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Technical Information
Proline Promass U 500

Coriolis flowmeter for single use

Application

- Measuring principle operates independently of physical fluid properties such as viscosity or density
- Highest measurement performance for liquids in single-use processes for the Life Sciences Industry

Device properties

- Standard cable between sensor and transmitter
- Fully traceable cGMP compliance
- One sensor fits four line sizes: ⅛ to 1"
- Remote version with up to 4 I/Os
- Backlit display with touch control and WLAN access
- Standard cable between sensor and transmitter

Your benefits

- Modern fieldbus communication protocols (2-wire)
- One sensor fits all DN – single variant with 4 disposable line sizes provides highest turndown ratio
- One-hand mounting of disposable – easy commissioning due to intuitive clamping mechanism
- Mounting angle - self drainabillity or air bubble escape
- Full access to process and diagnostic information – numerous, freely combinable I/Os and Ethernet
- Reduced complexity and variety – freely configurable I/O functionality
- Integrated verification – Heartbeat Technology

Endress+Hauser
People for Process Automation

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About this document

Symbols

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.

Communication-specific symbols

Symbol	Meaning
	Wireless Local Area Network (WLAN) Communication via a wireless, local network.
	LED Light emitting diode is off.
	LED Light emitting diode is on.
	LED Light emitting diode is flashing.

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
	Visual inspection

Symbols in graphics

Symbol	Meaning
1, 2, 3, ...	Item numbers
1., 2., 3., ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections
	Hazardous area
	Safe area (non-hazardous area)
	Flow direction

Function and system design

Measuring principle

The measuring principle is based on the controlled generation of Coriolis forces. These forces are always present in a system when both translational and rotational movements are superimposed.

$F_c = 2 \cdot \Delta m\ (v \cdot \omega)$

F_c = Coriolis force

Δm = moving mass

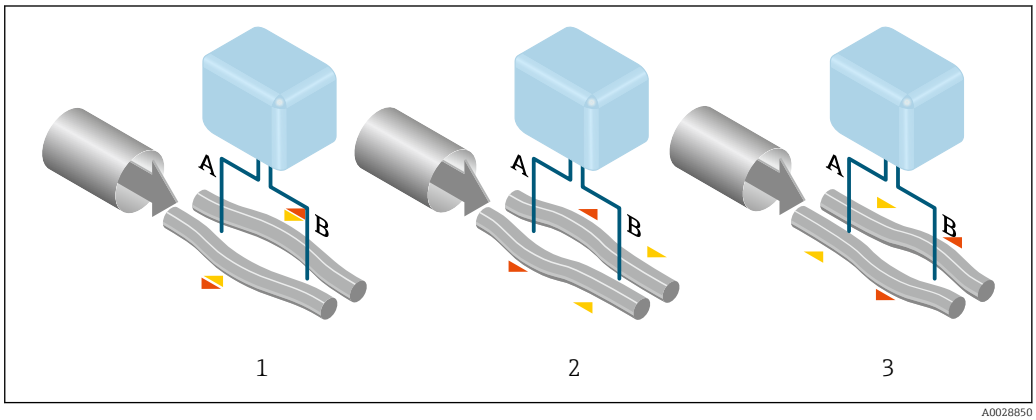
ω = rotational velocity

v = radial velocity in rotating or oscillating system

The amplitude of the Coriolis force depends on the moving mass Δm, its velocity v in the system and thus on the mass flow. Instead of a constant rotational velocity ω, the sensor uses oscillation.

In the sensor, two parallel measuring tubes containing flowing fluid oscillate in antiphase, acting like a tuning fork. The Coriolis forces produced at the measuring tubes cause a phase shift in the tube oscillations (see illustration):

- At zero flow (when the fluid is at a standstill) the two tubes oscillate in phase (1).
- Mass flow causes deceleration of the oscillation at the inlet of the tubes (2) and acceleration at the outlet (3).



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The phase difference (A-B) increases with increasing mass flow. Electrodynamic sensors register the tube oscillations at the inlet and outlet. System balance is ensured by the antiphase oscillation of the two measuring tubes. The measuring principle operates independently of temperature, pressure, viscosity, conductivity and flow profile.

Density measurement
The measuring tube is continuously excited at its resonance frequency. A change in the mass and thus the density of the oscillating system (comprising measuring tube and fluid) results in a corresponding, automatic adjustment in the oscillation frequency. The resonance frequency is thus a function of the medium density. The microprocessor utilizes this relationship to obtain a density signal.

Volume measurement
Together with the measured mass flow, this is used to calculate the volume flow.

Temperature measurement
The temperature of the measuring tube is determined in order to calculate the compensation factor due to temperature effects. This signal corresponds to the process temperature and is also available as an output signal.

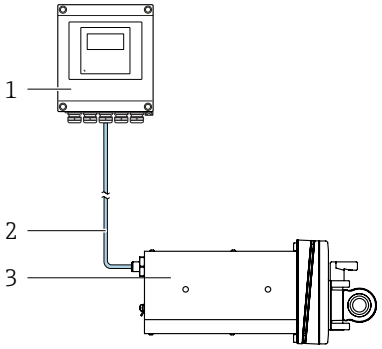
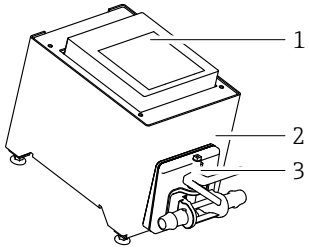
Measuring system

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

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

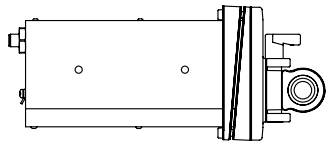
Proline 500 – digital transmitter

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

Order code for "Device version", option **NA** "Front panel mounting"	Order code for "Device version", option **NE** "Table version"
 *1 Transmitter* *2 Connecting cable: cable, separate, standard* *3 Sensor* - Front panel mounting for compact installation in systems - Transmitter installation in the protected area - GMP-compliant mounting and cleanability - Sensor for disposable measuring tube DN 4 to 25 (⅛ to 1 ")	 *1 Transmitter* *2 Table version* *3 Sensor* - Compact table unit for stand-alone operation - Sensor for disposable measuring tube DN 4 to 25 (⅛ to 1 ")
Connecting cable	
Can be ordered in various lengths → 🖹 57	-
- Length: Max. 300 m (1 000 ft) - Standard cable with common shield (pair-stranded)	-
Housing versions and materials	
- Transmitter housing Aluminum, coated: aluminum, AlSi10Mg, coated - Material of window in transmitter housing Aluminum, coated: glass	
Configuration	

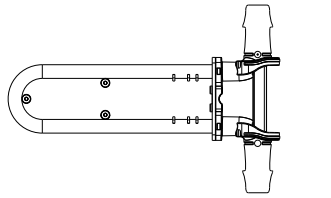
- External operation via 4-line, illuminated graphic local display (LCD) with touch control and guided menus ("Make-it-run" wizards) for application-specific commissioning.
- Via service interface or WLAN interface:
  - Operating tools (e.g. FieldCare, DeviceCare)
  - Web server (access via web browser, e.g. Microsoft Edge)	

Sensor


A0052967

- Nominal diameter range: DN 4 to 25 (⅛ to 1 ")
- Materials:
  - Stainless steel
  - Cast: 1.4409 CF3M - ASTM A 351
  - Seals: EPDM
  - Glass infrared scanner: Silicon optical window
  - Glass camera: Float glass
  - Coil holder: PA6-GF30
  - Wedge: Polycarbonate

Disposable measuring tube


A0052968

- Bent dual-tube system
- Excellent performance across a wide range of applications
- Simultaneous measurement of flow, volume flow, density and temperature (multivariable)
- Nominal diameter range: DN 4 to 25 (⅛ to 1 ")

Materials

- Disposable measuring tube:
  - Measuring tubes: stainless steel 1.4435, 316L
  - Process connections: Makrolon Rx 1805 polycarbonate
  - O-ring: Silicon
- Packaging:
  - Protection blister: PET-G
  - Peel pouch: PET-OPA-PE
  - Double pouch: HDPE

Reliability

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.

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 → 🖹 9	Not enabled	On an individual basis following risk assessment
Access code (also applies to web server login or FieldCare connection) → 🖹 9	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) → 🖹 9	Serial number	Assign an individual WLAN passphrase during commissioning
WLAN mode	Access point	On an individual basis following risk assessment
Web server → 🖹 9	Enabled	On an individual basis following risk assessment
CDI-RJ45 service interface → 🖹 9	–	On an individual basis following risk assessment

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.

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.

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, 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.

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.

Access via web server

The device can be operated and configured via a web browser with the integrated web server. 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.

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

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.

Input

Measured variable

Direct measured variables

- Mass flow
- Density
- Temperature

Calculated measured variables

- Volume flow
- Corrected volume flow
- Reference density

Measuring range

Measuring range for liquids

Full scale value defined at 0.2 bar pressure loss

DN		Measuring range full scale values $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[in]	[kg/min]	[lb/min]
4	1/8	0 to 2	0 to 4.4
6	1/4	0 to 4.8	0 to 10.6
15	1/2	0 to 28.6	0 to 63.1
25	1	0 to 75	0 to 165.3

Recommended measuring range

Flow limit → 40

Operable flow range

Over 1000 : 1.

Flow rates above the preset full scale value do not override the electronics unit, with the result that the totalizer values are registered correctly.

Input signal

Output and input variants

→ 13

External measured values

To increase the measurement accuracy of certain measured variables, the automation system can continuously write various measured values to the measuring device:
- Operating pressure to increase measurement accuracy (Endress+Hauser recommends the use of a pressure measuring device for absolute pressure)
- Medium temperature to increase measurement accuracy

Current input

The measured values are written from the automation system to the measuring device via the current input → 11.

Digital communication

The measured values can be written by the automation system via:
- Modbus RS485
- PROFINET with Ethernet-APL/SPE

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 ▪ Density

Status input

Maximum input values	▪ DC −3 to 30 V ▪ If status input is active (ON): R_i >3 kΩ
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

Output

Output and input variants

Depending on the option selected for output/input 1, different options are available for the other outputs and inputs. Only one option can be selected for each output/input 1 to 4. The following tables must be read vertically (↓).

Output/input 1 and options for output/input 2

Options for output/input 3 and 4 → 14

Order code for "Output; input 1" (020) →	Possible options												
Modbus RS485								↓	**MA**				
PROFINET over Ethernet-APL/SPE											↓	**RB**	
Order code for "Output; input 2" (021) →	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Not used	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**
Current output 4 to 20 mA	**B**			**B**		**B**	**B**		**B**	**B**	**B**	**B**	
User-configurable input/output [1] a user-configurable input/output.→ 18	**D**			**D**		**D**	**D**		**D**	**D**	**D**	**D**	
Pulse/frequency/switch output	**E**			**E**		**E**	**E**		**E**	**E**	**E**	**E**	
Relay output	**H**			**H**		**H**	**H**		**H**	**H**	**H**	**H**	
Current input 0/4 to 20 mA	**I**			**I**		**I**	**I**		**I**	**I**	**I**	**I**	
Status input	**J**			**J**		**J**	**J**		**J**	**J**	**J**	**J**	

1) A specific input or output can be assigned to

Output/input 1 and options for output/input 3 and 4

Options for output/input 2 → 13

Order code for "Output; input 1" (020) →	Possible options												
Modbus RS485								↓	**MA**				
PROFINET over Ethernet-APL/SPE, 10 Mbit/s, 2-wire											↓	**RB**	
Order code for "Output; input 3" (022), "Output; input 4" (023) [1] →	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Not used	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**
Current output 4 to 20 mA	**B**					**B**			**B**	**B**	**B**	**B**	
User-configurable input/output	**D**					**D**			**D**	**D**	**D**	**D**	
Pulse/frequency/switch output	**E**					**E**			**E**	**E**	**E**	**E**	
Relay output	**H**					**H**			**H**	**H**	**H**	**H**	
Current input 0/4 to 20 mA	**I**					**I**			**I**	**I**	**I**	**I**	
Status input	**J**					**J**			**J**	**J**	**J**	**J**	

1) The order code for "Output; input 4" (023) is only available for the Proline 500-digital transmitter, order code for "Integrated ISEM electronics", option A.

