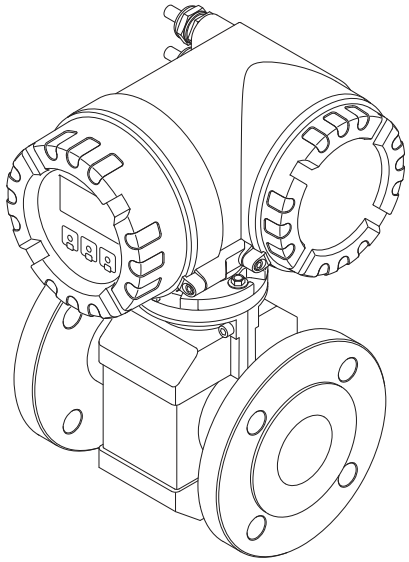
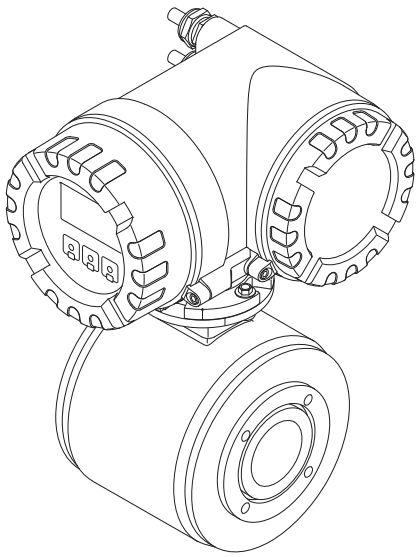
BA00047D/06/EN/16.17
71385937

Valid as of software version:
V 2.03.XX (device software, HART 5)
V 2.07.XX (device software, HART 7)

Operating Instructions
Proline Promag 53
HART

Electromagnetic flowmeter





Endress+Hauser
People for Process Automation

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1 Safety instructions

1.1 Designated use

The measuring device described in this Operating Manual is to be used only for measuring the flow rate of conductive fluids in closed pipes.

A minimum conductivity of 20 µS/cm is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 µS/cm.

Examples:
- Acids, alkalis
- Drinking water, wastewater, sewage sludge
- Milk, beer, wine, mineral water, etc.

Resulting from incorrect use or from use other than that designated the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

1.2 Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain.
- The device must be operated only by persons authorized and trained by the system operator. Strict compliance with the instructions in the Operating Instructions is mandatory.
- Endress+Hauser is willing to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However, small changes in temperature, concentration or the degree of contamination in the process can result in changes to the chemical resistance properties. For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of materials wetted by fluids in a specific application. The user is responsible for the choice of wetted materials with regard to their in-process resistance to corrosion.
- If welding work is performed on the piping system, do not ground the welding appliance through the flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, except in cases where special protective measures have been taken (e.g. galvanically isolated power supply SELV or PELV).
- Always note the regulations applicable in your country to the operation, maintenance and repair of electrical devices. Special instructions relating to the device can be found in the relevant sections of the documentation.

1.3 Operational safety

Note the following points:
- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. Depending on the approval and certification agency, the relevant symbol is depicted on the front page of the supplementary documentation on Ex ratings (e.g. Ⓔx Europe, <FM> USA, Ⓒ Canada).
- The measuring device meets the general safety requirements according to EN 61010-1 and the EMC requirements according to IEC/EN 61326 in addition to the NAMUR recommendations NE 21, NE 43 and NE 53.

- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- When hot fluid passes through the measuring tube, the surface temperature of the housing increases. In the case of the sensor, in particular, users should expect temperatures that can be close to the fluid temperature. If the temperature of the fluid is high, implement sufficient measures to prevent burning or scalding.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.

1.4 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.
To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material

1.5 Notes on safety conventions and icons

The devices are designed and tested to meet state-of-the-art safety requirements, and have left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 -1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". The devices can, however, be a source of danger if used incorrectly or for other than the designated use.
For this reason, always pay particular attention to the safety instructions indicated in these Operating Instructions by the following icons:



Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in personal injury or a safety hazard. Comply strictly with the instructions and proceed with care.



Caution!
"Caution" indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the device. Comply strictly with the instructions.



Note!
"Note" indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

2 Identification

2.1 Device designation

The flow measuring system consists of the following components:
- Promag 53 transmitter
- Promag E/H/L/P/W sensors

Two versions are available:
- Compact version: transmitter and sensor form a single mechanical unit.
- Remote version: transmitter and sensor are installed separately.

2.1.1 Nameplate of the transmitter

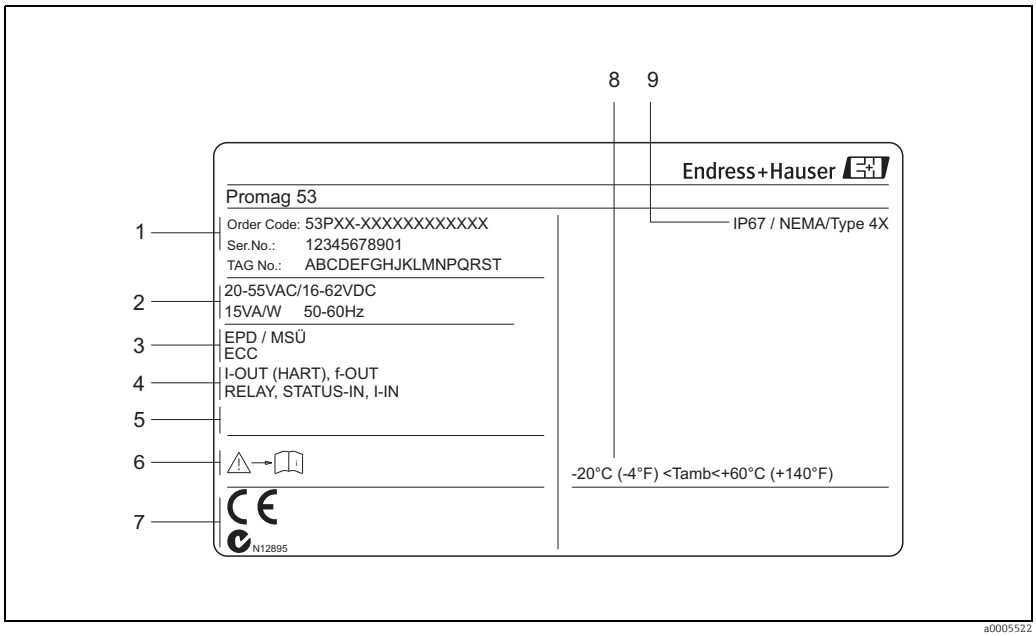


Fig. 1: Nameplate specifications for the "Promag 53" transmitter (example)

1 Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits
2 Power supply/frequency/power consumption
3 Additional functions and software
- *EPD: with empty pipe detection electrode*
- *ECC: with electrode cleaning*

4 Available outputs:
- *I-OUT (HART): with current output (HART)*
- *f-OUT: with pulse/frequency output*
- *RELAY: with relay output*
- *STATUS-IN: with status input (auxiliary input)*
- *I-IN: with current input*

5 Reserved for additional information on special products
6 Please comply with the Operating Instructions
7 Reserved for additional information on device version (approvals, certificates)
8 Permitted ambient temperature range
9 Degree of protection

2.1.2 Nameplate of the sensor

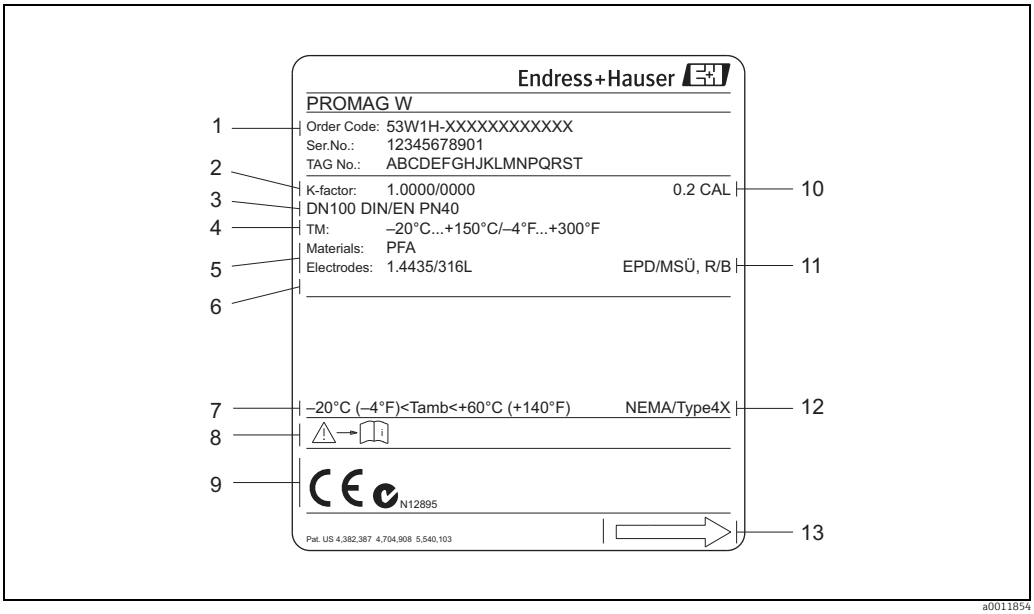


Fig. 2: Nameplate specifications for the "Promag W" sensor (example)

1 Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits
2 Calibration factor with zero point
3 Nominal diameter/nominal pressure
4 Medium temperature range
5 Materials: lining/measuring electrode
6 Reserved for additional information on special products
7 Permitted ambient temperature range
8 Please comply with the Operating Instructions
9 Reserved for additional information on device version (approvals, certificates)
10 Calibration tolerance
11 Additional information
- *EPD: with empty pipe detection electrode*
- *R/B: with reference electrode*

12 Degree of protection
13 Flow direction

2.1.3 Nameplate for connections

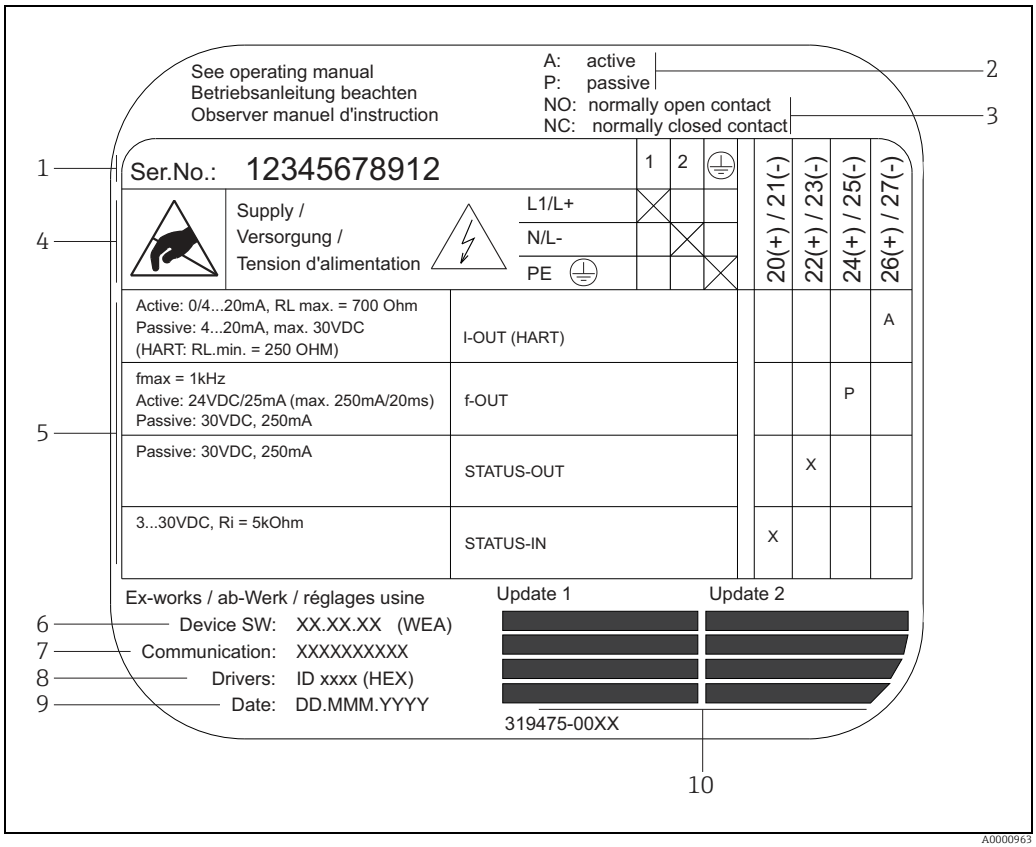


Fig. 3: Nameplate specifications for Proline transmitter connections (example)

1 Serial number
2 Possible configuration of current output
3 Possible configuration of relay contacts
4 Terminal assignment, cable for power supply
*Terminal **no. 1**:*
– L1 for AC, L+ for DC
*Terminal **no. 2**:*
– N for AC, L- for DC
5 Signals present at inputs and outputs, possible configurations and terminal assignment
6 Version of device software currently installed (incl. language group)
7 Type of communication installed
8 Information on current communication software (Device Revision, Device Description)
9 Date of installation
10 Current updates to data specified in points 6 to 9

2.2 Certificates and approvals

The devices are designed and tested to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have left the factory in a condition in which they are safe to operate. The devices comply with the standards EN 61010 -1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of IEC/EN 61326.
The measuring system described in these Operating Instructions therefore complies with the legal requirements of the EU Directives. Endress+Hauser confirms this by affixing the CE mark to it and by issuing the CE Declaration of Conformity.
The measuring system is in conformity with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

2.3 Registered trademarks

HART®
Registered trademark of HART Communication Foundation, Austin, USA

TRI-CLAMP®
Registered trademark of Ladish & Co., Inc., Kenosha, USA

KALREZ® and VITON®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, Field Xpert™, FieldCare®, Fieldcheck®, Applicator®
Registered or registration-pending trademarks of the Endress+Hauser Group

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

On receipt of the goods, check the following points:
- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protection plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

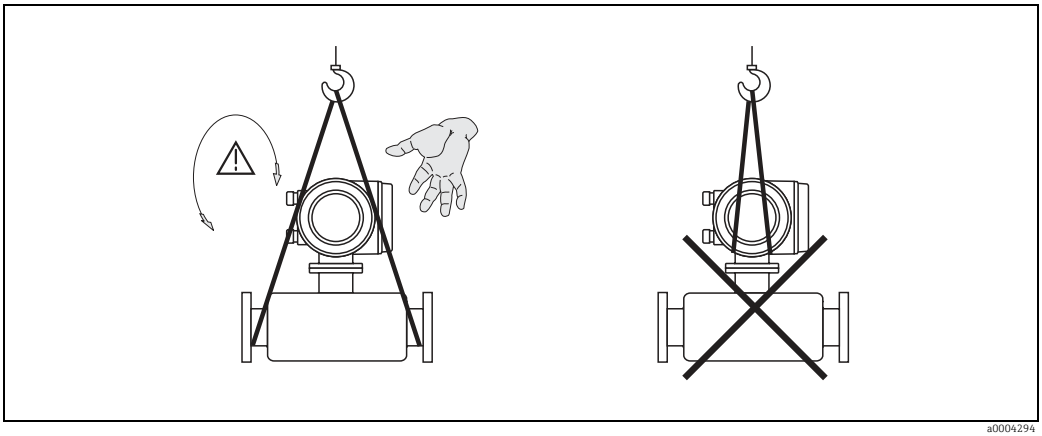
Special notes on flanged devices

Caution!
- The wooden covers mounted on the flanges before the device leaves the factory protect the linings on the flanges during storage and transportation. Do not remove these protection plates until *immediately before* the device is installed in the pipe.
- Do not lift flanged devices by the transmitter housing or, in the case of the remote version, by the connection housing.

Transporting flanged devices DN ≤ 300 (12")

Use webbing slings slung round the two process connections. Do not use chains, as they could damage the housing.

Warning!
Risk of injury if the measuring device slips. The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung.
At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.



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Fig. 4: Transporting sensors with DN ≤ 300 (12")

Transporting flanged devices DN > 300 (12")

Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

Caution!
Do not attempt to lift the sensor with the tines of a fork-lift truck beneath the metal casing. This would buckle the casing and damage the internal magnetic coils.

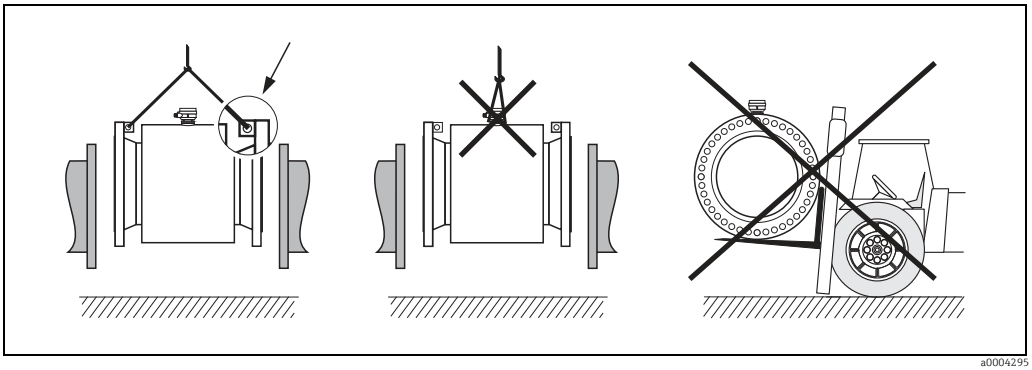


Fig. 5: Transporting sensors with DN > 300 (12")

3.1.3 Storage

Note the following points:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors → 128.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the lining.
- Do not remove the protection plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

3.2 Installation conditions

3.2.1 Dimensions

The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section on → 151.

3.2.2 Mounting location

The accumulation of air or gas bubbles in the measuring tube could result in an increase in measuring errors.
Avoid the following locations:
- At the highest point of a pipeline. Risk of air accumulating.
- Directly upstream from a free pipe outlet in a vertical pipeline.

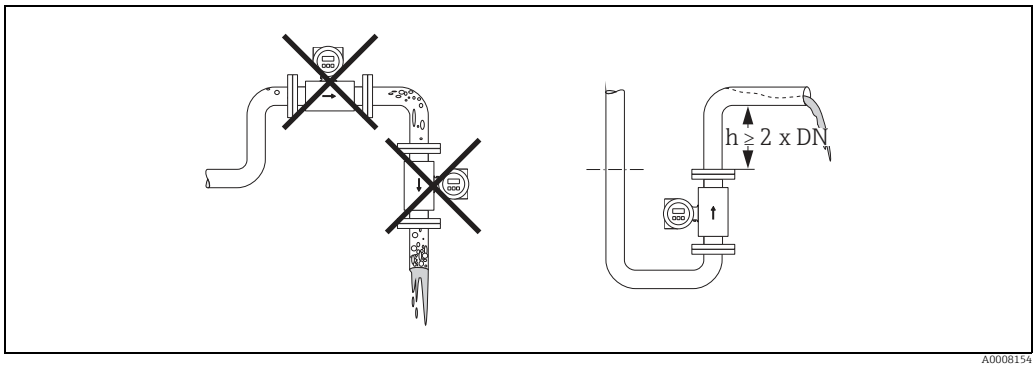


Fig. 6: Mounting location

Installing pumps

Do not install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum → 132.
It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock → 128.

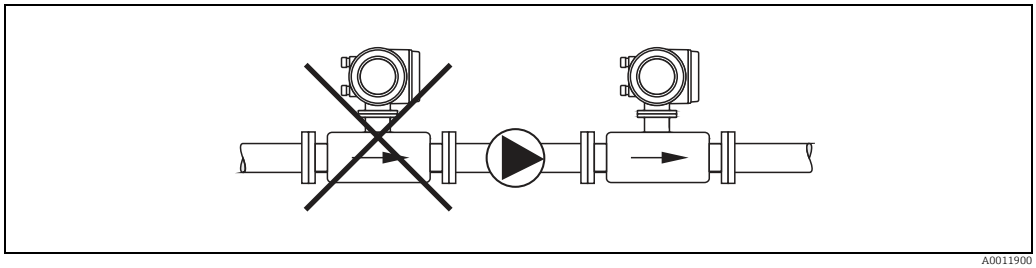


Fig. 7: Installing pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function offers additional protection by detecting empty or partially filled pipes → 99.

Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.

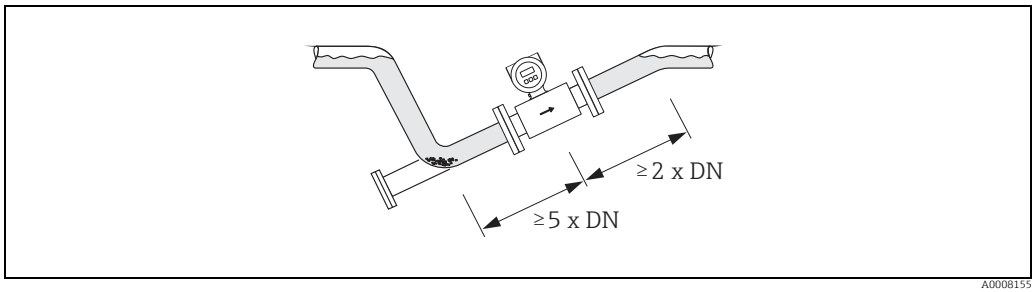


Fig. 8: Installation in partially filled pipe

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 m (16.3 ft). This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. This measure also prevents the system losing prime, which could cause air inclusions. Information on the lining's resistance to partial vacuum → 132.

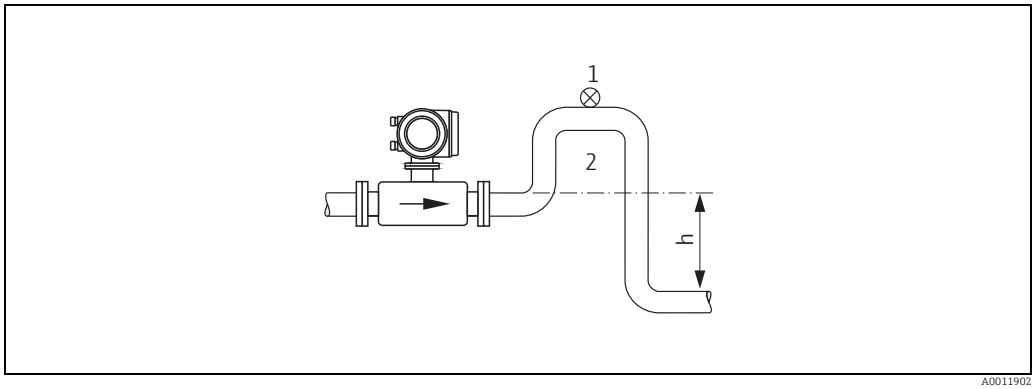


Fig. 9: Measures for installation in a down pipe

1 Vent valve
2 Siphon
h Length of down pipe (h ≥ 5 m (16.3 ft))

3.2.3 Orientation

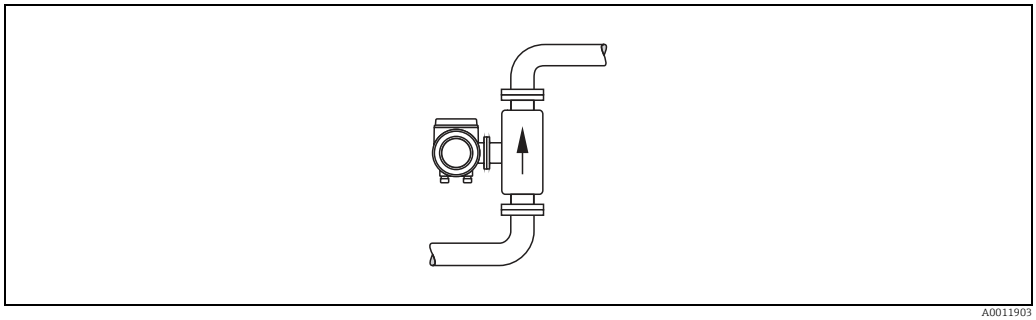
An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. Promag, nevertheless, supplies a range of functions and accessories for correct measuring of problematic fluids:

- Electrode Cleaning Circuitry (ECC) to prevent electrically conductive deposits in the measuring tube, e.g. for fluids causing buildup (see "Description of Device Functions" manual).
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes or in the case of degassing fluids → 📄 99.
- Exchangeable Measuring Electrodes for abrasive fluids (→ 📄 121).

Vertical orientation

A vertical orientation is ideal in the following cases:

- For self-emptying piping systems and when using empty pipe detection.
- For sludge containing sand or stones and where the solids cause sedimentation.



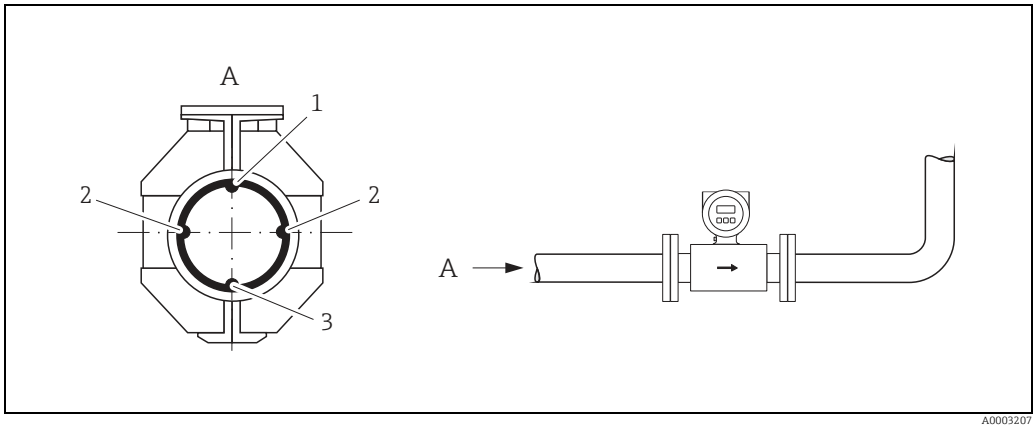
A0011903

Fig. 10: Vertical orientation

Horizontal orientation

The measuring electrode plane should be horizontal. This prevents brief insulation of the two electrodes by entrained air bubbles.

Caution!
Empty Pipe Detection functions correctly with the measuring device installed horizontally only when the transmitter housing is facing upward (see diagram). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled.



A0003207

Fig. 11: Horizontal orientation

1 EPD electrode for empty pipe detection
(not available for "measuring electrode only" option, not in Promag H (DN 2 to 8/ 1/12 to 5/16"))
2 Measuring electrodes for signal detection
3 Reference electrode for potential equalization
(not available for "measuring electrode only" option, not in Promag H)

3.2.4 Inlet and outlet runs

If possible, install the sensor in a location upstream of fittings such as valves, T-pieces, elbows, etc.

Compliance with the following requirements for the inlet and outlet runs is necessary in order to ensure measuring accuracy.
- Inlet run ≥ 5 × DN
- Outlet run ≥ 2 × DN

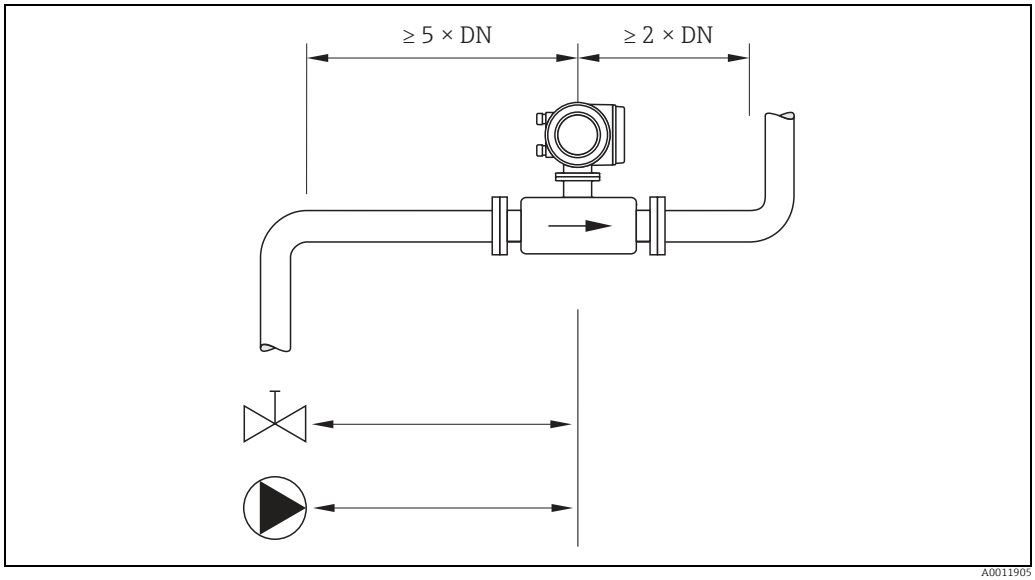


Fig. 12: Inlet and outlet runs

3.2.5 Vibrations

Secure and fix both the piping and the sensor if the vibrations are severe.

Caution!
It is advisable to install sensor and transmitter separately if vibration is excessively severe.
Information on the permitted resistance to vibration and shock → 128.

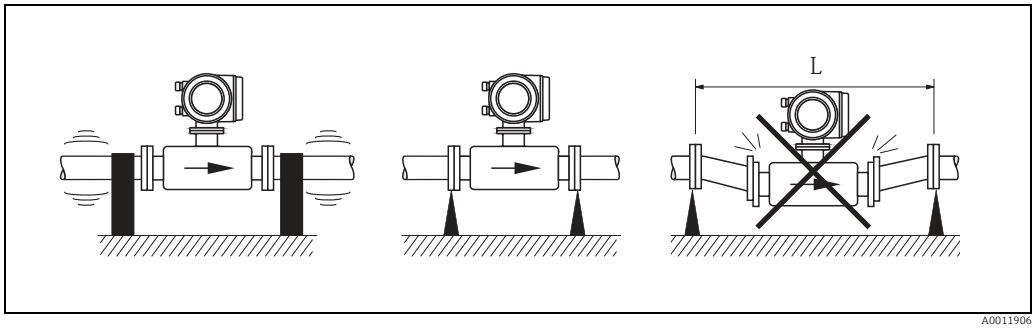


Fig. 13: Measures to prevent vibration of the measuring device (L > 10 m / 33 ft)

3.2.6 Foundations, supports

If the nominal diameter is DN ≥ 350 (14"), mount the sensor on a foundation of adequate load-bearing strength.

Caution!
Risk of damage.
Do not support the weight of the sensor on the metal casing: the casing would buckle and damage the internal magnetic coils.

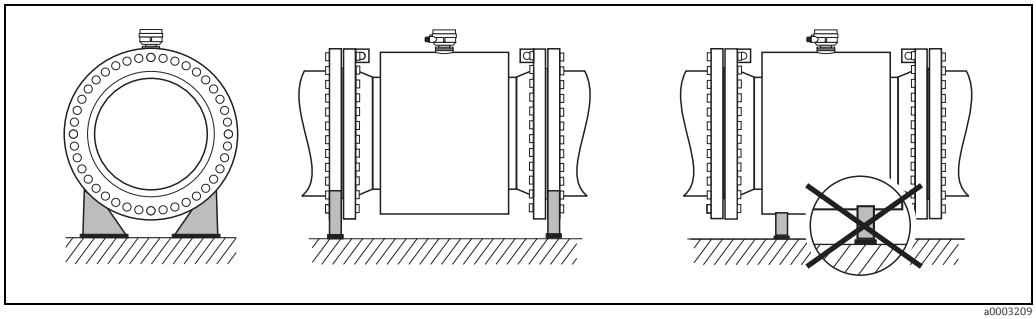


Fig. 14: Correct support for large nominal diameters (DN ≥ 350 / 14")

3.2.7 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by cross-section reduction.

Note!
- The nomogram only applies to liquids of viscosity similar to water.
- For Promag H the selection of a pipe with larger diameter for high viscosities of the fluid may be considered to reduce the pressure loss.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram, read off the pressure loss as a function of fluid velocity (*downstream* from the reduction) and the d/D ratio.

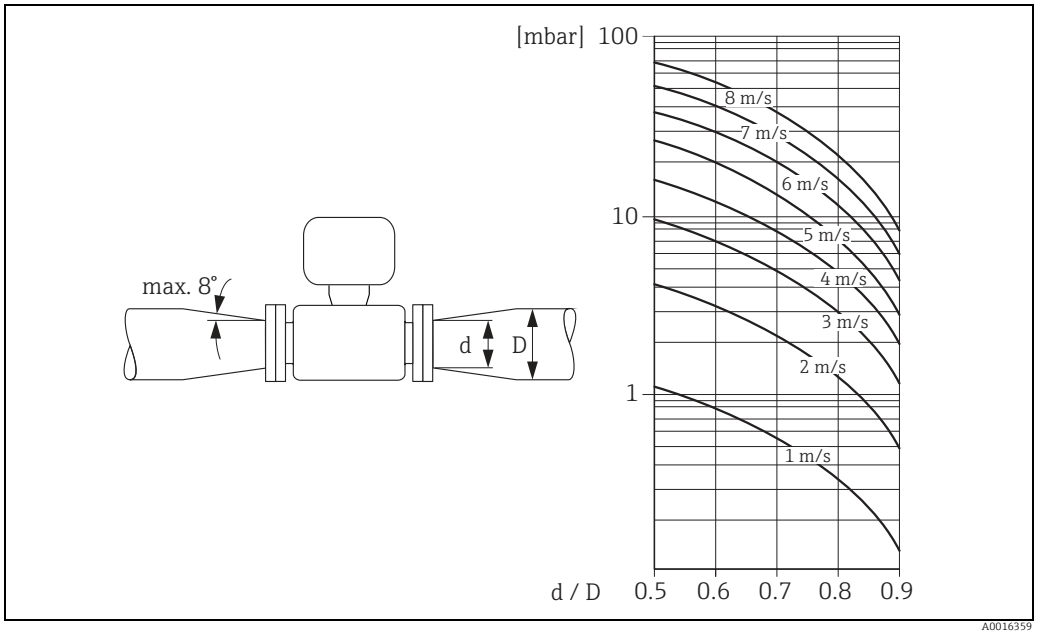


Fig. 15: Pressure loss due to adapters

3.2.8 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 and 3 m/s (6.5 to 9.8 ft/s)

The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:
- v < 2 m/s (v < 6.5 ft/s): for low conductivity values
- v > 2 m/s (v > 6.5 ft/s): for media that produce buildup (e.g. milk with high fat content)

Note!
- A necessary increase in the flow velocity can be achieved by reducing the sensor nominal diameter → 16.
- For Promag H the selection of a pipe with nominal diameter > DN 8 (3/8") for fluids with high levels of solids may be considered, to improve the stability of the signal and cleanability due to larger electrodes.

Recommended flow (SI units)

Nominal diameter [mm]	Promag E/P	Promag H	Promag L	Promag W
	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [dm³/min]			
2	–	0.06 to 1.8	–	–
4	–	0.25 to 7	–	–
8	–	1 to 30	–	–
15	4 to 100	4 to 100	–	–
25	9 to 300	9 to 300	9 to 300	9 to 300
32	15 to 500	–	15 to 500	15 to 500
40	25 to 700	25 to 700	25 to 700	25 to 700
50	35 to 1100	35 to 1100	35 to 1100	35 to 1100
65	60 to 2000	60 to 2000	60 to 2000	60 to 2000
80	90 to 3000	90 to 3000	90 to 3000	90 to 3000
100	145 to 4700	145 to 4700	145 to 4700	145 to 4700
125	220 to 7500	220 to 7500	220 to 7500	220 to 7500
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [m³/h]			
150	20 to 600	20 to 600	20 to 600	20 to 600
200	35 to 1100	–	35 to 1100	35 to 1100
250	55 to 1700	–	55 to 1700	55 to 1700
300	80 to 2400	–	80 to 2400	80 to 2400
350	110 to 3300	–	110 to 3300	110 to 3300
375	–	–	140 to 4200	140 to 4200
400	140 to 4200	–	140 to 4200	140 to 4200
450	180 to 5400	–	180 to 5400	180 to 5400
500	220 to 6600	–	220 to 6600	220 to 6600
600	310 to 9600	–	310 to 9600	310 to 9600
700	–	–	420 to 13500	420 to 13500
750	–	–	480 to 15000	480 to 15000
800	–	–	550 to 18000	550 to 18000
900	–	–	690 to 22500	690 to 22500
1000	–	–	850 to 28000	850 to 28000
1200	–	–	1250 to 40000	1250 to 40000
1400	–	–	1700 to 55000	1700 to 55000
1600	–	–	2200 to 70000	2200 to 70000
1800	–	–	2800 to 90000	2800 to 90000
2000	–	–	3400 to 110000	3400 to 110000
2200	–	–	4100 to 136000	–
2400	–	–	4800 to 162000	–

Recommended flow (US units)

Nominal diameter [inch]	Promag E/P	Promag H	Promag L	Promag W
	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [gal/min]			
1/12"	–	0.015 to 0.5	–	–
1/8"	–	0.07 to 2	–	–
3/8"	–	0.25 to 8	–	–
½"	1.0 to 27	1.0 to 27	–	–
1"	2.5 to 80	2.5 to 80	2.5 to 80	2.5 to 80
1 ½"	7 to 190	7 to 190	7 to 190	7 to 190
2"	10 to 300	10 to 300	10 to 300	10 to 300
3"	24 to 800	24 to 800	24 to 800	24 to 800
4"	40 to 1250	40 to 1250	40 to 1250	40 to 1250
6"	90 to 2650	90 to 2650	90 to 2650	90 to 2650
8"	155 to 4850	–	155 to 4850	155 to 4850
10"	250 to 7500	–	250 to 7500	250 to 7500
12"	350 to 10600	–	350 to 10600	350 to 10600
14"	500 to 15000	–	500 to 15000	500 to 15000
15"	–	–	600 to 19000	600 to 19000
16"	600 to 19000	–	600 to 19000	600 to 19000
18"	800 to 24000	–	800 to 24000	800 to 24000
20"	1000 to 30000	–	1000 to 30000	1000 to 30000
24"	1400 to 44000	–	1400 to 44000	1400 to 44000
28"	–	–	1900 to 60000	1900 to 60000
30"	–	–	2150 to 67000	2150 to 67000
32"	–	–	2450 to 80000	2450 to 80000
36"	–	–	3100 to 100000	3100 to 100000
40"	–	–	3800 to 125000	3800 to 125000
42"	–	–	4200 to 135000	4200 to 135000
48"	–	–	5500 to 175000	5500 to 175000
[inch]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [Mgal/d]			
54"	–	–	9 to 300	9 to 300
60"	–	–	12 to 380	12 to 380
66"	–	–	14 to 500	14 to 500
72"	–	–	16 to 570	16 to 570
78"	–	–	18 to 650	18 to 650
84"	–	–	24 to 800	–
90"	–	–	27 to 910	–

3.2.9 Length of connecting cable

In order to ensure measuring accuracy, please comply with the following instructions when installing the remote version:

- Secure the cable run or route the cable in an armored conduit. Movement of the cable can falsify the measuring signal, particularly if the fluid conductivity is low.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permissible cable length L_{max} depends on the fluid conductivity (→ 16).
- The maximum connecting cable length is 10 m (32.8 ft) when empty pipe detection (EPD → 99) is switched on.

