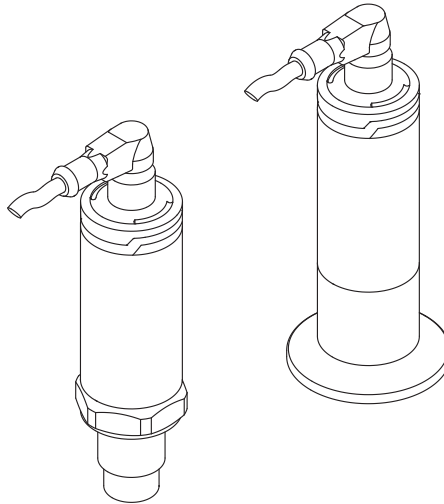
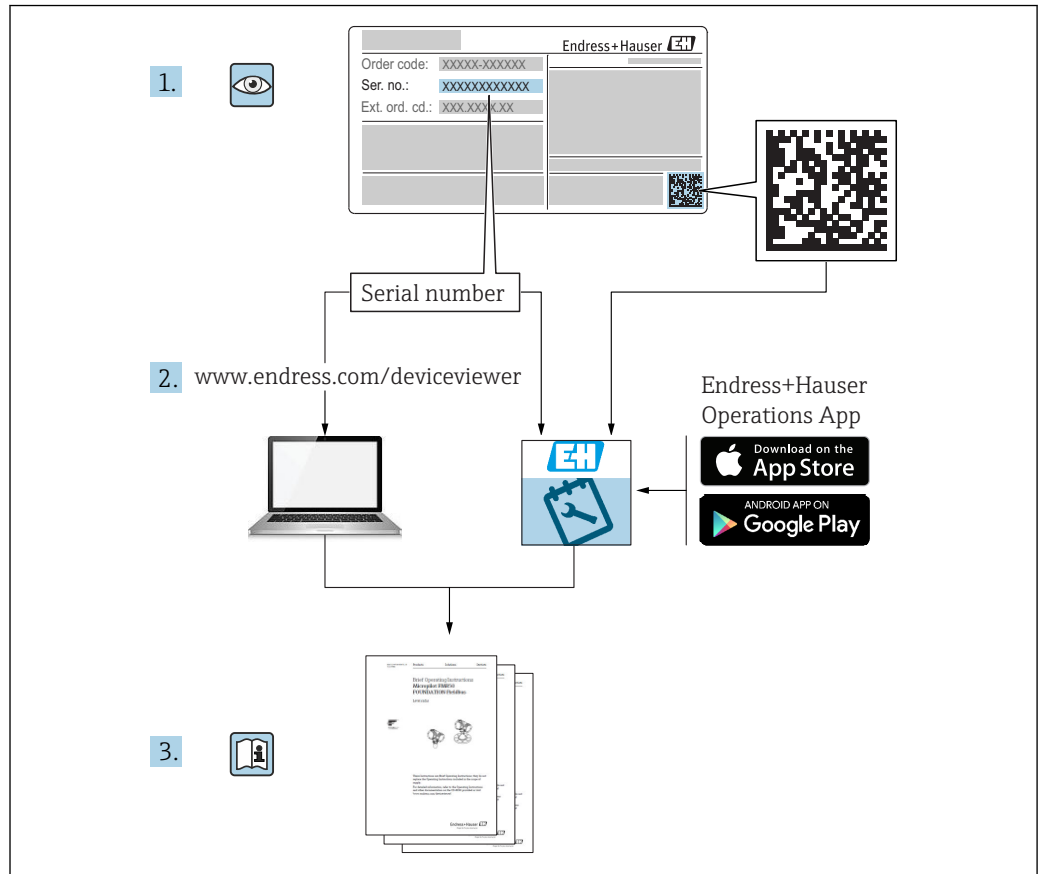


Operating Instructions

Liquitrend QMW43

Conductive and capacitive measurement of conductivity and thickness of buildup





A0023555

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1 About this document

1.1 Symbols

1.1.1 Document function

These Operating Instructions provide all of the information that is required in various phases of the life cycle of the device including:

- Product identification
- Incoming acceptance
- Storage
- Installation
- Connection
- Operation
- Commissioning
- Troubleshooting
- Maintenance
- Disposal

1.1.2 Safety symbols

CAUTION

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

DANGER

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

NOTICE

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

WARNING

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

1.1.3 Tool symbols



Open-ended wrench

1.1.4 Symbols for certain types of information and graphics

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



Notice or individual step to be observed



Result of a step

1, 2, 3, ...

Item numbers

A, B, C, ...

Views



Safety instructions

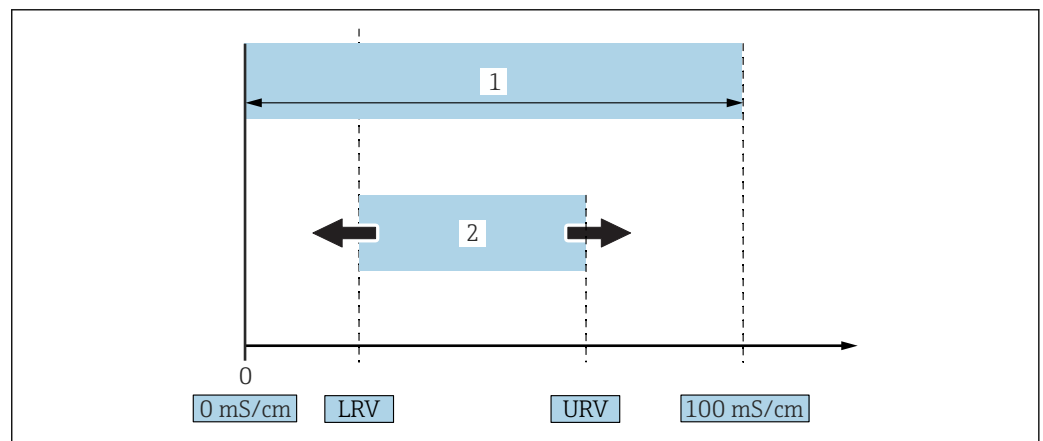
Observe the safety instructions contained in the associated Operating Instructions



Connecting cable immunity to temperature change

Specifies the minimum value of the temperature resistance of the connection cables

1.2 Terms and abbreviations



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1 Measuring range, span (conductivity)

1 Maximum conductivity measuring range

2 Adjusted span

Maximum conductivity measuring range

Span between 0 to 100 for editable range.

Adjusted span

Span between LRV (Lower Range Value) and URV (Upper Range Value)

The difference between the LRV and URV must be at least 1 mS/cm.

Factory setting: 0 to 100 mS/cm


Other configured spans can be ordered as customized spans.

Other abbreviations

UHT: Ultra-High Temperature

CIP: Cleaning in Place

1.3 Documentation

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

- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

1.4 Registered trademarks

 **IO-Link**

is a registered trademark of the IO-Link company group.

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out the necessary tasks, e. g., commissioning and maintenance:

- ▶ Trained, qualified specialists must have a relevant qualification for the specific function and task
- ▶ Are authorized by the plant owner/operator
- ▶ Are familiar with federal/national regulations
- ▶ Must have read and understood the instructions in the manual and supplementary documentation
- ▶ Follow instructions and comply with conditions

2.2 Designated use

Improper use can pose hazards

- ▶ Ensure that the measuring device is free of defects while it is in operation
- ▶ Use the measuring device only for media to which the process-wetted materials have an adequate level of resistance
- ▶ Do not exceed or undershoot the relevant limit values of the measuring device → see the "Technical data" section

2.2.1 Incorrect use

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

Clarification of borderline cases:

- ▶ For special materials and media used for cleaning, the manufacturer is happy to provide assistance in verifying the corrosion resistance of medium-wetted materials, but disclaims any warranty or liability.

Residual risks

Due to heat transfer from the process, the temperature of the electronics housing and the assemblies contained therein may rise to 80 °C (176 °F) during operation.

Danger of burns from contact with surfaces!

- ▶ If necessary, ensure protection against contact to prevent burns.

2.3 Workplace safety

When working on and with the device:

- ▶ Wear the required personal protective equipment according to federal/national regulations.

For welding work on the piping:

- ▶ Do not ground the welding unit via the device.

If working on and with the device with wet hands:

- ▶ Due to the increased risk of electric shock, gloves must be worn.

2.4 Operational safety

Risk of injury!


- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ The operator is responsible for ensuring 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, despite this, modifications are required, consult with Endress+Hauser.

Repair

Repairs are not envisaged for this device →  "Repair" section.

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 EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

2.6 IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device has safety mechanisms integrated to prevent users from inadvertently changing settings.

