)

Connecting the connecting cable to the sensor connection housing

Connection via terminals with order code for "Sensor connection housing":

- Option A "Aluminum, coated" → 40
- Option L "Cast, stainless" → 40

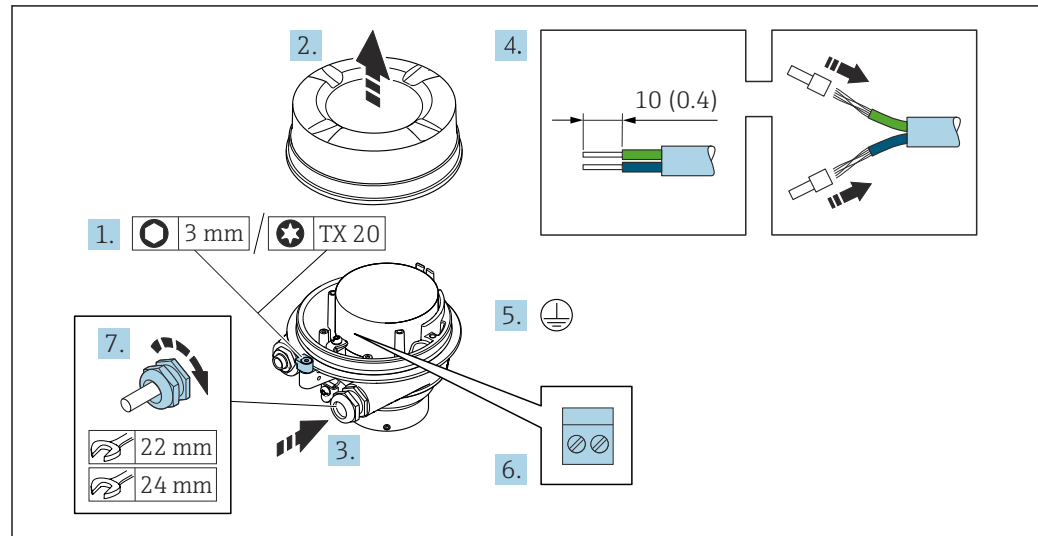
Connecting the connecting cable to the transmitter

The cable is connected to the transmitter via terminals → 41.

Connecting the sensor connection housing via terminals

For the device version with the order code for "Sensor connection housing":

- Option A "Aluminum coated"
- Option L "Cast, stainless"



A0029616

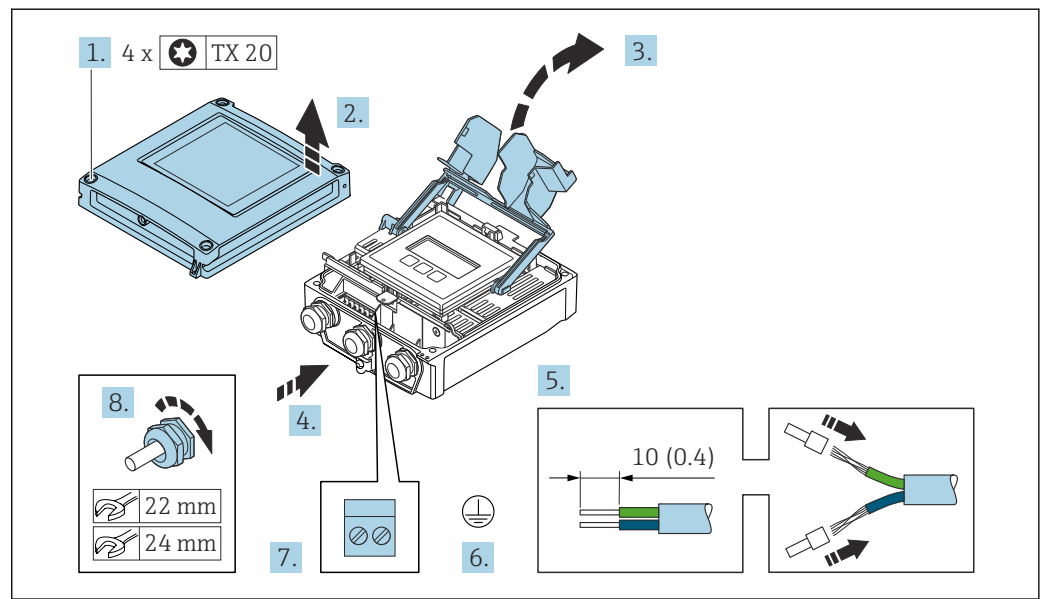
1. Loosen the securing clamp of the housing cover.
2. Unscrew the housing cover.
3. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable and cable ends. In the case of stranded cables, fit ferrules.
5. Connect the protective ground.
6. Connect the cable in accordance with the connecting cable terminal assignment.
7. Firmly tighten the cable glands.
 - ↳ This concludes the process for connecting the connecting cable.

⚠ WARNING

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

- Screw in the thread on the cover without using any lubricant. The thread on the cover is coated with a dry lubricant.
8. Screw on the housing cover.
 9. Tighten the securing clamp of the housing cover.

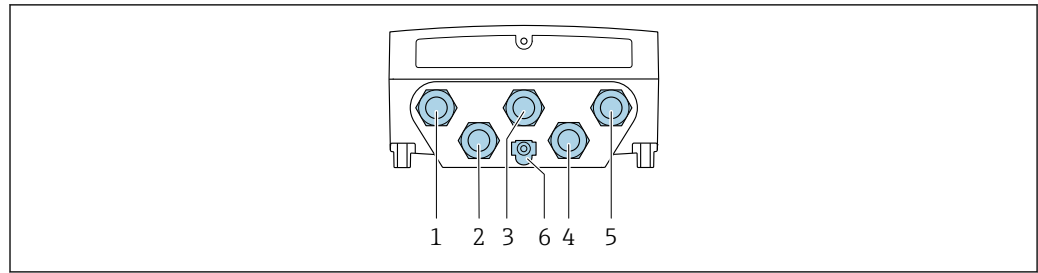
Connecting the connecting cable to the transmitter



A0029597

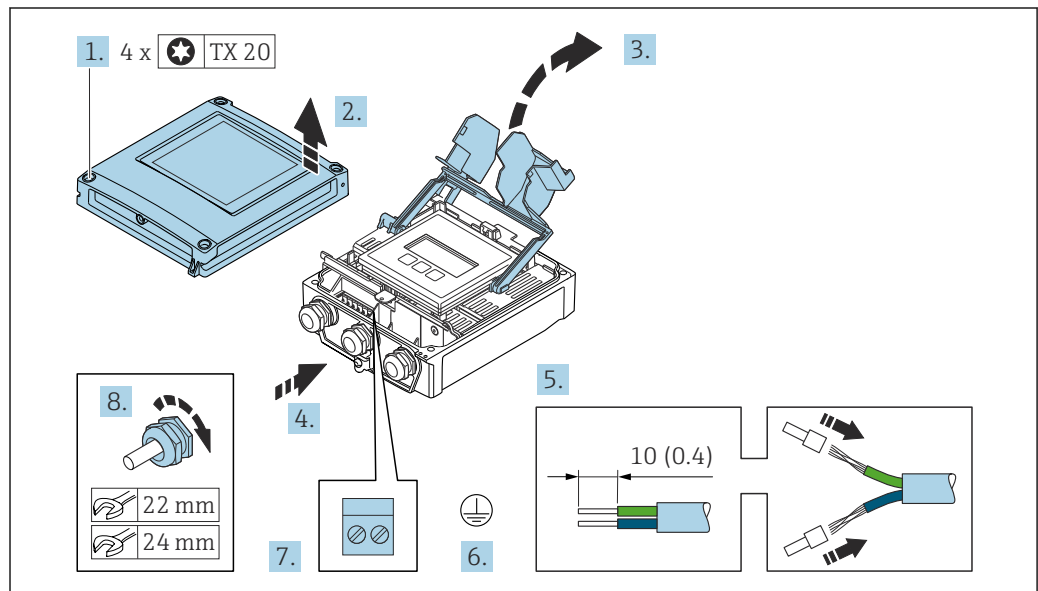
1. Loosen the 4 fixing screws on the housing cover.
2. Open the housing cover.
3. Fold open the terminal cover.
4. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
5. Strip the cable and cable ends. In the case of stranded cables, fit ferrules.
6. Connect the protective ground.
7. Connect the cable according to the terminal assignment for the connecting cable → 39.
8. Firmly tighten the cable glands.
↳ This concludes the process for connecting the connecting cable.
9. Close the housing cover.
10. Tighten the securing screw of the housing cover.
11. After connecting the connecting cable:
Connect the signal cable and the supply voltage cable → 42.

6.3.2 Connecting the signal cable and the supply voltage cable



A0028200

- 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 → 37.
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.

⚠ WARNING

Excessive tightening torque applied to the fixing screws!

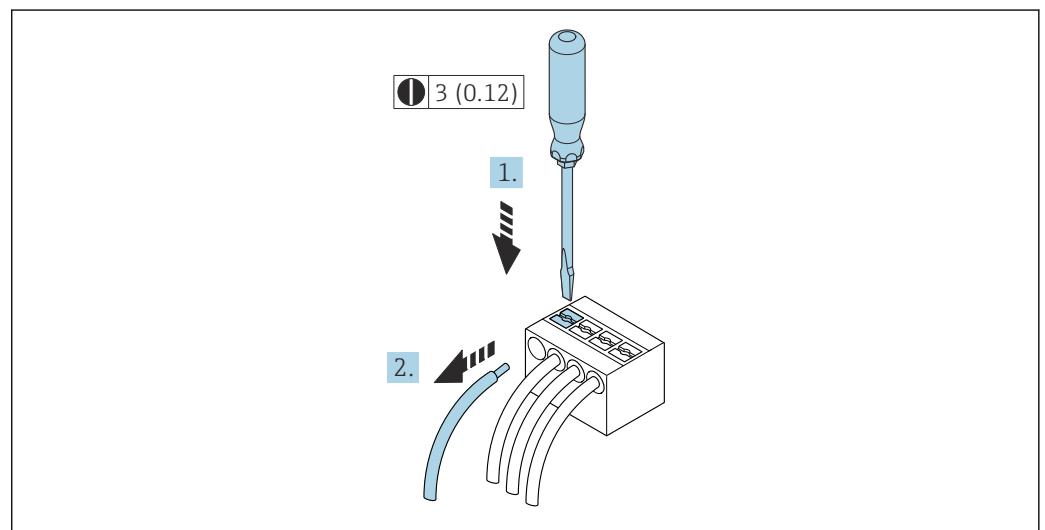
Risk of damaging the plastic transmitter.

- Tighten the fixing screws as per the tightening torque: 2 Nm (1.5 lbf ft)

11. Tighten the 4 fixing screws on the housing cover.

Removing a cable

To remove a cable from the terminal:



19 Engineering unit mm (in)

A0029598

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.

6.4 Potential equalization

6.4.1 Requirements

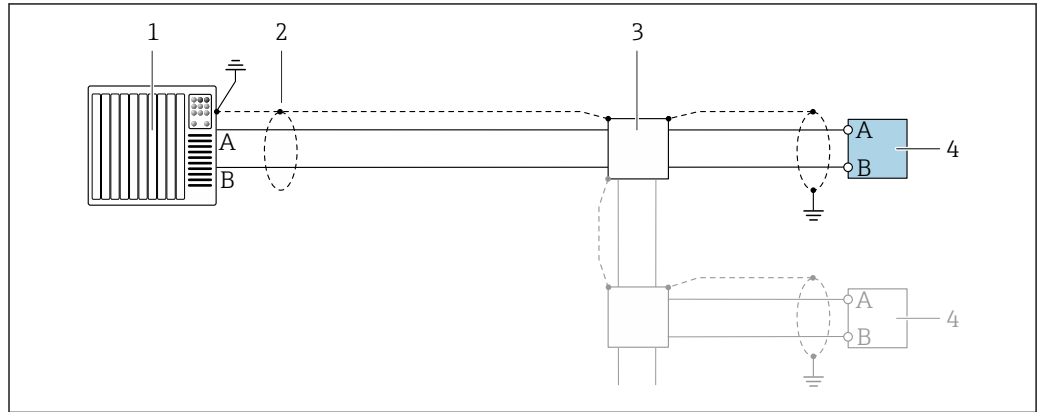
For potential equalization:

- Pay attention to in-house grounding concepts
- Take account of operating conditions like the pipe material and grounding
- Connect the medium, sensor and transmitter to the same electrical potential
- Use a ground cable with a minimum cross-section of 6 mm² (0.0093 in²) and a cable lug for potential equalization connections

6.5 Special connection instructions

6.5.1 Connection examples

Modbus RS485

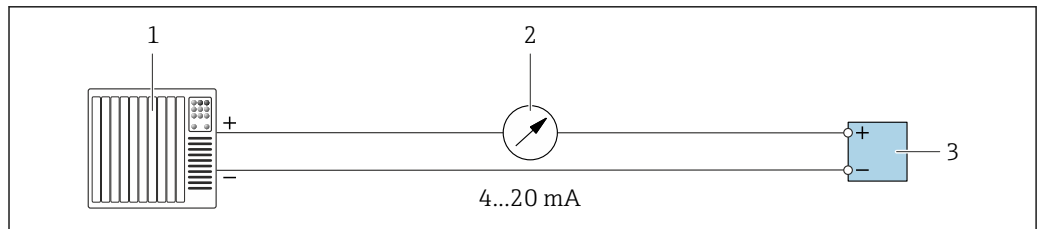


A0028765

20 Connection example for Modbus RS485, non-hazardous area and Zone 2; Class I, Division 2

- 1 Control system (e.g. PLC)
- 2 Cable shield provided at one end. The cable shield must be grounded at both ends to comply with EMC requirements; observe cable specifications
- 3 Distribution box
- 4 Transmitter

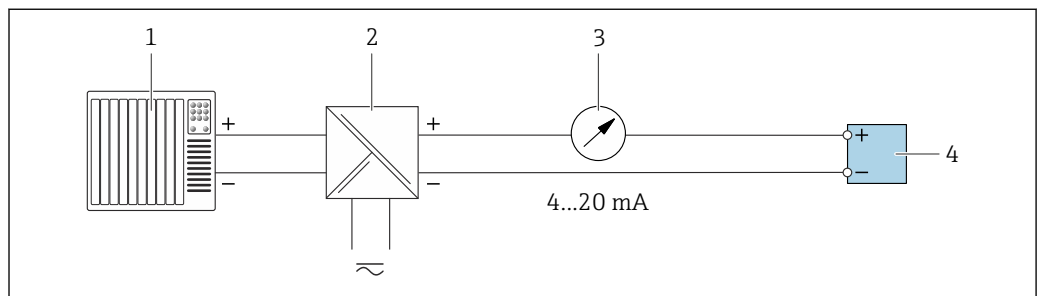
Current output 4-20 mA



A0028758

21 Connection example for 4-20 mA current output (active)

- 1 Automation system with current input (e.g. PLC)
- 2 Analog display unit: observe maximum load
- 3 Transmitter

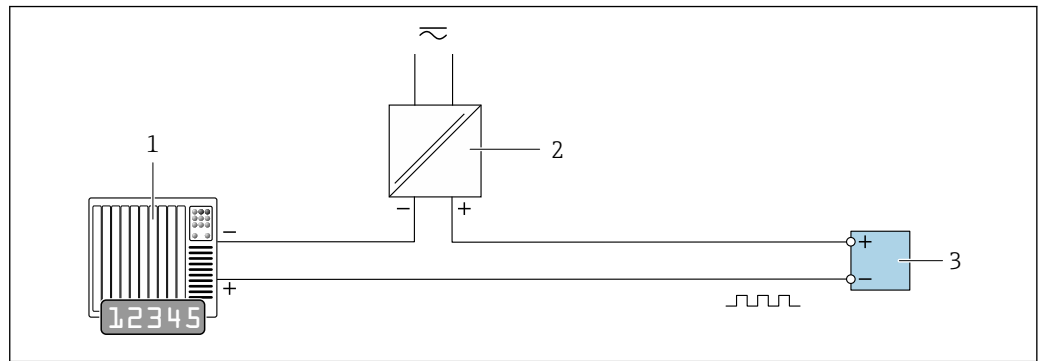


A0028759

22 Connection example for 4-20 mA current output (passive)

- 1 Automation system with current input (e.g. PLC)
- 2 Active barrier for power supply (e.g. RN221N)
- 3 Analog display unit: observe maximum load
- 4 Transmitter

Pulse/frequency output

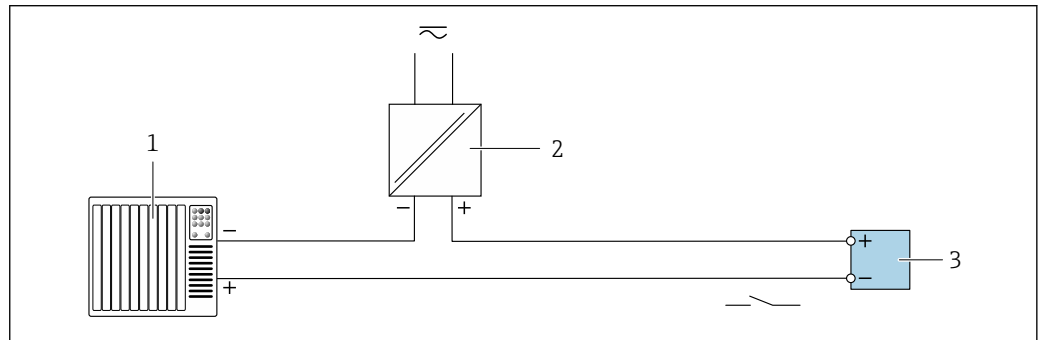


A0028761

23 Connection example for pulse/frequency output (passive)

- 1 Automation system with pulse/frequency input (e.g. PLC with 10 kΩ pull-up or pull-down resistor)
- 2 Power supply
- 3 Transmitter: observe input values → 176

Switch output

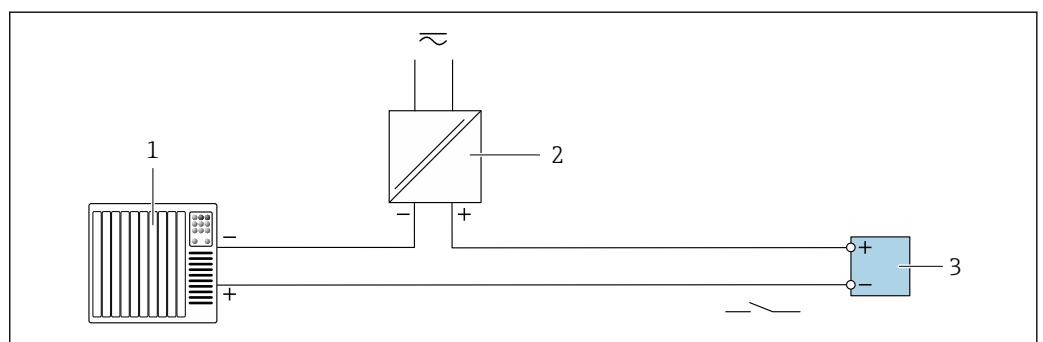


A0028760

24 Connection example for switch output (passive)

- 1 Automation system with switch input (e.g. PLC with a 10 kΩ pull-up or pull-down resistor)
- 2 Power supply
- 3 Transmitter: observe input values → 176

Relay output

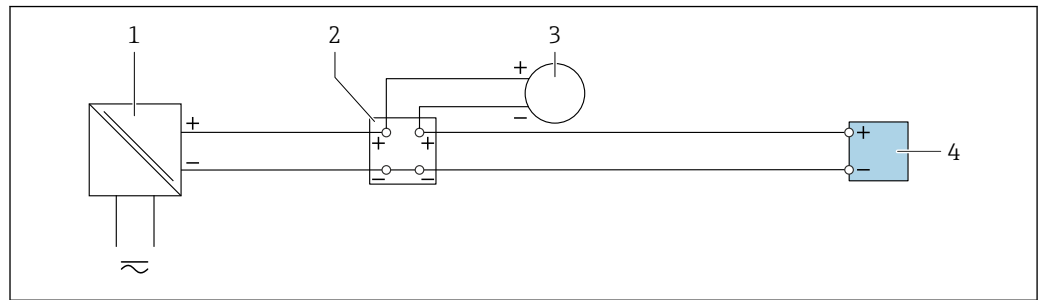


A0028760

25 Connection example for relay output (passive)

- 1 Automation system with relay input (e.g. PLC)
- 2 Power supply
- 3 Transmitter: observe input values → 178

Current input

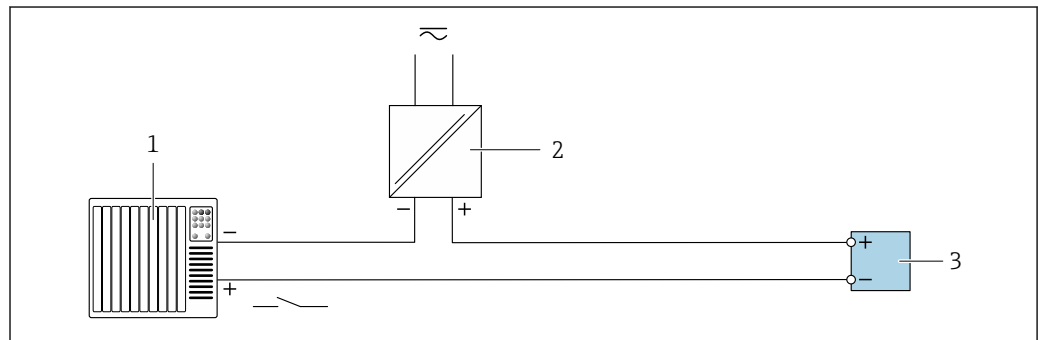


A0028915

26 Connection example for 4 to 20 mA current input

- 1 Power supply
- 2 Terminal box
- 3 External measuring device (to read in pressure or temperature, for instance)
- 4 Transmitter

Status input



A0028764

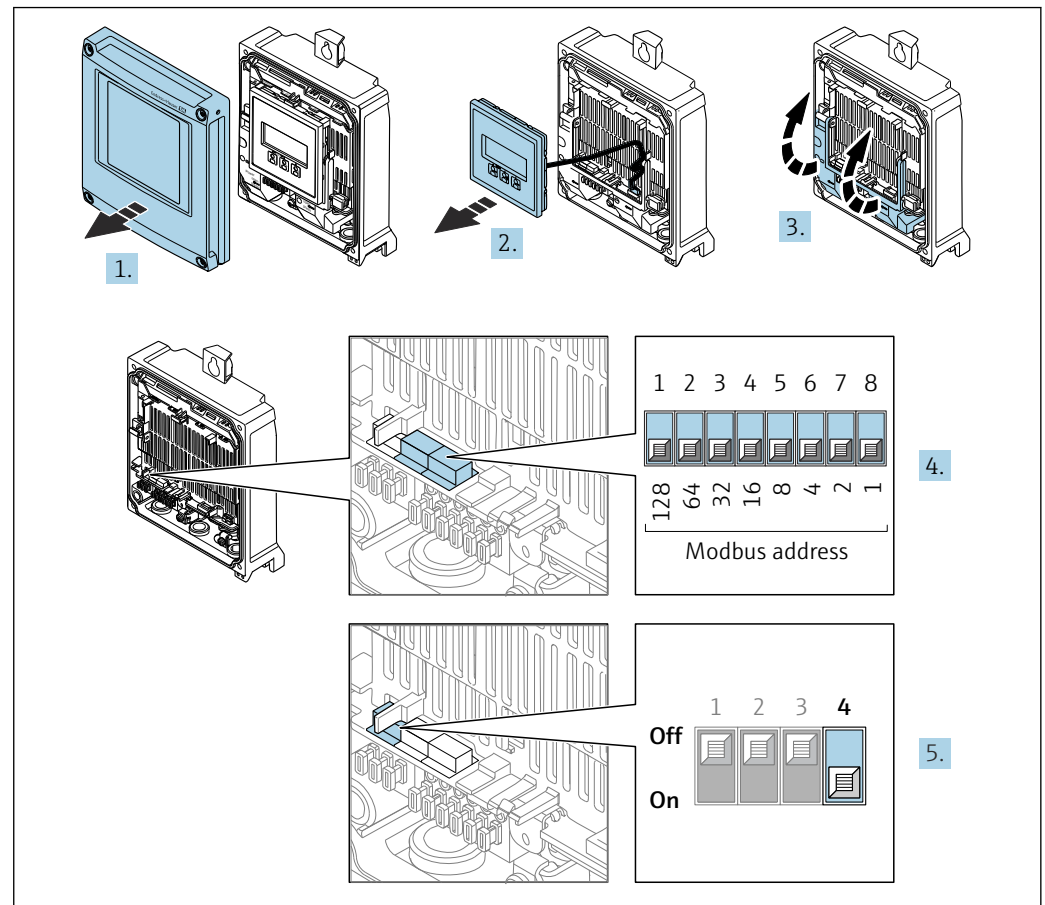
27 Connection example for status input

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

6.6 Hardware settings

6.6.1 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*

A0029677

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.

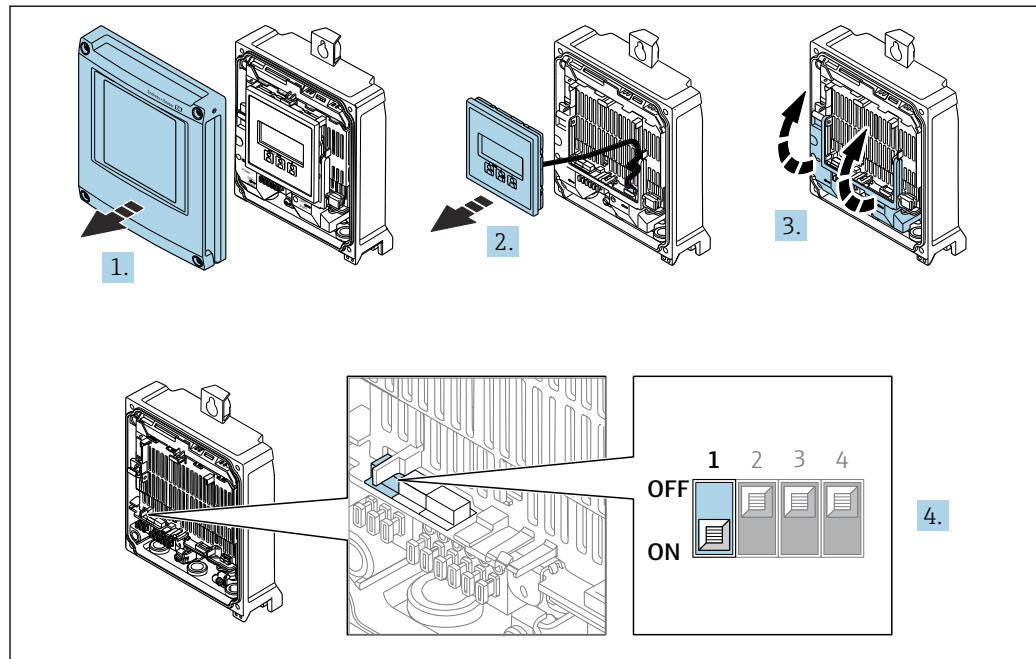
Software addressing

- ▶ 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.

6.6.2 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

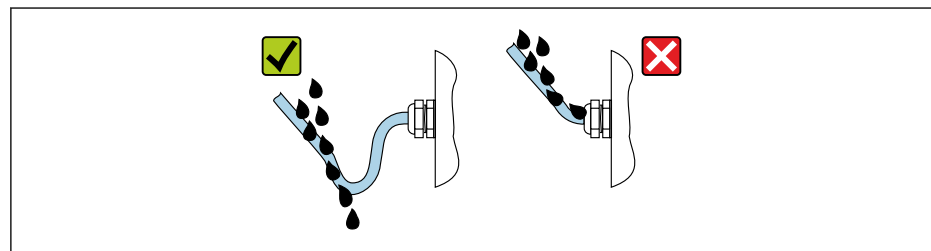
1. Open the housing cover.
2. Remove the display module.
3. Fold open the terminal cover.
4. Switch DIP switch no. 3 to **On**.

6.7 Ensuring the degree of protection

The measuring device 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 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").



A0029278

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

6.7.1 Degree of protection IP68, Type 6P enclosure, with "Cust-potted" option

Depending on the version, the sensor fulfills all the requirements for the degree of protection IP68 protection, Type 6P enclosure →  185 and can be used as a remote device version .

The degree of protection of the transmitter is always only IP66/67, Type 4X enclosure and the transmitter must be treated accordingly .