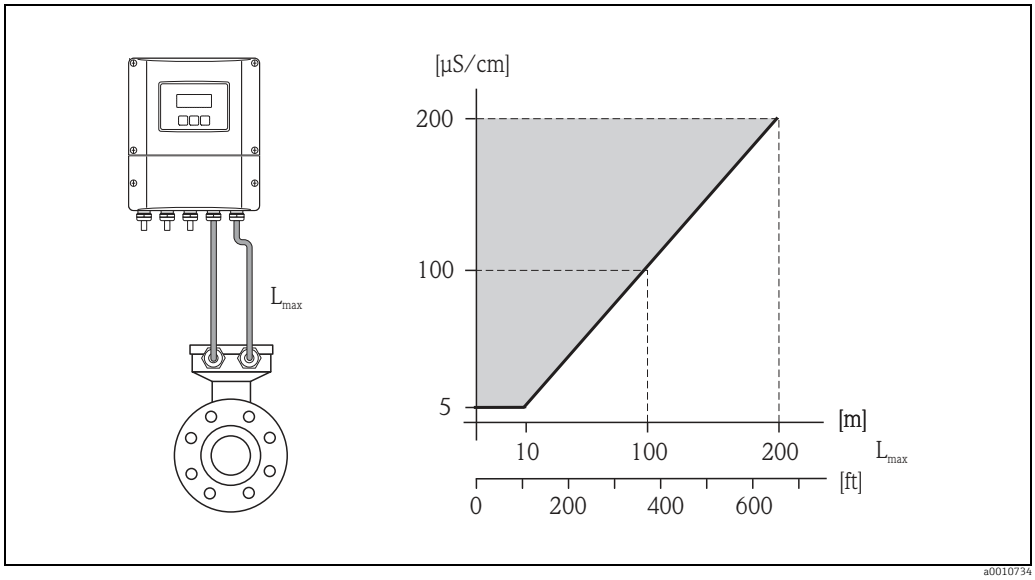


Fig. 16: Permitted lengths for connecting cable in remote version, as a function of the conductivity of the fluid

Gray shaded area = permissible range
L_{max} = length of connecting cable

3.3 Installation

3.3.1 Installing the Promag E sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE lining, which is turned over the flanges. Consequently, do not remove these protection plates **until immediately before** the sensor is installed in the pipe.
- Protection plates must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges:
- It is essential that you observe the necessary screw tightening torques on → 32.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

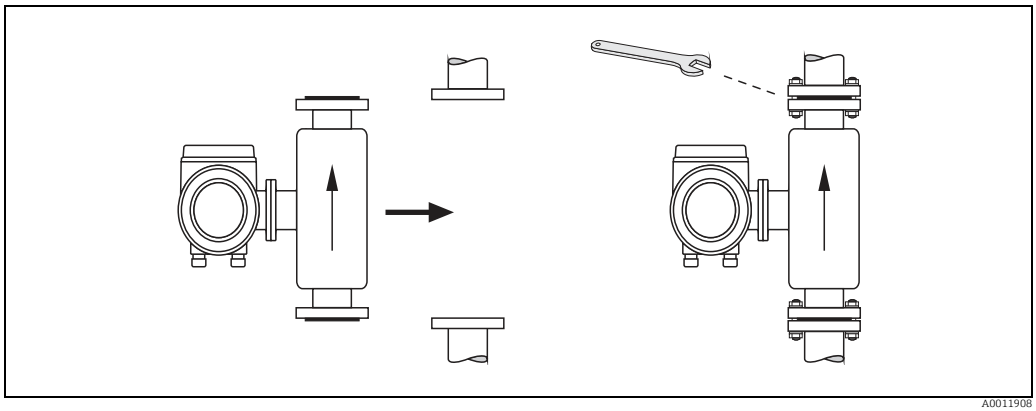


Fig. 17: Installing the Promag E sensor

Seals

Comply with the following instructions when installing seals:
- PFA or PTFE lining → seals are **not** required.
- Only use seals that comply with DIN EN 1514-1 for DIN flanges.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables can be ordered as accessories for potential equalization, → 102.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 57.

Screw tightening torques (Promag E)

Please note the following:
- The screw tightening torques listed below apply only to lubricated threads and to pipes not subjected to tensile stress.
- Tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.

Tightening torques for:
- EN (DIN) → 🖹 21
- ASME → 🖹 22
- JIS → 🖹 22

Promag E screw tightening torques for EN 1092-1 (DIN 2501), PN 6/10/16/40

Nominal diameter [mm]	EN (DIN) Pressure rating	Threaded fasteners	Flange thickness [mm]	Max. tightening torque PTFE [Nm]
15	PN 40	4 × M 12	16	11
25	PN 40	4 × M 12	18	26
32	PN 40	4 × M 16	18	41
40	PN 40	4 × M 16	18	52
50	PN 40	4 × M 16	20	65
65 *	PN 16	8 × M 16	18	43
80	PN 16	8 × M 16	20	53
100	PN 16	8 × M 16	20	57
125	PN 16	8 × M 16	22	75
150	PN 16	8 × M 20	22	99
200	PN 10	8 × M 20	24	141
200	PN 16	12 × M 20	24	94
250	PN 10	12 × M 20	26	110
250	PN 16	12 × M 24	26	131
300	PN 10	12 × M 20	26	125
300	PN 16	12 × M 24	28	179
350	PN 6	12 × M 20	22	200
350	PN 10	16 × M 20	26	188
350	PN 16	16 × M 24	30	254
400	PN 6	16 × M 20	22	166
400	PN 10	16 × M 24	26	260
400	PN 16	16 × M 27	32	330
450	PN 6	16 × M 20	22	202
450	PN 10	20 × M 24	28	235
450	PN 16	20 × M 27	40	300
500	PN 6	20 × M 20	24	176
500	PN 10	20 × M 24	28	265
500	PN 16	20 × M 30	34	448
600	PN 6	20 × M 24	30	242
600	PN 10	20 × M 27	28	345
600 *	PN 16	20 × M 33	36	658
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag E screw tightening torques for EN 1092-1, PN 6/10/16, P245GH/stainless-steel; Calculated according to EN 1591-1:2014 for flanges according to EN 1092-1:2013

Nominal diameter [mm]	EN(DIN) Pressure rating	Threaded fasteners	Flange thickness [mm]	Nom. tightening torque PTFE [Nm]
350	PN 10	16 × M 20	26	60
350	PN 16	16 × M 24	30	115

Nominal diameter [mm]	EN(DIN) Pressure rating	Threaded fasteners	Flange thickness [mm]	Nom. tightening torque PTFE [Nm]
400	PN 10	16 × M 24	26	90
400	PN 16	16 × M 27	32	155
450	PN 10	20 × M 24	28	90
450	PN 16	20 × M 27	34	155
500	PN 10	20 × M 24	28	100
500	PN 16	20 × M 30	36	205
600	PN 10	20 × M 27	30	150
600	PN 16	20 × M 33	40	310

Promag E screw tightening torques for ASME B16.5, Class 150

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque PTFE	
[mm]	[inch]	Pressure rating		[Nm]	[lbf · ft]
15	½"	Class 150	4 × ½"	6	4
25	1"	Class 150	4 × ½"	11	8
40	1 ½"	Class 150	4 × ½"	24	18
50	2"	Class 150	4 × 5/8"	47	35
80	3"	Class 150	4 × 5/8"	79	58
100	4"	Class 150	8 × 5/8"	56	41
150	6"	Class 150	8 × ¾"	106	78
200	8"	Class 150	8 × ¾"	143	105
250	10"	Class 150	12 × 7/8"	135	100
300	12"	Class 150	12 × 7/8"	178	131
350	14"	Class 150	12 × 1"	260	192
400	16"	Class 150	16 × 1"	246	181
450	18"	Class 150	16 × 1 ⅛"	371	274
500	20"	Class 150	20 × 1 ⅛"	341	252
600	24"	Class 150	20 × 1 ¼"	477	352

Promag E screw tightening torques for JIS B2220, 10/20K

Nominal diameter [mm]	Pressure rating	Threaded fasteners	Max. tightening torque PTFE [Nm]
15	20K	4 × M 12	16
25	20K	4 × M 16	32
32	20K	4 × M 16	38
40	20K	4 × M 16	41
50	10K	4 × M 16	54
65	10K	4 × M 16	74
80	10K	8 × M 16	38
100	10K	8 × M 16	47
125	10K	8 × M 20	80
150	10K	8 × M 20	99
200	10K	12 × M 20	82
250	10K	12 × M 22	133
300	10K	16 × M 22	99

3.3.2 Installing the Promag H sensor

The sensor is supplied, as per your order, with or without installed process connections. Installed process connections are screwed onto the sensor using 4 or 6 hexagonal-headed bolts.

Caution!
Depending on the application and the length of the pipe, the sensor must be supported or more securely mounted if necessary. Particularly when using process connections made of plastic, it is essential that the sensor be mounted securely. A wall mounting kit for this purpose can be ordered separately as an accessory from Endress+Hauser (→ 102).

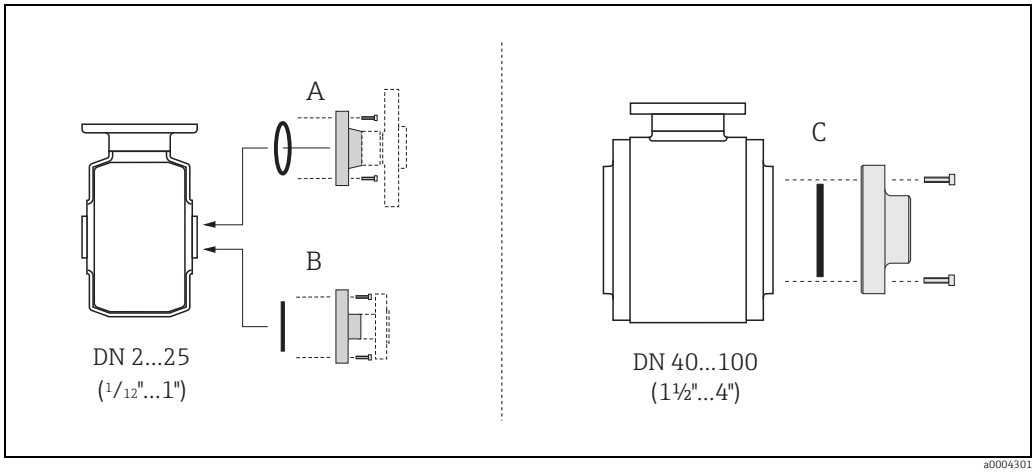


Fig. 18: Promag H process connections

A = DN 2 to 25 (1/12 to 1") / Process connections with O-ring
Weld nipple (DIN EN ISO 1127, ODT / SMS), flange (EN (DIN), ASME, JIS), flange made of PVDF (EN (DIN), ASME, JIS), external thread, internal thread, hose connection, PVC adhesive fitting

B = DN 2 to 25 (1/12 to 1") / Process connections with aseptic molded seal
Weld nipple (EN 10357 (DIN 11850), ODT/SMS), clamp (ISO 2852, DIN 32676, L14 AM7), coupling (DIN 11851, DIN 11864-1, SMS 1145), flange DIN 11864-2

C = DN 40 to 150 (1 ½ to 6") / Process connections with aseptic molded seal
Weld nipple (EN 10357 (DIN 11850), ODT/SMS, ASME BPE, ISO 2037), clamp (ISO 2852, DIN 32676, L14 AM7), coupling (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flange DIN 11864-2

Seals

When mounting the process connections, please ensure that the relevant seals are clean and properly centered.

Caution!
- In the case of metallic process connections, the screws must be fully tightened. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- In the case of process connections made of plastic, the maximum screw tightening torques for lubricated threads (7 Nm / 5.2 lbf ft) must be adhered to. In the case of plastic flanges, a seal must always be used between the connection and the counterflange.
- Depending on the application, the seals should be replaced periodically, particularly when molded seals (aseptic version) are used!
  The interval between replacements depends on the frequency of the cleaning cycles and on the temperatures of the fluid and the cleaning process. Replacement seals can be ordered as an accessory at a later stage → 102.

Using and installing grounding rings (DN 2 to 25 / 1/12 to 1")

In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalized using additional ground rings. If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the galvanic corrosion of the electrodes.

Caution!

- Depending on the option ordered, plastic rings may be installed at the process connections instead of ground rings. These plastic rings serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic rings/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from Endress+Hauser as accessories → 102. When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by galvanic corrosion! Information about the materials can be found on → 144.
- Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected.

1. Loosen the four or six hexagonal headed bolts (1) and remove the process connection from the sensor (4).
2. Remove the plastic ring (3), including the two O-ring seals (2).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (2) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again. With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft).

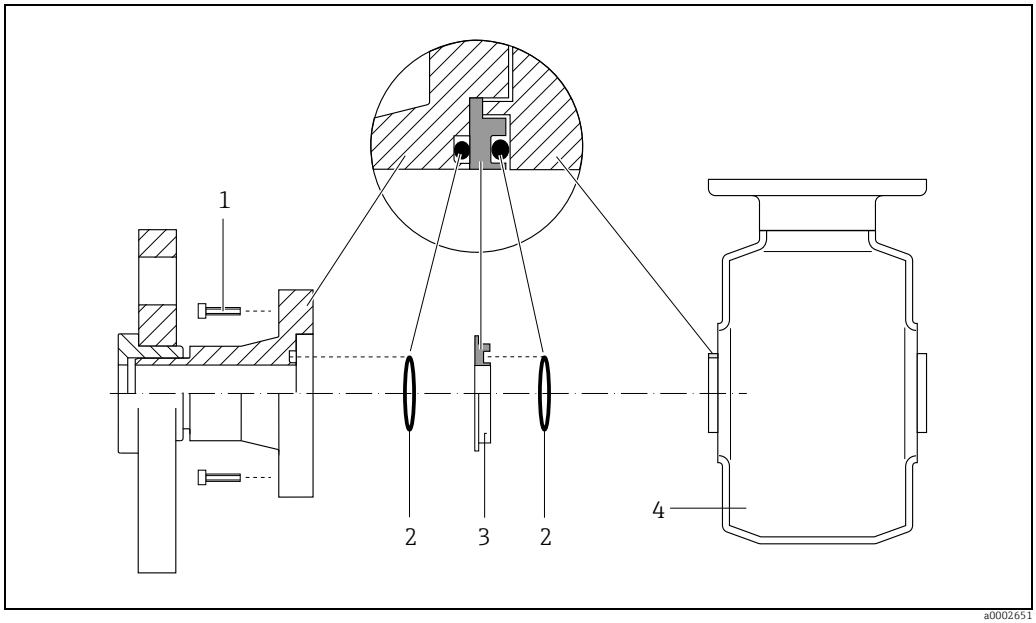


Fig. 19: Installing grounding rings in the Promag H (DN 2 to 25 / 1/12 to 1")

1 = Hexagonal-headed bolts, process connection
2 = O-ring seals
3 = Grounding ring or plastic ring (spacer)
4 = Sensor

Welding the transmitter into the pipe (weld nipple)

Caution!
Risk of electronics being destroyed. Please ensure that the welding system is *not* grounded via the sensor or transmitter.

1. Secure the sensor using several welding points in the piping. A welding jig suitable for this purpose can be ordered separately as an accessory → 102.
2. Loosen the screws at the process connection flange, and remove the sensor incl. seal from the piping.
3. Weld the process connection into the pipe.
4. Mount the sensor back into the pipe. When doing so, make sure that the seal is clean and positioned correctly.

Note!
- If the welding is done properly with thin-walled food pipes, the seal will not be damaged by heat even when mounted. Nonetheless, it is recommended that you dismantle the sensor and seal.
- For dismantling purposes, it must be possible to open the piping a total of approx. 8 mm.

Cleaning using pigs

When cleaning using pigs, please note the internal diameters of the measuring tube and the process connection. All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Information" → 151.

3.3.3 Installing the Promag L sensor

Caution!
- The protective covers mounted on the two sensor flanges (DN 25 to 300 / 1 to 12") are used to hold the lap joint flanges in place and to protect the PTFE liner during transportation. Consequently, do not remove these covers until **immediately before** the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 27.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.
- To comply with the device specification, a concentrical installation in the measuring section is required.

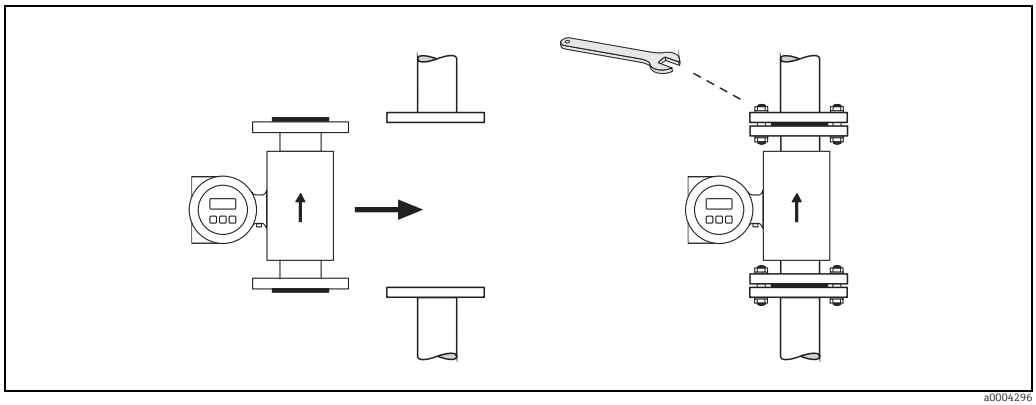


Fig. 20: Installing the Promag L sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- PTFE lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds such as graphite! An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables for potential equalization can be ordered as an accessory (→ 102).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 57.

Screw tightening torques (Promag L)

Please note the following:
- The screw tightening torques listed below apply only to lubricated threads and to pipes not subjected to tensile stress.
- Tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.

Promag L screw tightening torques for EN 1092-1 (DIN 2501), PN 6/10/16

Nominal diamter [mm]	EN (DIN) Pressure rating	Threaded fasteners	flange thickness [mm]	Max. tightening torques		
				Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
25	PN 10/16	4 × M 12	18	-	6	11
32	PN 10/16	4 × M 16	18	-	16	27
40	PN 10/16	4 × M 16	18	-	16	29
50	PN 10/16	4 × M 16	18	-	15	40
65*	PN 10/16	8 × M 16	18	-	10	22
80	PN 10/16	8 × M 16	20	-	15	30
100	PN 10/16	8 × M 16	20	-	20	42
125	PN 10/16	8 × M 16	22	-	30	55
150	PN 10/16	8 × M 20	22	-	50	90
200	PN 16	12 × M 20	24	-	65	87
250	PN 16	12 × M 24	26	-	126	151
300	PN 16	12 × M 24	28	-	139	177
350	PN 6	12 × M 20	22	111	120	-
350	PN 10	16 × M 20	26	112	118	-
350	PN 16	16 × M 24	30	152	165	-
400	PN 6	16 × M 20	22	90	98	-
400	PN 10	16 × M 24	26	151	167	-
400	PN 16	16 × M 27	32	193	215	-
450	PN 6	16 × M 20	22	112	126	-
450	PN 10	20 × M 24	28	153	133	-
500	PN 6	20 × M 20	24	119	123	-
500	PN 10	20 × M 24	28	155	171	-
500	PN 16	20 × M 30	34	275	300	-
600	PN 6	20 × M 24	30	139	147	-
600	PN 10	20 × M 27	28	206	219	-
600*	PN 16	20 × M 33	36	415	443	-
700	PN 6	24 × M 24	24	148	139	-
700	PN 10	24 × M 27	30	246	246	-
700	PN 16	24 × M 33	36	278	318	-
800	PN 6	24 × M 27	24	206	182	-
800	PN 10	24 × M 30	32	331	316	-
800	PN 16	24 × M 36	38	369	385	-
900	PN 6	24 × M 27	26	230	637	-
900	PN 10	28 × M 30	34	316	307	-
900	PN 16	28 × M 36	40	353	398	-
1000	PN 6	28 × M 27	26	218	208	-
1000	PN 10	28 × M 33	34	402	405	-
1000	PN 16	28 × M 39	42	502	518	-
1200	PN 6	32 × M 30	28	319	299	-
1200	PN 10	32 × M 36	38	564	568	-
1200	PN 16	32 × M 45	48	701	753	-
1400	PN 6	36 × M 33	32	430	-	-
1400	PN 10	36 × M 39	42	654	-	-
1400	PN 16	36 × M 45	52	729	-	-
1600	PN 6	40 × M 33	34	440	-	-
1600	PN 10	40 × M 45	46	946	-	-

Nominal diamter [mm]	EN (DIN) Pressure rating	Threaded fasteners	flange thickness [mm]	Max. tightening torques		
				Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
1600	PN 16	40 × M 52	58	1007	-	-
1800	PN 6	44 × M 36	36	547	-	-
1800	PN 10	44 × M 45	50	961	-	-
1800	PN 16	44 × M 52	62	1108	-	-
2000	PN 6	48 × M 39	38	629	-	-
2000	PN 10	48 × M 45	54	1047	-	-
2000	PN 16	48 × M 56	66	1324	-	-
2200	PN 6	52 × M 39	42	698	-	-
2200	PN 10	52 × M 52	58	1217	-	-
2400	PN 6	56 × M 39	44	768	-	-
2400	PN 10	56 × M 52	62	1229	-	-
* Designed acc. to EN 1092-1 (not to DIN 2501)						

Promag L screw tightening torques for EN 1092-1, PN 6/10/16, P245GH/stainless-steel; Calculated according to EN 1591-1:2014 for flange according to EN 1092-1:2013

Nominal diameter [mm]	EN(DIN) pressure rating	Threaded fastener	Flange thickness [mm]	Nom. tightening torques	
				Hard rubber [Nm]	Polyurethane [Nm]
350	PN 6	12 × M 20	22	60	75
350	PN 10	16 × M 20	26	70	80
400	PN 6	16 × M 20	22	65	70
400	PN 10	16 × M 24	26	100	120
400	PN 16	16 × M 27	32	175	190
450	PN 6	16 × M 20	22	70	90
450	PN 10	20 × M 24	28	100	110
500	PN 6	20 × M 20	24	65	70
500	PN 10	20 × M 24	28	110	120
500	PN 16	20 × M 30	36	225	235
600	PN 6	20 × M 24	30	105	105
600	PN 10	20 × M 27	30	165	160
600	PN 16	20 × M 33	40	340	340
700	PN 6	24 × M 24	30	110	110
700	PN 10	24 × M 27	35	190	190
700	PN 16	24 × M 33	40	340	340
800	PN 6	24 × M 27	30	145	145
800	PN 10	24 × M 30	38	260	260
800	PN 16	24 × M 36	41	465	455
900	PN 6	24 × M 27	34	170	180
900	PN 10	28 × M 30	38	265	275
900	PN 16	28 × M 36	48	475	475
1000	PN 6	28 × M 27	38	175	185
1000	PN 10	28 × M 33	44	350	360
1000	PN 16	28 × M 39	59	630	620
1200	PN 6	32 × M 30	42	235	250
1200	PN 10	32 × M 36	55	470	480
1200	PN 16	32 × M 45	78	890	900
1400	PN 6	36 × M 33	56	300	-
1400	PN 10	36 × M 39	65	600	-
1400	PN 16	36 × M 45	84	1050	-
1600	PN 6	40 × M 33	63	340	-
1600	PN 10	40 × M 45	75	810	-
1600	PN 16	40 × M 52	102	1420	-
1800	PN 6	44 × M 36	69	430	-

Nominal diameter [mm]	EN(DIN) pressure rating	Threaded fastener	Flange thickness [mm]	Nom. tightening torques	
				Hard rubber [Nm]	Polyurethane [Nm]
1800	PN 10	44 × M 45	85	920	-
1800	PN 16	44 × M 52	110	1600	-
2000	PN 6	48 × M 39	74	530	-
2000	PN 10	48 × M 45	90	1040	-
2000	PN 16	48 × M 56	124	1900	-
2200	PN 6	52 × M 39	81	580	-
2200	PN 10	52 × M 52	100	1290	-
2400	PN 6	56 × M 39	87	650	-
2400	PN 10	56 × M 52	110	1410	-

Promag L screw tightening torques for ASME B16.5, Class 150

Nominal diameter		ASME Pressure rating	Threaded fasteners	Max. tightening torque					
				Hard rubber		Polyurethane		PTFE	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
25	1"	Class 150	4 × 5/8"	-	-	5	4	14	13
40	1 ½"	Class 150	8 × 5/8"	-	-	10	17	21	15
50	2"	Class 150	4 × 5/8"	-	-	15	11	40	29
80	3"	Class 150	4 × 5/8"	-	-	25	18	65	48
100	4"	Class 150	8 × 5/8"	-	-	20	15	44	32
150	6"	Class 150	8 × ¾"	-	-	45	33	90	66
200	8"	Class 150	8 × ¾"	-	-	65	48	87	64
250	10"	Class 150	12 × 7/8"	-	-	126	93	151	112
300	12"	Class 150	12 × 7/8"	-	-	146	108	177	131
350	14"	Class 150	12 × 1"	135	100	158	117	-	-
400	16"	Class 150	16 × 1"	128	94	150	111	-	-
450	18"	Class 150	16 × 1 ⅛"	204	150	234	173	-	-
500	20"	Class 150	20 × 1 ⅛"	183	135	217	160	-	-
600	24"	Class 150	20 × 1 ¼"	268	198	307	226	-	-

Promag L screw tightening torques for AWWA, Class D

Nominal diameter		AWWA Pressure rating	Threaded fasteners	Max. tightening torque					
				Hard rubber		Polyurethane		PTFE	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215	-	-
750	30"	Class D	28 × 1 ¼"	287	212	302	223	-	-
800	32"	Class D	28 × 1 ½"	394	291	422	311	-	-
900	36"	Class D	32 × 1 ½"	419	309	430	317	-	-
1000	40"	Class D	36 × 1 ½"	420	310	477	352	-	-
–	42"	Class D	36 × 1 ½"	528	389	518	382	-	-
1200	48"	Class D	44 × 1 ½"	552	407	531	392	-	-

Promag L screw tightening torques for AS 2129, Table E

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque		
			Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
350	Table E	12 × M 24	203	-	-
400	Table E	12 × M 24	226	-	-
450	Table E	16 × M 24	226	-	-
500	Table E	16 × M 24	271	-	-

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque		
			Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
600	Table E	16 × M 30	439	-	-
700	Table E	20 × M 30	355	-	-
750	Table E	20 × M 30	559	-	-
800	Table E	20 × M 30	631	-	-
900	Table E	24 × M 30	627	-	-
1000	Table E	24 × M 30	634	-	-
1200	Table E	32 × M 30	727	-	-

Promag L screw tightening torques for AS 4087, PN16

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque		
			Hard rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]
350	PN 16	12 × M 24	203	-	-
375	PN 16	12 × M 24	137	-	-
400	PN 16	12 × M 24	226	-	-
450	PN 16	12 × M 24	301	-	-
500	PN 16	16 × M 24	271	-	-
600	PN 16	16 × M 27	393	-	-
700	PN 16	20 × M 27	330	-	-
750	PN 16	20 × M 30	529	-	-
800	PN 16	20 × M 33	631	-	-
900	PN 16	24 × M 33	627	-	-
1000	PN 16	24 × M 33	595	-	-
1200	PN 16	32 × M 33	703	-	-

3.3.4 Installing the Promag P sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE lining, which is turned over the flanges. Consequently, do not remove these protection plates **until immediately before** the sensor is installed in the pipe.
- Protection plates must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges:
- It is essential that you observe the necessary screw tightening torques on → 32.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

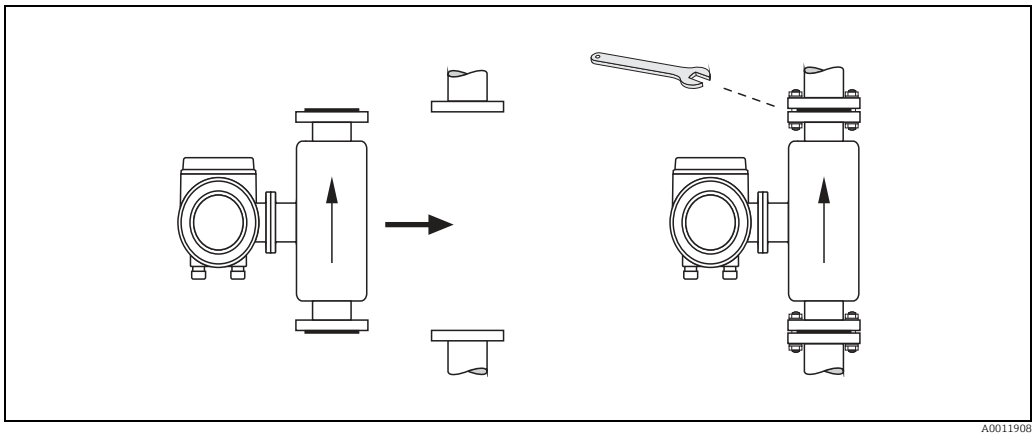


Fig. 21: Installing the Promag P sensor

Seals

Comply with the following instructions when installing seals:
- PFA or PTFE lining → seals are **not** required.
- Only use seals that comply with DIN EN 1514-1 for DIN flanges.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables can be ordered as accessories for potential equalization, → 102.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 57.

Installing the high-temperature version (with PFA lining)

The high-temperature version has a housing support for the thermal separation of sensor and transmitter. The high-temperature version is always used for applications in which high ambient temperatures are encountered in conjunction with high fluid temperatures. The high-temperature version is obligatory if the fluid temperature exceeds +150 °C (+300 °F).

Note!
You will find information on permissible temperature ranges on → 129.

Insulation
Pipes generally have to be insulated if they carry very hot fluids to avoid energy losses and prevent accidental contact with pipes at temperatures that could cause injury. Guidelines regulating the insulation of pipes have to be taken into account.

Caution!
Risk of electronics overheating. The housing support dissipates heat and its entire surface area must remain uncovered. Make sure that the sensor insulation does not extend past the top of the two sensor half-shells.

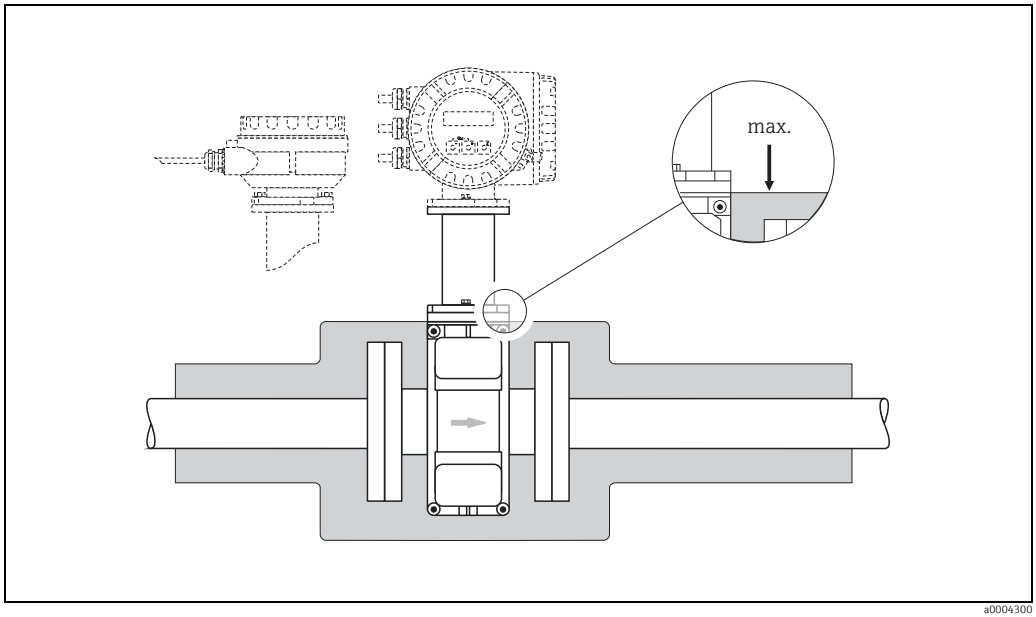


Fig. 22: Promag P sensor (high-temperature version): insulating the pipe

Screw tightening torques (Promag P)

Please note the following:
- The screw tightening torques listed below apply only to lubricated threads and to pipes not subjected to tensile stress.
- Tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.

Tightening torques for:
- EN (DIN) → 33
- ASME → 34
- JIS → 34
- AS 2129 → 35
- AS 4087 → 35

Promag P screw tightening torques for EN 1092-1 (DIN 2501), PN 10/16/25/40

Nominal diameter [mm]	EN (DIN) pressure rating	Threaded fasteners	Flange thickness [mm]	Max. tightening torques PTFE [Nm]	Max. tightening torques PFA [Nm]
15	PN 40	4 × M 12	16	11	–
25	PN 40	4 × M 12	18	26	20
32	PN 40	4 × M 16	18	41	35
40	PN 40	4 × M 16	18	52	47
50	PN 40	4 × M 16	20	65	59
65 *	PN 16	8 × M 16	18	43	40
65	PN 40	8 × M 16	22	43	40
80	PN 16	8 × M 16	20	53	48
80	PN 40	8 × M 16	24	53	48
100	PN 16	8 × M 16	20	57	51
100	PN 40	8 × M 20	24	78	70
125	PN 16	8 × M 16	22	75	67
125	PN 40	8 × M 24	26	111	99
150	PN 16	8 × M 20	22	99	85
150	PN 40	8 × M 24	28	136	120
200	PN 10	8 × M 20	24	141	101
200	PN 16	12 × M 20	24	94	67
200	PN 25	12 × M 24	30	138	105
250	PN 10	12 × M 20	26	110	–
250	PN 16	12 × M 24	26	131	–
250	PN 25	12 × M 27	32	200	–
300	PN 10	12 × M 20	26	125	–
300	PN 16	12 × M 24	28	179	–
300	PN 25	16 × M 27	34	204	–
350	PN 10	16 × M 20	26	188	–
350	PN 16	16 × M 24	30	254	–
350	PN 25	16 × M 30	38	380	–
400	PN 10	16 × M 24	26	260	–
400	PN 16	16 × M 27	32	330	–
400	PN 25	16 × M 33	40	488	–
450	PN 10	20 × M 24	28	235	–
450	PN 16	20 × M 27	40	300	–
450	PN 25	20 × M 33	46	385	–
500	PN 10	20 × M 24	28	265	–
500	PN 16	20 × M 30	34	448	–
500	PN 25	20 × M 33	48	533	–
600	PN 10	20 × M 27	28	345	–
600 *	PN 16	20 × M 33	36	658	–
600	PN 25	20 × M 36	58	731	–
* Designed acc. to EN 1092-1 (not to DIN 2501)					

Promag P screw tightening torques for EN 1092-1, PN 10/16/25, P245GH/stainless-steel; Calculated according to EN 1591-1:2014 for flange according to EN 1092-1:2013

Nominal diamter [mm]	EN (DIN) pressure rating	Threaded fasteners	Flange thickness [mm]	Nom. tightening torques PTFE [Nm]
350	PN 10	16 × M 20	26	60
350	PN 16	16 × M 24	30	115
350	PN 25	16 × M 30	38	220
400	PN 10	16 × M 24	26	90
400	PN 16	16 × M 27	32	155
400	PN 25	16 × M 33	40	290

Nominal diamter [mm]	EN (DIN) pressure rating	Threaded fasteners	Flange thickness [mm]	Nom. tightening torques PTFE [Nm]
450	PN 10	20 × M 24	28	90
450	PN 16	20 × M 27	34	155
450	PN 25	20 × M 33	46	290
500	PN 10	20 × M 24	28	100
500	PN 16	20 × M 30	36	205
500	PN 25	20 × M 33	48	345
600	PN 10	20 × M 27	30	150
600	PN 16	20 × M 33	40	310
600	PN 25	20 × M 36	48	500

Promag P screw tightening torques for ASME B16.5, Class 150/300

Nominal diameter		ASME Pressure rating	Screws Threaded fasteners	Max. tightening torque			
				PTFE		PFA	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
15	½"	Class 150	4 × ½"	6	4	–	–
15	½"	Class 300	4 × ½"	6	4	–	–
25	1"	Class 150	4 × ½"	11	8	10	7
25	1"	Class 300	4 × 5/8"	14	10	12	9
40	1 ½"	Class 150	4 × ½"	24	18	21	15
40	1 ½"	Class 300	4 × ¾"	34	25	31	23
50	2"	Class 150	4 × 5/8"	47	35	44	32
50	2"	Class 300	8 × 5/8"	23	17	22	16
80	3"	Class 150	4 × 5/8"	79	58	67	49
80	3"	Class 300	8 × ¾"	47	35	42	31
100	4"	Class 150	8 × 5/8"	56	41	50	37
100	4"	Class 300	8 × ¾"	67	49	59	44
150	6"	Class 150	8 × ¾"	106	78	86	63
150	6"	Class 300	12 × ¾"	73	54	67	49
200	8"	Class 150	8 × ¾"	143	105	109	80
250	10"	Class 150	12 × 7/8"	135	100	–	–
300	12"	Class 150	12 × 7/8"	178	131	–	–
350	14"	Class 150	12 × 1"	260	192	–	–
400	16"	Class 150	16 × 1"	246	181	–	–
450	18"	Class 150	16 × 1 ⅛"	371	274	–	–
500	20"	Class 150	20 × 1 ⅛"	341	252	–	–
600	24"	Class 150	20 × 1 ¼"	477	352	–	–

Promag P screw tightening torques for JIS B2220, 10/20K

Nominal diameter	JIS Pressure rating	Screws Threaded fasteners	Max. tightening torque	
			PTFE	PFA
[mm]			[Nm]	[Nm]
15	10K	4 × M 12	16	–
15	20K	4 × M 12	16	–
25	10K	4 × M 16	32	27
25	20K	4 × M 16	32	27
32	10K	4 × M 16	38	–
32	20K	4 × M 16	38	–

Nominal diameter [mm]	JIS Pressure rating	Screws Threaded fasteners	Max. tightening torque PTFE [Nm]	Max. tightening torque PFA [Nm]
40	10K	4 × M 16	41	37
40	20K	4 × M 16	41	37
50	10K	4 × M 16	54	46
50	20K	8 × M 16	27	23
65	10K	4 × M 16	74	63
65	20K	8 × M 16	37	31
80	10K	8 × M 16	38	32
80	20K	8 × M 20	57	46
100	10K	8 × M 16	47	38
100	20K	8 × M 20	75	58
125	10K	8 × M 20	80	66
125	20K	8 × M 22	121	103
150	10K	8 × M 20	99	81
150	20K	12 × M 22	108	72
200	10K	12 × M 20	82	54
200	20K	12 × M 22	121	88
250	10K	12 × M 22	133	–
250	20K	12 × M 24	212	–
300	10K	16 × M 22	99	–
300	20K	16 × M 24	183	–

Promag P tightening torques for JIS B2220, 10/20K

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Nom. tightening torques Hard rubber [Nm]	Nom. tightening torques Polyurethane [Nm]
350	10K	16 × M 22	109	109
350	20K	16 × M 30 x3	217	217
400	10K	16 × M 24	163	163
400	20K	16 × M 30x3	258	258
450	10K	16 × M 24	155	155
450	20K	16 × M 30x3	272	272
500	10K	16 × M 24	183	183
500	20K	16 × M 30x3	315	315
600	10K	16 × M 30	235	235
600	20K	16 × M 36x3	381	381

Promag P screw tightening torques for AS 2129, Table E

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque PTFE [Nm]
25	Table E	4 × M 12	21
50	Table E	4 × M 16	42

Promag P screw tightening torques for AS 4087, PN16

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque PTFE [Nm]
50	PN 16	4 × M 16	42

3.3.5 Installing the Promag W sensor

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges:
- It is essential that you observe the necessary screw tightening torques on → 37.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

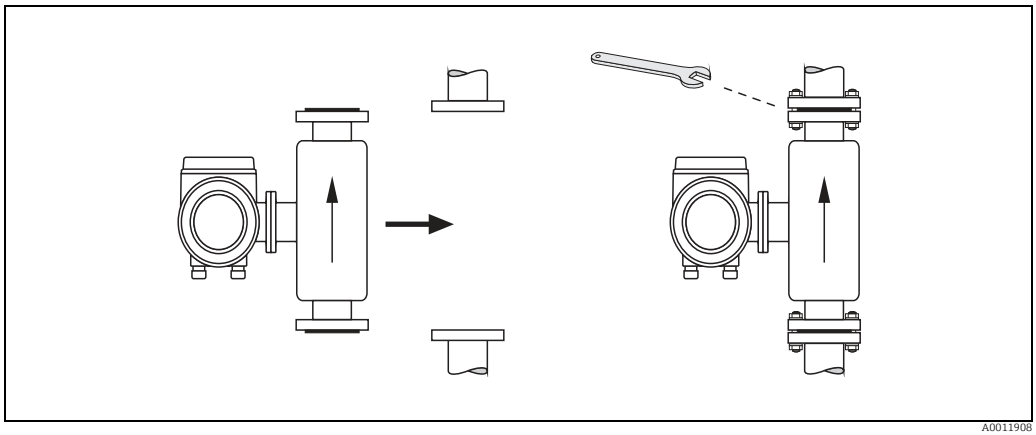


Fig. 23: Installing the Promag W sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** required.
- Polyurethane lining → seals are **not** required.
- Only use seals that comply with DIN EN 1514-1 for DIN flanges.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable

- If necessary, special ground cables can be ordered as accessories for potential equalization, → 102.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 57.

Screw tightening torques (Promag W)

Please note the following:
- The screw tightening torques listed below apply only to lubricated threads and to pipes not subjected to tensile stress.
- Tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.