Output signal

Modbus RS485

Physical interface	RS485 in accordance with EIA/TIA-485 standard
Terminating resistor	Integrated, can be activated via DIP switches

PROFINET with Ethernet-APL/SPE

Device use	**Device connection to an APL field switch** The device may only be operated according to the following APL port classifications: If used in non-hazardous areas: SLAX **Device connection to an SPE switch** ▪ In non-hazardous areas, the device can be used with an appropriate SPE switch: The device can be connected to an SPE switch with a maximum voltage of 30 V_{DC} and a minimum output power of 1.85 W connected. ▪ The SPE switch must support the 10BASE-T1L standard and PoDL power classes 10, 11 or 12 and have a function to disable power class detection.
PROFINET	According to IEC 61158 and IEC 61784
Ethernet-APL/SPE	According to IEEE 802.3cg, APL port profile specification v1.0, galvanically isolated
Data transmission	10 Mbit/s
Current consumption	**Transmitter** ▪ Max. 400 mA(24 V) ▪ Max. 200 mA (110 V, 50/60 Hz; 230 V, 50/60 Hz)
Permitted supply voltage	9 to 30 V
Network connection	With integrated reverse polarity protection

Current output 4 to 20 mA

Signal mode	Can be set to: ▪ Active ▪ Passive
Current range	Can be set to: ▪ 4 to 20 mA NAMUR ▪ 4 to 20 mA US ▪ 4 to 20 mA ▪ 0 to 20 mA (only if the signal mode is active) ▪ Fixed current
Maximum output values	22.5 mA
Open-circuit voltage	DC 28.8 V (active)
Maximum input voltage	DC 30 V (passive)
Load	0 to 700 Ω
Resolution	0.38 µA

Damping	Configurable: 0 to 999.9 s
Assignable measured variables	▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature ▪ Electronics temperature ▪ Oscillation frequency 0 ▪ Oscillation damping 0 ▪ Signal asymmetry ▪ Exciter current 0 The range of options increases if the measuring device has one or more application packages.

Pulse/frequency/switch output

Function	Can be configured as pulse, frequency or switch output
Version	Open collector Can be set to: ▪ Active ▪ Passive ▪ Passive NAMUR Ex-i, passive
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Voltage drop	For 22.5 mA: ≤ DC 2 V
Pulse output	
Maximum input values	DC 30 V, 250 mA (passive)
Maximum output current	22.5 mA (active)
Open-circuit voltage	DC 28.8 V (active)
Pulse width	Configurable: 0.05 to 2 000 ms
Maximum pulse rate	10 000 Impulse/s
Pulse value	Configurable
Assignable measured variables	▪ Mass flow ▪ Volume flow ▪ Corrected volume flow The range of options increases if the measuring device has one or more application packages.
Frequency output	
Maximum input values	DC 30 V, 250 mA (passive)
Maximum output current	22.5 mA (active)
Open-circuit voltage	DC 28.8 V (active)
Output frequency	Configurable: end value frequency 2 to 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 ▪ Density ▪ Reference density ▪ Temperature ▪ Electronics temperature ▪ Oscillation frequency 0 ▪ Oscillation damping 0 ▪ Signal asymmetry ▪ Exciter current 0 The range of options increases if the measuring device has one or more application packages.
Switch output	
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s
Number of switching cycles	Unlimited

Assignable functions	▪ Disable
	▪ On
	▪ Diagnostic behavior
	▪ Limit
	  ▪ Mass flow
	  ▪ Volume flow
	  ▪ Corrected volume flow
	  ▪ Density
	  ▪ Reference density
	  ▪ Temperature
	  ▪ Totalizer 1-3
	▪ Flow direction monitoring
	▪ Status
	  ▪ Partially filled pipe detection
	  ▪ Low flow cut off
	The range of options increases if the measuring device has one or more application packages.

Double pulse output

Function	Double pulse
Version	Open collector Can be set to: ▪ Active ▪ Passive ▪ Passive NAMUR
Maximum input values	DC 30 V, 250 mA (passive)
Open-circuit voltage	DC 28.8 V (active)
Voltage drop	For 22.5 mA: ≤ DC 2 V
Output frequency	Configurable: 0 to 1 000 Hz
Damping	Configurable: 0 to 999 s

Pulse/pause ratio	1:1
Assignable measured variables	▪ Mass flow ▪ Volume flow ▪ Corrected volume flow ▪ Density ▪ Reference density ▪ Temperature The range of options increases if the measuring device has one or more application packages.

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	▪ Disable
	▪ On
	▪ Diagnostic behavior
	▪ Limit
	  ▪ Mass flow
	  ▪ Volume flow
	  ▪ Corrected volume flow
	  ▪ Density
	  ▪ Reference density
	  ▪ Temperature
	  ▪ Totalizer 1-3
	▪ Flow direction monitoring
	▪ Status
	  ▪ Partially filled pipe detection
	  ▪ Low flow cut off
	The range of options increases if the measuring device has one or more application packages.

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

The technical values correspond to those of the inputs and outputs described in this section.

Signal on alarm

Depending on the interface, failure information is displayed as follows:

PROFINET with Ethernet-APL/SPE

Device diagnostics	Diagnostics according to PROFINET PA Profile 4

Modbus RS485

Failure mode	Choose from: ▪ NaN value instead of current value ▪ Last valid value

Current output 0/4 to 20 mA

4 to 20 mA

Failure mode	Choose from: ▪ 4 to 20 mA in accordance with NAMUR recommendation NE 43 ▪ 4 to 20 mA in accordance with US ▪ Min. value: 3.59 mA ▪ Max. value: 22.5 mA ▪ Definable value between: 3.59 to 22.5 mA ▪ Actual value ▪ Last valid value

0 to 20 mA

Failure mode	Choose from: ▪ Maximum alarm: 22 mA ▪ Definable value between: 0 to 20.5 mA

Pulse/frequency/switch output

Pulse output	
Fault mode	Choose from: ▪ Actual value ▪ No pulses
Frequency output	
Fault mode	Choose from: ▪ Actual value ▪ 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
  - Modbus TCP with Ethernet-APL/SPE
  - PROFINET with Ethernet-APL/SPE
- Via service interface
  - CDI-RJ45 service interface
  - WLAN interface

Plain text display	With information on cause and remedial measures

Web browser

Plain text display	With information on cause and remedial measures

Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: ▪ Supply voltage active ▪ Data transmission active ▪ Device alarm/error has occurred ▪ PROFINET network available ▪ PROFINET connection established ▪ PROFINET blinking feature

Load

Output signal → 15

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

Modbus RS485

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: Operating Instructions → 59. ▪ Modbus RS485 information ▪ Function codes ▪ Register information ▪ Response time ▪ Modbus data map

PROFINET with Ethernet-APL /SPE

Protocol	Application layer protocol for decentral device periphery and distributed automation, Version 2.43
Communication type	Ethernet Advanced Physical Layer 10BASE-T1L
Conformance Class	Conformance Class B (PA)
Netload Class	PROFINET Netload Robustness Class 2 10 Mbit/s
Baud rates	10 Mbit/s Full-duplex
Cycle times	64 ms
Polarity	Automatic correction of crossed "APL signal +" and "APL signal -" signal lines
Media Redundancy Protocol (MRP)	Not possible (point-to-point connection to APL field switch)
System redundancy support	System redundancy S2 (2 AR with 1 NAP)
Device profile	PROFINET PA profile 4 (Application interface identifier API: 0x9700)
Manufacturer ID	17
Device type ID	0xA43B
Device description files (GSD, DTM, FDI)	Information and files available at: ▪ www.endress.com → Downloads section ▪ www.profibus.com
Supported connections	▪ 2x AR (IO Controller AR) ▪ 2x AR (IO Supervisor Device AR connection allowed)
Configuration options for measuring device	▪ DIP switches on the electronics module, for device name assignment (last part) ▪ Asset management software (FieldCare, DeviceCare, Field Xpert) ▪ Integrated Web server via Web browser and IP address ▪ Device master file (GSD), can be read out via the integrated Web server of the measuring device. ▪ Onsite operation
Configuration of the device name	▪ DIP switches on the electronics module, for device name assignment (last part) ▪ DCP protocol ▪ Asset management software (FieldCare, DeviceCare, Field Xpert) ▪ Integrated Web server

Supported functions	▪ Identification & Maintenance, simple device identifier via:
	  ▪ Control system
	  ▪ Nameplate
	▪ Measured value status
	The process variables are communicated with a measured value status
	▪ Blinking feature via the local display for simple device identification and assignment
	▪ Device operation via asset management software (e.g. FieldCare, DeviceCare, SIMATIC PDM with FDI package)

System integration	Information regarding system integration: Operating Instructions → 🖹 59. ▪ Cyclic data transmission ▪ Overview and description of the modules ▪ Status coding ▪ Factory setting

Energy supply

Terminal assignment

Transmitter: supply voltage, input/outputs

Modbus RS485

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 (–)
		The terminal assignment depends on the specific device version ordered → 🖹 13.							

Modbus TCP with Ethernet-APL /SPE

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 (–)
		The terminal assignment depends on the specific device version ordered → 🖹 13.							

PROFINET with Ethernet-APL /SPE

Supply voltage		Input/output 1		Input/output 2		Input/output 3		Input/output 4	
1 (+)	2 (–)	26 (+)	27 (–)	24 (+)	25 (–)	22 (+)	23 (–)	20 (+)	21 (–)
		The terminal assignment depends on the specific device version ordered → 🖹 13.							

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 → 🖹 24

Available device plugs

Device plugs for fieldbus systems:
Order code for "Input; output 1"
Option **RB** "PROFINET with Ethernet-APL/SPE" → 🖹 23

Device plug for connecting to the service interface:
Order code for "Accessory mounted"
Option **NB**, RJ45 M12 adapter (service interface) → 🖹 23

Order code for "Input; output 1", option RB "PROFINET with Ethernet-APL/SPE"

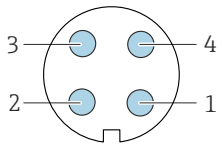
Order code "Electrical connection"	Cable entry/connection → 🖹 25	
	2	3
L, N, P, U	M12 plug × 1	–

Order code for "Accessory mounted", option NB "Adapter RJ45 M12 (service interface)"

Order code "Accessory mounted"	Cable entry/coupling → 🖹 25	
	Cable entry 2	Cable entry 3
NB	Plug M12 × 1	–

Pin assignment, device plug

PROFINET with Ethernet-APL /SPE



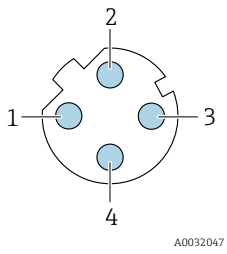
Pin	Assignment	Coding	Plug/socket
1	APL signal -	A	Socket
2	APL signal +		
3	Cable shield[1]		
4	Not used		
Metal plug housing	Cable shield		

[1] If a cable shield is used

Recommended plug:
- Binder, series 713, part no. 99 1430 814 04
- Phoenix, part no. 1413934 SACC-FS-4QO SH PBPA SCO

Service interface for

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



Pin		Assignment
1	+	Tx
2	+	Rx
3	-	Tx
4	-	Rx
Coding		**Plug/socket**
D		Socket

Recommended plug:
- Binder, series 825, part no. 99 3729 810 04
- Phoenix, part no. 1543223 SACC-M12MSD-4Q

Supply voltage

Order code "Power supply"	Terminal voltage		Frequency range
Option **I**	DC 24 V	±20%	–
	AC 100 to 240 V	−15…+10%	50/60 Hz

Power consumption

Transmitter

Max. 10 W (active power)

switch-on current	Max. 36 A (<5 ms) as per NAMUR Recommendation NE 21

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.

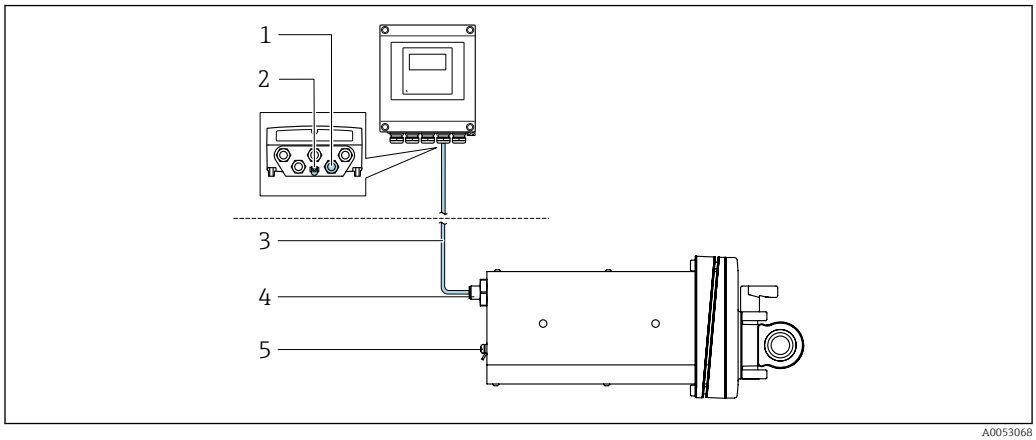
Overcurrent protection element

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.