To guarantee the degree of protection IP68, Type 6P enclosure for the "Cust-potted" options, carry out the following steps after electrical connection:

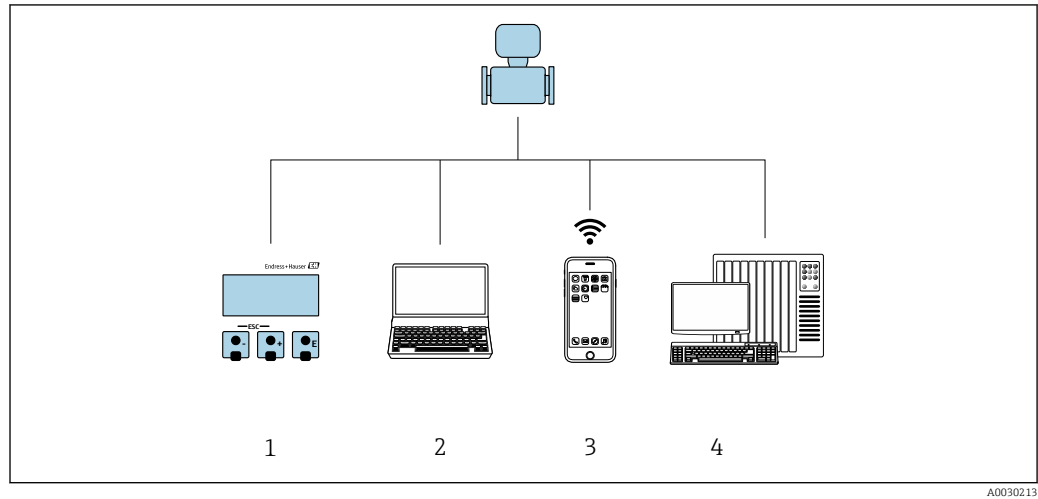
1. Firmly tighten the cable glands (torque: 2 to 3.5 Nm) until there is no gap between the bottom of the cover and the housing support surface.
2. Firmly tighten the union nut of the cable glands.
3. Pot the field housing with a potting compound.
4. Check that the housing seals are clean and fitted correctly. Dry, clean or replace the seals if necessary.
5. Tighten all housing screws and screw covers (torque: 20 to 30 Nm).

6.8 Post-connection check

Are cables or the device undamaged (visual inspection)?	☐
Is the protective earthing established correctly?	
Do the cables used comply with the requirements ?	☐
Do the mounted cables have adequate strain relief?	☐
Are all cable glands installed, securely tightened and leak-tight? Cable run with "water trap" →  48?	☐
Is the terminal assignment correct ?	☐
Are dummy plugs inserted in unused cable entries and have transportation plugs been replaced with dummy plugs?	

7 Operation options

7.1 Overview of operation options

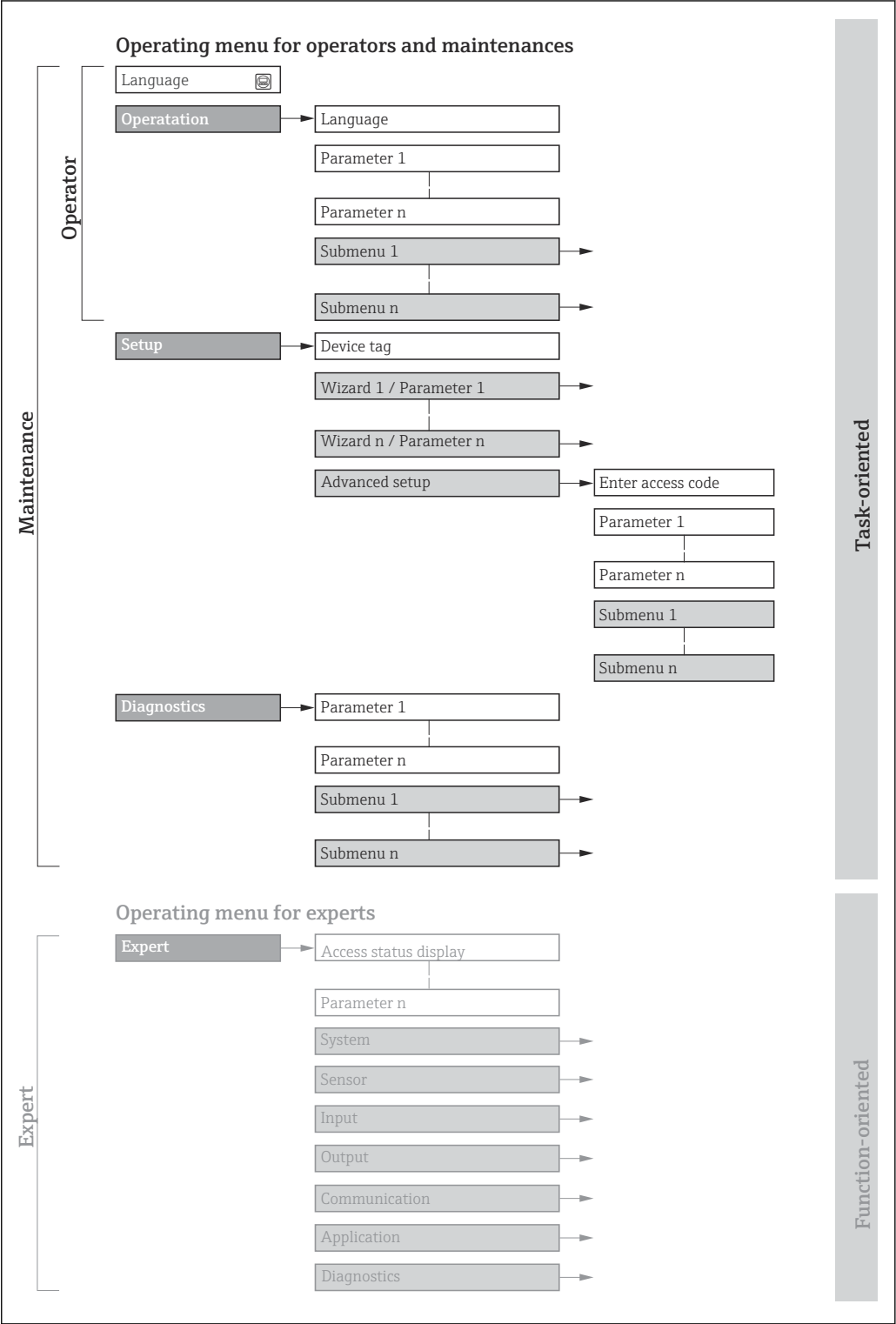


- 1 Local operation via display module
- 2 Computer with Web browser (e.g. Internet Explorer) or with operating tool (e.g. FieldCare, DeviceCare, AMS Device Manager, SIMATIC PDM)
- 3 Mobile handheld terminal with SmartBlue App
- 4 Control system (e.g. PLC)

7.2 Structure and function of the operating menu

7.2.1 Structure of the operating menu

 For an overview of the operating menu for experts: see the "Description of Device Parameters" document supplied with the device



 28 Schematic structure of the operating menu

A0018237-EN

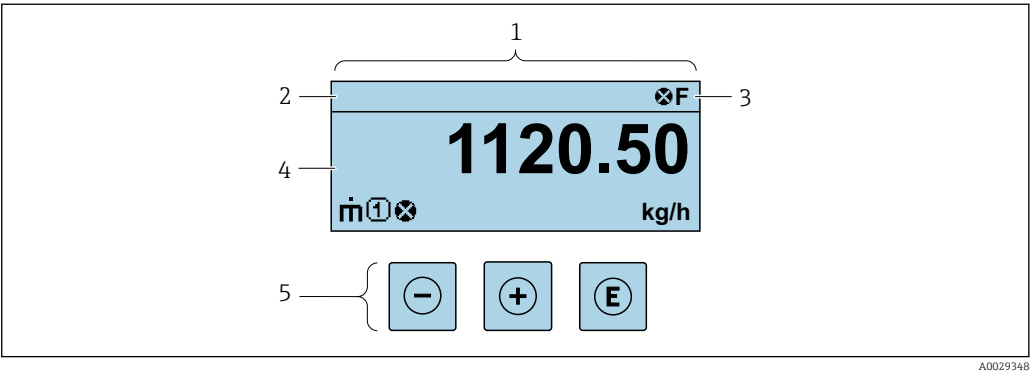
7.2.2 Operating philosophy

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/parameter		User role and tasks	Content/meaning
Language	Task-oriented	Role "Operator", "Maintenance" Tasks during operation: ■ Configuration of the operational display ■ Read measured values	■ Define the operating language ■ Define the web server operating language ■ Reset and control totalizers
Operation			■ Configuration of the operational display (e.g. display format, display contrast) ■ Reset and control totalizers
Setup		"Maintenance" role Commissioning: ■ Configuration of the measurement ■ Configuration of the inputs and outputs ■ Configuration of the communication interface	Wizards for fast commissioning: ■ Configure the system units ■ Display the I/O configuration ■ Configure the inputs ■ Configure the outputs ■ Configuration of the operational display ■ Configure the low flow cut off 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 The functionality of the device is checked on demand and the verification results are documented. ■ Simulation Is used to simulate measured values or output values.
Expert	Function-oriented	Tasks that require detailed knowledge of the operating principle 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 the parameters of the device and makes it possible to access these parameters directly using 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 pertain either to the measurement or to 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.

7.3 Access to operating menu via local display

7.3.1 Operational display



- 1 Operational display
- 2 Device tag
- 3 Status area
- 4 Display area for measured values (up to 4 lines)
- 5 Operating elements → 59

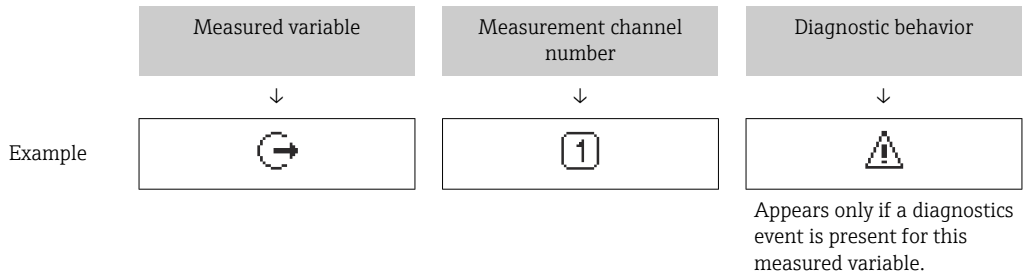
Status area

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

- Status signals → 146
 - **F**: Failure
 - **C**: Function check
 - **S**: Out of specification
 - **M**: Maintenance required
- Diagnostic behavior → 147
 - : Alarm
 - : 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
	Mass flow
	■ Volume flow ■ Corrected volume flow ■ FAD volume flow

$\dot{Q}$	Heat flow
ρ	▪ Density ▪ Reference density
P	Energy flow
v	Flow velocity
H	Calorific value
θ	Temperature

 The number and display format of the measured variables can be configured via the **Format display** parameter (→  106).

Totalizer

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

Output

Symbol	Meaning
	Output  The measurement channel number indicates which of the outputs is displayed.

Input

Symbol	Meaning
	Status input

Measurement channel numbers

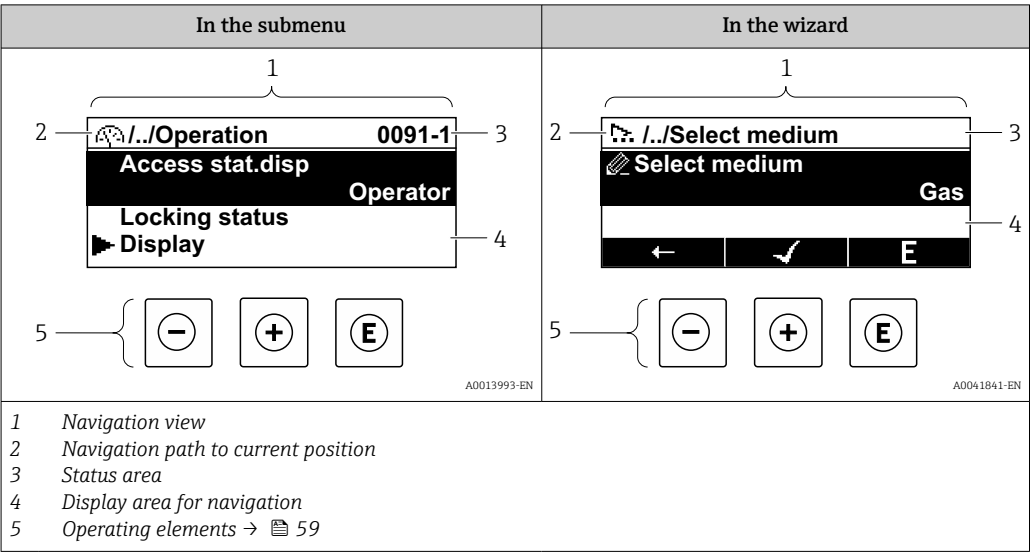
Symbol	Meaning
	Measurement channel 1 to 4  The measurement channel number is only displayed if more than one channel is present for the same measured variable type (e.g. Totalizer 1 to 3).

Diagnostic behavior

Symbol	Meaning
	Alarm ▪ Measurement is interrupted. ▪ Signal outputs and totalizers assume the defined alarm condition. ▪ A diagnostic message is generated.
	Warning ▪ Measurement is resumed. ▪ The signal outputs and totalizers are not affected. ▪ A diagnostic message is generated.

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

7.3.2 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

	Display symbol	Omission symbol	Parameter
	↓	↓	↓
Example	🔍	/ ../	Display

For more information about the icons in the menu, refer to the "Display area" section → 55

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

- For information on the diagnostic behavior and status signal → 146
- For information on the function and entry of the direct access code → 61

Display area

Menus

Symbol	Meaning
	Operation Appears: ■ In the menu next to the "Operation" selection ■ At the left in the navigation path in the Operation menu

	Setup Appears: ■ In the menu next to the "Setup" selection ■ At the left in the navigation path in the Setup menu
	Diagnostics Appears: ■ In the menu next to the "Diagnostics" selection ■ At the left in the navigation path in the Diagnostics menu
	Expert Appears: ■ 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
	Wizard
	Parameters within a wizard
	No display symbol exists for parameters in submenus.

Locking

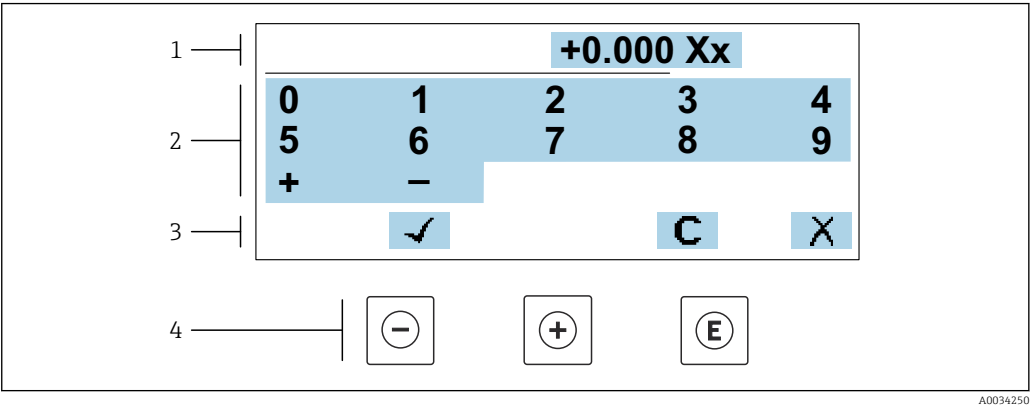
Symbol	Meaning
	Parameter locked When displayed in front of a parameter name, indicates that the parameter is locked. ■ By a user-specific access code ■ By the hardware write protection switch

Wizard operation

Symbol	Meaning
	Switches to the previous parameter.
	Confirms the parameter value and switches to the next parameter.
	Opens the editing view of the parameter.

7.3.3 Editing view

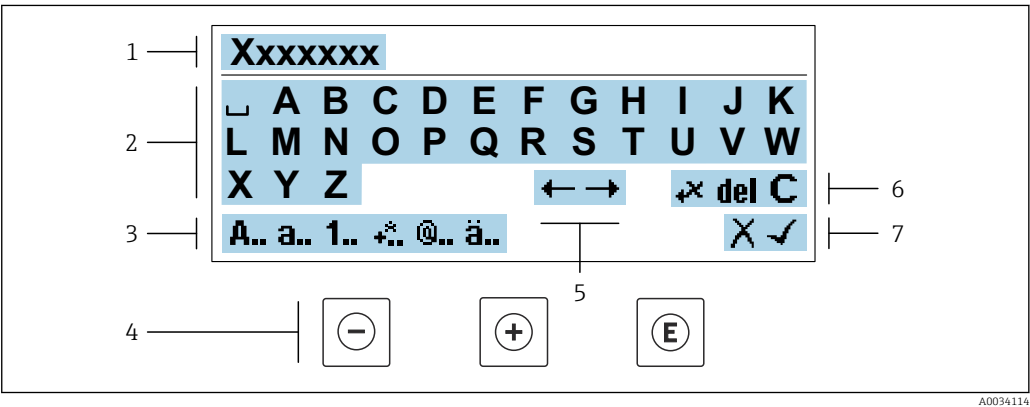
Numeric editor



29 For entering values in parameters (e.g. limit values)

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

Text editor



30 For entering text in parameters (e.g. device tag)

- 1 Entry display area
- 2 Current input screen
- 3 Change input screen
- 4 Operating elements
- 5 Move entry position
- 6 Delete entry
- 7 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
	Enter key - Pressing the key briefly confirms your selection. - Pressing the key for 2 s confirms your entry.
	Escape key combination (press keys simultaneously) Close the editing view without accepting a change.

Input screens

Symbol	Meaning
A..	Upper case
a..	Lower case
1..	Numbers
+..	Punctuation marks and special characters: = + - * / ² ³ ¼ ½ ¾ () [] < > { }
@..	Punctuation marks and special characters: " ' ^ . , ; : ? ! % μ ° € \$ £ ¥ \$ @ # / \ ~ & _
ä..	Umlauts and accents

Controlling data entries

Symbol	Meaning
	Move entry position
	Reject entry
	Confirm entry
	Delete character immediately to the left of the entry position
del	Delete character immediately to the right of the entry position
C	Clear all the characters entered

7.3.4 Operating elements

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

7.3.5 Opening the context menu

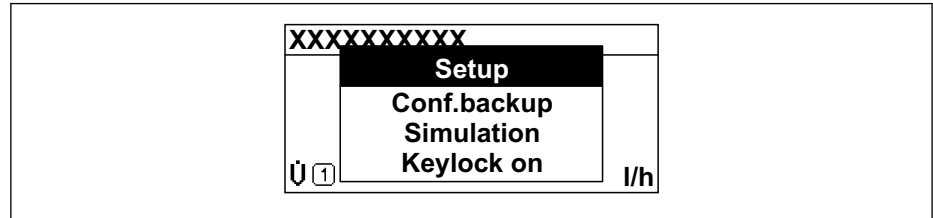
Using the context menu, the user can call up the following menus quickly and directly from the operational display:

- Setup
- Data backup
- Simulation

Calling up and closing the context menu

The user is in the operational display.

1. Press the  and  keys for longer than 3 seconds.
 - ↳ The context menu opens.



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

Calling up the menu via the context menu

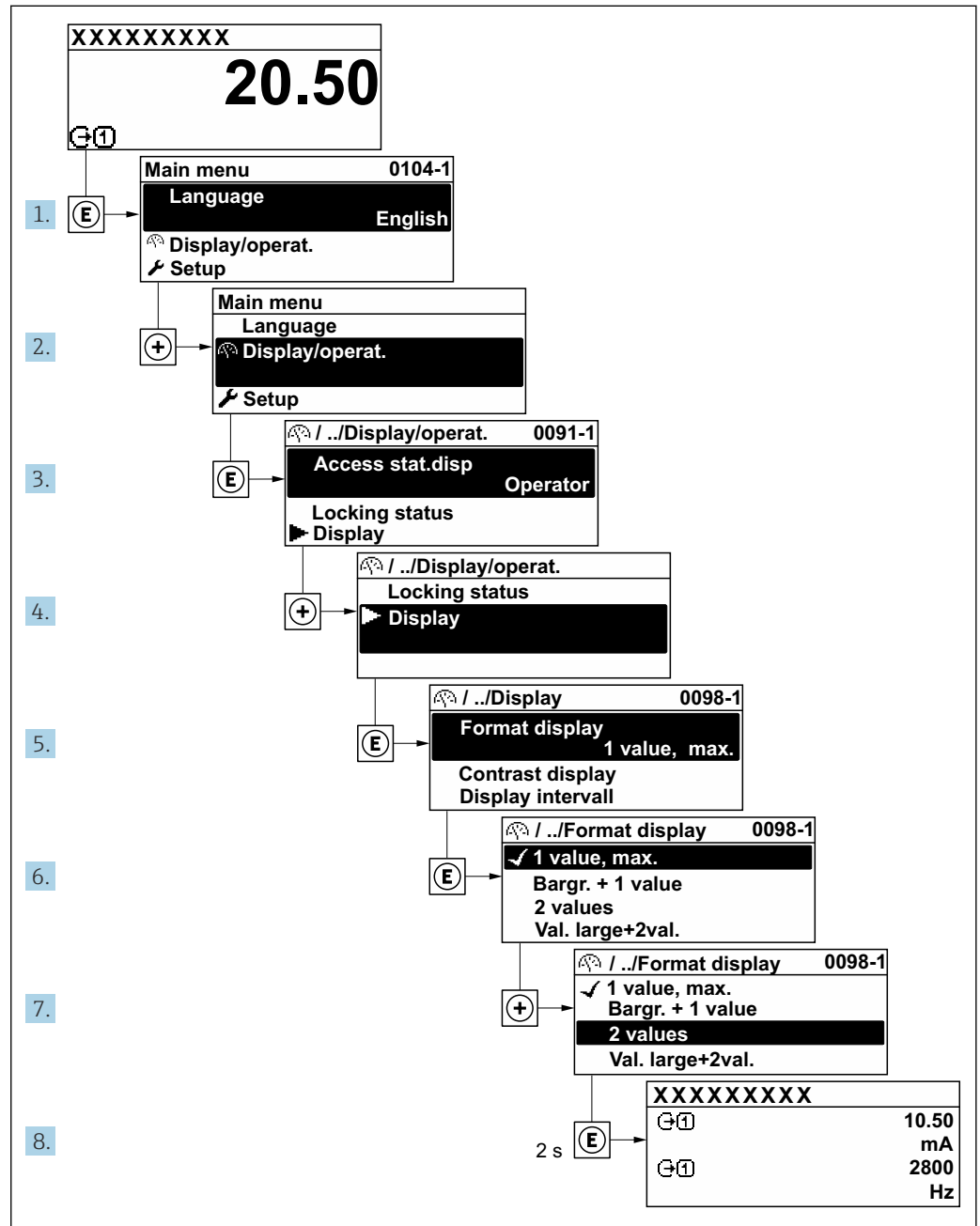
1. Open the context menu.
2. Press  to navigate to the desired menu.
3. Press  to confirm the selection.
 - ↳ The selected menu opens.

7.3.6 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
→  55

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



A0029562-EN

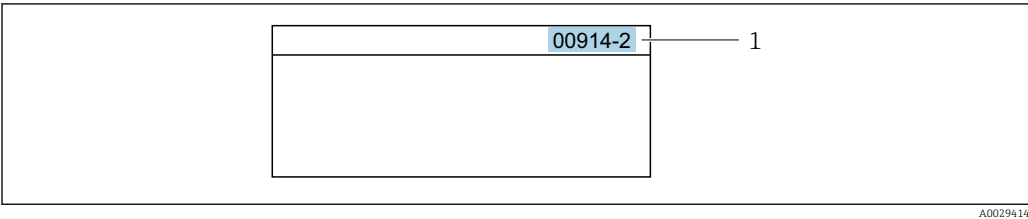
7.3.7 Calling the parameter directly

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

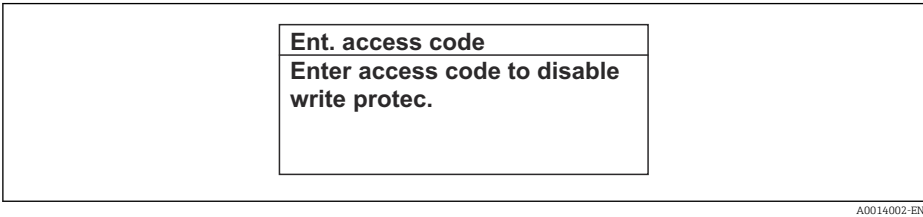
7.3.8 Calling up help text

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  for 2 s.
↳ The help text for the selected parameter opens.



 31 Example: Help text for parameter "Enter access code"

2. Press  +  simultaneously.
↳ The help text is closed.

7.3.9 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-EN

 For a description of the editing view - consisting of the text editor and numeric editor - with symbols → , for a description of the operating elements →  59

7.3.10 User roles and related access authorization

The two user roles "Operator" and "Maintenance" have different write access to the parameters if the customer defines a user-specific access code. This protects the device configuration via the local display from unauthorized access →  128.

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).	✓	✓
After an access code has been defined.	✓	✓ 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.	✓	— ¹⁾

- 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 →  128

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

7.3.11 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 →  128.

Parameter write protection via local operation can be disabled by entering the user-specific access code in the **Enter access code** parameter (→  109) via the respective access option.

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

2. Enter the access code.

- ↳ The -symbol in front of the parameters disappears; all previously write-protected parameters are now re-enabled.

7.3.12 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.

7.4 Access to operating menu via web browser

7.4.1 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, refer to the Special Documentation for the device ([Verweisziel existiert nicht, aber @y.link.required=true](#)) →  200

7.4.2 Requirements

Computer hardware

Hardware	Interface	
	CDI-RJ45	WLAN
Interface	The computer must have a RJ45 interface. ¹⁾	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)	

- 1) 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	▪ Microsoft Windows 8 or higher. ▪ Mobile operating systems: ▪ iOS ▪ Android  Microsoft Windows XP and Windows 7 is supported.	
Web browsers supported	▪ Microsoft Internet Explorer 8 or higher ▪ Microsoft Edge ▪ Mozilla Firefox ▪ Google Chrome ▪ Safari	

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's <i>Use a Proxy Server for Your LAN</i> setting must be deselected .	
JavaScript	JavaScript must be enabled.  If JavaScript cannot be enabled: Enter <code>http://192.168.1.212/servlet/basic.html</code> in the address bar of the web browser. A fully functional but simplified version of the operating menu structure starts in the web browser.  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	Use only the active network connections for the measuring device.	
	Switch off all other network connections such as WLAN for example.	Switch off all other network connections.

 In the event of connection problems: →  143

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 → 70

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 → 70

7.4.3 Establishing a connection**Via service interface (CDI-RJ45)***Preparing the measuring device**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 → 71.
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 → 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-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_t-mass_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.

- 1
- Picture of device
- 2
- Device name
- 3
- Device tag (→ 83)
- 4
- Status signal
- 5
- Current measured values
- 6
- Operating language
- 7
- User role
- 8
- Access code
- 9
- Login
- 10
- Reset access code (→ 118)

If a login page does not appear, or if the page is incomplete → 143

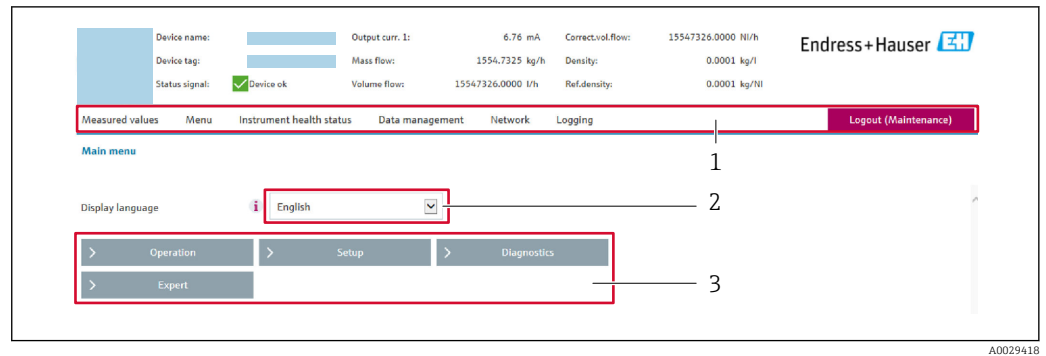
7.4.4 **Logging on**

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.

7.4.5 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 → 149
- Current measured values

Function row

Functions	Meaning
Measured values	Displays the measured values of the device
Menu	■ Access to the operating menu from the measuring device ■ The structure of the operating menu is the same as for the local display Detailed information on the structure of the operating menu: see the Description of Device Parameters
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

7.4.6 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 → Communication → Web server

Parameter overview with brief description

Parameter	Description	Selection
Web server functionality	Switch the Web server on and off.	■ Off ■ HTML Off ■ On

Function scope of the "Web server functionality" parameter

Option	Description
Off	■ The Web server is completely disabled. ■ Port 80 is locked.
On	■ The complete Web server functionality is available. ■ JavaScript is used. ■ The password is transferred in an encrypted state. ■ Any change to the password is also transferred in an encrypted state.

