Operating Instructions
Liquipoint FTW33

Conductive and capacitance point level measurement

IO-Link

Endress+Hauser

People for Process Automation
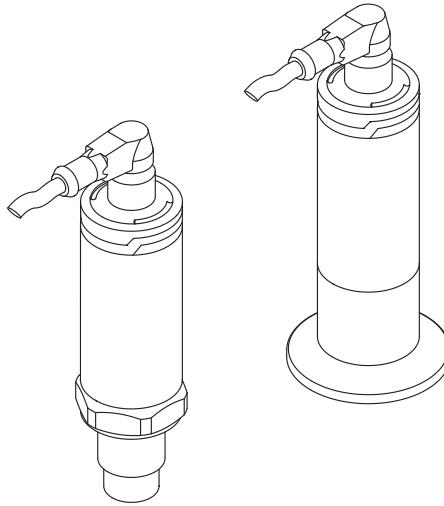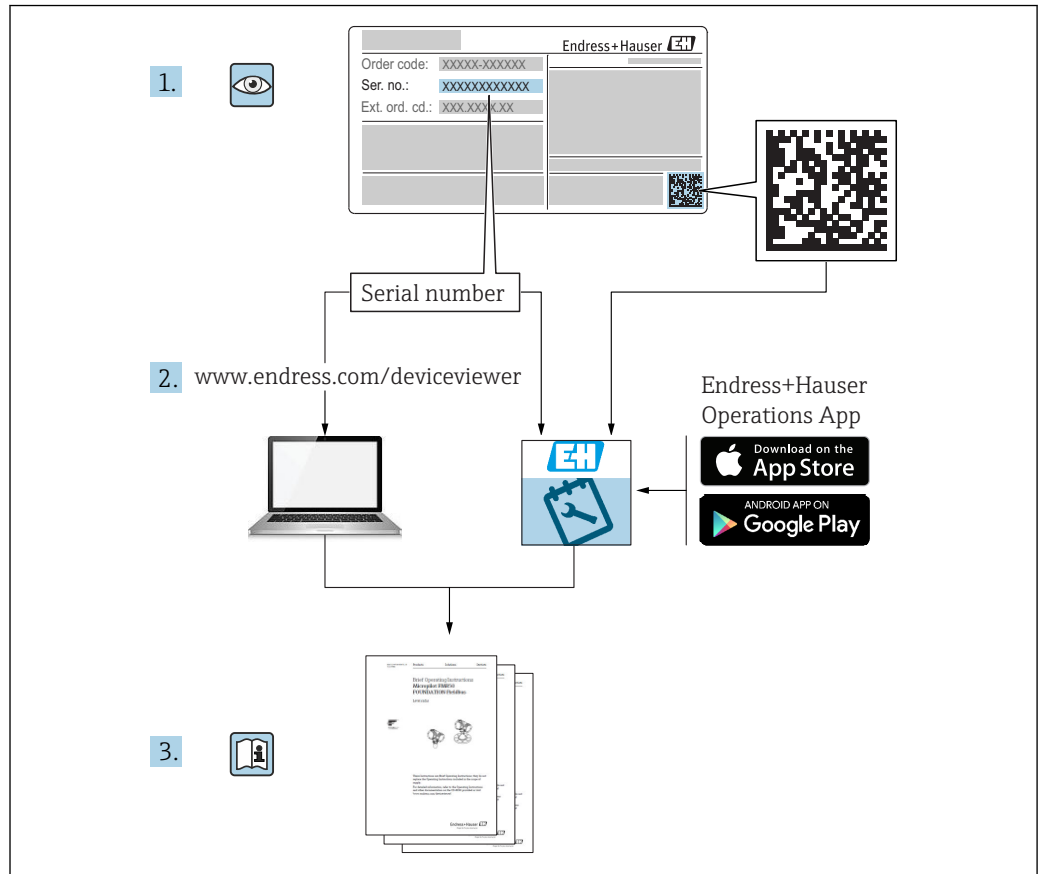
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Table of contents

1   About this document

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

1.2   Symbols used

1.2.1   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.

1.2.2   Tool symbols

✍
Open-ended wrench

1.2.3   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

i

Tip
Indicates additional information

▶

Notice or individual step to be observed

1. , 2. , 3.
Series of steps

└▸
Result of a step

1, 2, 3, …
Item numbers

A, B, C, …
Views

⚠EX
Hazardous area
Indicates the hazardous area

⚠
Safe area (non-hazardous area)
Indicates the non-hazardous area

⚠ → 📖
Safety instructions
Observe the safety instructions contained in the associated Operating Instructions

1.3   Documentation

The following documentation types are available in the Downloads area of the Endress
+Hauser website (www.endress.com/downloads):

i 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

1.3.1   Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of
the accessories and other products that can be ordered for the device.

1.3.2   Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value
The Brief Operating Instructions contain all the essential information from incoming
acceptance to initial commissioning.

1.3.3   Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the
device. They are an integral part of the Operating Instructions.

i The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

1.4   Registered trademarks

◈ IO-Link®

Is a registered trademark. It may only be used in conjunction with products and services by members of the IO-Link Community or by non-members who hold an appropriate license. For more detailed information on the use of IO-Link, please refer to the rules of the IO-Link Community at: www.io.link.com.

2   Basic safety instructions

2.1   Requirements for the personnel

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

The operating personnel must fulfill the following requirements:
- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2   Designated use

Application and media
The device described in these instructions may only be used as a point level switch for liquids and foams.

To ensure that the measuring device remains in proper condition for the operating time:
- ▶ Use the device only for media to which the process-wetted materials are sufficiently resistant.
- ▶ Observe the limit values in "Technical data".

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

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

Residual risks
Due to heat transfer from the process as well as power dissipation within the electronics, the temperature of the electronics housing and the assemblies contained therein may rise to 80 ℃ (176 ℉) during operation. When in operation, the sensor may reach a temperature close to the medium temperature.

Danger of burns from contact with surfaces!
- ▶ In the event of elevated fluid temperatures, ensure protection against contact to prevent burns.

2.3   Workplace safety

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

Conversions 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 the manufacturer.

Repair

To ensure continued operational safety and reliability,
▶ Carry out repairs on the device only if they are expressly permitted.
▶ Observe federal/national regulations pertaining to repair of an electrical device.
▶ Use original spare parts and accessories from the manufacturer only.

Hazardous area

To eliminate a danger for persons or for the facility when the device is used in the hazardous area (e.g. explosion protection, pressure vessel safety):
▶ Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area.
▶ Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

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.

3   Product description

Compact point level switch for liquids and pastes; to be used preferably in pipes and in storage, mixing and process vessels with or without an agitator for flush-mounted installation.

3.1   Product design
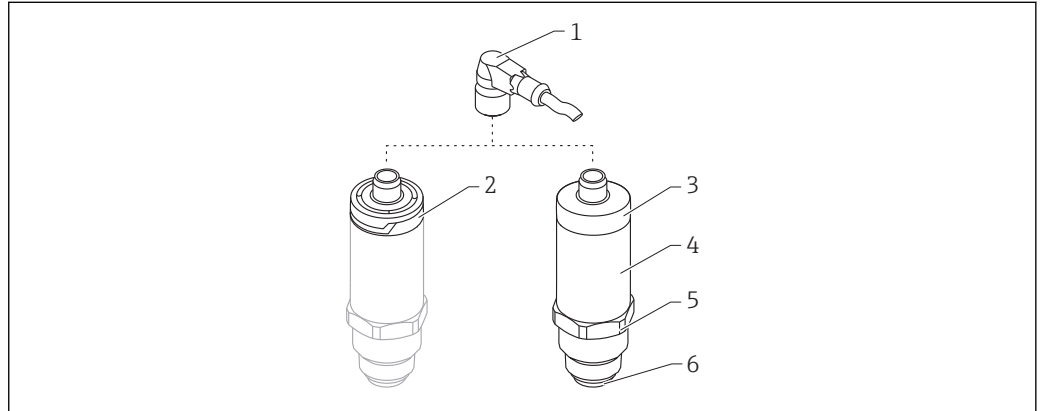
⊞ 1   Product design

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?

ℹ️   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
- Extended order code with breakdown of the device features on the delivery note

▸   Enter the serial number from the nameplates into *W@M Device Viewer*
   (www.endress.com/deviceviewer)
   ↳   All the information about the measuring device and the scope of the associated
      Technical Documentation are displayed.