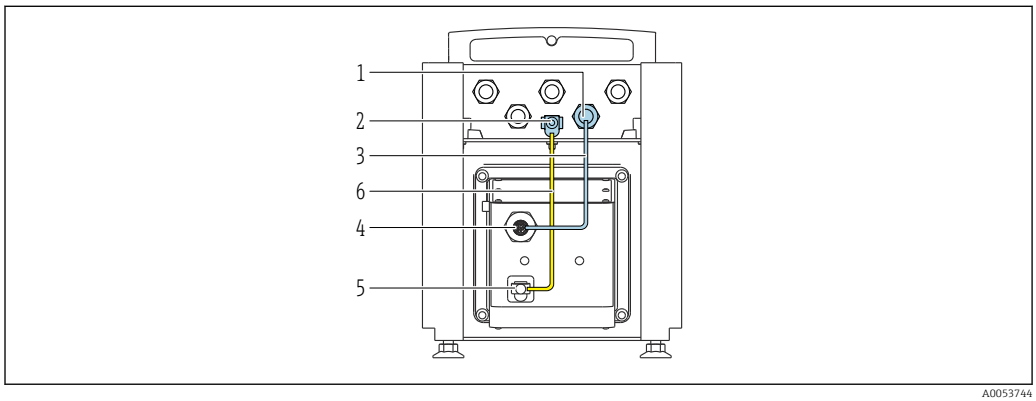
Electrical connection

Connection of connecting cable: Proline 500 – digital



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

1 M12 socket for fitting the connecting cable to the transmitter housing
2 Terminal connection for potential equalization (PE)
3 Connecting cable with M12 plug and M12 socket
4 M12 plug for fitting the connecting cable to the sensor
5 Terminal connection for potential equalization (PE)

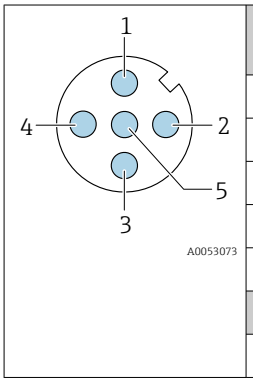


2 Order code for "Device version", option NE "Table version"

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

Pin assignment, device plug

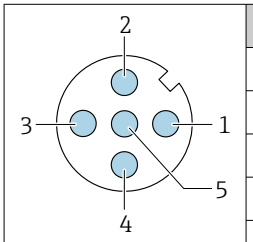
Connection at the transmitter



Pin	Color [1]	Assignment		Connection to terminal
1	Brown	+	Supply voltage	61
2	White	-		62
3	Blue	B	ISEM communication	63
4	Black	A		64
5	–		–	–
Coding		**Plug/socket**		
A		Socket		

1) Cable colors of connecting cable

Connection at the sensor



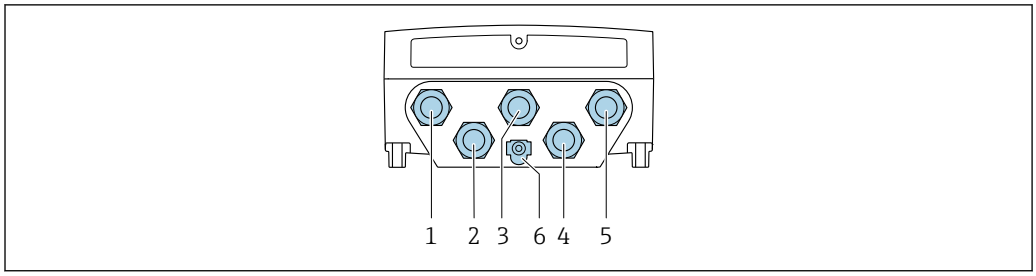
Pin	Color [1]	Assignment	
1	Brown	+	Supply voltage
2	White	-	
3	Blue	B	ISEM communication
4	Black	A	
5	–		–
Coding		**Plug/socket**	
A		Plug	

1) Cable colors of connecting cable

Transmitter connection

- Terminal assignment → 22
- Device plug pin assignment → 23

Transmitter connection: Proline 500 – digital



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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 *Terminal connection for potential equalization (PE)*

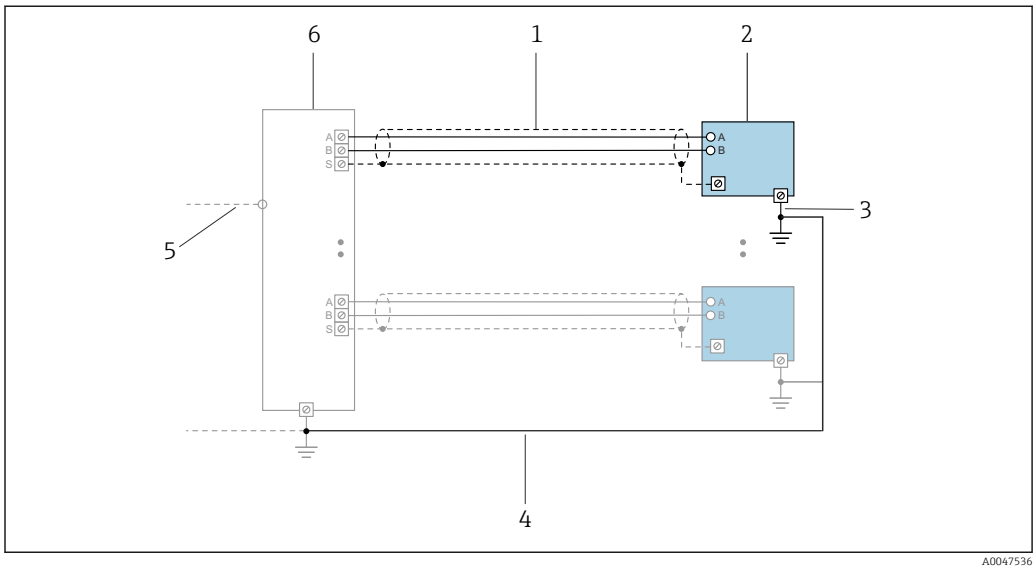
An adapter for the RJ45 to the M12 plug is optionally available:
Order code for "Accessories", option **NB**: "Adapter RJ45 M12 (service interface)"

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

Network connection (DHCP client) via service interface (CDI-RJ45) → 51

Connection examples

PROFINET with Ethernet-APL/SPE



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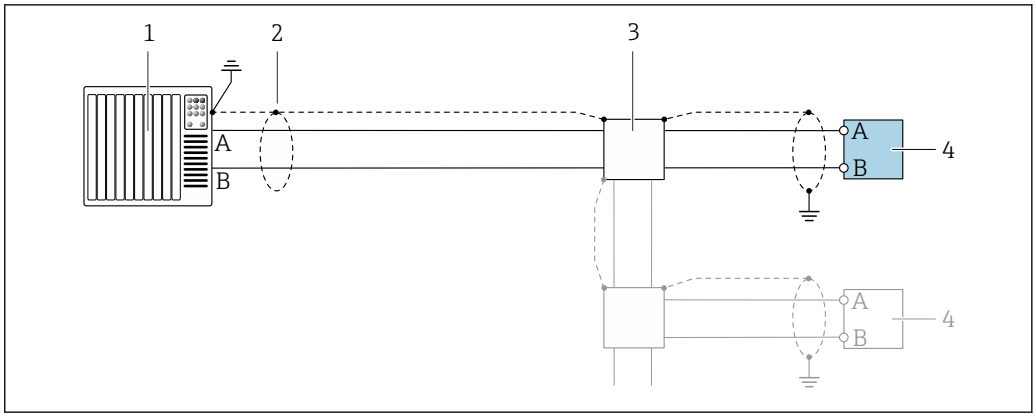
3 *Connection example for PROFINET with Ethernet-APL*

1 *Cable shield*
2 *Measuring device*
3 *Local grounding*
4 *Potential equalization*
5 *Trunk or TCP*
6 *Field switch*

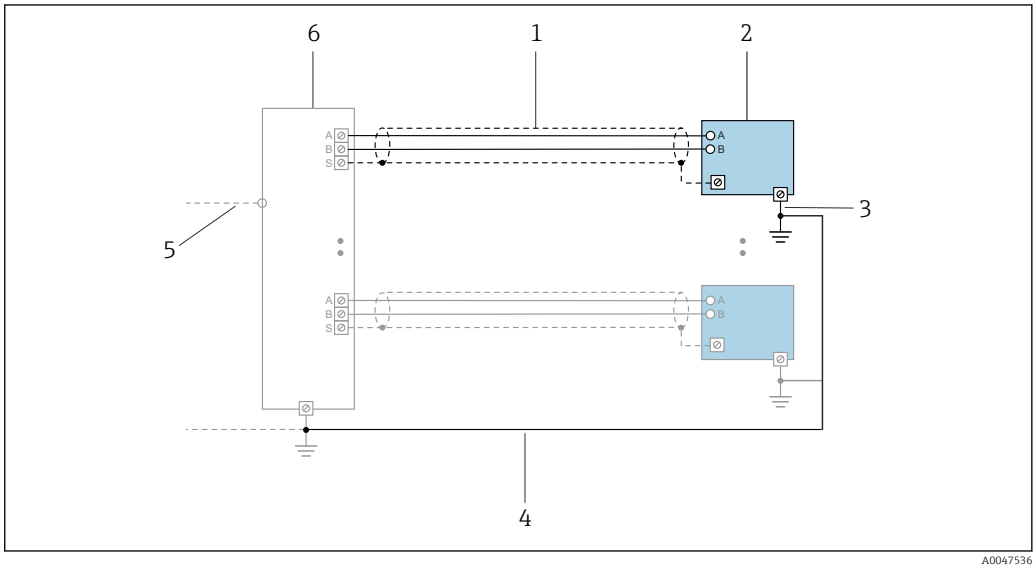
Modbus RS485



4 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*

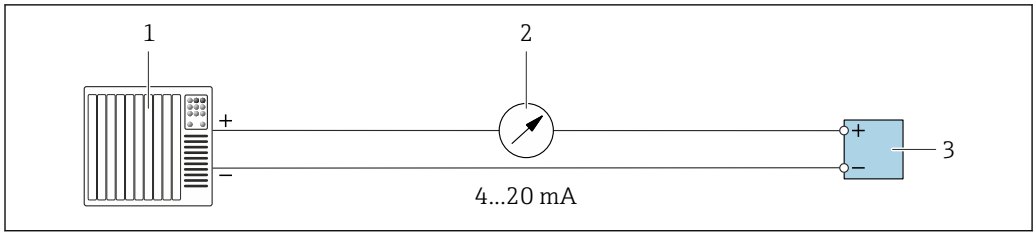
Modbus with TCP-APL



5 Connection example for Modbus with TCP-APL

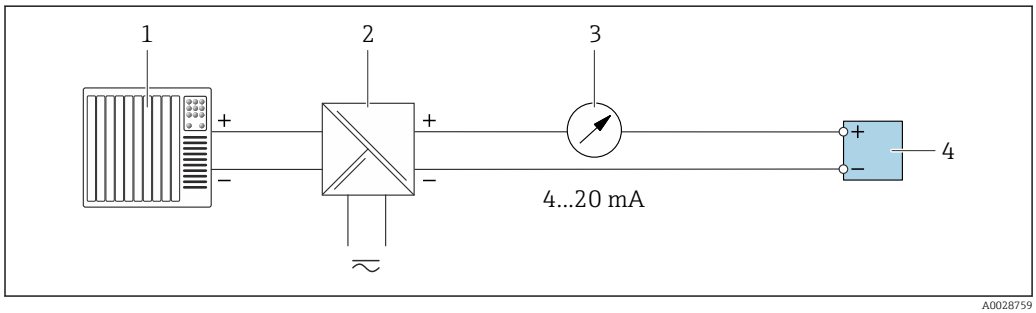
1 *Cable shield*
2 *Measuring device*
3 *Local grounding*
4 *Potential equalization*
5 *Trunk or TCP*
6 *Field switch*

Current output 4-20 mA



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

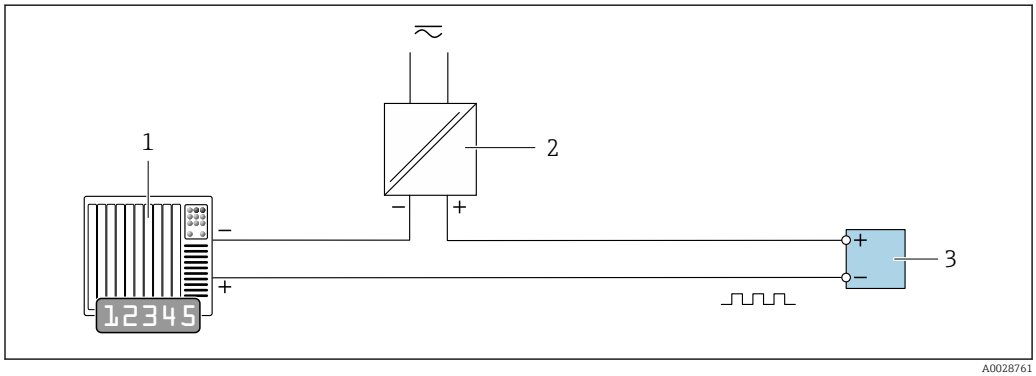
1 Automation system with current input (e.g. PLC)
2 Analog display unit: observe maximum load
3 Transmitter