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

7.4.7 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) →  66.

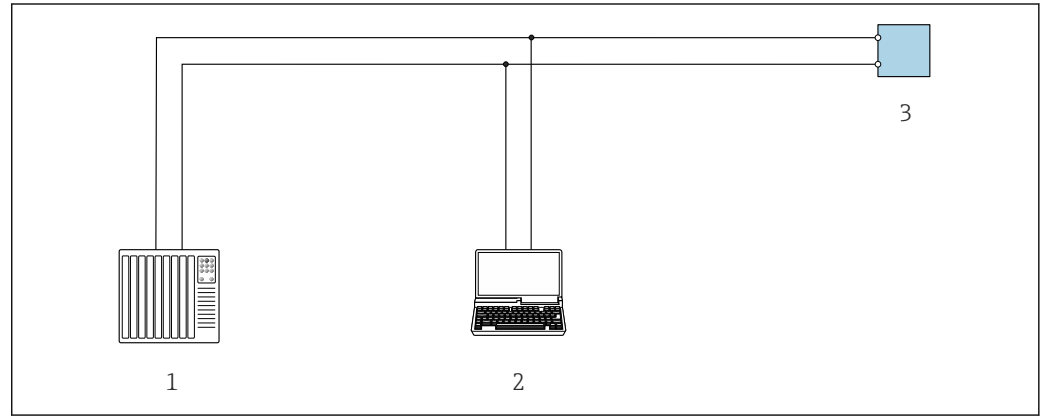
7.5 Access to the operating menu via the operating tool

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

7.5.1 Connecting the operating tool

Via Modbus RS485 protocol

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



32 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)

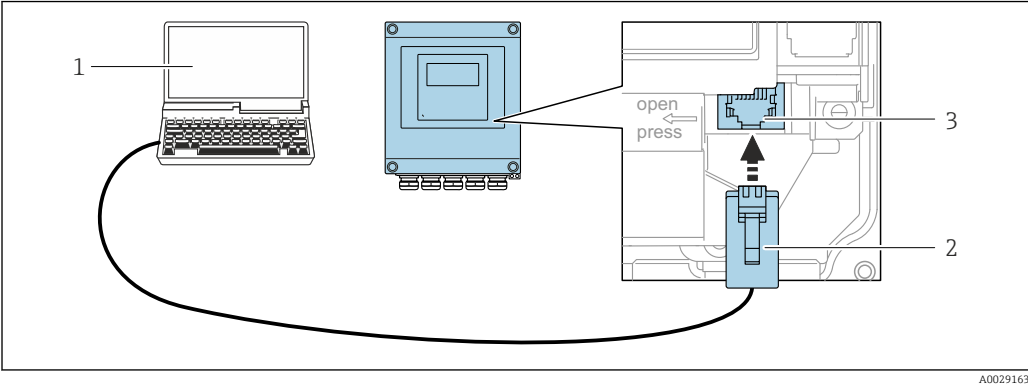
A point-to-point connection can be established to configure the device on site. With the housing open, the connection is established directly via the service interface (CDI-RJ45) of the device.

i An adapter for the RJ45 to the M12 plug is optionally available for the non-hazardous area:

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



33 Connection via service interface (CDI-RJ45)

- 1 Computer with web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) to access the integrated web server or with an operating tool "FieldCare", "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"

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	- Internal antenna - External antenna (optional) In the event of poor transmission/reception conditions at the place of installation. Only 1 antenna is active at any one time!
Range	- Internal antenna: typically 10 m (32 ft) - External antenna: typically 50 m (164 ft)
Materials (external antenna)	- Antenna: ASA plastic (acrylonitrile styrene acrylate) and nickel-plated brass - Adapter: Stainless steel and nickel-plated brass - Cable: Polyethylene - Plug: Nickel-plated brass - Angle bracket: Stainless steel

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_t-mass_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.

7.5.2 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 →  71
- WLAN interface →  72

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

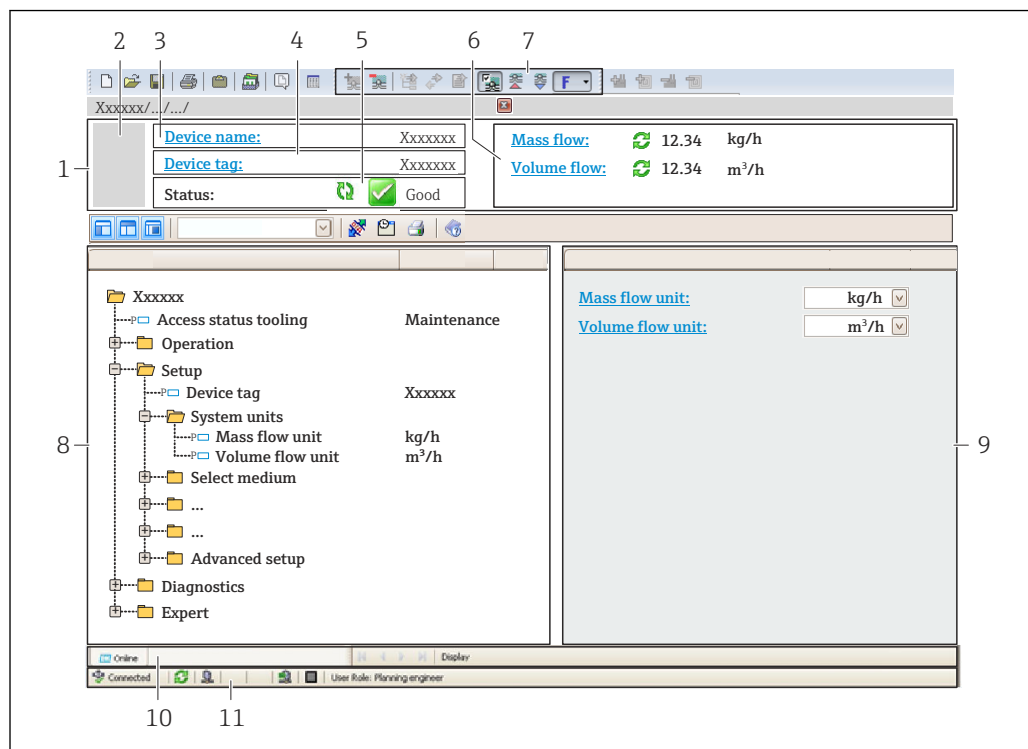
-  ■ Operating Instructions BA00027S
- Operating Instructions BA00059S

 Source for device description files →  75

Establishing a connection

-  ■ Operating Instructions BA00027S
- Operating Instructions BA00059S

User interface



A0021051-EN

- 1 Header
- 2 Picture of device
- 3 Device name
- 4 Device tag
- 5 Status area with status signal → 149
- 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

7.5.3 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 IN01047S



Source for device description files → 75

8 System integration

8.1 Overview of device description files

8.1.1 Current version data for the device

Firmware version	01.00.zz	- On the title page of the Operating Instructions - On the transmitter nameplate →  15 Firmware version parameter Diagnostics → Device information → Firmware version
Release date of firmware version	07.2020	---



For an overview of the various firmware versions for the device →  160

8.1.2 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	www.endress.com → Downloads area - USB stick (contact Endress+Hauser) - DVD (contact Endress+Hauser)
DeviceCare	www.endress.com → Downloads area - CD-ROM (contact Endress+Hauser) - DVD (contact Endress+Hauser)

8.2 Compatibility with earlier model

If the device is replaced, the measuring device 500 supports the compatibility of the Modbus registers for the process variables and the diagnostic information with the previous model. 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
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

 The Modbus registers are compatible but the diagnostic numbers are not. Overview of the new diagnostic numbers →  152.

8.3 Modbus RS485 information

8.3.1 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 one 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.  If the required device parameters are not available as a group, yet must nevertheless be addressed with a single telegram, use Modbus data map →  78	Write multiple device parameters
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 before 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.

8.3.2 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 "Description of device parameters" documentation.

8.3.3 Response time

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

8.3.4 Data types

The measuring device supports the following data types:

FLOAT (floating point number IEEE 754) Data length = 4 bytes (2 registers)			
Byte 3	Byte 2	Byte 1	Byte 0
SEEEEEEE	EMMMMMMM	MMMMMMMM	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)

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

8.3.5 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			
Options	1.	2.	3.	4.
1 - 0 - 3 - 2 *	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)	Byte 3 (EEEEEEEE)	Byte 2 (EEEEEEEE)
0 - 1 - 2 - 3	Byte 0 (MMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 2 (EEEEEEEE)	Byte 3 (EEEEEEEE)
2 - 3 - 0 - 1	Byte 2 (EEEEEEEE)	Byte 3 (EEEEEEEE)	Byte 0 (MMMMMMMM)	Byte 1 (MMMMMMMM)
3 - 2 - 1 - 0	Byte 3 (EEEEEEEE)	Byte 2 (EEEEEEEE)	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)
* = 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				
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 2 - 3 - 0 - 1	Byte 16	Byte 17 (MSB)	...	Byte 0 (LSB)	Byte 1
* = factory setting, MSB = most significant byte, LSB = least significant byte					

8.3.6 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.



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

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 → Communication → Modbus data map → 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			
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 register		Data type*	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
* 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.				

9 Commissioning

9.1 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-mounting" check → 32
- Checklist for "Post-connection check" → 49

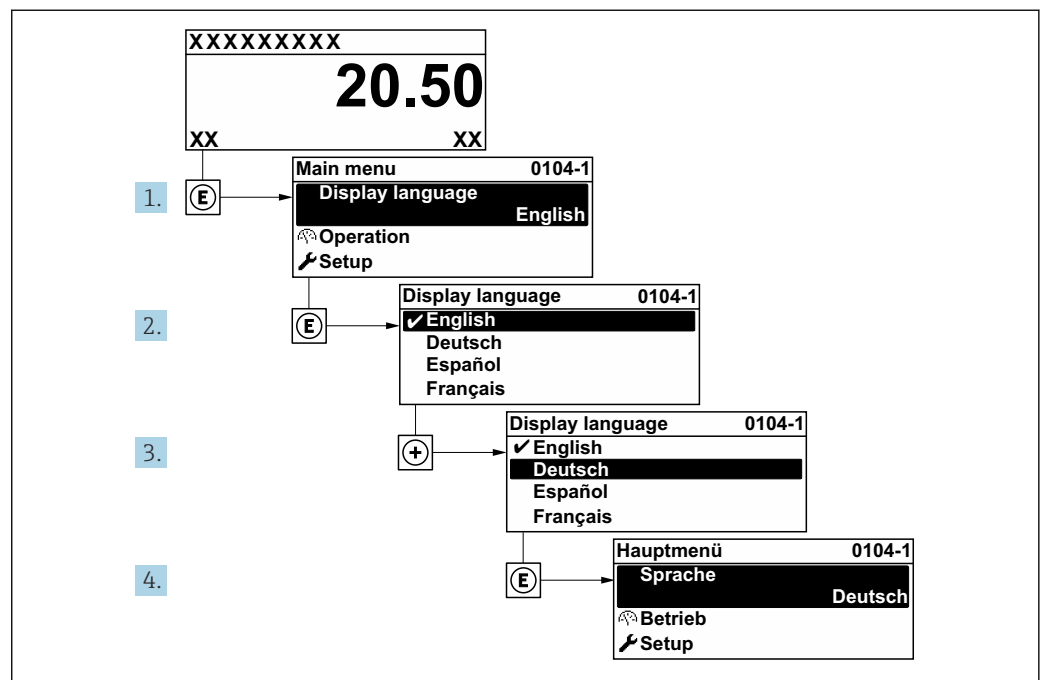
9.2 Switching on the measuring device

- ▶ Switch on the device upon successful completion of the post-mounting and post-connection 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" → 142.

9.3 Setting the operating language

Factory setting: English or ordered local language

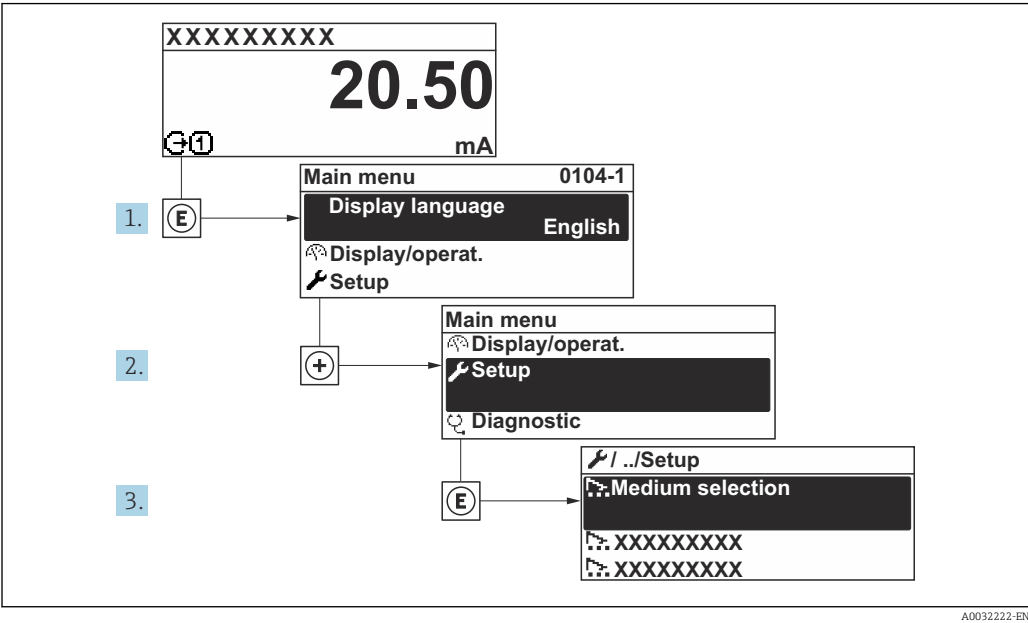


34 Taking the example of the local display

A0029420

9.4 Configuring the measuring device

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



35 Navigation to "Setup" menu using the example of the local display

i 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

▶ Measurement mode → 83

▶ Reference conditions → 87

▶ Sensor adjustment → 88

▶ System units → 89

▶ Communication → 91

▶ I/O configuration → 92

▶ Current input 1 to n → 93

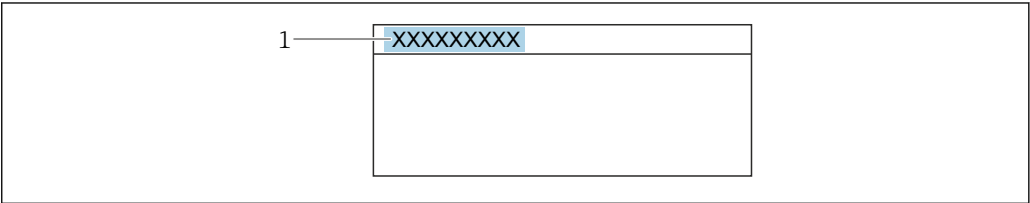
▶ Status input 1 to n

▶ Current output 1 to n → 95

► Pulse/frequency/switch output 1 to n	→ 98
► Relay output 1 to n	→ 104
► Display	→ 105
► Low flow cut off	→ 108
► Advanced setup	→ 109

9.4.1 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.



36 Header of the operational display with tag name

1 Tag name

Enter the tag name in the "FieldCare" operating tool → 74

Navigation

"Setup" menu → Device tag

Parameter overview with brief description

Parameter	Description	User entry
Device tag	Enter the name for the measuring point.	Max. 32 characters, such as letters, numbers or special characters (e.g. @, %, /).

9.4.2 Configuring the measurement mode

Properties of the medium can be configured in the **Measurement mode** submenu.

Navigation

"Setup" menu → Measurement mode

► Measurement mode	
Measurement application	→ 85
Select gas type	→ 85

Gas	→  85
Gas composition	→  85
Mol% Air	→  85
Mol% Ar	→  86
Mol% C2H4	→  86
Mol% C2H6	→  86
Mol% C3H8	→  86
Mol% CH4	→  86
Mol% Cl2	→  86
Mol% CO	→  86
Mol% CO2	→  86
Mol% H2	→  86
Mol% H2O	→  86
Mol% H2S	→  86
Mol% HCl	→  86
Mol% He	→  86
Mol% Kr	→  86
Mol% N2	→  86
Mol% n-C4H10	→  86
Mol% Ne	→  87
Mol% NH3	→  87
Mol% O2	→  87
Mol% O3	→  87
Mol% Xe	→  87
Special gas name	→  87

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Measurement application	–	Select measurement application.	■ Air or compressed air ■ Gas or gas mixture ■ Energy	–
Select gas type	–	Select measured gas type.	■ Single gas ■ Gas mixture ■ Special gas *	–
Gas	The Single gas option is selected in the Select gas type parameter parameter.	Select measured gas.	■ Air ■ Ammonia NH3 ■ Argon Ar ■ Butane C4H10 ■ Carbon dioxide CO2 ■ Carbon monoxide CO ■ Chlorine Cl2 ■ Ethane C2H6 ■ Ethylene C2H4 ■ Helium He ■ Hydrogen H2 ■ Hydrogen chloride HCl ■ Hydrogen sulfide H2S ■ Krypton Kr ■ Methane CH4 ■ Neon Ne ■ Nitrogen N2 ■ Oxygen O2 ■ Ozone O3 ■ Propane C3H8 ■ Xenon Xe	–
Gas composition	The Gas mixture option is selected in the Select gas type parameter parameter.	Select measured gas mixture.	■ Air ■ Hydrogen H2 ■ Helium He ■ Neon Ne ■ Argon Ar ■ Krypton Kr ■ Xenon Xe ■ Nitrogen N2 ■ Oxygen O2 ■ Chlorine Cl2 ■ Ammonia NH3 ■ Carbon monoxide CO ■ Carbon dioxide CO2 ■ Hydrogen sulfide H2S ■ Hydrogen chloride HCl ■ Methane CH4 ■ Propane C3H8 ■ Ethane C2H6 ■ Butane C4H10 ■ Ethylene C2H4 ■ Water ■ Ozone O3	–
Mol% Air	–	Enter amount of substance for the gas mixture. Air	0 to 100 %	–

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Mol% Ar	–	Enter amount of substance for the gas mixture. Ar = Argon	0 to 100 %	–
Mol% C ₂ H ₄	–	Enter amount of substance for the gas mixture. C ₂ H ₄ = ethylene	0 to 100 %	–
Mol% C ₂ H ₆	–	Enter amount of substance for the gas mixture. C ₂ H ₆ = ethane	0 to 100 %	–
Mol% C ₃ H ₈	–	Enter amount of substance for the gas mixture. C ₃ H ₈ = propane	0 to 100 %	–
Mol% CH ₄	–	Enter amount of substance for the gas mixture. CH ₄ = methane	0 to 100 %	–
Mol% Cl ₂	–	Enter amount of substance for the gas mixture. Cl ₂ = chlorine	0 to 100 %	–
Mol% CO	–	Enter amount of substance for the gas mixture. CO = carbon monoxide	0 to 100 %	–
Mol% CO ₂	–	Enter amount of substance for the gas mixture. CO ₂ = carbon dioxide	0 to 100 %	–
Mol% H ₂	–	Enter amount of substance for the gas mixture. H ₂ = hydrogen	0 to 100 %	–
Mol% H ₂ O	–	Enter amount of substance for the gas mixture. H ₂ O = water	0 to 20 %	–
Mol% H ₂ S	–	Enter amount of substance for the gas mixture. H ₂ S = hydrogen sulfide	0 to 100 %	–
Mol% HCl	–	Enter amount of substance for the gas mixture. HCl = hydrogen chloride	0 to 100 %	–
Mol% He	–	Enter amount of substance for the gas mixture. He = helium	0 to 100 %	–
Mol% Kr	–	Enter amount of substance for the gas mixture. Kr = krypton	0 to 100 %	–
Mol% N ₂	–	Enter amount of substance for the gas mixture. N ₂ = nitrogen	0 to 100 %	–
Mol% n-C ₄ H ₁₀	–	Enter amount of substance for the gas mixture. n-C ₄ H ₁₀ = n-butane	0 to 100 %	–

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Mol% Ne	–	Enter amount of substance for the gas mixture. Ne = neon	0 to 100 %	–
Mol% NH ₃	–	Enter amount of substance for the gas mixture. NH ₃ = ammonia	0 to 100 %	–
Mol% O ₂	–	Enter amount of substance for the gas mixture. O ₂ = oxygen	0 to 100 %	–
Mol% O ₃	As a mixture, only possible with O ₂ : ■ O ₃ : 0 to 35 % ■ O ₂ : 65 to 100 % O ₃ as single gas: 100 %	Enter amount of substance for the gas mixture.	0 to 100 %	–
Mol% Xe	–	Enter amount of substance for the gas mixture. Xe = xenon	0 to 100 %	–
Special gas name	Special gas option application package is available.	Shows the description of the gas ordered by the customer, e.g. gas name or gas composition.	–	–

* Visibility depends on order options or device settings

9.4.3 Configuring reference conditions

Reference properties can be configured in the **Reference conditions** submenu.

Navigation

"Setup" menu → Reference conditions

► Reference conditions		
Reference conditions	→	88
Reference pressure	→	88
Reference temperature	→	88
FAD conditions	→	88
FAD pressure	→	88
FAD temperature	→	88
Reference combustion temperature	→	88
Reference combustion temperature	→	88

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry
Reference conditions	–	Select reference conditions for calculation of the corrected volume flow.	■ 1013.25 mbara, 0 °C ■ 1013.25 mbara, 15 °C ■ 1013.25 mbara, 20 °C ■ 1013.25 mbara, 25 °C ■ 1000 mbara, 0 °C ■ 1000 mbara, 15 °C ■ 1000 mbara, 20 °C ■ 1000 mbara, 25 °C ■ 14.696 psia, 59 °F ■ 14.696 psia, 60 °F ■ User-defined
Reference pressure	The Others option is selected in the Reference conditions parameter.	Select reference conditions for the corrected volume flow.	0 to 250 bar a
Reference temperature	–	Enter reference temperature for calculating the reference density.	–200 to 450 °C
FAD conditions	The Air or compressed air option is selected in the Measurement application parameter parameter.	Select reference conditions for the calculation of the FAD density (FAD = free air delivery).	■ 1000 mbara, 20 °C ■ 14.504 psia, 68 °F ■ User-defined
FAD pressure	■ The Air or compressed air option is selected in the Measurement application parameter parameter. ■ The User-defined option is selected in the FAD conditions parameter parameter.	Enter reference pressure for the calculation of the FAD density (FAD = free air delivery).	0 to 250 bar a
FAD temperature	■ The Air or compressed air option is selected in the Measurement application parameter parameter. ■ The User-defined option is selected in the FAD conditions parameter parameter.	Enter reference temperature for the calculation of the FAD density (FAD = free air delivery).	–200 to 450 °C
Reference combustion temperature	The Energy option is selected in the Measurement application parameter parameter.	Enter reference combustion temperature to calculate the natural gas energy value.	–200 to 450 °C
Reference combustion temperature	–	Select ref. temp. (reference combustion temperature) for calculating the gas energy value.	■ 0 °C ■ 15 °C ■ 20 °C ■ 25 °C ■ 60 °F ■ User-defined

9.4.4 Sensor adjustment

Parameters pertaining to the pipe shape of the insertion version can be configured in the **Sensor adjustment** submenu.

 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").

▶ Sensor adjustment

Installation direction

→  89

Installation factor

→  89

Pipe shape	→ 89
Pipe inner diameter	→ 89
Duct height	→ 89
Duct width	→ 89

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry
Installation direction	–	Set sign of flow direction to match the direction of the arrow on the sensor.	■ Forward flow ■ Reverse flow
Installation factor	–	Enter factor to compensate the mounting-related measurement error.	0.01 to 100.0
Pipe shape	Only available with t-mass I.	Select the shape of the pipe.	■ Circular ■ Rectangular
Pipe inner diameter	Only available with t-mass I.	Enter the internal diameter of a circular pipe.	0.050 to 5 m
Duct height	Only available with t-mass I.	Enter inner duct height. Duct height and sensor shaft are parallel.	0.050 to 5 m
Duct width	Only available with t-mass I.	Enter inner duct width. The duct width is vertical to the sensor shaft.	0.050 to 5 m

9.4.5 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 → System units

► System units	
Mass flow unit	→ 90
Mass unit	→ 90
Corrected volume flow unit	→ 90
Corrected volume unit	→ 90
Volume flow unit	→ 90
Volume unit	→ 90

FAD volume flow unit	→  90
FAD volume unit	→  90
Energy flow unit	→  90
Energy unit	→  91
Calorific value unit	→  91
Density unit	→  91
Temperature unit	→  91
Pressure unit	→  91
Velocity unit	→  91
Length unit	→  91
Date/time format	→  91

Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Mass flow unit	Select mass flow unit.	Unit choose list	Depends on country: ■ kg/h ■ lb/h
Mass unit	Select mass unit.	Unit choose list	Country-specific: ■ kg ■ lb
Corrected volume flow unit	Select corrected volume flow unit.	Unit choose list	Country-specific: ■ Nm ³ /h ■ Sft ³ /h
Corrected volume unit	Select corrected volume unit.	Unit choose list	Country-specific: ■ Nm ³ ■ Sft ³
Volume flow unit	Select volume flow unit.	Unit choose list	Depends on country: ■ l/h ■ ft ³ /h
Volume unit	Select volume unit.	Unit choose list	Country-specific: ■ ft ³ ■ m ³
FAD volume flow unit	Select FAD volumen flow unit (FAD = free air delivery).	Unit choose list	Country-specific: ■ m ³ FAD/h ■ cf FAD/min
FAD volume unit	Select FAD volumen unit (FAD = free air delivery).	Unit choose list	Country-specific: ■ m ³ FAD ■ cf FAD
Energy flow unit	Select energy flow unit.	Unit choose list	Country-specific: ■ kW ■ Btu/h

Parameter	Description	Selection	Factory setting
Energy unit	Select energy unit.	Unit choose list	Country-specific: ■ kWh ■ Btu
Calorific value unit	Select calorific value unit.	Unit choose list	Country-specific: ■ kWh/Nm ³ ■ Btu/Sft ³
Density unit	Select density unit.	Unit choose list	Country-specific: ■ kg/m ³ ■ lb/ft ³
Temperature unit	Select temperature unit.	Unit choose list	Country-specific: ■ °C ■ °F
Pressure unit	Select process pressure unit.	Unit choose list	Country-specific: ■ bar a ■ psi a
Velocity unit	Select velocity unit.	Unit choose list	Country-specific: ■ m/s ■ ft/s
Length unit	Select length unit for nominal diameter.	Unit choose list	Country-specific: ■ mm ■ in
Date/time format	Select date and time format.	■ dd.mm.yy hh:mm ■ dd.mm.yy hh:mm am/pm ■ mm/dd/yy hh:mm ■ mm/dd/yy hh:mm am/pm	–

9.4.6 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 → Communication

► Communication

Bus address

→ ⓘ 92

Baudrate

→ ⓘ 92

Data transfer mode

→ ⓘ 92

Parity

→ ⓘ 92

Byte order

→ ⓘ 92

Failure mode

→ ⓘ 92

Parameter overview with brief description

Parameter	Description	User entry / Selection
Bus address	Enter device address.	1 to 247
Baudrate	Define data transfer speed.	1200 BAUD 2400 BAUD 4800 BAUD 9600 BAUD 19200 BAUD 38400 BAUD 57600 BAUD 115200 BAUD
Data transfer mode	Select data transfer mode.	- ASCII - 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
Byte order	Select byte transmission sequence.	0-1-2-3 3-2-1-0 1-0-3-2 2-3-0-1
Failure mode	Select measured value output behavior when a diagnostic message occurs via Modbus communication. NaN ¹⁾	- NaN value - Last valid value

1) Not a Number

9.4.7 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 → I/O configuration

► I/O configuration

I/O module 1 to n terminal numbers

I/O module 1 to n information

I/O module 1 to n type

Apply I/O configuration

I/O alteration code

→ 93

→ 93

→ 93

→ 93

→ 93

Parameter overview with brief description

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

* Visibility depends on order options or device settings

9.4.8 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

Current span

→ 94

Terminal number

→ 94

Signal mode

→ 94

Terminal number

→ 94

0/4 mA value

→ 94

20 mA value

→ 94

Failure mode

→ 94

Terminal number

→ 94

Failure value

→ 94

Terminal number

→ 94

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Current span	–	Select current range for process value output and upper/lower level for alarm signal.	▪ 4...20 mA (4...20.5 mA) ▪ 4...20 mA NAMUR (3.8...20.5 mA) ▪ 4...20 mA US (3.9...20.8 mA) ▪ 0...20 mA (0...20.5 mA)	Country-specific: ▪ 4...20 mA NAMUR (3.8...20.5 mA) ▪ 4...20 mA US (3.9...20.8 mA)
Terminal number	–	Shows the terminal numbers used by the current input module.	▪ Not used ▪ 24-25 (I/O 2) ▪ 22-23 (I/O 3) ▪ 20-21 (I/O 4) *	–
Signal mode	The measuring device is not approved for use in the hazardous area with type of protection Ex-i.	Select the signal mode for the current input.	▪ Passive ▪ Active *	Active
0/4 mA value	–	Enter 4 mA value.	Signed floating-point number	–
20 mA value	–	Enter 20 mA value.	Signed floating-point number	Depends on country and nominal diameter
Failure mode	–	Define input behavior in alarm condition.	▪ Alarm ▪ Last valid value ▪ Defined value	–
Failure value	In the Failure mode parameter, the Defined value option is selected.	Enter value to be used by the device if input value from external device is missing.	Signed floating-point number	–

* Visibility depends on order options or device settings

9.4.9 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.