Provide additional protection for the device and data transfer to/from the device

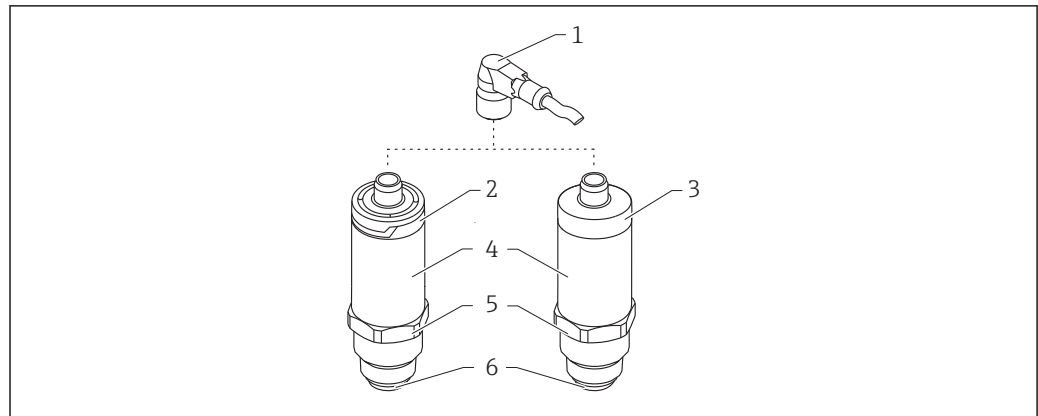
- ▶ IT security measures defined in the plant owner/operator's own security policy must be implemented by plant owners/operators themselves.

3 Product description

- Compact measuring device
- Continuous measurement of conductive and capacitive components of media for the measurement of buildup thickness and conductivity

Flush-mounting of the device in pipes or in storage, mixing and process vessels enables the optimization of CIP cleaning, UHT applications as well as process cycle times.

3.1 Product design



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2 Product design

- 1 M12 plug
- 2 Plastic housing cover IP65/67
- 3 Metal housing cover IP66/68/69
- 4 Housing
- 5 Process connection
- 6 Sensor

4 Incoming acceptance and product identification

4.1 Incoming acceptance

Check the following during incoming acceptance:

- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?
- Do the nameplate data match the ordering information on the delivery note?
- If required (see nameplate): Are the safety instructions (XA) provided?

i If one of these conditions is not met, please contact the manufacturer's sales office.

4.2 Product identification

The following options are available for the identification of the measuring device:

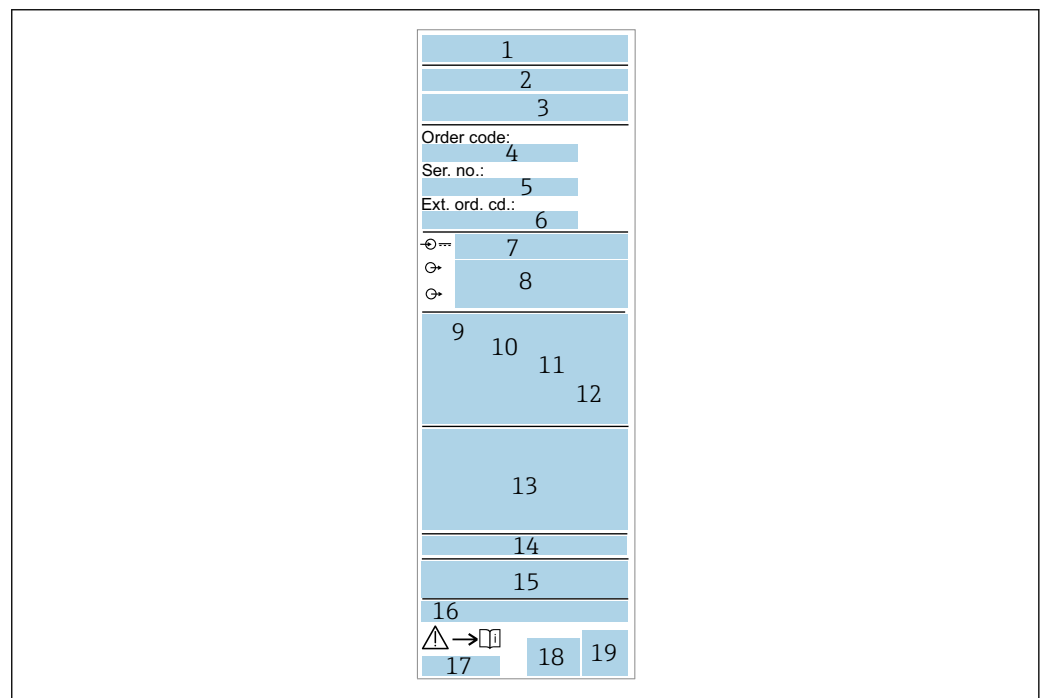
- Nameplate specifications
 - Serial number
 - 2-D matrix code (QR code)
 - Extended order code with breakdown of the device features on the delivery note
- Enter the serial number from the nameplates in the *W@M Device Viewer* (www.endress.com/deviceviewer)
- ↳ All the information about the measuring device and all associated Technical Documentation are displayed.

- ▶ Enter the serial number on the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) on the nameplate
 - ↳ All the information about the measuring device and all associated Technical Documentation are displayed.

4.3 Manufacturer address

Endress+Hauser SE+Co. KG
 Hauptstraße 1
 79689 Maulburg, Germany
 Address of the manufacturing plant: See nameplate.

4.4 Nameplate



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- 1 *Manufacturer name/logo*
- 2 *Device name*
- 3 *Manufacturer's address*
- 4 *Order code*
- 5 *Serial number*
- 6 *Extended order code*
- 7 *Supply voltage*
- 8 *Signal output*
- 9 *Process temperature*
- 10 *Ambient temperature range*
- 11 *Process pressure*
- 12 *Firmware*
- 13 *Certificate symbols, communication mode (optional)*
- 14 *Degree of protection, e. g. IP, NEMA*
- 15 *Approval-specific information*
- 16 *Measuring point identification (optional)*
- 17 *Document number of Operating Instructions*
- 18 *Manufacturing date: year-month*
- 19 *2-D matrix code (QR code)*

4.5 Storage, transport

4.5.1 Storage conditions

- Permitted storage temperature: -40 to $+85$ °C (-40 to $+185$ °F)
- Use original packaging.

4.5.2 Transporting the product to the measuring point

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

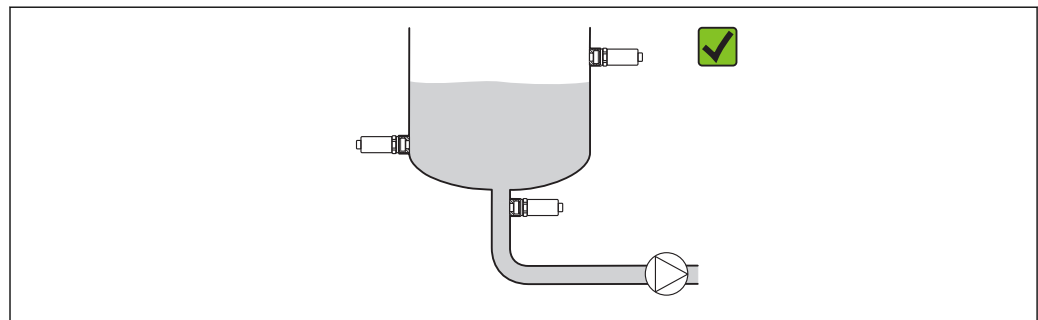
5 Installation

5.1 Installation conditions

5.1.1 Mounting location

Installation in vessel, pipe or tank.

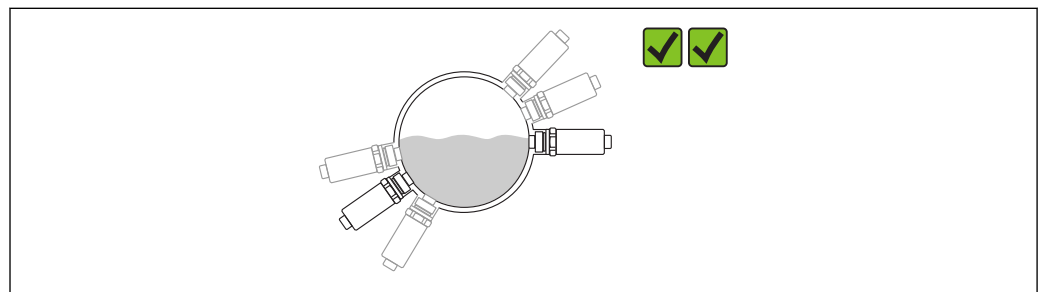
5.1.2 Vessel or tank



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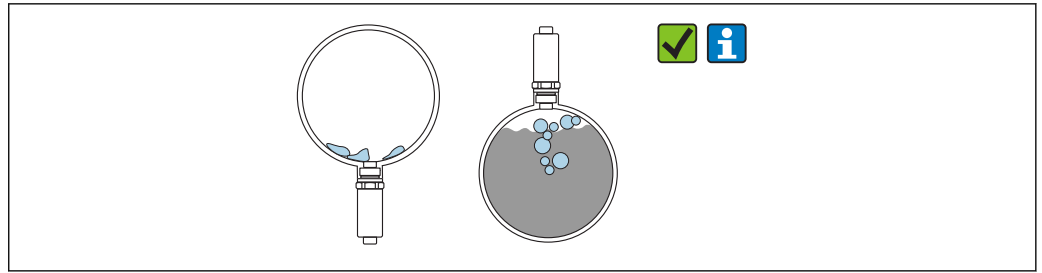
3 Installation examples

5.1.3 Pipes



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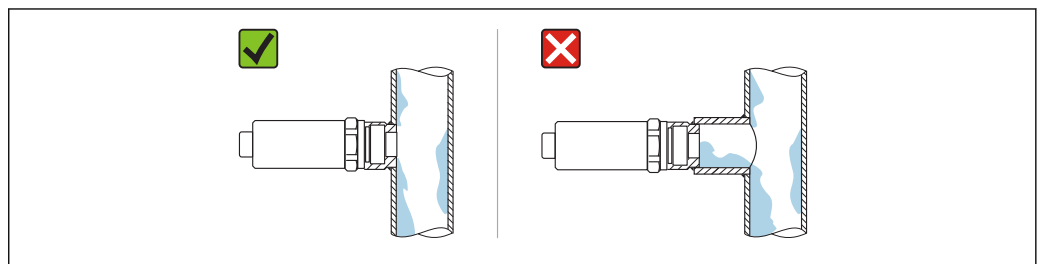
4 Horizontal orientation → preferred orientation



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5 Vertical orientation → formation of buildup or bubbles on the sensor must be taken into account

i The possibility of buildup or bubbles forming on the sensor when installed vertically must be taken into account. If the sensor is partially covered, or if encrustations or air bubbles have formed on the sensor, this will be reflected in the measured value.