▸   Enter the serial number from the nameplate into the *Endress+Hauser Operations App*
   or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code)
   provided on the nameplate
   ↳   All the information about the measuring device and the scope of the 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
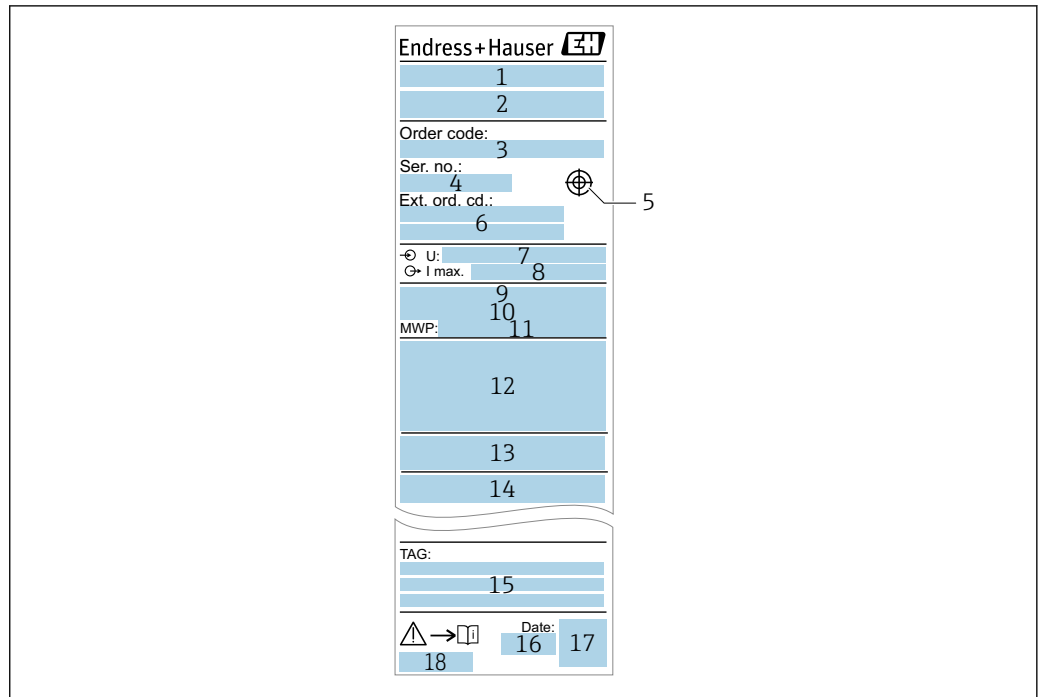
A0036915

1   Device name
2   Manufacturer address
3   Order code
4   Serial number
5   Marking for test magnet
6   Extended order code
7   Supply voltage
8   Signal output
9   Process temperature
10 Ambient temperature range
11 Process pressure
12 Certificate symbols, communication mode (optional)
13 Degree of protection: e. g. IP, NEMA
14 Certificate and approval relevant data
15 Measuring point identification (optional)
16 Manufacturing date: year-month
17 2-D matrix code (QR code)
18 Document number of Operating Instructions

4.5 Storage, Transport

4.5.1 Storage conditions

- Permitted storage temperature: –40 to +85 ℃ (–40 to +185 ℉)
- 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 is possible in any position in a vessel, pipe or tank.
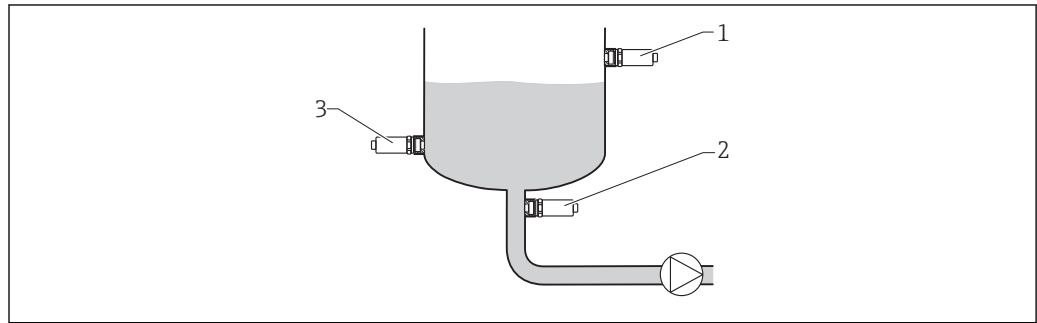
🖾 2   Installation examples

1   Overfill prevention or upper level detection (maximum safety)
2   Dry running protection for pump (minimum safety)
3   Lower level detection (minimum safety)

5.1.2   Installation in pipes

🖾 3   Mounting position in horizontal pipes

🖾 4   The measurement can be impaired if the sensor is partially covered or if air bubbles occur at the sensor.

🔲 *5   Flush-mounted installation*

5.1.3   Special mounting instructions

- Protect housing against impact.
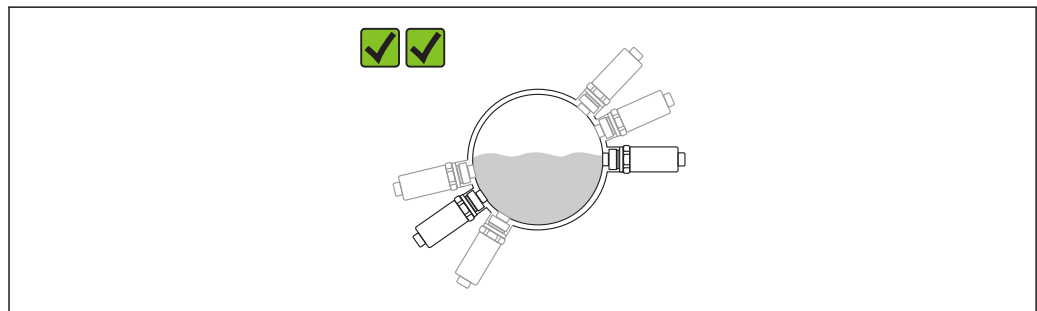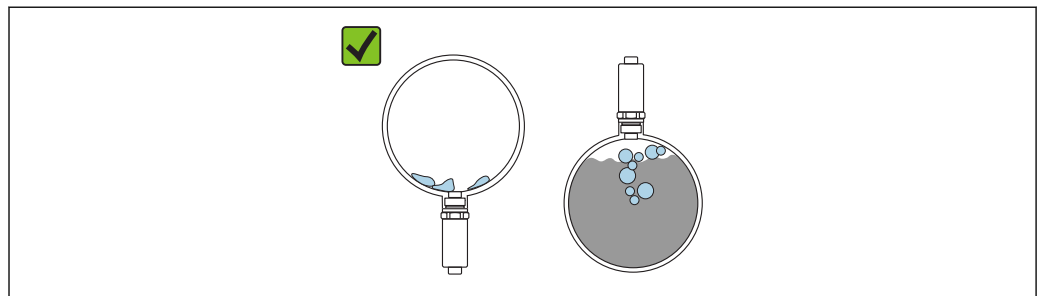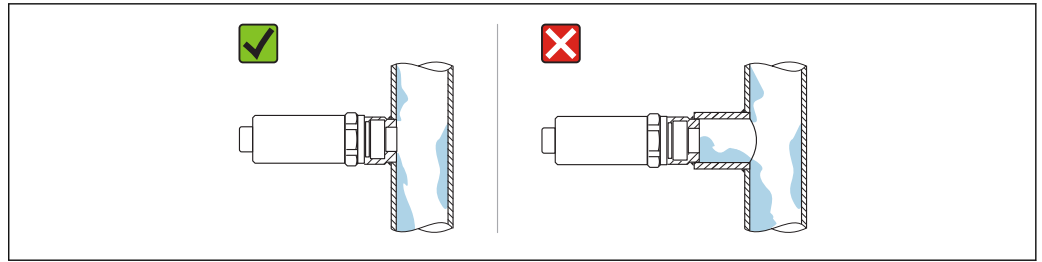- Moisture must not penetrate the housing when mounting the device, establishing the electrical connection and during operation.
- In the IP69 version, only remove the protection cap from the M12 plug shortly before establishing the electrical connection.

5.2   Installing the device

5.2.1   Required tools

Open-ended wrench or, for measuring points that are difficult to access, a hexagon tubular socket wrench 32 mm [1]
– When screwing in, turn by the hex bolt only.
– Torque: 15 to 30 Nm (11 to 22 lbf ft).