Navigation

"Setup" menu → Status input 1 to n

► Status input 1 to n

Assign status input

→ ⓘ 95

Terminal number

→ ⓘ 95

Active level

→ ⓘ 95

Terminal number

→ ⓘ 95

Response time status input

→ ⓘ 95

Terminal number

→ ⓘ 95

Parameter overview with brief description

Parameter	Description	Selection / User interface / User entry
Assign status input	Select function for the status input.	■ Off ■ Reset totalizer 1 ■ Reset totalizer 2 ■ Reset totalizer 3 ■ Reset all totalizers ■ Flow override ■ Gas group * ■ Zero point adjustment
Terminal number	Shows the terminal numbers used by the status input module.	■ Not used ■ 24-25 (I/O 2) ■ 22-23 (I/O 3) ■ 20-21 (I/O 4) *
Active level	Define input signal level at which the assigned function is triggered.	■ High ■ Low
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

* Visibility depends on order options or device settings

9.4.10 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

▶ Current output 1 to n

Assign current output 1 to n

Terminal number

Current span

Terminal number

Signal mode

Terminal number

0/4 mA value

20 mA value

Fixed current

Terminal number

Damping output 1 to n

→ 96

→ 96

→ 96

→ 96

→ 96

→ 96

→ 96

→ 97

→ 97

→ 96

→ 97

Failure mode	→ 97
Terminal number	→ 96
Failure current	→ 97
Terminal number	→ 96

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Assign current output 1 to n	–	Select process variable for current output.	■ Off * ■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow ■ Energy flow * ■ Heat flow * ■ Density ■ Flow velocity ■ Pressure ■ 2nd temperature delta heat * ■ Electronic temperature	–
Terminal number	–	Shows the terminal numbers used by the current output module.	■ Not used ■ 24-25 (I/O 2) ■ 22-23 (I/O 3) * ■ 20-21 (I/O 4) *	–
Current span	–	Select current range for process value output and upper/lower level for alarm signal.	■ 4...20 mA NAMUR (3.8...20.5 mA) ■ 4...20 mA US (3.9...20.8 mA) ■ 4...20 mA (4... 20.5 mA) ■ 0...20 mA (0... 20.5 mA) ■ Fixed current	Depends on country: ■ 4...20 mA NAMUR (3.8...20.5 mA) ■ 4...20 mA US (3.9...20.8 mA)
Signal mode	–	Select the signal mode for the current output.	■ Active * ■ Passive *	Active
0/4 mA value	One of the following options is selected in the Current span parameter (→ 96): ■ 4...20 mA NAMUR (3.8...20.5 mA) ■ 4...20 mA US (3.9...20.8 mA) ■ 4...20 mA (4... 20.5 mA) ■ 0...20 mA (0... 20.5 mA)	Enter 4 mA value.	Signed floating-point number	–

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
20 mA value	One of the following options is selected in the Current span parameter (→ 96): ■ 4...20 mA NAMUR (3.8...20.5 mA) ■ 4...20 mA US (3.9...20.8 mA) ■ 4...20 mA (4... 20.5 mA) ■ 0...20 mA (0... 20.5 mA)	Enter 20 mA value.	Signed floating-point number	Depends on country and nominal diameter
Fixed current	The Fixed current option is selected in the Current span parameter (→ 96).	Defines the fixed output current.	0 to 22.5 mA	22.5 mA
Damping output 1 to n	A process variable is selected in the Assign current output parameter (→ 96) and one of the following options is selected in the Current span parameter (→ 96): ■ 4...20 mA NAMUR (3.8...20.5 mA) ■ 4...20 mA US (3.9...20.8 mA) ■ 4...20 mA (4... 20.5 mA) ■ 0...20 mA (0... 20.5 mA)	Set reaction time for output signal to fluctuations in the measured value.	0.0 to 999.9 s	–
Failure mode	A process variable is selected in the Assign current output parameter (→ 96) and one of the following options is selected in the Current span parameter (→ 96): ■ 4...20 mA NAMUR (3.8...20.5 mA) ■ 4...20 mA US (3.9...20.8 mA) ■ 4...20 mA (4... 20.5 mA) ■ 0...20 mA (0... 20.5 mA)	Define output behavior in alarm condition.	■ Min. ■ Max. ■ Last valid value ■ Actual value ■ Defined value	–
Failure current	The Defined value option is selected in the Failure mode parameter.	Enter current output value in alarm condition.	0 to 22.5 mA	22.5 mA

* Visibility depends on order options or device settings

9.4.11 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 → Advanced setup → Pulse/frequency/switch output

► Pulse/frequency/switch output
1 to n

Operating mode

→ 98

Parameter overview with brief description

Parameter	Description	Selection
Operating mode	Define the output as a pulse, frequency or switch output.	■ Pulse ■ Frequency ■ Switch

Configuring the pulse output

Navigation

"Setup" menu → Pulse/frequency/switch output

► Pulse/frequency/switch output
1 to n

Operating mode

Terminal number

Signal mode

Assign pulse output

Pulse scaling

Pulse width

Failure mode

→ 99

→ 99

→ 99

→ 99

→ 99

→ 99

→ 99

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.	■ Pulse ■ Frequency ■ Switch	–
Terminal number	–	Shows the terminal numbers used by the PFS output module.	■ Not used ■ 24-25 (I/O 2) ■ 22-23 (I/O 3) ■ 20-21 (I/O 4) *	–
Signal mode	–	Select the signal mode for the PFS output.	■ Passive ■ Active * ■ Passive NAMUR	–
Assign pulse output 1 to n	The Pulse option is selected in the Operating mode parameter.	Select process variable for pulse output.	■ Off ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow * ■ Energy flow * ■ Heat flow *	–
Pulse scaling	The Pulse option is selected in the Operating mode parameter (→  98) and a process variable is selected in the Assign pulse output parameter (→  99).	Enter quantity for measured value at which a pulse is output.	Positive floating point number	Depends on country and nominal diameter
Pulse width	The Pulse option is selected in the Operating mode parameter (→  98) and a process variable is selected in the Assign pulse output parameter (→  99).	Define time width of the output pulse.	0.05 to 2 000 ms	–
Failure mode	The Pulse option is selected in the Operating mode parameter (→  98) and a process variable is selected in the Assign pulse output parameter (→  99).	Define output behavior in alarm condition.	■ Actual value ■ No pulses	–

* Visibility depends on order options or device settings

Configuring the frequency output

Navigation

"Setup" menu → Pulse/frequency/switch output

► Pulse/frequency/switch output 1 to n

Operating mode

→  100

Terminal number

→  100

Signal mode

→  100

Assign frequency output	→  100
Minimum frequency value	→  100
Maximum frequency value	→  101
Measuring value at minimum frequency	→  101
Measuring value at maximum frequency	→  101
Failure mode	→  101
Failure frequency	→  101
Invert output signal	→  101

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.	■ Pulse ■ Frequency ■ Switch	–
Terminal number	–	Shows the terminal numbers used by the PFS output module.	■ Not used ■ 24-25 (I/O 2) ■ 22-23 (I/O 3) ■ 20-21 (I/O 4) *	–
Signal mode	–	Select the signal mode for the PFS output.	■ Passive ■ Active * ■ Passive NAMUR	–
Assign frequency output	In the Operating mode parameter (→  98), the Frequency option is selected.	Select process variable for frequency output.	■ Off ■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow * ■ Energy flow * ■ Heat flow * ■ Density ■ Flow velocity ■ Pressure ■ 2nd temperature delta heat * ■ Electronic temperature	–
Minimum frequency value	The Frequency option is selected in the Operating mode parameter (→  98) and a process variable is selected in the Assign frequency output parameter (→  100).	Enter minimum frequency.	0.0 to 10 000.0 Hz	–

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Maximum frequency value	The Frequency option is selected in the Operating mode parameter (→ 98) and a process variable is selected in the Assign frequency output parameter (→ 100).	Enter maximum frequency.	0.0 to 10 000.0 Hz	–
Measuring value at minimum frequency	The Frequency option is selected in the Operating mode parameter (→ 98) and a process variable is selected in the Assign frequency output parameter (→ 100).	Enter measured value for minimum frequency.	Signed floating-point number	Depends on country and nominal diameter
Measuring value at maximum frequency	The Frequency option is selected in the Operating mode parameter (→ 98) and a process variable is selected in the Assign frequency output parameter (→ 100).	Enter measured value for maximum frequency.	Signed floating-point number	Depends on country and nominal diameter
Failure mode	The Frequency option is selected in the Operating mode parameter (→ 98) and a process variable is selected in the Assign frequency output parameter (→ 100).	Define output behavior in alarm condition.	■ Actual value ■ Defined value ■ 0 Hz	–
Failure frequency	In the Operating mode parameter (→ 98), the Frequency option is selected, in the Assign frequency output parameter (→ 100) a process variable is selected, and in the Failure mode parameter, the Defined value option is selected.	Enter frequency output value in alarm condition.	0.0 to 12 500.0 Hz	–
Invert output signal	–	Invert the output signal.	■ No ■ Yes	–

* Visibility depends on order options or device settings

Configuring the switch output

Navigation

"Setup" menu → Pulse/frequency/switch output

► Pulse/frequency/switch output 1 to n		
Operating mode	→	📄 102
Terminal number	→	📄 102
Signal mode	→	📄 102
Switch output function	→	📄 103
Assign diagnostic behavior	→	📄 103
Assign limit	→	📄 103
Assign status	→	📄 103
Switch-on value	→	📄 103
Switch-off value	→	📄 103
Switch-on delay	→	📄 103
Switch-off delay	→	📄 104
Failure mode	→	📄 104

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.	■ Pulse ■ Frequency ■ Switch	–
Terminal number	–	Shows the terminal numbers used by the PFS output module.	■ Not used ■ 24-25 (I/O 2) ■ 22-23 (I/O 3) ■ 20-21 (I/O 4) *	–
Signal mode	–	Select the signal mode for the PFS output.	■ Passive ■ Active * ■ Passive NAMUR	–

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Switch output function	The Switch option is selected in the Operating mode parameter.	Select function for switch output.	■ Off ■ On ■ Diagnostic behavior ■ Limit ■ Flow direction check * ■ Status	–
Assign diagnostic behavior	■ In the Operating mode parameter, the Switch option is selected. ■ In the Switch output function parameter, the Diagnostic behavior option is selected.	Select diagnostic behavior for switch output.	■ Alarm ■ Alarm or warning ■ Warning	–
Assign limit	■ The Switch option is selected in the Operating mode parameter. ■ The Limit option is selected in the Switch output function parameter.	Select process variable for limit function.	■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow ■ Energy flow * ■ Heat flow * ■ Density ■ Flow velocity ■ 2nd temperature delta heat * ■ Electronic temperature ■ Totalizer 1 ■ Totalizer 2 ■ Totalizer 3	–
Assign status	■ The Switch option is selected in the Operating mode parameter. ■ The Status option is selected in the Switch output function parameter.	Select device status for switch output.	■ Off ■ Low flow cut off	–
Switch-on value	■ The Switch option is selected in the Operating mode parameter. ■ The Limit option is selected in the Switch output function parameter.	Enter measured value for the switch-on point.	Signed floating-point number	Depends on country and nominal diameter
Switch-off value	■ The Switch option is selected in the Operating mode parameter. ■ The Limit option is selected in the Switch output function parameter.	Enter measured value for the switch-off point.	Signed floating-point number	–
Switch-on delay	■ The Switch option is selected in the Operating mode parameter. ■ The Limit option is selected in the Switch output function parameter.	Define delay for the switch-on of status output.	0.0 to 100.0 s	–

Parameter	Prerequisite	Description	Selection / User interface / User entry	Factory setting
Switch-off delay	▪ The Switch option is selected in the Operating mode parameter. ▪ The Limit option is selected in the Switch output function parameter.	Define delay for the switch-off of status output.	0.0 to 100.0 s	–
Failure mode	–	Define output behavior in alarm condition.	▪ Actual status ▪ Open ▪ Closed	–

* Visibility depends on order options or device settings

9.4.12 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 → Relay output 1 to n

► Relay output 1 to n

Terminal number

→ ⓘ 105

Relay output function

→ ⓘ 105

Assign limit

→ ⓘ 105

Assign diagnostic behavior

→ ⓘ 105

Assign status

→ ⓘ 105

Switch-off value

→ ⓘ 105

Switch-off delay

→ ⓘ 105

Switch-on value

→ ⓘ 105

Switch-on delay

→ ⓘ 105

Failure mode

→ ⓘ 105

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface / Selection / User entry	Factory setting
Terminal number	–	Shows the terminal numbers used by the relay output module.	■ Not used ■ 24-25 (I/O 2) ■ 22-23 (I/O 3) ■ 20-21 (I/O 4)	–
Relay output function	–	Select the function for the relay output.	■ Closed ■ Open ■ Diagnostic behavior ■ Limit ■ Flow direction check ■ Digital Output	–
Assign limit	The Limit option is selected in the Relay output function parameter.	Select process variable for limit function.	■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow * ■ Energy flow * ■ Heat flow * ■ Density ■ Flow velocity ■ 2nd temperature delta heat * ■ Electronic temperature ■ Totalizer 1 ■ Totalizer 2 ■ Totalizer 3	–
Assign diagnostic behavior	In the Relay output function parameter, the Diagnostic behavior option is selected.	Select diagnostic behavior for switch output.	■ Alarm ■ Alarm or warning ■ Warning	–
Assign status	In the Relay output function parameter, the Digital Output option is selected.	Select device status for switch output.	■ Off ■ Low flow cut off	–
Switch-off value	In the Relay output function parameter, the Limit option is selected.	Enter measured value for the switch-off point.	Signed floating-point number	–
Switch-off delay	In the Relay output function parameter, the Limit option is selected.	Define delay for the switch-off of status output.	0.0 to 100.0 s	–
Switch-on value	The Limit option is selected in the Relay output function parameter.	Enter measured value for the switch-on point.	Signed floating-point number	Depends on country and nominal diameter
Switch-on delay	In the Relay output function parameter, the Limit option is selected.	Define delay for the switch-on of status output.	0.0 to 100.0 s	–
Failure mode	–	Define output behavior in alarm condition.	■ Actual status ■ Open ■ Closed	–

* Visibility depends on order options or device settings

9.4.13 Configuring the local display

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

Navigation

"Setup" menu → Display

► Display		
Format display	→ 	106
Value 1 display	→ 	106
0% bargraph value 1	→ 	107
100% bargraph value 1	→ 	107
Value 2 display	→ 	107
Value 3 display	→ 	107
0% bargraph value 3	→ 	107
100% bargraph value 3	→ 	107
Value 4 display	→ 	107

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.	■ 1 value, max. size ■ 1 bargraph + 1 value ■ 2 values ■ 1 value large + 2 values ■ 4 values	–
Value 1 display	A local display is provided.	Select the measured value that is shown on the local display.	■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow ■ Energy flow * ■ Heat flow * ■ Density ■ Flow velocity ■ Pressure ■ 2nd temperature delta heat * ■ Electronic temperature ■ Totalizer 1 ■ Totalizer 2 ■ Totalizer 3 ■ Current output 1 * ■ Current output 2 * ■ Current output 3 * ■ Current output 4 *	–

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
0% bargraph value 1	A local display is provided.	Enter 0% value for bar graph display.	Signed floating-point number	–
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 the Value 1 display parameter (→ 106)	–
Value 3 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
0% bargraph value 3	A selection was made in the Value 3 display parameter.	Enter 0% value for bar graph display.	Signed floating-point number	–
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	–
Value 4 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
Value 5 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
Value 6 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
Value 7 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
Value 8 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–

* Visibility depends on order options or device settings

9.4.14 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 → Low flow cut off

► Low flow cut off

Assign process variable

→ ⓘ 108

On value low flow cutoff

→ ⓘ 108

Off value low flow cutoff

→ ⓘ 108

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Assign process variable	–	Select process variable for low flow cut off.	■ Off ■ Mass flow ■ Volume flow ■ Corrected volume flow ■ FAD volume flow *	–
On value low flow cutoff	A process variable is selected in the Assign process variable parameter (→ ⓘ 108).	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 Assign process variable parameter (→ ⓘ 108).	Enter off value for low flow cut off.	0 to 100.0 %	–

* Visibility depends on order options or device settings

9.5 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. 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 → Advanced setup

► Advanced setup		
Enter access code	→ 	109
► Totalizer 1 to n	→ 	109
► Display	→ 	111
► WLAN settings	→ 	114
► Configuration backup	→ 	115
► Administration	→ 	117

9.5.1 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	Enter access code to disable write protection of parameters.	Max. 16-digit character string comprising numbers, letters and special characters

9.5.2 Configuring the totalizer

In the **"Totalizer 1 to n" submenu** the individual totalizer can be configured.

Navigation

"Setup" menu → Advanced setup → Totalizer 1 to n

► Totalizer 1 to n		
Assign process variable	→ 	110
Unit totalizer 1 to n	→ 	110

Totalizer operation mode	→  110
Failure mode	→  110
Assign gas	→  110

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection	Factory setting
Assign process variable	–	Select process variable for totalizer.	■ Off ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow ■ Energy flow * ■ Heat flow *	–
Unit totalizer 1 to n	A process variable is selected in the Assign process variable parameter (→  110) of the Totalizer 1 to n submenu.	Select process variable totalizer unit.	Unit choose list	–
Totalizer operation mode	A process variable is selected in the Assign process variable parameter (→  110) of the Totalizer 1 to n submenu.	Select totalizer calculation mode.	■ Net flow total ■ Forward flow total ■ Reverse flow total	–
Failure mode	A process variable is selected in the Assign process variable parameter (→  110) of the Totalizer 1 to n submenu.	Define totalizer behavior in alarm condition.	■ Stop ■ Actual value ■ Last valid value	–
Assign gas (Only with order code for "Application package", option EV "Second gas group")	–	Select the gas that the totalizer uses. This gas is only totalized when it is currently active ('Active gas' parameter).	■ Both gases ■ Gas ■ Second gas	■ Both gases option (only with order code for "Application package", option EV "Second gas group") ■ Gas

* Visibility depends on order options or device settings

9.5.3 Carrying out additional display configurations

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

Navigation

"Setup" menu → Advanced setup → Display

► Display		
Format display	→	 112
Value 1 display	→	 112
0% bargraph value 1	→	 112
100% bargraph value 1	→	 112
Decimal places 1	→	 112
Value 2 display	→	 112
Decimal places 2	→	 112
Value 3 display	→	 112
0% bargraph value 3	→	 112
100% bargraph value 3	→	 112
Decimal places 3	→	 113
Value 4 display	→	 113
Decimal places 4	→	 113
Display language	→	 113
Display interval	→	 113
Display damping	→	 113
Header	→	 113
Header text	→	 113
Separator	→	 113
Backlight	→	 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.	■ 1 value, max. size ■ 1 bargraph + 1 value ■ 2 values ■ 1 value large + 2 values ■ 4 values	–
Value 1 display	A local display is provided.	Select the measured value that is shown on the local display.	■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow ■ Energy flow * ■ Heat flow * ■ Density ■ Flow velocity ■ Pressure ■ 2nd temperature delta heat * ■ Electronic temperature ■ Totalizer 1 ■ Totalizer 2 ■ Totalizer 3 ■ Current output 1 * ■ Current output 2 * ■ Current output 3 * ■ Current output 4 *	–
0% bargraph value 1	A local display is provided.	Enter 0% value for bar graph display.	Signed floating-point number	–
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 Value 1 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	–
Value 2 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
Decimal places 2	A measured value is specified in the Value 2 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	–
Value 3 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
0% bargraph value 3	A selection was made in the Value 3 display parameter.	Enter 0% value for bar graph display.	Signed floating-point number	–
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	–

Parameter	Prerequisite	Description	Selection / User entry	Factory setting
Decimal places 3	A measured value is specified in the Value 3 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	–
Value 4 display	A local display is provided.	Select the measured value that is shown on the local display.	For the picklist, see the Value 1 display parameter (→ 106)	–
Decimal places 4	A measured value is specified in the Value 4 display parameter.	Select the number of decimal places for the display value.	■ x ■ x.x ■ x.xx ■ x.xxx ■ x.xxxx	–
Display language	A local display is provided.	Set display language.	■ English ■ Deutsch ■ Français ■ Español ■ Italiano ■ Nederlands ■ Portuguesa ■ Polski ■ русский 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	–
Display damping	A local display is provided.	Set display reaction time to fluctuations in the measured value.	0.0 to 999.9 s	–
Header	A local display is provided.	Select header contents on local display.	■ Device tag ■ Free text	–
Header text	The Free text option is selected in the Header parameter.	Enter display header text.	Max. 12 characters, such as letters, numbers or special characters (e.g. @, %, /)	–
Separator	A local display is provided.	Select decimal separator for displaying numerical values.	■ . (point) ■ , (comma)	. (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.	■ Disable ■ Enable	–

* Visibility depends on order options or device settings

9.5.4 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

▶ WLAN settings

WLAN

→ ⓘ 114

WLAN mode

→ ⓘ 114

SSID name

→ ⓘ 114

Network security

→ ⓘ 115

Security identification

→ ⓘ 115

User name

→ ⓘ 115

WLAN password

→ ⓘ 115

WLAN IP address

→ ⓘ 115

WLAN MAC address

→ ⓘ 115

WLAN passphrase

→ ⓘ 115

Assign SSID name

→ ⓘ 115

SSID name

→ ⓘ 115

Connection state

→ ⓘ 115

Received signal strength

→ ⓘ 115

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
WLAN	–	Switch WLAN on and off.	■ Disable ■ Enable	–
WLAN mode	–	Select WLAN mode.	■ WLAN access point ■ WLAN Client	–
SSID name	The client is activated.	Enter the user-defined SSID name (max. 32 characters).	–	–

Parameter	Prerequisite	Description	Selection / User entry / User interface	Factory setting
Network security	–	Select the security type of the WLAN network.	■ Unsecured ■ WPA2-PSK ■ EAP-PEAP with MSCHAPv2 * ■ EAP-PEAP MSCHAPv2 no server authentic. * ■ EAP-TLS *	–
Security identification	–	Select security settings and download these settings via menu Data management > Security > WLAN.	■ Trusted issuer certificate ■ Device certificate ■ Device private key	–
User name	–	Enter user name.	–	–
WLAN password	–	Enter WLAN password.	–	–
WLAN IP address	–	Enter IP address of the WLAN interface of the device.	4 octet: 0 to 255 (in the particular octet)	–
WLAN MAC address	–	Enter MAC address of the WLAN interface of the device.	Unique 12-digit character string comprising letters and numbers	Each measuring device is given an individual address.
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.	■ Device tag ■ User-defined	–
SSID name	■ The User-defined option is selected in the Assign SSID name parameter. ■ The WLAN access point option is selected in the WLAN mode parameter.	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	–
Connection state	–	Displays the connection status.	■ Connected ■ Not connected	–
Received signal strength	–	Shows the received signal strength.	■ Low ■ Medium ■ High	–

* Visibility depends on order options or device settings

9.5.5 Configuration management

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

Navigation

"Setup" menu → Advanced setup → Configuration backup

► Configuration backup		
Operating time		→ ⓘ 116
Last backup		→ ⓘ 116
Configuration management		→ ⓘ 116
Backup state		→ ⓘ 116
Comparison result		→ ⓘ 116

Parameter overview with brief description

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

* Visibility depends on order options or device settings

Function scope of the "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 device memory to the device's HistoROM backup. The backup copy includes the transmitter data of the device.

Options	Description
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.

9.5.6 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 → Advanced setup → Administration

► Administration	
► Define access code	→ ⓘ 117
► Reset access code	→ ⓘ 118
Device reset	→ ⓘ 118

Using the parameter to define the access code

Navigation

"Setup" menu → Advanced setup → Administration → Define access code

► Define access code	
Define access code	→ ⓘ 117
Confirm access code	→ ⓘ 117

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 → Advanced setup → Administration → Reset access code

▶ Reset access code

Operating time

→ ⓘ 118

Reset access code

→ ⓘ 118

Parameter overview with brief description

Parameter	Description	User interface / User entry
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

Using the parameter to reset the device

Navigation

"Setup" menu → Advanced setup → Administration

Parameter overview with brief description

Parameter	Description	Selection
Device reset	Reset the device configuration - either entirely or in part - to a defined state.	▪ Cancel ▪ To delivery settings ▪ Restart device ▪ Restore S-DAT backup *

* Visibility depends on order options or device settings

9.5.7 In-situ adjustment

In-situ adjustment is used to adjust the flow output by the measuring device to the real flow of the facility. Flow profiles can be distorted by facility parts such as pipe elbows, extensions, reductions or valves. A distorted flow profile can, in turn, negatively impact the accuracy of the measuring device. By taking into consideration the actual process-specific conditions at the facility, including any effects from installation, in-situ adjustment provides flow display that is adapted to the local conditions.

In-situ adjustment can lead to better measurement results in the following cases:

- Process-specific facility conditions / installation effects
 - If the flow profile is distorted
 - For unfavorable inlet and outlet conditions
 - If the gas is unknown
 - If it is not possible to use a flow conditioner to rectify the distorted flow profile
 - If process conditions deviate significantly from reference conditions (pressure and temperature conditions of factory calibration)
- Third-party adjustments with the process gas actually used

In-situ adjustment has the following specific features:

- Can be used for both unidirectional and bidirectional sensors
- Can be defined for up to 16 flow points (for the entire operating range)
- At least one flow point is required for the adjustment but the general principle is that the more flow points that are defined, the better the measuring performance
- Measuring device can be configured without interrupting the process
- The measuring device takes account of the choice of process gas and the actual process conditions during the measurement
- The flow value can be entered manually via a display or an operating interface, or a flow value from a reference device can be read into the measuring device via a current input or bus communication

Prerequisites for optimum in-situ adjustment

- The accuracy of the flow reference used determines the performance of the measuring device adjusted in-situ. For this reason, the use of a reference device with a traceable calibration is recommended
- Calibration points all at the same temperature and pressure conditions
- Compositions of gases or gas mixtures are made available to the measuring device as these compositions are used for pressure and temperature compensation
- Precise pressure specifications are important if a volume flowmeter is used as the reference device
- If the flow values are indicated in corrected volume flow, it is important that the standard reference conditions in the reference device and in the device are identical



- For optimum results, it is advisable to use a reference device with traceable calibration for the adjustment.
- If a reference device is not available, a fan characteristic curve, for example, can act as the

Performing in-situ adjustment

1. Select the gas: Expert → Sensor → Measurement mode → Gas → Gas
 - ↳ This entry is important for measuring device pressure and temperature compensation.
2. Activate in-situ adjustment: Expert → Sensor → In-situ adjustment → Activate in-situ adjustment
3. Confirm selection: Yes
 - ↳ If an in-situ adjustment already exists, these adjustment points are loaded. An existing adjustment (an entire series of flow points) can be deleted from the measuring device using the "Clear values" function.
4. Select the reference value: Expert → Sensor → In-situ adjustment → Select flow reference
 - ↳ If volume flow is selected, it is important that the process pressure entered in the measuring device is as accurate as possible. In the case of corrected volume flow or FAD volume flow, the defined reference operating conditions must match those of the reference measuring device.

5. Select the entry method for the reference value: Expert → Sensor → In-situ adjustment → Input type reference value
 - ↳ If "Manual" is selected, the operator must enter the flow value manually via the display (or other operating interface). However, if "Current input" or "External value" (via bus communication) is selected, the current flow values are displayed as read only reference values. The available entry modes depend on the I/O modules available.

The user can first approach the flow points with the facility. As soon as a desired flow value is reached, the value can either be saved by confirming the value or be entered as a fixed value by hand.



The entry method depends on the selected entry mode.