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6 Flush mount orientation

5.1.4 Special mounting instructions

- When installing the plug, do not allow moisture to enter the plug or socket area
- Protect housing against impact

5.2 Mounting the measuring device

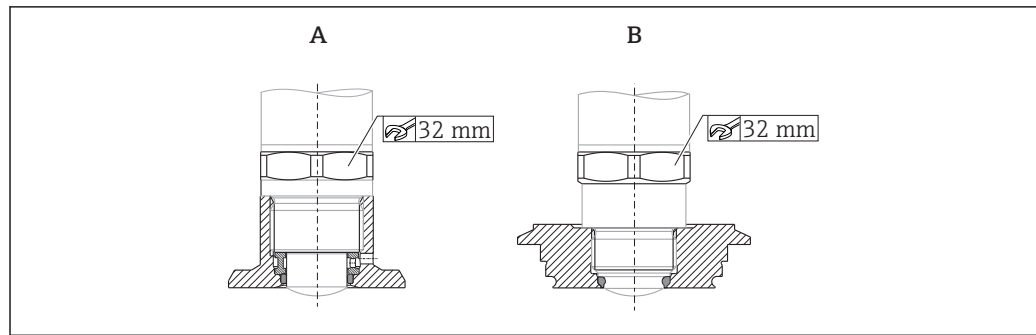
5.2.1 Required tools

- Open-ended wrench
- Hexagon socket wrench for measuring points that are difficult to access

When screwing into place, turn by the hex bolt only 32 mm.

Torque: 15 to 30 Nm (11 to 22 lbf ft)

5.2.2 Installation instructions



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7 Installation examples

- A Thread G 3/4", G 1"
 B Thread M24x1.5

5.3 Post-installation check

- Is the device undamaged (visual inspection)?
- Does the device comply with the measuring point specifications?
 - Process temperature
 - Process pressure
 - Ambient temperature range
 - Measuring range
- Are the measuring point identification and labeling correct (visual inspection)?
- Is the device adequately protected against precipitation and direct sunlight?
- Is the device adequately protected against impact?
- Are all mounting and safety screws securely tightened?
- Is the device properly secured?

6 Electrical connection

6.1 Connecting the device

⚠ WARNING

Risk of injury from the uncontrolled activation of processes!

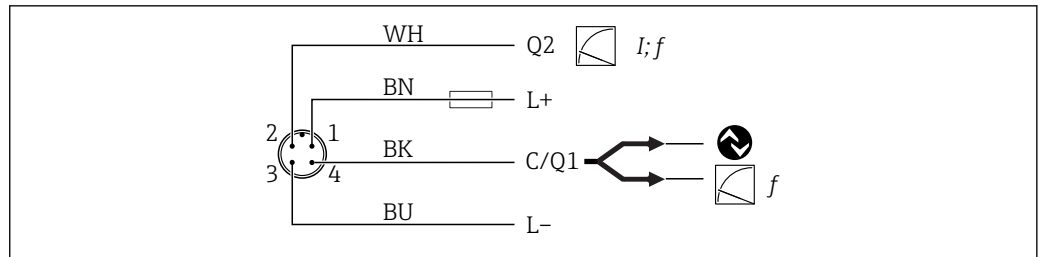
- ▶ Switch off the supply voltage before connecting the device.
- ▶ Make sure that downstream processes are not started unintentionally.

⚠ WARNING

Electrical safety is compromised by an incorrect connection!

- ▶ In accordance with IEC/EN61010 a suitable circuit breaker must be provided for the device .
- ▶ Voltage source: Non-hazardous contact voltage or Class 2 circuit (North America).
- ▶ The device must be operated with a fine-wire fuse 500 mA (slow-blow).

Protective circuits against reverse polarity are integrated.



8 Connection

Pin 1 Supply voltage +

Pin 2 Current output 4 to 20 mA or frequency 300 to 3 000 Hz

Pin 3 Supply voltage -

Pin 4 IO-Link communication or frequency 300 to 3 000 Hz

6.2 Post-connection check

- Are the device and cable undamaged (visual inspection)?
- Does the supply voltage match the specifications on the nameplate?
- If supply voltage is present, is the green LED lit?
- With IO-Link communication: is the green LED flashing?

7 Operation options

7.1 IO-Link information

IO-Link is a point-to-point connection for communication between the device and an IO-Link master. This requires an IO-Link compatible module (IO-Link master) for operation. The IO-Link communication interface enables direct access to the process and diagnostic data. It also provides the option of configuring the device during operation.

The device supports the following characteristics of the physical layer:

- IO-Link specification: version 1.1
- IO-Link Smart Sensor Profile 2nd Edition
- SIO mode: Yes
- Speed: COM2; 38.4 kBaud
- Minimum cycle time: 6 ms
- Process data width: 32 bit
- IO-Link data storage: Yes
- Block configuration: Yes

i Regardless of the customer-specific default settings selected, the device always has the option of communicating or being configured via IO-Link.



7.2 IO-Link download

<http://www.endress.com/download>

- Select "Device Driver" from the list displayed
- In the Type search field, select "IO Device Description (IODD)"
- In the Product Code search field, select the product root
- Click "Search" button → Select result → Download

Optional: In the Text Search search field, enter the device name.


7.3 Structure of the operating menu

 "Overview of the operating menu" section →  28

8 System integration

8.1 Process data

Bit	0 (LSB)	1	...	22	23 (MSB)	24	...	31	
Device	Conductivity: 0 to 110 000 µS/cm, resolution 0.1 µS/cm					Buildup: 0 to 10 mm, resolution 0.1 mm			
	UInt24: offset = 0, gradient = 0.1					UInt8: offset = 0, gradient = 0.1			

 In addition, the value for buildup and conductivity can be read via ISDU (hex) 0x0028 – acyclic service.

8.2 Reading out and writing device data (ISDU – Indexed Service Data Unit)

Device data are always exchanged acyclically and at the request of the IO-Link master. Using the device data, the following parameter values or device statuses can be read out:

8.2.1 Endress+Hauser-specific device data

Identifier	ISDU (dec)	ISDU (hex)	Size [byte]	Data type	Access	Default value	Value range	Offset/gradient	Data storage	Range limits
Extended order code	259	0x0103	60	String	r/-					
ENP_VERSION	257	0x0101	16	String	r/-					
Device Type	256	0x0100	2	UInteger16	r/-	0x91FB				
Simulation buildup	66	0x0042	1	UInt8	r/w	0 ~ OFF	0 ~ OFF 1 ~ ON		No	0 to 1
Simulated buildup	85	0x0055	4	Int16	r/w	10	0 to 10.0		Yes	0 to 10.0
Simulation conductivity	90	0x005A	1	UInt8	r/w	0 ~ OFF	0 ~ OFF 1 ~ ON		No	0 to 1
Simulated conductivity	86	0x0056	4	UInt32	r/w	100 000.0	0 to 110 000.0		Yes	0 to 110 000.0
Device search	69	0x0045	1	UInt8	r/w	0 ~ OFF	0 ~ OFF 1 ~ ON	0/1	No	0 to 1
Sensor check	70	0x0046	1	UInt8	-/w	0 ~ OFF	0 ~ OFF 1 ~ ON	0/1	No	0 to 1
Operating Mode 1 (OU1)	108	0x006C	1	UInt8	r/w	OFF	0 ~ OFF 3 ~ Frequency		Yes	0 to 4
Operating Mode 2 (OU2)	97	0x0061	1	UInt8	r/w	3 ~ Frequency (Conductivity)	2 ~ 4-20 mA (Buildup) 3 ~ Frequency 4 ~ 4-20 mA (Conductivity)		Yes	0 to 4