7 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

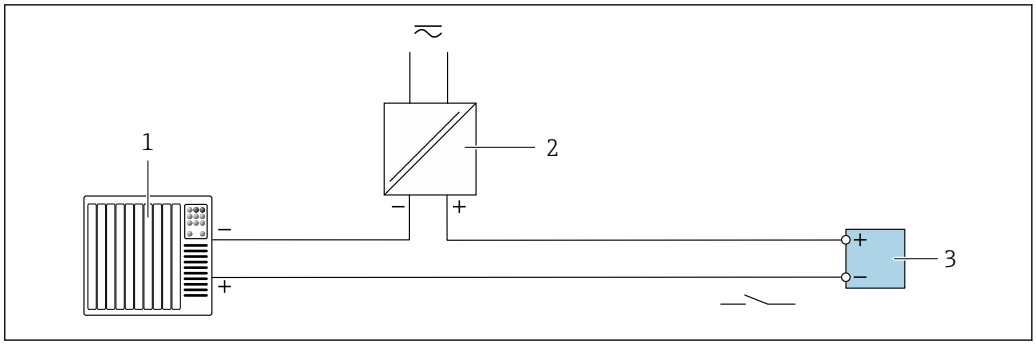
Pulse/frequency output



8 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 → 16

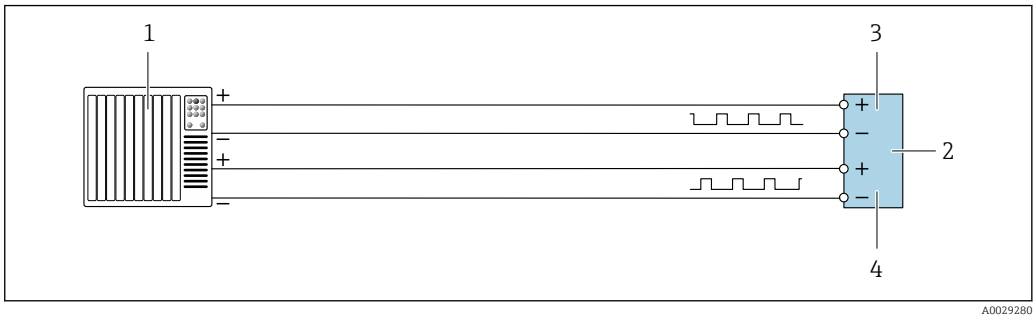
Switch output



9 Connection example for switch output (passive)

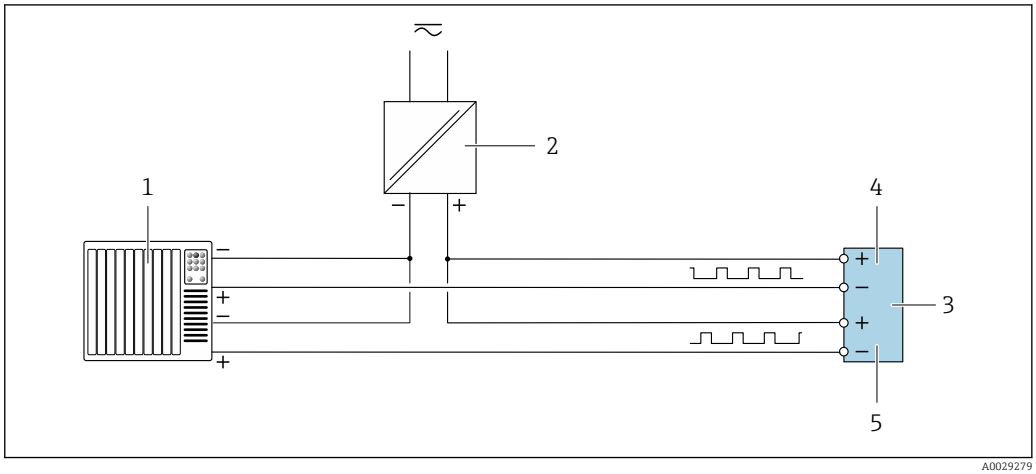
1 Automation system with switch input (e.g. PLC with a 10 kΩ pull-up or pull-down resistor)
2 Power supply
3 Transmitter: observe input values → 16

Double pulse output



10 Connection example for double pulse output (active)

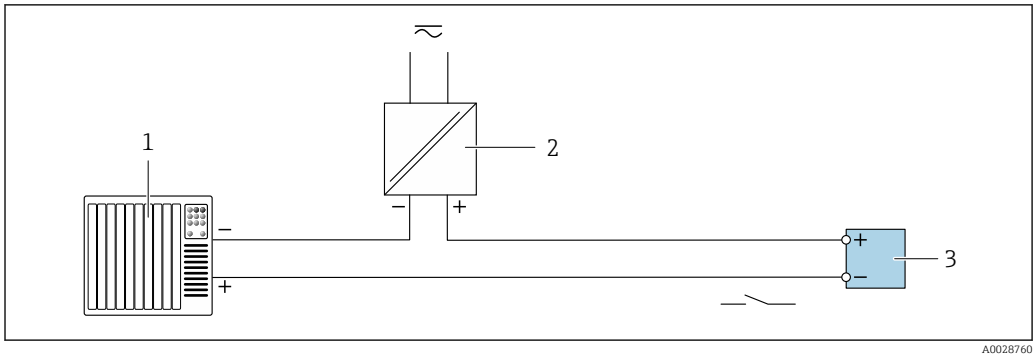
1 Automation system with double pulse input (e.g. PLC)
2 Transmitter: observe input values → 17
3 Double pulse output
4 Double pulse output (slave), phase-shifted



11 Connection example for double pulse output (passive)

1 Automation system with double pulse input (e.g. PLC with a 10 kΩ pull-up or pull-down resistor)
2 Power supply
3 Transmitter: observe input values → 17
4 Double pulse output
5 Double pulse output (slave), phase-shifted

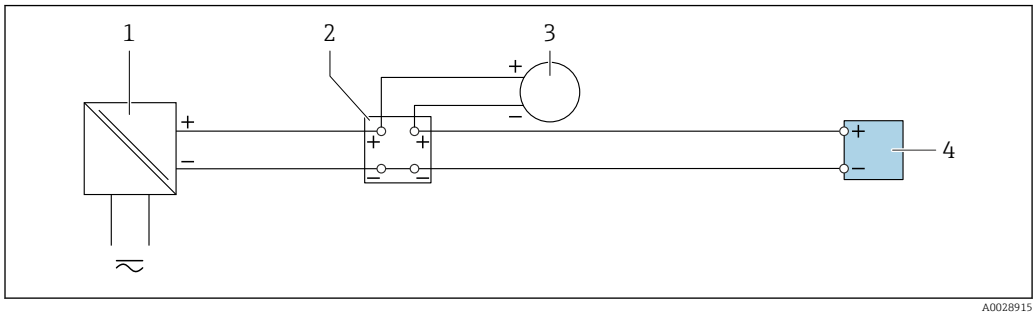
Relay output



12 Connection example for relay output (passive)

1 Automation system with relay input (e.g. PLC)
2 Power supply
3 Transmitter: observe input values → 18

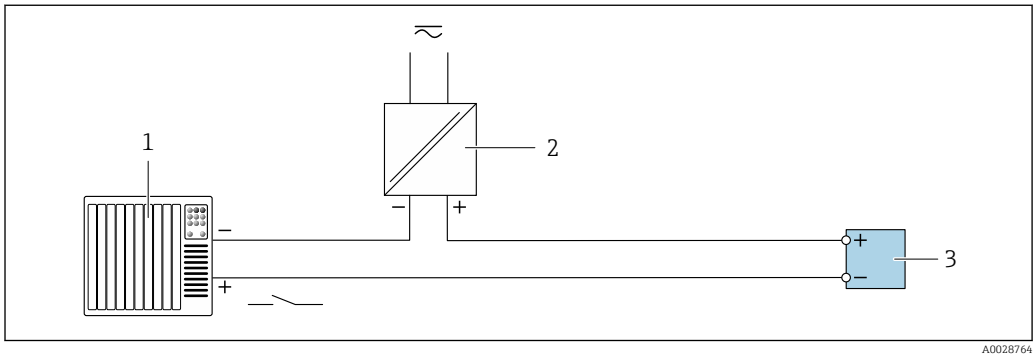
Current input



13 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



14 Connection example for status input

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

Potential equalization

Requirements

For potential equalization:
- Pay attention to in-house grounding concepts
- Take account of operating conditions like the pipe material and grounding
- Medium, Connect the sensor and transmitter to the same electric potential [1)]
- Use a ground cable with a minimum cross-section of 6 mm^2 (10 AWG) and a cable lug for potential equalization connections

Terminals

Spring-loaded terminals: Suitable for strands and strands with ferrules.
Conductor cross-section 0.2 to 2.5 mm^2 (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

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.

Protective grounding cable for the outer ground terminal

Conductor cross-section < 2.1 mm^2 (14 AWG)

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

The grounding impedance must be less than 2 Ω.

Signal cable

PROFINET with Ethernet-APL/SPE

The reference cable type for APL segments is fieldbus cable type A, MAU type 1 and 3 (specified in IEC 61158-2). This cable meets the requirements for intrinsically safe applications according to IEC TS 60079-47 and can also be used in non-intrinsically safe applications.

Cable type	A
Cable capacitance	45 to 200 nF/km
Loop resistance	15 to 150 Ω/km
Cable inductance	0.4 to 1 mH/km

Further details are provided in the Ethernet-APL/SPE Engineering Guideline (https://www.ethernet-apl.org).

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 pF/m
Wire cross-section	> 0.34 mm^2 (22 AWG)

1) Order code for "Device version", option NE "Table version": Sensor and transmitter are wired internally.

Cable type	Twisted pairs
Loop resistance	≤110 Ω/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.

Modbus TCP-APL

Twisted, shielded two-wire cable. Cable type A is recommended .

The cable parameters are required for use in a 2-WISE intrinsically safe system.

Cable type	A
Cable capacitance	45 to 200 nF/km
Loop resistance	15 to 150 Ω/km
Inductance	0.4 to 1 mH/km

Current output 0/4 to 20 mA

Standard installation cable is sufficient.

Pulse /frequency /switch output

Standard installation cable is sufficient.

Double pulse 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.

Choice of connecting cable between the transmitter and sensor

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

Standard cable

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

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

Cross-section	Cable length [max.]
0.34 mm² (AWG 22)	80 m (240 ft)
0.50 mm² (AWG 20)	120 m (360 ft)
0.75 mm² (AWG 18)	180 m (540 ft)
1.00 mm² (AWG 17)	240 m (720 ft)
1.50 mm² (AWG 15)	300 m (900 ft)

connecting cable

Design	2 × 2 × 0.34 mm² PUR cable with common shield
Flame resistance	According to DIN EN 60332-1-2 (60 seconds)
Oil resistance	According to DIN EN 60811-2-1 (for 168h at 90°C)
Shield	Tin-plated copper braid
Continuous operating temperature	When mounted in a fixed position: –40 to +105 °C (–40 to +221 °F); when cable can move freely: –25 to +105 °C (–13 to +221 °F)
Available cable lengths	Fixed: 2 m (6 ft), 5 m (15 ft), 10 m (30 ft)
Device plug, side 1	M12 socket, 5-pin, A-coded
Device plug, side 2	M12 plug, 5-pin, A-coded

Overvoltage protection

Mains voltage fluctuations	→ 🖹 23
Overvoltage category	Overvoltage category II
Short-term, temporary overvoltage	Between cable and ground up to 1200 V, for max. 5 s
Long-term, temporary overvoltage	Between cable and ground up to 500 V

Performance characteristics

Reference operating conditions

- Error limits based on ISO 11631
- Water
  - +15 to +45 °C (+59 to +113 °F)
  - 2 to 6 bar (29 to 87 psi)
- Data as indicated in the calibration protocol
- Accuracy based on accredited calibration rigs according to ISO 17025

To obtain measured errors, use the *Applicator* sizing tool → 🖹 58

Maximum measurement error

o.r. = of reading; 1 g/cm³ = 1 kg/l; T = medium temperature

In non-condensing environment.

Base accuracy

Design fundamentals → 🖹 35

Mass flow and volume flow (liquids)

±0.5 % o.r.

Temperature

±2.5 °C (±4.5 °F)

Zero point stability

DN		Zero point stability	
[mm]	[in]	[kg/min]	[lb/min]
4	1/8	0.0006	0.00132
6	1/4	0.0023	0.00507
15	1/2	0.0082	0.01808
25	1	0.0227	0.05004

Flow values

Flow values as turndown parameters depending on nominal diameter.

SI units

DN	1:1	1:10	1:20	1:50	1:100	1:500
[mm]	[kg/min]	[kg/min]	[kg/min]	[kg/min]	[kg/min]	[kg/min]
4	450	45	22.5	9	4.5	0.9
6	1000	100	50	20	10	2
15	6500	650	325	130	65	13
25	18000	1800	900	360	180	36

US units

DN	1:1	1:10	1:20	1:50	1:100	1:500
[inch]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]
1/8	16.54	1.654	0.827	0.331	0.165	0.033
1/4	36.75	3.675	1.838	0.735	0.368	0.074
1/2	238.9	23.89	11.95	4.778	2.389	0.478
1	661.5	66.15	33.08	13.23	6.615	1.323

Accuracy of outputs

The outputs have the following base accuracy specifications.

Current output

Accuracy	±5 µA

Pulse/frequency output

o.r. = of reading

Accuracy	Max. ±50 ppm o.r. (over the entire ambient temperature range)

Repeatability

o.r. = of reading; 1 g/cm^3 = 1 kg/l; T = medium temperature

Base repeatability

Design fundamentals → 35

Mass flow and volume flow (liquids)

±0.25 % o.r.