Tightening torques for:

- EN (DIN) → 🖹 37
- JIS → 🖹 39
- ASME → 🖹 40
- AWWA → 🖹 41
- AS 2129 → 🖹 41
- AS 4087 → 🖹 42

Promag W screw tightening torques for EN 1092-1 (DIN 2501), PN 6/10/16/25/40

Nominal diameter [mm]	EN (DIN) pressure rating	Threaded fasteners	Flange thickness [mm]	Max. tightening torque	
				Hard rubber [Nm]	Polyurethane [Nm]
25	PN 40	4 × M 12	18	-	15
32	PN 40	4 × M 16	18	-	24
40	PN 40	4 × M 16	18	-	31
50	PN 40	4 × M 16	20	48	40
65*	PN 16	8 × M 16	18	32	27
65	PN 40	8 × M 16	22	32	27
80	PN 16	8 × M 16	20	40	34
80	PN 40	8 × M 16	24	40	34
100	PN 16	8 × M 16	20	43	36
100	PN 40	8 × M 20	24	59	50
125	PN 16	8 × M 16	22	56	48
125	PN 40	8 × M 24	26	83	71
150	PN 16	8 × M 20	22	74	63
150	PN 40	8 × M 24	28	104	88
200	PN 10	8 × M 20	24	106	91
200	PN 16	12 × M 20	24	70	61
200	PN 25	12 × M 24	30	104	92
250	PN 10	12 × M 20	26	82	71
250	PN 16	12 × M 24	26	98	85
250	PN 25	12 × M 27	32	150	134
300	PN 10	12 × M 20	26	94	81
300	PN 16	12 × M 24	28	134	118
300	PN 25	16 × M 27	34	153	138
350	PN 6	12 × M 20	22	111	120
350	PN 10	16 × M 20	26	112	118
350	PN 16	16 × M 24	30	152	165
350	PN 25	16 × M 30	38	227	252
400	PN 6	16 × M 20	22	90	98
400	PN 10	16 × M 24	26	151	167
400	PN 16	16 × M 27	32	193	215
400	PN 25	16 × M 33	40	289	326
450	PN 6	16 × M 20	22	112	126
450	PN 10	20 × M 24	28	153	133
450	PN 16	20 × M 27	40	198	196
450	PN 25	20 × M 33	46	256	253
500	PN 6	20 × M 20	24	119	123

Nominal diameter [mm]	EN (DIN) pressure rating	Threaded fasteners	Flange thickness [mm]	Max. tightening torque	
				Hard rubber [Nm]	Polyurethane [Nm]
500	PN 10	20 × M 24	28	155	171
500	PN 16	20 × M 30	34	275	300
500	PN 25	20 × M 33	48	317	360
600	PN 6	20 × M 24	30	139	147
600	PN 10	20 × M 27	28	206	219
600 *	PN 16	20 × M 33	36	415	443
600	PN 25	20 × M 36	58	431	516
700	PN 6	24 × M 24	24	148	139
700	PN 10	24 × M 27	30	246	246
700	PN 16	24 × M 33	36	278	318
700	PN 25	24 × M 39	46	449	507
800	PN 6	24 × M 27	24	206	182
800	PN 10	24 × M 30	32	331	316
800	PN 16	24 × M 36	38	369	385
800	PN 25	24 × M 45	50	664	721
900	PN 6	24 × M 27	26	230	637
900	PN 10	28 × M 30	34	316	307
900	PN 16	28 × M 36	40	353	398
900	PN 25	28 × M 45	54	690	716
1000	PN 6	28 × M 27	26	218	208
1000	PN 10	28 × M 33	34	402	405
1000	PN 16	28 × M 39	42	502	518
1000	PN 25	28 × M 52	58	970	971
1200	PN 6	32 × M 30	28	319	299
1200	PN 10	32 × M 36	38	564	568
1200	PN 16	32 × M 45	48	701	753
1400	PN 6	36 × M 33	32	430	398
1400	PN 10	36 × M 39	42	654	618
1400	PN 16	36 × M 45	52	729	762
1600	PN 6	40 × M 33	34	440	417
1600	PN 10	40 × M 45	46	946	893
1600	PN 16	40 × M 52	58	1007	1100
1800	PN 6	44 × M 36	36	547	521
1800	PN 10	44 × M 45	50	961	895
1800	PN 16	44 × M 52	62	1108	1003
2000	PN 6	48 × M 39	38	629	605
2000	PN 10	48 × M 45	54	1047	1092
2000	PN 16	48 × M 56	66	1324	1261
* Designed acc. to EN 1092-1 (not to DIN 2501)					

Promag W screw tightening torques for EN 1092-1, PN 6/10/16/25, P245GH/stainless-steel; Calculated according to EN 1591-1:2014 for flange according to EN 1092-1:2013

Nominal diameter [mm]	EN (DIN) pressure rating	Threaded fasteners	flange thickness [mm]	Nom. tightening torque	
				Hard rubber [Nm]	Polyurethane [Nm]
350	PN 6	12 × M 20	22	60	75
350	PN 10	16 × M 20	26	70	80
350	PN 16	16 × M 24	30	125	135
350	PN 25	16 × M 30	38	230	235
400	PN 6	16 × M 20	22	65	70
400	PN 10	16 × M 24	26	100	120
400	PN 16	16 × M 27	32	175	190

Nominal diameter [mm]	EN (DIN) pressure rating	Threaded fasteners	flange thickness [mm]	Nom. tightening torque	
				Hard rubber [Nm]	Polyurethane [Nm]
400	PN 25	16 × M 33	40	315	325
450	PN 6	16 × M 20	22	70	90
450	PN 10	20 × M 24	28	100	110
450	PN 16	20 × M 27	34	175	190
450	PN 25	20 × M 33	46	300	310
500	PN 6	20 × M 20	24	65	70
500	PN 10	20 × M 24	28	110	120
500	PN 16	20 × M 30	36	225	235
500	PN 25	20 × M 33	48	370	370
600	PN 6	20 × M 24	30	105	105
600	PN 10	20 × M 27	30	165	160
600	PN 16	20 × M 33	40	340	340
600	PN 25	20 × M 36	48	540	540
700	PN 6	24 × M 24	30	110	110
700	PN 10	24 × M 27	35	190	190
700	PN 16	24 × M 33	40	340	340
700	PN 25	24 × M 39	50	615	595
800	PN 6	24 × M 27	30	145	145
800	PN 10	24 × M 30	38	260	260
800	PN 16	24 × M 36	41	465	455
800	PN 25	24 × M 45	53	885	880
900	PN 6	24 × M 27	34	170	180
900	PN 10	28 × M 30	38	265	275
900	PN 16	28 × M 36	48	475	475
900	PN 25	28 × M 45	57	930	915
1000	PN 6	28 × M 27	38	175	185
1000	PN 10	28 × M 33	44	350	360
1000	PN 16	28 × M 39	59	630	620
1000	PN 25	28 × M 52	63	1300	1290
1200	PN 6	32 × M 30	42	235	250
1200	PN 10	32 × M 36	55	470	480
1200	PN 16	32 × M 45	78	890	900
1400	PN 6	36 × M 33	56	300	-
1400	PN 10	36 × M 39	65	600	-
1400	PN 16	36 × M 45	84	1050	-
1600	PN 6	40 × M 33	63	340	-
1600	PN 10	40 × M 45	75	810	-
1600	PN 16	40 × M 52	102	1420	-
1800	PN 6	44 × M 36	69	430	-
1800	PN 10	44 × M 45	85	920	-
1800	PN 16	44 × M 52	110	1600	-
2000	PN 6	48 × M 39	74	530	-
2000	PN 10	48 × M 45	90	1040	-
2000	PN 16	48 × M 56	124	1900	-

Promag W screw tightening torques for JIS B2220, 10/20K

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque	
			Hard rubber [Nm]	Polyurethane [Nm]
25	10K	4 × M 16	–	19

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]	Max. tightening torque Polyurethane [Nm]
25	20K	4 × M 16	–	19
32	10K	4 × M 16	–	22
32	20K	4 × M 16	–	22
40	10K	4 × M 16	–	24
40	20K	4 × M 16	–	24
50	10K	4 × M 16	40	33
50	20K	8 × M 16	20	17
65	10K	4 × M 16	55	45
65	20K	8 × M 16	28	23
80	10K	8 × M 16	29	23
80	20K	8 × M 20	42	35
100	10K	8 × M 16	35	29
100	20K	8 × M 20	56	48
125	10K	8 × M 20	60	51
125	20K	8 × M 22	91	79
150	10K	8 × M 20	75	63
150	20K	12 × M 22	81	72
200	10K	12 × M 20	61	52
200	20K	12 × M 22	91	80
250	10K	12 × M 22	100	87
250	20K	12 × M 24	159	144
300	10K	16 × M 22	74	63
300	20K	16 × M 24	138	124

Promag W screw tightening torques for JIS B2220, 10/20K

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Nom. tightening torque Hard rubber [Nm]	Nom. tightening torque Polyurethane [Nm]
350	10K	16 × M 22	109	109
350	20K	16 × M 30 x3	217	217
400	10K	16 × M 24	163	163
400	20K	16 × M 30x3	258	258
450	10K	16 × M 24	155	155
450	20K	16 × M 30x3	272	272
500	10K	16 × M 24	183	183
500	20K	16 × M 30x3	315	315
600	10K	16 × M 30	235	235
600	20K	16 × M 36x3	381	381
700	10K	16 × M 30	300	300
750	10K	16 × M 30	339	339

Promag W screw tightening torques for ASME B16.5, Class 150/300

Nominal diameter [inch]	ASME Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]	Max. tightening torque Polyurethane [Nm]
1"	Class 150	4 × ½"	–	7

Nominal diameter [inch]	ASME Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]	Max. tightening torque Polyurethane [Nm]
1"	Class 300	4 × 5/8"	–	8
1 ½"	Class 150	4 × ½"	–	10
1 ½"	Class 300	4 × ¾"	–	15
2"	Class 150	4 × 5/8"	35	22
2"	Class 300	8 × 5/8"	18	11
3"	Class 150	4 × 5/8"	60	43
3"	Class 300	8 × ¾"	38	26
4"	Class 150	8 × 5/8"	42	31
4"	Class 300	8 × ¾"	58	40
6"	Class 150	8 × ¾"	79	59
6"	Class 300	12 × ¾"	70	51
8"	Class 150	8 × ¾"	107	80
10"	Class 150	12 × 7/8"	101	75
12"	Class 150	12 × 7/8"	133	103
14"	Class 150	12 × 1"	135	158
16"	Class 150	16 × 1"	128	150
18"	Class 150	16 × 1 ⅛"	204	234
20"	Class 150	20 × 1 ⅛"	183	217
24"	Class 150	20 × 1 ¼	268	307

Promag W screw tightening torques for AWWA, Class D

Nominal diameter [inch]	AWWA Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]	Max. tightening torque Polyurethane [Nm]
28"	Class D	28 × 1 ¼"	247	292
30"	Class D	28 × 1 ¼"	287	302
32"	Class D	28 × 1 ½"	394	422
36"	Class D	32 × 1 ½"	419	430
40"	Class D	36 × 1 ½"	420	477
42"	Class D	36 × 1 ½"	528	518
48"	Class D	44 × 1 ½"	552	531
54"	Class D	44 × 1 ¾"	730	633
60"	Class D	52 × 1 ¾"	758	832
66"	Class D	52 × 1 ¾"	946	955
72"	Class D	60 × 1 ¾"	975	1087
78"	Class D	64 × 2"	853	786

Promag W screw tightening torques for AS 2129, Table E

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]
50	Table E	4 × M 16	32
80	Table E	4 × M 16	49
100	Table E	8 × M 16	38

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]
150	Table E	8 × M 20	64
200	Table E	8 × M 20	96
250	Table E	12 × M 20	98
300	Table E	12 × M 24	123
350	Table E	12 × M 24	203
400	Table E	12 × M 24	226
500	Table E	16 × M 24	271
600	Table E	16 × M 30	439
700	Table E	20 × M 30	355
750	Table E	20 × M 30	559
800	Table E	20 × M 30	631
900	Table E	24 × M 30	627
1000	Table E	24 × M 30	634
1200	Table E	32 × M 30	727

Promag W screw tightening torques for AS 4087, PN16

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]
50	PN 16	4 × M 16	32
80	PN 16	4 × M 16	49
100 *	PN 16	8 × M 16	38
150	PN 16	8 × M 20	52
200	PN 16	8 × M 20	77
250	PN 16	8 × M 20	147
300	PN 16	12 × M 24	103
350	PN 16	12 × M 24	203
375	PN 16	12 × M 24	137
400	PN 16	12 × M 24	226
500	PN 16	16 × M 24	271
600	PN 16	16 × M 30	393
700	PN 16	20 × M 27	330
750	PN 16	20 × M 30	529
800	PN 16	20 × M 33	631
900	PN 16	24 × M 33	627
1000	PN 16	24 × M 33	595
1200	PN 16	32 × M 33	703
* Designed acc. to AS 2129 (not to AS 4087)			

3.3.6 Turning the transmitter housing

Turning the aluminum field housing

Warning!
The rotating mechanism in devices with Ex d/de or FM/CSA Cl. I Div. 1 approval is different to that described here. The relevant procedure is described in the Ex-specific documentation.

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing as far as it will go.
4. Turn the transmitter housing to the desired position (max. 2 × 90° in either direction).
5. Lower the housing into position and reengage the bayonet catch.
6. Retighten the two securing screws.

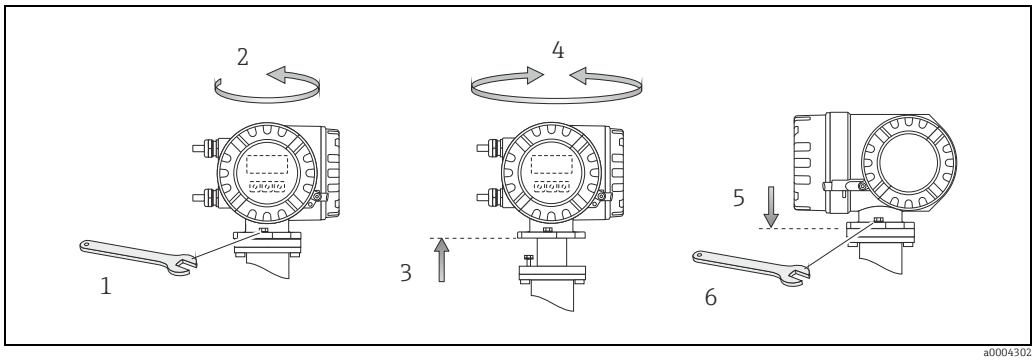


Fig. 24: Turning the transmitter housing (aluminum field housing)

Turning the stainless steel field housing

a. Loosen the two securing screws.
b. Carefully lift the transmitter housing as far as it will go.
c. Turn the transmitter housing to the desired position (max. 2 × 90° in either direction).
d. Lower the housing into position once more.
e. Retighten the two securing screws.

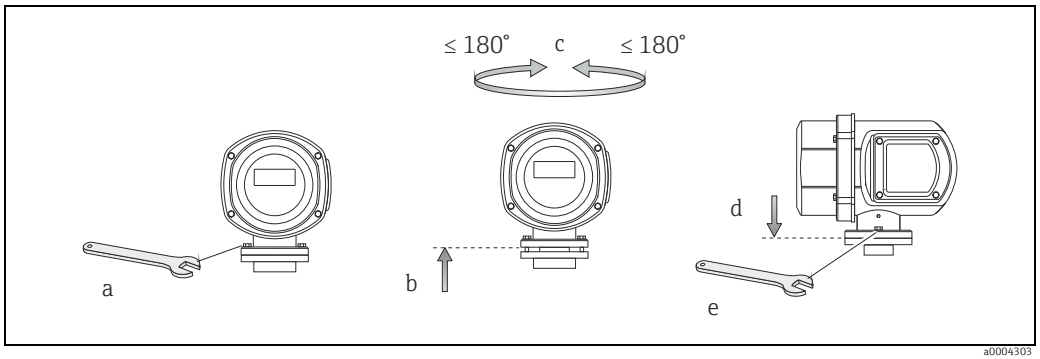


Fig. 25: Turning the transmitter housing (stainless steel field housing)

3.3.7 Turning the local display

1. Unscrew the electronics compartment cover from the transmitter housing.
2. Press the latches on the side of the display module and pull the module out of the electronics compartment cover.
3. Turn the display to the desired position (max. 4 × 45° in both directions) and position it back on the electronics compartment cover.
4. Screw the cover of the electronics compartment firmly onto the transmitter housing.

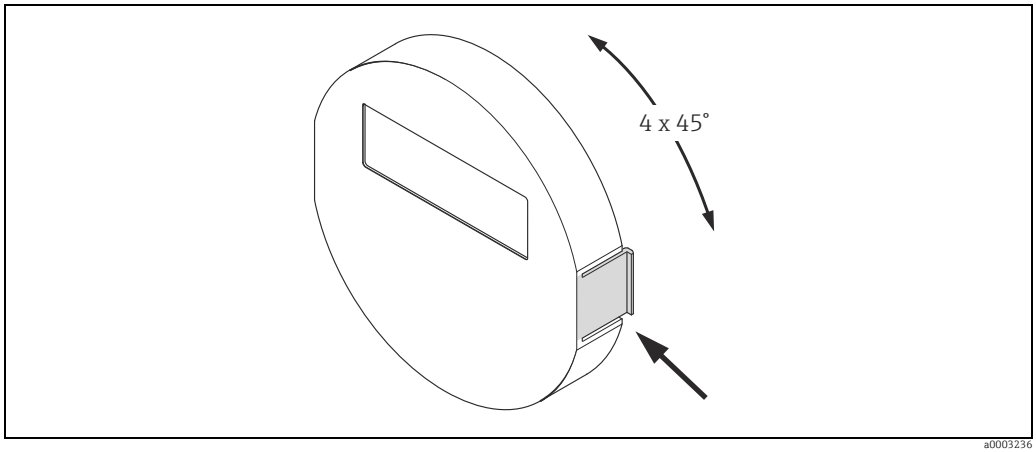


Fig. 26: Turning the local display (field housing)

3.3.8 Installing the wall-mount housing

There are various ways of installing the wall-mount housing:

- Mounted directly on the wall
- Panel mounting (with separate mounting kit, accessories) → 🖹 46.
- Pipe mounting (with separate mounting kit, accessories) → 🖹 46.

Caution!

- Make sure that the permitted ambient temperature range is observed (see nameplate or → 🖹 128). Install the device in a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Mounted directly on the wall

1. Drill the holes as illustrated.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm (0.26")
   – Screw head: max. Ø 10.5 mm (0.4")
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

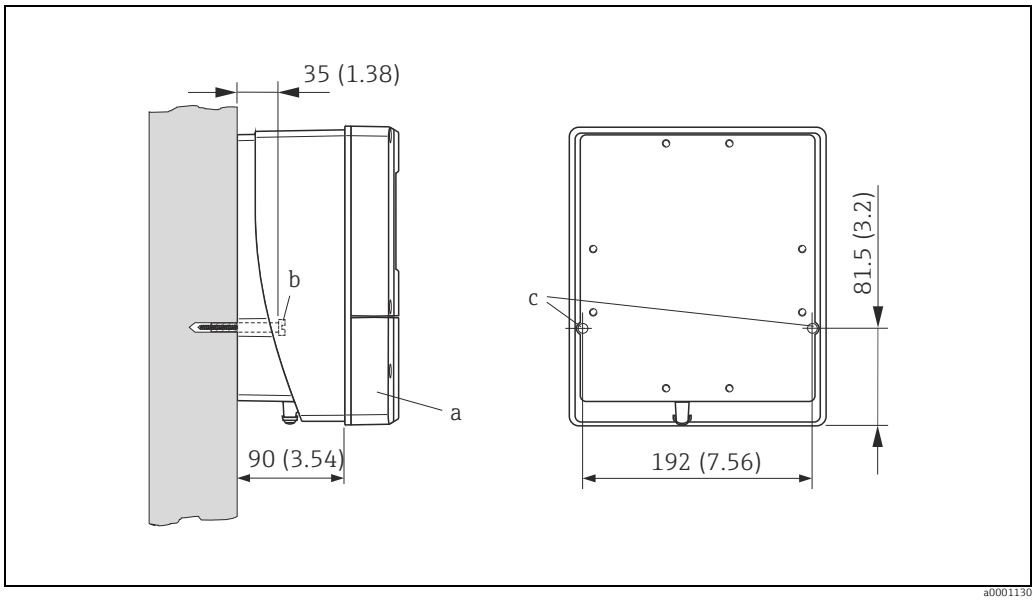


Fig. 27: Mounted directly on the wall. Engineering unit mm (in)

Panel mounting

1. Prepare the opening in the panel as illustrated.
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Place the threaded rods in the fasteners and screw them down until the housing is seated tightly against the panel wall. Afterwards, tighten the locking nuts. Additional support is not necessary.

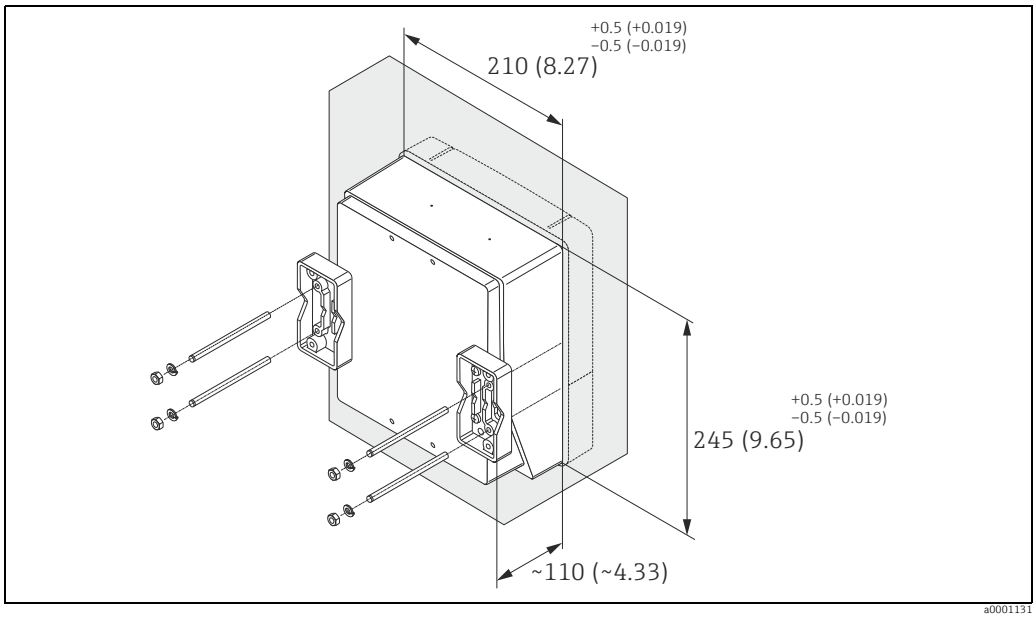


Fig. 28: Panel mounting (wall-mount housing. Engineering unit mm (in))

Pipe mounting

The assembly should be performed by following the instructions in the following diagram.

Caution!
If the device is mounted to a warm pipe, make sure that the housing temperature does not exceed +60 °C (+140 °F), which is the maximum permissible temperature.

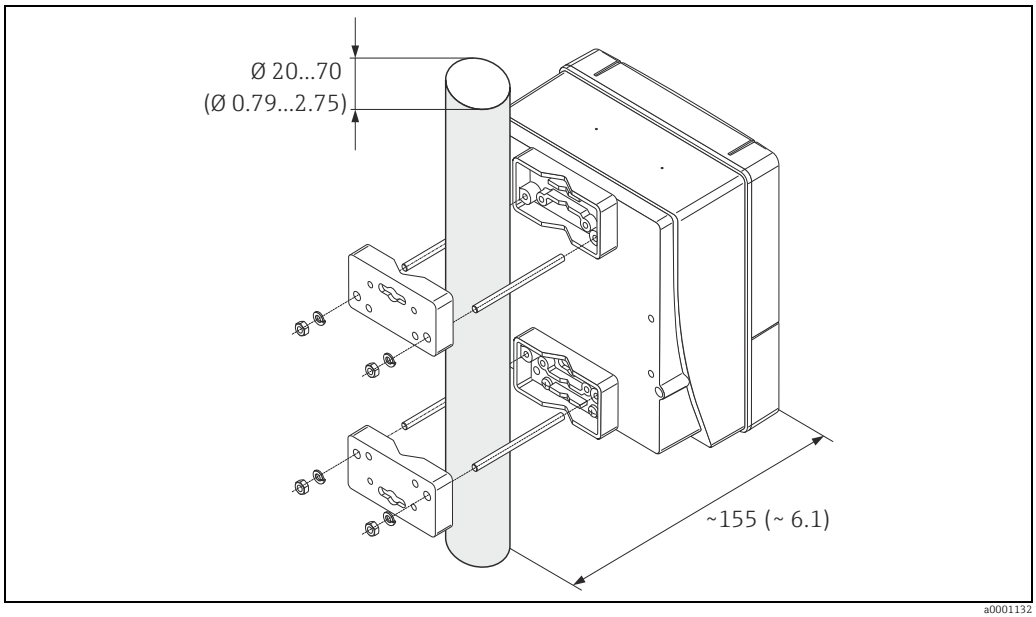


Fig. 29: Pipe mounting (wall-mount housing). Engineering unit mm (in)

3.4 Post-installation check

Perform the following checks after installing the measuring device in the pipe:

Device condition/specifications	Notes
Is the device damaged (visual inspection)?	–
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	→ 🖹 125
Installation	**Notes**
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	–
Is the position of the measuring electrode plane correct?	→ 🖹 14
Is the position of the empty pipe detection electrode correct?	→ 🖹 14
Were all screws tightened to the specified tightening torques when the sensor was installed?	→ 🖹 20
Were the correct seals installed (type, material, installation)?	→ 🖹 36
Are the measuring point number and labeling correct (visual inspection)?	–
Process environment / process conditions	**Notes**
Are the inlet and outlet runs respected?	Inlet run ≥ 5 × DN Outlet run ≥ 2 × DN
Is the measuring device protected against moisture and direct sunlight?	–
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g in accordance with IEC 600 68-2-6 → 🖹 128

4 Wiring

Warning!
When connecting Ex-certified devices, please take note of the instructions and wiring diagrams in the Ex-specific supplement to these Operating Instructions. Should you have any questions, please contact your Endress+Hauser sales office for assistance.

Note!
The device does not have an internal circuit breaker. An external switch or circuit breaker must therefore be installed which can be used to disconnect the device from the main power source.

4.1 Connecting the remote version

4.1.1 Connecting the sensor

Warning!
- Risk of electric shock! Switch off the power supply before opening the device. Do **not** install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock! Connect the protective conductor to the ground terminal on the housing before the power supply is applied.

Caution!
- Only sensors and transmitters with the same serial number can be connected to one another. Communication problems can occur if the devices are not connected in this way.
- Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil current cable.

Procedure

1. Transmitter: Remove the cover from the connection compartment (a).
2. Sensor: Remove the cover from the connection housing (b).
3. Feed the electrode cable (c) and the coil current cable (d) through the appropriate cable entries.

   Caution!
   Route the connecting cables securely (see "Connecting cable length" → 19).
4. Terminate the signal and coil current cable as indicated in the table:
   Promag E/L/P/W → Refer to the table → 50
   Promag H → Refer to the "Cable termination" table → 51
5. Establish the wiring between the sensor and the transmitter.
   The electrical wiring diagram that applies to your device can be found:
   – In the corresponding graphic:
   → 30 (Promag E/L/P/W); → 31 (Promag H)
   – In the cover of the sensor and transmitter

   Note!
   The cable shields of the Promag H sensor are grounded by means of the strain relief terminals (see also the "Cable termination" table → 51)

   Caution!
   Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighbouring cable shields inside the connection housing.
6. Transmitter: Screw the cover on the connection compartment (a).
7. Sensor: Secure the cover on the connection housing (b).

Promag E/L/P/W

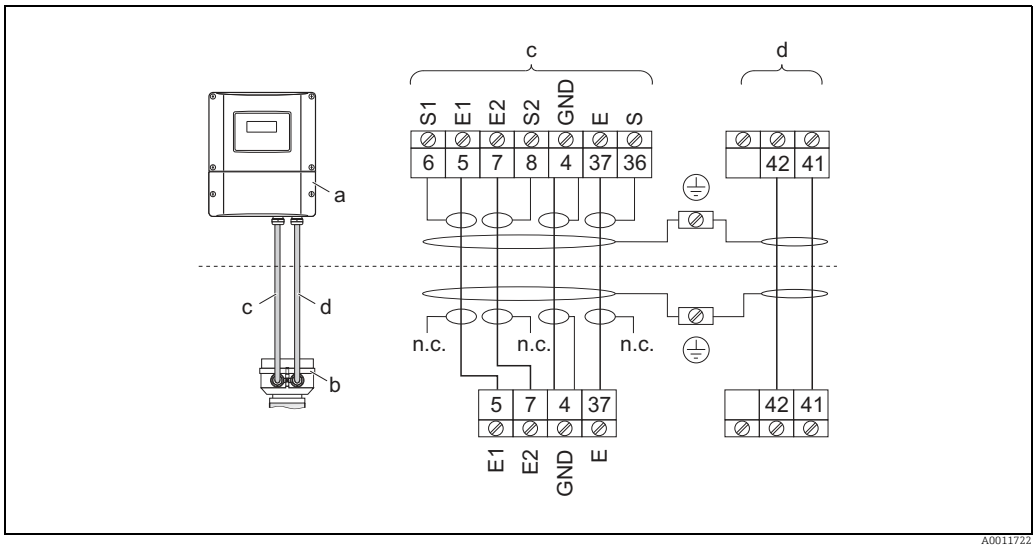


Fig. 30: Connecting the remote version of Promag E/L/P/W

a Wall-mount housing connection compartment
b Cover of the sensor connection housing
c Electrode cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colours/Terminal No.:
5/6 = brown, 7/8 = white, 4 = green, 37/36 = yellow

Promag H

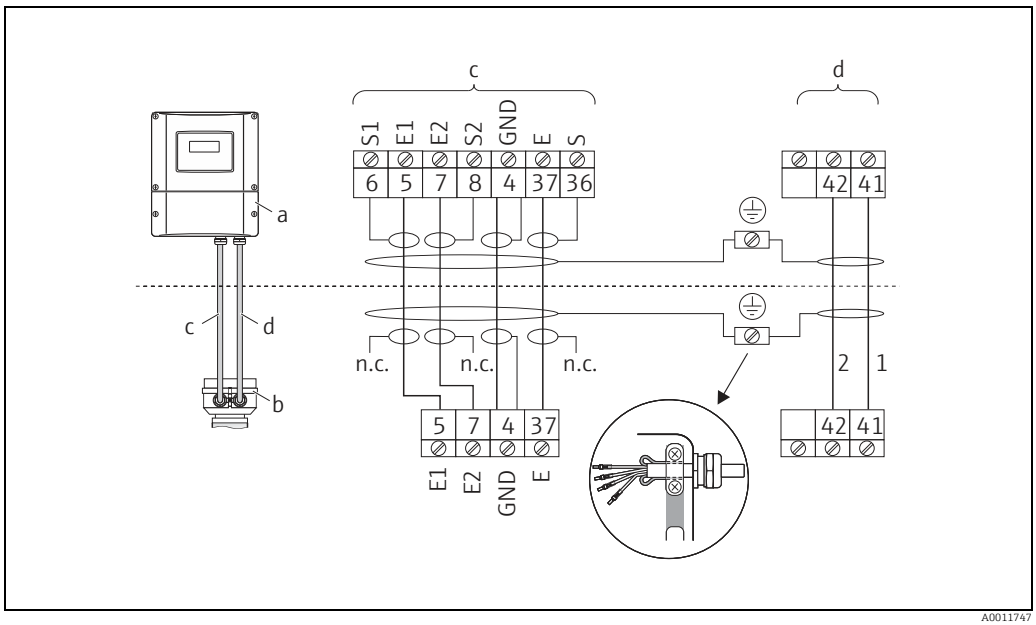


Fig. 31: Connecting the remote version of Promag H

a Wall-mount housing connection compartment
b Cover of the sensor connection housing
c Electrode cable
d Coil current cable
n.c. Not connected, insulated cable shields

Wire colours/Terminal No.:
5/6 = brown, 7/8 = white, 4 = green, 37/36 = yellow

Cable termination in remote version
Promag E/L/P/W

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with wire end ferrules (detail B: ① = red ferrules, Ø 1.0 mm; ② = white ferrules, Ø 0.5 mm)
* Stripping for reinforced cables only

Caution!
When fitting the connectors, pay attention to the following points:
- *Electrode cable* → Make sure that the wire end ferrules do not touch the wire shields on the sensor side! Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.

TRANSMITTER

Electrode cable

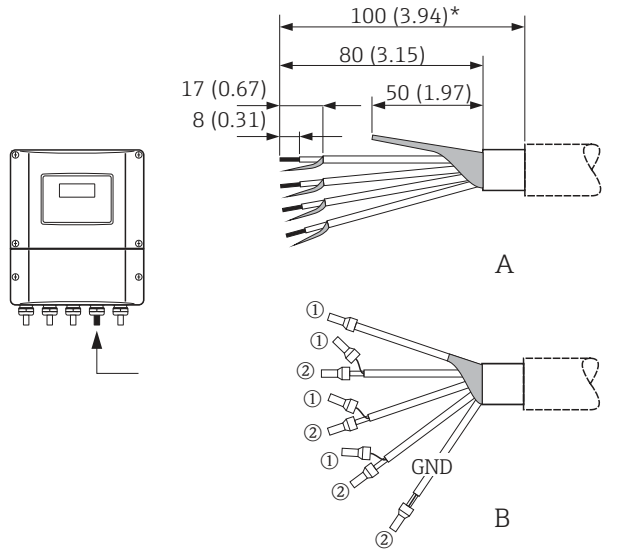


Fig. 32: Engineering unit mm (in)

Coil current cable

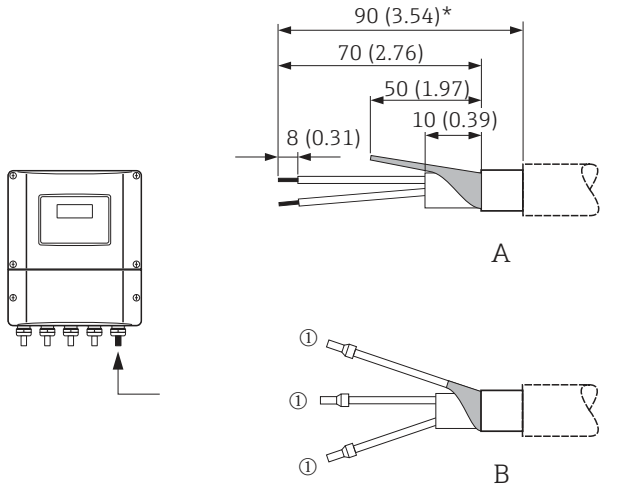


Fig. 33: Engineering unit mm (in)

SENSOR

Electrode cable

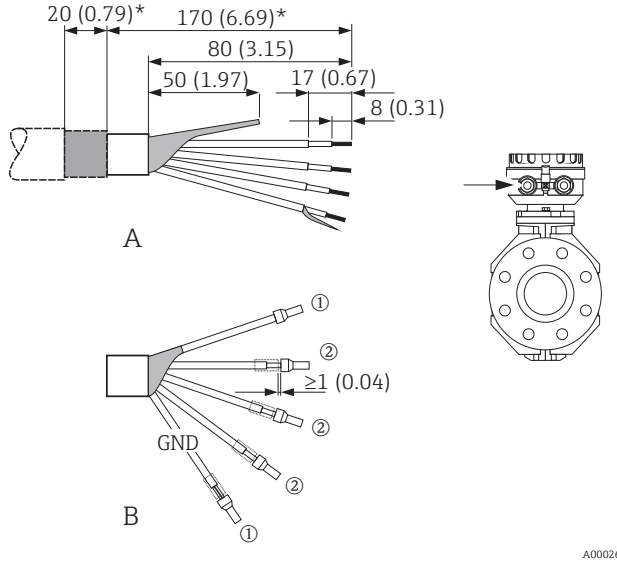


Fig. 34: Engineering unit mm (in)

Coil current cable

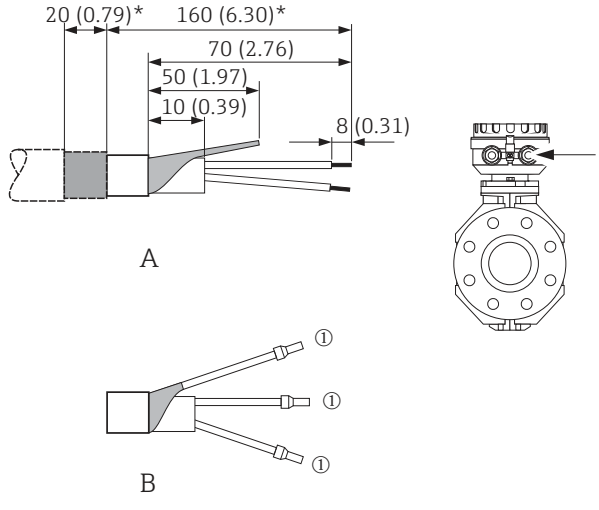


Fig. 35: Engineering unit mm (in)

Cable termination in remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with wire end ferrules (detail B: ① = ferrules red, Ø 1.0 mm; ② = ferrule white, Ø 0.5 mm)

Caution!
When fitting the connectors, pay attention to the following points:
- *Electrode cable* → Make sure that the wire end ferrules do not touch the wire shields on the sensor side! Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

TRANSMITTER

Electrode cable

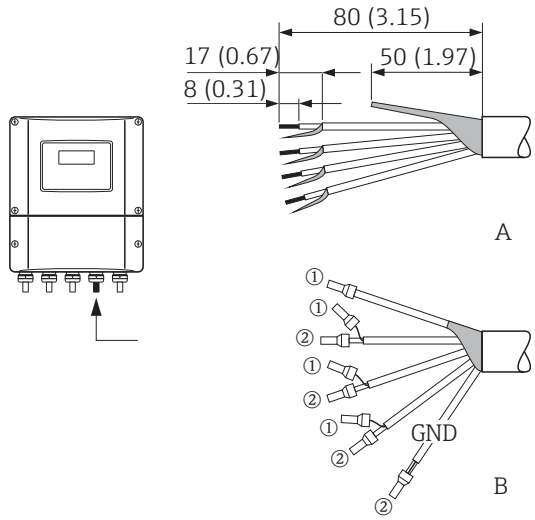


Fig. 36: Engineering unit mm (in)

Coil current cable

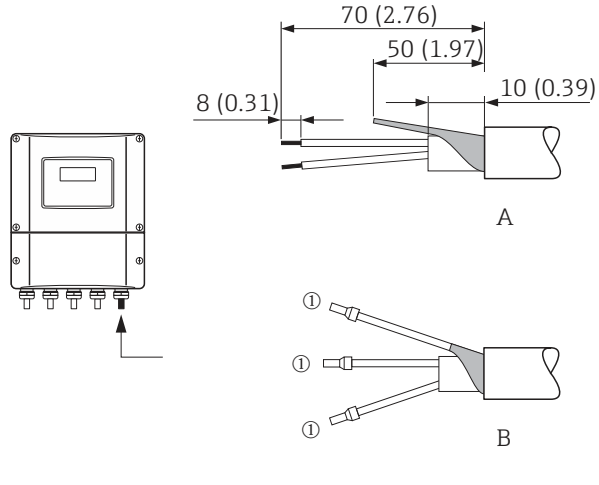


Fig. 37: Engineering unit mm (in)

SENSOR

Electrode cable

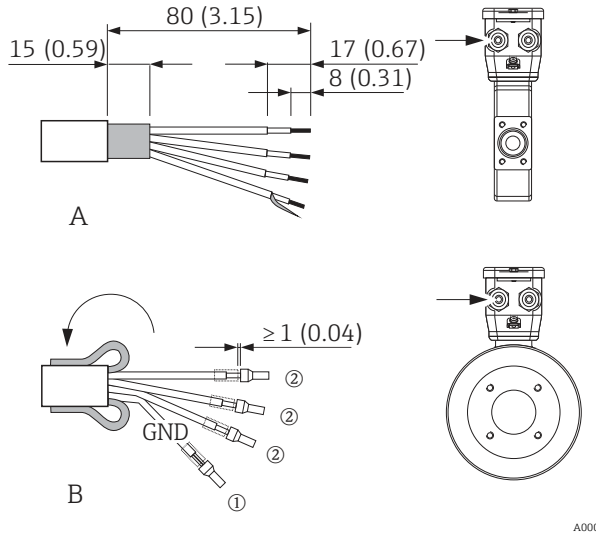


Fig. 38: Engineering unit mm (in)

Coil current cable

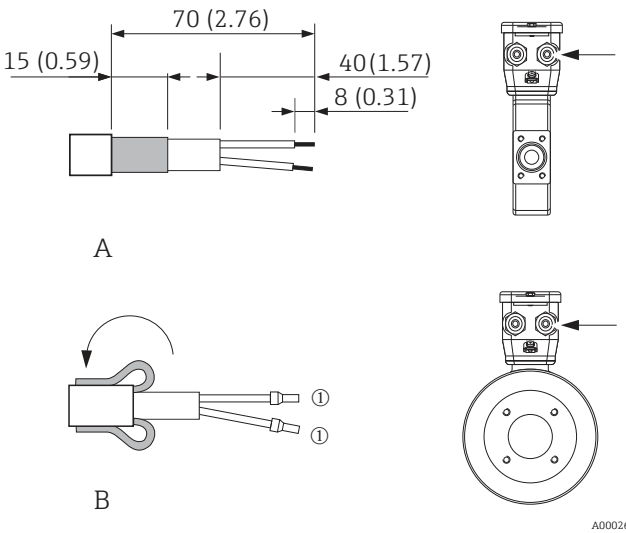


Fig. 39: Engineering unit mm (in)

4.1.2 Cable specifications

Electrode cable

- 3 × 0.38 mm² PVC cable with common, braided copper shield (Ø~ 9.5 mm/ 0.37") and individually shielded cores
- With Empty Pipe Detection (EPD): 4 × 0.38 mm² PVC cable with common, braided copper shield (Ø~ 9.5 mm/ 0.37") and individually shielded cores
- Conductor resistance: ≤ 50 Ω km
- Capacitance: core/shield: ≤ 420 pF/m
- Operating temperature: –20 to +80 °C
- Conductor cross-section: max. 2.5 mm²

Coil current cable

- 3 × 0.75 mm² PVC cable with common, braided copper shield (Ø~ 9 mm/ 0.35")
- Conductor resistance: ≤ 37 Ω km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Operating temperature: –20 to +80 °C
- Conductor cross-section: max. 2.5 mm²
- Test current for cable insulation: ≥1433 V AC rms 50/60 Hz or ≥2026 V DC

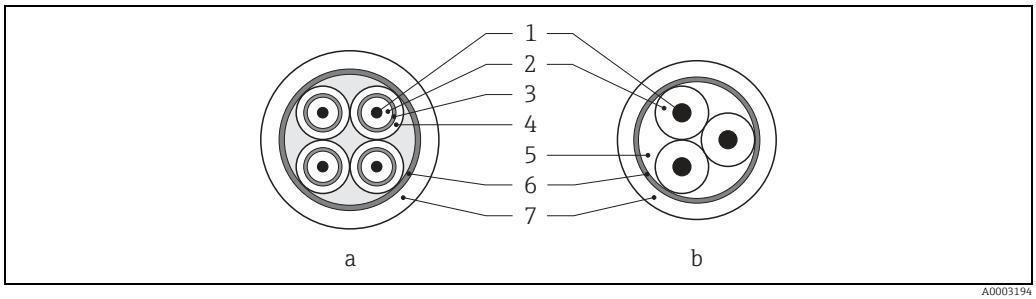


Fig. 40: Cable cross-section

a Electrode cable
b Coil current cable

1 = Core, 2 = Core insulation, 3 = Core shield, 4 = Core jacket, 5 = Core reinforcement, 6 = Cable shield, 7 = Outer jacket

Reinforced connecting cables

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid.