Identifier	ISDU (dec)	ISDU (hex)	Size [byte]	Data type	Access	Default value	Value range	Offset/gradient	Data storage	Range limits
Damping buildup (TAU)	106	0x006A	2	UInt16	r/w	5	0.1 to 60 s	0/0.1	Yes	1 to 600
Damping conductivity (TAU)	105	0x0069	2	UInt16	r/w	5	0.1 to 60 s	0/0.1	Yes	1 to 600
DC-Media	104	0x0068	2	UInt16	r/w	13	2 to 85	0/0.1	Yes	200 to 8 500
Calibrate buildup zero (GTZ)	67	0x0043	1	UInt8	-/w	0	0 ~ Empty 1 ~ Set Zero			0 to 1
Offset buildup	98	0x0062	2	UInt16	r/w	0	0 to 10	0/0.01	Yes	1 to 90
Get DC-Media	87	0x0057	1	UInt16	-/w		0 to 1		No	0 to 1
Lower Range Value for 4 mA	116	0x0074	4	UInt32	r/w	0.0	0 to 150000	0/0.01	Yes	1 to 150 000
Upper Range Value for 20 mA	117	0x0075	4	UInt32	r/w	110 000	0 to 150000	0/0.01	Yes	1 to 150 000
Lower Range Value for 300 Hz	114	0x0072	4	UInt32	r/w	0.0	0 to 150000	0/0.01	Yes	1 to 150 000
Upper Range Value for 3000 Hz	115	0x0073	4	UInt32	r/w	110 000	0 to 150000	0/0.01	Yes	1 to 150 000
Operating hours	96	0x0060	4	UInt32	r/-	0	0 to 2 ³²	0/0.016667	No	0 to 2 ³²
µC-Temperature	91	0x005B	1	Int8	r/-		-128 to 127	°C: 0/1 °F: 32/1.8 K: 273.15/1	No	-128 to 127
Unit changeover (UNI) - µC-Temperature	80	0x0050	1	UInt8	r/w	°C	0 ~ °C 1 ~ °F 2 ~ K	0/0	Yes	0 to 2
Minimum µC-Temperature	92	0x005C	1	Int16	r/-	127		°C: 0/1 °F: 32/1.8 K: 273.15/1	No	-32768 to 32767
Maximum µC-Temperature	93	0x005D	1	Int16	r/-	-128		°C: 0/1 °F: 32/1.8 K: 273.15/1	No	-32768 to 32767
Reset µC-Temperatures [button]	94	0x005E	1	UIntegerT	-/w	False	0 ~ False 1 ~ Reset Temperature			0 to 1

 Please refer to the parameter description for an explanation of abbreviations.

8.2.2 IO-Link-specific device data

Identifier	ISDU (dec)	ISDU (hex)	Size [byte]	Data type	Access	Default value	Data storage
Serial number	21	0x0015	max. 16	String	r/-		
Firmware Version	23	0x0017	max. 64	String	r/-		
ProductID	19	0x0013	max. 64	String	r/-	QMW43	
ProductName	18	0x0012	max. 64	String	r/-	Liquitrend	
ProductText	20	0x0014	max. 64	String	r/-	Buildup, homogeneity, product recognition	
VendorName	16	0x0010	max. 64	String	r/-	Endress+Hauser	
VendorId	7 to 8	0x0007 to 0x0008			r/-	17	

Identifier	ISDU (dec)	ISDU (hex)	Size [byte]	Data type	Access	Default value	Data storage
VendorText	17	0x0011	max. 64	String	r/-	People for Process Automation	
Device ID	9 to 11	0x0009 to 0x000B			r/-	0x000600	
Hardware Revision	22	0x0016	max. 64	String	r/-		
Application Specific Tag	24	0x0018	32	String	r/w		
Actual Diagnostics (STA)	260	0x0104	4	String	r/-		No
Last Diagnostic (LST)	261	0x0105	4	String	r/-		No

8.2.3 System commands

Identifier	ISDU (dec)	ISDU (hex)	Value range	Access
Reset to factory settings (RES)	130	0x0082		-/w
Device Access Locks.Data Storage Lock	12	0x000C	0 ~ False 2 ~ True	

9 Commissioning

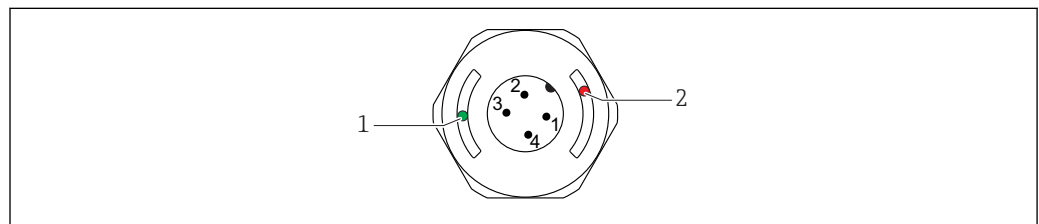
9.1 Function check

Prior to commissioning, make sure that the post-installation and post-connection checks have been performed.

Checklists in sections

- Post-installation check
- Post-connection check

9.2 Light signals (LEDs)



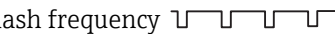

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9 Position of LEDs in housing cover

- 1 green (GN), status, communication
2 red (RD), warning or fault


Description of the function of the LEDs

Position 1: green (GN) status, communication

- Lit: no communication
- Flashing: active communication, flash frequency 
- Flashing with increased luminosity: device search (device identification), flash frequency 

Position 2: red (RD) warning or fault

- Warning/maintenance required:
 - Flashing: error is remediable, e. g. invalid adjustment
- Fault/device failure:
 - Lit: see diagnostics and troubleshooting

 There is no external signaling via LEDs on the metal housing cover (IP69).

9.3 Changing device parameters via IO-Link

Block configuration:

All changed parameters become active only after download.

Direct configuration:

A single changed parameter becomes active immediately after input.

Confirm each change with Enter to ensure that the value is accepted.

 WARNING

Risk of injury and damage to property due to uncontrolled activation of processes!

- ▶ Make sure that downstream processes are not started unintentionally.

Commissioning with customer-specific default settings:

The device can be put into operation without any additional configuration.

Commissioning with factory settings:

If an application-specific setting is required, the span and the output assignment can be adjusted via the IO-Link interface.

10 Operation

10.1 Measurement of buildup in pipes or tanks

10.1.1 Application example

- System state = emptied
- Output OU1 setting on device = buildup (buildup measurement)
- Output OU2 setting on device = conductivity


The device is installed in a pipe or on a tank wall. During the process, there are times when the pipe or tank is not filled.

For the purpose of controlling a cleaning cycle and ensuring the quality of the end product, it is important to know whether residues of the medium or cleaning agent are still present.

The device detects the thickness of the buildup in the pipe or on the tank wall. The buildup measurement is output as a measured value at the output used.

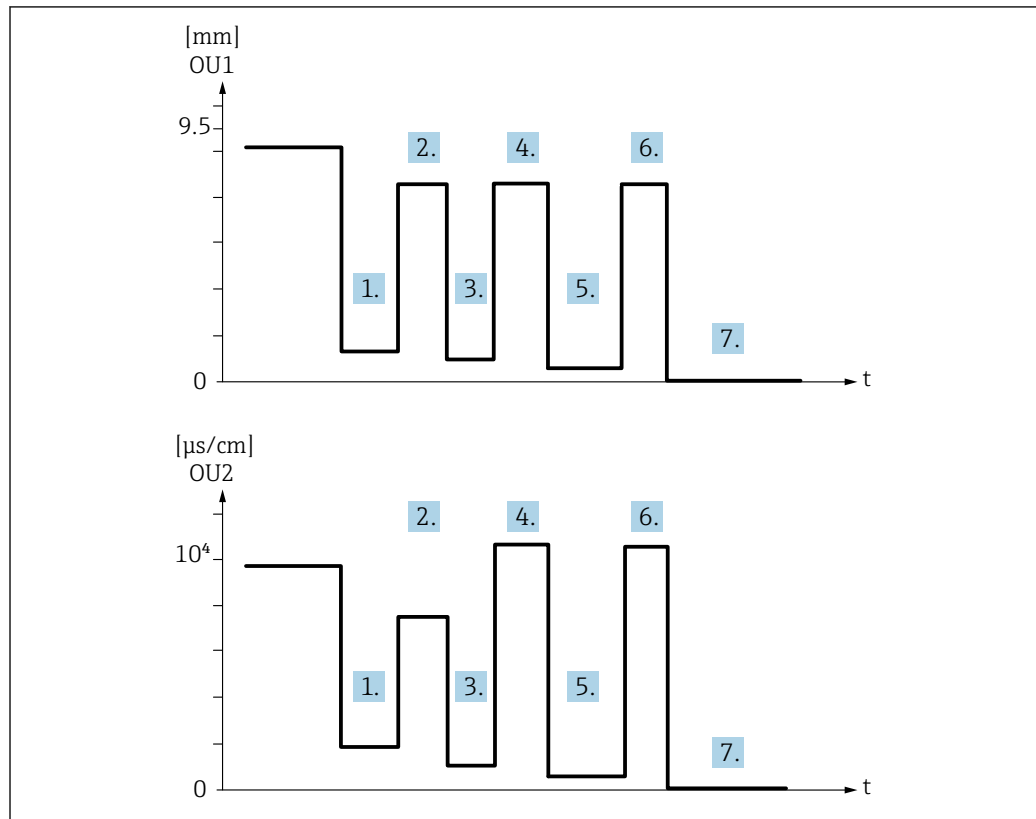
The thickness of the buildup can be output in the range from 0 to 10 mm, as shown in this example.

The output is set to ≥ 0.1 mm as long as it is still possible to detect an electrical conductivity of a medium or cleaning agent, for example.

 Examples of media: biofilms, very thin, conductive films of dirt or films caused by residue of the cleaning agent used are output with a value of 0.1 mm.

Output OU2 (set to conductivity) outputs the conductivity actually present without temperature compensation. This makes it possible to differentiate contamination with chemicals from the medium. Examples:

- A very low residual conductivity in the single-digit $\mu\text{S}/\text{cm}$ range is indicative of a film of water that has not drained due to the sensor installation.
- If the residual conductivity value is far higher, this indicates fluid or cleaning agent residue.