5.2.2   Installation
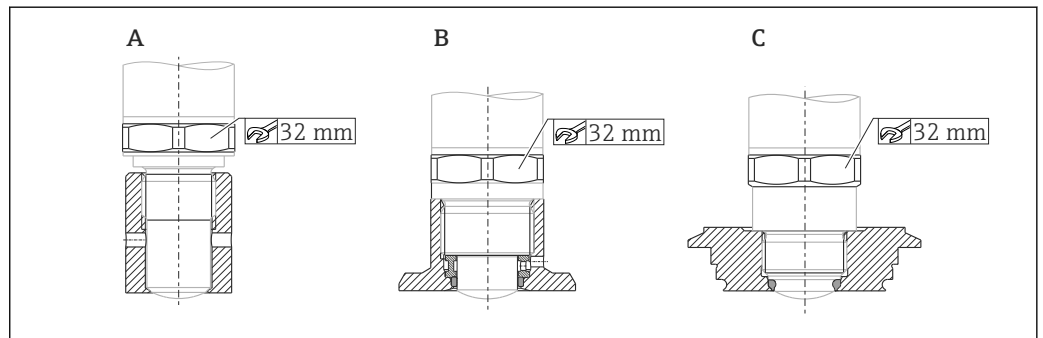
A   Thread G ½"
B   Thread G ¾"/G 1"
C   Thread M24 × 1.5

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

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1)   Can be ordered as an optional accessory

❏ 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 Connection conditions

The measuring device has two modes of operation:

- Maximum point level detection (MAX): e. g. for overfill prevention
  The device keeps the electrical switch closed as long as the sensor is not yet covered by liquid or the measured value is within the process window.
- Minimum point level detection (MIN): e. g. to protect pumps from dry running.
  The device keeps the electrical switch closed as long as the sensor is covered by liquid or the measured value is outside the process window.

Choosing the "MAX"/"MIN" mode of operation ensures that the device switches in a safe manner even in the event of an alarm condition, e. g. if the power supply line is disconnected. The electronic switch opens if the point level is reached, if a fault occurs or if the power fails (quiescent current principle).

- IO-Link: Communication on pin 4; switch mode on pin 2.
- SIO mode: If there is no communication, the device switches to the SIO mode = standard IO mode.

The functions configured in the factory for the MAX and MIN modes can be changed via IO-Link:

HNO/HNC hysteresis

6.2 Supply voltage

SIO mode
10 to 30 VDC

IO-Link mode
18 to 30 VDC

IO-Link communication is guaranteed only if the supply voltage is at least 18 V.

6.3 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 separate 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.
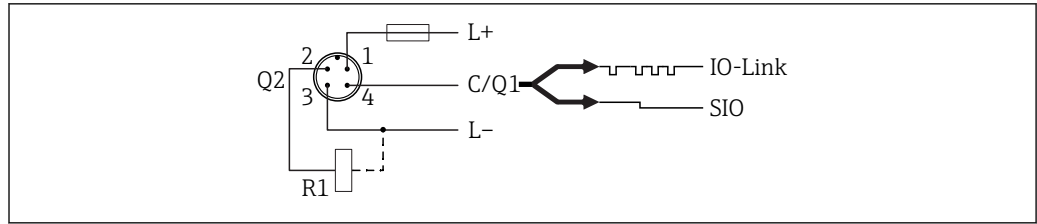
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Pin 1   Supply voltage +
Pin 2   2nd switch output
Pin 3   Supply voltage -
Pin 4   IO-Link communication or 1st switch output (SIO mode)

6.3.1   SIO mode (without IO-Link communication)

Minimum safety		
Terminal assignment	**MIN output**	**LED yellow (ye) 1**
		ye1
	$+ \llcorner 4$	
	$+ \diagup 4$	
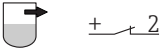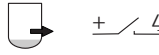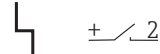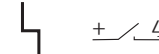
Maximum safety		
Terminal assignment	**MAX output**	**LED yellow (ye) 2**
		ye2
	$+ \diagup 2$	
	$+ \llcorner 2$	

Function monitoring

When both outputs are connected, the MIN and MAX outputs assume opposite states (XOR) when the device is operating fault-free. In the event of an alarm condition or a cable break, both outputs are de-energized. This means that function monitoring is possible in addition to level monitoring. The behavior of the switch outputs can be configured via IO-Link.

Connection for function monitoring using XOR operation					
Terminal assignment	**MAX output**	**LED yellow (ye) 2**	**MIN output**	**LED yellow (ye) 1**	**LED red (rd)**
	ye2		ye1		
	$+ \diagup 2$		$+ \llcorner 4$		

Connection for function monitoring using XOR operation					
Terminal assignment	**MAX output**	**LED yellow (ye) 2**	**MIN output**	**LED yellow (ye) 1**	**LED red (rd)**
	+ 2	⦿	+ 4	⦿	⦿
	+ 2	⦿	+ 4	⦿	☼

6.4   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 Local operation

7.1.1 Operational display (LEDs)
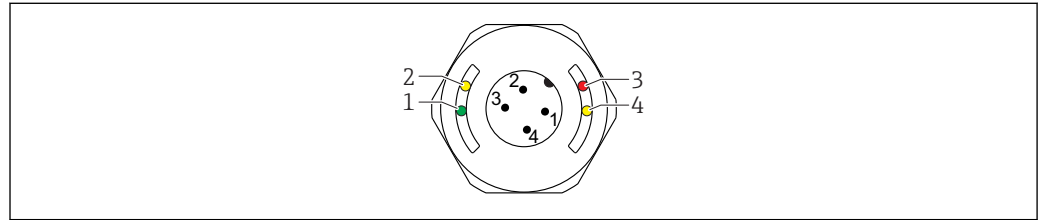
⊡ 6   LEDs in the housing cover

1   Status/Communication
2   Switch status/switch output 2
3   Warning/Maintenance required
4   Switch status/switch output 1

ℹ️ There is no external signaling via LEDs on the metal housing cover (IP69). A connecting cable with an M12 plug and LED indicator can be ordered as an accessory if necessary. See "Accessories".

7.2 Operation via test magnet

The test magnet is included in the scope of delivery.

A switch output function test can be carried out directly at the machine by means of a test magnet.

7.3 Operation via IO-Link operating menu

7.3.1 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 while in operation.

Physical layer, the devices supports the following features:
- IO-Link specification: version 1.1
- IO-Link Smart Sensor Profile 2nd Edition
- SIO mode: Yes
- Speed: COM2; 38.4 kBaud
- Minimum cycle time: TBD
- Process data width: 16 bit
- IO-Link data storage: Yes
- Block configuration: Yes
- Device operational: The device is operational 4 s after the supply voltage has been applied

7.3.2   IO-Link download

http://www.endress.com/download
- Select "Software" as the media type.
- Select "Device Driver" as the software type.
  Select IO-Link (IODD).
- In the "Text Search" field enter the device name.

8 Overview of the operating menu

The menu structure has been implemented according to VDMA 24574-1 and complemented by Endress+Hauser-specific menu items.

IO-Link	Level 1	Level 2	Details
Identification	Serial number		
	Firmware version		
	Extended Ordercode		→ 🕮 33
	ProductName		
	ProductText	Capacitance point level switch	
	VendorName		
	VendorText		
	Hardware Revision		
	ENP_VERSION		→ 🕮 33
	Application Specific Tag		→ 🕮 33
	Device Type		
Diagnosis	Actual Diagnostics (STA)		→ 🕮 34
	Last Diagnostic (LST)		→ 🕮 34
	Simulation Switch Output (OU1)		→ 🕮 34
	Simulation Switch Output (OU2)		→ 🕮 34
	Device search		→ 🕮 35
	Sensor check		→ 🕮 35
Parameter	Application	Active switchpoints	→ 🕮 36
		Reset user switchpoints	
		Calibrate coverage, Output 1/2 (OU1/OU2)	
		Switch point value, Output 1/2 (SP1/SP2) Switchback point value, Output 1/2 (rP1/rP2) (Coverage)	→ 🕮 36
		Switching delay time, Output 1/2 (dS1/dS2) Switchback delay time, Output 1/2 (dR1/dS2)	→ 🕮 37
		Output 1/2 (OU1/OU2)	→ 🕮 38
	System	Operating hours	→ 🕮 39
		µC-temperature	→ 🕮 39
		Unit changeover (UNI) - µC-temperature	→ 🕮 39
		Minimum µC-temperature	→ 🕮 39
		Maximum µC-temperature	→ 🕮 39
		Reset µC-temperatures	
		Reset to factory settings (RES)	
		Device Access Locks.Data Storage Lock	→ 🕮 40
Observation	Coverage		→ 🕮 40
	Switch State Output 1 (OU1)		→ 🕮 40
	Switch State Output 2 (OU2)		→ 🕮 40

9 System integration

9.1 Process data

The device has two switch outputs. Both outputs are transmitted as process data via IO-Link.
- In the SIO mode, switch output 1 is switched at pin 4 of the M12 plug. In the IO-Link communication mode, this pin is reserved exclusively for communication.
- In addition, switch output 2 is always switched at pin 2 of the M12 plug.
- The process data of the point level switch are transmitted cyclically in 16-bit chunks.