The measured flow value is checked to determine its validity on the basis of the following criteria:

- Average absolute deviation of the flow value
- Standard deviation of the flow value

If a criterion is not met, the value is rejected and the message "Invalid" is displayed. If both criterion are met, the message "Passed" is displayed. If the flow value fluctuates too much, "Unstable" is displayed. If an existing adjustment is "readjusted", and with a maximum of 16 defined flow values, the flow value that is closest to the new adjusted value is replaced. Here, "Replaced" is displayed as the status.



The user can also add a description to the adjustment. Three different text fields, with 16 alphanumeric characters per field, are available for this purpose. It is advisable to use the text fields to identify the adjustment using the name of the gas/gas mixture and the process conditions of the adjustment. If the in-situ adjustment is adjusted by a calibration laboratory with the gas that is actually used by the operator, it is advisable to also include the name of the laboratory, the date of the adjustment and the name of the operator in the description.

Special cases

Individual flow point

A maximum of 16 flow points can be defined. However, in certain situations it may not always be possible to adjust multiple flow points. In such cases, the measuring device can be adjusted with just a few operating points. The minimum number of flow points that are required is one. If only one operating point is adjusted, the measuring device uses default values to replace the missing adjustment values. Therefore, the operator should be aware that the accuracy of the in-situ adjustment can suffer when just one flow point is defined if the measured flow is not close to the adjustment value.

Bidirectional flow

Measuring devices that are equipped with the bidirectional option can be adjusted in situ in both flow directions or in just one flow direction, as required. If the measuring device is only adjusted in one direction, it is important that the adjustment is in the positive direction (forward flow) as these adjustment points are automatically replicated to the negative direction (reverse flow).

Unknown gas composition

If the gas or gas mixture is unknown, or if the gas composition cannot be defined by the standard gas selection, the user can define the process gas as "Air". This method has the disadvantage that compensation in the event of variations in the pressure and temperature cannot be guaranteed. If the operator is not sure of the exact composition of the gas but can make an approximate guess, it is recommended to use this approximate gas composition instead of air.

"In-situ adjustment" submenu

Navigation

"Expert" menu → Sensor → In-situ adjustment

► In-situ adjustment		
Activate in-situ adjustment (17360)	→	 122
Input type reference value (17351)	→	 122
Delete values (17355)	→	 122
Confirm (17356)	→	 122
Select flow reference (17354)	→	 122
Stability check (17366)	→	 122
Actual flow value (17365)	→	 122
External reference value (17352)	→	 122
Reference value (17353)	→	 122
Apply value (17364)	→	 122
Status (17367)	→	 122
Description 1 (17359)	→	 122
Description 2 (17358)	→	 122
Description 3 (17357)	→	 122
Description 4 (17002)	→	 122
► Adjustment values in use	→	 123

Parameter overview with brief description

Parameter	Description	Selection / User interface / User entry	Factory setting
Activate in-situ adjustment	Activate the in-situ adjustment. The points stored by the user are used for the in-situ adjustment.	■ No ■ Yes	–
Input type reference value	Select input type for the reference value.	■ Off ■ Manual ■ Current input 1 * ■ Current input 2 * ■ Current input 3 * ■ External value *	–
Delete values	Delete previous adjustment values and descriptions.	■ No ■ Yes	–
Confirm	Confirm deletion.	■ No ■ Yes	–
Select flow reference	Select process variable. This process variable is used as reference value for the in situ adjustment.	■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow	–
Stability check	Activate stability check. New adjustment value is only accepted when the measurement is stable.	■ No ■ Yes	–
Actual flow value	Shows the actual flow in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	–2 000 to 2 000 %	–
External reference value	Shows the external reference value for the in situ adjustment.	Signed floating-point number	–
Reference value	Enter fixed value as reference value used for the in situ adjustment.	Signed floating-point number	–
Apply value	Apply the actual value.	■ No ■ Yes	–
Status	Shows the validity of the actual reference value.	■ Passed ■ Replaced ■ Unstable ■ Invalid	–
Description 1	Description for in-situ adjustment: e.g. facility, operator, date.	–	–
Description 2	Description for in-situ adjustment: e.g. facility, operator, date.	–	–
Description 3	Description for in-situ adjustment: e.g. facility, operator, date.	–	–
Description 4	Description for in-situ adjustment: e.g. facility, operator, date.	–	–

* Visibility depends on order options or device settings

"Adjustment values in use" submenu

Navigation

"Expert" menu → Sensor → In-situ adjustment → Adjustment values in use

► Adjustment values in use		
Gas description 1/2 (17361)	→	 124
Gas description 2/2 (17362)	→	 124
Flow value 1 (17368)	→	 124
Flow value 2 (17369)	→	 124
Flow value 3 (17370)	→	 124
Flow value 4 (17371)	→	 124
Flow value 5 (17372)	→	 124
Flow value 6 (17373)	→	 124
Flow value 7 (17374)	→	 124
Flow value 8 (17375)	→	 124
Flow value 9 (17376)	→	 124
Flow value 10 (17377)	→	 124
Flow value 11 (17378)	→	 124
Flow value 12 (17379)	→	 124
Flow value 13 (17380)	→	 124
Flow value 14 (17381)	→	 124
Flow value 15 (17382)	→	 124
Flow value 16 (17383)	→	 124

Parameter overview with brief description

Parameter	Description	User interface	Factory setting
Gas description 1/2	Shows the 1st part of the description of the set gas used in the in-situ adjustment.	-	-
Gas description 2/2	Shows the 2nd part of the description of the set gas used in the in-situ adjustment.	-	-
Flow value 1	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 2	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 3	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 4	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 5	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 6	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 7	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 8	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 9	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 10	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 11	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 12	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 13	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 14	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 15	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-
Flow value 16	Shows the stored flow value in relation to the maximum, factory-measured value that is adapted to the actual process conditions.	-2 000 to 2 000 %	-

9.6 Configuration management

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

Navigation

"Setup" menu → Advanced setup → Configuration backup

► Configuration backup

Operating time

→ 116

Last backup

→ 116

Configuration management

→ 116

Backup state

→ 116

Comparison result

→ 116

Parameter overview with brief description

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

9.6.1 Function scope of the "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.

Options	Description
Restore	The last backup copy of the device configuration is restored 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.

9.7 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 → Simulation

► Simulation	
Assign simulation process variable	→ 127
Process variable value	→ 127
Current input 1 to n simulation	→ 128
Value current input 1 to n	→ 128
Status input simulation 1 to n	→ 128
Input signal level 1 to n	→ 128
Current output 1 to n simulation	→ 127
Value current output 1 to n	→ 127
Frequency output simulation 1 to n	→ 127
Frequency value 1 to n	→ 127
Pulse output simulation 1 to n	→ 127
Pulse value 1 to n	→ 127

Switch output simulation 1 to n	→  127
Switch status 1 to n	→  127
Relay output 1 to n simulation	→  127
Switch status 1 to n	→  128
Device alarm simulation	→  128
Diagnostic event category	→  128
Diagnostic event simulation	→  128

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry
Assign simulation process variable	–	Select a process variable for the simulation process that is activated.	■ Off ■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow ■ Energy flow * ■ Heat flow * ■ Density ■ Flow velocity
Process variable value	A process variable is selected in the Assign simulation process variable parameter (→  127).	Enter the simulation value for the selected process variable.	Depends on the process variable selected
Current output 1 to n simulation	–	Switch the simulation of the current output on and off.	■ Off ■ On
Value current output 1 to n	In the Current output 1 to n simulation parameter, the On option is selected.	Enter the current value for simulation.	3.59 to 22.5 mA
Frequency output simulation 1 to n	In the Operating mode parameter, the Frequency option is selected.	Switch the simulation of the frequency output on and off.	■ Off ■ On
Frequency value 1 to n	In the Frequency output simulation 1 to n parameter, the On option is selected.	Enter the frequency value for the simulation.	0.0 to 12 500.0 Hz
Pulse output simulation 1 to n	In the Operating mode parameter, the Pulse option is selected.	Set and switch off the pulse output simulation.  For Fixed value option: Pulse width parameter (→  99) defines the pulse width of the pulses output.	■ Off ■ Fixed value ■ Down-counting value
Pulse value 1 to n	In the Pulse output simulation 1 to n parameter, the Down-counting value option is selected.	Enter the number of pulses for simulation.	0 to 65 535
Switch output simulation 1 to n	In the Operating mode parameter, the Switch option is selected.	Switch the simulation of the switch output on and off.	■ Off ■ On
Switch status 1 to n	–	Select the status of the status output for the simulation.	■ Open ■ Closed
Relay output 1 to n simulation	–	Switch simulation of the relay output on and off.	■ Off ■ On

Parameter	Prerequisite	Description	Selection / User entry
Switch status 1 to n	The On option is selected in the Switch output simulation 1 to n parameter parameter.	Select status of the relay output for the simulation.	■ Open ■ Closed
Device alarm simulation	–	Switch the device alarm on and off.	■ Off ■ On
Diagnostic event category	–	Select a diagnostic event category.	■ Sensor ■ Electronics ■ Configuration ■ Process
Diagnostic event simulation	–	Select a diagnostic event to simulate this event.	■ Off ■ Diagnostic event picklist (depends on the category selected)
Current input 1 to n simulation	–	Switch simulation of the current input on and off.	■ Off ■ On
Value current input 1 to n	In the Current input 1 to n simulation parameter, the On option is selected.	Enter the current value for simulation.	0 to 22.5 mA
Status input simulation 1 to n	–	Switch simulation of the status input on and off.	■ Off ■ On
Input signal level 1 to n	In the Status input simulation parameter, the On option is selected.	Select the signal level for the simulation of the status input.	■ High ■ Low

* Visibility depends on order options or device settings

9.8 Protecting settings from unauthorized access

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

- Protect access to parameters via access code →  128
- Protect access to local operation via key locking →  64
- Protect access to measuring device via write protection switch →  130

9.8.1 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 write-protected 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 (→  117).
2. Maximum of 16-digit character string comprising numbers, letters and special characters as the access code.

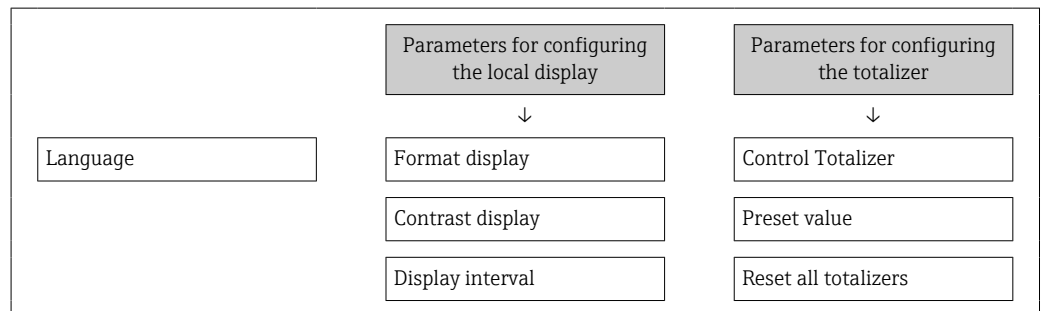
3. Enter the access code again in the **Confirm access code** parameter (→  117) to confirm.

↳ The  symbol appears in front of all write-protected parameters.

- 
 - Disabling parameter write protection via access code →  63.
 - If the access code is lost: Resetting the access code →  129.
 - 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 →  63
- 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 (→  117).
 2. Define a 16-digit (max.) numeric code as the access code.
 3. Enter the access code again in the **Confirm access code** parameter (→  117) to confirm.
- ↳ The web browser switches to the login page.

- 
 - Disabling parameter write protection via access code →  63.
 - If the access code is lost: Resetting the access code →  129.
 - The user role with which the user is currently logged in is displayed in the **Access status** parameter.
 - Navigation path: Operation → Access status
 - User roles and their access rights →  63

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

i 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 (→ 118).
 - ↳ The access code has been reset to the factory setting **0000**. It can be redefined → 128.

i 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.

9.8.2 Write protection via write protection switch

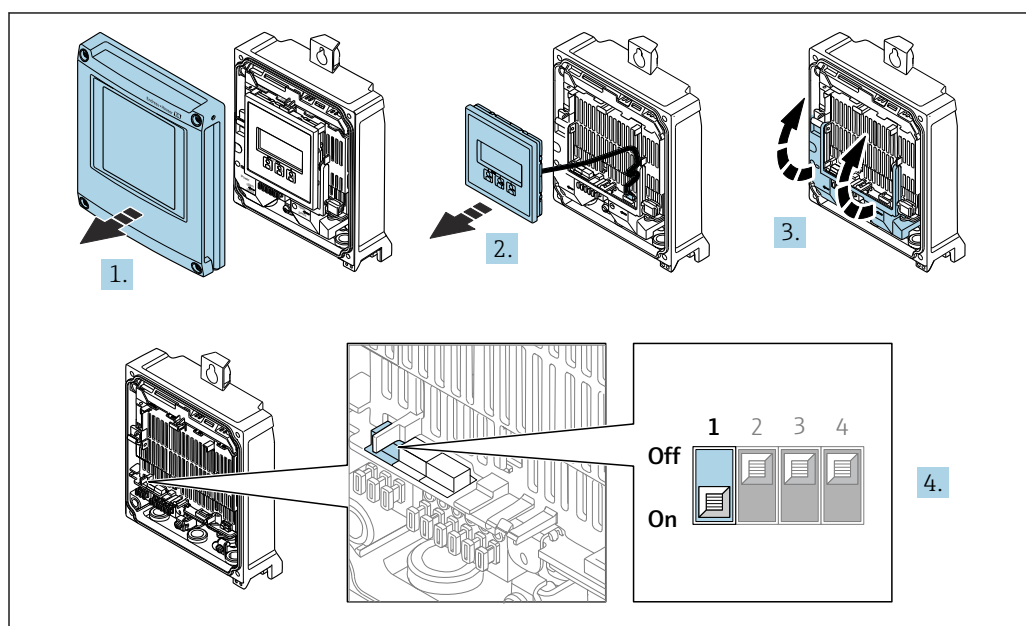
Unlike parameter write protection via a user-specific access code, this allows the user to lock write access to the entire operating menu - apart from the **"Contrast display" parameter**.

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

Enabling/disabling write protection

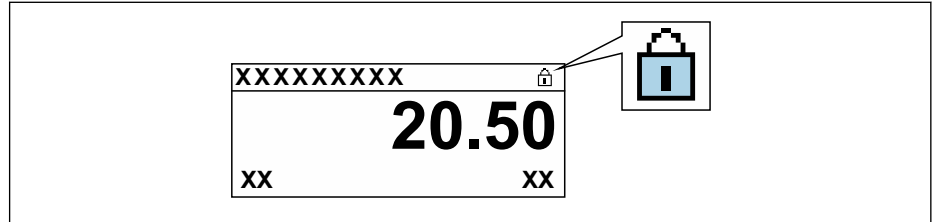


1. Open the housing cover.
2. Remove the display module.
3. Fold open the terminal cover.

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/to the **OFF** position (factory setting) disables hardware write protection.

- ↳ In the **Locking status** parameter, the **Hardware locked** option is displayed
 → 132. When hardware write protection is active, the  symbol appears in the header of the measured value display and in the navigation view in front of the parameters.



A0029425

5. Insert the display module.

6. Close the housing cover.

7. WARNING**Excessive tightening torque applied to the fixing screws!**

Risk of damaging the plastic transmitter.

- ▶ Tighten the fixing screws as per the tightening torque: 2 Nm (1.5 lbf ft)

Tighten the securing screws.

10 Operation

10.1 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 Access status parameter applies → ⓘ 63. 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) → ⓘ 130.
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.

10.2 Adjusting the operating language

-  Detailed information:
- To configure the operating language → ⓘ 81
 - For information on the operating languages supported by the measuring device → ⓘ 192

10.3 Configuring the display

- Detailed information:
- On the basic settings for the local display → ⓘ 105
 - On the advanced settings for the local display → ⓘ 111

10.4 Reading off measured values

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

Navigation
"Diagnostics" menu → Measured values

▶ Measured values

▶ Process variables

▶ System values

▶ Input values

▶ Output values

▶ Totalizer

→ ⓘ 133

→ ⓘ 134

→ ⓘ 135

→ ⓘ 136

→ ⓘ 134

10.4.1 Process variables

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

Navigation

"Diagnostics" menu → Measured values → Process variables

► Process variables		
Mass flow	→ 	133
Corrected volume flow	→ 	133
Volume flow	→ 	133
FAD volume flow	→ 	133
Energy flow	→ 	134
Temperature	→ 	134
Density	→ 	134
Flow velocity	→ 	134
Heat flow	→ 	134

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Mass flow	–	Displays the mass flow that is currently measured. <i>Dependency</i> The unit is taken from: Mass flow unit parameter (→  90)	Signed floating-point number
Corrected volume flow	–	Displays the corrected volume flow that is currently calculated. <i>Dependency</i> The unit is taken from the Corrected volume flow unit parameter (→  90).	Signed floating-point number
Volume flow	–	Displays the volume flow that is currently measured. <i>Dependency</i> The unit is taken from the Volume flow unit parameter (→  90).	Signed floating-point number
FAD volume flow	The Air or compressed air option is selected in the Measurement application parameter.	Displays the FAD volume flow that is currently calculated. <i>Dependency</i> The unit is taken from: FAD volume flow unit parameter (→  90)	Signed floating-point number

Parameter	Prerequisite	Description	User interface
Energy flow	The Energy option is selected in the Measurement application parameter.	Shows the energy flow currently calculated.	Signed floating-point number
Temperature	–	Displays the temperature that is currently measured. <i>Dependency</i> The unit is taken from: Temperature unit parameter (→ ⓘ 91)	Signed floating-point number
Density	–	Shows the density currently calculated.	Signed floating-point number
Flow velocity	–	Shows the flow velocity currently calculated.	Signed floating-point number
Heat flow	The Energy option is selected in the Measurement application parameter.	Shows the heat flow currently calculated.	Signed floating-point number

10.4.2 System values

The **System values** submenu contains all the parameters needed to display the current measured values for every system value.

Navigation

"Diagnostics" menu → Measured values → System values

► System values

Electronic temperature → ⓘ 134

Parameter overview with brief description

Parameter	Description	User interface
Electronic temperature	Indication of the current temperature of the electronics.	Signed floating-point number

10.4.3 "Totalizer" submenu

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

Navigation

"Diagnostics" menu → Measured values → Totalizer

► Totalizer

Totalizer value 1 to n → ⓘ 135

Totalizer overflow 1 to n → ⓘ 135

Parameter overview with brief description

Parameter	Description	User interface
Totalizer value 1 to n	Displays the current totalizer counter value.	Signed floating-point number
Totalizer overflow 1 to n	Displays the current totalizer overflow.	Integer with sign

10.4.4 "Input values" submenu

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

Navigation

"Diagnostics" menu → Measured values → Input values

► Input values	
► Current input 1 to n	→ 135
► Status input 1 to n	→ 135

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 → Measured values → Input values → Current input 1 to n

► Current input 1 to n	
Measured values 1 to n	→ 135
Measured current 1 to n	→ 135

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 → Measured values → Input values → Status input 1 to n

► Status input 1 to n

Value status input

→ 136

Parameter overview with brief description

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

10.4.5 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

► Current output 1 to n

→ 136

► Pulse/frequency/switch output 1 to n

→ 137

► Relay output 1 to n

→ 137

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 → Measured values → Output values → Value current output 1 to n

► Current output 1 to n

Output current 1 to n

→ 137

Measured current 1 to n

→ 137

Parameter overview with brief description

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 → Measured values → Output values → Pulse/frequency/switch output 1 to n

► Pulse/frequency/switch output 1 to n		
Output frequency 1 to n		→ 137
Pulse output 1 to n		→ 137
Switch status 1 to n		→ 137

Parameter overview with brief description

Parameter	Prerequisite	Description	User interface
Output frequency 1 to n	In the Operating mode parameter, the Frequency 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 Pulse option is selected in the Operating mode parameter parameter.	Displays the pulse frequency currently output.	Positive floating-point number
Switch status 1 to n	The Switch option is selected in the Operating mode 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 → Measured values → Output values → Relay output 1 to n

► Relay output 1 to n		
Switch status		→ 138
Switch cycles		→ 138
Max. switch cycles number		→ 138

Parameter overview with brief description

Parameter	Description	User interface
Switch status	Shows the current relay switch status.	■ Open ■ Closed
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

10.5 Adapting the measuring device to the process conditions

The following are available for this purpose:

- Basic settings using the **Setup** menu (→  82)
- Advanced settings using the **Advanced setup** submenu (→  109)

10.6 Performing a totalizer reset

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

- Control Totalizer
- Reset all totalizers

Navigation

"Operation" menu → Totalizer handling

► Totalizer handling		
Control Totalizer 1 to n		→  138
Preset value 1 to n		→  138
Totalizer value 1 to n		→  139
Reset all totalizers		→  139

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry / User interface
Control Totalizer 1 to n	A process variable is selected in the Assign process variable parameter (→  110) of the Totalizer 1 to n submenu.	Control totalizer value.	■ Totalize ■ Reset + hold ■ Preset + hold ■ Reset + totalize ■ Preset + totalize ■ Hold
Preset value 1 to n	A process variable is selected in the Assign process variable parameter (→  110) of the Totalizer 1 to n submenu.	Specify start value for totalizer. <i>Dependency</i>  The unit of the selected process variable is defined in the Unit totalizer parameter (→  110) for the totalizer.	Signed floating-point number

Parameter	Prerequisite	Description	Selection / User entry / User interface
Totalizer value	–	Displays the current totalizer counter value.	Signed floating-point number
Reset all totalizers	–	Reset all totalizers to 0 and start.	■ Cancel ■ Reset + totalize

10.6.1 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 ¹⁾	The totaling process is stopped and the totalizer is set to its defined start value from the Preset value 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 Preset value parameter and the totaling process is restarted.
Hold	Totalizing is stopped.

1) Visible depending on the order options or device settings

10.6.2 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.

10.7 Displaying data logging

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.

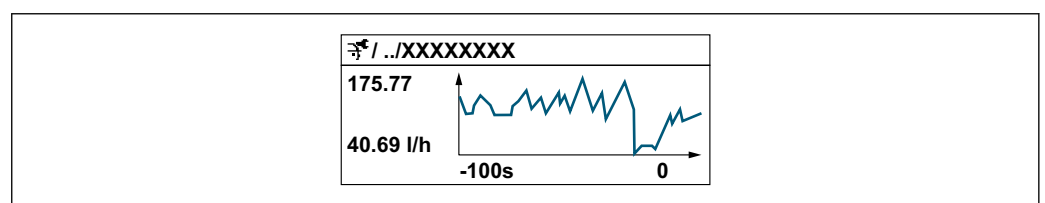


Data logging is also available via:

- Plant Asset Management Tool FieldCare → 73.
- Web browser

Function range

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



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- 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 logging

Assign channel 1

Assign channel 2

Assign channel 3

Assign channel 4

Logging interval

Clear logging data

Data logging

Logging delay

Data logging control

Data logging status

Entire logging duration

► Display channel 1

► Display channel 2

► Display channel 3

► Display channel 4

→  141

→  141

→  141

→  141

→  141

→  141

→  141

→  141

→  141

→  141

→  141

Parameter overview with brief description

Parameter	Prerequisite	Description	Selection / User entry / User interface
Assign channel 1	The Extended HistoROM application package is available.	Assign process variable to logging channel.	■ Off ■ Temperature ■ Mass flow ■ Corrected volume flow ■ FAD volume flow * ■ Volume flow ■ Energy flow ■ Heat flow * ■ Density ■ Flow velocity ■ Pressure ■ 2nd temperature delta heat * ■ Electronic temperature ■ Current output 1 * ■ Current output 2 * ■ Current output 3 * ■ Current output 4 *
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 the Assign channel 1 parameter (→  141)
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 the Assign channel 1 parameter (→  141)
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 the Assign channel 1 parameter (→  141)
Logging interval	The Extended HistoROM 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
Clear logging data	The Extended HistoROM application package is available.	Clear the entire logging data.	■ Cancel ■ Clear data
Data logging	–	Select the type of data logging.	■ Overwriting ■ Not overwriting
Logging delay	In the Data logging parameter, the Not overwriting option is selected.	Enter the time delay for measured value logging.	0 to 999 h
Data logging control	In the Data logging parameter, the Not overwriting option is selected.	Start and stop measured value logging.	■ None ■ Delete + start ■ Stop
Data logging status	In the Data logging parameter, the Not overwriting option is selected.	Displays the measured value logging status.	■ Done ■ Delay active ■ Active ■ Stopped
Entire logging duration	In the Data logging parameter, the Not overwriting option is selected.	Displays the total logging duration.	Positive floating-point number

* Visibility depends on order options or device settings

11 Diagnostics and troubleshooting

11.1 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 → 42.
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	- Terminals are not plugged into the I/O electronics module correctly. - Terminals are not plugged into the main electronics module correctly.	Check terminals.
Local display dark and no output signals	- I/O electronics module is defective. - Main electronics module is defective.	Order spare part → 163.
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 $\boxplus$ + $\boxminus$. - Set the display darker by simultaneously pressing $\boxminus$ + $\boxplus$.
Local display is dark, but signal output is within the valid range	Display module is defective.	Order spare part → 163.
Backlighting of local display is red	Diagnostic event with "Alarm" diagnostic behavior has occurred.	Take remedial measures → 152
Text on local display appears in a language that cannot be understood.	The selected operating language cannot be understood.	- Press $\boxminus$ + $\boxplus$ for 2 s ("home position"). - Press $\boxminus$. - Configure the required language in the Display language parameter (→ 113).
Message on local display: "Communication Error" "Check Electronics"	Communication between the display module and the electronics is interrupted.	- Check the cable and the connector between the main electronics module and display module. - Order spare part → 163.

For output signals

Error	Possible causes	Remedial action
Signal output outside the valid range	Main electronics module is defective.	Order spare part → 163.
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".

For access

Error	Possible causes	Remedial action
No write access to parameters.	Hardware write protection is enabled.	Set the write protection switch on the main electronics module to the OFF position (Verweisziel existiert nicht, aber @y.link.required=true) → 130.
No write access to parameters.	Current user role has limited access authorization.	1. Check user role → 63. 2. Enter correct customer-specific access code → 63.
Connection via Modbus RS485 is not possible.	Modbus RS485 bus cable is connected incorrectly.	Check the terminal assignment → 37.
Connection via Modbus RS485 is not possible.	Modbus RS485 cable is incorrectly terminated.	Check the terminating resistor → 47.
Connection via Modbus RS485 is not possible.	Settings for the communication interface are incorrect.	Check the Modbus RS485 configuration → 91.
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 → 70.
	The Ethernet interface is incorrectly configured on the PC.	▶ Check the properties of the Internet protocol (TCP/IP) → 66. ▶ 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 → 66
Connection to the web server is not possible.	WLAN access data are incorrect.	■ Check WLAN network status. ■ Log on to the device again using WLAN access data. ■ Check that WLAN is enabled for the device and operating device → 66.
	WLAN communication is disabled.	–
It is not possible to connect to the web server, FieldCare or DeviceCare.	WLAN network is not available.	■ Check whether WLAN reception is available: LED on the display module lights up in blue. ■ Check if the WLAN connection is enabled: LED on display module flashes blue. ■ Switch on instrument function.
No network connection or unstable network connection.	WLAN network is weak.	■ Operating device outside of receiving range: Check the network status on the operating device. ■ To improve network performance, use an external WLAN antenna.
	Parallel WLAN and Ethernet communication.	■ Check network settings. ■ Temporarily enable only the WLAN as an interface.
Web browser is frozen and no further operation possible.	Data transfer is active.	Wait until data transfer or current action is finished.
	Connection lost	▶ Check cable connection and power supply. ▶ Refresh web browser and restart if necessary.
The web browser contents are difficult to read or incomplete.	The web browser version used is not the best option.	▶ Use correct web browser version → 65. ▶ Empty the web browser cache. ▶ Restart the web browser.
	Unsuitable view settings.	Change the font size/display ratio of the web browser.
No contents displayed in the web browser or contents incomplete.	■ JavaScript is not enabled. ■ JavaScript cannot be enabled.	▶ Enable JavaScript. ▶ Enter http://XXX.XXX.X.XX/servlet/basic.html as the IP address.