Density (liquids)

- Basic accuracy:
  ±0.01 g/cm³
- Repeatability:
  ±0.005 g/cm³

Temperature

±0.125 °C (±0.225 °F)

Response time

The response time depends on the configuration (damping).

Influence of ambient temperature

Current output

Temperature coefficient	Max. 1 µA/°C

Pulse/frequency output

Temperature coefficient	No additional effect. Included in accuracy.

Influence of medium temperature

Mass flow

o.f.s. = of full scale value

If there is a difference between the temperature during zero adjustment and the process temperature, the additional measurement error of the sensors is typically ±0.0002 %o.f.s./°C (±0.0001 % o. f.s./°F).

The influence is reduced when the zero adjustment is performed at process temperature.

Density
Density performance is identical across the entire temperature range.

Temperature
±0.005 · T °C (± 0.005 · (T − 32) °F)

Influence of medium pressure

A difference between the calibration pressure and process pressure does not affect accuracy.

A pressure of >0.2 bar is required for accurate measurement. Pressures lower than this can lead to incorrect measurement results due to cavitation and the formation of air bubbles.

Design fundamentals

o.r. = of reading, o.f.s. = of full scale value

BaseAccu = base accuracy in % o.r., BaseRepeat = base repeatability in % o.r.

MeasValue = measured value; ZeroPoint = zero point stability

Calculation of the maximum measured error as a function of the flow rate

Flow rate	Maximum measured error in % o.r.
$\geq \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A0021332	$\pm$ BaseAccu A0021339
$< \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A0021333	$\pm \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021334

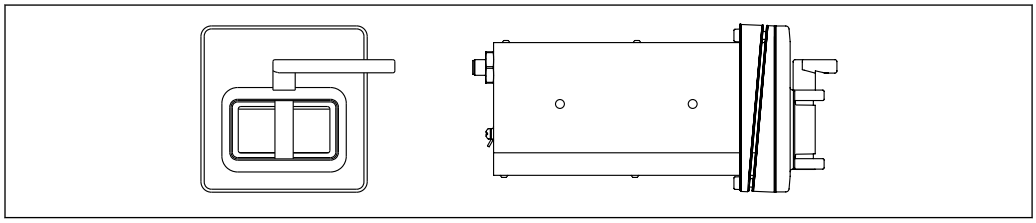
Calculation of the maximum repeatability as a function of the flow rate

Flow rate	Maximum repeatability in % o.r.
$\geq \frac{½ \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021335	± BaseRepeat A0021340
$< \frac{½ \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021336	$\pm ½ \cdot \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021337

Mounting

Installation point

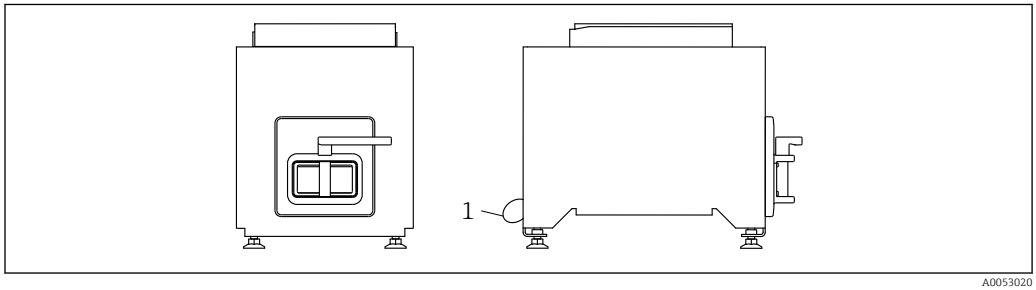
Front panel mounting



A0053021

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

Table version

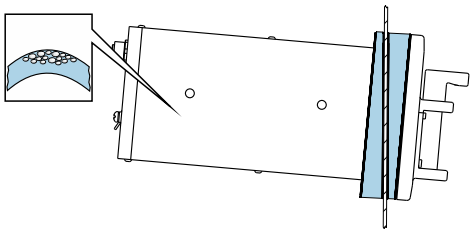
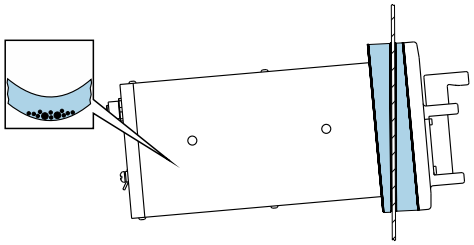


A0053020

16 Order code for "Device version", option NE "Table version"

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

Orientation

Orientation	
Wedge pointing upwards Gas accumulation in the measuring tube possible. Self-draining.	 A0053028
Wedge pointing downwards Recommended orientation Solids accumulation in the measuring tube possible.	 A0053029

Inlet and outlet runs

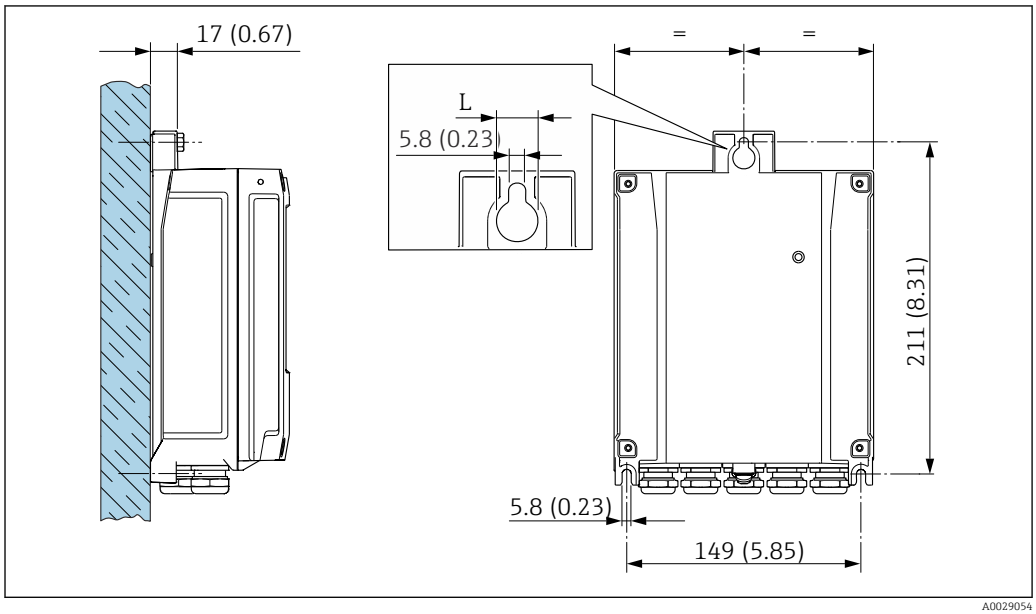
No special precautions need to be taken for fittings that create turbulence, such as valves, elbows or T-pieces, as long as no cavitation occurs → 🖹 40.

Mounting the transmitter housing

Proline 500 – digital transmitter

Wall mounting

Required tools:
Drill with drill bit ⌀ 6.0 mm



17 *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)

Special mounting instructions

Drainability

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

Sterility

When installing in sterile applications, please refer to the information in the "Certificates and approvals/sterility" section → 54

Biotech

When installing in biotech applications, please refer to the information in the "Certificates and approvals/biotech" section → 54

Environment

Ambient temperature range

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

Dependency of ambient temperature on medium temperature → 40

Storage temperature

–40 to +70 °C (–40 to +158 °F)

Shelf life	Disposable measuring tube ▪ Maximum 5 years pre-gamma ▪ Maximum 2 years post-gamma
Climate class	DIN EN 60068-2-38 (test Z/AD)
Relative humidity	The device is suitable for indoor use with a relative humidity of 5 to 40 %.
Operating height	According to EN 61010-1 ▪ ≤ 2 000 m (6 562 ft) ▪ > 2 000 m (6 562 ft) with additional overvoltage protection (e.g. Endress+Hauser HAW Series)
Degree of protection	**Transmitter** ▪ IP66/67, Type 4X enclosure, suitable for pollution degree 4 ▪ When the housing is open: IP20, Type 1 enclosure, suitable for pollution degree 2 ▪ Display module: IP20, Type 1 enclosure, suitable for pollution degree 2 **Sensor** ▪ IP54 ▪ With housing open: IP20 **External WLAN antenna** IP67
Shock and vibration resistance	**Vibration sinusoidal, in accordance with IEC 60068-2-6** Sensor ▪ 2 to 8.4 Hz, 3.5 mm peak ▪ 8.4 to 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** Transmitter ▪ 10 to 200 Hz, 0.01 g^2/Hz ▪ 200 to 2 000 Hz, 0.003 g^2/Hz ▪ Total: 2.70 g rms **Shock half-sine, according to IEC 60068-2-27** Transmitter 6 ms 50 g **Rough handling shocks according to IEC 60068-2-31**
Mechanical load	Transmitter housing, sensor and disposable measuring tube: ▪ Protect against mechanical effects, such as shock or impact ▪ Do not use as a ladder or climbing aid
Electromagnetic compatibility (EMC)	As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21) 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.

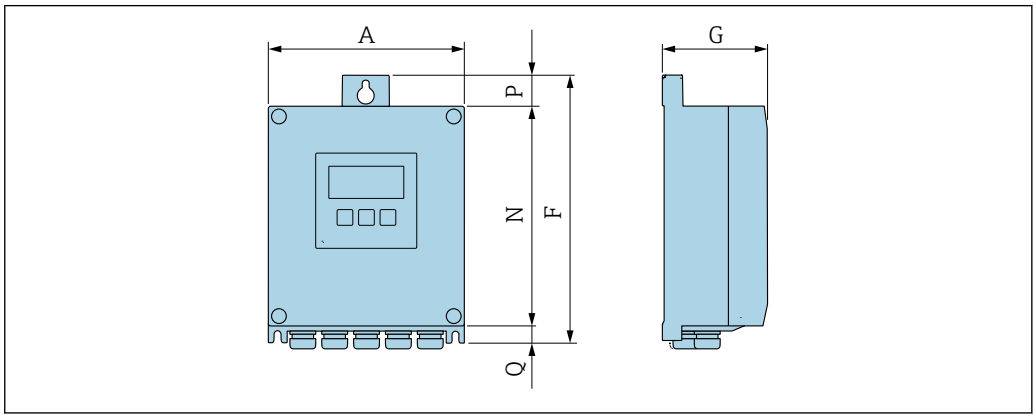
Process

Medium temperature range	3 to 60 °C (37.4 to 140 °F)
Medium density	800 to 1 500 kg/m³ (1 764 to 3 307 lb/cf)
Medium pressure	6 bar (87 psi)
Flow limit	Select the nominal diameter by optimizing between the required flow range and permissible pressure loss. For an overview of the full scale values for the measuring range, see the "Measuring range" section → 11 ▪ The minimum recommended full scale value is approx. 1/20 of the maximum full scale value ▪ In most applications, 20 to 50 % of the maximum full scale value can be considered ideal ▪ A low full scale value must be selected for abrasive media (such as liquids with entrained solids): flow velocity < 1 m/s (< 3 ft/s). To calculate the flow limit, use the *Applicator* sizing tool → 58
Pressure loss	To calculate the pressure loss, use the *Applicator* sizing tool → 58
Static pressure	It is important that cavitation does not occur, or that gases entrained in the liquids do not outgas. This is prevented by means of a sufficiently high static pressure. For this reason, the following mounting locations are recommended: Downstream from pumps (no danger of vacuum)
Vibrations	The operational reliability of the measuring system is not affected by plant vibrations.