Bit	0 (LSB)	1	...	12	13 (MSB)	14	15
Device	Coverage [0 to 100 %], resolution approx. 0.1 %					OU1	OU2

Bit 14 reflects the status of switch output 1 and bit 15 the status of switch output 2. Here, the logical state "1" at the specific switch output corresponds to "closed" or 24 V_{DC}.

The remaining 14 bits contain the value for the coverage [0 to 100 %] following conversion using the factor 0.1.

Bit	Process value	Value range
14	OU1	0 = open 1 = closed
15	OU2	0 = open 1 = closed
0 to 13	Coverage [0 to 100 %]	Integer

In addition, the coverage value can be read via ISDU (hex) 0x0028 – acyclic service.

9.2 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:

9.2.1 Endress+Hauser-specific device data

Designation	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/-	0x91FC				
ε_r - Media [1]	104	0x0068	2	Uint16	r/w	13		0/0.01	Yes	1.9 to 85
Get Calibration 1/2 [Button] [1]	87	0x0057	1	UIntegerT	-/w		1 ~ Get Calibration		No	
Simulation Switch Output (OU1)	89	0x0059	1	UInt8	r/w	Off	0 ~ Off 1 ~ ou1 = high 2 ~ ou2 = low	0/1	No	0 to 2

Designation	ISDU (dec)	ISDU (hex)	Size (byte)	Data type	Access	Default value	Value range	Offset/Gradient	Data storage	Range limits
Simulation Switch output (OU2)	68	0x0044	1	UInt8	r/w	Off	0 ~ Off 1 ~ ou1 = high 2 ~ ou2 = low	0/1	No	0 to 2
Device search	69	0x0045	1	UInt8	r/w	Off	0 ~ Off 1 ~ On	0/1	No	0 to 1
Sensor check	70	0x0046	1	UInt8	-/w	–	1 ~ Check	0/1	No	
Active switchpoints	64	0x0040	1	UInt8	r/w	Standard	0 ~ Standard 1 ~ Extended 3 ~ User			0 to 3
Reset user switchpoints (1/2)	65	0x0041	1	UIntegerT	r/w	False	0 ~ False 1 ~ True			0 to 1
Switching delay time, Output 1 (dS1)	81	0x0051	2	UInt16	r/w	0.5	0.3 to 60	0/0.1	Yes	0.3 to 60
Switching delay time, Output 2 (dS2)	83	0x0053	2	UInt16	r/w	1	0.3 to 60	0/0.1	Yes	0.3 to 60
Switchback delay time, Output 1 (dR1)	82	0x0052	2	UInt16	r/w	0.5	0.3 to 60	0/0.1	Yes	0.3 to 60
Switchback delay time, Output 2 (dR2)	84	0x0054	2	UInt16	r/w	1	0.3 to 60	0/0.1	Yes	0.3 to 60
Switch point value Output 1 (SP1) [1]	71	0x0047	2	UInt16	r/w	20		0/0.1	Yes	15 to 100
Switch point value Output 1 (SP1)	73	0x0049	2	UInt16	r/-	Standard: 23 Extended: 40		0 / 0.1	Yes	0 to 6 553.5
Switch point value Output 2 (SP2) [1]	75	0x004B	2	UInt16	r/w	20		0/0.1	Yes	15 to 100
Switch point value Output 2 (SP2)	78	0x004F	2	UInt16	r/-	Standard: 23 Extended: 40		0 / 0.1	Yes	0 to 6 553.5
Switchback point value Output 1 (rP1) [1]	72	0x0048	2	UInt16	r/w	18		0/0.1	Yes	15 to 100
Switchback point value Output 1 (rP1)	74	0x004A	2	UInt16	r/-	Standard: 21 Extended: 38		0 / 0.1	Yes	0 to 6 553.5
Switchback point value Output 2 (rP2) [1]	76	0x004C	2	UInt16	r/w	18		0/0.1	Yes	15 to 100
Switchback point value Output 2 (rP2)	79	0x004A	2	UInt16	r/-	Standard: 21 Extended: 38		0 / 0.1	Yes	0 to 6 553.5
Output 1 (OU1)	101	0x0065	1	UInt8	r/w	HNO	0 ~ HNO 1 ~ HNC		Yes	0 to 1
Output 2 (OU2)	95	0x005F	1	UInt8	r/w	HNC	0 ~ HNO 1 ~ HNC		Yes	0 to 1
Operating hours	96	0x0060	4	UInt32	r/-	0		0/0.016667	No	0 to 2 ^32
µC-temperature	91	0x005B	1	Int8	r/-			°C: 0/1 °F: 32/1.8 K: 273.15/1	No	−128 to 127

Designation	ISDU (dec)	ISDU (hex)	Size (byte)	Data type	Access	Default value	Value range	Offset/Gradient	Data storage	Range limits
Unit changeover (UNI) - µC-temperature	80	0x0050	1	UInt8	r/w	℃	0 ~ ℃ 1 ~ ℉ 2 ~ K	0/0	Yes	0 to 2
Minimum µC-temperature	92	0x005C	1	Int16	r/-	127		℃: 0/1 ℉: 32/1.8 K: 273.15/1	No	−32 768 to 32 767
Maximum µC-temperature	93	0x005D	1	Int16	r/-	-128		℃: 0/1 ℉: 32/1.8 K: 273.15/1	No	−32 768 to 32 767
Reset µC-temperatures [button]	94	0x005E	1	UIntegerT	-/w	False	0 ~ False 1 ~ Reset Temperature			

1)   Only visible if active switchpoints = USER

ℹ Please refer to parameter description for explanation of abbreviations

9.2.2   IO-Link-specific device data

Designation	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/-	FTW33	
ProductName	18	0x0012	max. 64	String	r/-	Liquipoint	
ProductText	20	0x0014	max. 64	String	r/-	Capacitance point level switch	
VendorName	16	0x0010	max. 64	String	r/-	Endress+Hauser	
VendorId	7 to 8	0x0007 to 0x0008			r/-	17	
VendorText	17	0x0011	max. 64	String	r/-	People for Process Automation	
Device ID	9 to 11	0x0009 to 0x000B			r/-	0x000500	
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

9.2.3   System commands

Designation	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	r/w

10   Commissioning

10.1   Function check

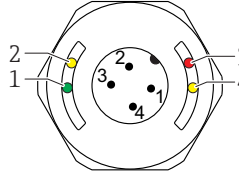Prior to commissioning, make sure that the post-installation and post-connection checks have been performed.
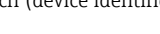
See:
- "Post-installation check" checklist
- "Post-connection check" checklist

10.2   Commissioning the local display

10.2.1   Light signals (LEDs)

Position of LEDs in housing cover

A0038425

Position	LED color	Description of function
1	green (gn)	Status/Communication • lit: SIO mode • flashing: Active communication, flash frequency ⎍⎍⎍⎍⎍⎍ • flashes with increased luminosity: Device search (device identification), flash frequency ⎍⎍⎍⎍⎍⎍
2	yellow (ye)2	Switch status/switch output 2 lit: If the sensor is covered by medium
3	red (rd)	Warning/Maintenance required flashing: Error remediable, e. g. invalid calibration Fault/device failure lit: see Diagnostics and troubleshooting
4	yellow (ye)1	Switch status/switch output 1 lit: If the sensor is covered by medium
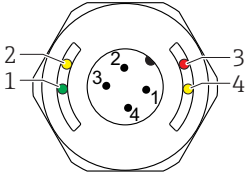
ℹ️ There is no external signaling via LEDs on the metal housing cover (IP69). A connecting cable with an M12 plug and LED indicator can be ordered as an accessory if necessary. See "Accessories".
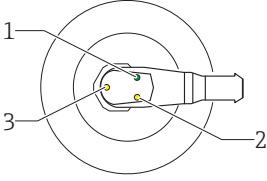
10.2.2   Function of LEDs

ℹ️ Any configuration of the switch outputs is possible. The following table shows the behavior of the LEDs in the SIO mode:

LEDs on housing cover with M12 plug, IO-Link

Operating modes		MAX		MIN		Warning	Fault
Sensor		free	covered	free	covered		
A0038425		⊐→	⊐→	↳→	↳→	⌐	⌐
1: green (gn)		☼	☼	☼	☼	☼	☼
2: yellow (ye) 2		●	☼	●	☼	● / ☼	●
3: red (rd)		●	●	●	●	☼ (flashing)	☼
4: yellow (ye) 1		●	☼	●	☼	● / ☼	●

LEDs on M12 plug (signals status of switch outputs)

Operating modes		MAX		MIN	
Sensor		free	covered	free	covered
		⊐→	⊐→	↳→	↳→
1: green (gn)		☼	☼	☼	☼
2: yellow (ye) 2		☼	●	●	☼
3: yellow (ye) 1		☼	●	●	☼

10.3 Commissioning with an operating menu

If an existing configuration is changed, measuring operation continues! The new or modified entries are only accepted once the setting has been made.