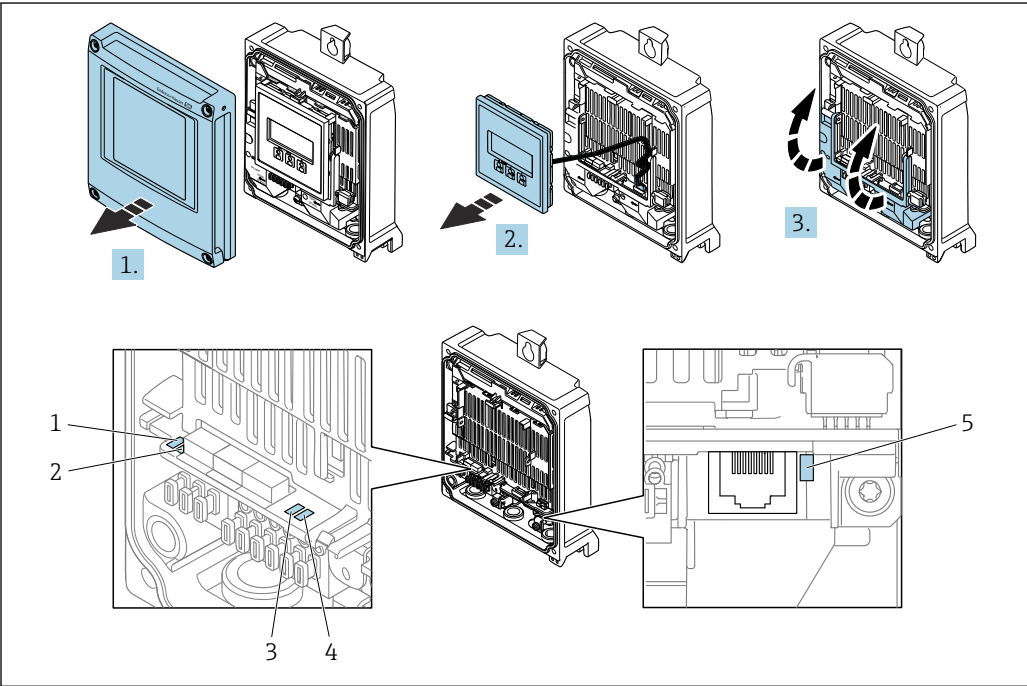
Error	Possible causes	Remedial action
Operation with FieldCare or DeviceCare not possible via CDI-RJ45 service interface (port 8000).	Firewall of the PC or network prevents communication.	Depending on the settings of the firewall used on the PC or in the network, the firewall must be disabled or adjusted 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.

11.2 Diagnostic information via light emitting diodes

11.2.1 Transmitter

Proline 500 – digital

Different LEDs in the transmitter provide information on the device status.



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- 1 Supply voltage
- 2 Device status
- 3 Not used
- 4 Communication
- 5 Service interface (CDI) active

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

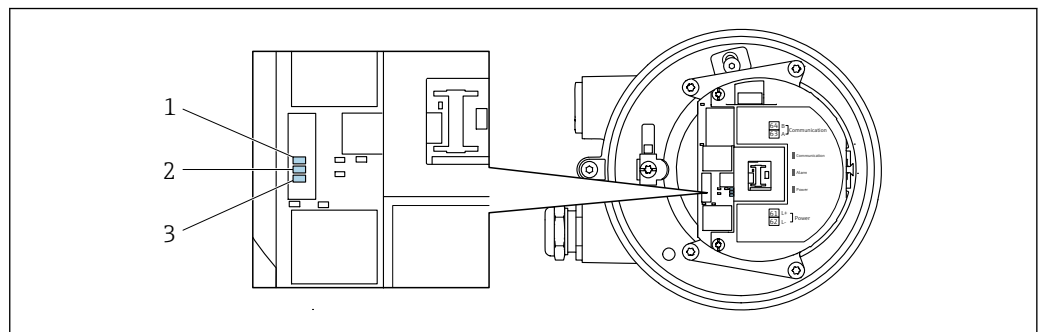
LED	Color	Meaning
1 Supply voltage	Off	Supply voltage is off or too low.
	Green	Supply voltage is OK.
2 Device status (normal operation)	Off	Firmware error
	Green	Device status is OK.

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/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.

11.2.2 Sensor connection housing

Proline 500 – digital

Various light emitting diodes (LED) on the ISEM electronics unit (intelligent sensor electronics module) in the sensor connection housing provide information about the device status.



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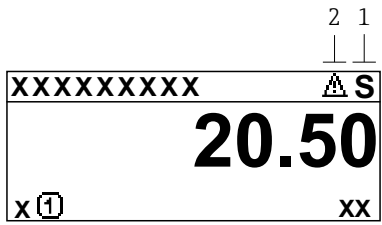
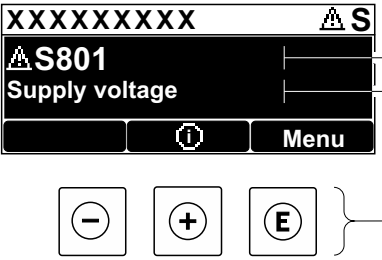
- 1 Communication
- 2 Device status
- 3 Supply voltage

LED	Color	Meaning
1 Communication	White	Communication active.
2 Device status (normal operation)	Red	Error
	Flashing red	Warning
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 Supply voltage	Green	Supply voltage is ok.
	Off	Supply voltage is off or too low.

11.3 Diagnostic information on local display

11.3.1 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.

Operational display in alarm condition	Diagnostic message
	
1 Status signal 2 Diagnostic behavior 3 Diagnostic behavior with diagnostic code 4 Short text 5 Operating elements	

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 → 155
 - Via submenus → 156

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

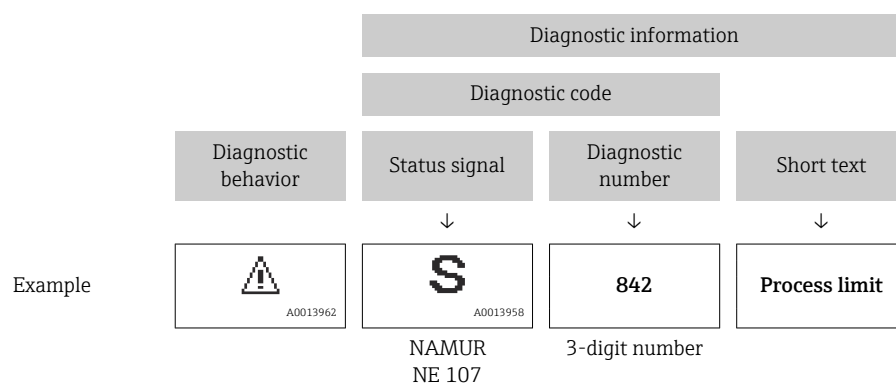
Symbol	Meaning
F	Failure A device error has occurred. The measured value is no longer valid.
C	Function check The device is in service mode (e.g. during a simulation).
S	Out of specification The device is being operated: Outside its technical specification limits (e.g. outside the process temperature range)
M	Maintenance required Maintenance is required. The measured value remains valid.

Diagnostic behavior

Symbol	Meaning
	Alarm ■ Measurement is interrupted. ■ Signal outputs and totalizers assume the defined alarm condition. ■ A diagnostic message is generated.
	Warning ■ Measurement is resumed. ■ The signal outputs and totalizers are not affected. ■ A diagnostic message is generated.

Diagnostic information

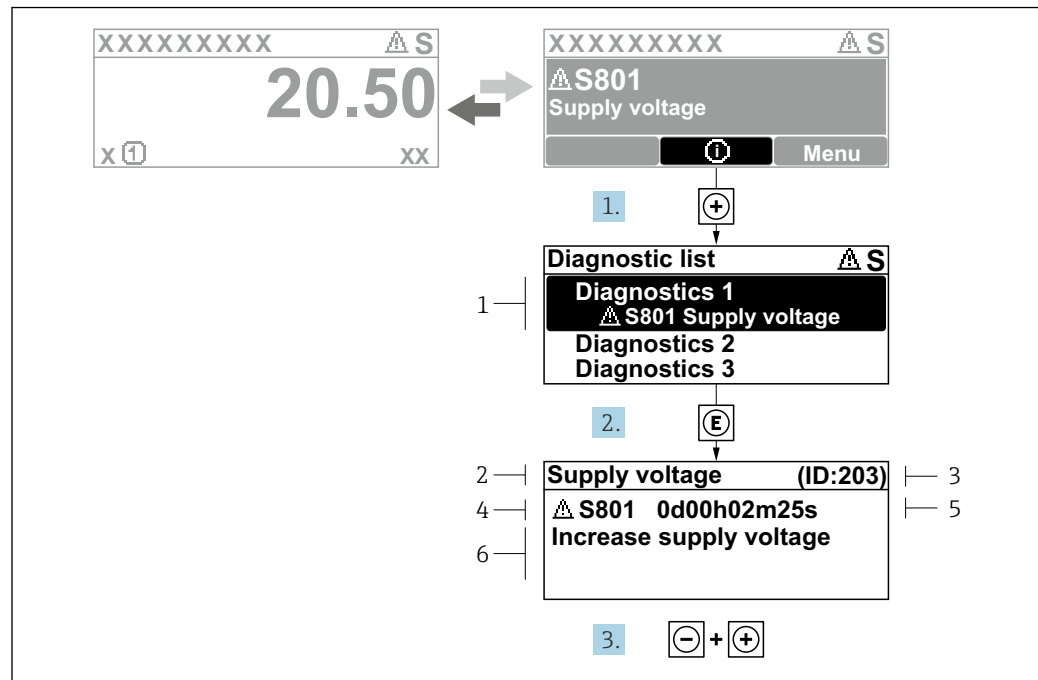
The fault can be identified using the diagnostic information. The short text helps you by providing information about the fault. In addition, the corresponding symbol for the diagnostic behavior is displayed in front of the diagnostic information on the local display.



Operating elements

Operating key	Meaning
	Plus key <i>In menu, submenu</i> Opens the message about the remedial measures.
	Enter key <i>In menu, submenu</i> Opens the operating menu.

11.3.2 Calling up remedial measures



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 $\oplus$ (① symbol).
↳ The **Diagnostic list** submenu opens.
2. Select the desired diagnostic event with $\oplus$ or $\ominus$ and press $\boxplus$.
↳ The message about the remedial measures opens.
3. Press $\ominus + \oplus$ simultaneously.
↳ The message about the remedial measures closes.

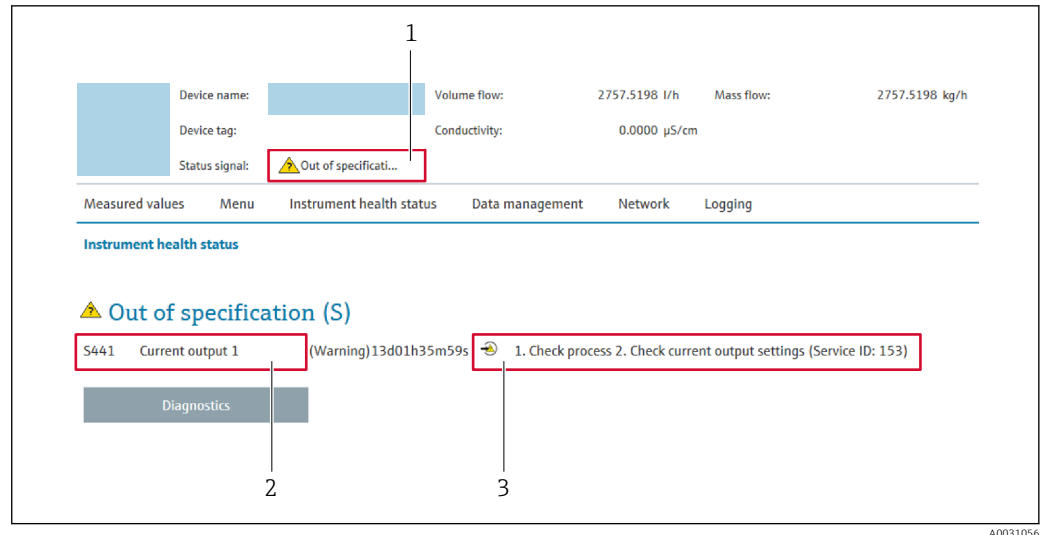
The user is in the **Diagnostics** menu at an entry for a diagnostics event, e.g. in the **Diagnostic list** submenu or **Previous diagnostics** parameter.

1. Press $\boxplus$.
↳ The message for the remedial measures for the selected diagnostic event opens.
2. Press $\ominus + \oplus$ simultaneously.
↳ The message for the remedial measures closes.

11.4 Diagnostic information in the web browser

11.4.1 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

i In addition, diagnostic events which have occurred can be shown in the **Diagnostics** menu:

- Via parameter → 155
- Via submenu → 156

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
	Failure A device error has occurred. The measured value is no longer valid.
	Function check The device is in service mode (e.g. during a simulation).
	Out of specification The device is being operated: Outside its technical specification limits (e.g. outside the process temperature range)
	Maintenance required Maintenance is required. The measured value remains valid.

i The status signals are categorized in accordance with VDI/VDE 2650 and NAMUR Recommendation NE 107.

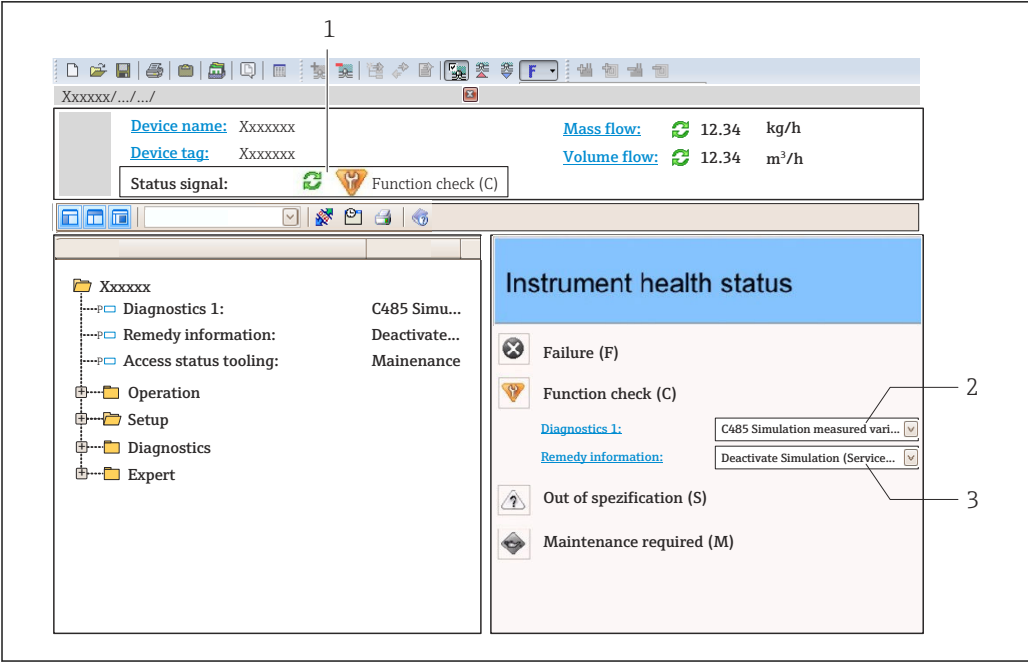
11.4.2 Calling up remedy information

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.

11.5 Diagnostic information in FieldCare or DeviceCare

11.5.1 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.



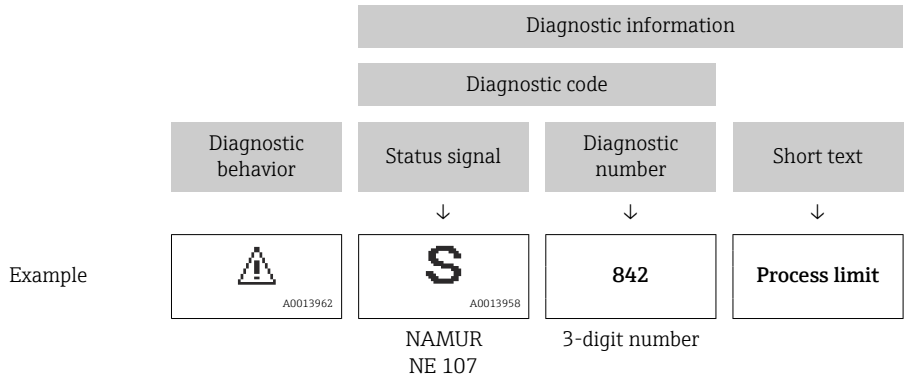
- 1 Status area with status signal → 146
- 2 Diagnostic information → 147
- 3 Remedial measures with service ID

i In addition, diagnostic events which have occurred can be shown in the **Diagnostics** menu:

- Via parameter → 155
- Via submenu → 156

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.



11.5.2 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.

11.6 Diagnostic information via communication interface

11.6.1 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
→  152

11.6.2 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

Parameters	Description	Selection	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.	■ NaN value ■ Last valid value  NaN = not a number	NaN value

11.7 Adapting the diagnostic information

11.7.1 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 → System → Diagnostic handling → 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 Event logbook submenu (Event list 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.

11.8 Overview of diagnostic information

 The amount of diagnostic information and the number of measured variables affected increase if the measuring device has one or more application packages.

 In the case of some items of diagnostic information, the diagnostic behavior can be changed. Adapting the diagnostic information →  151

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
004	Sensor error	Change sensor	F	Alarm
082	Data storage	1. Check module connections 2. Change electronic modules	F	Alarm
083	Memory content	1. Restart device 2. Restore HistoROM S-DAT backup ('Device reset' parameter) 3. Replace HistoROM S-DAT	F	Alarm
144	Sensor drift	1. Check sensor 2. Replace sensor	F	Alarm ¹⁾
Diagnostic of electronic				
201	Device failure	Restart device	F	Alarm
242	Software incompatible	1. Check software 2. Flash or change main electronics module	F	Alarm
252	Modules incompatible	1. Check electronic modules 2. Check if correct modules are available (e.g. NEx, Ex) 3. Replace electronic modules	F	Alarm
252	Modules incompatible	1. Check if correct electronic modul is plugged 2. Replace electronic module	F	Alarm
262	Sensor electronic connection faulty	1. Check or replace connection cable between sensor electronic module (ISEM) and main electronics 2. Check or replace ISEM or main electronics	F	Alarm
270	Main electronic failure	Change main electronic module	F	Alarm
271	Main electronic failure	1. Restart device 2. 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	1. Restart device 2. Change I/O module	F	Alarm
281	Electronic initialization	Firmware update active, please wait!	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
283	Memory content	Reset device	F	Alarm
283	Memory content	Restart device	F	Alarm
302	Device verification in progress	Device verification active, please wait.	C	Warning
303	I/O 1 to n configuration changed	1. Apply I/O module configuration (parameter 'Apply I/O configuration') 2. Afterwards reload device description and check wiring	M	Warning
311	Electronic failure	1. Do not reset device 2. 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	1. Restart device 2. Check electronic modules 3. Change I/O Modul or main electronics	F	Alarm
372	Sensor electronic (ISEM) faulty	1. Restart device 2. Check if failure recurs 3. Replace sensor electronic module (ISEM)	F	Alarm
373	Sensor electronic (ISEM) faulty	Transfer data or reset device	F	Alarm
375	I/O- 1 to n communication failed	1. Restart device 2. Check if failure recurs 3. Replace module rack inclusive electronic modules	F	Alarm
378	Supply voltage ISEM faulty	Check supply voltage to the ISEM	F	Alarm
382	Data storage	1. Insert T-DAT 2. Replace T-DAT	F	Alarm
383	Memory content	1. Restart device 2. Delete T-DAT via 'Reset device' parameter 3. Replace T-DAT	F	Alarm
387	HistoROM data faulty	Contact service organization	F	Alarm
Diagnostic of configuration				
330	Flash file invalid	1. Update firmware of device 2. Restart device	M	Warning
331	Firmware update failed	1. Update firmware of device 2. Restart device	F	Warning
410	Data transfer	1. Check connection 2. Retry data transfer	F	Alarm
412	Processing download	Download active, please wait	C	Warning
431	Trim 1 to n	Carry out trim	C	Warning
437	Configuration incompatible	Restart device	F	Alarm
438	Dataset	1. Check data set file 2. Check device configuration 3. Up- and download new configuration	M	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
441	Current output 1 to n	1. Check process 2. Check current output settings	S	Warning ¹⁾
442	Frequency output 1 to n	1. Check process 2. Check frequency output settings	S	Warning ¹⁾
442	Frequency output 1 to n		S	Warning
443	Pulse output 1 to n	1. Check process 2. Check pulse output settings	S	Warning ¹⁾
444	Current input 1 to n	1. Check process 2. Check current input settings	S	Warning ¹⁾
453	Flow override	Deactivate flow override	C	Warning
484	Failure mode simulation	Deactivate simulation	C	Alarm
485	Measured variable simulation	Deactivate simulation	C	Warning
486	Current input 1 to n simulation	Deactivate simulation	C	Warning
491	Current output 1 to n simulation	Deactivate simulation	C	Warning
492	Simulation frequency output 1 to n	Deactivate simulation frequency output	C	Warning
493	Simulation pulse output 1 to n	Deactivate simulation pulse output	C	Warning
494	Switch output simulation 1 to n	Deactivate simulation switch output	C	Warning
495	Diagnostic event simulation	Deactivate simulation	C	Warning
496	Status input simulation	Deactivate simulation status input	C	Warning
520	I/O 1 to n hardware configuration invalid	1. Check I/O hardware configuration 2. Replace wrong I/O module 3. Plug the module of double pulse output on correct slot	F	Alarm
537	Configuration	1. Check IP addresses in network 2. Change IP address	F	Warning
539	Flow computer configuration incorrect	1. Check input value (pressure, temperature) 2. Check allowed values of the medium properties	S	Alarm
594	Relay output simulation	Deactivate simulation switch output	C	Warning
Diagnostic of process				
803	Current loop	1. Check wiring 2. Change I/O module	F	Alarm
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⁾

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
842	Process limit	Low flow cut off active! 1. Check low flow cut off configuration	S	Warning ¹⁾
882	Input signal	1. Check input configuration 2. Check external device or process conditions	F	Alarm
941	Flow velocity too high	1. Check process cond. 2. Increase system pressure	S	Alarm
961	Delta temperature	Check flow rate	S	Alarm
976	Mass flow out of calibrated range	1. Check process cond. 2. Increase system pressure	S	Warning ¹⁾
977	Reverse flow detected	Check flow direction	S	Warning ¹⁾
979	Unstable process conditions	1. Check process cond. 2. Increase system pressure	S	Warning ¹⁾

1) Diagnostic behavior can be changed.

11.9 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 →  148
- Via web browser →  149
- Via "FieldCare" operating tool →  150
- Via "DeviceCare" operating tool →  150

 Other pending diagnostic events can be displayed in the **Diagnostic list** submenu
→  156

Navigation

"Diagnostics" menu

 Diagnostics	
Actual diagnostics	→  156
Previous diagnostics	→  156
Operating time from restart	→  156
Operating time	→  156

Parameter overview with brief description

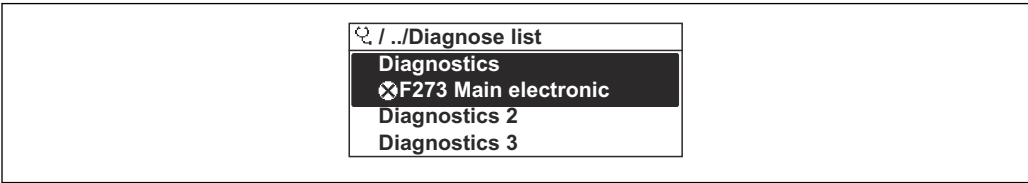
Parameter	Prerequisite	Description	User interface
Actual diagnostics	A diagnostic event has occurred.	Shows the current occurred diagnostic event along with its diagnostic information.  If two or more messages occur simultaneously, the message with the highest priority is shown on the display.	Symbol for diagnostic behavior, diagnostic code and short message.
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)

11.10 Diagnostic 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 Taking the example of the local display

-  To call up the measures to rectify a diagnostic event:
- Via local display → 148
 - Via web browser → 149
 - Via "FieldCare" operating tool → 150
 - Via "DeviceCare" operating tool → 150

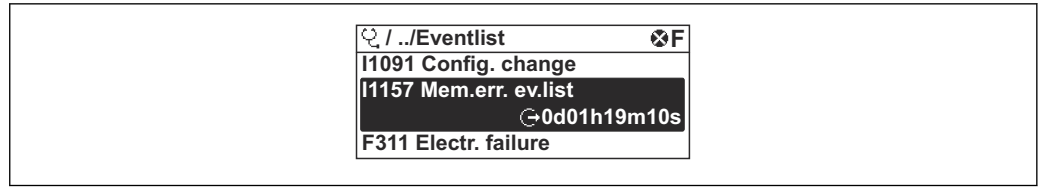
11.11 Event logbook

11.11.1 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 → Event list



A0014008-EN

39 Taking 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 → 152
- Information events → 157

In addition to the operation time of its occurrence, each event is also assigned a symbol that indicates whether the event has occurred or is ended:

- Diagnostic event
 - : 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 → 148
- Via web browser → 149
- Via "FieldCare" operating tool → 150
- Via "DeviceCare" operating tool → 150

For filtering the displayed event messages → 157

11.11.2 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 → Event logbook → Filter options

Filter categories

- All
- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)
- Information (I)

11.11.3 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
I1090	Configuration reset
I1091	Configuration changed

Info number	Info name
I1092	HistoROM backup deleted
I1137	Electronic changed
I1151	History reset
I1155	Reset electronic temperature
I1156	Memory error trend
I1157	Memory error event list
I1221	Zero point adjust failure
I1222	Zero point adjustment ok
I1256	Display: access status changed
I1264	Safety sequence aborted
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
I1457	Measurement error verification failed
I1459	I/O module verification failed
I1461	Sensor verification failed
I1462	Sensor electronic module verific. failed
I1512	Download started
I1513	Download finished
I1514	Upload started
I1515	Upload finished
I1554	Safety sequence started
I1555	Safety sequence confirmed
I1556	Safety mode off
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
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

Info number	Info name
I1639	Max. switch cycles number reached
I1649	Hardware write protection activated
I1650	Hardware write protection deactivated
I1712	New flash file received
I1725	Sensor electronic module (ISEM) changed
I1726	Configuration backup failed

11.12 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 (→ ⓘ 118).

11.12.1 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.  This option is displayed only in an alarm condition.

11.13 Device information

The **Device information** submenu contains all parameters that display different information for device identification.

Navigation

"Diagnostics" menu → Device information

► Device information		
Device tag	→ ⓘ	160
Serial number	→ ⓘ	160
Firmware version	→ ⓘ	160
Device name	→ ⓘ	160
Order code	→ ⓘ	160
Extended order code 1	→ ⓘ	160

Extended order code 2	→  160
Extended order code 3	→  160
ENP version	→  160

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. @, %, /).	–
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	–

11.14 Firmware history



It is possible to flash the firmware to the current version or the previous version using the service interface.



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:

- In the Download Area of the Endress+Hauser web site: www.endress.com → Downloads
- Specify the following details:
 - Text search: Manufacturer's information
 - Media type: Documentation – Technical Documentation

12 Maintenance

12.1 Maintenance tasks

No special maintenance work is required.

12.1.1 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.

12.1.2 Sensing element cleaning

Cleaning the sensing element

The measuring device can be removed for cleaning.

Use key size 36 mm (1.42 in) to remove the sensor.

WARNING

Injury from measuring device being ejected!

- Ensure the system is depressurized before commencing the cleaning work.

NOTICE

Damage to the sensing element!

- Make sure the sensing elements do not hit against anything.

NOTICE

The use of unsuitable equipment or cleaning liquids can damage the measuring device.

- Do not use pigs to clean the pipe.
- Use an oil-free cleaning agent that does not form a film to clean the sensor.

NOTICE

Damage to the sealing surfaces!

- Make sure the sealing surfaces do not hit against anything.

1. Ensure the system is unpressurized.
2. Release the compression fitting of the measuring device.
3. Carefully remove the measuring device from the process pipe.

4. **NOTICE**

The protective guard protects the sensing element from damage!

- Do not remove the protective guard.

Gently clean the sensing elements using a soft brush.

5. Carefully insert the measuring device into the process pipe.
 - ↳ Make sure the measuring device is aligned correctly.

6. **For PEEK ferrules:**

Tighten compression fitting with 1 turn.

7. **For metal ferrules:**

Tighten compression fitting with a ¼ turn.



Increase the pressure in the piping system and check for leaks once the desired pressure is reached.

12.1.3 Recalibration

The long-term stability of a measuring device depends on the integrity of the sensor, among other things. Impurities can also cause a coating to form on the sensor, which can cause a change in the measuring signal. Therefore, if the sensor is used in applications in which impurities (such as oil residue or dust) can occur, it is advisable to check the sensor for contamination at regular intervals and clean it if necessary (see →  161). The intervals depend on the type, condition and extent of the contamination.

Process conditions such as thermal shocks or constant variations in temperatures can create the conditions in which the measuring signal drifts over time. A recalibration can rectify these undesired changes in the measuring signal and restore the original measuring state.