Mechanical construction

Dimensions in SI units

Housing of Proline 500 – digital transmitter

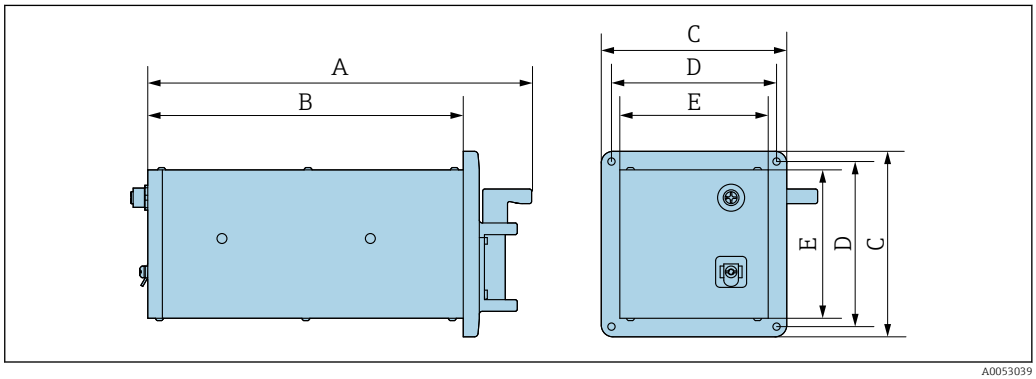


A0033789

Order code for "Transmitter housing", option A "Aluminum, coated" and order code for "Integrated ISEM electronics", option A "Sensor"

A [mm]	F [mm]	G [mm]	N [mm]	P [mm]	Q [mm]
167	232	89	187	24	21

Sensor

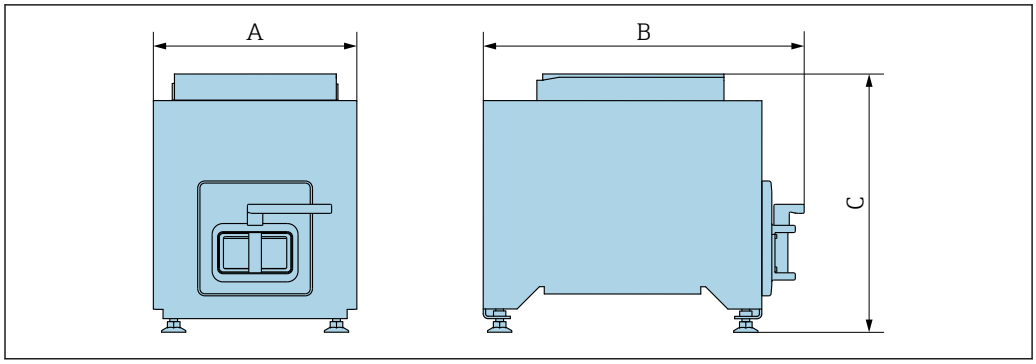


A0053039

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

A [mm]	B [mm]	C [mm]	D [mm]	E [mm]
263	216	127	113	101.6

Table version



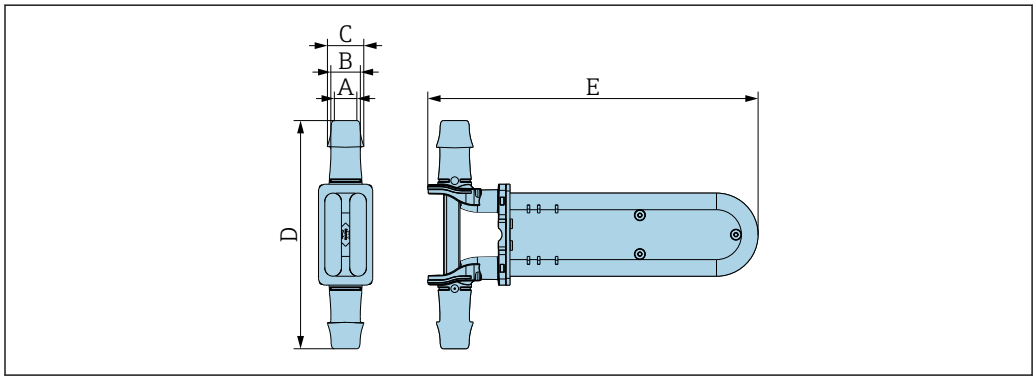
A0053046

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

A [mm]	B [mm]	C [mm]
210	345	267

Accessories

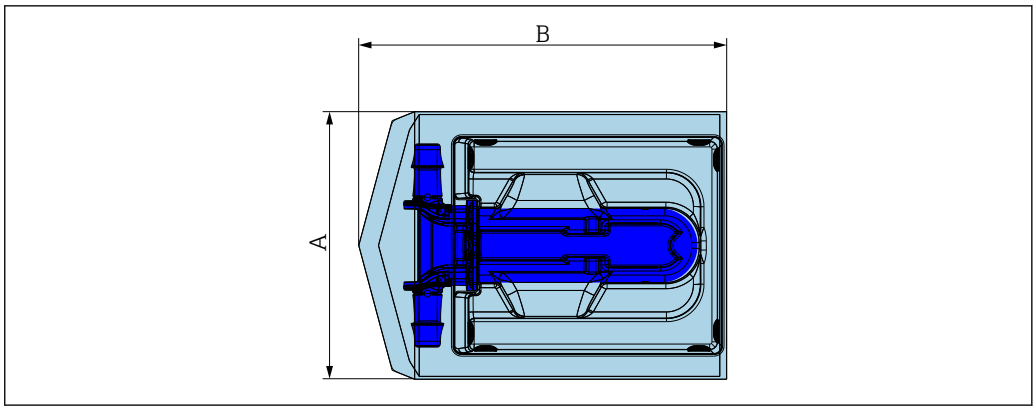
Disposable measuring tube



A0053733

Unpacked

Nominal diameter [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]
4	3	3.8	4.7	95	247
6	5.3	6.4	8.5	111	247
15	9	11.6	15.5	145	250
25	17.5	21.4	28.4	179	259



A0053734

Packed

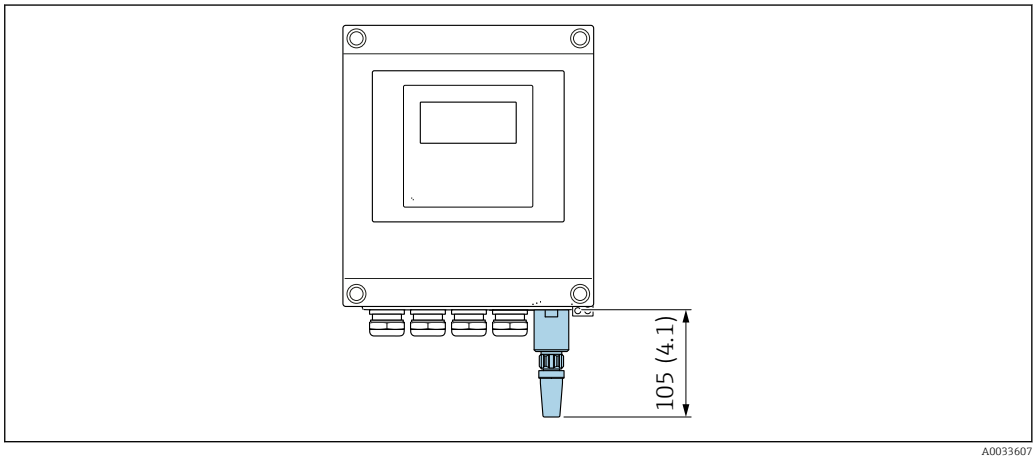
Nominal diameter [mm]	A [mm]	B [mm]
4	275	305
6	275	305
15	275	305
25	275	305

External WLAN antenna

The external WLAN antenna is not suitable for use in hygienic applications.

Proline 500 – digital

External WLAN antenna mounted on device

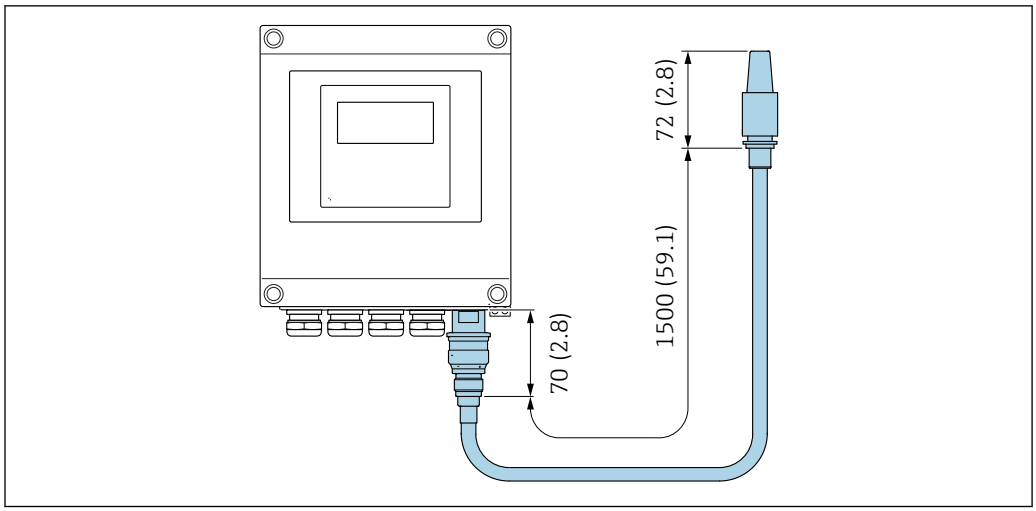


A0033607

18 *Engineering unit mm (in)*

External WLAN antenna mounted with cable

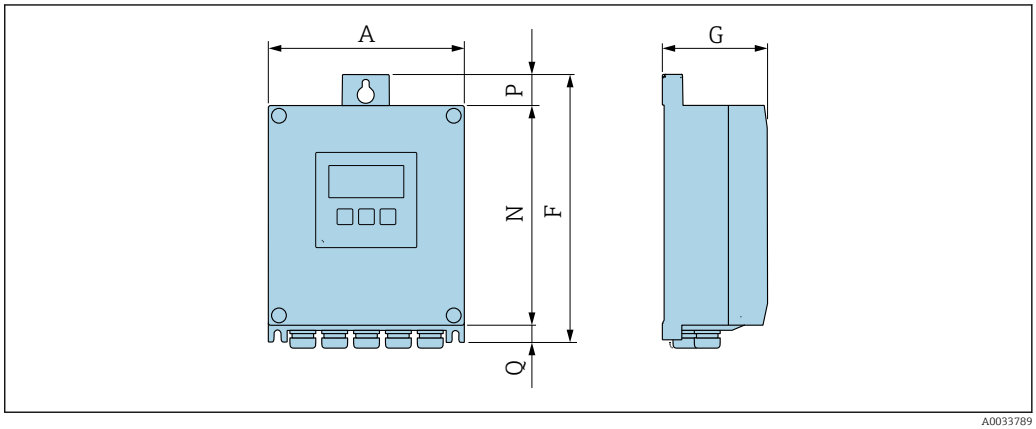
The external WLAN antenna can be mounted separately from the transmitter if the transmission/ reception conditions at the transmitter mounting location are poor.



19 *Engineering unit mm (in)*

Dimensions in US units

Housing of Proline 500 – digital transmitter

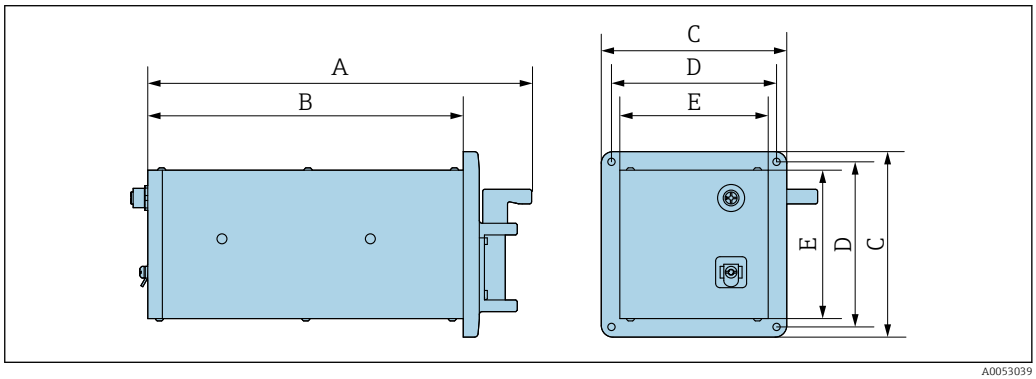


A0033789

Order code for "Transmitter housing", option A "Aluminum, coated" and order code for "Integrated ISEM electronics", option A "Sensor"