Parameter changes are not accepted until after the parameters have been downloaded.

If using block configuration, parameter changes are accepted only after the parameters have been downloaded.

⚠ WARNING

Risk of injury and damage to property due to uncontrolled activation of processes!
▸ Make sure that downstream processes are not started unintentionally.

IO-Link communication
- Commissioning with factory settings: The device is configured for use with water-based media. The device can be commissioned directly when used with water-based media. Factory setting: Output 1 and output 2 are configured for XOR operation.
- Commissioning with customer-specific settings: The device can be configured differently to the factory settings via IO-Link. Select User in the **Active switchpoints** parameter.

> - Each change must be confirmed with Enter to ensure that the value is accepted.
> - Incorrect switching is suppressed by adjusting the settings in the switching delay/switchback delay (Switching delay time/Switchback delay time parameters).

11 Operation

11.1 Customer-specific IO-Link settings

11.1.1 Hysteresis function, level detection

Wet calibration (required only for non-conductive media)

1. Navigate to the Application menu level
   ↳ Configuration: **Parameter** → **Application** → **Active switchpoints** = **User**
2. Immerse the device in the medium to be detected
3. Adopt the ε_r of the process medium present.
   ↳ Configuration: **Parameter** → **Application** → **User Calibration** → **Get Calibration 1/2**
   The switch limits can be adjusted accordingly

11.2 Advanced settings

11.2.1 Process fluid

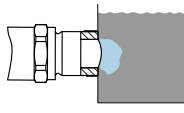For reliable point level detection, the device can be adapted to the process conditions in question.

The following settings can be made via IO-Link: **Parameter** → **Application** → **Active switchpoints**
- **Standard** preconfigured for:
  Water- or alcohol-based media ($\varepsilon_r \geq 10$)
  For example, water, milk and various dairy products, soft drinks, beer
- **Extended** preconfigured for:
  Oil-based media ($\varepsilon_r > 2.4$)
  For example: Oils, ketchup, mustard, mayonnaise, honey, nougat spread
- **User**; can be freely configured to customer medium:
  - **Switch point value Output 1/2**
  - **Switchback point value Output 1/2**
  - ε_r

> For dielectric constants (DC values) of many media commonly used in various industries refer to:
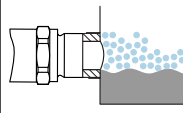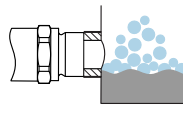> - the Endress+Hauser DC manual (CP01076F)
> - the Endress+Hauser "DC Values App" (available for Android and iOS)

Adhesive and viscous media

Setting	Light buildup	Heavy buildup	Surface drying
Standard	✅✅	❌	✅✅
Extended	✅ 1)	✅	✅ 1)

1) Surface drying or insulating, non-homogeneous layers can cause the sensor to signal "free" and should therefore be avoided or eliminated, particularly in maximum safety mode (overflow). The Standard setting is preferable in this type of application.

Media with foam formation

Setting		
Standard	Sensor signal "covered"	Sensor signal "free" 1)
Extended	Sensor signal "free"	Sensor signal "free"

1) Very coarsely-pored foam cannot be detected by the sensor.

The device is delivered with the "Standard" setting. Optionally, it can be ordered with "Extended" as the default setting.
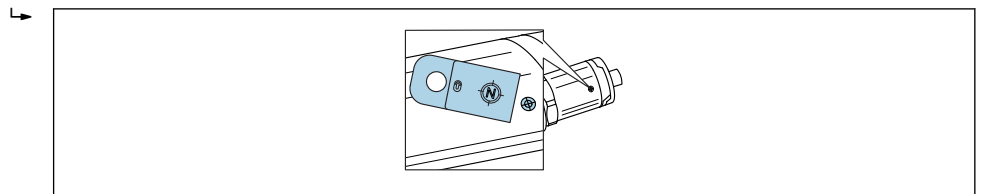
11.3 Switch output function test

⚠ WARNING

Risk of injury!

▶ Ensure that no uncontrolled processes are activated in the system.

Carry out a function test while the device is in operation.

1. Hold the test magnet against the marking for approx. 2 seconds

   A0036907

   ⊠ 7   Position for test magnet on housing

   Status inverted; indicated by yellow LED

2. Remove test magnet
   ↳ Original status is adopted once again

3. Test magnet is held against the marking for longer than 30 seconds
   ↳ Red LED flashing; original status is adopted once again

12 Diagnostics and troubleshooting

12.1 Troubleshooting

If an electronic/sensor defect is present, the device changes to error mode and displays the diagnostic event F270. The status of the process data is rendered invalid. The switch output(s) is/are opened.

General errors

Error	Possible cause	Solution
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	- Communication cable not connected. - Communication cable incorrectly attached to device. - Communication cable incorrectly attached to the IO-Link master.	Check wiring and cables.
No transmission of process data	There is an error in the device.	Correct errors that are displayed as a diagnostic event.

12.2 Diagnostic information via LED indicator

LED indicator on housing cover

Malfunction	Possible cause	Corrective action
Green LED not lit	No power supply	Check plug, cable and power supply.
Red LED flashing	Overload or short-circuit in load circuit	- Clear the short-circuit. - Reduce maximum load current to below 200 mA if one switch output is active. - Maximum load current = 105 mA per output if both switch outputs are active.
	Ambient temperature outside of specification	Operate measuring device in specified temperature range.
	Test magnet held against marking for too long	Repeat function test.
Red LED lit	Internal sensor error	Replace device.

12.3 Diagnostic events

12.3.1 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 A0013956	**"Failure"** A device error has occurred. The measured value is no longer valid.
M A0013957	**"Maintenance required"** Maintenance is required. The measured value is still valid.
C A0013959	**"Function check"** The device is in the service mode (e. g. during a simulation).
S A0013958	**"Out of specification"** The device is being operated: • 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.

Diagnostic event	
Status signal	Event number
↓	↓
C A0013959	**469**

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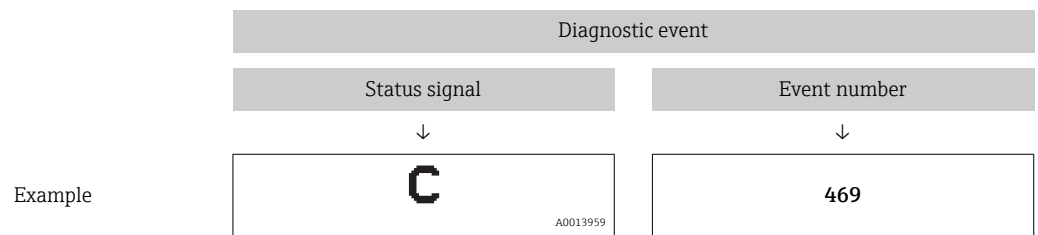
If two or more diagnostic events are pending simultaneously, only the message with the highest priority is shown.

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

12.3.2   Overview of diagnostic events

Status signal/ Diagnostic event	Diagnostic behavior	IO-Link EventQualifier	EventCode	Event text	Reason	Corrective measure
F270	Fault	IO-Link Error	0x5000	Defect in electronics/ sensor	Electronics/sensor defective	Replace device
S804	Warning	IO-Link Warning	0x1801	Load current > 200 mA	Load current > 200 mA	Increase load resistance at switch output
				Overload at switch output 2	Overload at switch output 2	• Check output wiring • Replace device
C485	Warning	IO-Link Warning	0x8C01 [1]	Simulation active	When the simulation of a switch output or current output is active, the device displays a warning.	Switch off simulation
C182	Message	IO-Link Message	0x1807 [1]	Invalid calibration	Switch point/switchback point are too close together or inter-changed.	• Check probe coverage • Perform configuration again
C103	Message	IO-Link Message	0x1813	Sensor check failed	Sensor check failed	• Repeat cleaning • New calibration recommended and check switching behavior • Replace device
-	Message	IO-Link Message	0x1814	Sensor check passed	Sensor check	-
-	Information	IO-Link Information	0x1815	Timeout Reedcontact	Timeout reed contact	Remove test magnet
S825	Warning	IO-Link Warning	0x1812	Ambient temperature outside of specification	Ambient temperature outside of specification	Operate device in the specified temperature range

1)   EventCode as per IO-Link standard 1.1

12.4   Behavior of the device in the event of a fault

The device displays warnings and faults via IO-Link. All the device warnings and faults are for information purposes only and do not have a safety function. The 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. A distinction must be made between the following types of error here:

- Warning:
  - The device continues measuring if this type of error occurs. The output signal is not affected (exception: simulation is active).
  - The switch output remains in the state defined by the switch points.
- Fault:
  - The device does **not** continue measuring if this type of error occurs. The output signal assumes its fault state (switch outputs de-energized).
  - The fault state is displayed via IO-Link.
  - The switch output changes to the "open" state.