10 Application example: tank cleaning

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Description of the graphic "Application example: tank cleaning"

At the end of a production run:

1. Tank is emptied.
 - ↳ Considerable product residue in the tank.
Signal OU1: buildup ≥ 1 mm
Signal OU2: conductivity < conductivity of medium when tank is filled
2. Perform cleaning in place (CIP); rinse, e.g. with water.
3. Tank is emptied.
 - ↳ Product residue still in the tank.
Signal OU1: buildup ≥ 0.1 mm
Signal OU2: conductivity < measured values from point 1, but > 0 $\mu\text{S}/\text{cm}$
4. Clean or rinse again.
5. Tank is emptied.
 - ↳ Product residue still in the tank.
Signal OU1: buildup ≥ 0.1 mm
Signal OU2: conductivity < measured values from point 1, but > 0 $\mu\text{S}/\text{cm}$
6. Clean or rinse again.

7. Tank is emptied.
 - ↳ The sensor no longer detects any product residue.
Signal OU1: buildup ~ 0 mm
Signal OU2: conductivity ~ 0 $\mu\text{S}/\text{cm}$
-  Contact your Endress+Hauser sales partner if the device is to be used in pipes or tanks that are always filled, or to determine the homogeneity of mixtures.

11 Diagnostics and troubleshooting

11.1 Error indication

If an electronics/sensor defect is present in the device, the device changes to the error mode and displays the diagnostic event F270 via IO-Link communication. The status of the process data is rendered invalid.

When an error or a defect occurs, the analog outputs used (4 to 20 mA/frequency) switch to the defined failure current/frequency range.

11.2 General troubleshooting

Device does not respond

Supply voltage does not match the value indicated on the nameplate.

- ▶ Apply correct voltage.

The polarity of the supply voltage is wrong.

- ▶ Correct the polarity.

Connecting cables are not in contact with the terminals.

- ▶ Check for electrical contact between cables and correct.

No communication

Connecting cable is defective, incorrectly connected or is not making contact.

- ▶ Check wiring and cables.

There is an error in the device, which is preventing communication.

- ▶ Replace device.

No transmission of process data

Internal sensor error or electronics error.

- ▶ Correct all errors that are displayed as a diagnostic event .

11.3 Diagnostic information via light emitting diodes

Green LED not lit

No supply voltage.

- ▶ Check connector, cable and supply voltage.

LED not flashing

No communication.

- ▶ Check connector, cable, supply voltage and IO-Link master.

LED flashing red

Overload or short-circuit in load circuit.

- ▶ Clear the short-circuit.

Ambient temperature outside of specification.

- ▶ Operate measuring device in specified temperature range.

Red LED continuously lit

Internal sensor error.

- ▶ Replace device.

 There is no external signaling via LEDs on the metal housing cover (IP69).

11.4 Diagnostic events

11.4.1 Diagnostic message

Faults that are detected by the device's self-monitoring system are displayed as a diagnostic message via IO-Link.

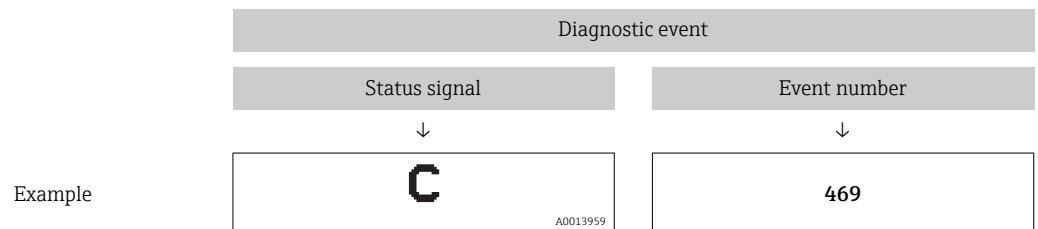
Status signals

The overview of diagnostic events lists the messages that may occur. The Actual Diagnostic (STA) parameter displays the message with the highest priority. The device has four different status information codes according to NE107:


F <small>A0013956</small>	"Failure" A device error has occurred. The measured value is no longer valid.
M <small>A0013957</small>	"Maintenance required" Maintenance is required. The measured value is still valid.
C <small>A0013959</small>	"Function check" The device is in the service mode (e. g. during a simulation).
S <small>A0013958</small>	"Out of specification" The device is being operated: <ul style="list-style-type: none"> ▪ Outside its technical specifications (e. g. during warm-up or cleaning process) ▪ Outside the parameter configuration undertaken by the user (e. g. level outside of configured span)

Diagnostics event and event text

The fault can be identified by means of the diagnostic event.



If two or more diagnostic events are pending simultaneously, only the message with the highest priority is shown.

 The last diagnostic message is displayed – see Last Diagnostic (LST) in the **Diagnosis** submenu.

11.4.2 Overview of diagnostic events

A: Status signal/diagnostic event

B: Diagnostic behavior

C: IO-Link/EventQualifier

D: EventCode

E: Event text

A	B	C	D	E
C485	Warning	IO-Link Warning	0x8C01 ¹⁾	Simulation active
S825	Warning	IO-Link Warning	0x1812	Ambient temperature outside of specification
S971	Warning	IO-Link Warning	0x1811	Measured value is outside sensor range
F270	Fault	IO-Link Error	0x5000	Defect in electronics/sensor
S803	Fault	IO-Link Error	0x1804	Current loop
S804	Fault	IO-Link Error	0x1801	Overload at output 1/2
C103	Message	IO-Link Message	0x1813	Sensor check failed
C182	Message	IO-Link Message	0x1807	Invalid calibration
-	Message	IO-Link Message	0x1814	Sensor check passed

1) EventCode as per IO-Link standard 1.1

Causes and remedial action

Warnings

C485

When the simulation of conductivity or buildup is active, the device displays a warning.

- ▶ Deactivate simulation.

S825

Ambient temperature outside of specification.

- ▶ Operate the device in the specified temperature range.

S971

The measured value is outside the set sensor range.

- ▶ Operate the device in the configured measuring range or set the measuring range.

Faults

F270

Electronics/sensor defective.

- ▶ Replace device.

S803

Impedance of load resistance at analog output too high.

- ▶ Check the cable and load at the current output.
- ▶ If a current output is not required, then switch off the current output via the configuration.
- ▶ Connect current output to load.

S804

Output 1/2 overloaded.

- ▶ Load at analog output is too high.
- ▶ Check the output circuit.
- ▶ Increase the load resistance at output 1/2.

*Messages***C103**

Sensor check failed.

- ▶ Check the installation position
- ▶ Clean or replace the sensor.

C182

Measuring range too small.

- ▶ Increase the measuring range

Sensor check passed

Sensor check passed (no status signal indicator).

- ▶ No action required.

11.5 Behavior of the device in the event of a fault

- Warnings and faults displayed via IO-Link
- The warnings and faults displayed are for information purposes only and do not have a safety function
- Errors diagnosed by the device are displayed via IO-Link in accordance with NE107

Depending on the diagnostic message, the device behaves as per a warning or fault condition.

- Warning:
 - The device continues measuring if this type of error occurs. The output signal is not affected (exception: simulation is active).
 - The current output or frequency output remains in the measuring mode.
- Fault:
 - The fault state is displayed via IO-Link.
 - In the fault state, the output concerned adopts its fault signal (current output < 3.6 mA/frequency output < 260 Hz)

11.6 Resetting the measuring device

Standard Command

Navigation

Parameter → System → Standard Command

Description

WARNING

If the user confirms the "Standard Command" function by pressing the "Reset to factory settings" button, this causes the device to be immediately reset to the as-delivered state.

Downstream processes can be affected. The behavior of the current outputs can change.

- ▶ Make sure that downstream processes are not started unintentionally.

To perform a reset there is no additional locking, e.g. device unlocking is not required to perform a reset. Furthermore, the device status is also reset. Any customer-specific configuration carried out at the factory is not affected by a reset (customer-specific configuration remains).

The following parameters are **not** reset when a reset is performed:

- Minimum μ C-Temperature
- Maximum μ C-Temperature
- Last Diagnostic (LST)
- Operating hours

12 Maintenance

No special maintenance work is required.

12.1 Cleaning

The sensor must be cleaned if necessary. Cleaning can also be done while it is installed (e.g. CIP Cleaning in Place / SIP Sterilization in Place). Care must be taken to ensure that no damage occurs to the sensor in the process.

13 Repair

Repair is not envisaged for this measuring device.

13.1 Return

The measuring device must be returned if the wrong device has been ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium.

For the procedure and conditions for safe, swift and professional device returns, see the information on the Endress+Hauser website at <http://www.endress.com/support/return-material>

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the website for more information:
<http://www.endress.com/support/return-material>
2. Return the device if the device must be repaired or replaced, or if the wrong device was ordered or delivered.