A [in]	F [in]	G [in]	N [in]	P [in]	Q [in]
6.57	9.13	3.50	7.36	0.94	0.83

Sensor

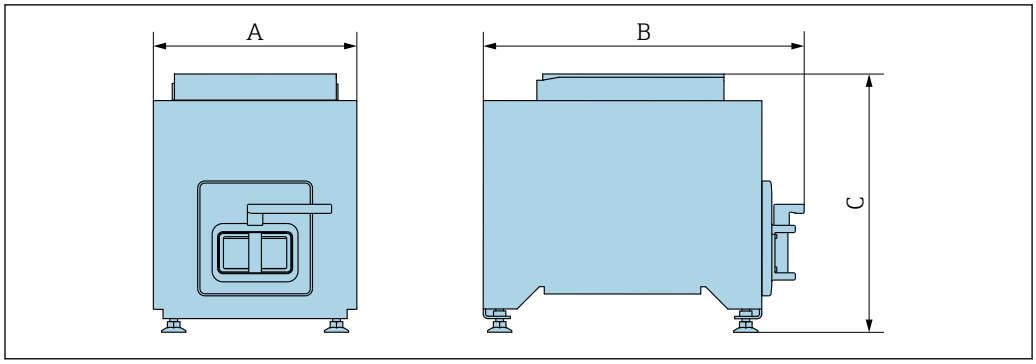


A0053039

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

A [in]	B [in]	C [in]	D [in]	E [in]
10.35	8.5	5	4.45	4

Table version



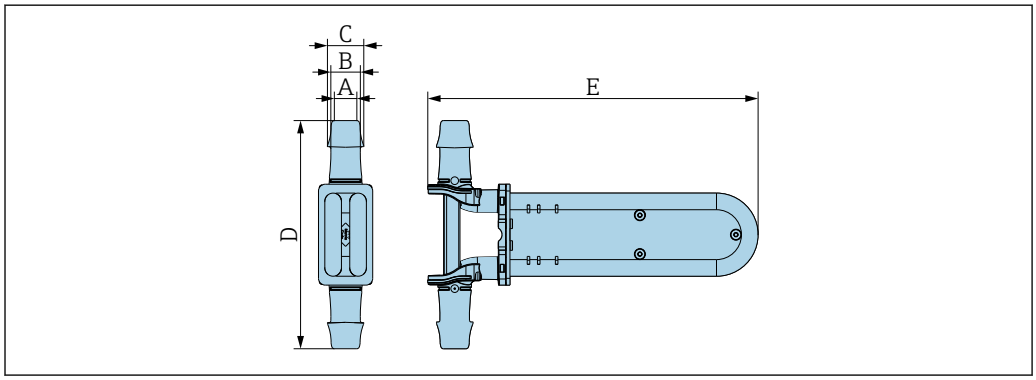
A0053046

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

A [in]	B [in]	C [in]
8.27	13.58	10.51

Accessories

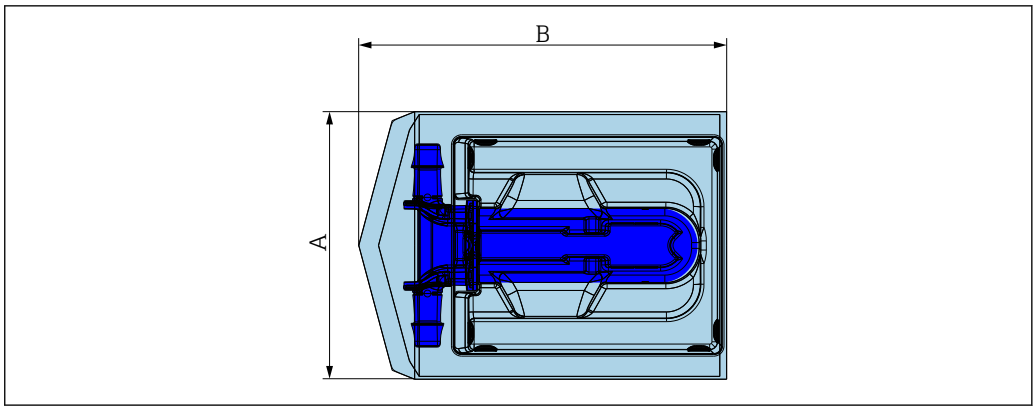
Disposable measuring tube



A0053733

Unpacked

Nominal diameter [in]	A [in]	B [in]	C [in]	D [in]	E [in]
⅛	0.118	0.15	0.185	3.74	9.724
¼	0.209	0.252	0.335	4.37	9.724
½	0.354	0.457	0.61	5.709	9.843
1	0.689	0.843	1.118	7.047	10.197



A0053734

Packed

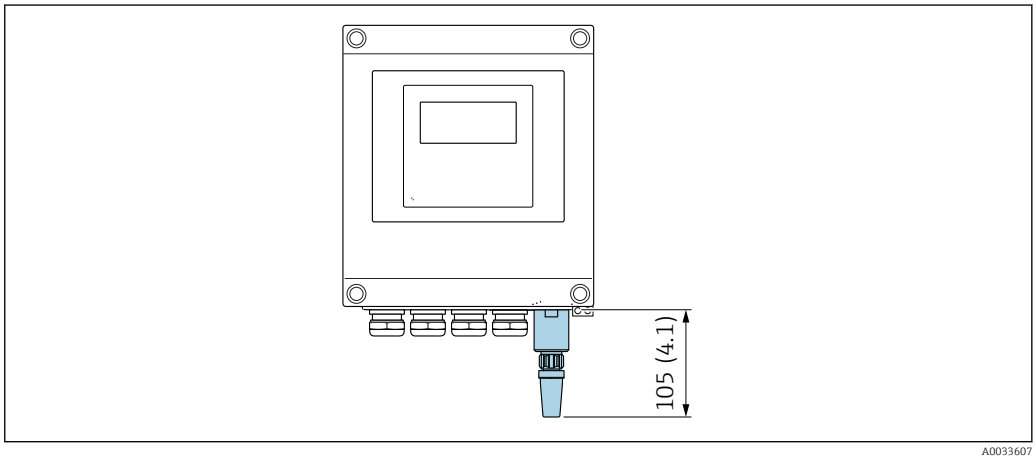
Nominal diameter [in]	A [in]	B [in]
1/8	10.8	12
1/4	10.8	12
1/2	10.8	12
1	10.8	12

External WLAN antenna

The external WLAN antenna is not suitable for use in hygienic applications.

Proline 500 – digital

External WLAN antenna mounted on device

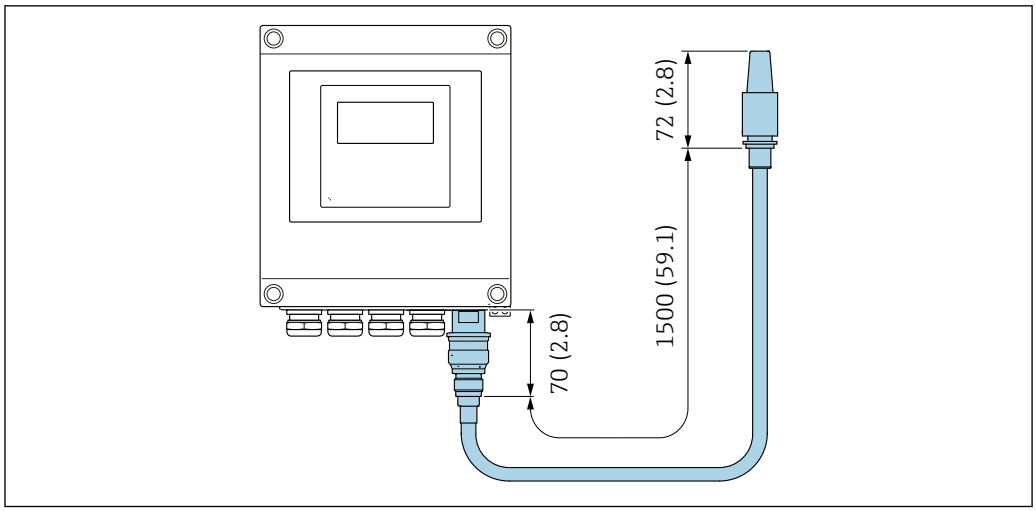


A0033607

20 *Engineering unit mm (in)*

External WLAN antenna mounted with cable

The external WLAN antenna can be mounted separately from the transmitter if the transmission/ reception conditions at the transmitter mounting location are poor.



21 *Engineering unit mm (in)*

Weight

Transmitter
Proline 500 – digital aluminum: 2.4 kg (5.3 lbs)

Weight in SI units

- Sensor: 8.65 kg
- Table version: 12.1 kg
- Disposable measuring tube: 0.6 kg

Weight in US units

- Sensor: 19.07 lbs
- Table version: 26.68 lbs
- Disposable measuring tube: 1.32 lbs

Materials

Transmitter housing

Housing of Proline 500 – digital transmitter

Order code for "Transmitter housing":
Option **A** "Aluminum coated": aluminum, AlSi10Mg, coated

Window material

Order code for "Transmitter housing":
Option **A** "Aluminum, coated": glass

Cable entries/cable glands

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"	Nickel-plated brass

Connecting cables

UV rays can impair the cable outer sheath. Protect the cable from exposure to sun as much as possible.

Connecting cable for sensor - Proline 500 – digital transmitter

PE-X cable with copper shield

Disposable measuring tube

- Measuring tubes:
  Stainless steel 1.4435, 316 L
- Hose connection nipple:
  Makrolon Rx 1805 polycarbonate

Available process connections

Accessories

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

Surface roughness

All data refer to parts in contact with the medium. The following surface roughness categories can be ordered.

- Steel:
  Ra_{max} = 0.76 µm (30 µin) mechanically polished
- Plastic:
  Ra_{max} = 0.76 µm (30 µin)

Display and user interface

Operation concept

Operator-oriented menu structure for user-specific tasks

- Commissioning
- Operation
- Diagnosis
- Expert level

Quick and safe commissioning

- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief descriptions of the individual parameter functions
- Access to the device via web server
- WLAN access to the device via mobile handheld terminal, tablet or smart phone

Reliable operation

- Operation in local language
- Uniform operating philosophy applied to device and operating tools
- If replacing electronic modules, transfer the device configuration via the integrated memory (HistoROM backup) which contains the process and measuring device data and the event logbook. No need to reconfigure.

Efficient diagnostics increase measurement reliability

- Troubleshooting measures can be called up via the device and in the operating tools
- Diverse simulation options, logbook for events that occur and optional line recorder functions

Languages

Can be operated in the following languages:

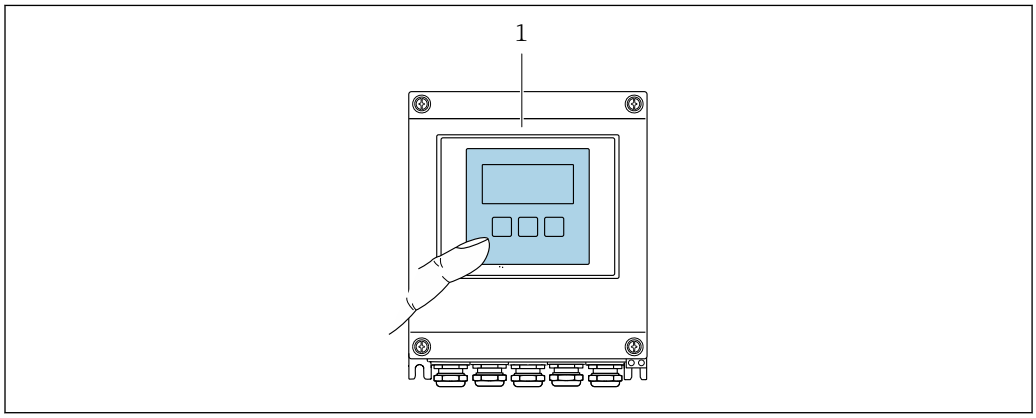
- Via local operation
  English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Korean, Vietnamese, Czech, Swedish
- Via web browser
  English, German, French, Spanish, Italian, Dutch, Portuguese, Polish, Russian, Turkish, Chinese, Japanese, Vietnamese, Czech, Swedish
- Via "FieldCare", "DeviceCare" operating tool: English, German, French, Spanish, Italian, Chinese, Japanese

Onsite operation

Via display module

Features:
- Order code for "Display; operation", option F "4-line, illuminated, graphic display; touch control"
- Order code for "Display; operation", option G "4-line, illuminated, graphic display; touch control + WLAN"

Information about WLAN interface → 52



22 *Operation with touch control*

1 Proline 500 – digital

Display elements

- 4-line, illuminated, graphic display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured

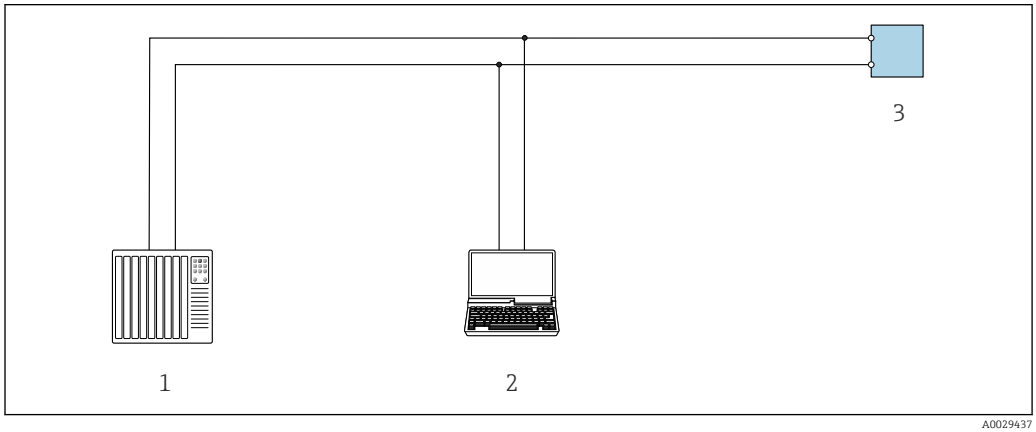
Operating elements

External operation via touch control (3 optical keys) without opening the housing: ⊞, ⊟, ⊡

Remote operation

Via Modbus RS485 protocol

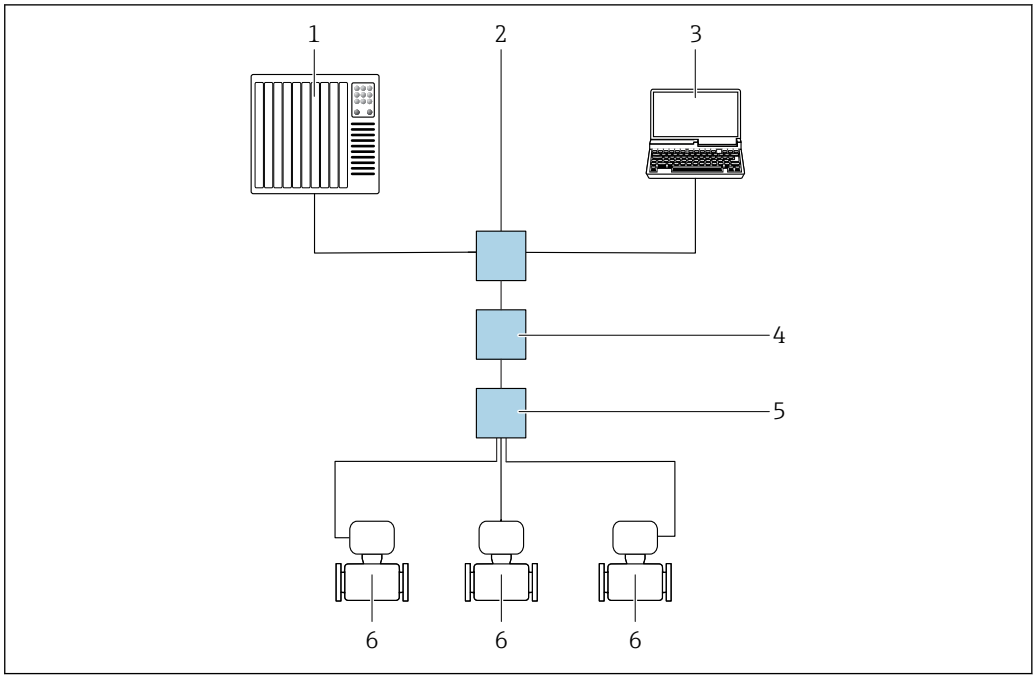
This communication interface is available in device versions with a Modbus RS485 output.