12.5   Resetting to factory settings (reset)

Reset to factory settings (RES)

Navigation	Parameter → System → Reset to factory settings (RES)

Description

> ⚠ **WARNING**
>
> **Confirming the "Standard Command" with "Reset to factory settings" causes an immediate reset to the factory settings of the order configuration.**
> If the factory settings have been changed, downstream processes might be affected following a reset (the behavior of the switch output or current output might be changed).
> ▶ Make sure that downstream processes are not started unintentionally.

The reset is not subject to additional locking, such as in the form of device locking. The reset also depends on the device status.
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 µC-temperature
• Maximum µC-temperature
• Last Diagnostic (LST)
• Operating hours

Note

The last error is not reset in a reset.

13 Maintenance

No special maintenance work is required.

13.1 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.

14 Repairs

Repair is not envisaged for this measuring device.

14.1 Return

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 repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

14.2 Disposal

When disposing, separate and recycle the device components based on the materials.

15   Description of Device Parameters

15.1   Identification

Extended ordercode

Navigation	Identification → Extended ordercode
Description	Used to replace 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

15.2   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 latest device status (error or warning) that was rectified during operation.

Simulation Switch Output 1 (OU1)

Navigation   Diagnosis → Simulation Switch Output 1 (OU1)

Description   The simulation affects the process data only. It does not affect the physical switch output.
                        If a simulation is active, a warning to this effect is displayed so that it is obvious to the user
                        that the device is in simulation mode. A warning is communicated via IO-Link (C485 - sim-
                        ulation active). The simulation must be ended actively via the menu. If the device is discon-
                        nected from the power supply during the simulation and power is then resupplied,
                        simulation mode is not resumed, and instead the device continues operation in measuring
                        mode.

Options   • OFF
                        • OU1 = HIGH
                        • OU1= LOW

Simulation Switch Output 2 (OU2)

Navigation   Diagnosis → Simulation Switch Output 2 (OU2)

Description   The simulation affects the process data and the physical switch output. If a simulation is
                        active, a warning to this effect is displayed via IO-Link so that it is obvious to the user that
                        the device is in simulation mode (C485 - simulation active). The simulation must be ended
                        actively via the menu. If the device is disconnected from the power supply during the simu-
                        lation and power is then resupplied, simulation mode is not resumed, and instead the
                        device continues operation in measuring mode.

Options   • OFF
                        • OU2 = HIGH
                        • OU2 = LOW

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 frequency ⎍⎍⎍⎍⎍_⎍⎍⎍⎍⎍ .
Note	There is no external signaling via LEDs on the metal housing cover (IP69).
Options	• OFF • ON
Factory setting	OFF

Sensor check

Navigation	Diagnosis → Sensor check
Description	This parameter is used to test if the measuring point 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.

The device must be removed before the sensor check since the free value is influenced by the type of installation.

Options	Check: Following the test, one of the following messages is displayed: • Message (0x1814) for sensor check passed • Message C103 (0x1813) for sensor check failed

15.3   Parameter

15.3.1   Application

Active switchpoints

Navigation	Parameter → Application → Active switchpoints
Description	Choice between standard or customer-specific, user-definable switch points
Switch-on value	Last setting selected prior to switching off device
Options	• Standard • Extended • User
Factory setting	Standard

Switch point value, Output 1/2 (SP1/SP2)
Switchback point value, Output 1/2 (rP1/rP2)

Navigation
Application → Output Switch 1/2 → Switch point value, Output 1/2 (SP1/SP2)
Application → Output Switch 1/2 → Switchback point value, Output 1/2 (rP1/rP2)

Note
The switching sensitivity of the sensor is set using the SP1/rP1 or SP2/rP2 parameters. Since the parameter settings depend on one another, the parameters are described all together.

- SP1 = switch point 1
- SP2 = switch point 2
- rP1 = switchback point 1
- rP2 = switchback point 2

Description
The switching sensitivity of the sensor can be configured using the switch point and switchback point. The switch sensitivity can be adapted to the medium (depending on the DC value (dielectric constant) or conductivity of medium).

- Sensor switches if there is slight coverage = very sensitive.
- Sensor switches if there is heavy buildup = not sensitive.

The set value for the switch point SP1/SP2 must be greater than the switchback point rP1/rP2!
A diagnostic message is displayed if a switch point SP1/SP2 is entered that is ≤ switchback point rP1/rP2.
When the set switchback point rP1/rP2 is reached, an electrical signal change takes place again at the switch output (OU1/OU2). The difference between the value of the switch point SP1/SP2 and the value of the switchback point rP1/rP2 is known as the hysteresis.
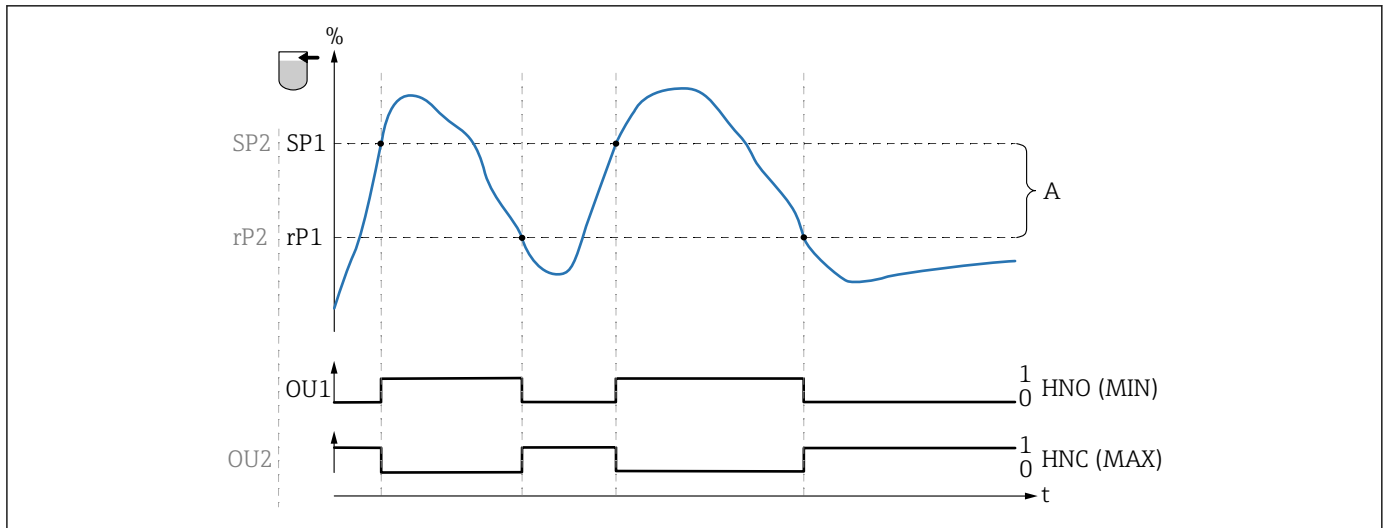
A0034529

⊞ 8   Calibration (default)

0   0-signal, output open
1   1-signal, output closed
A   Hysteresis (difference between the value of the switch point SP1/SP2 and the value of the switchback point rP1/rP2)
%   Coverage of sensor
HNO Normally open contact (MIN)
HNC Normally closed contact (MAX)
SP1 Switch point 1/SP2: Switch point 2
rP1 Switchback point 1/rP2: Switchback point 2

Note	The various points for the switching delay can be adjusted to ensure that rapid switching back and forth at the switch limits is suppressed.
Switch-on value	Last value selected prior to switching off.
Options	No selection. The user is free to edit the values.
Input range	15 to 100 %

Switching delay time, Output 1/2 (dS1/dS2)
Switchback delay time, Output 1/2 (dR1/dS2)

Navigation	Application → Output Switch 1/2 → Switching delay time, Output 1/2 (dS1/dS2) Application → Output Switch 1/2 → Switchback delay time, Output 1/2 (dR1/dR2)
Note	The switching delay time/switchback delay time functions are implemented using the "dS1"/"dS2" and "dR1"/dR2" parameters. Since the parameter settings depend on one another, the parameters are described all together. • dS1 = switching delay time, output 1 • dS2 = switching delay time, output 2 • dR1 = switchback delay time, output 1 • dR2 = switchback delay time, output 2