We recommend such cables for the following cases:
- Directly buried cable
- Cables endangered by rodents
- Device operation which should comply with the IP 68 (NEMA 6P) standard of protection

Operation in zones of severe electrical interference

The measuring device complies with the general safety requirements in accordance with EN 61010-1 and the EMC requirements of IEC/EN 61326.

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.

4.2 Connecting the measuring unit

4.2.1 Connecting the transmitter

Warning!
- Risk of electric shock! Switch off the power supply before opening the device. Do not install or wire the device while it is energized. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock! Connect the protective conductor to the ground terminal on the housing before the power supply is applied (not necessary if the power supply is galvanically isolated).
- Compare the specifications on the nameplate with the local voltage supply and frequency. Also comply with national regulations governing the installation of electrical equipment.

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and the electrode cable (b) through the appropriate cable entries.
3. Perform the wiring:
   – Wiring diagram (aluminum housing) → 🖼 41
   – Wiring diagram (stainless steel housing) → 🖼 42
   – Wiring diagram (wall-mount housing) → 🖼 43
   – Terminal assignment → 🖹 55
4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.

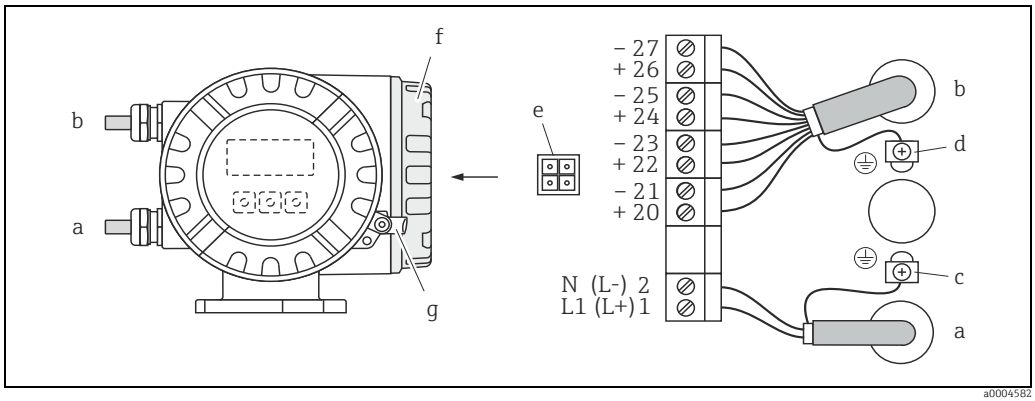


Fig. 41: Connecting the transmitter (aluminum field housing). Cable cross-section: max. 2.5 mm²

a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
*b Electrode cable: Terminals **Nos. 20–27** → 🖹 55*
c Ground terminal for protective ground
d Ground terminal for electrode cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment
g Securing clamp

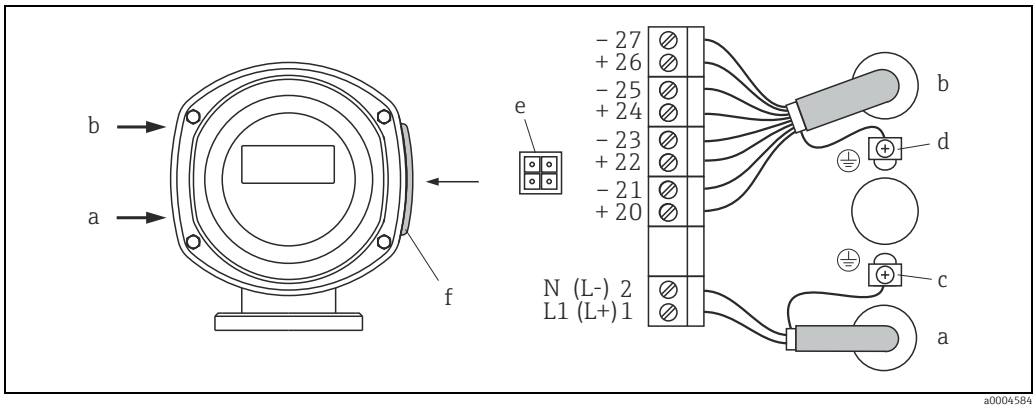


Fig. 42: Connecting the transmitter (stainless steel field housing); cable cross-section: max. 2.5 mm²

a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
*b Electrode cable: Terminals **Nos. 20–27** → 📄 55*
c Ground terminal for protective ground
d Ground terminal for electrode cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment

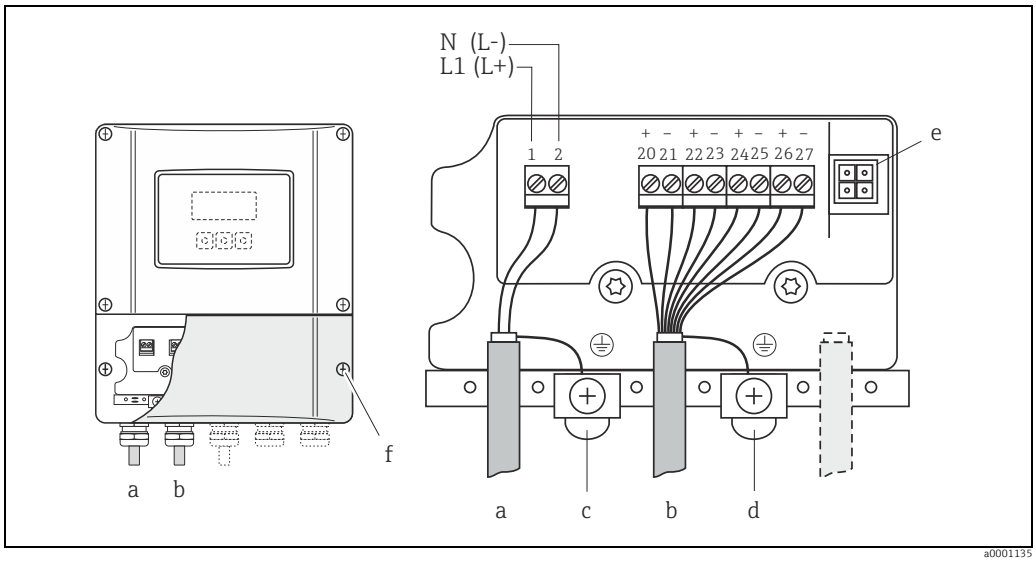


Fig. 43: Connecting the transmitter (wall-mount housing); cable cross-section: max. 2.5 mm²

a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
*b Electrode cable: Terminals **Nos. 20–27** → 📄 55*
c Ground terminal for protective ground
d Ground terminal for electrode cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment

4.2.2 Terminal assignment

Note!
The electrical characteristic quantities are listed in the "Technical data" section → 125.

Order code for "Input / Output"	Terminal No.			
	20 (+) / 21 (–)	22 (+) / 23 (–)	24 (+) / 25 (–)	26 (+) / 27 (–)
Fixed communication boards (fixed assignment)				
A	–	–	Frequency output	Current output HART
B	Relay output 2	Relay output 1	Frequency output	Current output HART
S	–	–	Frequency output, Ex i	Current output, Ex i, active, HART
T	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
Flexible communication boards				
C	Relay output 2	Relay output 1	Frequency output	Current output HART
D	Status input	Relay output	Frequency output	Current output HART
L	Status input	Relay output 2	Relay output 1	Current output HART
M	Status input	Frequency output	Frequency output	Current output HART
2	Relay output	Current output	Frequency output	Current output HART
4	Current input	Relay output	Frequency output	Current output HART
5	Status input	Current input	Frequency output	Current output HART

Ground terminal → 53

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) and 27 (-)
- Connection by means of the 4 to 20 mA circuit.

Note!
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
  - CURRENT SPAN function → "4–20 mA HART" or "4-20 mA (25 mA) HART"
  - Switch HART write protection on or off → 📄 84

Connection of the HART handheld communicator

See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

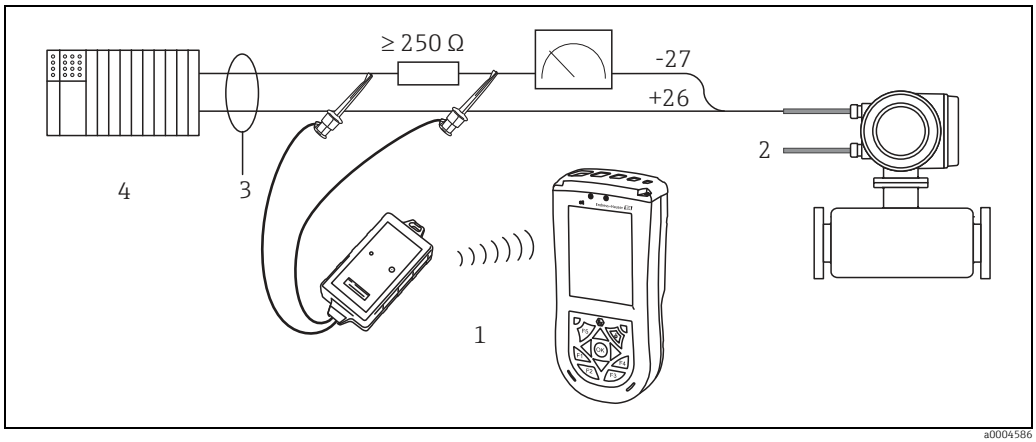


Fig. 44: Electrical connection of HART handheld Field Xpert SFX100

1 = HART handheld Field Xpert SFX100, 2 = Auxiliary energy, 3 = Shielding, 4 = Other devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with operating software (e.g. "FieldCare"), a HART modem (e.g. "Commubox FXA195") is needed.

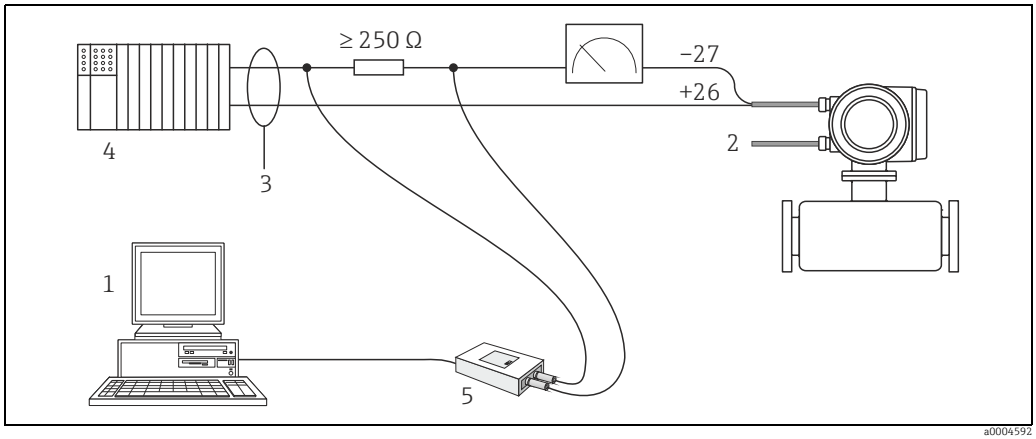


Fig. 45: Electrical connection of a PC with operating software

1 = PC with operating software, 2 = Auxiliary energy, 3 = Shielding, 4 = Other devices or PLC with passive input, 5 = HART modem, e.g. Commubox FXA195

4.3 Potential equalization

Warning!
The measuring system must be included in potential equalization.

Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most Promag sensors have a reference electrode installed as standard, which guarantees the required potential equalization.

The following must also be taken into account for potential equalization:
- Company-internal grounding guidelines
- Operating conditions such as material/grounding of piping etc. (see table)

4.3.1 Potential equalization, Promag E/L/P/W

Reference electrode available as standard

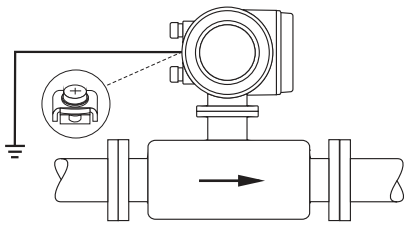
4.3.2 Potential equalization, Promag H

No reference electrode available!
There is always one electrical connection to the fluid via the metallic process connection.

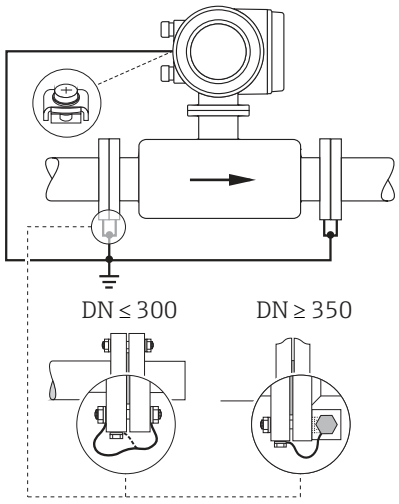
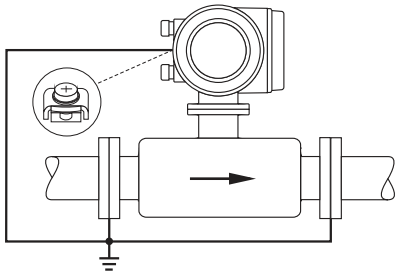
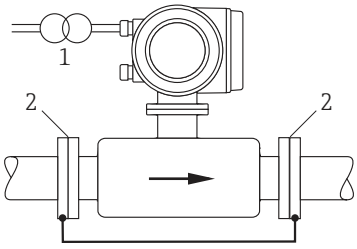
Caution!
When using process connections made of plastic, potential equalization must be guaranteed through the use of grounding rings → 24.
The necessary grounding rings may be ordered separately as an accessory from Endress+Hauser (→ 102).

4.3.3 Connection examples for potential equalization

Standard case

Operating conditions	Potential equalization
When using the measuring device in: ▪ Metallic, grounded piping Potential equalization is carried out via the ground terminal of the transmitter. Note! For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping.	 A0011892 *Fig. 46: Via the transmitter's ground terminal*

Special cases

Operating conditions	Potential equalization
When using the measuring device in: ▪ Metallic, ungrounded piping This type of connection occurs when: ▪ The usual potential equalization cannot be guaranteed ▪ Extremely high equalizing currents are expected A ground cable (copper wire, at least 6 mm² (0.0093 in²)) is used to connect both sensor flanges to the respective pipe flange and ground them. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. The installation of the ground cable depends on the nominal diameter: ▪ DN ≤ 300 (12"): The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws. ▪ DN ≥ 350 (14"): The ground cable connects directly to the metal transport bracket. ✎ Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 *Fig. 47: Via the transmitter's ground terminal and the pipe flanges*
When using the measuring device in: ▪ Plastic pipes ▪ Isolating lined pipes This type of connection occurs when: ▪ The usual potential equalization cannot be guaranteed ▪ Extremely high equalizing currents are expected Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, min. 6 mm² (0.0093 in²)). When installing the ground disks, please comply with the enclosed Installation Instructions.	 *Fig. 48: Via the transmitter's ground terminal and the optionally available ground disks*
When using the measuring device in: ▪ Pipes with cathodic protection The device is installed in the pipeline in such a way that it is potential-free. Using a ground cable (copper wire, min. 6 mm² (0.0093 in″)), only the two pipe flanges are connected. When doing so, the ground cable is mounted directly on the conductive flange coating using flange screws. Please note the following during installation: ▪ The relevant regulations for potential-free installations must be observed. ▪ There must not be an electrically conductive connection between the piping and the device. ▪ The mounting material must be able to withstand the relevant torques.	 *Fig. 49: Potential equalization and cathodic protection* *1 Isolation transformer power supply* *2 Electrically isolated*

4.4 Degree of protection

The devices fulfill all the requirements for IP 67 (NEMA 4X).

Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection (NEMA 4X) is maintained:
- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All housing screws and screw covers must be firmly tightened.
- The cables used for connection must be of the specified external diameter → 127.
- Tighten cable glands to prevent leakages.
- The cables must loop down before they enter the cable entries ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Close off unused cable entries using suitable insert plugs.
- Do not remove the grommet from the cable entry.

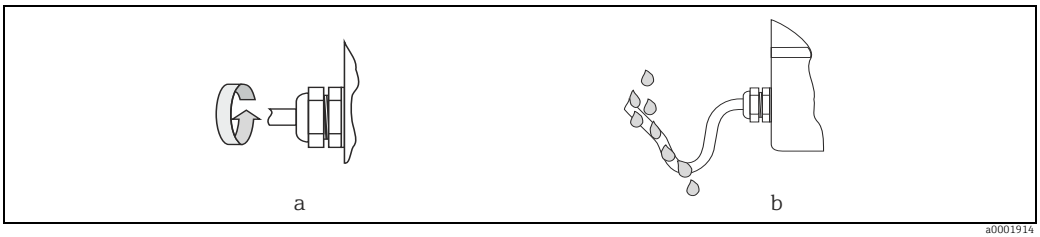


Fig. 50: Installation instructions, cable entries

Caution!
Do not loosen the screws of the sensor housing as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

Note!
- The sensor can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters (10 ft)). In this case the transmitter must be installed remote from the sensor.

4.5 Post-connection check

Perform the following checks after completing electrical installation of the measuring device:

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	▪ 85 to 250 V AC (50 to 60 Hz) ▪ 20 to 28 V AC (50 to 60 Hz) 11 to 40 V DC
Do the cables used comply with the necessary specifications?	→ 🖹 52
Do the cables have adequate strain relief?	–
Is the cable type route completely isolated? Without loops and crossovers?	–
Are the power-supply and electrode cables correctly connected?	See the wiring diagram inside the cover of the connection compartment
Only remote version: Is the flow sensor connected to the matching transmitter electronics?	Check serial number on nameplates of sensor and connected transmitter
Only remote version: Is the connecting cable between sensor and transmitter connected correctly?	→ 🖹 48
Are all screw terminals firmly tightened?	–
Have the measures for grounding/potential equalization been correctly implemented?	→ 🖹 57
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 🖹 59
Are all housing covers installed and firmly tightened?	–

5 Operation

5.1 Display and operating elements

The local display enables you to read important parameters directly at the measuring point or to configure your device using the "Quick Setup" or the function matrix.
The display consists of four lines; this is where measured values and/or status variables (direction of flow, empty pipe, bar graph, etc.) are displayed. You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ see the "Description of Device Functions" manual).

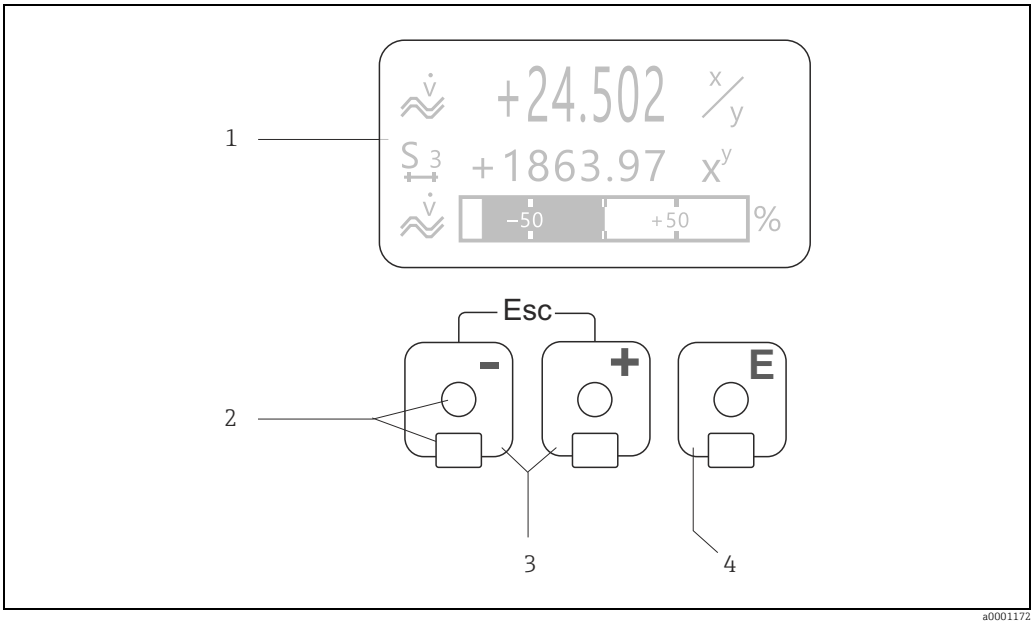


Fig. 51: Display and operating elements

1 Liquid crystal display
The backlit, four-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode display).
2 Optical sensors for Touch Control
3 ⊞/⊟-keys
- *HOME position → Direct access to totalizer values and actual values of inputs/outputs*
- *Enter numerical values, select parameters*
- *Select different blocks, groups and function groups within the function matrix*

*Press the ⊟/⊞ keys **simultaneously** to trigger the following functions:*
- *Exit the function matrix step by step → HOME position*
- *Press and hold down the ⊟/⊞ keys for longer than 3 seconds → Return directly to the HOME position*
- *Cancel data entry*

4 Ⓔ key (Enter key)
- *HOME position → Entry into the function matrix*
- *Save the numerical values you input or settings you change*

5.1.1 Display (operating mode)

The display area consists of three lines in all; this is where measured values are displayed, and/or status variables (direction of flow, bar graph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ see the "Description of Device Functions" manual).

Multiplex mode:
A maximum of two different display variables can be assigned to each line. Variables multiplexed in this way alternate every 10 seconds on the display.

Error messages:
Display and presentation of system/process errors → 67.

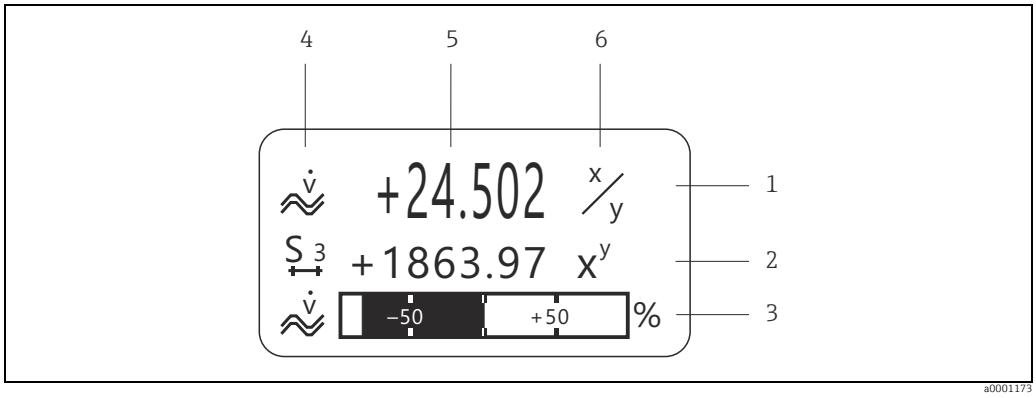


Fig. 52: Typical display for normal operating mode (HOME position)

1 Main line shows main measured values, e.g. flow
2 Supplementary line shows supplementary measured or status variables, e.g. totalizer reading.
3 Information line shows additional information on measured or status variables, e.g. bar graph representation of the full scale value attained by the flow rate
4 "Info icons" field shows additional information in the form of icons on the measured values displayed. A complete overview of all icons and their meaning can be found on → 63
5 "Measured values" field shows the current measured values
6 "Engineering unit" field shows the engineering units and time units defined for the current measured values.

5.1.2 Additional display functions

Depending on the order option (F-CHIP → 99), the local display has different display functions.

Device without batching software

From HOME position, use the ⊞⊟ keys to open an "Info Menu" containing the following information:
- Totalizer (including overflow)
- Actual values or states of the configured inputs/outputs
- Device TAG number (user-definable)

⊞⊟ → Scan of individual values within the Info Menu
⊟⊞ (Esc key) → Back to HOME position

Device with batching software

On measuring instruments with installed batching software (F-Chip → 99) and a suitably configured display line, you can carry out filling processes directly using the local display. You will find a detailed description on → 62.

5.1.3 Icons

The icons which appear in the field on the left make it easier to read and recognize measured variables, device status, and error messages.

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
ϟ	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
| 1 to n	Current output 1 to n or current input	P 1 to n	Pulse output 1 to n
F 1 to n	Frequency output 1 to n	S 1 to n	Status/relay output 1 to n or status input
Σ 1 to n	Totalizer 1 to n		
 a0001181	Measuring mode: PULSATING FLOW	 a0001182	Measuring mode: SYMMETRY (bidirectional)
 a0001183	Measuring mode: STANDARD	 a0001184	Counting mode totalizer: BALANCE (forward and reverse flow)
 a0001185	Counting mode totalizer: forward	 a0001186	Counting mode totalizer: reverse
 a0001187	Signal input (current or status input)		
 a0001188	Volume flow	 a0001195	Mass flow
 a0001200	Fluid density	 a0001207	Fluid temperature
 a0001201	Batching quantity upwards	 a0001202	Batching quantity downwards
 a0001203	Batching quantity	 a0001204	Batch sum
 a0001205	Batch counter (x times)	 a0001206	Remote configuration Active device operation via: HART, e.g. FieldCare, Field Xpert

5.1.4 Controlling the batching processes using the local display

Filling processes can be controlled directly by means of the local display with the aid of the optional "(Batching)" software package (F-CHIP, accessories → 102). Therefore, the device can be fully deployed in the field as a "batch controller".

Procedure:

1. Configure all the required batching functions and assign the lower display info line (= BATCHING KEYS) using the "Batch" Quick Setup menu (→ 91) or using the function matrix (→ 65).
   The following "softkeys" then appear on the bottom line of the local display → 53:
   – START = left display key (⊟)
   – PRESET = middle display key (⊞)
   – MATRIX = right display key (Ⓔ)
2. Press the "PRESET (⊞)" key. Various batching process functions requiring configuration will now appear on the display:

"PRESET" → Initial settings for the batching process		
No.	**Function**	**Configuration**
7200	BATCH SELECTOR	⊞⊟ → Select the batching liquid (BATCH #1 to 6)
7203	BATCH QUANTITY	If the "ACCESS CUSTOMER" option was selected for the "PRESET batch quantity" prompt in the "Batching" Quick Setup, the batching quantity can be altered via the local display. If the "LOCKED" option was selected, the batching quantity can only be read and cannot be altered until the private code has been entered.
7265	RESET TOTAL BATCH SUM/ COUNTER	Resets the batching quantity counter or the total batching quantity to "0".

3. After exiting the PRESET menu, you can now start the batching process by pressing "START (⊟)". New softkeys (STOP / HOLD or GO ON) now appear on the display. You can use these to interrupt, continue or stop the batching process at any time → 64.
   STOP (⊟) → Stops batching process
   HOLD (⊞) → Interrupts batching process (softkey changes to "GO ON")
   GO ON (⊞) → Continues batching process (softkey changes to "HOLD")
   After the batch quantity is reached, the "START" or "PRESET" softkeys reappear on the display.

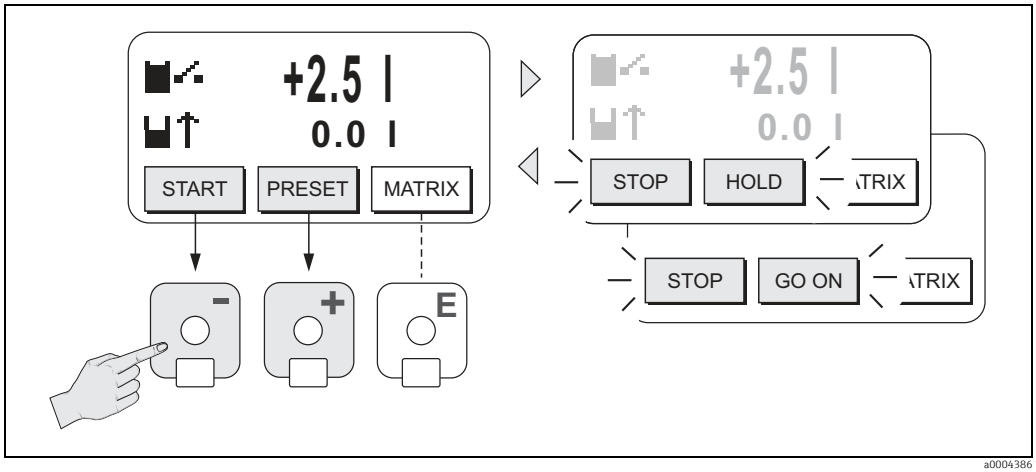


Fig. 53: Controlling batching processes using the local display (softkeys)

5.2 Brief Operating Instructions for the function matrix

Note!
- See the general notes → 66.
- Function descriptions → See the "Description of Device Functions" manual.

1. HOME position → E → Enter the function matrix.
2. ⊕/⊖ → Select a block (e.g. MEASURED VARIABLES)) → E.
3. ⊕/⊖ → Select a group (e.g. SYSTEM UNITS) → E.
4. ⊕/⊖ → Select a function group (e.g. CONFIGURATION) → E.
5. Select a function (e.g. UNIT VOLUME FLOW) and change parameters/enter numerical values:
   ⊕⊖ → Select or enter release code, parameters, numerical values
   E → Save entries
6. Exit the function matrix:
   – Press and hold down Esc key (⊖+⊕) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (⊖+⊕) → Return step by step to HOME position

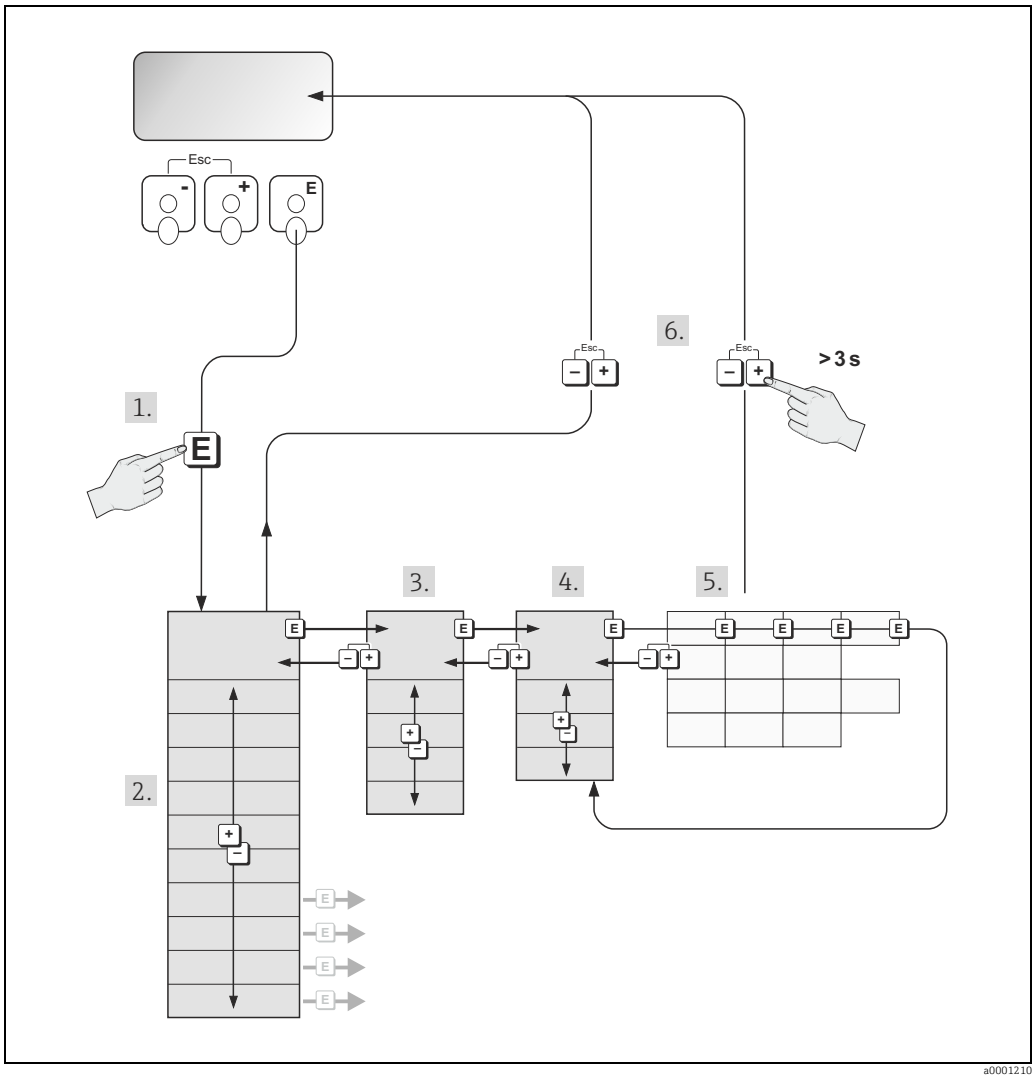


Fig. 54: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

The Quick Setup menu is adequate for commissioning with the necessary standard settings. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged on a number of menu levels (blocks, groups, and function groups).

Comply with the following instructions when configuring functions:
- You select functions as described → 📖 65.
  Each cell in the function matrix is identified by a numerical or letter code on the display.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press ⊞⊟ to select "SURE [YES]"and press Ⓔ again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is automatically disabled if you do not press a key within 60 seconds following automatic return to the HOME position.



Caution!
All functions are described in detail, including the function matrix itself, in the "Description of Device Functions" manual, which is a separate part of these Operating Instructions.



Note!
- The transmitter continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the power supply fails, all preset and parameterized values remain safely stored in the EEPROM.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 53) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ "Description of Device Functions" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the ⊞/⊟ keys are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the customer's code, programming is always enabled.
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.



Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy. There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the Endress+Hauser service organization. Please contact Endress+Hauser first if you have any questions.

5.2.3 Disabling the programming mode

Programming mode is disabled if you do not press a key within 60 seconds following automatic return to the HOME position.
You can also disable programming in the ACCESS CODE function by entering any number (other than the customer's code).

5.3 Error messages

5.3.1 Type of error

Errors which occur during commissioning or measuring operation are displayed immediately. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:
- *System errors:* This group comprises all device errors, e.g. communication errors, hardware errors, etc. → 📄 106.
- *Process error:* This group includes all application errors e.g. empty pipe, etc. → 📄 110.

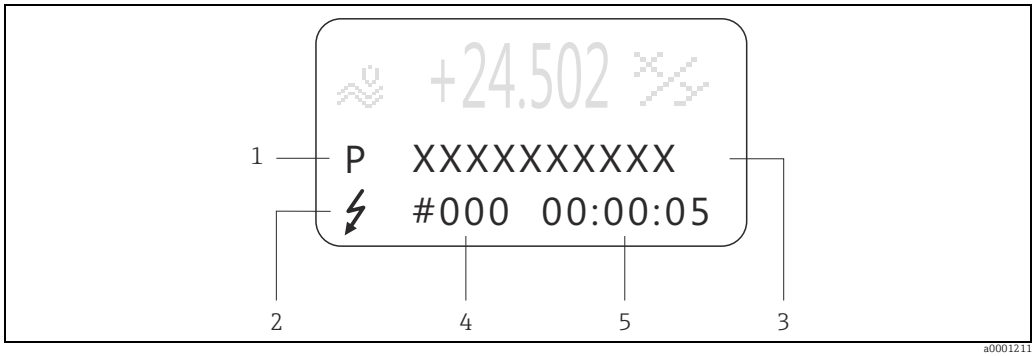


Fig. 55: Error messages on the display (example)

1 Error type: P = process error, S = system error
2 Error message type: ϟ = fault message, ! = notice message
3 Error designation
4 Error number
5 Duration of most recent error occurrence (hours : minutes : seconds)

5.3.2 Error message type

Users have the option of weighting system and process errors differently, by defining them as **Fault messages** or **Notice messages.** You can define messages in this way with the aid of the function matrix (see the "Description of Device Functions" manual).
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)
- Displayed as → Exclamation mark (!), type of error (S: system error, P: process error)
- The error in question has no effect on the current measuring operation and the outputs of the measuring device.

Fault message (ϟ)
- Displayed as → Lightning flash (ϟ), type of error (S: system error, P: process error)
- The error in question interrupts or stops the current measuring operation and has an immediate effect on the outputs. The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix → 📄 113.

Note!
- Error conditions can be output via the relay outputs.
- If an error message occurs, an upper or lower signal level for the breakdown information according to NAMUR 43 can be output via the current output.

5.3.3 Confirming error messages

For the sake of plant and process safety, the measuring device can be configured in such a way that fault messages displayed (ϟ) always have to be rectified and acknowledged locally by pressing E. Only then do the error messages disappear from the display.
This option can be switched on or off by means of the "ACKNOWLEDGE FAULT MESSAGES" function (see the "Description of Device Functions" manual).

Note!
- Fault messages (ϟ) can also be reset and confirmed via the status input.
- Notice messages (!) do not require acknowledgment. Note, however, that they remain visible until the cause of the error has been rectified.

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → 56.
The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes. The HART master, e.g. a handheld terminal or PC-based operating programs (such as FieldCare), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using so-called "commands". There are three different command groups:

There are three different command groups:
- *Universal commands*
  All HART device support and use universal commands. The following functionalities, for example, are linked to them:
  – Identify HART devices
  – Reading digital measured values (volume flow, totalizer, etc.)
- *Common practice commands:*
  Common practice commands offer functions which are supported and can be executed by most but not all field devices.
- *Device-specific commands:*
  These commands allow access to device-specific functions which are not HART standard. Amongst other things, such commands access individual field device information, such as empty-pipe/full-pipe calibration values, low flow cutoff settings, etc.

Note!
The device has access to all three command classes.
List of all "universal commands" and "common practice commands" → 72.

5.4.1 Operating options

For the complete operation of the measuring device, including device-specific commands, there are DD files available to the user to provide the following operating aids and programs:



Note!
- In the CURRENT SPAN function (current output 1), the HART protocol demands the setting "4-20 mA HART" or "4-20 mA (25 mA) HART".
- HART write protection can be enabled or disabled by means of a jumper on the I/O board → 84.

Field Xpert HART Communicator

Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program "FieldCare"

Fieldcare is Endress+Hauser's FDT-based plant Asset Management Tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA193.

Operating program "SIMATIC PDM" (Siemens)

SIMATIC PDM is a standardized, manufacturer-independent tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

Operating program "AMS" (Emerson Process Management)

AMS (Asset Management Solutions): program for operating and configuring devices.

5.4.2 Current device description files

The following table illustrates the suitable device description file for the operating tool in question and then indicates where these can be obtained.

HART protocol:

Order code "Power Supply; Display", option A, B, C, D, E, F, G, H, X, 7, 8 (HART 5)		
Valid for software	2.03.XX	→ "Device software" function (8100)
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 42_{hex}	 → "Manufact ID" function (6040) → "Device ID" function (6041)
HART version data	Device Revision 6/ DD Revision 1	
Software release	01.2011	

Order code "Power Supply; Display", option P, Q, R, S, T, U, 4, 5 (HART 7)		
Valid for software	2.07.XX	→ "Device software" function (8100)
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 42_{hex}	 → "Manufact ID" function (6040) → "Device ID" function (6041)
HART version data	Device Revision 9/ DD Revision 1	
Software release	12.2014	

Operating	Sources for obtaining device descriptions
Handheld terminal Field Xpert SFX100	Use update function of handheld terminal
FieldCare / DTM	▪ www.endress.com → Download ▪ CD-ROM (Endress+Hauser order number 56004088) ▪ DVD (Endress+Hauser order number 70100690)
AMS	www.endress.com → Download
SIMATIC PDM	www.endress.com → Download

Tester/simulator	Sources for obtaining device descriptions
Fieldcheck	Update via FieldCare using the Flow Device FXA193/291 DTM in the Fieldflash module

5.4.3 Device and process variables

Device variables:
The following device variables are available using the HART protocol:

Code (decimal)	Device variable
0	OFF (not assigned)
1	Volume flow
2	Mass flow
52	Batch upwards
53	Batch downwards
250	Totalizer 1
251	Totalizer 2
252	Totalizer 3

Process variables:

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → Mass flow
- Fourth process variable (FV) → not assigned

Note!
You can set or change the assignment of device variables to process variables using Command 51 → 🖹 77.