13.2 Disposal

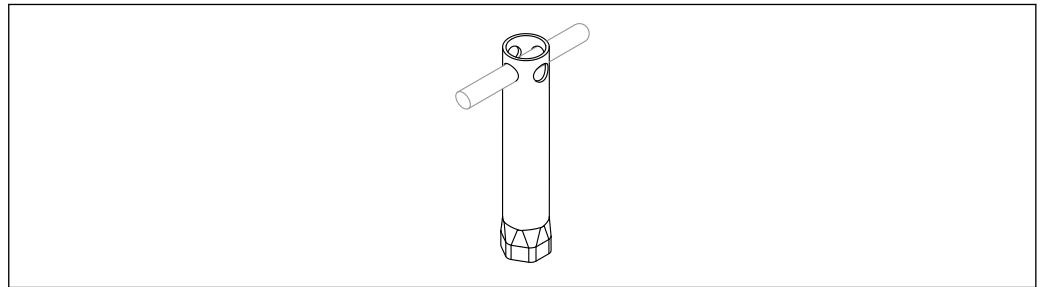


If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to Endress+Hauser for disposal under the applicable conditions.

14 Accessories

Accessories can be ordered with the device (optional) or separately.

14.1 Hexagon tubular socket wrench 32 mm



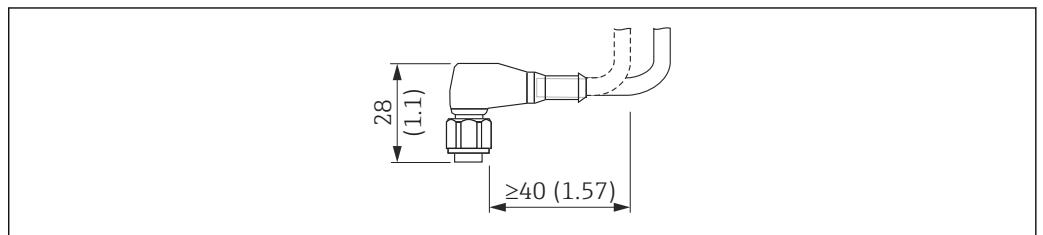
A0038864

11 Hexagon tubular socket wrench

Order number: 52010156

To mount the device in locations that are difficult to access.

14.2 Plug-in jack, elbowed 90°



A0024477

12 Example of plug-in jack M12. Unit of measurement mm (in)

Plug-in jack M12 IP69

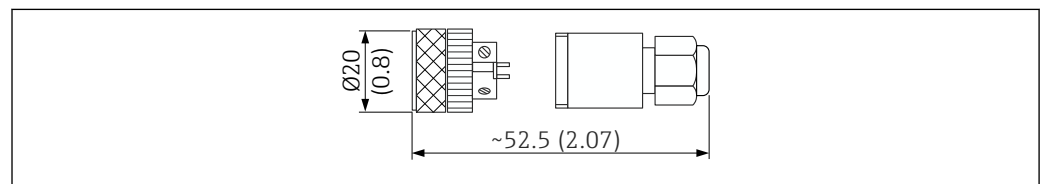
- Terminated connector
- 5 m (16 ft) PVC cable (orange)
- Body: PVC (orange)
- Slotted nut 316L (1.4435)
- Order number: 52024216

Plug-in jack M12 IP67

- Terminated connector
- 5 m (16 ft) PVC cable (gray)
- Body: PUR (blue)
- Slotted nut Cu Sn/Ni
- Order number: 52010285

i Core colors for M12 plug:

- 1 = BN (brown)
- 2 = WH (white)
- 3 = BU (blue)
- 4 = BK (black)

14.3 Plug-in jack, straight

13 Dimensions of self-terminated connection. Unit of measurement mm (in)

Plug-in jack M12 IP67

- Straight
- Self-terminated connection to M12 connector
- Body: PBT
- Slotted nut Cu Sn/Ni
- Order number: 52006263

14.4 Process adapter M24 thread**Material**

For all versions:

- Adapter
316L (1.4435)
- Seal
EPDM

Process adapter M24 PN25

Available versions:

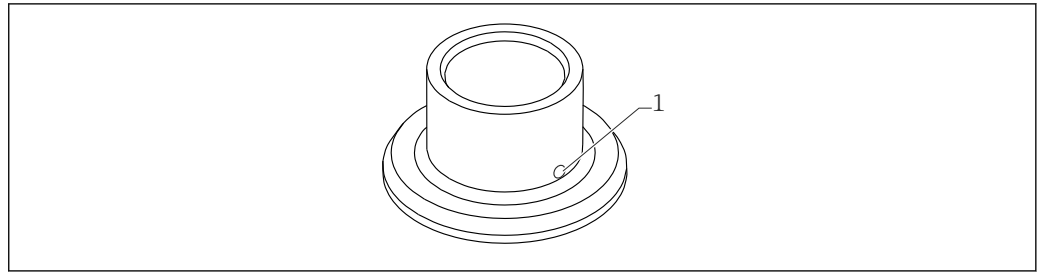
- DIN11851 DN50 with slotted nut
- SMS 1 1/2"

Process adapter M24 PN40

Available versions:

- Varivent F
- Varivent N

14.5 Weld-in adapter



A0023557

14 Sample drawing of weld-in adapter

1 Leakage hole

G 3/4"

Available versions:

- \varnothing 50 mm (1.97 in) - Installation on vessel
- \varnothing 29 mm (1.14 in) - Installation in pipe

G 1"

Available versions:

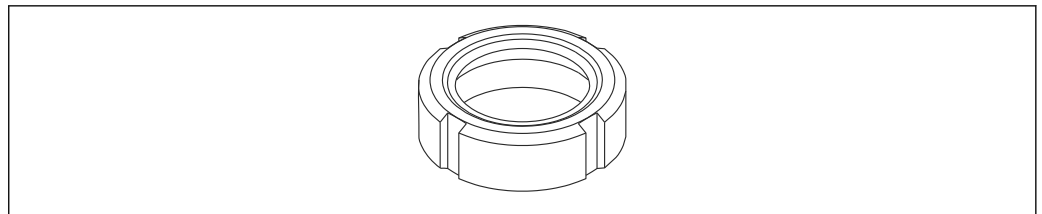
- \varnothing 53 mm (2.09 in) - Installation on vessel
- \varnothing 60 mm (2.36 in) - Installation on pipe

M24

Available versions:

- \varnothing 65 mm (2.56 in) - Installation on vessel

14.6 Grooved union nut DIN11851



A0023556

15 Sample drawing of grooved union nut

Material

For all versions:































304 (1.4307)

For milk pipe DIN11851

Available versions:

- DN25 - F26
- DN40 - F40
- DN50 - F50

15 Overview of the operating menu

Level 0 - IO-Link	Level 1	Level 2	Level 3	Details
Identification	Serial number			
	Firmware Version			
	Extended order code			→  29
	ProductID			
	ProductName			
	ProductText			
	VendorName			
	VendorText			
	Hardware Revision			
	ENP_VERSION			→  29
	Application Specific Tag			→  29
	Device Type			
	Diagnosis	Actual Diagnostics (STA)		
Last Diagnostic (LST)				→  29
Simulation buildup				→  30
Simulated buildup				→  30
Simulation conductivity				→  30
Simulated conductivity				→  30
Device search				→  30
Sensor check				→  31
Parameters	Application	Sensor	Operating Mode (OU1)	→  31
			Operating Mode (OU2)	→  31
			Damping buildup (TAU)	→  32
			Damping conductivity (TAU)	→  32
			DC-Media	→  32
			Calibrate buildup zero (GTZ)	→  32
			Offset buildup	→  32
			Get DC-Media	→  33
	Current Output 2 (OU2)	Lower Range Value for 4 mA	→  33	
		Upper Range Value for 20 mA	→  33	
		Frequency Output 2 (OU2)	Lower Range Value for 300 Hz	→  33
			Upper Range Value for 3000 Hz	→  33
	System		Operating hours	→  34
			µC-Temperature	→  34
			Unit changeover (UNI) - µC-Temperature	→  34
			Minimum µC-Temperature	→  34
			Maximum µC-Temperature	→  35
Reset µC-Temperatures			→  35	
Standard Command			→  23	
Device Access Locks.Data Storage Lock			→  35	

16 Description of Device Parameters

16.1 Identification

Extended order code

Navigation	Identification → Extended order code
Description	Used to replace (reorder) the device. Displays the extended order code (max. 60 alphanumeric characters).
Factory setting	As per order specifications

ENP_VERSION

Navigation	Identification → ENP_VERSION
Description	Displays the ENP version (ENP: electronic name plate)

Application Specific Tag

Navigation	Identification → Application Specific Tag
Description	Used for unique identification of device in the field. Enter device tag (max. 32 alphanumeric characters).
Factory setting	As per order specifications

16.2 Diagnosis

Actual Diagnostics (STA)

Navigation	Diagnosis → Actual Diagnostics (STA)
Description	Displays the current device status.

Last Diagnostic (LST)

Navigation	Diagnosis → Last Diagnostic (LST)
Description	Displays the last device status (error or warning) that was rectified during operation.