Description   To prevent rapid switching back and forth when values are close to the switch point "SP1"/"SP2" or switchback point "rP1"/"rP2", a delay in the range of 0.3 to 60 seconds, to one decimal place, can be set for individual points.
If the measured value leaves the switching range during the delay time, the delay time starts again from scratch.
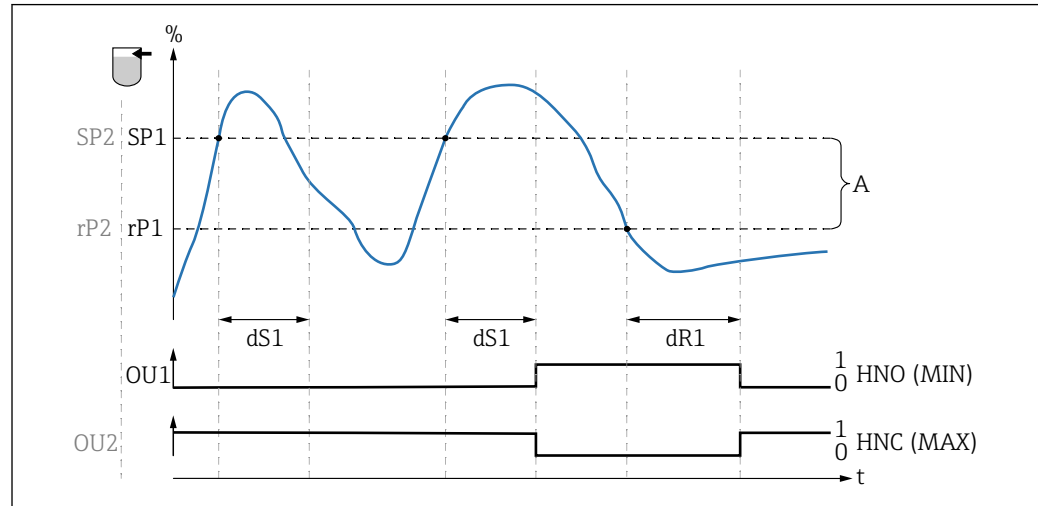
A0034590

0   0-signal, output open in the quiescent state
1   1-signal, output closed in the quiescent state
A   Hysteresis (difference between the value of the switch point "SP1" and the value of the switchback point "rP1")
HNO Normally open contact (MIN)
HNC Normally closed contact (MAX)
%   Coverage of sensor
SP1 Switch point 1/SP2: Switch point 2
rP1 Switchback point 1/rP2: Switchback point 2
dS1 Set time for which the specific switch point must be reached continuously without interruption until an electrical signal change takes place.
dR1 Set time for which the specific switchback point must be reached continuously without interruption until an electrical signal change takes place.

Switch on value   Last value selected prior to switching off.

Options   No selection. The user is free to edit the values.

Input range   0.3 to 60 s

Factory setting   0.5 s (Switching delay time dS1/dS2)
1.0 s (Switchback delay time dR1/dR2)

Output 1/2 (OU1/OU2)

Navigation   Application → Output Switch 1/2 → Output 1/2 (OU1/OU2)

Description   Hysteresis: Determining whether sensor is free or covered.

Switch on value   Last function selected prior to switching off.

Options   • Hysteresis normally open (MIN)
                         • Hysteresis normally closed (MAX)

Factory setting   Output 1 (OU1): HNO
                               Output 2 (OU2): HNC

15.3.2   System

Operating hours

Navigation   Parameter → System → Operating hours

Description   This parameter counts the operating hours in minutes during the period in which operat-
                               ing voltage is present.

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 new unit is calculated and displayed.

Switch on value   Last unit selected prior to switching off.

Options   ▪ ℃
                               ▪ ℉
                               ▪ K

Factory setting   ℃

Minimum µC-temperature

Navigation   Parameter → System → Minimum µC-temperature

Description   This parameter is used as the minimum peak indicator and makes it possible to call up ret-
                               roactively the lowest electronics temperature measured.
                               If the value of the peak indicator is overwritten, the value is automatically set to the tem-
                               perature currently measured.

Maximum µC-temperature

Navigation	Parameter → System → Maximum μC-temperature

Description	This parameter is used as the maximum peak indicator and makes it possible to call up retroactively the highest electronics temperature measured. If the value of the peak indicator is overwritten, the value is automatically set to the temperature currently measured.

Reset to factory settings (RES)

Navigation	Parameter → System → Reset to factory settings (RES)

Description	**⚠ WARNING** **Confirming the "Standard Command" with "Reset to factory settings" causes an immediate reset to the factory settings of the order configuration.** If the factory settings have been changed, downstream processes might be affected following a reset (the behavior of the switch output or current output might be changed). ▶ Make sure that downstream processes are not started unintentionally. The reset is not subject to additional locking, such as in the form of device locking. The reset also depends on the device status. 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 μC-temperature • Maximum μC-temperature • Last Diagnostic (LST) • Operating hours
Note	The last error is not reset in a reset.

Device Access Locks.Data Storage Lock [1] Activation/deactivation of DataStorage

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

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

Description	The device supports DataStorage. If a device is being replaced, this allows the configuration of the old device to be written to the new device. If, when a device is being replaced, the original configuration of the new device is to be retained, the **Device Access Locks.Data Storage Lock** parameter can be used to prevent the parameters from being overwritten. If this parameter is set to "true", the new device does not adopt the data stored in the master's DataStorage.

Options	• false • true

15.4 Observation

The process data are transmitted acyclically.

16 Accessories

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

16.1 Device-specific accessories

16.1.1 Test magnet
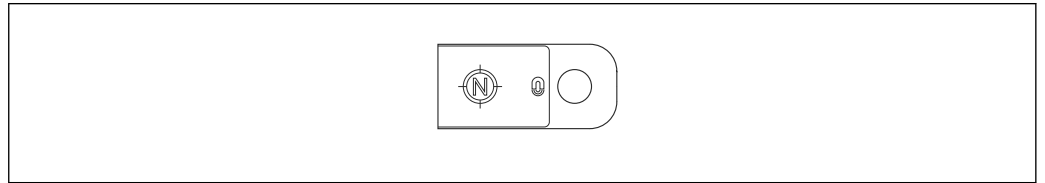
🖾 *9   Test magnet*

Order number: 71267011

16.1.2 Hexagon tubular socket wrench 32 mm
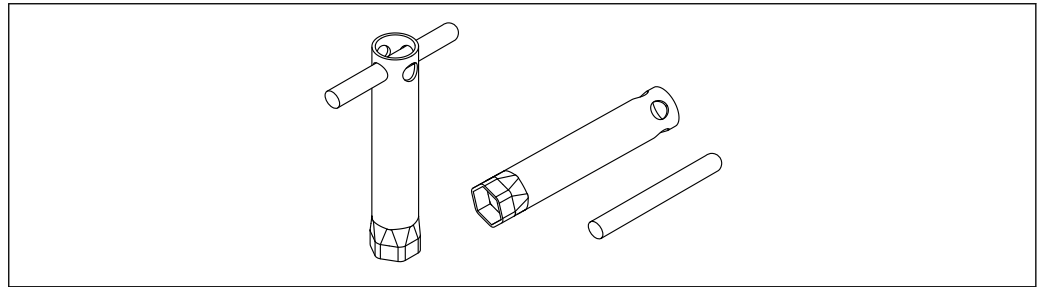
🖾 *10   Hexagon tubular socket wrench*

Order number: 52010156

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

16.1.3 Plug-in jack
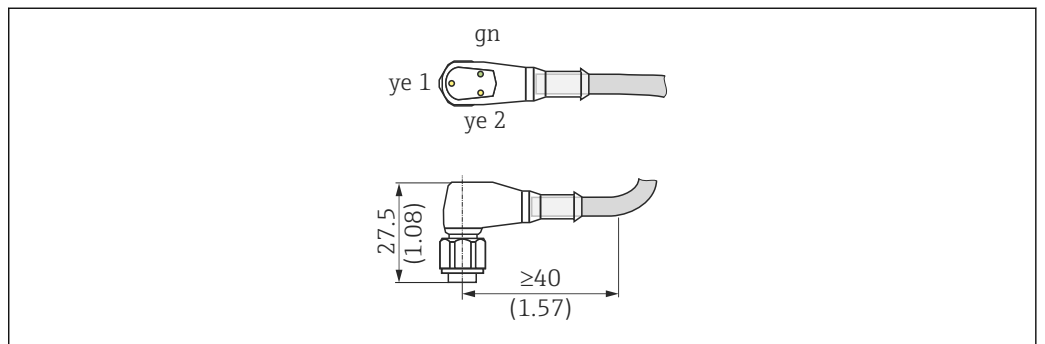
🖾 *11   Dimensions of plug-in jack, engineering unit: mm (in)*