5.4.4 Universal/Common practice HART commands

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Universal Commands			
0 (HART 5)	Read unique device identifier Access type = read	None	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: ▪ Byte 0: Fixed value 254 ▪ Byte 1: Manufacturer ID, 17 = E+H ▪ Byte 2: Device type ID, e.g. 66 = Promag 53 ▪ Byte 3: Number of preambles ▪ Byte 4: Universal commands rev. no. ▪ Byte 5: Device-specific rev. no. Commands ▪ Byte 6: Software revision ▪ Byte 7: Hardware revision ▪ Byte 8: Additional device information ▪ Bytes 9-11: Device identification
0 (HART 7)	Read unique device identifier Access type = read	None	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 22 byte device ID: ▪ Byte 0: Fixed value 254 ▪ Byte 1: Manufacturer ID, 17 = E+H ▪ Byte 2: Device type ID, e.g.66 = Promag 53 ▪ Byte 3: Number of preambles ▪ Byte 4: Universal commands rev. no. ▪ Byte 5: Device-specific rev. no. Commands ▪ Byte 6: Software revision ▪ Byte 7: Hardware revision ▪ Byte 8: Additional device information ▪ Byte 9-11: Device identification ▪ Byte 12: Minimum number of preambles that are sent by the slave to the master with the response message ▪ Byte 13: Maximum number of device variables ▪ Byte 14-15: Configuration change counter ▪ Byte 16: Extended field device status ▪ Byte 17-18: Manufacturer ID code
1	Read primary process variable Access type = read	None	▪ Byte 0: HART unit code of the primary process variable ▪ Bytes 1-4: Primary process variable *Factory setting:* Primary process variable = Volume flow ✎ Note! ▪ You can set or change the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "240".
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	None	▪ Bytes 0-3: actual current of the primary process variable in mA ▪ Bytes 4-7: Percentage of the set measuring range *Factory setting:* Primary process variable = Volume flow ✎ Note! You can set the assignment of device variables to process variables using Command 51.

<table>
<tr><th colspan="2">Command No.
HART command / Access type</th><th>Command data
(numeric data in decimal form)</th><th>Response data
(numeric data in decimal form)</th></tr>
<tr><td>3</td><td>Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables
Access type = read</td><td>None</td><td>24 bytes are sent as a response:
▪ Bytes 0-3: primary process variable current in mA
▪ Byte 4: HART unit code of the primary process variable
▪ Bytes 5-8: Primary process variable
▪ Byte 9: HART unit code of the second process variable
▪ Bytes 10-13: Second process variable
▪ Byte 14: HART unit code of the third process variable
▪ Bytes 15-18: Third process variable
▪ Byte 19: HART unit code of the fourth process variable
▪ Bytes 20-23: Fourth process variable
Factory setting:
▪ Primary process variable = Volume flow
▪ Second process variable = Totalizer 1
▪ Third process variable = Mass flow
▪ Fourth process variable = OFF (not assigned)
Note!
▪ You can set the assignment of device variables to process variables using Command 51.
▪ Manufacturer-specific units are represented using the HART unit code "240".</td></tr>
<tr><td>6
(HART 5)</td><td>Set HART shortform address
Access type = write</td><td>Byte 0: Desired address (0 to 15)
Factory setting:
0
Note!
With an address >0 (multidrop mode), the current output of the primary process variable is fixed at 4 mA..</td><td>Byte 0: Active address</td></tr>
<tr><td>6
(HART 7)</td><td>Set HART address and loop current mode
Access type = write</td><td>Byte 0: Desired address (0 to 63)
Factory setting:
0
Note!
With an address >0 (multidrop mode), the current output of the primary process variable is fixed at 4 mA.</td><td>Byte 0: Active address
Byte 1: Loop current mode</td></tr>
<tr><td>9
(HART 7)</td><td>Write long HART tag name
Access type = write</td><td>None</td><td>This command allows a master (PLC) to request the value and status of up to four devices or dynamic variables..
<table>
<tr><th>Number of device variables requested</th><th>Number of data bytes requested</th><th>Number of data bytes in response</th></tr>
<tr><td>1</td><td>1</td><td>9</td></tr>
<tr><td>2</td><td>2</td><td>17</td></tr>
<tr><td>3</td><td>3</td><td>25</td></tr>
<tr><td>4</td><td>4</td><td>33</td></tr>
</table></td></tr>
</table>

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: ▪ Byte 0: Fixed value 254 ▪ Byte 1: Manufacturer ID, 17 = E+H ▪ Byte 2: Device type ID, 66 = Promag 53 ▪ Byte 3: Number of preambles ▪ Byte 4: Universal commands rev. no. ▪ Byte 5: Device-specific rev. no. Commands ▪ Byte 6: Software revision ▪ Byte 7: Hardware revision ▪ Byte 8: Additional device information ▪ Bytes 9-11: Device identification
12	Read user message Access type = read	None	Bytes 0-24: User message Note! You can write the user message using Command 17.
13	Read TAG, descriptor and date Access type = read	None	▪ Bytes 0-5: TAG ▪ Bytes 6-17: descriptor ▪ Bytes 18-20: Date Note! You can write the TAG, descriptor and date using Command 18.
14	Read sensor information on primary process variable	None	▪ Bytes 0-2: Sensor serial number ▪ Byte 3: HART unit code of sensor limits and measuring range of the primary process variable ▪ Bytes 4-7: Upper sensor limit ▪ Bytes 8-11: Lower sensor limit ▪ Bytes 12-15: Minimum span Note! ▪ The data relate to the primary process variable (= volume flow). ▪ Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	None	▪ Byte 0: Alarm selection ID ▪ Byte 1: Transfer function ID ▪ Byte 2: HART unit code for the set measuring range of the primary process variable ▪ Bytes 3-6: End of measuring range, value for 20 mA ▪ Bytes 7-10: Start of measuring range, value for 4 mA ▪ Bytes 11-14: Attenuation constant in [s] ▪ Byte 15: Write protection ID ▪ Byte 16: OEM dealer ID, 17 = E+H *Factory setting:* Primary process variable = Volume flow Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "240".
16	Read the device production number Access type = read	None	Bytes 0-2: Production number

<table>
<tr><th colspan="2">Command No.
HART command / Access type</th><th>Command data
(numeric data in decimal form)</th><th colspan="3">Response data
(numeric data in decimal form)</th></tr>
<tr><td>17</td><td>Write user message
Access = write</td><td>You can save any 32-character long text in the device under this parameter:
Bytes 0-23: Desired user message</td><td colspan="3">Displays the current user message in the device:
Bytes 0-23: Current user message in the device</td></tr>
<tr><td>18</td><td>Write TAG, descriptor and date
Access = write</td><td>With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date:
▪ Bytes 0-5: TAG
▪ Bytes 6-17: descriptor
▪ Bytes 18-20: Date</td><td colspan="3">Displays the current information in the device:
▪ Bytes 0-5: TAG
▪ Bytes 6-17: descriptor
▪ Bytes 18-20: Date</td></tr>
<tr><td>20
(HART 7)</td><td>Read long HART tag name
Access type = read</td><td>None</td><td colspan="3">The long tag name with the international character set (ISO Latin 1) makes it possible to use longer names as required by many users in industry.
The long tag name occupies 16 consecutive buffer memory addresses.
32 characters are saved in ASCII format, the first character in the least significant byte (LSB) of the lowest buffer memory address.</td></tr>
<tr><td>21
(HART 7)</td><td>Read unique ID assigned to long HART tag name
Access type = read</td><td>None</td><td colspan="3">This command can either be issued with the long frame address of the device or the broadcast address
No response if the long HART tag name and the device do not match.
This comparison is case-sensitive.
If the long frame address is used, no response if the address and the long HART tag name of the device do not match</td></tr>
<tr><td rowspan="15">22
(HART 7)</td><td rowspan="15">Write long HART tag name
Access type = write</td><td rowspan="15">Byte 0-31: Long HART tag name response codes</td><td colspan="3">Response codes</td></tr>
<tr><td>Code</td><td>Class</td><td>Description</td></tr>
<tr><td>0</td><td>Success</td><td>No command-specific errors</td></tr>
<tr><td>1-4</td><td></td><td>Undefined</td></tr>
<tr><td>5</td><td>Error</td><td>Too few data bytes received</td></tr>
<tr><td>6</td><td>Error</td><td>Device-specific command error</td></tr>
<tr><td>7</td><td>Error</td><td>In write protect mode</td></tr>
<tr><td>8-15</td><td></td><td>Undefined</td></tr>
<tr><td>16</td><td>Error</td><td>Access Restricted</td></tr>
<tr><td>17-31</td><td></td><td>Undefined</td></tr>
<tr><td>32</td><td>Error</td><td>Busy (A DR cannot be started)</td></tr>
<tr><td>33</td><td>Error</td><td>DR Initiated</td></tr>
<tr><td>34</td><td>Error</td><td>DR Running</td></tr>
<tr><td>35</td><td>Error</td><td>DR Dead</td></tr>
<tr><td>36</td><td>Error</td><td>DR Conflict</td></tr>
</table>

The following table contains all the common practice commands supported by the device.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable in seconds *Factory setting:* Primary process variable = Volume flow	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: ▪ Byte 0: HART unit code of the primary process variable ▪ Bytes 1-4: upper range, value for 20 mA ▪ Bytes 5-8: lower range, value for 4 mA *Factory setting:* Primary process variable = Volume flow Note! ▪ You can set the assignment of device variables to process variables using Command 51. ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: ▪ Byte 0: HART unit code for the set measuring range of the primary process variable ▪ Bytes 1-4: Upper range, value for 20 mA ▪ Bytes 5-8: Lower range, value for 4 mA Note! Manufacturer-specific units are represented using the HART unit code "240".
38	Device status reset (Configuration changed) Access = write	None	None
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0-3: Output current in mA *Factory setting:* Primary process variable = Volume flow Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0-3: Output current in mA
42	Perform master reset Access = write	None	None
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Volume flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
48	Read additional device status Access = read	None	The device status is displayed in extended form as the response: Coding: see table → 80

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
50	Read assignment of the device variables to the four process variables Access = read	None	Display of the current variable assignment of the process variables: ▪ Byte 0: Device variable code to the primary process variable ▪ Byte 1: Device variable code to the second process variable ▪ Byte 2: Device variable code to the third process variable ▪ Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Code 1 for volume flow ▪ Second process variable: Code 250 for totalizer 1 ▪ Third process variable: Code 2 for mass flow ▪ Fourth process variable: Code 0 for OFF (not assigned) Note! You can set the assignment of device variables to process variables using Command 51.
51	Write assignments of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: ▪ Byte 0: Device variable code to the primary process variable ▪ Byte 1: Device variable code to the second process variable ▪ Byte 2: Device variable code to the third process variable ▪ Byte 3: Device variable code to the fourth process variable *Code of the supported device variables:* See information → 71 *Factory setting:* ▪ Primary process variable = Volume flow ▪ Second process variable = Totalizer 1 ▪ Third process variable = Mass flow ▪ Fourth process variable = OFF (not assigned)	The variable assignment of the process variables is displayed as a response: ▪ Byte 0: Device variable code to the primary process variable ▪ Byte 1: Device variable code to the second process variable ▪ Byte 2: Device variable code to the third process variable ▪ Byte 3: Device variable code to the fourth process variable
53	Write device variable unit Access = write	This command set the unit of the given device variables. Only those units which suit the device variable are transferred: ▪ Byte 0: Device variable code ▪ Byte 1: HART unit code *Code of the supported device variables:* See information → 71 Note! ▪ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ▪ If you change the unit of the device variable, this has no impact on the system units.	The current unit of the device variables is displayed in the device as a response: ▪ Byte 0: Device variable code ▪ Byte 1: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (2 to 20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: Number of preambles

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
95 (HART 7)	Read device communication statistics Access type = read	None	The device communication statistics command provides statistics about device communication 6 bytes follow by way of response ▪ Byte 0-1: Number of STX messages received by the device ▪ Byte 2-3: Number of ACK messages sent by the device ▪ Byte 4-6: Number of BACK messages sent by the device
523 (HART 7)	Read condensed status mapping array Access type = read	Byte 0: Start index of the status map Byte 1: Number of status map entries to be read	This command returns the requested condensed status map entries of the field device. Each entry in the status map corresponds to either a bit of the field device status or a bit of command 48. Two status map codes are packed into a byte. The least significant nibble corresponds to the smaller of the two indices of the status map array. The following is returned by way of response: ▪ Byte 0: Current start index of the status map ▪ Byte 1: Number of status map entries to be read ▪ Byte 2.0-2.3: First status map code ▪ Byte 2.4-2.7: Second status map code ▪ Byte 3.0-3.3: Third status map code … ▪ Byte (2+(n-2)/2).0-(2+(n-2)/2).3: (n-1)-th status map code ▪ Byte (2+(n-2)/2).4-(2+(n-2)/2).7: n-th status map code
524 (HART 7)	Write condensed status mapping Access = write	This command changes the status map of the field device. Each entry in the status map corresponds to either a bit of the field device status or a bit of command 48. Two status map codes are packed into a byte. The least significant nibble corresponds to the smaller of the two indices of the status map array. ✎ Note! Modified mapping is active immediately as soon as this command is executed and can therefore cause immediate changes to the condensed status. This command must always write at least two status map entries. This means that the number of entries to be written must always be an even number. ▪ Byte 0: Current start index of the status map ▪ Byte 1: Number of status map entries to be written ▪ Byte 2.0-2.3: First status map code ▪ Byte 2.4-2.7: Second status map code ▪ Byte 3.0-3.3: Third status map code … ▪ Byte (2+(n-2)/2).0-(2+(n-2)/2).3: (n-1)-th status map code ▪ Byte (2+(n-2)/2).4-(2+(n-2)/2).7: n-th status map code	▪ Byte 0: Current start index of the status map ▪ Byte 1: Number of status map entries to be written ▪ Byte 2.0-2.3: First status map code ▪ Byte 2.4-2.7: Second status map code ▪ Byte 3.0-3.3: Third status map code … ▪ Byte (2+(n-2)/2).0-(2+(n-2)/2).3: (n-1)-th status map code ▪ Byte (2+(n-2)/2).4-(2+(n-2)/2).7: n-th status map code

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
525 (HART 7)	Reset condensed status map Access = write	None This command resets the status map (i.e. the default values for the status map are written to the status map array). ✎ Note! The condensed status map reset becomes effective immediately as soon as this command is executed and can result in immediate changes to the condensed status	None
526 (HART 7)	Write simulation status mode Access = write	Byte 0: Status simulation mode code This command is used to activate or deactivate status simulation mode. The status simulation mode enables the point-to-point verification of the system response to changes in the device status or command 48 response. If status simulation is enabled: ▪ All device-initiated changes to the device status and command 48 response are disabled ▪ The simulation status active bit is set When status simulation is enabled, the device status and command 48 response are influenced by the host application only when command 527 is received. If status simulation is disabled: ▪ The simulation status active bit is reset ▪ The current values that apply for the device status and command 48 response are active ▪ Normal internal updating of the device status and command 48 response are resumed The status simulation mode is also disabled if power supply to the device is interrupted or if the device is reset.	The following is returned by way of response: Byte 0: Status simulation mode code
527 (HART 7)	Simulation status bit Access = write	Byte 0: Index of the simulated bit Byte 1: Value of the simulated bit When the status simulation mode is enabled, this command allows the device status bits or the bits in the command 48 response to be set or reset individually.	The following is returned by way of response: Byte 0: Index of the simulated bit Byte 1: Value of the simulated bit

5.4.5 Device status/Error messages

You can read the extended device status, in this case, current error messages, via Command "48". The command delivers information which are partly coded in bits (see table below).

Note!
For a detailed explanation of the device status and error messages and their elimination, see → 105.

HART 5

Byte-Bit	Error No.	Short description of error → 105
0-0	001	Serious device error
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
1-1	031	S-DAT: defective or missing
1-2	032	S-DAT: Error accessing saved values
1-3	041	T-DAT: defective or missing
1-4	042	T-DAT: Error accessing saved values
1-5	051	I/O- board and the amplifier board are not compatible
3-3	111	Totalizer checksum error
3-4	121	I/O board and the amplifier board are not compatible.
3-6	205	T-DAT: Data download unsuccessful
3-7	206	T-DAT: Data upload unsuccessful
4-3	251	Internal communication error on amplifier board
4-4	261	No data reception between amplifier and I/O board
5-0	321	Coil current of the sensor is outside the tolerance.
5-7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-0	340	
6-1	341	
6-2	342	
6-3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-4	344	
6-5	345	
6-6	346	
6-7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7-0	348	
7-1	349	
7-2	350	
7-3	351	Current output: Actual flow value is out of range.
7-4	352	
7-5	353	
7-6	354	
7-7	355	Frequency output: Actual flow value is out of range.
8-0	356	
8-1	357	
8-2	358	
8-3	359	Pulse output: The pulse output frequency is outside the permitted range.
8-4	360	
8-5	361	
8-6	362	
10-7	401	Measuring tube partially filled or empty

Byte-Bit	Error No.	Short description of error → 🖹 105
11-2	461	EPD adjustment not possible because the fluid's conductivity is either too low or too high.
11-4	463	The EPD adjustment values for empty pipe and full pipe are identical and therefore incorrect.
11-6	471	Max. permitted batching time has been exceeded.
11-7	472	Underbatching: the minimum quantity was not reached. Overbatching: the maximum permitted batching quantity was exceeded.
12-0	473	The predefined batch quantity point was exceeded. End of filling process approaching.
12-1	481	Actual relaxation time has exceeded the limit value.
12-2	482	Electrical potential of electrode 1 has exceeded the limit value.
12-3	483	Electrical potential of electrode 2 has exceeded the limit value.
12-7	501	New amplifier software version is loaded. Currently no other commands are possible.
13-2	571	Batching process in progress (valves are open)
13-3	572	Batching process has been stopped (valves are closed)
14-3	601	Positive zero return active
14-7	611	Simulation current output active
15-0	612	
15-1	613	
15-2	614	
15-3	621	Simulation frequency output active
15-4	622	
15-5	623	
15-6	624	
15-7	631	Simulation pulse output active
16-0	632	
16-1	633	
16-2	634	
16-3	641	Simulation status output active
16-4	642	
16-5	643	
16-6	644	
16-7	651	Simulation relay output active
17-0	652	
17-1	653	
17-2	654	
17-3	661	Simulation current input active
17-7	671	Simulation status input active
18-0	672	
18-1	673	
18-2	674	
18-3	691	Simulation of response to error (outputs) active
18-4	692	Simulation of volume flow is active
22-4	061	F-CHIP is defective or not on I/O board
24-5	363	Current input: Actual current value is out of range.

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Byte-Bit	Error No.	Short description of error → 105
0-0	001	Critical failure
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
0-3	031	S-DAT is missing
0-4	032	S-DAT is defective
0-5	041	T-DAT is defective or missing
0-6	042	T-DAT: Error accessing saved values.
0-7	101	Gain deviation compared to reference gain
1-0	111	Totalizer checksum error
1-1	205	T-DAT: Data download unsuccessful
1-2	206	T-DAT: Data upload unsuccessful
1-3	251	Internal communication error on amplifier board
1-4	261	No data reception between amplifier and I/O board
1-6	321	Coil current of the sensor is outside the tolerance.
1-7	355	Frequency output: Actual flow value is out of range.
2-0	356	
2-1	357	
2-2	358	
2-3	359	Pulse output: The pulse output frequency is outside the permitted range.
2-4	360	
2-5	361	
2-6	362	
2-7	401	Measuring tube partially filled or empty
3-0	461	EPD adjustment not possible because the fluid's conductivity is either too low or too high.
3-1	463	The EPD adjustment values for empty pipe and full pipe are identical and therefore incorrect.
3-2	502	Upload and download of device files. Currently no other commands are possible.
3-3	601	Positive zero return active
3-4	621	Simulation frequency output active
3-5	622	
3-6	623	
3-7	624	
4-0	631	Simulation pulse output active
4-1	632	
4-2	633	
4-3	634	
4-4	641	Simulation status output active
4-5	642	
4-6	643	
4-7	644	
5-0	651	Simulation relay output active.
5-1	652	
5-2	653	
5-3	654	
5-4	661	Simulation current output active.

Byte-Bit	Error No.	Short description of error → 🖹 105
10-0	351	Current output: The actual value for the flow lies outside the set limits.
10-1	352	
10-2	353	
13-0	611	Simulation current output active.
13-1	612	
13-2	613	
13-3	614	
14-0	671	Simulation status input active.
14-1	672	
14-2	673	
14-3	674	
14-4	691	Simulation of response to error (outputs) active.
14-5	692	Simulation of volume flow is active.
14-7	471	The maximum permitted batching time was exceeded
15-0	472	Under batching: The minimum quantity was not reached. Over batching: The maximum permitted batching quantity was exceeded.
15-1	473	The predefined batch quantity point was exceeded. End of filling process approaching.
15-2	571	Batching process in progress (valves are open)
15-3	572	Batching process has been stopped (valves are closed)
15-4	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
15-5	340	
15-6	341	
15-7	342	
16-0	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
16-1	344	
16-2	345	
16-3	346	
16-4	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
16-5	348	
16-6	349	
16-7	350	
17-0	121	I/O board and the amplifier board are not compatible.
17-1	061	F-CHIP is defective or not on I/O board
17-2	363	Current input: Actual current value is out of range.
17-6	698	The measuring device is being checked on site via the test and simulation device.
17-7	474	Maximum flow value entered is overshot.

5.4.6 Switching HART write protection on and off

A jumper on the I/O board provides the means of activating or deactivating HART write protection.

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → 🖹 116.
3. Switch HART write protection on or off, as applicable, by means of the jumper (→ 🖹 56).
4. Installation of the I/O board is the reverse of the removal procedure.

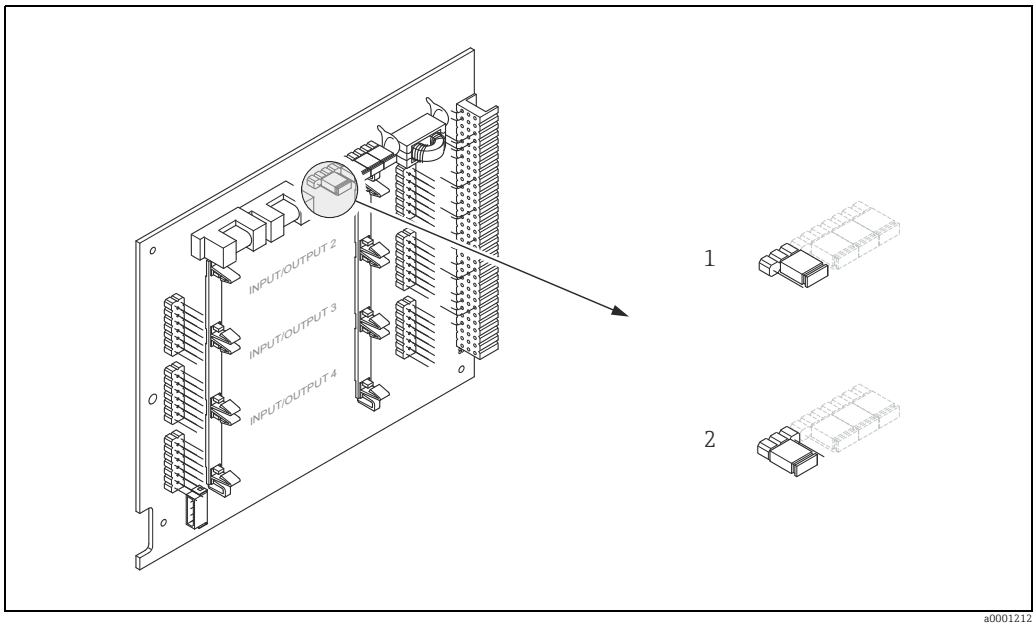


Fig. 56: Switching HART write protection on and off

1 Write protection OFF (default), i.e. HART protocol unlocked
2 Write protection ON, i.e. HART protocol locked

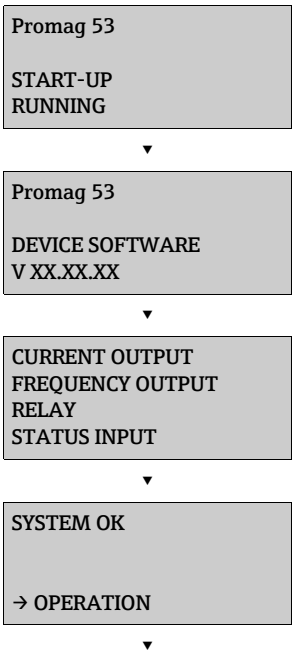
6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist for "Post-installation check" → 47
- Checklist for "Post-connection check" → 60

6.2 Switching on the measuring device

Once the connection checks have been successfully completed, it is time to switch on the power supply. The device is now operational.
The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:



Startup message

Current software version

List of installed input/output modules

Beginning of normal measuring mode

Normal measuring mode commences as soon as startup completes.
Various measured value and/or status variables appear on the display (HOME position).

Note!
If startup fails, an error message indicating the cause is displayed.

6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured by means of a configuration program, such as FieldCare from Endress+Hauser.
If the measuring device is equipped with a local display, all the important device parameters for standard operation can be configured quickly and easily by means of the following Quick Setup menus. Additional functions can be configured too.

- "Commissioning" Quick Setup menu → 🖹 86.
- "Pulsating flow" Quick Setup menu → 🖹 88.
- "Batching" Quick Setup menu → 🖹 88.

6.3.1 "Commissioning" Quick Setup menu

✎ Note!
- The display returns to the cell SETUP COMMISSIONING (1002) if you press the ESC key combination during parameter interrogation. The stored parameters remain valid.
- The "Commissioning" Quick Setup must be carried out before any of the other Quick Setups described in this Operating Instructions are run.

① The DELIVERY SETTINGS option sets each selected unit to the factory setting.
The ACT.SETTING option accepts the units previously set by you.

② Only units not yet configured in the current setup are offered for selection in each cycle. The unit for mass and volume is derived from the corresponding flow unit.

③ The "YES" option remains visible until all the units have been configured.
"NO" is the only option displayed when no further units are available.

④ Only the outputs not yet configured in the current setup are offered for selection in each cycle.

⑤ The "YES" option remains visible until all the outputs have been parameterized.
"NO" is the only option displayed when no further outputs are available.

⑥ The "automatic parameterization of the display" option contains the following basic settings/factory settings

YES	Main line = volume flow Additional line = totalizer 1 Information line = operating/system conditions
NO	The existing (selected) settings remain.

⑦ The Quick Setup "Batching" is only available when the optional software package BATCHING is installed.

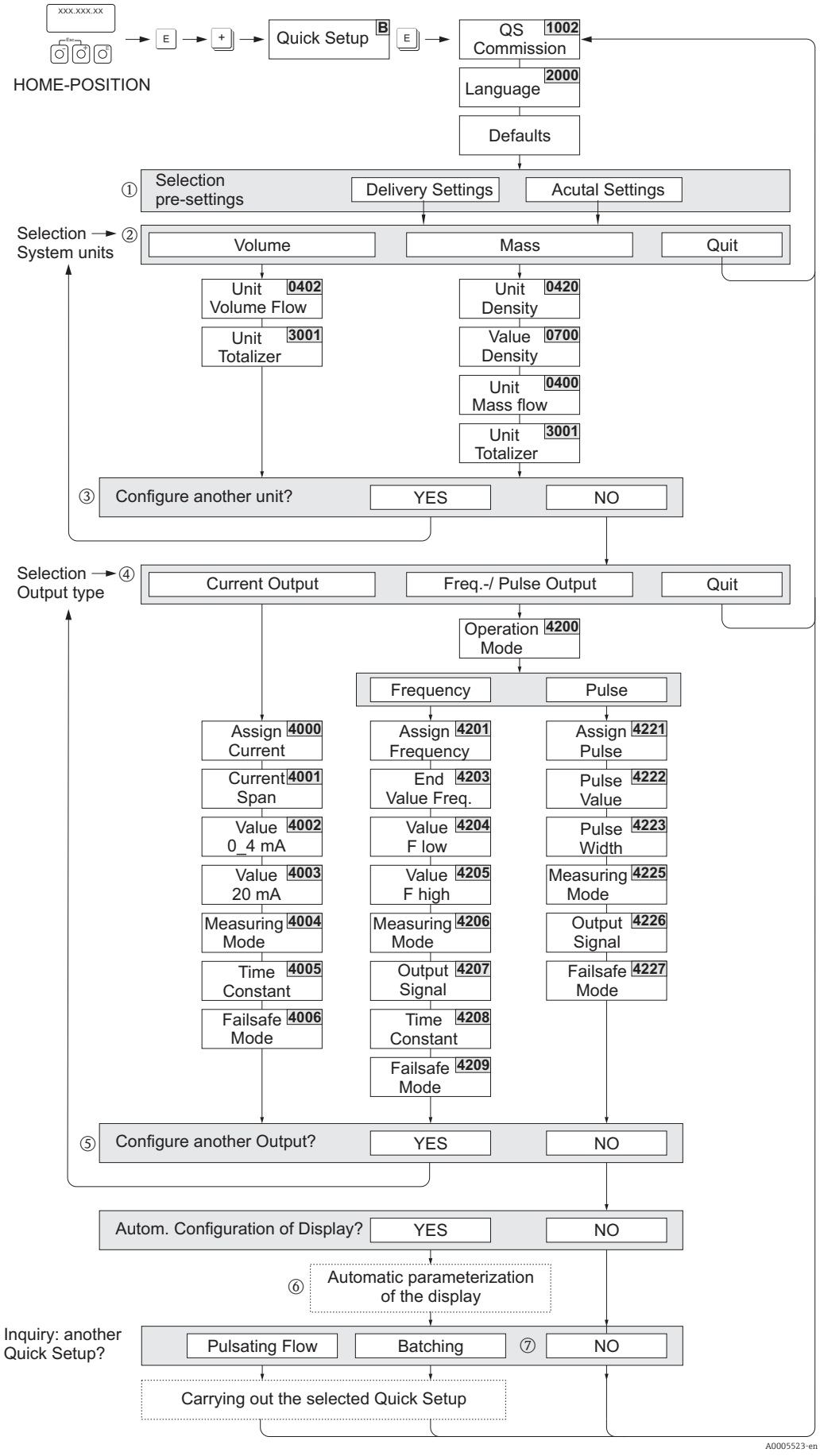


Fig. 57: Quick Setup for straightforward commissioning

6.3.2 "Pulsating flow" Quick Setup menu

Note!
The "Pulsating flow" Quick Setup is only available if the device has a current output or a pulse/frequency output.

Certain pumps of a construction which necessitates a pulsating pumping action, such as reciprocating, peristaltic and cam-type pumps, create a flow characterized by severe periodic fluctuations. Negative flows can occur with pumps of these types on account of the closing volume of the valves or valve leaks.

Note!
Before carrying out the "Pulsating Flow" Quick Setup, the "Commissioning" Quick Setup must be executed → 86.

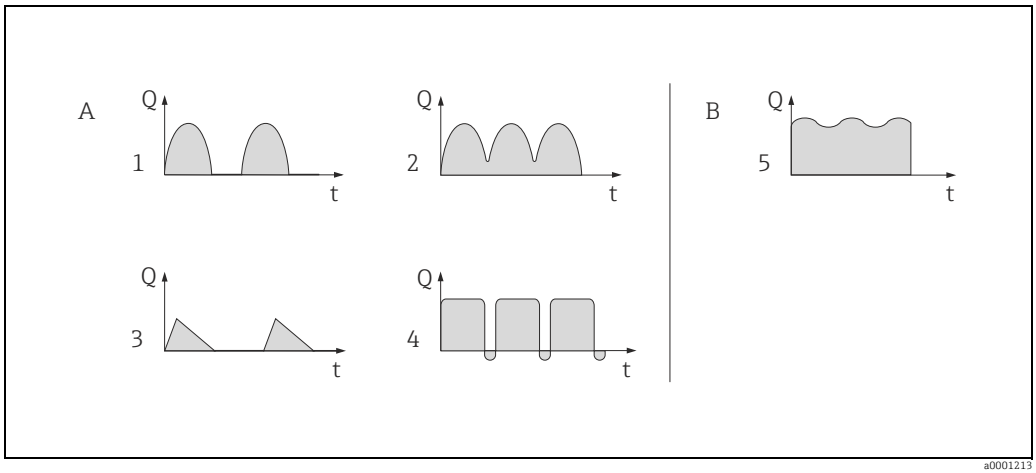


Fig. 58: Flow characteristics of various types of pump

A with severely pulsating flow
B with slightly pulsating flow

1 1-cylinder cam pump
2 2-cylinder cam pump
3 Magnetic pump
4 Peristaltic pump, flexible connecting hose
5 Multi-cylinder reciprocating pump

Severely pulsating flow

Once several device functions have been configured in the "Pulsating Flow" Quick Setup menu, flow fluctuations can be compensated over the entire flow range and pulsating liquid flows measured correctly. The following describes in detail how to use this Quick Setup menu.

Note!
It is always advisable to work run the "Pulsating Flow" Quick Setup if there is any uncertainty about the exact flow characteristic.

Slightly pulsating flow

If flow fluctuations are no more than minor, as is the case, for example with gear-type, three-cylinder or multi-cylinder pumps, it is **not** absolutely necessary to work through the "Pulsating Flow" menu.
In cases of this nature, however, it is advisable to adapt the functions listed below (see "Description of Device Functions" manual) to suit local process conditions in order to ensure a stable, unvarying output signal. This applies particularly to the current output:

- Measuring system damping: SYSTEM DAMPING function → increase the value.
- Current output damping: TIME CONSTANT function → increase the value.

Using the "Pulsating Flow" Quick Setup menu

This Quick Setup menu guides you systematically through the setup procedure for all the device functions that have to be configured for measuring pulsating flows. Note that this has no effect on values already configured, such as measuring range, current range or full scale value.

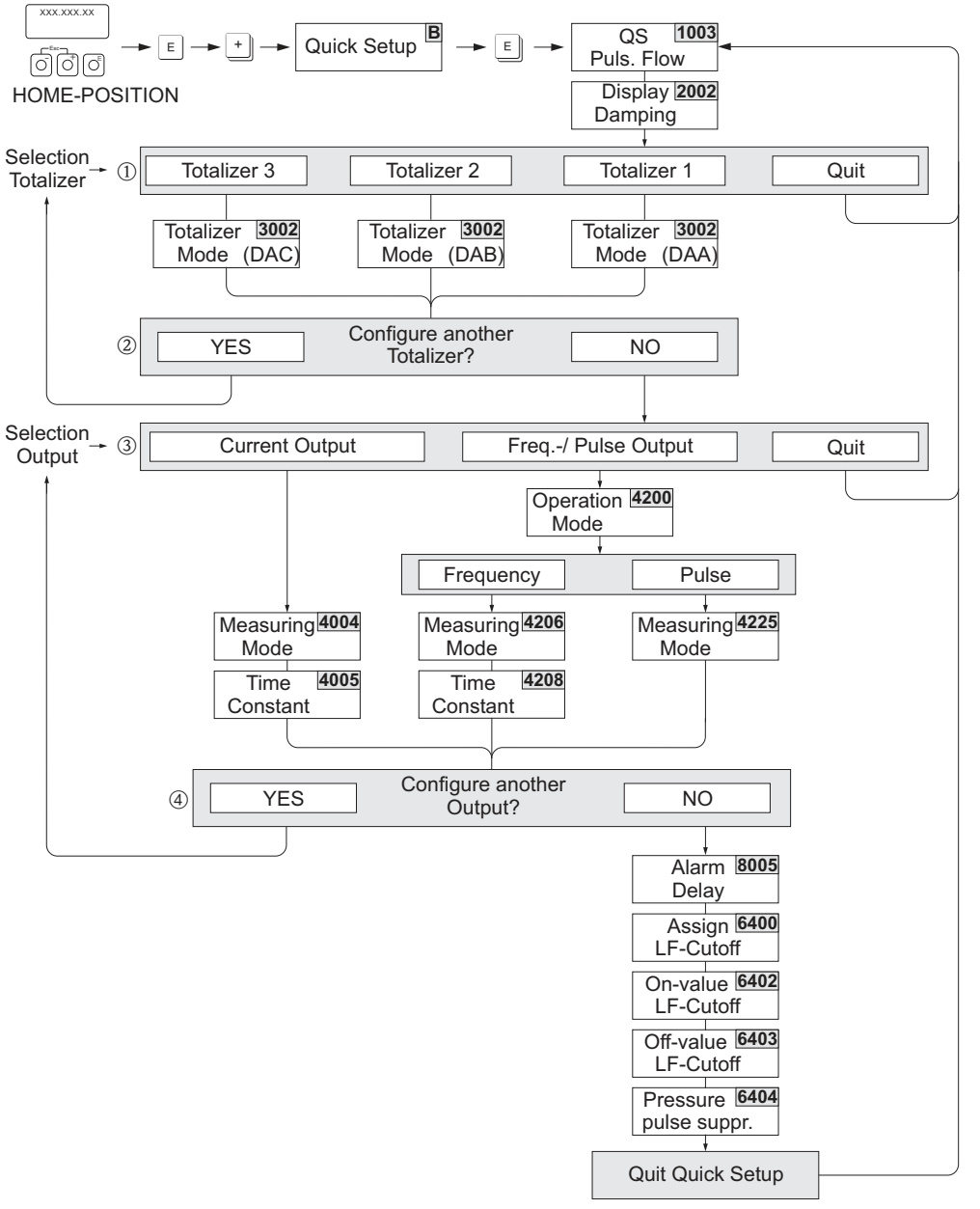


Fig. 59: Quick Setup for measuring severely pulsating flows. Recommended settings see next page

① Only the output not yet configured in the current setup is offered for selection in the second cycle.

② The "YES" option remains visible until both outputs have been parameterized. "NO" is the only option displayed when no further outputs are available.

③ Only the outputs not yet configured in the current Setup are offered for selection in each cycle.

④ The "YES" option remains visible until all the outputs have been configured. "NO" is the only option displayed when no further outputs are available.

Note!
- The display returns to the cell QUICK SETUP PULSATING FLOW (1003) if you press the ESC key ( ) during parameter interrogation.
- You can call up this setup menu either directly from the Commissioning Quick Setup menu or manually by means of the function QUICK SETUP PULSATING FLOW (1003).

"Pulsating flow" Quick Setup menu		
HOME position → E → MEASURED VARIABLE → ⊞ → QUICK SETUP → → QS PULSATING FLOW (1003)		
Function No.	Function name	Select using ⊞⊟ Go to next function using E
1003	QS-PULS FLOW	YES After E is pressed by way of confirmation, the quick setup menu calls up all the subsequent functions in succession.

▼

Basic configuration		
2002	DISPLAY DAMPING	3 s
3002	TOTALIZER MODE (DAA)	BALANCE (Totalizer 1)
3002	TOTALIZER MODE (DAB)	BALANCE (Totalizer 2)
3002	TOTALIZER MODE (DAC)	BALANCE (Totalizer 3)
Signal type for "CURRENT OUTPUT 1 to n"		
4004	MEASURING MODE	PULSATING FLOW
4005	TIME CONSTANT	1 s
Signal type for "PULSE/FREQ. OUTPUT 1 to n" (for FREQUENCY operating mode)		
4206	MEASURING MODE	PULSATING FLOW
4208	TIME CONSTANT	0 s
Signal type for "PULSE/FREQ. OUTPUT 1 to n" (for PULSE operating mode)		
4225	MEASURING MODE	PULSATING FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LOW FLOW CUT OFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUT OFF	Recommended setting: $\text{On-value} \approx \frac{\text{max. full scale (per DN)*}}{1000}$ a0004432-en **Full scale values → 17*
6403	OFF-VALUE LOW FLOW CUT OFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s

▼

Back to the HOME position
→ Press and hold down Esc keys for longer than three seconds or
→ repeatedly press and release Esc keys → exit the function matrix step by step

6.3.3 "Batching" Quick Setup menu

Note!
This function is only available when the additional "batching" software is installed in the measuring device (order option). You can order this software from Endress+Hauser as an accessory at a later date.

This Quick Setup menu guides you systematically through the setup procedure for all the device functions that have to be parameterized and configured for batching operation. These basic settings allow simple (one step) batching processes.
Additional settings, e.g. for the calculation of after runs or for multi-stage batching procedures, must be made via the function matrix itself (see the "Description of Device Functions" manual).

Caution!
The "Batching" Quick Setup sets certain device parameters for discontinuous measurement operation. If the measuring instrument is used for continuous flow measurement at a later time, we recommend at you rerun the "Commissioning" and/or "Pulsating Flow" Quick Setup.

Note!
- Before carrying out the Quick Setup "Batching" the Quick Setup "Commissioning" has to be executed → 🖹 86.
- You can find detailed information on the batching functions in the separate "Description of Device Functions" manual".
- You can also directly control filling process using the local display. During Quick Setup, an appropriate dialog appears concerning the automatic display configuration. Acknowledge this by clicking "YES".
  This assigns special batching functions (START, PRESET, MATRIX) to the bottom line of the display. These can be directly executed onsite using the three operating keys (⊞/⊟/Ⓔ). Therefore, the measuring device can be fully deployed in the field as a "batch controller" → 🖹 64.