Simulation buildup/Simulation conductivity

Navigation	Diagnosis → Simulation buildup/Simulation conductivity
Description	Parameter switches the simulation on or off. The value to be simulated can be configured in the Simulated buildup/Simulated conductivity parameter.
Options	ON OFF
Factory setting	OFF

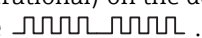
Simulated buildup

Navigation	Diagnosis → Simulated buildup
Description	The value to be simulated is entered in this parameter. If simulation is activated, the value is output via the corresponding outputs and IO-Link. A warning indicates that the device is in the simulation mode. A warning is output via IO-Link (C485 - simulation active). The simulation must be ended actively via the menu. If the device is disconnected from the power supply during the simulation and power is then resupplied, the simulation mode is not resumed, and instead the device continues operation in the measuring mode.
Options	0 to 10.0 mm (editable)

Simulated conductivity


Navigation	Diagnosis → Simulated conductivity
Description	The value to be simulated is entered in this parameter. When simulation is activated, this value is output via the corresponding outputs and IO-Link. If a simulation is active, a warning to this effect is displayed so that it is clear to the user that the device is in the simulation mode. A warning is communicated via IO-Link (C485 - simulation active). The simulation must be ended actively via the menu. If the device is disconnected from the power supply during the simulation and power is then resupplied, the simulation mode is not resumed, and instead the device continues operation in the measuring mode.
Options	0 to 110 000.0 (editable)

Device search

Navigation	Diagnosis → Device search
Description	This parameter is used to uniquely identify the device during installation. The green LED is lit (= operational) on the device and starts to flash with increased luminosity, flash sequence  .

Note	There is no external signaling via LEDs on the metal housing cover (IP69).
Options	<ul style="list-style-type: none"> ■ OFF ■ ON
Factory setting	OFF

Sensor check

Navigation	Diagnosis → Sensor check
Description	<p>This parameter is used to test if the sensor is functioning correctly. The sensor must not be covered and must be free of residue. The device compares the current measured values with the measured values from the factory calibration.</p> <p> The device must be removed before the sensor check since the free value is influenced by the type of installation.</p>
Options	<p>One of the following messages is displayed following the test:</p> <ul style="list-style-type: none"> ■ Sensor check passed; message (0x1814) ■ Sensor check failed; message C103 (0x1813)

16.3 Parameters

16.3.1 Application

Sensor

Operating Mode (OU1) Operating Mode (OU2)

Navigation	<p>Application → Sensor → Operating Mode (OU1)</p> <p>Application → Sensor → Operating Mode (OU2)</p>
Description	The parameter is used to assign the physical outputs to the process data.
Note	<p>Options for:</p> <ul style="list-style-type: none"> ■ Physical output 1: off or frequency (buildup) ■ Physical output 2: off, current (conductivity or buildup) or frequency (conductivity)
Switch-on value	As per current configuration in the device
Options	<p>OU1</p> <ul style="list-style-type: none"> ■ OFF ■ Frequency (buildup) <p>OU2</p> <ul style="list-style-type: none"> ■ OFF ■ 4 to 20 mA (buildup) ■ 4 to 20 mA (conductivity) ■ Frequency (conductivity)

Damping buildup (TAU)
Damping conductivity (TAU)

Navigation	Application → Sensor → Damping buildup (TAU) Application → Sensor → Damping conductivity (TAU)
Description	The parameter affects the display of the measured value with a time lag according to the behavior of a PT ₁ element. A TAU corresponds to 63.2 % of the expected measured value. The measured value is reached after 5 TAU.
Switch-on value	As set in the device.
Input range	0.1 to 60.0 s
Factory setting	2 s
Note	The damping setting can be ordered as a preset value in the product structure via order code 570 "Service", option HS "Damping setting to spec."

DC-Media

Navigation	Application → Sensor → DC-Media
Note	The dielectric constant can be ordered as preset to 2.7 in the product structure via order code 570 "Service", option HT "Configuration output 1 + output 2".
Description	For applications with non-conductive media, the preset value for the dielectric constant can be adjusted or changed to the value of the current medium. The dielectric constant value is used as a multiplier for calculating the buildup of non-conductive media.
Input range	1.5 to 85
Factory setting	13

Calibrate buildup zero (GTZ)

Navigation	Application → Sensor → Calibrate buildup zero (GTZ)
Note	Only perform this function when the installation is empty.
Description	Permanent buildup which is not relevant can be automatically suppressed with this function. The value determined is applied to the "Offset buildup" parameter.
Options	Set Zero Empty

Offset buildup

Navigation	Application → Sensor → Offset buildup
Description	The parameter displays the value that was last suppressed by the device in the "Calibrate buildup zero (GTZ)" parameter. Alternatively, a manually defined value for signal suppression can also be entered here.
Input range	0 to 9.0 mA

Get DC-Media

Navigation	Application → Sensor → Get DC-Media
Note	This function can only be used with media conductivity values $\geq 5 \mu\text{S/cm}$. The system must be filled completely to use this function.
Description	This function determines the current dielectric constant of the medium present. The value determined for the dielectric constant is communicated to the DC-Media parameter.

Current Output 2 (OU2)

Lower Range Value for 4 mA (LRV) Upper Range Value for 20 mA (URV)

Navigation	Application → Current Output 2 (OU2) → Lower Range Value for 4 mA (LRV) Application → Current Output 2 (OU2) → Upper Range Value for 20 mA (URV)
Note	The configured measuring range for buildup is always = 0 to 10. The parameter is therefore not displayed in this case. The configured measuring range for conductivity can be changed. The span can be ordered as a preset value in the product structure via order code 570 "Service", option HT "Configuration output 1 + output 2".
Description	For specifying the measuring range for the current output.
Input range: Minimum span:	0 to 110 000.0 1 000.0
Switch on value	Last configured value.

Frequency Output 2 (OU2)

Lower Range Value for 300 Hz (LRV) Upper Range Value for 3000 Hz (URV)

Navigation	Application → Frequency Output 2 (OU2) → Lower Range Value for 300 Hz (LRV) Application → Frequency Output 2 (OU2) → Upper Range Value for 3000 Hz (URV)
-------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------

Note	The configured measuring range for buildup is always = 0 to 10. The parameter is therefore not shown/displayed in this case. The configured measuring range for conductivity can be changed. The span can be ordered as a preset value in the product structure via order code 570 "Service", option HT "Configuration output 1 + output 2".
Description	For specifying the measuring range for the frequency output.
Input range	0 to 110 000.0
Minimum span	1000,0
Switch on value	Last configured value.

16.3.2 System

Operating hours

Navigation	Parameter → System → Operating hours
Description	This parameter counts the operating hours during the period in which operating voltage is present. The value is output in industrial hours.

µC-temperature

Navigation	Parameter → System → µC-temperature
Description	This parameter displays the current µC-temperature on the electronics.

Unit changeover (UNI) - µC-Temperature

Navigation	Parameter → System → Unit changeover (UNI) - µC-Temperature
Description	This parameter is used to select the electronics temperature unit. Once a new electronics temperature unit has been selected, the value is converted to the new unit and displayed.
Switch on value	Last unit selected prior to switching off.
Options	°C °F K
Factory setting	°C

Minimum µC-Temperature

Navigation Parameter → System → Minimum μ C-Temperature

Description This parameter is used as the minimum peak indicator and makes it possible to call up retroactively the lowest electronics temperature measured.

Maximum μ C-Temperature

Navigation Parameter → System → Maximum μ C-Temperature

Description This parameter is used as the maximum peak indicator and makes it possible to call up retroactively the highest electronics temperature measured.

Reset μ C-Temperature

Navigation Parameter → System → Reset μ C-Temperature

Description Use this function to set the maximum/minimum peak indicators for the μ C temperature to the temperature currently present. The minimum and maximum indicators have the same value once the function has been executed.

Standard Command

Navigation Parameter → System → Standard Command

Description

⚠ WARNING

If the user confirms the "Standard Command" function by pressing the "Reset to factory settings" button, this causes the device to be immediately reset to the as-delivered state.

Downstream processes can be affected. The behavior of the current outputs can change.
 ► Make sure that downstream processes are not started unintentionally.

To perform a reset there is no additional locking, e.g. device unlocking is not required to perform a reset. Furthermore, the device status is also reset. Any customer-specific configuration carried out at the factory is not affected by a reset (customer-specific configuration remains).

The following parameters are **not** reset when a reset is performed:

- Minimum μ C-Temperature
- Maximum μ C-Temperature
- Last Diagnostic (LST)
- Operating hours

Device Access Locks.Data Storage Lock ¹⁾ Activation/deactivation of data storage

1) The "Device Access Locks.Data Storage Lock" parameter is an IO-Link standard parameter. The name of the parameter may be available in the language configured in the IO-Link operating tool that is used. The display depends on the particular operating tool.

Navigation Parameter → System → Device Access Locks.Data Storage Lock

Description	<p>The device supports data storage. When the device is replaced, the configuration of the old device can be written to the new device.</p> <p>The Device Access Locks.Data Storage Lock parameter can be used to prevent the parameters from being overwritten. The original configuration of the new device is maintained.</p> <p>If the "true" option is selected, the new device does not apply the data that are saved in the master's data storage.</p>
Options	<p>false</p> <p>true</p>

17 Technical data

17.1 Input

Measured process variable

Electrical conductivity, dielectric constant (ϵ_r) of the medium

Calculated process variable

Thickness of buildup

Measuring range	<p>Conductivity 0 $\mu\text{S}/\text{cm}$ to 100 mS/cm Minimum permitted span: 3 000 $\mu\text{S}/\text{cm}$ can be ordered; 1 000 $\mu\text{S}/\text{cm}$ can be configured at the device via the IO-Link interface</p> <p>Thickness of buildup 0 to 10 mm</p>
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17.2 Output

Output signal	<p>The following options can be selected in the Product Configurator, order code for "Output":</p> <p>Preconfigured assignment of the outputs:</p> <ul style="list-style-type: none"> ■ Option B <ul style="list-style-type: none"> ■ OU1: frequency (buildup) ■ OU2: frequency (conductivity) ■ Option C <ul style="list-style-type: none"> ■ OU1: frequency (buildup) ■ OU2: 4 to 20 mA (conductivity) <p>Select the HT option if the device is to be adjusted to non-conductive media and the measuring range is to be preconfigured.</p> <p>Variable assignment of the outputs with the conductivity and thickness of buildup parameters:</p> <ul style="list-style-type: none"> ■ Option 7 <ul style="list-style-type: none"> ■ OU1: IO-Link ■ OU2: 4 to 20 mA (off, conductivity or buildup depending on the order, select the HT option) ■ Option 8 <ul style="list-style-type: none"> ■ OU1: IO-Link ■ OU2: frequency (off or conductivity depending on the order, select the HT option)
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Signal on alarm The behavior of the output in the event of a failure is regulated in accordance with NAMUR NE43.