23 *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

Via APL network



24 *Options for remote operation via APL network*

1 *Automation system, e.g. Simatic S7 (Siemens)*
2 *Ethernet switch, e.g. Scalance X204 (Siemens)*
3 *Computer with Web browser (e.g. Internet Explorer) for access to integrated Web server or computer with operating tool (e.g. FieldCare, DeviceCare with PROFINET COM DTM or SIMATIC PDM with FDI-Package)*
4 *APL power switch (optional)*
5 *APL field switch*
6 *Measuring device*

Service interface

Via service interface (CDI-RJ45)

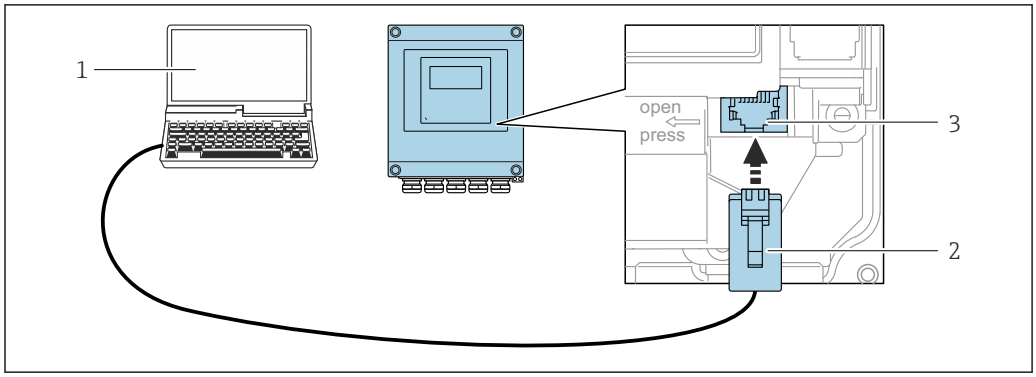
A point-to-point connection can be established to configure the device onsite. With the housing open, the connection is established directly via the service interface (CDI-RJ45) of the device.

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

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

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

Proline 500 – digital transmitter

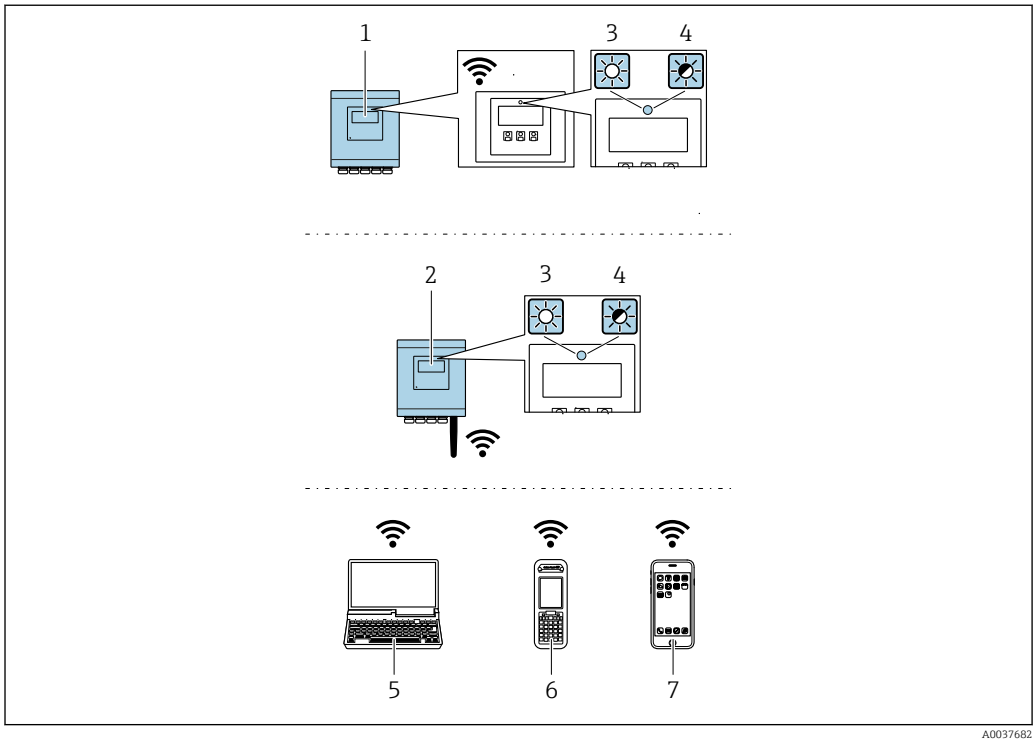


25 Connection via service interface (CDI-RJ45)

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

Via WLAN interface

The optional WLAN interface is available on the following device version:
Order code for "Display; operation", option G "4-line, illuminated; touch control + WLAN"



1 *Transmitter with integrated WLAN antenna*
2 *Transmitter with external WLAN antenna*
3 *LED lit constantly: WLAN reception is enabled on measuring device*
4 *LED flashing: WLAN connection established between operating unit and measuring device*
5 *Computer with WLAN interface and web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device web server or with operating tool (e.g. FieldCare, DeviceCare)*
6 *Mobile handheld terminal with WLAN interface and web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device web server or operating tool (e.g. FieldCare, DeviceCare)*
7 *Smart phone or tablet (e.g. Field Xpert SMT70)*

Function	WLAN: IEEE 802.11 b/g (2.4 GHz) ▪ Access Point with DHCP server (factory setting) ▪ Network
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. Available as an accessory . 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

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 → 59
DeviceCare SFE100	Notebook, PC or tablet with Microsoft Windows system	▪ CDI-RJ45 service interface ▪ WLAN interface ▪ Fieldbus protocol	→ 58
FieldCare SFE500	Notebook, PC or tablet with Microsoft Windows system	▪ CDI-RJ45 service interface ▪ WLAN interface ▪ Fieldbus protocol	→ 58
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	→ 58

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 using Ethernet-APL/SPE, 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.

Access to the network is required for the Ethernet-APL/SPE connection.

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

Supported functions
Data exchange between the operating unit (such as a notebook, for example,) and measuring device:
- Upload the configuration from the measuring device (XML format, configuration backup)
- Save the configuration to the measuring device (XML format, restore configuration)
- Export event list (.csv file)
- Export parameter settings (.csv file or PDF file, document the measuring point configuration)
- Export the Heartbeat verification report (PDF file, only available with the **Heartbeat Verification** application package)
- Flash firmware version for device firmware upgrade, for example
- Download driver for system integration
- Visualize up to 1000 saved measured values (only available with the **Extended HistoROM** application package)

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)".

Material certificate

- Bioburden
- Inorganic and organic residues
- Cytotoxicity growth inhibition
- Sensitization
- Systemic toxicity
- GC/MS fingerprints a. extraction
- Physico-chemical resistance
- Biocompatibility of plastics

- Hemolysis
- ISO Class 7 clean room
- Medical devices QM
- Conformities
- Ingredients for rubber parts
- Ingredients for plastic parts
- Medical packaging
- Gamma radiation
- O-ring standard
- FDA

A comprehensive listing of the serial number-specific disposable measuring tube can be found in the certificate of conformity for single-use requirements in the biopharmaceutical industry.

PROFINET with Ethernet-APL/SPE certification

PROFINET interface

The measuring device is certified and registered by the PNO (PROFIBUS Nutzerorganisation e. V./ PROFIBUS User Organization). The measuring system meets all the requirements of the following specifications:

- Certified according to:
  - Test specification for PROFINET devices
  - PROFINET PA Profile 4
  - PROFINET netload robustness Class 2 10 Mbit/s
  - APL conformance test
- The device can also be operated with certified devices of other manufacturers (interoperability)
- The device supports PROFINET S2 system redundancy.

Radio approval

The measuring device has radio approval.

For detailed information on the radio approval, see the Special Documentation → 59

Additional certification

CRN approval

Some device versions have CRN approval. A CRN-approved process connection with a CSA approval must be ordered for a CRN-approved device.

Tests and certificates

External standards and guidelines

- EN 60529
  Degrees of protection provided by enclosure (IP code)
- IEC/EN 60068-2-6
  Environmental influences: Test procedure - Test Fc: vibrate (sinusoidal).
- IEC/EN 60068-2-31
  Environmental influences: Test procedure - Test Ec: shocks due to rough handling, primarily for devices.
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements
- 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
- NAMUR NE 132
  Coriolis mass meter
- ETSI EN 300 328
  Guidelines for 2.4 GHz radio components.
- EN 301489
  Electromagnetic compatibility and radio spectrum matters (ERM).
- Animal free (ADI)

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

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 → 59

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.

Device-specific accessories

For the transmitter

Accessories	Description
Transmitter Proline 500 – digital	Transmitter for replacement or storage. Use the order code to define the following specifications: ▪ Approvals ▪ Output ▪ Input ▪ Display/operation ▪ Housing ▪ Software Proline 500 – digital transmitter: Order number: 8X5BXX-*********A Proline 500 – digital transmitter: Installation Instructions EA01151D
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 → 🖹 52. Order number: 71351317 Installation Instructions EA01238D
Connecting cable Proline 500 – digital Sensor – Transmitter	The connecting cable can be ordered directly with the measuring device (order code for "Cable, sensor connection) or as an accessory (order number DK8012). The following cable lengths are available: order code for "Cable, sensor connection" ▪ Option C: 2 m (6 ft) ▪ Option J: 5 m (15 ft) ▪ Option L: 10 m (30 ft) Maximum possible cable length for a Proline 500 – digital connecting cable: 300 m (1 000 ft)

For the sensor

Accessories	Description
Disposable measuring tube	Order number: ▪ DN ⅛ ": DK8014-04SBOAADA2 ▪ DN ¼ ": DK8014-06SBOAADA2 ▪ DN ½ ": DK8014-15SBOAADA2 ▪ DN 1 ": DK8014-25SBOAADA2

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 SMT50 table PC for device configuration enables mobile plant asset management. 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 TI01555S ▪ Operating Instructions BA02053S ▪ 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

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Choice of measuring devices for industrial requirements ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and accuracy. ▪ Graphic illustration of the calculation results ▪ Determination of the partial order code, administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://portal.endress.com/webapp/applicator ▪ As a downloadable DVD for local PC installation.
Netilion	IIoT ecosystem: Unlock knowledge Endress+Hauser 's Netilion IIoT ecosystem enables you to optimize your plant performance, digitize workflows, share knowledge and improve collaboration. Based on decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem that enables you to gain useful insights from data. This knowledge can be used to optimize processes, leading to higher plant availability, efficiency and reliability, and ultimately to a more profitable plant. www.netilion.endress.com
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. Operating Instructions BA00027S and BA00059S
DeviceCare	Tool to connect and configure Endress+Hauser field devices. Innovation brochure IN01047S

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

Supplementary information on the semi-standard options is available in the relevant Special Documentation in the TSP database.

Brief Operating Instructions

Brief Operating Instructions for the sensor

Measuring device	Documentation code
Proline Promass U	KA0XXXXD

Brief Operating Instructions for the transmitter

Measuring device	Documentation code PROFINET with Ethernet-APL/SPE
Proline 500 – digital	KA01521D

Operating Instructions

Measuring device	Documentation code PROFINET with Ethernet-APL/SPE
Promass U 500	BA0XXXXD

Description of device parameters

Measuring device	Documentation code PROFINET with Ethernet-APL/SPE
Promass 500	GP01173D

Device-dependent additional documentation

Special documentation

Contents	Documentation code
Information on the Pressure Equipment Directive	SD01614D
Radio approvals for WLAN interface for A309/A310 display module	SD01793D

Installation instructions

Contents	Note
Installation instructions for spare part sets and accessories	Documentation code: specified for each individual accessory → 57.

Registered trademarks

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Ethernet-APL™
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