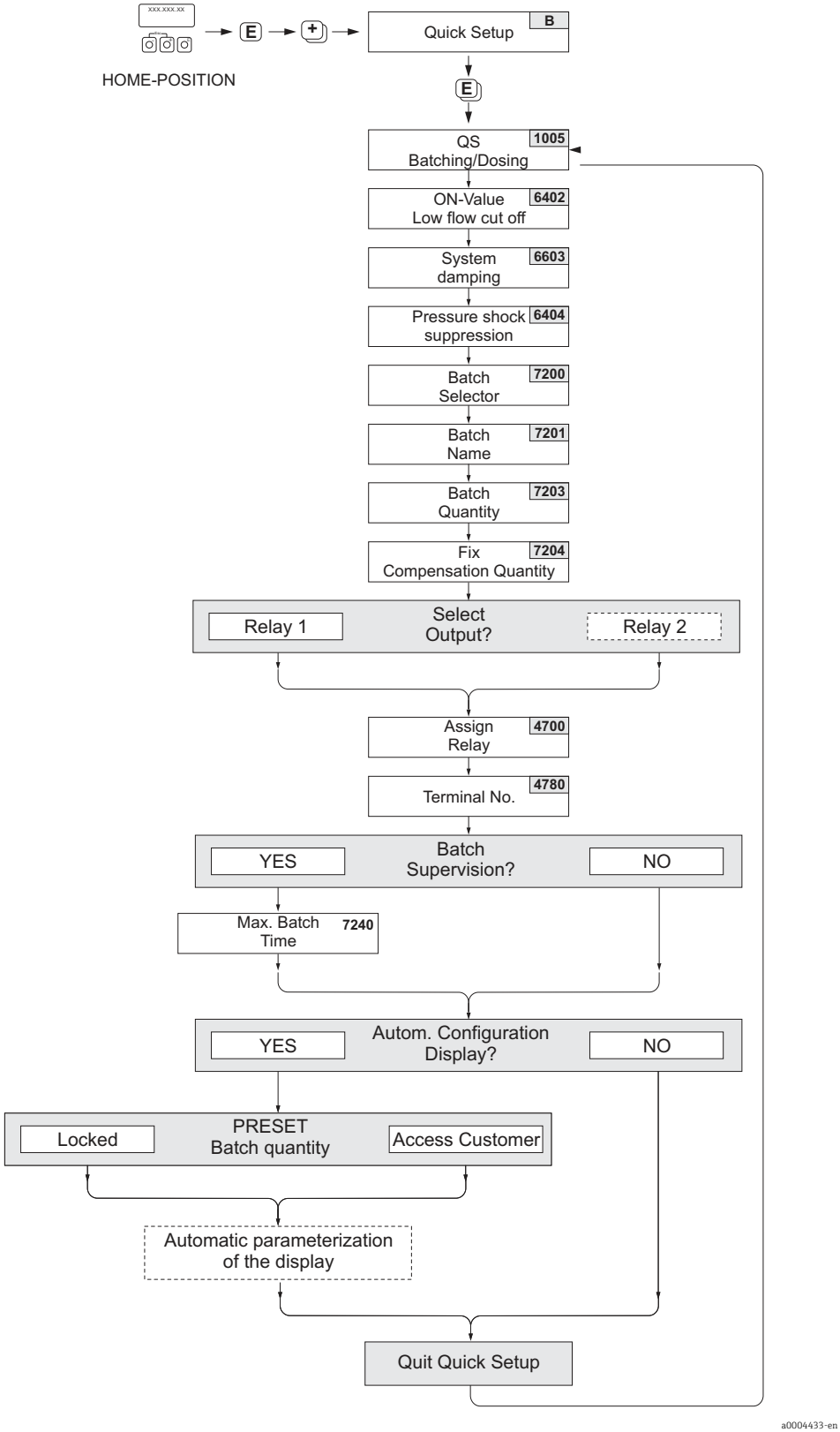


Fig. 60: Quick Setup "Batching". Recommended settings see next page

Recommended settings

"Batching" Quick Setup menu		
HOME-Position → E → MEASURED VARIABLE → ⊞ → QUICK SETUP → 📋 → QUICK SETUP BATCHING (1005)		
Function No.	Function name	Setting to be selected (⊞) (to next function with E)
1005	QUICK SETUP BATCHING / DOSING	YES After E is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
▼		
✎ Note! Functions with a gray background are configured automatically (by the measuring system itself)		
6400	ASSIGN LOW FLOW CUTOFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUTOFF	Recommended settings see on → 🖹 90 in function 6402.
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6603	SYSTEM DAMPING	9 ✎ Note! The parameter has to be optimized for highly accurate and short filling processes: to do this, put the setting to "0".
6404	PRESSURE SHOCK SUPPRESSION	0 seconds
7200	BATCH SELECTOR	BATCH #1
7201	BATCH NAME	BATCH #1
7202	ASSIGN BATCH VARIABLE	Volume
7203	BATCH QUANTITY	0
7204	FIX COMPENSATION QUANTITY	0
7205	COMPENSATION MODE	OFF
7208	BATCH STAGES	1
7209	INPUT FORMAT	Value input
4700	ASSIGN RELAY	BATCH VALVE 1
4780	TERMINAL NUMBER	Output (display only)
7220	OPEN VALVE 1	0% or 0 [unit]
7240	MAXIMUM BATCH TIME	0 seconds (= switched off)
7241	MINIMUM BATCH QUANTITY	
7242	MAXIMUM BATCH QUANTITY	
2200	ASSIGN (main line)	BATCH NAME
2220	ASSIGN (Multiplex main line)	OFF
2400	ASSIGN (additional line)	BATCH DOWNWARDS
2420	ASSIGN (Multiplex additional line)	OFF
2600	ASSIGN (information line)	BATCHING KEYS
2620	ASSIGN (Multiplex information line)	OFF
▼		
Back to the HOME position: → Press and hold down Esc key for longer than three seconds or → Repeatedly press and release Esc key → Exit the function matrix step by step		

6.3.4 Data backup/transmission

Using the T-DAT SAVE/LOAD function, you can transfer data (device parameters and settings) between the T-DAT (exchangeable memory) and the EEPROM (device storage unit).

This is required in the following instances:
- Creating a backup: current data are transferred from an EEPROM to the T-DAT.
- Replacing a transmitter: current data are copied from an EEPROM to the T-DAT and then transferred to the EEPROM of the new transmitter.
- Duplicating data: current data are copied from an EEPROM to the T-DAT and then transferred to EEPROMs of identical measuring points.

Note!
For information on installing and removing the T-DAT → 116.

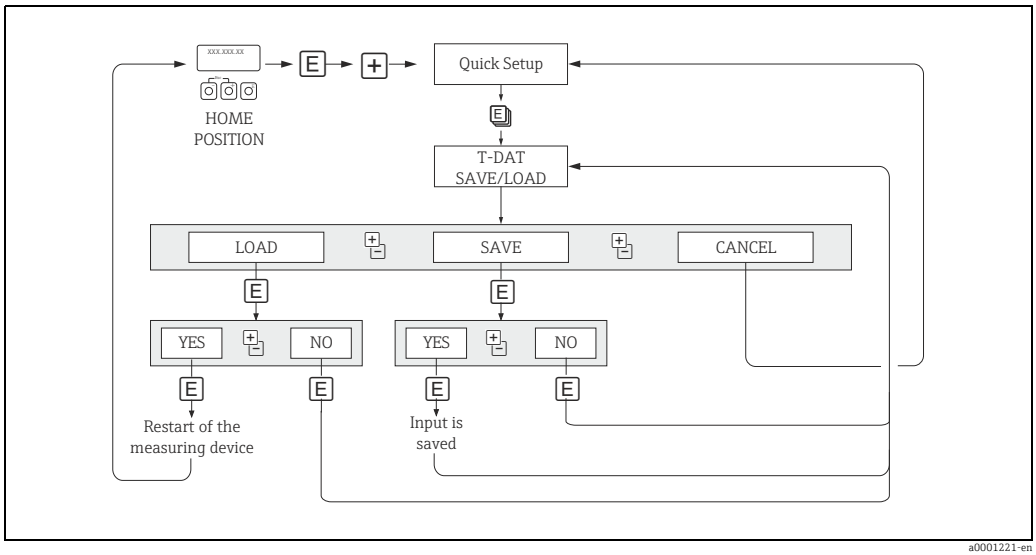


Fig. 61: Data backup/transmission with T-DAT SAVE/LOAD function

Information on the LOAD and SAVE options available:

LOAD: Data are transferred from the T-DAT to the EEPROM.

Note!
- Any settings already saved on the EEPROM are deleted.
- This option is only available, if the T-DAT contains valid data.
- This option can only be executed if the software version of the T-DAT is the same or newer than that of the EEPROM. Otherwise, the error message "TRANSM. SW-DAT" appears after restarting and the LOAD function is then no longer available.

SAVE:
Data are transferred from the EEPROM to the T-DAT.

6.4 Configuration

6.4.1 Current outputs: active/passive

The current outputs can be configured as "active" or "passive" by means of various jumpers on the I/O board or on the current submodule.

Caution!
The configuration of the current outputs as "active" or "passive" is only possible on non-Ex i I/O
boards. Ex i I/O boards are permanently wired as "active" or "passive". See Table → 55.

Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → 116.
3. Position jumpers → 62, → 63.

   Caution!
   – Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagrams. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.
   – Note that the position of the current submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → 55.
4. Installation of the I/O board is the reverse of the removal procedure.

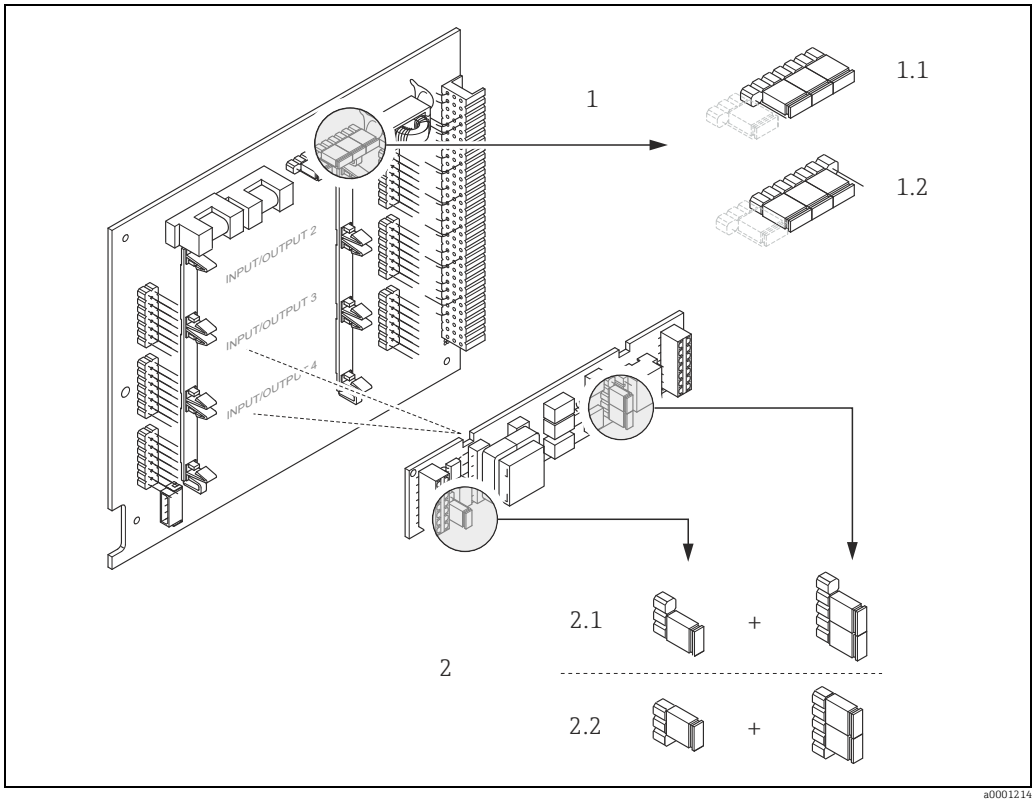


Fig. 62: Configuring the current outputs with the aid of jumpers (convertible I/O board)

1 Current output 1 with HART
1.1 Active current output (factory setting)
1.2 Passive current output
2 Current output 2 (optional, plug-in module)
2.1 Active current output (factory setting)
2.2 Passive current output

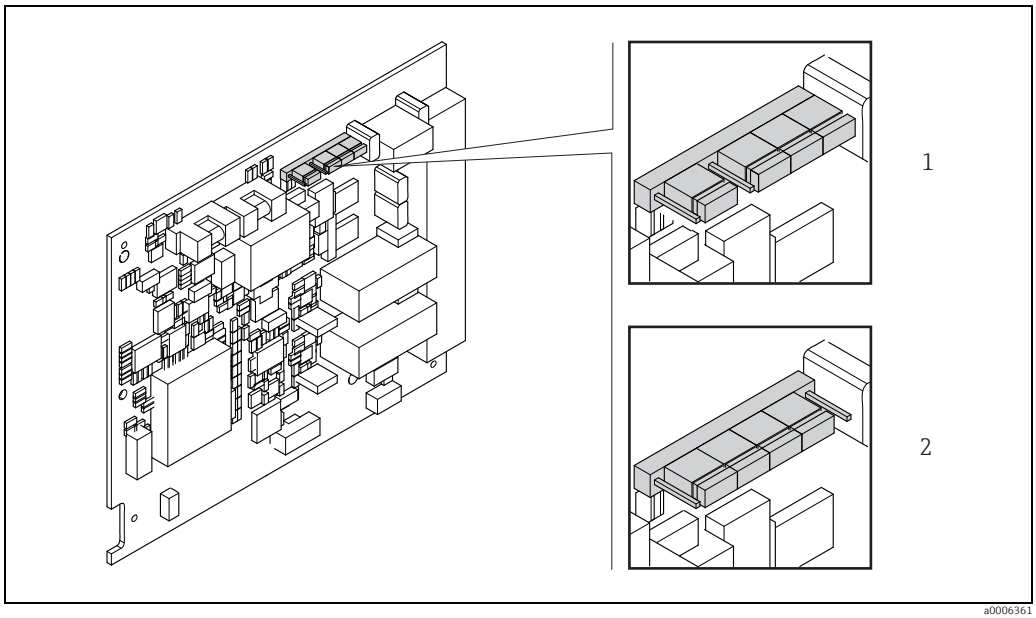


Fig. 63: Configuring the current output with the aid of jumpers (fixed I/O board)

1 Active current output (factory setting)
2 Passive current output

6.4.2 Current input: active/passive

The current input can be configured as "active" or "passive" by means of various jumpers on the current input submodule.

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → 📄 116.
3. Position jumpers → 🔲 64.

   ☝ Caution!
   – Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagram. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.
   – Note that the position of the current input submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → 📄 55.
4. Installation of the I/O board is the reverse of the removal procedure.

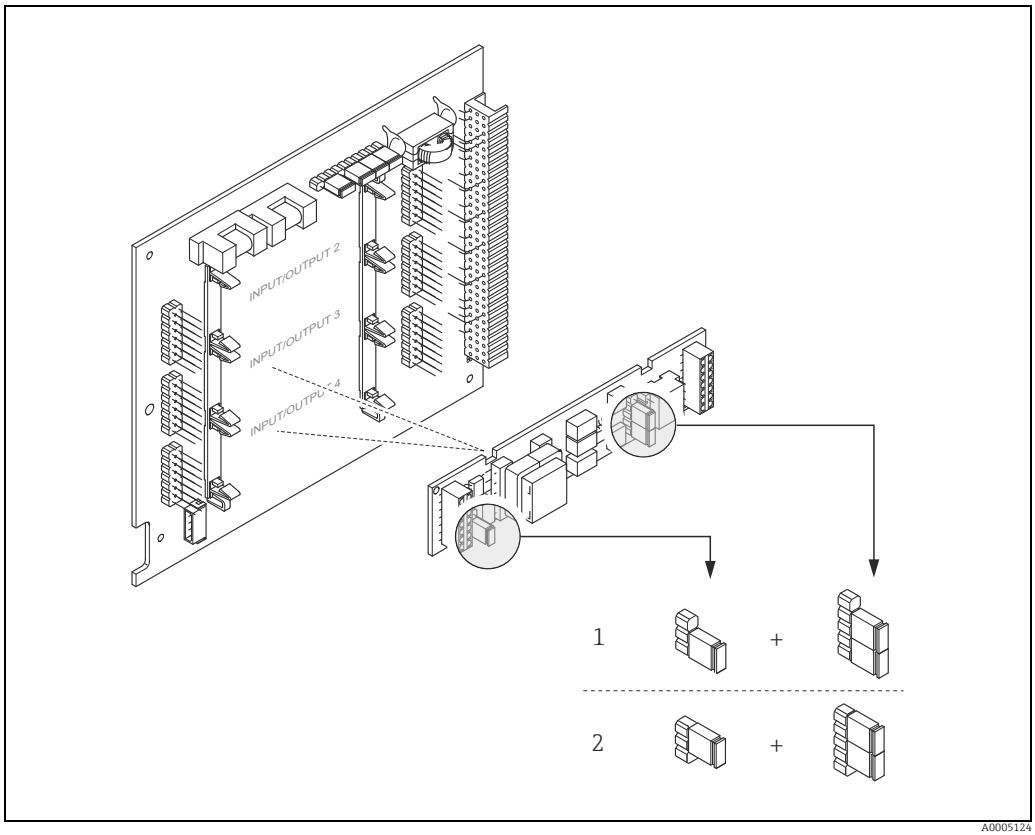


Fig. 64: Configuring the current input with the aid of jumpers (I/O board)

1 Active current input (factory setting)
2 Passive current input

6.4.3 Relay contacts: Normally closed/normally open

The relay contact can be configured as normally open (NO or make) or normally closed (NC or break) contacts by means of two jumpers on the I/O board or on the relay submodule respectively. This configuration can be called up at any time with the ACTUAL STATUS RELAY function (4740).

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → 📄 116.
3. Position jumpers → 🔲 65, → 🔲 66.

   ☝ Caution!
   – If you change the setting you must always change the positions of **both** jumpers. Set the jumpers exactly as indicated.
   – Note that the position of the relay submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → 📄 55.
4. Installation of the I/O board is the reverse of the removal procedure.

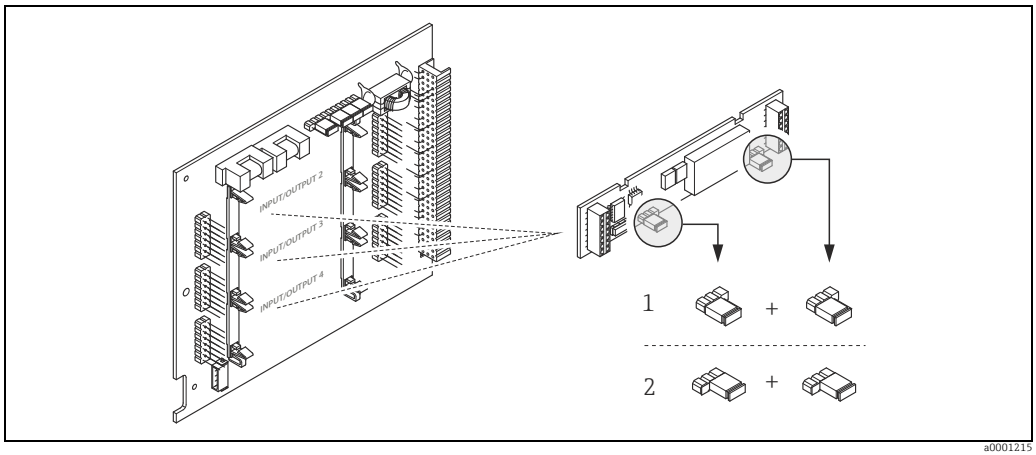


Fig. 65: Configuring relay contacts (NC/NO) for the flexible module board.

1 Configured as NO contact (factory setting, relay 1)
2 Configured as NC contact (factory setting, relay 2, if installed)

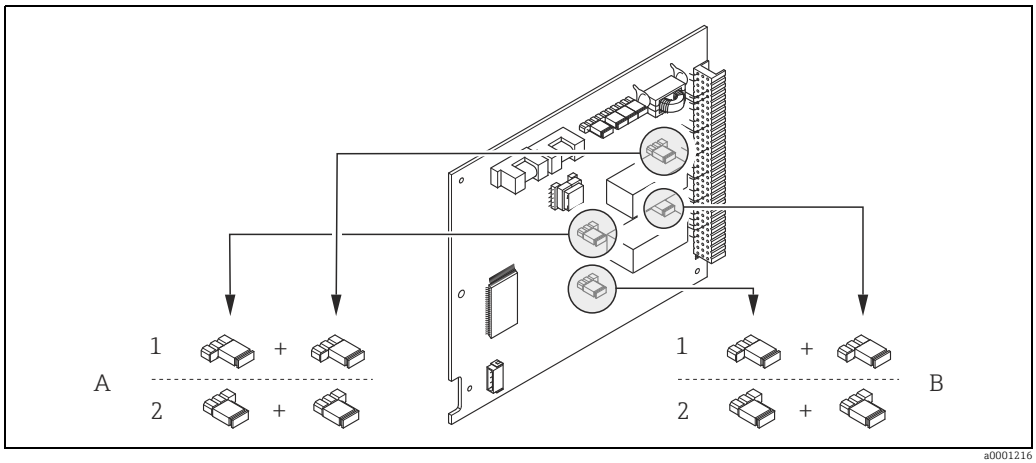


Fig. 66: Configuring relay contacts (NC/NO) for the fixed module board. A = relay 1; B = relay 2

1 Configured as NO contact (factory setting, relay 1)
2 Configured as NC contact (factory setting, relay 2)

6.5 Adjustment

6.5.1 Empty-pipe/Full-pipe adjustment

Flow cannot be measured correctly unless the measuring pipe is completely full.
This status can be monitored at all times with the Empty Pipe Detection function:
- EPD = Empty Pipe Detection (with the help of an EPD electrode).
- OED = Open Electrode Detection (Empty Pipe Detection with the help of the measuring electrodes, if the sensor is not equipped with an EPD electrode or the orientation is not suitable for using EPD).

Caution!
A **detailed** description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found in the separate "Description of Device Functions" Manual:
- EPD/OED ADJUSTMENT (6481) → Carrying out the adjustment.
- EPD (6420) → Switching on and off EPD/OED.
- EPD RESPONSE TIME (6425) → Input of the response time for EPD/OED.

Note!
- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory with water (approx. 500 µS/cm). If the liquid conductivity differs from this reference, empty-pipe/full-pipe adjustment has to be performed again on site.
- The default setting for EPD/OED when the devices are delivered is OFF; the function has to be activated if required.
- The EPD/OED process error can be output by means of the configurable relay outputs.

Performing empty-pipe and full-pipe adjustment (EPD/OED)

1. Select the corresponding function in the function matrix:
   HOME → E → + → BASIC FUNCTIONS → E → + → PROCESS PARAMETERS → E → + → ADJUSTMENT → E → EPD/OED ADJUSTMENT
2. Empty the piping. In case of an EPD adjustment, the wall of the measuring tube should be wetted with fluid for the adjustment procedure but this is not the case with an OED adjustment!
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E to confirm.
4. After empty-pipe adjustment, fill the piping with fluid.
5. Start full-pipe adjustment: Select "FULL PIPE ADJUST" or "OED FULL ADJUST" and press E to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E.
7. Now select the "EPD" function (6420). Switch on Empty Pipe Detection by selecting the following settings:
   – EPD → Select ON STANDARD or ON SPECIAL and press E to confirm.
   – OED → Select OED and confirm with E.

Caution!
The adjustment coefficients must be valid before you can activate the EPD/OED function. If adjustment is incorrect the following messages might appear on the display:
- ADJUSTMENT FULL = EMPTY
  The adjustment values for empty pipe and full pipe are identical. In such instances, empty-pipe adjustment/full-pipe adjustment **must** be carried out again.
- ADJUSTMENT NOT OK
  Adjustment is not possible because the fluid's conductivity is out of range.

6.6 Data storage devices

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored. By plugging and unplugging such modules, device configurations can be duplicated onto other measuring devices to cite just one example.

6.6.1 HistoROM/S-DAT (sensor DAT)

The S-DAT is an exchangeable data storage device in which all sensor data are stored, i.e., nominal diameter, serial number, calibration factor, zero point.

6.6.2 HistoROM/T-DAT (transmitter DAT)

The T-DAT is an exchangeable data storage device in which all transmitter parameters and settings are stored.
Storing of specific parameter settings from the device memory (EEPROM) to the T-DAT module and vice versa must be carried out by the user (= manual save function). Detailed instructions regarding this can be found on → 🖹 94.

6.6.3 F-CHIP (function chip)

The F-CHIP is a microprocessor component which contains additional software packages which are used to enhance the functionality and therefore the range of application of the transmitter.
If an upgrade is carried out at a later stage, the F-CHIP can be ordered as an accessory and can simply be inserted into the I/O board. After startup, the transmitter can access this software immediately.
Accessories → 🖹 102
Inserting into the I/O board → 🖹 115

Caution!
To avoid any confusion, once the F-CHIP has been put on the I/O board, it is labeled with the transmitter's serial number i.e. the F-CHIP can then no longer be used for another measuring device.

7 Maintenance

No special maintenance work is required.

7.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing or the seals.

7.2 Seals

The seals in the Promag H sensor should be replaced periodically, particularly when molded seals (aseptic version) are used!
The interval between replacements depends on the frequency of the cleaning cycles and on the temperature of the fluid and of the cleaning process.

Replacement seals (accessory) → 102.

8 Accessories

Various accessories, which can be ordered separately or with the device from Endress+Hauser, are available for the device. Detailed information can be provided by the Endress+Hauser service organization or can be found on the product page of the Endress+Hauser website: www.endress.com

8.1 Device-specific accessories

Accessory	Description	Order code
Transmitter Promag 53	Transmitter for replacement or for stock. Use the order code to define the following specifications: ▪ Approvals ▪ Degree of protection / version ▪ Cable type for remote version ▪ Cable entries ▪ Display / power supply / operation ▪ Software ▪ Outputs / inputs	53XXX – XXXXX * * * * * * * *
Software packages for Promag 53	Software add-ons on F-CHIP, can be ordered individually: ▪ Electrode Cleaning Circuitry (ECC) ▪ Batching	DK5SO-*
Conversion kit for outputs/inputs	Conversion kit with appropriate plug-in point modules to change the current input/output configuration to a new version.	DKUI-*

8.2 Accessories specific to measuring principle

Accessory	Description	Order code
Mounting kit for Promag 53 transmitter	Mounting kit for wall-mount housing (remote version). Suitable for: ▪ Wall mounting ▪ Pipe mounting ▪ Panel mounting Mounting set for aluminum field housing. Suitable for Pipe mounting.	DK5WM – *
Cable for remote version	Coil and electrode cables, various lengths. Reinforced cable on request.	DK5CA – * *
Ground cable for Promag E/L/P/W	A set consists of two ground cables.	DK5GC – * * *
Ground disk for Promag E/L/P/W	Ground disk for potential equalization.	DK5GD – * * * * *
Mounting kit for Promag H	Mounting kit for Promag H, consisting of: ▪ 2 Process connections ▪ Screws ▪ Seals	DKH * * – * * * *
Adapter connection for Promag A/H	Adapter connections for installation of Promag 53 H instead of Promag 30/33 A or Promag 30/33 H/DN 25.	DK5HA – * * * * * *
Grounding rings for Promag H	If the process connections are made of PVC or PVDF, ground rings are necessary to ensure that potential is matched. A set comprises 2 ground rings.	DK5HR – ***
Seal set for Promag H	For regular replacement of seals in the Promag H sensor.	DK5HS – ***
Wall mounting kit Promag H	Wall mounting kit for Promag H transmitter.	DK5HM – **

Accessory	Description	Order code
Welding jig for Promag H	Weld nipple as process connection: Welding jig for installation in piping.	DK5HW – ***

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator Field Xpert SFX 100	Handheld terminal for remote configuration and for obtaining measured values via the 4 to 20 mA HART current output. Contact your Endress+Hauser representative for more information.	SFX100 – *******
Fieldgate FXA320	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ 2-channel analog input (4 to 20 mA) ▪ 4 binary inputs with event counter function and frequency measurement ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values.	FXA320 – *****
Fieldgate FXA520	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ Web server for remote monitoring of up to 30 measuring points ▪ Intrinsically safe version [EEx ia]IIC for applications in hazardous areas ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values ▪ Remote diagnosis and remote configuration of connected HART devices	FXA520 – ****
FXA195	The Commubox FXA195 connects intrinsically safe Smart transmitters with HART protocol to the USB port of a personal computer. This makes the remote operation of the transmitters possible with the aid of configuration programs (e.g. FieldCare). Power is supplied to the Commubox by means of the USB port	FXA195 – *

8.4 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DXA80 – *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant asset management tool. It can configure all intelligent field devices in your plant and supports you in the administration of these devices. Through the use of status information, it is also an easy but effective means of monitoring the status of these devices.	See product list on the Endress+Hauser website: www.endress.com
FXA193	Service interface of device to the PC for operation via FieldCare.	FXA193 – *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all relevant process variables: Measuring values are recorded reliably, limit values monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on an SD card or USB stick. The PC software package ReadWin® 2000, which is supplied as standard, is used for configuration, visualization and storage of the recorded data.	RSG40-**********

9 Troubleshooting

9.1 Troubleshooting instructions

If faults occur after commissioning or during operation, always start troubleshooting with the checklist below. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The necessary procedures must be carried out before you return the device to Endress+Hauser → 🖹 5.
Always enclose a duly completed "Declaration of Contamination" form. You will find a preprinted blank of this form at the back of this manual.

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → terminals 1, 2. 2. Check the power line fuse → 🖹 120. 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC / 16 to 62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 🖹 115.
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → 🖹 115. 2. Display module defective → order spare parts → 🖹 115. 3. Measuring electronics defective → order spare parts → 🖹 115.
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the OS buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output.	Electronics board defective → order spare parts → 🖹 115.

▼

Status signals on display (only HART 7)
The status signals provide information on the state and reliability of the device by categorizing the cause of the diagnostic information (diagnostic event). The status signals are categorized according to VDI/VDE 2650 and NAMUR Recommendation NE 107: F = Failure, C = Function Check, S = Out of Specification, M = Maintenance Required **Category F (Failure)** A device error has occurred. The measured value is no longer valid. **Category C (Function check** The device is in service mode (e.g. during a simulation). **Category S (Out of specification** The device is operated: ▪ Outside its technical specification limits (e.g. outside the process temperature range) ▪ Outside of the configuration carried out by the user (e.g. maximum flow in parameter **20 mA-Value**) **Category M (Maintenance required** Maintenance is required. The measured value remains valid.

▼

Error messages on display	
Errors which occur during commissioning or operation are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Error type: **S** = system error, **P** = process error – Error message type: ↯ = fault message, **!** = notice message – **EMPTY PIPE** = type of error, e.g. measuring tube is only partly filled or completely empty – **03:00:05** = duration of error occurrence (in hours, minutes and seconds) – **#401** = error number ☞ Caution! ▪ Also observe the information on → 🖹 67. ▪ The measuring system interprets simulations and positive zero return as system errors, but displays them only as a notice message.	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → 🖹 106.
Error number: No. 401 – 499	Process error (application error) has occurred → 🖹 110.

▼

Other errors (without error message)	
Some other errors have occurred.	Diagnosis and rectification → 🖹 112.

9.2 System error messages

Serious system errors are **always** recognized by the device as "Fault message", and are shown as a lightning flash (↯) on the display. Fault messages immediately affect the outputs.

☞ Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The necessary procedures on → 🖹 123 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed "Declaration of Contamination" form. You will find a master copy of this form at the back of this manual.

✎ Note!
Also observe the information on → 🖹 67.

No.	Error message / Type	Status signals (from the factory, only HART 7)	Cause	Remedy (spare part → 🖹 115)
S = System error ↯ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)				
No. # 0xx → Hardware error				
001	S: CRITICAL FAILURE ↯: # 001	F	Serious device error	Replace the amplifier board.
011	S: AMP HW EEPROM ↯: # 011	F	Amplifier: Defective EEPROM	Replace the amplifier board.
012	S: AMP SW EEPROM ↯: # 012	F	Amplifier: Error accessing EEPROM data	The EEPROM data blocks in which an error has occurred are displayed in the TROUBLESHOOTING function. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. ✎ Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111 / CHECKSUM TOTAL).

No.	Error message / Type	Status signals (from the factory, only HART 7)	Cause	Remedy (spare part → 🖹 115)
031	S: SENSOR HW DAT ↯: # 031	F	1. S-DAT is not plugged into the amplifier board correctly (or is missing). 2. S-DAT is defective.	1. Check whether the S-DAT is correctly plugged into the amplifier board. 2. Replace the S-DAT if it is defective. Check that the new replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. 4. Plug the S-DAT into the amplifier board.
032	S: SENSOR SW DAT ↯: # 032	F		
041	S: TRANSM. HW-DAT ↯: # 041	F	Transmitter DAT: 1. T DAT is not correctly plugged into the amplifier board (or is missing). 2. T-DAT is defective.	1. Check whether the T-DAT is correctly plugged into the amplifier board. 2. Replace the T-DAT if it is defective. Check that the new replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. 4. Plug the T-DAT into the amplifier board.
042	S: TRANSM. SW-DAT ↯: # 042	F	Transmitter DAT: Error accessing the calibration values stored in the S-DAT.	
061	S: HW F-CHIP ↯: # 061	F	Transmitter F-CHIP: 1. F-CHIP is defective. 2. F-CHIP is not plugged into the I/O board or is missing.	1. Replace the F-CHIP. Accessories → 🖹 102 2. Plug the F-CHIP into the I/O board → 🖹 116
No. # 1xx → Software error				
101	S: GAIN ERROR AMP ↯: # 101	F	Gain deviation compared to reference gain > 25%.	Replace the amplifier board.
111	S: CHECKSUM TOTAL ↯: # 111	F	Totalizer checksum error.	1. Restart the measuring device. 2. Replace the amplifier board if necessary.
121	S: A / C COMPATIB. !: # 121	F	Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality). ✎ Note! ▪ The indication on the display as notice message appears only for 30 seconds (with listing in "Previous system condition" function). ▪ This condition can occur if only one electronics board has been exchanged; the extended software functionality is not available. The previously existing software functionality is still working and the measurement possible.	Module with lower software version has either to be updated by FieldCare with the required software version or the module has to be replaced.
No. # 2xx → Error in DAT / no communication				
205	S: LOAD T-DAT !: # 205	M	Transmitter DAT: Data backup (downloading) to T-DAT failed, or error when accessing (uploading) the calibration values stored in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → 🖹 116 2. Replace the T-DAT if it is defective. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary.
206	S: SAVE T-DAT !: # 206	M		

No.	Error message / Type	Status signals (from the factory, only HART 7)	Cause	Remedy (spare part → 📄 115)
251	S: COMMUNICATION I/O ϟ: # 251	F	Internal communication error on amplifier board.	Replace the amplifier board.
261	S: COMMUNICATION I/O ϟ: # 261	F	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts.
No. # 3xx → System limits exceeded				
321	S: TOL. COIL CURR. ϟ: # 321	F	Sensor: Coil current is out of tolerance.	⚠ Warning! Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards! Remote version: 1. Check wiring of terminals 41/42 → 📄 48 2. Check coil current cable connector. Compact and remote version: If the error can not be resolved, please contact your local Endress+Hauser service organization.
339 to 342	S: STACK CUR OUT n !: # 339 to 342	S	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (ϟ) ▪ Configure the fault response of the output to "ACTUAL VALUE" so that the temporary buffer can be cleared. ▪ Clear the temporary buffer by the measures described under Item 1.
343 to 346	S: STACK FREQ. OUT n !: # 343 to 346	S		
347 to 350	S: STACK PULSE OUT n !: # 343 to 346	S	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse weighting 2. Increase the max. pulse frequency if the totalizer can handle a higher number of pulses. 3. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (ϟ) ▪ Configure the fault response of the output to "ACTUAL VALUE" so that the temporary buffer can be cleared. ▪ Clear the temporary buffer by the measures described under Item 1.
351 to 354	S: CURRENT RANGE n !: # 351 to 354	S	Current output: flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 to 358	S: FREQ. RANGE n !: # 355 to 358	S	Frequency output: flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.

No.	Error message / Type	Status signals (from the factory, only HART 7)	Cause	Remedy (spare part → 📄 115)
359 to 362	S: PULSE RANGE !: # 359 to 362	S	Pulse output: the pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ a0004437 3. Reduce flow.
363	S: CUR IN. RANGE !: # 363	S	Current input: The actual value for the current lies outside the set limits.	1. Change set lower-range or upper-range value. 2. Check settings of the external sensor.
No. # 5xx → Application error				
501	S: SW.-UPDATE ACT. !: # 501	–	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT !: # 502	C	Uploading or downloading the device data via operating program. Currently no other functions are possible.	Wait until the procedure is finished.
571	S: BATCH RUNNING !: # 571	–	Batching is started and active (valves are open).	No measures needed (during the batching process some other functions may not be activated).
572	S: BATCH HOLD !: # 572	–	Batching has been interrupted (valves are closed).	1. Continue batching with command "GO ON". 2. Interrupt batching with "STOP" command.
No. # 6xx → Simulation mode active				
601	S: POS. ZERO-RETURN !: # 601	C ≠	Positive zero return active ☝ Caution! This message has the highest display priority!	Switch off positive zero return
611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	C	Simulation current output active	Switch off simulation
621 to 624	S: SIM. FREQ. OUT. n !: # 621 to 624	C	Simulation frequency output active	Switch off simulation
631 to 634	S: SIM. PULSE n !: # 631 to 634	C	Simulation pulse output active	Switch off simulation
641 to 644	S: SIM. STAT. OUT n !: # 641 to 644	C	Simulation status output active	Switch off simulation

No.	Error message / Type	Status signals (from the factory, only HART 7)	Cause	Remedy (spare part → 115)
651 to 654	S: SIM. RELAY n !: # 651 to 654	C	Simulation relay output active.	Switch off simulation.
661	S: SIM. CURR. IN n !: # 661	C	Simulation current input active.	Switch off simulation.
671 to 674	S: SIM. STATUS IN n !: # 671 to 674	C	Simulation status input active	Switch off simulation
691	S: SIM. FAILSAFE !: # 691	C	Simulation of response to error (outputs) active	Switch off simulation
692	S: SIM. MEASURAND !: # 692	C	Simulation of a measured variable active (e.g. mass flow).	Switch off simulation
698	S: DEV. TEST ACT. !: # 698	C	The measuring device is being checked on site via the test and simulation device.	–
1) Status signal is changeable.				

9.3 Process error messages

Note!
Also observe the information on → 67.

No.	Error message / Type	Status signals (from the factory, only HART 7)	Cause	Remedy (spare part → 115)
P = Process error ↯ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)				
401	EMPTY PIPE ↯: # 401	S [1]	Measuring tube partially filled or empty	1. Check the process conditions of the plant 2. Fill the measuring tube
461	ADJ. NOT OK !: # 461	S	EPD calibration not possible because the fluid's conductivity is either too low or too high.	The EPD function cannot be used with fluids of this nature.
463	FULL = EMPTY ↯: # 463	M	The EPD calibration values for empty pipe and full pipe are identical, therefore incorrect.	Repeat calibration, making sure procedure is correct → 99.

No.	Error message / Type	Status signals (from the factory, only HART 7)	Cause	Remedy (spare part → 115)
471	P: > BATCH TIME ϟ: # 471	S	The maximum permitted batching time was exceeded.	1. Increase flow rate. 2. Check valve (opening). 3. Adjust time setting to changed batch quantity. Note! If the errors listed above occur, these are displayed in the Home position flashing continuously. ▪ General: These error messages can be reset by configuring any batching parameter. It is sufficient to confirm with the OS key and then the F key. ▪ Batching via status input: The error message can be reset by means of a pulse. Another pulse then restarts the batching. ▪ Batching via operating keys (soft keys) The error message is reset by pressing the START key. Pressing the START key a second time starts the batching process. ▪ Batching via the BATCHING PROCESS function (7260): The error message can be reset by pressing the STOP, START, HOLD or GO ON keys. Pressing the START key a second time starts the batching process.
472	P: >< BATCH QUANTITY ϟ: # 472	S	– Underbatching: The minimum quantity was not reached. – Overbatching: The maximum permitted batching quantity was exceeded.	Underbatching: 1. Increase fixed correction quantity. 2. Valve closes too quickly with active after run correction. Enter smaller after run as mean value. 3. If the batching quantity changes, the minimum batching quantity must be adjusted. Overbatching: 1. Reduce fixed correction quantity. 2. Valve closes too slowly with active after run correction. Enter larger after run as mean value. 3. If the batching quantity changes, the maximum batching quantity must be adjusted. Note! Please observe Note in error message No. 471
473	P: PROGRESS NOTE ϟ: # 473	–	End of filling process approaching. The running filling process has exceeded the predefined batch quantity point for the display warning message.	No measures required (if necessary prepare to replace container).
474	P: MAX. FLOW !: # 474	S	Maximum flow value entered is overshot.	Reduce the flow value. Note! Please observe Note in error message No. 471
1) Status signal is changeable.				