Example: M12 with LED

Plug-in jack M12 IP69 with LED
- Elbowed 90°, terminated at one end
- 5 m (16 ft) PVC cable (orange)
- Body: PVC (transparent)
- Slotted nut 316L
- 52018763

Plug-in jack M12 IP69 without LED
- Elbowed 90°, terminated at one end
- 5 m (16 ft) PVC cable (orange)
- Body: PVC (orange)
- Slotted nut 316L (1.4435)
- 52024216

Plug-in jack M12 IP67 without LED
- Elbowed 90°
- 5 m (16 ft) PVC cable (gray)
- Slotted nut Cu Sn/Ni
- Body: PUR (blue)
- 52010285
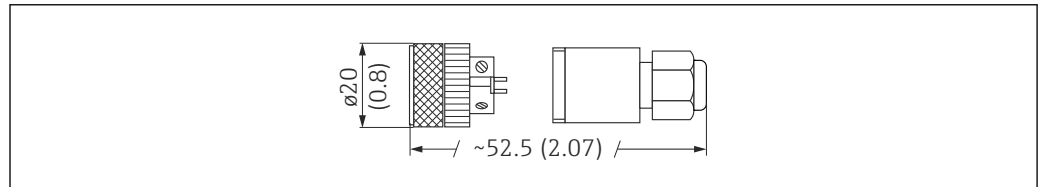
⊡ 12   Dimensions of self-terminated connection, engineering unit: mm (in)

Plug-in jack M12 IP67 without LED
- Straight, self-terminated connection to M12 plug
- Slotted nut Cu Sn/Ni
- Body: PBT
- 52006263

Core colors for M12 plug:
- 1 = BN (brown)
- 2 = WT (white)
- 3 = BU (blue)
- 4 = BK (black)

16.1.4   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 ½"

Process adapter M24 PN40
Available versions:
- Varivent F
- Varivent N

16.1.5   Weld-in adapter
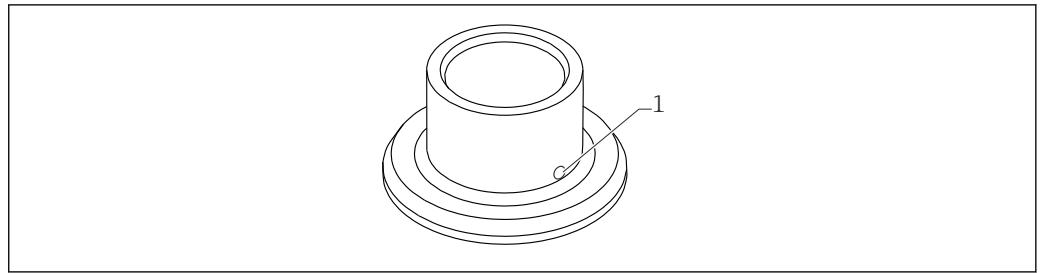
A0023557

🖾 *13   Sample drawing of weld-in adapter*

1   Leakage hole

G ¾"
Available versions:
- ø 50 mm (1.97 in) - Installation on vessel
- ø 29 mm (1.14 in) - Installation in pipe

G 1"
Available versions:
- ø 53 mm (2.09 in) - Installation on vessel
- ø 60 mm (2.36 in) - Installation on pipe

M24
Available versions:
ø 65 mm (2.56 in) - Installation on vessel

16.1.6   Grooved union nut DIN11851
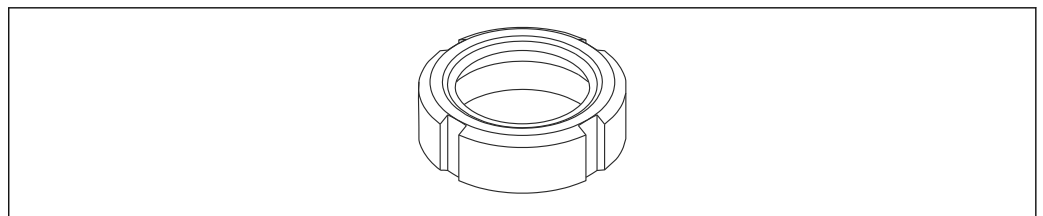
A0023556

🖾 *14   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

17 Technical data

17.1 Input

| Measured variable | The change in medium capacitance is detected by the electrode in contact with the process. Detection occurs based on the medium covering the electrode. |

| Measuring range | • Standard: Water- or alcohol-based media, $\varepsilon_r \geq 10$
• Extended: Oil-based media $2.4 < \varepsilon_r < 10$ or media that form heavy buildup
• Device with IO-Link communication: Adjustment up to $\varepsilon_r > 2.4$ via the IO-Link interface for water-, alcohol- and oil-based liquids or powdered products |

17.2 Output

| Switch output | • 2 DC-PNP outputs, freely configurable
• 1 switch output active: 200 mA connectable load (short-circuit proof)
  ⓘ Unlike the IO-Link standard, the SIO mode supports 200 mA
• Both switch outputs active: Connectable load of 105 mA each (short-circuit proof)
• Safety-related switching
  The electrical switch opens if the point level is reached or if faults or a power outage occur.
  – Maximum point level detection (MAX): e. g. for overfill protection
  – Minimum point level detection (MIN): e. g. to protect pumps from dry running
• Residual voltage: < 3 V
• Residual current: < 100 μA |

17.3 Performance characteristics

| Reference operating conditions | **The following reference conditions apply to the performance characteristics:**
• Ambient temperature: 20 °C (68 °F) ±5 °C (9 °F)
• Medium: Water, conductivity approx. 200 μS/cm |

| Maximum uncertainty | ±1 mm (0.04 in) in accordance with DIN 61298-2 |

| Hysteresis | Maximum 1 mm (0.04 in) |

| Non-repeatability | ±0.5 mm (0.02 in) in accordance with DIN 61298-2 |

| Switching delay | Switching delay time/switchback delay time of outputs
• 0.5 s when the sensor is covered (can be configured via IO-Link 0.3 to 60 s)
• 1 s when the sensor is free (can be configured via IO-Link 0.3 to 60 s)

Optional: 0.3 s; 1.5 s or 5 s when the sensor is covered and free, see product structure, order code for "Service", option HS "Switching delay" |

| Switch-on time | < 2 s (no defined switching status before this) |

17.4 Environment

Ambient temperature range	At the housing: −40 to +70 °C (−40 to +158 °F)
Storage temperature	−40 to +85 °C (−40 to +185 °F)
Operating altitude	Up to 2 000 m (6 600 ft) above sea level
Climate class	DIN EN 60068-2-38/IEC 68-2-38: Test Z/AD
Degree of protection	• 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(RMS) = 50 m/s², f = 5 to 2 000 Hz, t = 3 axes × 2 h
Shock resistance	As per test Ea, prEN 60068-2-27:2007: a = 300 m/s² = 30 g, 3 axes × 2 directions × 3 shocks × 18 ms
Cleaning	Resistant to typical cleaning agents from the outside, in accordance with Ecolab test.
Electromagnetic compatibility	Electromagnetic compatibility in accordance with all the relevant requirements of the EN 61326 series. For details, refer to the Declaration of Conformity. Only the requirements of IEC/EN 61131-9 are met if IO-Link communication is used. 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").

17.5 Process

Process temperature range	−20 to +100 °C (−4 to +212 °F) • 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)
Process fluid	For reliable point level detection, the device can be adapted to the process conditions in question.

The following settings can be made via IO-Link: **Parameter** → **Application** → **Active switchpoints**
- **Standard** preconfigured for:
  Water- or alcohol-based media ($\varepsilon_r \geq 10$)
  For example, water, milk and various dairy products, soft drinks, beer
- **Extended** preconfigured for:
  Oil-based media ($\varepsilon_r > 2.4$)
  For example: Oils, ketchup, mustard, mayonnaise, honey, nougat spread
- **User**; can be freely configured to customer medium:
  – **Switch point value Output 1/2**
  – **Switchback point value Output 1/2**
  – ε_r

ℹ️ For dielectric constants (DC values) of many media commonly used in various industries refer to:
- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)

Adhesive and viscous media

Setting	Light buildup	Heavy buildup	Surface drying
Standard	✅✅	❌	✅✅
Extended	✅ [1]	✅	✅ [1]

[1] Surface drying or insulating, non-homogeneous layers can cause the sensor to signal "free" and should therefore be avoided or eliminated, particularly in maximum safety mode (overflow). The Standard setting is preferable in this type of application.

Media with foam formation

Setting		
Standard	Sensor signal "covered"	Sensor signal "free" [1]
Extended	Sensor signal "free"	Sensor signal "free"

[1] Very coarsely-pored foam cannot be detected by the sensor.

ℹ️ The device is delivered with the "Standard" setting. Optionally, it can be ordered with "Extended" as the default setting.

Index

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