Determining the recalibration intervals:

- In the event of critical measurements and in order to determine the recalibration intervals, a calibration check should be performed once a year.
The next recalibration can then be scheduled earlier or later depending on the results of these checks.
- A recalibration every three years is recommended for non-critical applications or for use in clean and dry gases.
- Heartbeat Verification can be used to help determine when a recalibration should be performed. By performing verifications regularly, it is possible to compare the verification results with the initial values determined at the factory. If these values deviate from one another, this can indicate that the device needs to be recalibrated.

12.2 Measuring and test equipment

Endress+Hauser offers a wide variety of measuring and test equipment, such as W@M or device tests.

 Your Endress+Hauser Sales Center can provide detailed information on the services.

List of some of the measuring and testing equipment: →  168

12.3 Endress+Hauser services

Endress+Hauser offers a wide variety of services for maintenance such as recalibration, maintenance service or device tests.

 Your Endress+Hauser Sales Center can provide detailed information on the services.

13 Repair

13.1 General information

13.1.1 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.

13.1.2 Notes for repair and conversion

For repair and modification 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 every repair and each conversion and enter them into the *W@M* life cycle management database and Netilion Analytics.

13.2 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.
- Can be read out via the **Serial number** parameter (→  160) in the **Device information** submenu.

13.3 Endress+Hauser services

Endress+Hauser offers a wide range of services.



Your Endress+Hauser Sales Center can provide detailed information on the services.

13.4 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:
<http://www.endress.com/support/return-material>
↳ Select the region.
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

13.5 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.

13.5.1 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.

13.5.2 Disposing of the measuring device

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 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.

14.1 Device-specific accessories

14.1.1 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: 6X5BXX-*****A  Proline 500 transmitter for replacement: It is essential to specify the serial number of the current transmitter when ordering. On the basis of the serial number, the device-specific data (e.g. calibration factors) of the replaced device can be used for the new transmitter.  Proline 500 – digital transmitter: Installation Instructions EA01287D
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 →  72.  Order number: 71351317  Installation Instructions EA01238D
Pipe mounting set	Pipe mounting set for transmitter.  Proline 500 – digital transmitter Order number: 71346427  Installation Instructions EA01195D
Weather protection cover Transmitter Proline 500 – digital	Is used to protect the measuring device from the effects of the weather: e.g. rainwater, excess heating from direct sunlight.  Proline 500 – digital transmitter Order number: 71343504  Installation Instructions EA01191D

Display guard Proline 500 – digital	Is used to protect the display against impact or scoring, for example from sand in desert areas.  Order number: 71228792  Installation Instructions EA01093D
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). The following cable lengths are available: order code for "Cable, sensor connection" ■ Option B: 20 m (65 ft) ■ Option E: User-configurable up to 50 mmax. ■ Option F: User-configurable up to 165 ftmax.  Maximum possible cable length for a Proline 500 – digital connecting cable: 300 m (1 000 ft)

14.1.2 For the sensor

Accessories	Description
Mounting boss	Order code for "Accessory enclosed" ■ Option PC "Mounting boss, G1" ■ Option PD "Mounting boss, 1" NPT" ■ Option PE "Mounting boss, G$\frac{3}{4}$" ■ Option PF "Mounting boss, $\frac{3}{4}$" NPT"  Can be ordered separately: order code DK6MB
Cold tap (ambient pressure)	Order code for "Accessory enclosed" ■ Option PR "Cold tap G1", ambient pressure" ■ Option PS "Cold tap 1" NPT, ambient pressure" ■ Option PT "Cold tap G$\frac{3}{4}$", ambient pressure" ■ Option PU "Cold tap $\frac{3}{4}$" NPT, ambient pressure"  Can be ordered separately: order code DK6ML
Hot tap (low pressure)	Order code for "Accessory enclosed" ■ Option PG "Hot tap G1", low pressure max. 4.5 bar/65 psig" ■ Option PH "Hot tap 1" NPT, low pressure max. 4.5 bar/65 psig" ■ Option PK "Hot tap G$\frac{3}{4}$", low pressure max. 4.5 bar/65 psig" ■ Option PL "Hot tap $\frac{3}{4}$" NPT, low pressure max. 4.5 bar/65 psig"  Mounting set contains mounting boss (process connection), sensor connection with safety chain and ball valve. To insert or remove the sensor at process pressures up to max. 4.5 barg (65 psi).  If the accessory is ordered separately, individual combinations can be selected. Order code DK6003

Hot tap (medium pressure)	Order code for "Accessory enclosed" ▪ Option PI "Hot tap G1", medium pressure max. 16 bar/230 psig ▪ Option PJ "Hot tap 1" NPT, medium pressure max. 16 bar/230 psig ▪ Option PM "Hot tap G3/4", medium pressure max. 16 bar/230 psig ▪ Option PN "Hot tap 3/4" NPT, medium pressure max. 16 bar/230 psig  Mounting set contains mounting boss (process connection), sensor connection, ball valve and extractor assembly. To insert or remove the sensor at process pressures up to max. 16 barg (230 psi).  If the accessory is ordered separately, individual combinations can be selected. Order code DK6003
Flow conditioner	 Can be ordered separately: order code DK6004 Available for the following pipe diameters: ▪ DN 80 (3") ▪ DN 100 (4") ▪ DN 150 (6") ▪ DN 200 (8") ▪ DN 250 (10") ▪ DN 300 (12") Available for the following process connections: ▪ PN10, EN1092-1 ▪ PN16, EN1092-1 ▪ PN25, EN1092-1 ▪ PN40, EN1092-1 ▪ Cl.150, ASME B16.5 ▪ Cl.300, ASME B16.5 ▪ 10K, JIS B2220 ▪ 20K, JIS B2220  Screws and seals are not included in the delivery.

14.2 Communication-specific accessories

Accessories	Description
Fieldgate FXA42	Transmission of the measured values of connected 4 to 20 mA analog measuring devices, as well as digital measuring devices  ▪ Technical Information TI01297S ▪ Operating Instructions BA01778S ▪ Product page: www.endress.com/fxa42
Field Xpert SMT50	The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle.  ▪ Technical Information TI01342S ▪ Operating Instructions BA01709S ▪ Product page: www.endress.com/smt50

Field Xpert SMT70	The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle.  ■ Technical Information TI01342S ■ Operating Instructions BA01709S ■ Product page: www.endress.com/smt70
Field Xpert SMT77	The Field Xpert SMT77 tablet PC for device configuration enables mobile plant asset management in areas categorized as Ex Zone 1.  ■ Technical Information TI01418S ■ Operating Instructions BA01923S ■ Product page: www.endress.com/smt77

14.3 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.
W@M	W@M Life Cycle Management Improved productivity with information at your fingertips. Data relevant to a plant and its components is generated from the first stages of planning and during the asset's complete life cycle. W@M Life Cycle Management is an open and flexible information platform with online and on-site tools. Instant access for your staff to current, in-depth data shortens your plant's engineering time, speeds up procurement processes and increases plant uptime. Combined with the right services, W@M Life Cycle Management boosts productivity in every phase. For more information, see: www.endress.com/lifecyclemanagement
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

14.4 System components

Accessories	Description
Memograph M graphic data manager	The Memograph M graphic data manager provides information on all the relevant measured variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a SD card or USB stick.  ■ Technical Information TI00133R  ■ Operating Instructions BA00247R
Ceraphant PTC31B	The pressure transmitter for measuring the absolute and gauge pressure in gases, steam, liquids and dusts. It can be used to read in the operating pressure value.  ■ Technical Information TI01130P  ■ Operating Instructions BA01270P
Cerabar PMC21	The pressure transmitter for measuring the absolute and gauge pressure in gases, steam, liquids and dusts. It can be used to read in the operating pressure value.  ■ Technical Information TI01133P  ■ Operating Instructions BA01271P
Cerabar S PMC71	The pressure transmitter for measuring the absolute and gauge pressure of gases, steam and liquids. It can be used to read in the operating pressure value.  ■ Technical Information TI00383P  ■ Operating Instructions BA00271P

15 Technical data

15.1 Application

The measuring device is intended only for the flow measurement of gases.

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.

15.2 Function and system design

Measuring principle	Mass flow measurement based on thermal measuring principle.
Measuring system	The measuring system consists of a transmitter and a sensor. The transmitter and sensor are mounted in physically separate locations. They are interconnected by connecting cables. Information on the structure of the device →  14

15.3 Input

Measured variable

Measured process variables

- Mass flow
- Temperature

Calculated process variables

- Corrected volume flow
- Volume flow
- FAD volume flow
- Flow velocity
- Calorific value
- 2nd temperature heat difference
- Heat flow
- Energy flow
- Density

Process variables available for order

Order code for "Sensor version":

- Option SB "Bidirectional" measures the flow in both directions (»positive« and »negative« flow) and totalizes the flow in both directions. The device is calibrated in both directions.
- Option SC "Reverse flow detection" only measures the flow in the positive direction. The reverse flow is detected by the device but is not totalized. The device is only calibrated in the positive forward flow direction.

Order code for "Application package":

Option EV "Second gas group" enables the configuration of two different standard gases/gas mixtures in the device and allows the user to switch from one gas group to another using the status input or (if available) via bus communication.

Measuring range

The available measuring range depends on the choice of gas and size of the pipe. Each measuring device is calibrated individually with air under reference operating conditions. No recalibration is required in the case of customer-specific gases, as the device's Gas Engine functionality converts from air to these gases.

The measuring ranges calibrated for air are indicated in the following section. For information on other gases and process conditions, contact your sales organization or use the Applicator selection software.

SI units

- Order code for "Sensor version; sensor; insertion tube", option SA "Unidirectional; stainless steel; stainless steel"
- Order code for "Sensor version; sensor; insertion tube", option HA "Unidirectional; Alloy; stainless steel"

DN [mm]	Full scale value [kg/h] (Air, 20°C, 1.013 bar a)		Full scale value [Nm ³ /h] (Air, 0°C, 1.013 bar a)	
	Minimum	Maximum	Minimum	Maximum
80	21	2 086	16	1 613
100	33	3 260	25	2 521
150	73	7 335	57	5 672
200	130	13 040	101	10 084
250	204	20 375	158	15 757

DN [mm]	Full scale value [kg/h] (Air, 20°C, 1.013 bar a)		Full scale value [Nm ³ /h] (Air, 0°C, 1.013 bar a)	
	Minimum	Maximum	Minimum	Maximum
300	293	29 340	227	22 689
400	522	52 160	403	40 337
500	815	81 500	630	63 026
600	1 174	117 360	908	90 758
700	1 597	159 740	1 235	123 531
1 000	3 260	326 000	2 521	252 105
1 500	7 335	733 501	5 672	567 236

- Order code for "Sensor version; sensor; insertion tube.", option SB "Bidirectional; stainless steel; stainless steel"
- Order code for "Sensor version; sensor; insertion tube.", option SC "Reverse flow detection; stainless steel; stainless steel"

DN [mm]	Full scale value [kg/h] (Air, 20°C, 1.013 bar a)		Full scale value [Nm ³ /h] (Air, 0°C, 1.013 bar a)	
	Minimum	Maximum	Minimum	Maximum
80	13	1 310	10	1 012
100	23	2 310	17	1 786
150	47	4 750	36	3 673
200	84	8 475	65	6 553
250	132	13 250	102	10 246
300	190	19 000	146	14 692
400	337	33 750	260	26 099
500	530	53 000	409	40 986
600	762	76 250	589	58 966
700	1 038	103 820	802	80 286
1 000	2 119	211 900	1 638	163 868
1 500	4 767	476 750	3 686	368 683

US units

- Order code for "Sensor version; sensor; insertion tube", option SA "Unidirectional; stainless steel; stainless steel"
- Order code for "Sensor version; sensor; insertion tube", option HA "Unidirectional; Alloy; stainless steel"

DN [in]	Full scale value [lb/h] (Air, 68°F, 14.7 psi a)		Full scale value [SCFM] (Air, 59°F, 14.7 psi a)	
	Minimum	Maximum	Minimum	Maximum
3	42	4 173	9	909
4	74	7 419	16	1 616
6	167	16 693	36	3 636
8	297	29 677	65	6 464
10	464	46 371	101	10 100
12	668	66 774	145	14 544

DN [in]	Full scale value [lb/h] (Air, 68°F, 14.7 psi a)		Full scale value [SCFM] (Air, 59°F, 14.7 psi a)	
	Minimum	Maximum	Minimum	Maximum
16	1 187	118 709	259	25 856
20	1 855	185 482	404	40 400
24	2 671	267 094	582	58 176
28	3 635	363 545	792	79 184
40	7 419	741 929	1 616	161 600
60	16 693	1 669 340	3 636	363 600

- Order code for "Sensor version; sensor; insertion tube:", option SB "Bidirectional; stainless steel; stainless steel"
- Order code for "Sensor version; sensor; insertion tube:", option SC "Reverse flow detection; stainless steel; stainless steel"

DN [in]	Full scale value [lb/h] (Air, 68°F, 14.7 psi a)		Full scale value [SCFM] (Air, 59°F, 14.7 psi a)	
	Minimum	Maximum	Minimum	Maximum
3	29	2 981	6	648
4	52	5 257	11	1 144
6	108	10 810	23	2 354
8	192	19 287	42	4 200
10	301	30 155	65	6 567
12	432	43 241	94	9 417
16	768	76 810	167	16 729
20	1 206	120 620	262	26 272
24	1 735	173 533	377	37 797
28	2 362	236 279	514	51 463
40	4 822	482 253	1 050	105 039
60	10 850	1 085 012	2 363	236 326

The flow rates listed are only representative for the calibrated conditions and do not necessarily reflect the measuring capacity of the measuring device under operating conditions and the actual pipe internal diameters present on site. To make sure that the correct device version and sizing is selected to suit the application, contact the sales organization or use the Applicator selection software.

Special applications

High gas flow velocities (>70 m/s)

In the case of high gas flow velocities, it is advisable to read in the process pressure dynamically or to enter the pressure as accurately as possible, as a velocity-dependent correction is performed.

Light gases (hydrogen, helium)

- The reliable measurement of light gases can be difficult due to their very high thermal conductivity. Depending on the application, the flow rates of light gases are often particularly slow and the flow profiles are not sufficiently developed. The flows are frequently in the laminar flow range, while turbulent flow would actually be needed for optimum measurement.
- Despite loss of accuracy and linearity in applications with light gases and low flow rates, the device measures with a good degree of repeatability and is therefore suitable for monitoring flow conditions (e.g. leak detection).
- The recommended inlet runs must be doubled for light gases. →  21

Operable flow range

- 200:1 with factory calibration
- Up to 1000:1 with application-specific adjustment

Input signal

External values

The measuring device provides interfaces which allow values measured externally →  174 to be transmitted to the measuring device:

- Analog inputs 4-20 mA
- Digital inputs

Pressure values can be transmitted as absolute or gauge pressure. For gauge pressure, the atmospheric pressure must be known or specified by the customer.

Current input

The measured values are written from the automation system to the measuring device via the current input →  174.

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	■ 4 to 20 mA (active) ■ 0/4 to 20 mA (passive)
Resolution	1 µA
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	■ Pressure ■ Temperature ■ Mol-% (gas analyzer) ■ External reference flow rate (in-situ adjustment)

Status input

Maximum input values	■ DC -3 to 30 V ■ If status input is active (ON): $R_i > 3 \text{ k}\Omega$
Response time	Configurable: 5 to 200 ms

Input signal level	▪ Low signal: DC -3 to +5 V ▪ High signal: DC 12 to 30 V
Assignable functions	▪ Off ▪ Reset the individual totalizers separately ▪ Reset all totalizers ▪ Flow override ▪ Second gas group ▪ Zero point adjustment

15.4 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 span	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 µA
Damping	Configurable: 0 to 999.9 s
Assignable measured variables	■ Mass flow ■ Volume flow ■ Corrected volume flow ■ FAD volume flow ■ Flow velocity ■ Temperature ■ Energy flow ■ Pressure ■ Density ■ Heat flow ■ Electronics temperature ■ 2nd temperature heat difference For SIL (application package), only mass flow

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
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	■ Mass flow ■ Volume flow ■ Corrected volume flow ■ FAD volume flow ■ Energy flow ■ Heat flow For SIL (application package), only mass flow
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 10 000 Hz ($f_{\max} = 12\,500$ Hz)
Damping	Configurable: 0 to 999.9 s
Pulse/pause ratio	1:1
Assignable measured variables	■ Mass flow ■ Volume flow ■ Corrected volume flow ■ FAD volume flow ■ Flow velocity ■ Temperature ■ Energy flow ■ Pressure ■ Density ■ Heat flow ■ Electronic temperature ■ 2nd temperature heat difference For SIL (application package), only mass flow
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	■ Off ■ On ■ Diagnostic behavior ■ Limit value ■ Off ■ Mass flow ■ Volume flow ■ Corrected volume flow ■ FAD volume flow ■ Heat flow ■ Energy flow ■ Flow velocity ■ Density ■ Calorific value ■ Temperature ■ 2nd temperature heat difference ■ Totalizer 1-3 ■ Electronic temperature ■ Flow direction monitoring ■ Status - Low flow cut off

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)	■ DC 30 V, 0.1 A ■ AC 30 V, 0.5 A
Assignable functions	■ Off ■ On ■ Diagnostic behavior ■ Limit value ■ Off ■ Mass flow ■ Volume flow ■ Corrected volume flow ■ FAD volume flow ■ Heat flow ■ Energy flow ■ Flow velocity ■ Density ■ Temperature ■ 2nd temperature heat difference ■ Totalizer 1-3 ■ Electronics temperature ■ Flow direction monitoring ■ Status - Low flow cut off

User-configurable input/output

One 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
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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
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Pulse/frequency/switch output

Pulse output	
Fault mode	Choose from: ■ Actual value ■ No pulses
Frequency output	
Fault mode	Choose from: ■ Actual value ■ 0 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
---------------------	---

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
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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 →  144
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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	■ Direct data access: typically 25 to 50 ms ■ Auto-scan buffer (data range): typically 3 to 5 ms
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0
Function codes	■ 03: Read holding register ■ 04: Read input register ■ 06: Write single registers ■ 08: Diagnostics ■ 16: Write multiple registers ■ 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: ■ 06: Write single registers ■ 16: Write multiple registers ■ 23: Read/write multiple registers
Supported baud rate	■ 1 200 BAUD ■ 2 400 BAUD ■ 4 800 BAUD ■ 9 600 BAUD ■ 19 200 BAUD ■ 38 400 BAUD ■ 57 600 BAUD ■ 115 200 BAUD
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 →  76. ■ Modbus RS485 information ■ Function codes ■ Register information ■ Response time ■ Modbus data map

15.5 Power supply

Terminal assignment →  37

Supply voltage	Order code "Power supply"	Terminal voltage		Frequency range
	Option D	DC 24 V	±20%	–
	Option E	AC 100 to 240 V	–15...+10%	50/60 Hz, ±4 Hz
	Option I	DC 24 V	±20%	–
		AC 100 to 240 V	–15...+10%	50/60 Hz, ±4 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 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 →  39

Potential equalization →  43

Terminals

Spring-loaded terminals: Suitable for strands and strands with ferrules.
Conductor cross-section 0.2 to 2.5 mm² (24 to 12 AWG).

Cable entries

- Cable gland: M20 × 1.5 with cable Ø 6 to 12 mm (0.24 to 0.47 in)
- Thread for cable entry:
 - NPT ½"
 - G ½"
 - M20

Cable specification →  33

Overvoltage protection	Mains voltage fluctuations	→  181
	Overvoltage category	Overvoltage category II
	Short-term, temporary overvoltage	Up to 1200 V between cable and ground, for max. 5 s
	Long-term, temporary overvoltage	Up to 500 V between cable and ground

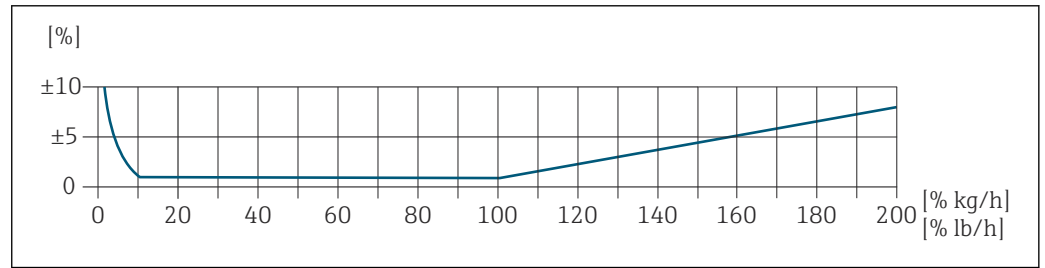
15.6 Performance characteristics

Reference operating conditions

- Error limits based on ISO 11631
- Dry air with +20 to +30 °C (+68 to +86 °F) at 0.8 to 1.5 bar (12 to 22 psi)
- Specifications as per calibration protocol
- Accuracy based on accredited calibration rigs that are traced to ISO 17025.

 To obtain measured errors, use the *Applicator* sizing tool →  168

Maximum measured error



A0042739

Calibrated measuring range

The measuring accuracy is specified in relation to the mass flow and divided into two ranges:

- ±1.0 % of the current measured value for 100% to 10% of the calibrated measuring range (under reference operating conditions)
- ±0.10 % of the calibrated full scale value for 10% to 1% of the calibrated measuring range (under reference operating conditions)

The measuring device is calibrated and adjusted on an accredited and traceable calibration rig and its accuracy is certified in a calibration report ¹⁾ (5 control points).

Order code for "Calibration flow":

- Option G "Factory calibration": calibration report (5 control points)
- Option K "Traceable ISO/IEC17025": Swiss Calibration Services (SCS) calibration report (5 control points) which confirms traceability to the national calibration standard

 For information on calibrated measuring ranges and maximum full scale values →  171

Extended measuring range

The device has an extended measuring range that goes beyond the maximum calibrated value (100%). Here, the last measured values in the calibrated range are taken and then extrapolated. The end of the extrapolated range is only reached once the productive energy of the sensor is exceeded and/or the Mach number is greater than listed below.

Mach number	Order code
0.2	■ Order code for "Sensor version; sensor; insertion tube:", option SB "Bidirectional; stainless steel; stainless steel" ■ Order code for "Sensor version; sensor; insertion tube:", option SC "Reverse flow detection; stainless steel; stainless steel"
0.4	■ Order code for "Sensor version; sensor; insertion tube:", option SA "Unidirectional; stainless steel; stainless steel" ■ Order code for "Sensor version; sensor; insertion tube:", option HA "Unidirectional; Alloy; stainless steel"

1) Two calibration reports for the order code for "Sensor version; sensor; insertion tube:", option SB "Bidirectional; stainless steel; stainless steel"

The accuracy is specified in relation to the mass flow.
 $\pm 1.0\% \pm (\text{current measured value in } \% - 100\%) \times 0.07$ for 100% to 200% of the calibrated measuring range (under reference operating conditions)

Accuracy of outputs

The outputs have the following base accuracy specifications.

Current output

Accuracy	$\pm 5 \mu\text{A}$
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Pulse/frequency output

o.r. = of reading

Accuracy	Max. ± 50 ppm o.r. (over the entire ambient temperature range)
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Repeatability	± 0.25 % of the display value for velocities above 1.0 m/s (3.3 ft/s)
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Response time	Typically < 3 s for 63 % of a step change (in both directions)
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Influence of ambient temperature

Current output

Temperature coefficient	Max. $1 \mu\text{A}/^\circ\text{C}$
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Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.
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Influence of medium temperature	Air: 0.02 % per $^\circ\text{C}$ (0.036 % per $^\circ\text{F}$) of the process temperature change in relation to the reference temperature
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Influence of medium pressure	Air: 0.3 % per bar (0.02 % per psi) of the process pressure change (from the set process pressure)
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15.7 Mounting

Mounting requirements	→  19
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15.8 Environment

Ambient temperature range

Measuring device	–40 to +60 $^\circ\text{C}$ (–40 to +140 $^\circ\text{F}$) - Order code for "Test, certificate", option JP: –50 to +60 $^\circ\text{C}$ (–58 to +140 $^\circ\text{F}$)
Readability of the local display	–20 to +60 $^\circ\text{C}$ (–4 to +140 $^\circ\text{F}$) The readability of the display may be impaired at temperatures outside the temperature range.

NOTICE**Danger of overheating**

- ▶ Ensure that the temperature at the lower end of the transmitter housing does not exceed 80 °C (176 °F).
- ▶ Ensure that sufficient convection takes place at the transmitter neck.
- ▶ When using in potentially explosive atmospheres, observe the information in the device-specific Ex documentation. For detailed information on the temperature tables, see the separate document entitled "Safety Instructions" (XA) for the device.
- ▶ Ensure that a sufficiently large area of the transmitter neck remains exposed. The uncovered part serves as a radiator and protects the electronics from overheating and excessive cooling.
- ▶ If operating outdoors:
Avoid direct sunlight, particularly in warm climatic regions.

 You can order a weather protection cover from Endress+Hauser →  165.

Storage temperature	–50 to +80 °C (–58 to +176 °F), preferably at +20 °C (+68 °F)
Atmosphere	If a plastic transmitter housing is permanently exposed to certain steam and air mixtures, this can damage the housing.  In cases of doubt, please contact the Sales Center.
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 ■ IP66/67, Type 4X enclosure, suitable for pollution degree 4 ■ When the housing is open: IP20, Type 1 enclosure, suitable for pollution degree 2 <i>Optional</i> Order code for "Sensor options", option CC "IP68, Type 6P, Cust-potted" External WLAN antenna IP67
Vibration- and shock-resistance	Vibration sinusoidal, in accordance with IEC 60068-2-6 Sensor ■ 2 to 8.4 Hz, 3.5 mm peak ■ 8.4 to 2 000 Hz, 1 g peak Transmitter ■ 2 to 8.4 Hz, 7.5 mm peak ■ 8.4 to 2 000 Hz, 2 g peak Vibration broad-band random, according to IEC 60068-2-64 Sensor ■ 10 to 200 Hz, 0.003 g²/Hz ■ 200 to 2 000 Hz, 0.001 g²/Hz ■ Total: 1.54 g rms

Transmitter

- 10 to 200 Hz, 0.01 g²/Hz
- 200 to 2 000 Hz, 0.003 g²/Hz
- Total: 2.70 g rms

Shock half-sine, according to IEC 60068-2-27

- Sensor
6 ms 30 g
- Transmitter
6 ms 50 g

Rough handling shocks according to IEC 60068-2-31

Interior cleaning

Suitable for cleaning-in-place (CIP) and sterilization-in-place (SIP).

Manufacturer options for delivery of parts

- Oil- and grease-free wetted parts, no declaration. Order code for "Service", option HA.
- Oil- and grease-free wetted parts as per IEC/TR 60877-2.0 and BOC 50000810-4, with declaration. Order code for "Service", option HB. The plant operator must ensure that the measuring device meets the requirements of the operator's oxygen application.

Electromagnetic compatibility (EMC)

As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)



Details are provided in the Declaration of Conformity.



This unit is not intended for use in residential environments and cannot guarantee adequate protection of the radio reception in such environments.

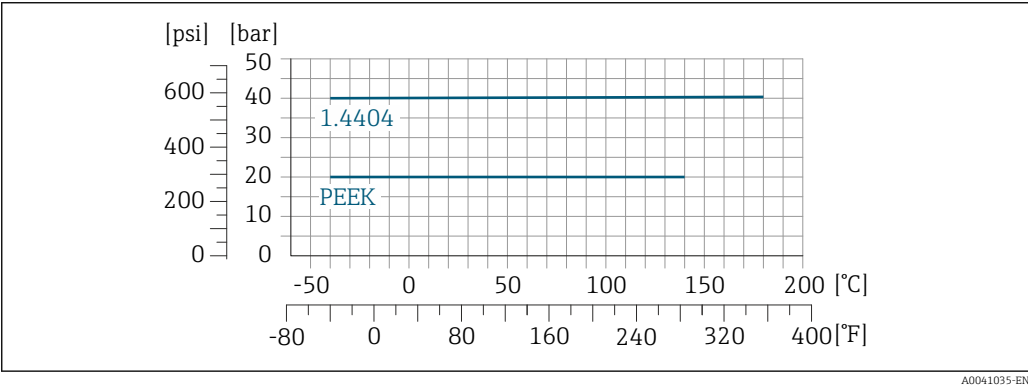
15.9 Process

Medium temperature range	Sensor -40 to +180 °C (-40 to +356 °F) Seals - Sealing rings: - EPDM -40 to +140 °C (-40 to +284 °F) - FKM -40 to +180 °C (-40 to +356 °F) - Ferrule: - PEEK -40 to +140 °C (-40 to +284 °F) - PVDF -20 to +110 °C (-4 to +230 °F) 1.4404 -40 to +180 °C (-40 to +356 °F)  Ferrule in 1.4404: ferrule has a fixed position on the shaft. Restriction for repeat calibrations (observe minimum insertion depth →  20)
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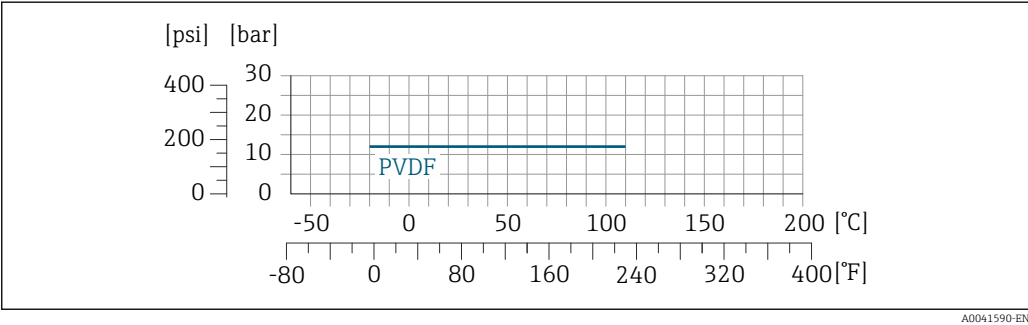
Medium pressure range	Minimum 0.5 bar absolute. Maximum permitted medium pressure →  187
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Pressure/temperature ratings	The following pressure/temperature diagrams apply to all pressure-bearing parts of the device and not just the process connection. The diagrams show the maximum permissible medium pressure depending on the specific medium temperature.
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Ferrule



 40 With compression fitting material 1.4404/F316L/F316



 41 With compression fitting material 1.4404/F316L/F316

Flow limit	 Measuring range →  171
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The maximum flow depends on the gas type and the pipe nominal diameter used. The end of the measuring range is reached when the Mach number listed below is reached.