9.4 Process errors without messages

Symptoms	Rectification
✎ Note! You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault. The functions outlined below, such as DISPLAY DAMPING, are described in detail in the "Description of Device Functions" manual.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Remote version: – Switch off the power supply and check the wiring → 🖹 48 – If necessary, reverse the connections at terminals 41 and 42 2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly.
Measured-value reading fluctuates even though flow is steady.	1. Check grounding and potential equalization → 🖹 57. 2. The medium is too inhomogeneous. Check the following medium characteristics: – Gas bubble percentage too high? – Solids percentage too high? – Conductivity fluctuations too high? 3. SYSTEM DAMPING function → increase value (→ BASIC FUNCTION/SYSTEMPARAMETER/ CONFIGURATION). 4. TIME CONSTANT function → increase value (→ OUTPUTS/CURRENT OUTPUT/ CONFIGURATION). 5. DISPLAY DAMPING function → increase value (→ USER INTERFACE / CONTROL/BASIC CONFIGURATION).
Measured-value reading or measured-value output pulsates or fluctuates, e.g. because of reciprocating pump, peristaltic pump, diaphragm pump or pump with similar delivery characteristic.	Run the "Pulsating flow" Quick Setup → 🖹 88. If the problem persists despite these measures, a pulsation damper will have to be installed between pump and measuring device.
There are differences between the flowmeter's internal totalizer and the external metering device.	This symptom is due primarily to backflow in the piping, because the pulse output cannot subtract in the STANDARD or SYMMETRY measuring modes. There is the following solution: The flow in both directions should be taken into account. Set the MEASURING MODE function to PULSATING FLOW for the pulse output in question.
Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalization → 🖹 55. 2. Check the fluid for presence of gas bubbles. 3. Activate ON-VALUE LOW FLOW CUT OFF function, i.e. enter or increase on value (→ BASIC FUNCTION/PROCESSPARAMETER/CONFIGURATION).
Measured-value reading on display, even though measuring tube is empty.	1. Perform empty-pipe/full-pipe adjustment and then switch on empty pipe detection → 🖹 99. 2. Remote version: Check the terminals of the EPD cable → 🖹 48. 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Select the BUS ADDRESS function and change the setting to "0". 2. Low flow cutoff too high → reduce the relevant value in the ON-VALUE LOW FLOW CUT OFF function.
The fault cannot be rectified or some other fault not described above has arisen. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: ▪ **Request the services of an Endress+Hauser service technician** If you contact our service organization to have a service technician sent out, please be ready to quote the following information: – Brief description of the fault – Nameplate specifications (→ 🖹 6): order code, serial number ▪ **Returning devices to Endress+Hauser** The necessary procedures (→ 🖹 123) must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a master copy of this form at the back of this manual. ▪ **Replace transmitter electronics** Components in the measuring electronics defective → order spare parts → 🖹 115.

9.5 Response of outputs to errors

Note!
The failsafe mode of current, pulse and frequency outputs can be customized by means of various functions in the function matrix. You will find detailed information on these procedures in the "Description of Device Functions" manual.

You can use positive zero return to reset the signals of the current, pulse and frequency outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions: simulations, for example, are suppressed.

Error response mode of outputs		
	System/process error is current	**Positive zero return is activated**
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on → 67.		
Current output	MINIMUM VALUE 0–20 mA → 0 mA 4–20 mA → 2 mA 4–20 mA HART → 2 mA 4–20 mA NAMUR → 3.5 mA 4–20 mA HART NAMUR → 3.5 mA 4–20 mA US → 3.75 mA 4–20 mA HART US → 3.75 mA 0–20 mA (25 mA) → 0 mA 4–20 mA (25 mA) → 2 mA 4–20 mA (25 mA) HART → 2 mA MAXIMUM VALUE 0–20 mA → 22 mA 4–20 mA → 22 mA 4–20 mA HART → 22 mA 4–20 mA NAMUR → 22.6 mA 4–20 mA HART NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 4–20 mA HART US → 22.6 mA 0–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) HART → 25 mA HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Pulse output	FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"

Error response mode of outputs		
	System/process error is current	**Positive zero return is activated**
Frequency output	FALLBACK VALUE Signal output → 0 Hz FAILSAFE LEVEL Output of the frequency specified in the FAILSAFE VALUE function (4211). HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer	STOP The totalizers are paused until the fault is rectified. ACTUAL VALUE The fault is ignored . The totalizers continue to count in accordance with the current flow value. HOLD VALUE The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Relay output	Fault or power supply failure: relay → de-energized In the "Description of Device Functions" manual you will find detailed information on relay switching response for various configurations such as error message, flow direction, EPD, limit value, etc.	No effect on relay output

9.6 Spare parts

You will find detailed troubleshooting instructions in the preceding sections → 105.
The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.
Fault rectification can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.

Note!
You can order spare parts directly from your Endress+Hauser service organization by providing the serial number printed on the transmitter nameplate → 6.

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (screws, etc.)
- Mounting instructions
- Packaging

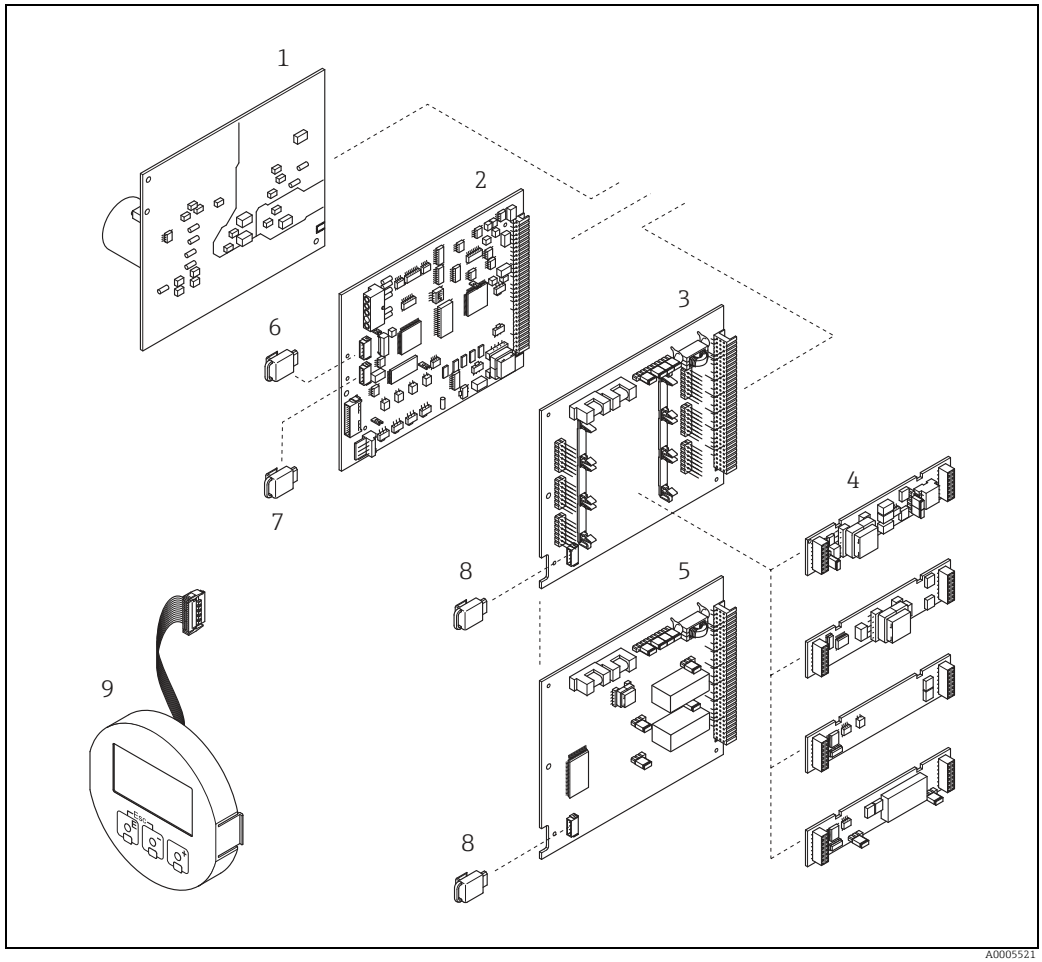


Fig. 67: Spare parts for Promag transmitter (field and wall-mount housing)

1 Power unit board
2 Amplifier board
3 I/O board (COM module), flexible assignment
4 Pluggable input/output submodules; product structure → 102
5 I/O board (COM module), permanent assignment
6 S-DAT (sensor data storage device)
7 T-DAT (transmitter data storage device)
8 F-CHIP (function chip for optional software)
9 Display module

9.6.1 Removing and installing electronics boards

Field housing



Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purpose-built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.



Caution!
Use only original Endress+Hauser parts.

Removing and installing the boards → 68:

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the local display (1) as follows:
   – Press in the latches (1.1) at the side and remove the display module.
   – Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
3. Remove the screws and remove the cover (2) from the electronics compartment.
4. Removing power unit board (4) and I/O board (6, 7):
   Insert a thin pin into the hole provided (3) and pull the board clear of its holder.
5. Removing submodules (6.2, only for devices with flexibly assigned I/O board):
   No additional tools are required for removing the submodules (inputs/outputs) from the I/O board or plugging them into it.

   Caution!
   Only certain combinations of submodules on the I/O board are permissible → 55.
   The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:
   – Slot "INPUT/OUTPUT 2" = Terminals 24/25
   – Slot "INPUT/OUTPUT 3" = Terminals 22/23
   – Slot "INPUT/OUTPUT 4" = Terminals 20/21
6. Remove amplifier board (5):
   – Disconnect the plug of the electrode cable (5.1) including S-DAT (5.3) from the board.
   – Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Insert a thin pin into the hole provided (3) and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

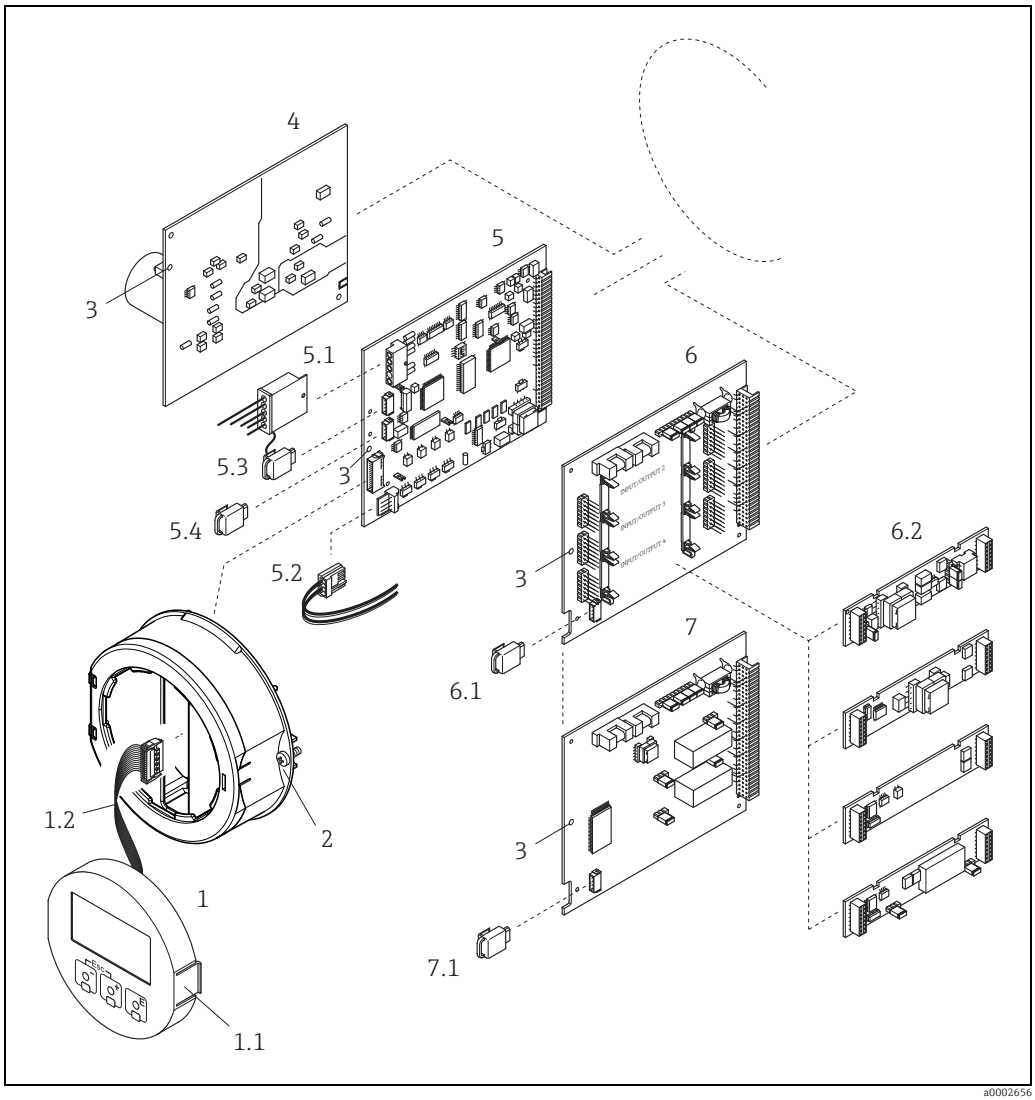


Fig. 68: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws for electronics compartment cover
3 Aperture for installing /removing boards
4 Power unit board
5 Amplifier board
5.1 Electrode cable (sensor)
5.2 Coil current cable (sensor)
5.3 S-DAT (sensor data storage device)
5.4 T-DAT (transmitter data storage device)
6 I/O board (flexible assignment)
6.1 F-CHIP (function chip for optional software)
6.2 Pluggable submodules (inputs/outputs)
7 I/O boards (permanent assignment)
7.1 F-CHIP (function chip for optional software)

Wall-mount housing

Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purpose-built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.

Caution!
Use only original Endress+Hauser parts.

Installing and removing the boards → 119:

1. Remove the screws and open the hinged cover (1) of the housing.
2. Loosen the screws securing the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
3. Disconnect the following cable plugs from amplifier board (7):
   – Electrode cable plug (7.1) including S-DAT (7.3)
   – Plug of coil current cable (7.2): To do so, loosen the plug locking of the coil current cable (5.2) and carefully disconnect the plug from the board, i.e. without moving it to and fro.
   – Ribbon cable plug (3) of the display module
4. Remove the cover (4) from the electronics compartment by loosening the screws.
5. Removing boards (6, 7, 8):
   Insert a thin pin into the hole provided (5) and pull the board clear of its holder.
6. Removing submodules (8.2, only for devices with flexibly assigned I/O board):
   No additional tools are required for removing the submodules (inputs/outputs) from the I/O board or plugging them into it.

   Caution!
   Only certain combinations of submodules on the I/O board are permissible → 55.
   The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:
   – Slot "INPUT/OUTPUT 2" = Terminals 24/25
   – Slot "INPUT/OUTPUT 3" = Terminals 22/23
   – Slot "INPUT/OUTPUT 4" = Terminals 20/21
7. Installation is the reverse of the removal procedure.

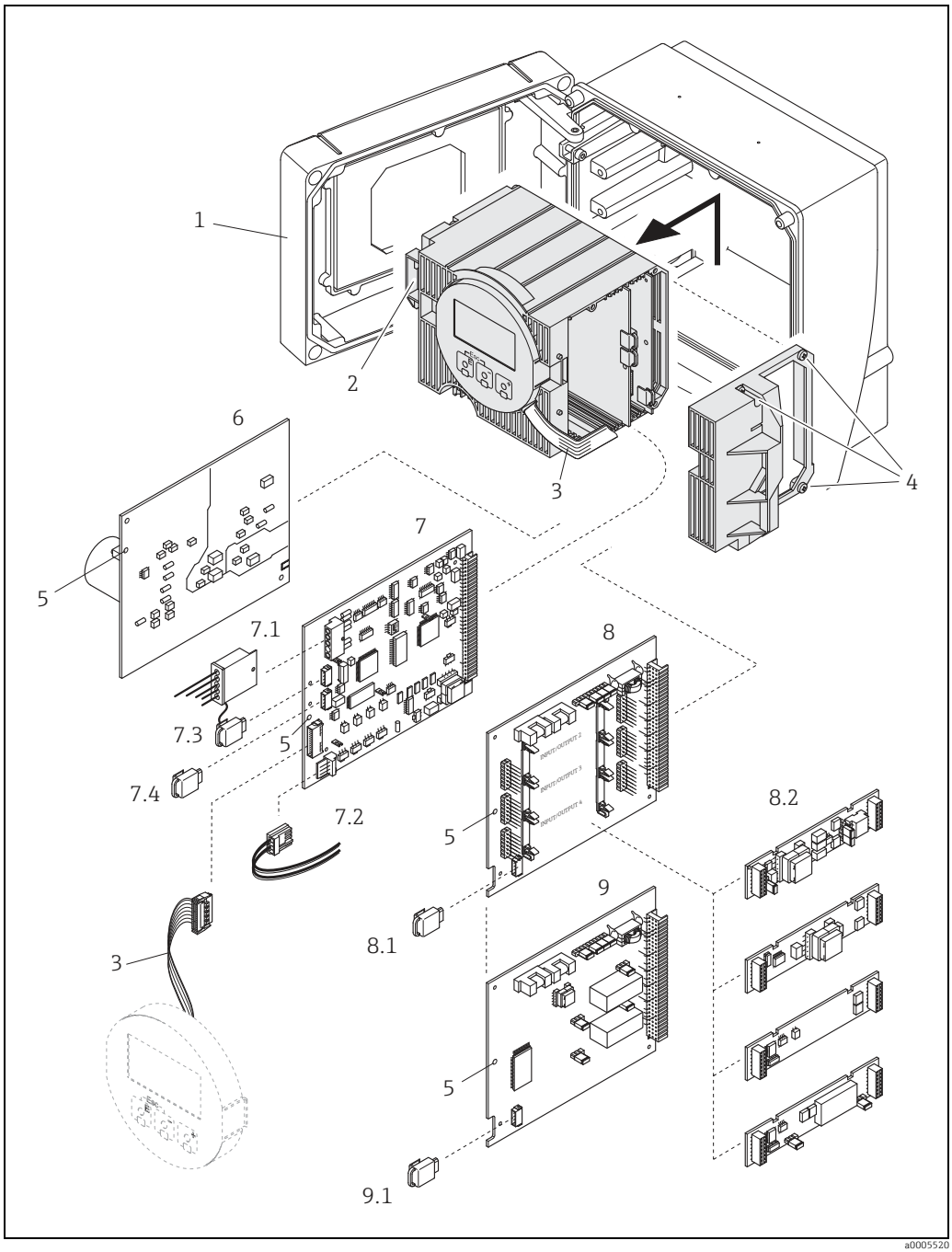


Fig. 69: Wall-mounted housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Screws for electronics compartment cover
5 Aperture for installing /removing boards
6 Power unit board
7 Amplifier board
7.1 Electrode cable (sensor)
7.2 Coil current cable (sensor)
7.3 S-DAT (sensor data storage device)
7.4 T-DAT (transmitter data storage device)
8 I/O board (flexible assignment)
8.1 F-CHIP (function chip for optional software)
8.2 Pluggable submodules (inputs/outputs)
9 I/O boards (permanent assignment)
9.1 F-CHIP (function chip for optional software)

9.6.2 Replacing the device fuse

Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

The main fuse is on the power supply board → 70.
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove power unit board → 116.
3. Remove cap (1) and replace the device fuse (2).
   Use only the following types of fuses:
   – 85 to 260 V AC: 0.8 A slow-blow / 250 V
     20 to 55 V AC and 16 to 62 V DC: 2 A slow-blow / 250 V
   – Ex-rated devices → See the Ex documentation
4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

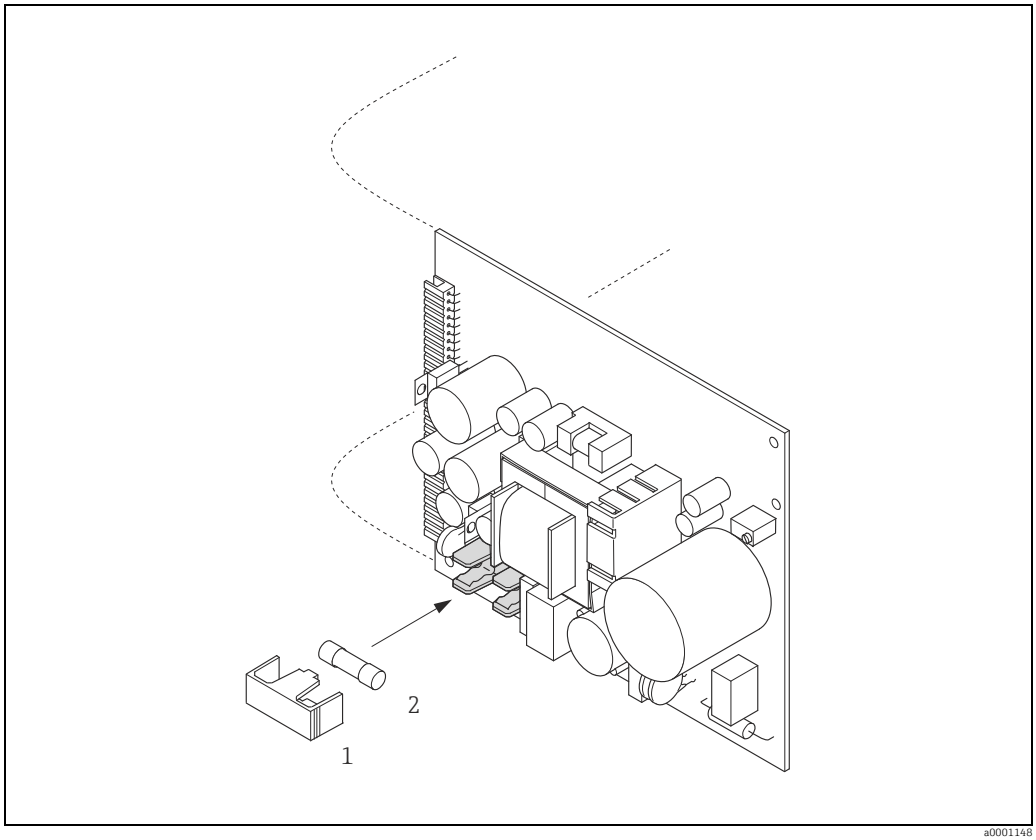


Fig. 70: Replacing the device fuse on the power supply board

1 Protection cap
2 Device fuse

9.6.3 Replacing the exchangeable electrode

The Promag W sensor (DN 350 to 2000 / 14 to 78") can be supplied with optional exchangeable measuring electrodes. This design allows the measuring electrodes to be exchanged or cleaned under process conditions.

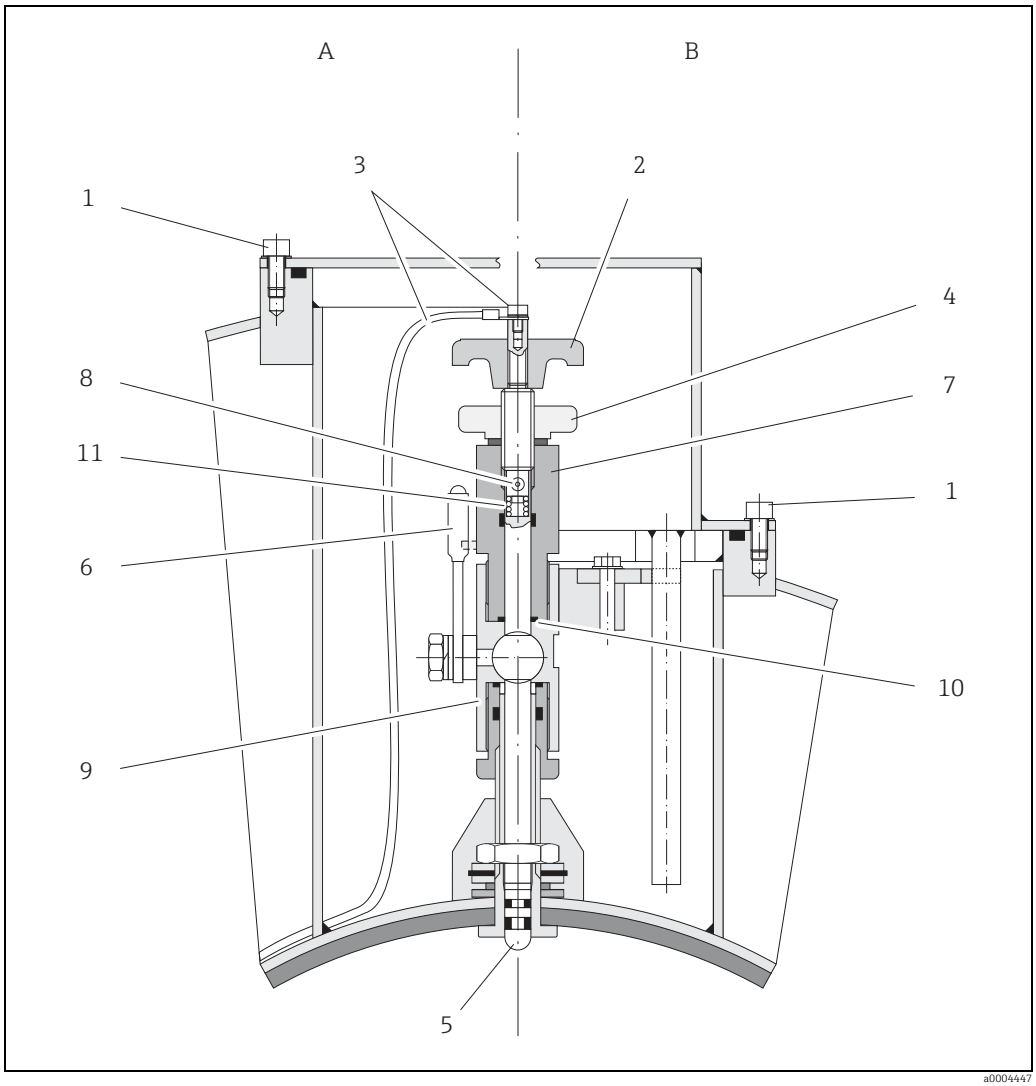


Fig. 71: Device for replacing the exchangeable measuring electrodes

View A = DN 1200 to 2000 (48 to 78")

View B = DN 350 to 1050 (14 to 42")

1 Socket head cap screw
2 Rotary handle
3 Electrode cable
4 Knurled nut (counter nut)
5 Measuring electrode
6 Stop cock (ball valve)
7 Retaining cylinder
8 Locking bolt (rotary handle)
9 Ball valve housing
10 Seal (retaining cylinder)
11 Coil spring

Removing the electrode	Fitting the electrode
1 Release the socket head cap screw (1) and remove the cap.	1 Insert the new electrode (5) from underneath into the retaining cylinder (7). Ensure that the seals at the tip of the electrode are clean.
2 Unscrew the electrode cable (3) secured on the rotary handle (2).	2 Attach the rotary handle (2) to the electrode and secure with the locking bolt (8). Caution! Ensure that the coil spring (11) is inserted to guarantee perfect electrical contact and thus correct measuring signals.
3 Release the knurled nut (4) by hand. This knurled nut serves as a counter nut.	3 Pull the electrode back until the tip is no longer protruding from the retaining cylinder (7).
4 Unscrew the electrode (5) using the rotary handle (2). It can now be pulled out of the retaining cylinder (7) up to a defined point. Warning! Risk of injury! The electrode can bounce back to its stop under process conditions (pressure in the pipe). Exert counter pressure against it when releasing.	4 Screw the retaining cylinder (7) onto the ball valve housing (9) and secure tightly by hand. The seal (10) at the retaining cylinder must be fitted and clean. Note! Ensure that the rubber hoses attached to the retaining cylinder (7) and stop cock (6) are the same color (red or blue).
5 Close the stop cock (6) after you have pulled out the electrode as far as it will go. Warning! Do not open the stop cock after this to ensure that no fluid comes out.	5 Open the stop cock (6) and screw the electrode as far as it will go into the retaining cylinder using the rotary handle (2).
6 You can now unscrew the entire electrode with the retaining cylinder (7).	6 Now, screw the knurled nut (4) on the retaining cylinder. This secures the electrode in position.
7 Remove the rotary handle (2) from the electrode (5) by pushing out the locking bolt (8). Ensure that you do not lose the coil spring (11).	7 Secure the electrode cable (3) on the rotary handle (2) once more using the socket head cap screw. Caution! Ensure that the socket head cap screw of the electrode cable is securely tightened. This guarantees perfect electrical contact and thus correct measuring signals.
8 Now replace the old electrode with the new one. You can order replacement electrodes separately from Endress+Hauser	8 Refit the cover and tighten the socket head cap screw (a).

9.7 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.
To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material

9.8 Disposal

Please observe the regulations applicable in your country or region.

9.9 Software history

Date	Software-Version	Changes to software	Documentation
12.2014	2.07.XX	Software expansion: ▪ Status signals according VDI/VDE 2650 and NAMUR Recommendation NE 107 ▪ Introduction HART 7 – New functionalities – New Universal / Common practice HART commands – Amplifier update	71271698/14.14
01.2011	2.03.XX	Improved HART communication	71249449/13.14
12.2009	2.02.XX	Introduction of Calf history	71107993/12.09
03.2005	2.00.XX	Software expansion: ▪ Language group (contains the language Chinese and English) New functionalities: ▪ DEVICE SOFTWARE → Device software displayed (NAMUR-recommendation 53) Unit US Kgal	50097083/03.05
11.2004	Amplifier: 1.06.01 Communication module: 1.04.00	Software update relevant only for production	50097083/10.03
10.2003	Amplifier: 1.06.00 Communication module: 1.03.00	Software expansion: ▪ Language groups ▪ Flow direction pulse output selectable New functionalities: ▪ Second Totalizer ▪ Adjustable backlight (display) ▪ Operation hours counter ▪ Simulation function for pulse output ▪ Access code for counter ▪ Reset function (fault history) ▪ Up-/download with FieldTool	50097083/10.03
08.2003	Communication module: 1.02.01	Software expansion: ▪ New / revised functionalities Special documentation: ▪ Current span NAMUR NE 43 ▪ Failsafe mode function ▪ Trouble-shooting function ▪ System and process error messages ▪ Response of status output	50097083/08.03

Date	Software-Version	Changes to software	Documentation
08.2002	Amplifier: 1.04.00	Software expansion: ▪ New / revised functionalities Special documentation: ▪ Current span NAMUR NE 43 ▪ Quick Setup "Batching" ▪ EPD (new mode) ▪ Failsafe mode function ▪ Acknowledge fault function ▪ Trouble-shooting function ▪ Function "T-DAT SAVE/LOAD" ▪ System and process error messages ▪ Response of relay and status output	50097083/08.02
06.2001	Amplifier: 1.02.00 Communication module: 1.02.00	Software expansion: ▪ New functionalities New functionalities: ▪ Device functions in general ▪ "Batching" software function ▪ "OED" software function ▪ "Advanced Diagnostics" software function ▪ "Pulse width" software function	50097083/06.01
09.2000	Amplifier: 1.01.01 Communication module: 1.01.00	Software expansion: ▪ Functional adaptations	none
08.2000	Amplifier: 1.01.00	Software expansion: ▪ Functional adaptations	none
04.2000	Amplifier: 1.00.00 Communication module: 1.00.00	Original software. Compatible with: ▪ FieldTool ▪ Commuwin II (version 2.05.03 and higher) ▪ HART Communicator DXR 375 (from OS 4.6) with Rev. 1, DD 1.	–

10 Technical data

10.1 Application

→ 📄 4

10.2 Function and system design

Measuring principle

Electromagnetic flow measurement on the basis of Faraday's Law.

Measuring system

→ 📄 6

10.3 Input

Measured variable

Flow rate (proportional to induced voltage).

Measuring range

Typical v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified measuring accuracy.

Operable flow range

Over 1000 : 1

Input signal

Status input (auxiliary input):

U = 3 to 30 V DC, R_i = 5 kΩ galvanically isolated
Configurable for: totalizer(s) reset, positive zero return, error-message reset

Current input:

Active/passive selectable, galvanically isolated, full scale value adjustable, resolution: 3 µA, temperature coefficient: typically 0.005 % o.f.s./°C; (0.003 % o.f.s./°F)
- Active: 4 to 20 mA, $R_i \geq 150\ \Omega$, U_{out} = 24 V DC, short-circuit proof
- Passive: 0/4 to 20 mA, $R_i \leq 150\ \Omega$, U_{max} = 30 V DC

10.4 Output

Output signal

Current output:

Active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s), full scale value adjustable, temperature coefficient: typically 0.005% o.f.s/°C (0.003 % o.f.s/°F), resolution: 0.5 µA.

- Active: 0/4 to 20 mA, $R_L < 700\ \Omega$ (for HART: $R_L \geq 250\ \Omega$)
- Passive: 4 to 20 mA; supply voltage V_S: 18 to 30 V DC; $R_i \geq 150\ \Omega$

Pulse / frequency output:

Active/passive selectable (Ex i version passive only), galvanically isolated
- Active: 24 V DC, 25 mA (max. 250 mA over 20 ms), R_L > 100 Ω
- Passive: open collector, 30 V DC, 250 mA
- Frequency output: end frequency 2 to 10000 Hz (f_{max} = 12500 Hz), on/off ratio 1:1, pulse width max. 2 s
- Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.05 to 2000 ms)

Signal on alarm

Current output:
Failsafe mode selectable (e.g. according to NAMUR recommendation NE 43)

Pulse / frequency output:
Failsafe mode selectable

Relay output:
"de-energized" in the event of a fault or power supply failure

Details → 113

Load

See "output signal".

Low flow cut off

Switch points for low flow cut off freely selectable.

Galvanic isolation

All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

Switching output

Relay output:

Normally closed (NC or break) or normally open (NO or make) contacts available
(default: relay 1 = NO, relay 2 = NC),
max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.
Configurable for: error messages, empty pipe detection (EPD), direction of flow, limit values.

10.5 Power supply

Terminal assignment

→ 48

Supply voltage

- 20 to 55 V AC, 45 to 65 Hz
- 85 to 260 V AC, 45 to 65 Hz
- 16 to 62 V DC

Power consumption

Power consumption

- AC: <15 VA (including sensor)
- DC: <15 W (including sensor)

Switch-on current

- Max. 8.5 A (< 50 ms) for 24 V DC
- Max. 3 A (< 5 ms) for 260 V AC

Power supply failure

Lasting min. 1 power cycle:
- EEPROM or HistoROM/T-DAT saves measuring system data if power supply fails
- HistoROM/S-DAT: exchangeable data storage device which stores sensor characteristic data (nominal diameter, serial number, calibration factor, zero point etc.)

Potential equalization

→ 57

Cable entries

Power supply and electrode cable (inputs/outputs):
- Cable gland M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 in)
- Cable gland sensor for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 in)
- Cable entries for thread ½" NPT, G ½"

Connecting cable for remote version:
- Cable gland M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 in)
- Cable gland sensor for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 in)
- Cable entries for thread ½" NPT, G ½"

Cable specifications remote version

→ 🖹 48

10.6 Performance characteristics

Reference operating conditions

- Error limits following DIN EN 29104, future ISO 20456
- Water, typically +15 to +45°C (+59 to +113 °F); 0,5 to 7 bar (73 to 101 psi)
- Specification as per calibration protocol
- Data on the measured error based on accredited calibration rigs traced back to ISO 17025

Maximum measured error

Standard: ±0.2% o.r. ± 2 mm/s (o.r. = of reading)

Note!
Supply-voltage fluctuations have no effect within the specified range.

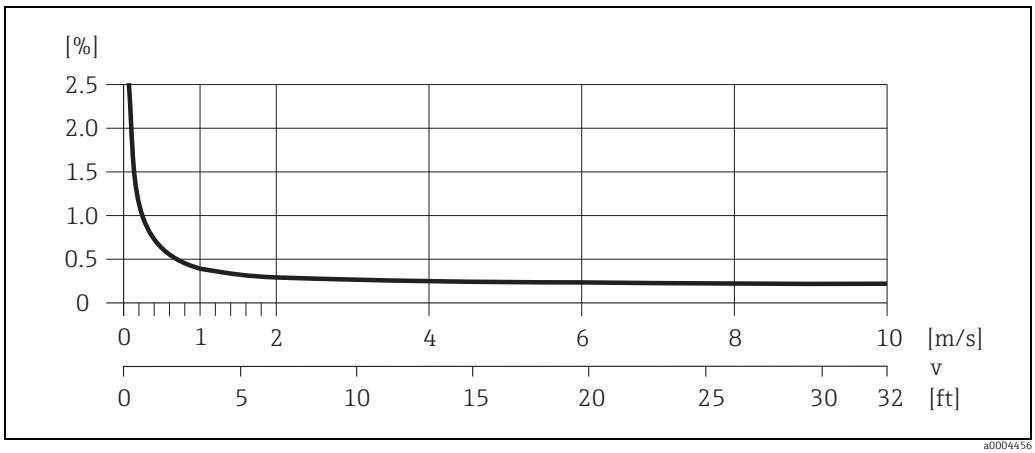


Fig. 72: Max. measured error in % of reading

Repeatability

Standard: max. ±0.1% o.r. ± 0.5 mm/s (o.r. = of reading)

10.7 Installation

Installation instructions

→ 🖹 12

Inlet and outlet runs

Inlet run: typically ≥ 5 × DN
Outlet run: typically ≥ 2 × DN

Length of connecting cable

- The permissible cable length L_{max} for the remote version depends on the conductivity of the medium → 🖹 19.
- A minimum conductivity of 20 µS/cm is required to measure demineralized water.

10.8 Environment

Ambient temperature range

Transmitter:
- Standard: −20 to +60 °C (−4 to +140 °F)
- Optional: −40 to +60 °C (−40 to +140 °F)



Note!
At ambient temperatures below −20 °C (−4 °F), the readability of the display may be impaired.

Sensor:
- Flange material carbon steel: −10 to +60 °C (+14 to +140 °F)
- Flange material stainless steel: −40 to +60 °C (−40 to +140 °F)



Caution!
Do not exceed the min. and max. temperatures for the lining of the measuring tube (→ "Medium temperature range").

Note the following points:
- Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ "Medium temperature range").

Storage temperature

The storage temperature corresponds to the operating temperature range of the transmitter and sensor.



Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the lining.

Degree of protection

Transmitter
- As standard: IP 67, type 4X enclosure
- Promag L when housing is open: IP 20, type 1 enclosure

Sensor
- As standard: IP 67, type 4X enclosure
- Optionally available for remote version for Promag P/W:
  – IP 68, type 6P enclosure

Shock and vibration resistance

Acceleration up to 2 g in accordance with IEC 600 68-2-6
(High-temperature version: no data available)

Interior cleaning



Caution!
The maximum fluid temperature permitted for the measuring device must not be exceeded.