Frequency

$f < 260 \text{ Hz}$

Current

$I < 3.6 \text{ mA}$ (as per NAMUR NE43)

- Failure current is output and "S803" displayed (output: MIN alarm current)
- Periodic checking to establish if it is possible to quit fault state

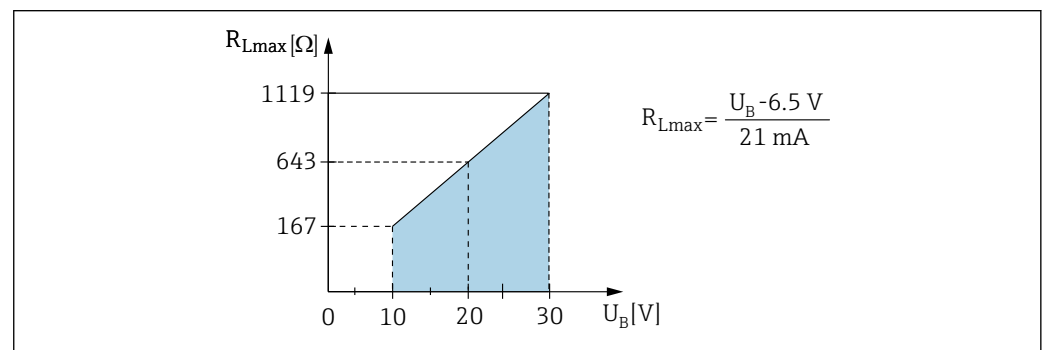
Signal range

- Frequency, lower range value: 300 Hz
- Frequency, end: 3 000 Hz
- Signal range: 270 to 3 100 Hz
- Current: 3.8 to 20.5 mA

Load

Load for 4 to 20 mA output

Depends on the supply voltage U_B of the power supply unit: do not exceed the maximum load resistance R_L (including supply line resistance) as otherwise it will not be possible to set the corresponding current.



16 Load for 4 to 20 mA output

17.3 Performance characteristics

Reference operating conditions

- Ambient temperature: constant 20 °C (68 °F) $\pm 5 \text{ °C}$ (9 °F)
- Medium: water, conductivity approx. $200 \text{ } \mu\text{S/cm}$
- Medium temperature: 20 °C (68 °F) $\pm 5 \text{ °C}$ (9 °F)
 - Conductivity: fully covered, sensor covered by 20 mm of medium
 - Coverage: up to max. 6 mm

Maximum measured error under reference conditions

Conductivity

$\leq 5 \%$

Typical measured error


Conductivity

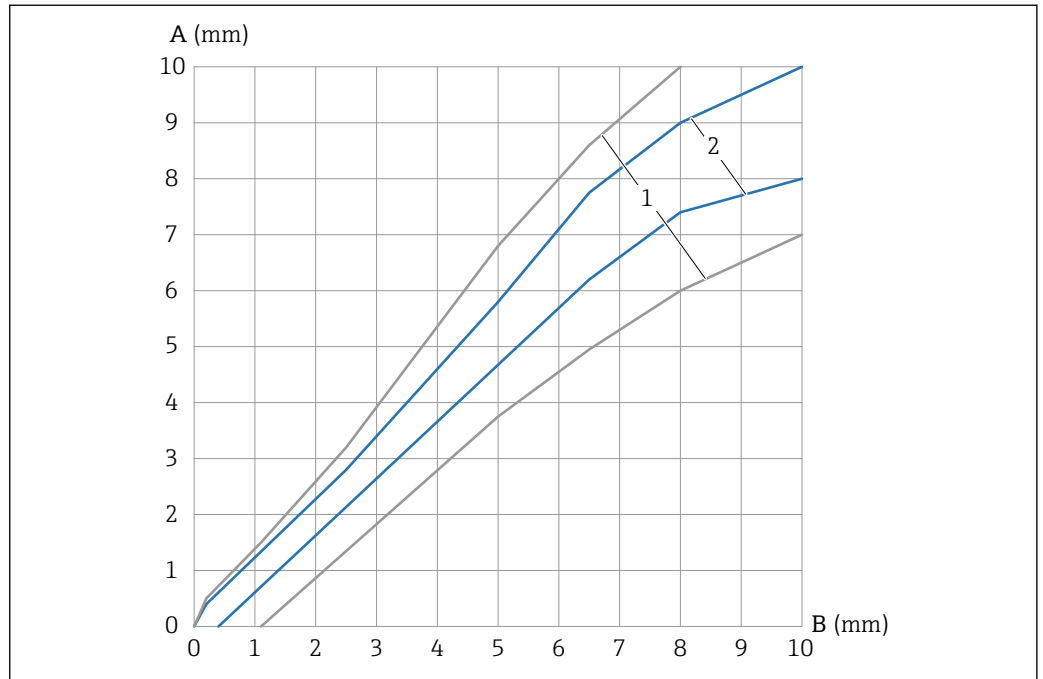
0 to 2 mS/cm: $\leq 5 \%$ of reading $\pm 0.2 \text{ } \mu\text{S/cm}$
 2 to 20 mS/cm: $\leq 7 \%$ of reading
 20 to 50 mS/cm: $\leq 10 \%$ of reading
 50 to 100 mS/cm: $\leq 15 \%$ of reading


The sensor must be covered by at least 20 mm of medium.

The data indicated are typical measured errors. In individual cases, the effects of factors such as polarization can result in different values.

Buildup

 The typical measured error is between the limits indicated.



 17 Buildup measured error

- A Buildup measured value
- B Actual buildup
- 1 0 to 100 mS/cm
- 2 0.01 to 20 mS/cm

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Non-repeatability

Conductivity

- 0 to 2 mS/cm: $\leq 0.5\%$ of reading $\pm 0.2 \mu\text{S/cm}$
- 2 to 20 mS/cm: $\leq 0.75\%$ of reading
- 20 to 50 mS/cm: $\leq 1.5\%$ of reading
- 50 to 100 mS/cm: $\leq 2.5\%$ of reading

Buildup

$\leq 0.25 \text{ mm}$

Switch-on time

$< 2 \text{ s}$

Response time

Configurable damping

- 0.1 to 60 s
- T63: as per set damping. Output has behavior of PT₁ element.

Dead time

250 ms

17.4 Environment


Ambient temperature range

At the housing: -40 to $+70 \text{ }^\circ\text{C}$ (-40 to $+158 \text{ }^\circ\text{F}$)

Storage temperature

-40 to $+85 \text{ }^\circ\text{C}$ (-40 to $+185 \text{ }^\circ\text{F}$)

Humidity	Operation up to 100 %. Do not connect in a condensing atmosphere.
Operating altitude	Up to 2 000 m (6 600 ft) above sea level
Pollution degree	Pollution degree 4
Climate class	DIN EN 60068-2-38/IEC 68-2-38: Test Z/AD
Degree of protection	<ul style="list-style-type: none"> ■ IP65/67 NEMA type 4X enclosure (plastic housing cover) ■ IP66/68/69 NEMA type 4X/6P enclosure (metal housing cover)
Vibration resistance	As per test Fh, EN 60068-2-64:2008: $a(\text{RMS}) = 50 \text{ m/s}^2$, $f = 5 \text{ to } 2\,000 \text{ Hz}$, $t = 3 \text{ axes} \times 2 \text{ h}$
Shock resistance	As per test Ea, prEN 60068-2-27:2007: $a = 300 \text{ m/s}^2 = 30 \text{ g}$, $3 \text{ axes} \times 2 \text{ directions} \times 3 \text{ shocks} \times 18 \text{ ms}$
Cleaning	Resistant to typical cleaning agents from the outside, in accordance with Ecolab test.

Electromagnetic compatibility	<p>Electromagnetic compatibility in accordance with all the relevant requirements of the EN 61326 series.</p> <p> Details: Declaration of Conformity</p> <p>Only the requirements of IEC/EN 61131-9 are met if IO-Link communication is used.</p> <p>If the device is installed in plastic structures, its function may be influenced by strong electromagnetic fields. Emission requirements for class A equipment are met (only for use in "industrial environments").</p>
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17.5 Process

Process temperature range	<p>-20 to +100 °C (-4 to +212 °F)</p> <ul style="list-style-type: none"> ■ For 1 h: +150 °C (+302 °F) ■ M24 process adapter with EPDM process seal for 1 h: +130 °C (+266 °F)
Process pressure range	-1 to +25 bar (-14.5 to +362.5 psi)

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