Mach number	Order code
0.2	- Order code for "Sensor version; sensor; insertion tube:", option SB "Bidirectional; stainless steel; stainless steel" - Order code for "Sensor version; sensor; insertion tube:", option SC "Reverse flow detection; stainless steel; stainless steel"
0.4	- Order code for "Sensor version; sensor; insertion tube:", option SA "Unidirectional; stainless steel; stainless steel" - Order code for "Sensor version; sensor; insertion tube:", option HA "Unidirectional; Alloy; stainless steel"

 Use the Applicator to size the device.

Pressure loss

 Use the Applicator for precise calculations.

System pressure

→  26

Hot tap, process pressure

Only use the hot tap for mounting and removal at process pressure for non-toxic, innocuous gases.

Medium pressure version

- Max. process pressure: 20 bar (290 psi)
- Max. extraction pressure: 16 bar (230 psi)
- Max. extraction temperature: +50 °C (+122 °F)
- Min. insertion sensor length: 435mm (17")

Low pressure version

- Max. process pressure: 20 bar (290 psi)
- Max. extraction pressure: 4.5 bar (65 psi)
- Max. extraction temperature: +50 °C (+122 °F)
- Min. insertion sensor length: 335mm (13")

Cold tap, ambient pressure

Cold tap for mounting and removal at ambient pressure.

- Max. process pressure: 20 bar (290 psi)
- Max. extraction pressure: 1 bar (14.5 psi)
- Max. extraction temperature: +50 °C (+122 °F)
- Min. insertion sensor length: 335mm (13")

Mounting boss

To mount the device directly on the process pipe.
Max. process pressure: 40 bar (580 psi)

15.10 Mechanical construction

Design, dimensions

 For the dimensions and installation lengths of the device, see the "Technical Information" document, "Mechanical construction" section .

Weight

Transmitter

- Proline 500 – digital polycarbonate: 1.4 kg (3.1 lbs)
- Proline 500 – digital aluminum: 2.4 kg (5.3 lbs)

Sensor

- Sensor with cast connection housing version, stainless: +3.7 kg (+8.2 lbs)
- Sensor with aluminum connection housing version:

Weight in SI units

Installed length [mm]	Weight [kg]
235	2.2
335	2.3
435	2.4
608	2.5

Weight in US units

Installed length [in]	Weight [lbs]
9	4.9
13	5.1
17	5.3
24	5.5

Materials**Transmitter housing**

Housing of Proline 500 – digital transmitter

Order code for "Transmitter housing":

- Option **A** "Aluminum coated": aluminum, AlSi10Mg, coated
- Option **D** "Polycarbonate": polycarbonate

Window material

Order code for "Transmitter housing":

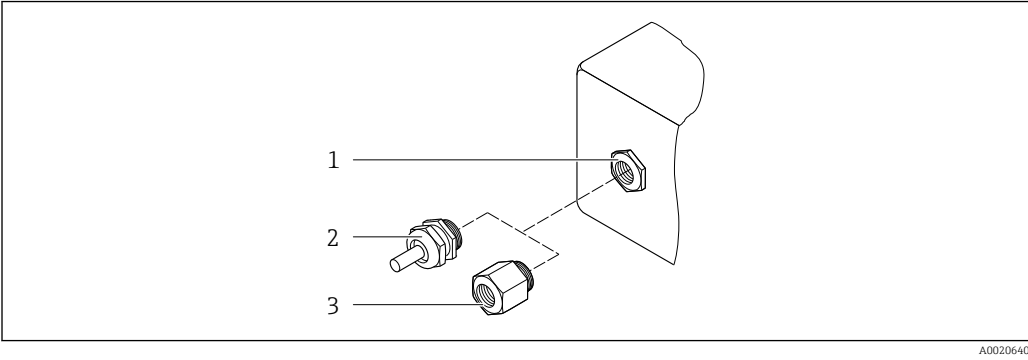
- Option **A** "Aluminum, coated": glass
- Option **D** "Polycarbonate": plastic

Sensor connection housing

Order code for "Sensor connection housing":

- Option **A** "Aluminum coated": aluminum, AlSi10Mg, coated
- Option **L** "Cast, stainless": 1.4409 (CF3M) similar to 316L

Cable entries/cable glands



42 Possible cable entries/cable glands

1 Female thread M20 × 1.5

2 Cable gland M20 × 1.5

3 Adapter for cable entry with female thread G ½" or NPT ½"

Cable entries and adapters	Material
Cable gland M20 × 1.5	Plastic
- Adapter for cable entry with female thread G ½" - Adapter for cable entry with female thread NPT ½" i Only available for certain device versions: - Order code for "Transmitter housing": - Option A "Aluminum, coated" - Option D "Polycarbonate" - Order code for "Sensor connection housing": Proline 500 – digital: - Option A "Aluminum coated" - Option B "Stainless"	Nickel-plated brass

Materials for insertion tube

Stainless steel, 1.4404 (316/316L)

Process connections, process coupling

Stainless steel, 1.4404 (316/316L)

Sensing element

Unidirectional

- Stainless steel, 1.4404 (316/316L)
- Alloy C22, 2.4602 (UNS N06022);

Bidirectional

Stainless steel, 1.4404 (316/316L)

Reverse flow detection

Stainless steel, 1.4404 (316/316L)

Ferrules

- PEEK
- PVDF
- 1.4404 (316/316L)

Flat ring seal

- EPDM
- FKM

 For aggressive media (e.g. chlorine or ozone), we recommend special materials (Alloy for sensing element, PVDF or 1.4404 for ferrules and FKM for flat seal). For any requests, please contact the Endress+Hauser sales organization responsible for your area.

Sensor guard

Stainless steel, 1.4404 (316/316L)

Accessories*Protective cover*

Stainless steel, 1.4404 (316L)

External WLAN antenna

- Antenna: ASA plastic (acrylonitrile styrene acrylate) and nickel-plated brass
- Adapter: Stainless steel and nickel-plated brass
- Cable: Polyethylene
- Plug: Nickel-plated brass
- Angle bracket: Stainless steel

Mounting boss (DK6MB)

Stainless steel, 1.4404 (316/316L)

*Cold/hot tap, low pressure and medium pressure**Welding socket*

Stainless steel 1.4404 (316L)

Ball valve

- Stainless cast steel CF3M or CF8M
- Seal: PTFE

Sensor connection

Stainless steel, 1.4404 (316/316L)

Cold tap, atmospheric pressure

- Stainless steel, 1.4404 (316/316L)
- Stainless cast steel CF3M or CF8M
- Seal: PTFE

Process connections

- G $\frac{3}{4}$ ", ISO 228/1 compression fitting
- G1", ISO 228/1, compression fitting
- $\frac{3}{4}$ " NPT, compression fitting
- 1" NPT, compression fitting

 For information on the different materials used in the process connections →  190

15.11 Display and user interface

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
Local operation	Via display module Equipment: ■ 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 →  72 <i>Display elements</i> ■ 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 <i>Operating elements</i> ■ External operation via touch control (3 optical keys) without opening the housing: , ,  ■ Operating elements also accessible in the various zones of the hazardous area
Remote operation	→  71
Service interface	→  71
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	■ CDI-RJ45 service interface ■ WLAN interface	Special Documentation for device
DeviceCare SFE100	Notebook, PC or tablet with Microsoft Windows system	■ CDI-RJ45 service interface ■ WLAN interface ■ Fieldbus protocol	→  168
FieldCare SFE500	Notebook, PC or tablet with Microsoft Windows system	■ CDI-RJ45 service interface ■ WLAN interface ■ Fieldbus protocol	→  168

Supported operating tools	Operating unit	Interface	Additional information
Field Xpert	SMT70/77/50	■ All Fieldbus protocols ■ WLAN interface ■ Bluetooth ■ CDI-RJ45 service interface	Operating Instructions BA01202S Device description files: Use update function of handheld terminal
SmartBlue app	Smart phone or tablet with iOS or Android	WLAN	→  168

 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 log (PDF file, only available with the **Heartbeat Verification** →  199 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 →  199)

 Special Documentation for web server

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.

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	■ Event logbook, e.g. diagnostic events ■ Parameter data record backup ■ Device firmware package	■ Measured value logging ("Extended HistoROM" order option) ■ Current parameter data record (used by firmware at run time) ■ Indicator (minimum/maximum values) ■ Totalizer value	■ Sensor data: e.g. nominal diameter ■ Serial number ■ Calibration data ■ Device configuration (e.g. SW options, fixed I/O or multi I/O)
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 1 000 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

15.12 Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com 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)".

Ex approval The measuring device is certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA) document. Reference is made to this document on the nameplate.

 The separate Ex documentation (XA) containing all the relevant explosion protection data is available from your Endress+Hauser sales center.

Proline 500 – digital

ATEX/IECEX

Currently, the following versions for use in hazardous areas are available:

Ex db

Transmitter		Sensor	
Category	Type of protection	Category	Type of protection
II(1)G	[Ex ia] IIC	II1/2G	Ex db ia IIC T4...T1 Ga/Gb
II(1)G	[Ex ia] IIC	II2G	Ex db ia IIC T4...T1 Gb
II3G	Ex ec nC [ia Ga] IIC T5...T1 Gc	II1/2G	Ex db ia IIC T4...T1 Ga/Gb
II3G	Ex ec nC [ia Ga] IIC T5...T1 Gc	II2G	Ex db ia IIC T4...T1 Gb

Ex tb

Transmitter		Sensor	
Category	Type of protection	Category	Type of protection
II(1)D	[Ex ia] IIIC	II2D	Ex tb IIIC T** °C Db

Non-Ex / Ex ec

Transmitter		Sensor	
Category	Type of protection	Category	Type of protection
Non - Ex	Non-Ex	II3G	Ex ec IIC T4...T1 Gc
II3G	Ex ec nC IIC T5...T1 Gc	II3G	Ex ec IIC T4...T1 Gc

cCSA_{US}

Currently, the following versions for use in hazardous areas are available:

IS (Ex nA, Ex i)

Transmitter	Sensor
Class I Division 2 Groups A - D	Class I, II, III Division 1 Groups A-G

NI (Ex nA)

Transmitter	Sensor
Class I Division 2 Groups A - D	Class I Division 2 Groups A - D

Ex db

Transmitter	Sensor
Ex ec nC [ia Ga] IIC T5...T1 Gc	Ex db ia IIC T4...T1 Gb
Ex ec nC [ia Ga] IIC T5...T1 Gc	Ex db ia IIC T4...T1 Ga/Gb

Ex nA

Transmitter	Sensor
Class I, Zone 2 AEx/ Ex nA IIC T5...T4 Gc	Class I, Zone 2 AEx/ Ex nA IIC T5...T1 Gc

Ex tb

Transmitter	Sensor
Non - Ex	Zone 21, AEx/Ex ia tb IIIC T** °C Db

Functional safety

The measuring device can be used for flow monitoring systems (min., max., range) up to SIL 2 (single-channel architecture; order code for "Additional approval", option LA) and SIL 3 (multi-channel architecture with homogeneous redundancy) and is independently evaluated and certified in accordance with IEC 61508.

The following types of monitoring in safety equipment are possible:

Mass flow



Functional safety manual with information and restrictions for the SIL device
→ 200

Radio approval

The measuring device has radio approval.



For detailed information on the radio approval, see the Special Documentation
→ 200

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.

External standards and guidelines

- EN 60529
Degrees of protection provided by enclosure (IP code)
- EN 61010-1
Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements
- IEC/EN 61326-2-3
Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements).
- 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
- ETSI EN 300 328
Guidelines for 2.4 GHz radio components.
- EN 301489
Electromagnetic compatibility and radio spectrum matters (ERM).

Classification of process sealing between electrical systems and (flammable or combustible) process fluids in accordance with ANSI/ISA 12.27.01

Endress+Hauser devices are designed in accordance with ANSI/ISA 12.27.01, allowing the user to waive the use and save the cost of installing external secondary process seals in the conduit as required by the process sealing sections of ANSI/NFPA 70 (NEC) and CSA 22.1 (CEC). These devices comply with the North American installation practice and provide a very safe and cost-saving installation for pressurized applications with hazardous fluids. Further information can be found in the control drawings of the relevant devices.

15.13 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 → 200

Diagnostic functionality	Order code for "Application package", option EA "Extended HistoROM" Comprises extended functions concerning the event log and the activation of the measured value memory. Event log: Memory volume is extended from 20 message entries (standard version) to up to 100 entries. Data logging (line recorder): ■ Memory capacity for up to 1000 measured values is activated. ■ 250 measured values can be output via each of the 4 memory channels. The recording interval can be defined and configured by the user. ■ Measured value logs can be accessed via the local display or operating tool e.g. FieldCare, DeviceCare or Web server.
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For detailed information, see the Operating Instructions for the device.

Heartbeat Technology	Order code for "Application package", option EB "Heartbeat Verification + Monitoring" Heartbeat Verification Meets the requirement for traceable verification to DIN ISO 9001:2008 Chapter 7.6 a) "Control of monitoring and measuring equipment". ■ Functional testing in the installed state without interrupting the process. ■ Traceable verification results on request, including a report. ■ Simple testing process via local operation or other operating interfaces. ■ Clear measuring point assessment (pass/fail) with high test coverage within the framework of manufacturer specifications. ■ Extension of calibration intervals according to operator's risk assessment.
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Heartbeat Monitoring

Continuously supplies data, which are characteristic of the measuring principle, to an external condition monitoring system for the purpose of preventive maintenance or process analysis. These data enable the operator to:

- Draw conclusions - using these data and other information - about the impact on the measuring performance over time.
- Schedule servicing in time.
- Monitor the process or product quality, e.g. process stability.



Special Documentation SD02712D

Second gas group

Package	Description
Second gas group	This application package enables the configuration of two different standard gases/gas mixtures in the device and allows the user to switch from one gas group to another using the status input or (if available) via bus communication.

15.14 Accessories

 Overview of accessories available for order →  165

15.15 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 device	Documentation code
Proline t-mass I	KA01443D

Brief Operating Instructions for the transmitter

Measuring device	Documentation code
Proline 500 – digital	KA01447D

Technical Information

Measuring device	Documentation code
t-mass I 500	TI01503D

Description of Device Parameters

Measuring device	Documentation code
t-mass 500	GP01146D

Supplementary device-dependent documentation **Safety instructions**
Safety instructions for electrical equipment for hazardous areas.

Contents	Documentation code
ATEX/IECEx Ex d/Ex de	XA01970D
ATEX/IECEx Ex ec	XA01971D
cCSAus XP	XA01974D
cCSAus Ex d/ Ex de	XA01972D
cCSAus Ex nA	XA01973D

Remote display and operating module DKX001

Contents	Documentation code
ATEX/IECEX Ex i	XA01494D
ATEX/IECEX Ex ec	XA01498D
cCSAus IS	XA01499D
cCSAus Ex nA	XA01513D
INMETRO Ex i	XA01500D
INMETRO Ex ec	XA01501D
NEPSI Ex i	XA01502D
NEPSI Ex nA	XA01503D

Special documentation

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01614D
Remote display and operating module DKX001	SD01763D
Radio approvals for WLAN interface for A309/A310 display module	SD01793D
Web server	SD02488D
Heartbeat Technology	SD02480D

Installation Instructions

Contents	Comment
Installation instructions for spare part sets and accessories	- Access the overview of all the available spare part sets via <i>Device Viewer</i> →  163 - Accessories available for order with Installation Instructions

Index

A

- Access authorization to parameters
 - Read access 63
 - Write access 63
- Access code 63
 - Incorrect input 63
- Adapting the diagnostic behavior 151
- Additional certification 198
- Ambient temperature
 - Influence 184
- Application 170
- Approvals 196
- Auto scan buffer
 - see Modbus RS485 Modbus data map

C

- Cable entries
 - Technical data 181
- Cable entry
 - Degree of protection 48
- CE mark 10, 196
- Certificates 196
- Check
 - Connection 49
- Checklist
 - Post-connection check 49
 - Post-installation check 32
- Cleaning
 - Cleaning the sensing element 161
 - Exterior cleaning 161
 - Sensing element 161
- Cold tap, ambient pressure 188
- Commissioning 81
 - Advanced settings 109
 - Configuring the measuring device 82
- Configuring error response mode, Modbus RS485 . . 151
- Connecting the connecting cable
 - Proline 500 – digital transmitter 41
 - Sensor connection housing, Proline 500 - digital . . 39
 - Terminal assignment of Proline 500 - digital 39
- Connecting the measuring device
 - Proline 500 – digital 39
- Connecting the signal cable/supply voltage cable
 - Proline 500 – digital transmitter 42
- Connection
 - see Electrical connection
- Connection cable 33
- Connection preparations 38
- Connection tools 33
- Context menu
 - Calling up 59
 - Closing 59
 - Explanation 59
- Current consumption 181

D

- Date of manufacture 16, 17
- Declaration of Conformity 10
- Defining the access code 128, 129
- Degree of protection 48, 185
- Design
 - Measuring device 14
- Device components 14
- Device description files 75
- Device locking, status 132
- Device name
 - Sensor 17
 - Transmitter 16
- Device repair 163
- Device revision 75
- Device type ID 75
- Device Viewer 163
- DeviceCare 74
 - Device description file 75
- Diagnosis
 - Symbols 146
- Diagnostic behavior
 - Explanation 147
 - Symbols 147
- Diagnostic information
 - Communication interface 151
 - Design, description 147, 150
 - DeviceCare 149
 - FieldCare 149
 - Light emitting diodes 144
 - Local display 146
 - Overview 152
 - Remedial measures 152
 - Web browser 148
- Diagnostic list 156
- Diagnostic message 146
- DIP switch
 - see Write protection switch
- Direct access 61
- Direct access code 55
- Disabling write protection 128
- Display
 - see Local display
- Display area
 - For operational display 53
 - In the navigation view 55
- Display values
 - For locking status 132
- Displaying data logging 139
- Disposal 164
- Document
 - Function 6
 - Symbols 6
- Document function 6

E

Editing view	57
Input screen	58
Using operating elements	57, 58
Electrical connection	
Computer with web browser (e.g. Microsoft Edge)	71
Degree of protection	48
Measuring device	33
Operating tool (e.g. FieldCare, DeviceCare, AMS Device Manager, SIMATIC PDM)	71
Operating tools	
Via Modbus RS485 protocol	71
Via service interface (CDI-RJ45)	71
Via WLAN interface	72
Web server	71
WLAN interface	72
Electromagnetic compatibility	186
Electronics module	14
Enabling write protection	128
Enabling/disabling the keypad lock	64
Endress+Hauser services	
Maintenance	162
Repair	163
Environment	
Storage temperature	185
Vibration- and shock-resistance	185
Error messages	
see Diagnostic messages	
Event list	156
Event logbook	156
Ex approval	196
Extended order code	
Sensor	17
Transmitter	16
Exterior cleaning	161

F

Field of application	
Residual risks	10
FieldCare	73
Device description file	75
Establishing a connection	73
Function	73
User interface	74
Filtering the event logbook	157
Firmware	
Release date	75
Version	75
Firmware history	160
Flow conditioner	22
Flow limit	187
Function codes	76
Functional Safety (SIL)	197
Functions	
see Parameters	

G

Galvanic isolation	180
--------------------	-----

H

Hardware write protection	130
HART protocol	
Revision	75
Help text	
Calling up	62
Closing	62
Explanation	62
HistoROM	115, 125
Hot tap, process pressure	188

I

Identifying the measuring device	15
Incoming acceptance	15
Influence	
Ambient temperature	184
Medium pressure	184
Information about this document	6
Input	171
Inspection	
Installation	32
Received goods	15
Installation conditions	
Sensor heating	26
System pressure	26
Intended use	9

L

Languages, operation options	192
Line recorder	139
Local display	192
Navigation view	55
see Diagnostic message	
see In alarm condition	
see Operational display	
Text editor	57
Low flow cut off	180

M

Main electronics module	14
Maintenance	161
Maintenance tasks	161
Recalibration	162
Managing the device configuration	115, 125
Manufacturer ID	75
Materials	189
Measured variables	
see Process variables	
Measuring and test equipment	162
Measuring device	
Configuring	82
Conversion	163
Design	14
Disposal	164
Preparing for electrical connection	38
Preparing for mounting	28
Removing	164
Repairs	163
Switching on	81

Measuring principle	170
Measuring system	170
Medium pressure	
Influence	184
Menu	
Diagnostics	155
Setup	83
Menus	
For measuring device configuration	82
For specific settings	109
Modbus RS485	
Configuring error response mode	151
Diagnostic information	151
Function codes	76
Modbus data map	78
Read access	76
Reading out data	79
Register addresses	77
Register information	77
Response time	77
Scan list	79
Write access	76
Mounting	19
Mounting preparations	28
Mounting tool	28
N	
Nameplate	
Sensor	17
Transmitter	16
Navigation path (navigation view)	55
Navigation view	
In the submenu	55
In the wizard	55
Numeric editor	57
O	
Onsite display	
Numeric editor	57
Operable flow range	174
Operating elements	59, 147
Operating keys	
see Operating elements	
Operating menu	
Menus, submenus	51
Structure	51
Submenus and user roles	52
Operating philosophy	52
Operation	132
Operation options	50
Operational display	53
Operational safety	10
Order code	16, 17
Output signal	176
Output variables	176
P	
Packaging disposal	18

Parameter	
Changing	62
Entering values or text	62
Parameter settings	
Adjustment values in use (Submenu)	123
Administration (Submenu)	118
Advanced setup (Submenu)	109
Communication (Submenu)	91
Configuration backup (Submenu)	115, 125
Current input	93
Current input (Wizard)	93
Current input 1 to n (Submenu)	135
Current output	95
Current output (Wizard)	95
Data logging (Submenu)	139
Define access code (Wizard)	117
Device information (Submenu)	159
Diagnostics (Menu)	155
Display (Submenu)	111
Display (Wizard)	105
I/O configuration	92
I/O configuration (Submenu)	92
In-situ adjustment (Submenu)	121
Low flow cut off (Wizard)	108
Measurement mode (Wizard)	83
Process variables (Submenu)	133
Pulse/frequency/switch output	98
Pulse/frequency/switch output (Wizard)	98, 99, 102
Pulse/frequency/switch output 1 to n (Submenu)	137
Reference conditions (Submenu)	87
Relay output	104
Relay output 1 to n (Submenu)	137
Relay output 1 to n (Wizard)	104
Reset access code (Submenu)	118
Setup (Menu)	83
Simulation (Submenu)	126
Status input	94
Status input 1 to n (Submenu)	94, 135
System units (Submenu)	89
System values (Submenu)	134
Totalizer (Submenu)	134
Totalizer 1 to n (Submenu)	109
Totalizer handling (Submenu)	138
Value current output 1 to n (Submenu)	136
Web server (Submenu)	70
WLAN settings (Wizard)	114
Post-connection check	81
Post-connection check (checklist)	49
Post-installation check (checklist)	32
Post-mounting check	81
Potential equalization	43
Power consumption	181
Power supply failure	181
Process	
Cold tap, ambient pressure	188
Hot tap, process pressure	188
Process connections	191
Product safety	10

Proline 500 – digital transmitter

- Connecting the signal cable/supply voltage cable . . . 42
- Protecting parameter settings 128

R

- Radio approval 197
- RCM marking 196
- Read access 63
- Reading off measured values 132
- Reading out diagnostic information, Modbus RS485 . . . 151
- Recalibration 162
- Registered trademarks 8
- Remedial measures
 - Calling up 148
 - Closing 148
- Remote operation 192
- Repair 163
 - Notes 163
- Repair of a device 163
- Replacement
 - Device components 163
- Requirements for personnel 9
- Response time 184
- Return 163

S

- Safety 9
- Sensor adjustment 88
- Sensor heating 26
- Serial number 16, 17
- Setting the operating language 81
- Settings
 - Adapting the measuring device to the process
 - conditions 138
 - Administration 117
 - Advanced display configurations 111
 - Communication interface 91
 - Current input 93
 - Current output 95
 - I/O configuration 92
 - In-situ adjustment 118
 - Local display 105
 - Low flow cut off 108
 - Managing the device configuration 115, 125
 - Measurement mode 83
 - Operating language 81
 - Pulse output 98
 - Pulse/frequency/switch output 98, 99
 - Reference conditions 87
 - Relay output 104
 - Resetting the device 159
 - Resetting the totalizer 138
 - Simulation 126
 - Status input 94
 - Switch output 102
 - System units 89
 - Tag name 83
 - Totalizer 109
 - Totalizer reset 138

- WLAN 114
- Signal on alarm 178
- SIL (functional safety) 197
- Software release 75
- Spare part 163
- Spare parts 163
- Special
 - Installation instructions 27
- Special connection instructions 44
- Standards and guidelines 198
- Status area
 - For operational display 53
 - In the navigation view 55
- Status signals 146, 149
- Storage concept 194
- Storage conditions 18
- Storage temperature 18
- Storage temperature range 185
- Structure
 - Operating menu 51
- Submenu
 - Adjustment values in use 123
 - Administration 117, 118
 - Advanced setup 109
 - Communication 91
 - Configuration backup 115, 125
 - Current input 1 to n 135
 - Data logging 139
 - Device information 159
 - Display 111
 - Event list 156
 - I/O configuration 92
 - In-situ adjustment 121
 - Input values 135
 - Measured values 132
 - Output values 136
 - Overview 52
 - Process variables 133
 - Pulse/frequency/switch output 1 to n 137
 - Reference conditions 87
 - Relay output 1 to n 137
 - Reset access code 118
 - Simulation 126
 - Status input 1 to n 94, 135
 - System units 89
 - System values 134
 - Totalizer 134
 - Totalizer 1 to n 109
 - Totalizer handling 138
 - Value current output 1 to n 136
 - Web server 70
- Supply voltage 181
- Switch output 178
- Symbols
 - Controlling data entries 58
 - For communication 53
 - For diagnostic behavior 53
 - For locking 53
 - For measured variable 53

For measurement channel number	53
For menus	55
For parameters	55
For status signal	53
For submenu	55
For wizard	55
In the status area of the local display	53
Input screen	58
Operating elements	57
System design	
Measuring system	170
see Measuring device design	
System integration	75
System pressure	26

T

Technical data, overview	170
Temperature range	
Ambient temperature range for display	192
Storage temperature	18
Terminal assignment	37
Terminal assignment of connecting cable for Proline	
500- digital	
Sensor connection housing	39
Terminals	181
Text editor	57
Tool	
For mounting	28
Transport	18
Tool tip	
see Help text	
Tools	
For electrical connection	33
Totalizer	
Configuring	109
Transporting the measuring device	18
Troubleshooting	
General	142

U

UKCA marking	196
Use of measuring device	
Borderline cases	9
Incorrect use	9
see Intended use	
User interface	
Current diagnostic event	155
Previous diagnostic event	155
User roles	52

V

Version data for the device	75
Vibration- and shock-resistance	185

W

W@M	162, 163
W@M Device Viewer	15
Weight	
SI units	189
Transport (notes)	18

US units	189
Wizard	
Current input	93
Current output	95
Define access code	117
Display	105
Low flow cut off	108
Measurement mode	83
Pulse/frequency/switch output	98, 99, 102
Relay output 1 to n	104
WLAN settings	114
WLAN settings	114
Workplace safety	10
Write access	63
Write protection	
Via access code	128
Via write protection switch	130
Write protection switch	130



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