CIP cleaning possible:
Promag E (110 °C / 230 °F), Promag H/P

CIP cleaning not possible:
Promag L/W

SIP cleaning possible:
Promag H, Promag P (with PFA lining)

SIP cleaning not possible:
Promag E/L/W

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation NE 21
- Emission: to limit value for industry EN 55011

10.9 Process

Medium temperature range

The permitted temperature depends on the lining of the measuring tube:

Promag E

PTFE: −10 to +110 °C (+14 to +230 °F)

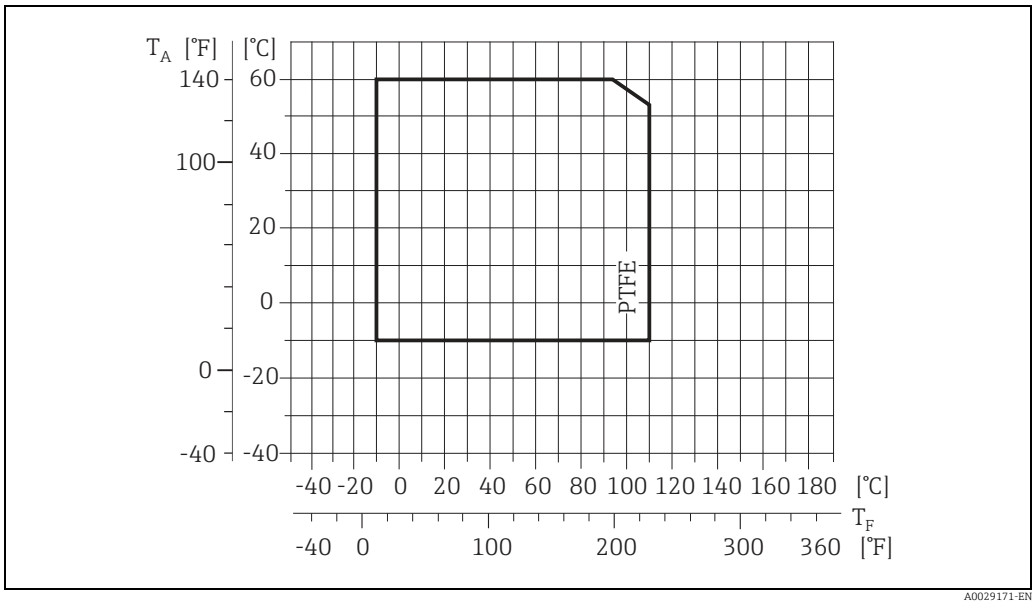


Abb. 73: Compact and remote version (T_A = Ambient temperature, T_F = Fluid temperature)

Promag H

Sensor:
- DN 2 to 25 (1/12 to 1"): −20 to +150 °C (−4 to +302 °F)
- DN 40 to 150 (1 ½ to 6"): −20 to +150 °C (−4 to +302 °F)

Seals:
- EPDM: −20 to +150 °C (−4 to +302 °F)
- Silicone (VMQ): −20 to +150 °C (−4 to +302 °F)
- Viton (FKM): −20 to +150 °C (−4 to +302 °F)
- Kalrez: −20 to +150 °C (−4 to +302 °F)

Promag L

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 350 to 2400 / 14 to 90")
- −20 to +50 °C (−4 to +122 °F) for polyurethane (DN 25 to 1200 / 1 to 48")
- −20 to +90 °C (−4 to +194 °F) for PTFE (DN 25 to 300 / 1 to 12")

Promag P

Standard
- −40 to +130 °C (−40 to +266 °F) for PTFE (DN 15 to 600 / ½ to 24"), restrictions → see diagrams below
- −20 to +130 °C (−4 to +266 °F) for PFA/HE (DN 25 to 200 / 1 to 8"), restrictions → see diagrams below
- −20 to +150 °C (−4 to +302 °F) for PFA (DN 25 to 200 / 1 to 8"), restrictions → see diagrams below

Optional
High-temperature version (HT): −20 to +180 °C (−4 to +356 °F) for PFA (DN 25 to 200 / 1 to 8")

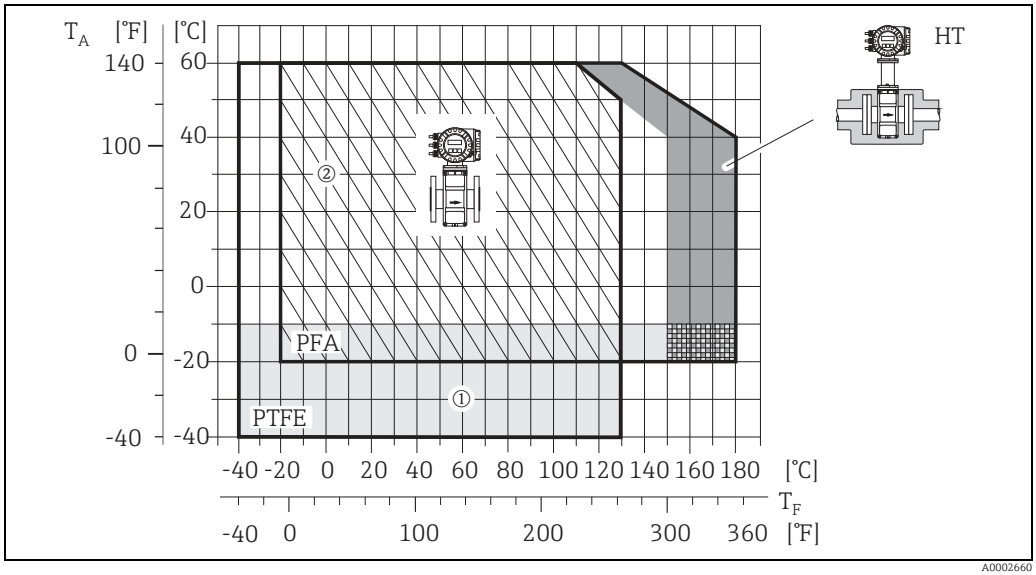


Fig. 74: Promag P compact version (with PFA or PTFE lining)

T_A = ambient temperature; T_F = fluid temperature; HT = high-temperature version with insulation
1 = Light gray area → temperature range from −10 to −40 °C (−14 to −40 °F) applies only to stainless steel flanges
2 = Diagonally hatched area → foam lining (HE) + degree of protection IP68 = fluid temperature max. 130°C (266 °F)

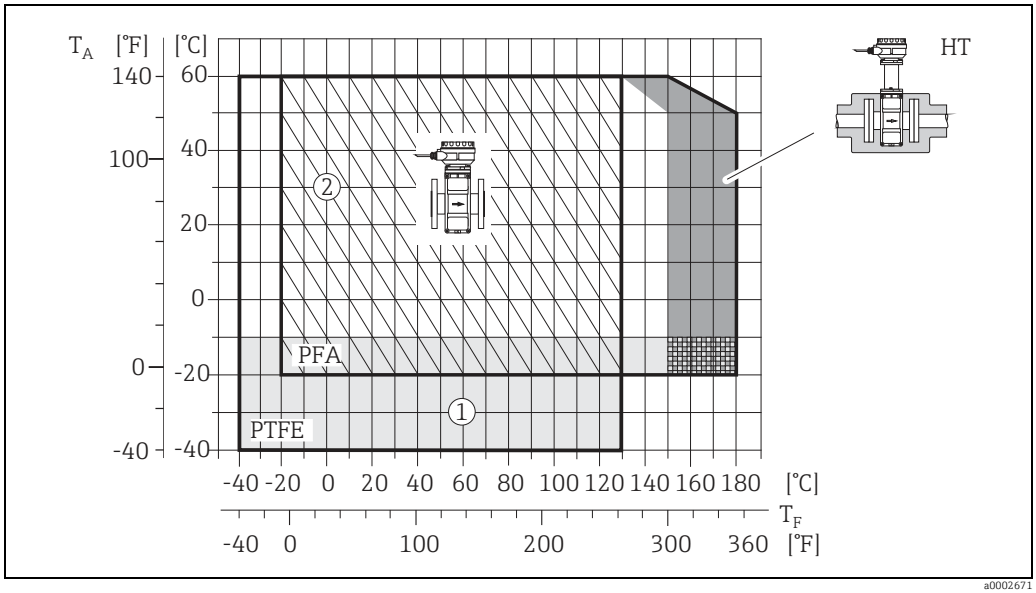


Fig. 75: Remote versions (with PFA or PTFE lining)

T_A = ambient temperature; T_F = fluid temperature; HT = high-temperature version with insulation
1 = Light gray area → temperature range from −10 to −40 °C (−14 to −40 °F) applies only to stainless steel flanges
2 = Diagonally hatched area → foam lining (HE) + degree of protection IP68 = fluid temperature max. 130°C (266 °F)

Promag W

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 65 to 2000 / 2½ to 80")
- −20 to +50 °C (−4 to +122 °F) for polyurethane (DN 25 to 1200 / 1 to 48")

Conductivity of the fluid

The minimum conductivity is:
- ≥ 5 µS/cm for fluids generally
- ≥ 20 µS/cm for demineralized water

Note!
In the remote version, the required minimum conductivity is also influenced by the length of the connecting cable → 19.

Pressure-temperature ratings

An overview of the pressure-temperature ratings for the process connections are to be found in the "Technical Information" documents of the device in question.
List of supplementary documentation → 151 section.

Limiting medium pressure range (nominal pressure)

Promag E

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 600 / 14 to 24")
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 40 (DN 15 to 150 / ½ to 2")
- ASME B 16.5
  - Class 150 (½ to 24")
- JIS B2220
  - 10K (DN 50 to 300 / 2 to 12")
  - 20K (DN 15 to 40 / ½ to 1½")

Promag H

The permissible nominal pressure depends on the process connection, the seal and the nominal diameter.
Details are provided in the separate documentation "Technical Information" → 151.

Promag L

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 2400 / 14 to 90")
  - PN 10 (DN 200 to 2400 / 8 to 90")
  - PN 16 (DN 25 to 2000 / 1 to 78")
- EN 1092-1, lap joint flange, stampel plate
  - PN 10 (DN 25 to 300 / 1 to 12")
- ASME B16.5
  - Class 150 (1 to 24")
- AWWA C207
  - Class D (28 to 90")
- AS2129
  - Table E (350 to 1200 / 14 to 48")
- AS4087
  - PN 16 (350 to 1200 / 14 to 48")

Promag P

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 25 (DN 200 to 600 / 8 to 24")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- JIS B2220
  - 10K (DN 50 to 300 / 600 / 2 to 24")

- 20K (DN 25 to 300 / 600 / 2 to 24")
- AS 2129
  - Table E (DN 25 / 1"), 50 / 2")
- AS 4087
  - PN 16 (DN 50 / 2")

Promag W

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 2000 / 14 to 84")
  - PN 10 (DN 200 to 2000 / 8 to 84")
  - PN 16 (DN 65 to 2000 / 3 to 84")
  - PN 25 (DN 200 to 1000 / 8 to 40")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- AWWA
  - Class D (28 to 78")
- JIS B2220
  - 10K (DN 50 to 750 / 2 to 30")
  - 20K (DN 25 to 600 / 1 to 24")
- AS 2129
  - Table E (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")
- AS 4087
  - PN 16 (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")

Pressure tightness (measuring tube lining)

Promag E (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures							
		25 °C		80 °C		100 °C		110 °C	
		77 °F		176 °F		212 °F		230 °F	
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]
15	½"	0	0	0	0	0	0	100	1.45
25	1"	0	0	0	0	0	0	100	1.45
32	–	0	0	0	0	0	0	100	1.45
40	1 ½"	0	0	0	0	0	0	100	1.45
50	2"	0	0	0	0	0	0	100	1.45
65	–	0	0	*	*	40	0.58	130	1.89
80	3"	0	0	*	*	40	0.58	130	1.89
100	4"	0	0	*	*	135	1.96	170	2.47
125	–	135	1.96	*	*	240	3.48	385	5.58
150	6"	135	1.96	*	*	240	3.48	385	5.58
200	8"	200	2.90	*	*	290	4.21	410	5.95
250	10"	330	4.79	*	*	400	5.80	530	7.69
300	12"	400	5.80	*	*	500	7.25	630	9.14
350	14"	470	6.82	*	*	600	8.70	730	10.59
400	16"	540	7.83	*	*	670	9.72	800	11.60
450	18"	Partial vacuum is impermissible!							
500	20"								
600	24"								

* No value can be quoted.

Promag H (measuring tube lining: PFA)

Nominal diameter		Pressure tightness, measuring tube lining: limit values for absolute pressure [mbar] ([psi]) at various fluid temperature					
		25 °C	80° C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	77 °F	176° F	212 °F	266 °F	302 °F	356 °F
2 to 150	1/12 to 6"	0	0	0	0	0	0

Promag L (Measuring tube lining: Polyurethane, Hard rubber)

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures		
			25 °C	50 °C	80 °C
[mm]	[inch]		77 °F	122 °F	176 °F
25 to 1200	1 to 48"	25 to 1200	1 to 48"	0	–
350 to 2400	14 to 90"	Hard rubber	0	0	0

Promag L (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures			
		25 °C		90 °C	
		77 °F		194 °F	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]
25	1"	0	0	0	0
32	–	0	0	0	0
40	1 ½"	0	0	0	0
50	2"	0	0	0	0
65	–	0	0	40	0.58
80	3"	0	0	40	0.58
100	4"	0	0	135	1.96
125	–	135	1.96	240	3.48
150	6"	135	1.96	240	3.48
200	8"	200	2.90	290	4.21
250	10"	330	4.79	400	5.80
300	12"	400	5.80	500	7.25

Promag P (Measuring tube lining: PFA)

Nominal diameter		Resistance of measuring tube lining to partial vacuum: limit values for absolute pressure [mbar] ([psi]) at various fluid temperatures					
		25 °C	80° C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	77 °F	176° F	212 °F	266 °F	302 °F	356 °F
25	1"	0	0	0	0	0	0
32	-	0	0	0	0	0	0
40	1 ½"	0	0	0	0	0	0
50	2"	0	0	0	0	0	0
65	-	0	*	0	0	0	0
80	3"	0	*	0	0	0	0
100	4"	0	*	0	0	0	0
125	-	0	*	0	0	0	0
150	6"	0	*	0	0	0	0
200	8"	0	*	0	0	0	0

Nominal diameter		Resistance of measuring tube lining to partial vacuum: limit values for absolute pressure [mbar] ([psi]) at various fluid temperatures					
		25 °C	80° C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	77 °F	176° F	212 °F	266 °F	302 °F	356 °F
* No value can be quoted.							

Promag P (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum: limit values for absolute pressure [mbar] ([psi]) at various fluid temperatures								
		25 °C		80° C	100 °C		130 °C		150 °C	180 °C
		77 °F		176° F	212 °F		266 °F		302 °F	356 °F
[mm]	[inch]	[mbar]	[psi]		[mbar]	[psi]	[mbar]	[psi]		
15	½"	0	0	0	0	0	100	1.45	–	–
25	1"	0	0	0	0	0	100	1.45	–	–
32	-	0	0	0	0	0	100	1.45	–	–
40	1 ½"	0	0	0	0	0	100	1.45	–	–
50	2"	0	0	0	0	0	100	1.45	–	–
65	-	0	0	*	40	0.58	130	1.89	–	–
80	3"	0	0	*	40	0.58	130	1.89	–	–
100	4"	0	0	*	135	1.96	170	2.47	–	–
125	-	135	1.96	*	240	3.48	385	5.58	–	–
150	6"	135	1.96	*	240	3.48	385	5.58	–	–
200	8"	200	2.90	*	290	4.21	410	5.95	–	–
250	10"	330	4.79	*	400	5.80	530	7.69	–	–
300	12"	400	5.80	*	500	7.25	630	9.14	–	–
350	14"	470	6.82	*	600	8.70	730	10.59	–	–
400	16"	540	7.83	*	670	9.72	800	11.60	–	–
450	18"	Partial vacuum is impermissible								
500	20"									
600	24"									
* No value can be quoted.										

Promag W

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum: limit values for absolute pressure [mbar] ([psi]) at various fluid temperatures						
			25 °C	50 °C	80° C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]		77 °F	122 °F	176° F	212 °F	266 °F	302 °F	356 °F
25 to 1200	1 to 48"	Polyurethane	0	0	-	-	-	-	-
65 to 2000	3 to 78"	Hard rubber	0	0	0	-	-	-	-

Limiting flow

Further information can be found in the "Nominal diameter and flow rate" → 17 section.

Pressure loss

- No pressure loss if the sensor is installed in piping with the same nominal diameter (for Promag H only from DN 8 (⅜")).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → 16.

10.10 Mechanical construction

Design, dimensions

The dimensions and face-to-face length of the sensor and transmitter can be found in the separate "Technical Information" documentation for each device which can be downloaded in PDF format from www.endress.com. A list of available "Technical Information" documentation can be found in the "Documentation" → 🖹 151 section.

Weight (SI units)

Promag E

Weight data in kg							
Nominal diameter		Compact version					
		EN (DIN)				ASME	JIS
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K
15	½"	–	–	–	6.5	6.5	6.5
25	1"	–	–	–	7.3	7.3	7.3
32	–	–	–	–	8.0	–	7.3
40	1½"	–	–	–	9.4	9.4	8.3
50	2"	–	–	–	10.6	10.6	9.3
65	–	–	–	12.0	–	–	11.1
80	3"	–	–	14.0	–	14.0	12.5
100	4"	–	–	16.0	–	16.0	14.7
125	–	–	–	21.5	–	–	21.0
150	6"	–	–	25.5	–	25.5	24.5
200	8"	–	45.0	46.0	–	45.0	41.9
250	10"	–	65.0	70.0	–	75.0	69.4
300	12"	–	70.0	81.0	–	110.0	72.3
350	14"	77.4	88.4	104	–	137.4	–
400	16"	89.4	104.4	125	–	168.4	–
450	18"	103	118	149	–	193	–
500	20"	115	132.4	190	–	228.4	–
600	24"	155.4	181	300	–	329	–

- Transmitter (compact version): 1.8 kg
- Weight data without packaging material

Weight data in kg								
Nominal diameter		Remote version (without cable)						Transmitter
		Sensor						
		EN (DIN)				ASME	JIS	
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K	Wall-mount housing
15	½"	–	–	–	4.5	4.5	4.5	6.0
25	1"	–	–	–	5.3	5.3	5.3	6.0
32	–	–	–	–	6.0	–	5.3	6.0
40	1½"	–	–	–	7.4	7.4	6.3	6.0
50	2"	–	–	–	8.6	8.6	7.3	6.0
65	–	–	–	10.0	–	–	9.1	6.0
80	3"	–	–	12.0	–	12.0	10.5	6.0
100	4"	–	–	14.0	–	14.0	12.7	6.0
125	–	–	–	19.5	–	–	19.0	6.0
150	6"	–	–	23.5	–	23.5	22.5	6.0
200	8"	–	43.0	44.0	–	43.0	39.9	6.0
250	10"	–	63.0	68.0	–	73.0	67.4	6.0
300	12"	–	68.0	79.0	–	108.0	70.3	6.0
350	14"	73.1	84.1	100	–	133.1	–	6.0
400	16"	85.1	100.1	121	–	164.1	–	6.0

Weight data in kg								
Nominal diameter		Remote version (without cable)						
		Sensor						Transmitter
		EN (DIN)				ASME	JIS	
450	18"	99	114	145	–	189	–	6.0
500	20"	111	128.1	186	–	224.1	–	6.0
600	24"	158.1	177	296	–	325	–	6.0

- Transmitter (remote version): 3.1 kg
- Weight data without packaging material

Promag H

Note!
The following weights apply to standard pressure ratings and without packaging material.

Nominal diameter	Compact version (DIN)		Remote version (without cable; DIN)	
DIN	Aluminum field housing	Stainless steel field housing	Sensor	Transmitter (wall-mount housing)
[mm]	[kg]	[kg]	[kg]	[kg]
2	5.2	5.7	2.0	6.0
4	5.2	5.7	2.0	6.0
8	5.3	5.8	2.0	6.0
15	5.4	5.9	1.9	6.0
25	5.5	6.0	2.8	6.0
40	7.1	7.6	4.1	6.0
50	7.6	8.1	4.6	6.0
65	8.4	8.9	5.4	6.0
80	9.0	9.5	6.0	6.0
100	10.3	10.8	7.3	6.0
125	15.7	16.2	12.7	6.0
150	18.1	18.6	15.1	6.0
Transmitter (compact version): 3.4 kg				

Promag L

Weight data in kg												
Nominal diameter		Compact version (including transmitter)[1]										
[mm]	[inch]	EN (DIN)						ASME/ AWWA		AS		
25	1"	PN 6	–	PN 10	–	PN 16	7.3	ASME / Class 150	7.9	PN 16	–	Tabelle E	–
32	–		–		–		8.0		–		–		–
40	1 ½"		–		–		9.0		7.5		–		–
50	2"		–		–		9.4		7.6		–		–
65	–		–		–		10.4		–		–		–
80	3"		–		–		12.4		12.8		–		–
100	4"		–		–		14.4		16.1		–		–
125	–		–		–		15.9		–		–		–
150	6"		–		–		23.9		24.4		–		–
200	8"		–		43.4		44.9		49.6		–		–
250	10"		–		63.4		70.7		75.1		–		–
300	12"		–		68.4		85.8		100		–		–
350	14"		77.4		88.4		107		137		99.4		99.4
375	15"		–		–		–		–		105		–
400	16"		89.4		104		125		168		124		120
450	18"		104		119		150		191		142		152
500	20"		114		132		191		228		191		182
600	24"		155		182		301		327		283		281
700	28"		215		274		335	AWWA / Class D	278		386		350
750	30"		–		–		–		338		470		458
800	32"		289		374		462		402		569		518
900	36"		384		476		582		498		739		739
1000	40"		493		615		795		666		854		856
–	42"		–		–		–		771		–		–
1200	48"		707		916		1314		1035		1368		1368
–	54"		–		–		–		1438		–		–
1400	–		1126		1482		1906		–		–		–
–	60"		–		–		–		1785		–		–
1600	–		1521		2197		2698		–		–		–
–	66"		–		–		–		2463		–		–
1800	72"		2001		2838		3687		2857		–		–
–	78"		2777		3508		4646		3532		–		–
2000	–		2777		3508		4646		3532		–		–
–	84"		–		–		–		3883		–		–
2200	–		3065		4172		–		–		–		–
–	90"		–		–		–		4847		–		–
2400	–		3940		5035		–		–		–		–
Transmitter Promag (compact version): 3.4 kg (Weight data valid without packaging material)													

1) Lap joint flanges / welded flanges DN > 300 (12")

Weight data in kg

Nominal diameter		Remote version (sensor plus sensor housing without cable)[1]											
[mm]	[inch]	EN (DIN)						ASME/ AWWA		AS			
25	1"	PN 6	–	PN 10	–	PN 16	5.3	ASME / Class 150	5.9	PN 16	–	Table E	–
32	–		–		–		6.0		–		–		–
40	1 ½"		–		–		7.0		5.5		–		–
50	2"		–		–		7.4		5.6		–		–
65	–		–		–		8.4		–		–		–
80	3"		–		–		10.4		10.8		–		–
100	4"		–		–		12.4		14.1		–		–
125	–		–		–		13.9		–		–		–
150	6"		–		–		21.9		22.4		–		–
200	8"		–		41.4		42.9		47.6		–		–
250	10"		–		61.4		68.7		73.1		–		–
300	12"		–		66.4		83.8		98		–		–
350	14"		75.4		86.4		103		139		97.4		97.4
375	15"		–		102		–		–		103		–
400	16"		87.4		102		121		170		123		118
450	18"		103		118		149		193		141		151
500	20"		112		130		190		230		190		180
600	24"		156		181		300		329		282		280
700	28"		214		273		334	AWWA / Class D	278		385		349
750	30"		–		–		–		339		471		457
800	32"		288		373		461		402		568		517
900	36"		383		475		581		498		738		738
1000	40"		492		614		794		666		853		855
–	42"		–		–		–		771		-		–
1200	48"		706		915		1313		1035		1367		1367
–	54"		–		–		–		1438		–		–
1400	–		1125		1381		1905		–		–		–
–	60"		–		–		–		1785		–		–
1600	–		1520		2196		2697		–		–		–
–	66"		–		–		–		2463		–		–
1800	72"		2000		2837		3686		2857		–		–
–	78"		2776		2837		4645		3532		–		–
2000	–		2776		3507		4645		3532		–		–
–	84"		–		–		–		3883		–		–
2200	–		3064		4171		–		–		–		–
–	90"		–		–		–		4847		–		–
2400	–		3939		5034		–		–		–		–

Transmitter Promag (remote version): 3.4 kg
(Weight data valid without packaging material)

1) Lap joint flanges / welded flanges DN > 300 (12")

Weight data in kg						
Nominal diameter		Compact version[1)]		Remote version (without cable)1)		
[mm]	[inch]	EN (DIN)		Sensor EN (DIN)		Transmitter
25	1"	PN 10	5.8	PN 10	3.8	4.2
32	–		5.4		3.4	4.2
40	1 ½"		6.3		4.7	4.2
50	2"		5.4		3.4	4.2
65	–		6.2		4.2	4.2
80	3"		7.2		5.2	4.2
100	4"		9.7		7.7	4.2
125	5"		13.2		11.2	4.2
150	6"		17.2		15.2	4.2
200	8"		35.7		33.7	4.2
250	10"		54.2		52.2	4.2
300	12"		55.2		53.2	4.2
Transmitter Promag (compact version): 3.4 kg (Weight data valid for standard pressure ratings and without packaging material)						

1) Lap joint flanges, stamped plate

Promag P

Note!
The following weights apply to standard pressure ratings and without packaging material.

Nominal diameter	Weight data in kg							
	Compact version				Remote version (without cable)			
					Sensor			Transmitter
[mm]	EN (DIN) / AS*		JIS		EN (DIN) / AS*		JIS	
15	PN 40	6.5	10K	6.5	PN 40	4.5	10K	4.5	6.0
25		7.3		7.3		5.3		5.3	6.0
32		8.0		7.3		6.0		5.3	6.0
40		9.4		8.3		7.4		6.3	6.0
50		10.6		9.3		8.6		7.3	6.0
65	PN 16	12.0		11.1	PN 16	10.0		9.1	6.0
80		14.0		12.5		12.0		10.5	6.0
100		14.4		14.7		14.0		12.7	6.0
125		16.0		21.0		19.5		19.0	6.0
150		21.5		24.5		23.5		22.5	6.0
200	PN 10	45		41.9	PN 10	43		39.9	6.0
250		65		69.4		63		67.4	6.0
300		70		72.3		68		70.3	6.0
350		115		81.0		113		79.0	6.0
400		135		102		133		100	6.0
450		175		130		173		128	6.0
500		175		144		173		142	6.0
600		235		190		233		188	6.0
Promag transmitter (compact version): 3.4 kg High-temperature version: +1.5 kg * Only DN 25 and 50 are available for flanges as per AS								

Promag W



Note!
The following weights apply to standard pressure ratings and without packaging material.

Nominal diameter	Weight data in kg							
	Compact version				Remote version (without cable)			
					Sensor			Transmitter
[mm]	EN (DIN) / AS*		JIS		EN (DIN) / AS*		JIS	
25	PN 40	7.3	10K	7.3	PN 40	5.3	10K	5.3	6.0
32		8.0		7.3		6.0		5.3	6.0
40		9.4		8.3		7.4		6.3	6.0
50		10.6		9.3		8.6		7.3	6.0
65	PN 16	12.0		11.1	PN 16	10.0		9.1	6.0
80		14.0		12.5		12.0		10.5	6.0
100		16.0		14.7		14.0		12.7	6.0
125		21.5		21.0		19.5		19.0	6.0
150		25.5		24.5		23.5		22.5	6.0
200	PN 10	45		41.9	PN 10	43		39.9	6.0
250		65		69.4		63		67.4	6.0
300		70		72.3		68		70.3	6.0
350	PN 10	115		81.1	PN 10	113		79.1	6.0
	PN 6	105		-	PN 6	103		-	6.0
375	PN 10	134		-	PN 10	133		-	6.0
400	PN 10	135		102	PN 10	133		100	6.0
	PN 6	120		-	PN 6	118		-	6.0
450	PN 10	175		130	PN 10	173		128	6.0
	PN 6	161		-	PN 6	159		-	6.0
500	PN 10	175		144	PN 10	173		142	6.0
	PN 6	156		-	PN 6	154		-	6.0
600	PN 10	235		190	PN 10	233		188	6.0
	PN 6	208		-	PN 6	206		-	6.0
700	PN 10	355		282	PN 10	353		280	6.0
	PN 6	304		-	PN 6	302		-	6.0
800	PN 10	435		-	PN 10	433		-	6.0
	PN 6	357		-	PN 6	355		-	6.0
900	PN 10	575		-	PN 10	573		-	6.0
	PN 6	485		-	PN 6	589		-	6.0
1000	PN 10	700		-	PN 10	698		-	6.0
	PN 6	589		-	PN 6	587		-	6.0
1200	PN 6	850		-	PN 6	848		-	6.0
1400		1300		-		1298		-	6.0
1600		1700		-		1698		-	6.0
1800		2200		-		2198		-	6.0
2000		2800		-		2798		-	6.0

Promag transmitter (compact version): 3.4 kg
*Only DN 80, 100, 150 to 400, 500 and 600 are available for flanges as per AS

Weight (US units)

Promag E (ASME)

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
			Sensor	Transmitter
		ASME	ASME	
[mm]	[inch]	Class 150	Class 150	Wall-mount housing
15	½"	14.3	9.92	13.2
25	1"	16.1	11.7	
40	1½"	20.7	16.3	
50	2"	23.4	19.0	
80	3"	30.9	26.5	
100	4"	35.3	30.9	
150	6"	56.2	51.8	
200	8"	99.2	94.8	
250	10"	165.4	161.0	
300	12"	242.6	238.1	
350	14"	303.0	293.5	
400	16"	371.3	361.8	
450	18"	424	417	
500	20"	503.6	494.1	
600	24"	666.8	725	

- Transmitter: 4.0 lbs (compact version); 6.8 lbs (remote version)
- Weight data without packaging material

Promag H

Note!
The following weights apply to standard pressure ratings and without packaging material.

Nominal diameter	Compact version (DIN)		Remote version (without cable; DIN)	
DIN	Aluminum field housing	Stainless steel field housing	Sensor	Transmitter (wall-mount housing)
[in]	[lbs]	[lbs]	[lbs]	[lbs]
1/12"	11.5	12.6	4.0	13.0
1/8"	11.5	12.6	4.0	13.0
3/8"	11.7	12.8	4.0	13.0
½"	11.9	13.0	4.0	13.0
1"	12.1	13.2	6.0	13.0
1 ½"	15.7	16.8	4.1	13.0
2"	16.8	17.9	4.6	13.0
3"	19.8	20.9	6.0	13.0
4"	22.7	23.8	7.3	13.0
6"	39.9	41.0	15.1	13.0
Transmitter (compact version): 7.5 lbs				

Promag L (ASME/AWWA)

Weight data in lbs					
Nominal diameter		Compact version[1]		Remote version1)	
[mm]	[inch]	ASME/AWWA		ASME/AWWA	
25	1"	ASME / Class 150	17.4	ASME / Class 150	13
32	–		–		–
40	1 ½"		16.5		12.1
50	2"		16.8		12.3
65	–		–		–
80	3"		28.2		23.8
100	4"		35.5		31.1
125	–		–		–
150	6"		53.8		49.4
200	8"		109		105
250	10"		166		161
300	12"		221		216
350	14"		302		306
375	15"		–		–
400	16"		370		274
450	18"		421		425
500	20"		503		507
600	24"		726		725
700	28"	AWWA / Class D	613	AWWA / Class D	612
750	30"		745		746
800	32"		886		885
900	36"		1098		1097
1000	40"		1468		1467
–	42"		1701		1700
1200	48"		2283		2282
–	54"		3171		3170
1400	–		–		–
–	60"		3935		3934
1600	–		–		–
–	66"		5430		5429
1800	72"		6300		6299
–	78"		7787		7786
2000	–		7787		-
–	84"		8561		8560
2200	–		–		–
–	90"		10686		10685
2400	–		–		–
Transmitter Promag (compact version): 7.5lbs Transmitter Promag (remote version): 13.2 lbs (Weight data valid without packaging material)					

1) Lap joint flanges / welded flanges DN > 300 (12")

Promag P (ASME)

Note!
The following weights apply to standard pressure ratings and without packaging material.

Nominal diameter [inch]	Weight data in lbs				
	Compact version ASME/AWWA		Remote version (without cable) Sensor ASME/AWWA		Transmitter
½"	Class 150	14	Class 150	10	13
1"		16		12	13
1 ½"		21		16	13
2"		23		19	13
3"		31		26	13
4"		35		31	13
6"		56		52	13
8"		99		95	13
10"		165		161	13
12"		243		238	13
14"		386		381	13
16"		452		448	13
18"		562		558	13
20"		628		624	13
24"		893		889	13
Promag transmitter (compact version): 7.5 lbs High-temperature version: + 3.3 lbs					

Promag W

Note!
The following weights apply to standard pressure ratings and without packaging material.

Nominal diameter [inch]	Weight data in lbs				
	Compact version ASME/AWWA		Remote version (without cable) Sensor ASME/AWWA		Transmitter
1"	Class 150	16	Class 150	12	13
1 ½"		21		16	13
2"		23		19	13
3"		31		26	13
4"		35		31	13
6"		56		52	13
8"		99		95	13
10"		143		161	13
12"		243		238	13
14"		386		381	13
16"		452		448	13
18"		562		558	13
20"		628		624	13
24"		893		889	13

Nominal diameter [inch]	Weight data in lbs				
	Compact version		Remote version (without cable)		
	ASME/AWWA		Sensor ASME/AWWA		Transmitter
28"	Class D	882	Class D	878	13
30"		1014		1010	13
32"		1213		1208	13
36"		1764		1760	13
40"		1985		1980	13
42"		2426		2421	13
48"		3087		3083	13
54"		4851		4847	13
60"		5954		5949	13
66"		8159		8154	13
72"		9041		9036	13
78"		10143		10139	13
Promag transmitter (compact version): 7.5 lbs					

Materials

Promag E

- Transmitter housing
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 600 (14 to 24"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L) (with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304L) (with protective lacquering)
- Electrodes: 1.4435 (316, 316L), Alloy C22, Tantalum
- Flanges (with protective lacquering)
  - EN 1092-1 (DIN2501): carbon steel, S235JRG2, S235JR+N, P245GH, E250C1, A105
  - ASME B16.5: carbon steel, A105
  - JIS B2220: carbon steel, A105, A350 LF2

  1 DN DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering
- Seals: to DIN EN 1514-1 IBC form
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag H

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum or stainless steel field housing (1.4301 (316L))
  - Wall-mounted housing: powder-coated die-cast aluminum
  - Window material: glass or polycarbonate
- Sensor housing: stainless steel 1.4301 (304)
- Wall mounting kit: stainless steel 1.4301 (304)
- Measuring tube: stainless steel 1.4301 (304)
- Liner: PFA (USP class VI; FDA 21 CFR 177.1550: 3A)
- Electrodes:
  - Standard: 1.4435 (316, 316L)

- Option: Alloy C22, Tantalum, Platinum

- Flange:
  - All connections stainless-steel 1.4404 (F316L)
  - EN (DIN), ASME, JIS made of PVDF
  - Adhesive fitting made of PVC

- Seals
  - DN 2 to 25 (1/12 to 1"): O-ring (EPDM, Viton, Kalrez), gasket seal (EPDM*, Viton, Silicone*)
  - DN 40 to 150 (1½ to 6"): gasket seal (EPDM*, Silicone*)
    * = USP class VI; FDA 21 CFR 177.2600: 3A

- Ground rings: 1.4435 (316, 316L) (optional: Tantalum, Alloy C22)

Promag L

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum

- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 1200 (14 to 48"): with protective lacquering

- Measuring tube:
  - DN 25 to 300 (1 to 12"): Stainless-steel, 1.4301/1.4306 (304L)
  - DN 350 to 1200 (14 to 48"): Stainless-steel, 1.4301/1.4307 (304)
  - DN 1350 to 2400 (54 to 90"): Stainless-steel, 1.4301/1.4307

- Electrodes: 1.4435 (316L), Alloy C22, 2.4602 (UNS N06022)

- Flange
  - EN 1092-1 (DIN 2501)
    - DN 25 to 300
      Lap joint flange:
      - Stainless-steel, 1.4306/1.4307
      - Carbon steel, 235JR
      Lap joint flange, stampel plate:
      - Stainless-steel, 1.4301 (304)
      - Carbon steel, RSt37-2
    - DN 350 to 2400: carbon steel, S235JRG2, S235JR+N, P250GH, P245GH, E250C, A105
    - DN 350 to 600: Stainless-steel, 1.4571
    - DN 700 to 1000: Stainless-steel, 1.4404
  - ASME B16.5
    - DN ≤ 300 (12"), lap joint flange:
      - Stainless-steel, F316L
      - Carbon steel, A105
    - DN ≥ 350 (14"):
      - Carbon steel, A105
      - Stainless-steel, F316L
  - AWWA C207: A105, A181 Cl.70, E250C, S235JRG2, P265GH, S275JR
  - AS 2129: Carbon steel, A105, P235GH, P265GH, S235JRG2, E250C
  - AS 4087: Carbon steel, A105, P265GH, S275JR, E250C

- Seals: to DIN EN 1514-1 IBC form

- Ground disks: 1.4435 (316L) or Alloy C22

Promag P

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum

- Sensor housing
  - DN 15 to 300 (½ to 12"): powder-coated die-cast aluminum
  - DN 350 to 2000 (14 to 84"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L); for flanges made of carbon steel with Al/Zn protective coating
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304L); for flanges made of carbon steel with Al/Zn protective coating
- Electrodes: 1.4435 (316, 316L), Platinum, Alloy C22, Tantalum, Titanium
- Flange
  - EN 1092-1 (DIN2501):
    - Stainless-steel, 1.4571, F316L
    - Carbon steel, S235JRG2, S235JR+N, P245GH, P250GH, A105, E250C1
    (1 DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ASME B16.5:
    - Stainless-steel, F316L
    - Carbon steel, A105
    (DN ≤ 300 mit Al/Zn-Schutzbeschichtung; DN ≥ 350 mit Schutzlackierung)
  - AWWA: 1.0425 (316L)
  - JIS B2220:
    - Stainless-steel, 1.0425 F316L1
    - Carbon steel, A105, A350 LF2
    (1 DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129: Carbon steel, A105, P235GH, P265GH, S235JRG2, E250C
  - AS 4087: Carbon steel, A105, P265GH, S275JR, E250C
- Seals: to DIN EN 1514-1 IBC form
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag W

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 2000 (14 to 84"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L)
  (for flanges made of carbon steel with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304)
  (for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435 (316, 316L) or Alloy C22, Tantalum
- Flange
  - EN 1092-1 (DIN2501)
    - DN 25 to 3001:
      - Stainless-steel, 1.4571, F316L
      - Carbon steel, S235JRG2, S235JR+N, P250GH, E250C, A105
    - DN 350 to 6001:
      - Stainless-steel, 1.4571, F316L
      - Carbon steel, P245GH, S235JRG2, S235JR+N, P250GH, E250C
    - DN > 600:
      - Stainless-steel, 1.4404/F316L
      - Carbon steel, P245GH
  - ASME B16.5: Carbon steel, A105

- AWWA: Carbon steel, A105, Cl.70 A181, P265GH, S275JR, E250C
- JIS B2220:
  - Carbon steel, A105, A350 LF2
  - Stainless-steel, F316L
  (DN ≤ 300 (12") mit Al/Zn-Schutzbeschichtung; DN ≥ 350 (14") mit Schutzlackierung)
- AS 2129: Carbon steel, A105, P235GH, P265GH, S235JRG2
- AS 4087: Carbon steel, A105, P265GH, S275JR

- Seals: to DIN EN 1514-1 IBC form
- Ground disks: 1.4435 (316, 316L), Alloy C22, Titanium, Tantalum

1 For flange material carbon steel with Al/Zn protective coating (DN 25 to 300 (1 to 12")), protective varnish (IP68) (DN 50 to 300 (2 to 12")) or protective varnish ≥ DN 350 (14")

Fitted electrodes

Promag E/L

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection
- 1 reference electrode for potential equalization

Promag H

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection, not for DN 2 to 8 ($^{1}/_{12}$ to 5/16")

Promag P

Available as standard:
- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection
- 1 Reference electrode for potential equalization

Optionally available:
- Platinum measuring electrodes only

Promag W

Available as standard:
- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection
- 1 Reference electrode for potential equalization

Optionally available:
- Exchangeable measuring electrodes for DN 350 to 2000 (14 to 78")

Process connection

Promag E

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤300 (12") = form A
  - DN ≥ 350 (14") = flat face
  - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1
- ASME B16.5
- JIS B2220

Promag H

With O-ring:
- Weld nipple DIN (EN), ISO 1127, ODT/SMS
- Flange EN (DIN), ASME, JIS
- Flange made of PVDF EN (DIN), ASME, JIS
- External thread

- Internal thread
- Hose connection
- PVC adhesive fitting

With molded seal:
- Weld nipple EN 10357 (DIN 11850), ODT/SMS, ASME BPE, ISO 2037
- Clamp ISO 2852, DIN 32676, L14 AM7
- Coupling DIN 11851, DIN 11864-1, ISO 2853, SMS 1145
- Flange DIN 11864-2

Promag L

Flange connection:
- EN 1092-1 (DIN 2501)
  - DN ≤300 (12") = form A
  - DN ≥ 350 (14") = form B
  - 1.0038 (S235JRG2), A105
- ASME B16.5
- AWWA C207
- AS 2129
- AS 4087

Promag P/W

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤300 (12") = form A
  - DN ≥ 350 (14") = flat face
  - DN 65 PN 16 and DN 600 PN 16 exclusively according to EN 1092-1
- ASME B16.5
- AWWA C207 (only Promag W)
- JIS 10K, 20K
- AS 2129
- AS 4087

Surface roughness

All data relate to parts in contact with fluid.

- Liner → PFA: ≤ 0.4 µm (15 µin)
- Electrodes: 0.3 to 0.5 µm (12 to 20 µin)
- Process connection made of stainless-steel (Promag H):
  - With O-ring seal: ≤ 1.6 µm (63 µin)
  - With aseptic gasket seal: ≤ 0.8 µm (31.5 µin)
  - Optional: ≤ 0.38 µm (15 µin)

10.11 Operability

Display elements

- Liquid crystal display: illuminated, four lines with 16 characters per line
- Custom configurations for presenting different measured values and status variables
- 3 totalizers
- At ambient temperatures below −20 °C (−4 °F), the readability of the display may be impaired.

Operating elements

- Onsite operation with three optical sensor keys (⊟/⊞/Ⓔ)
- Application-specific Quick Setup menus for straightforward commissioning

Language packages

Language groups available for operation in different countries:

Valid until software version 2.03.XX			
Order code	**Option**		**Contents**
Power Supply; Display	WEA	Western Europe and America	English, German, Spanish, Italian, French, Dutch and Portuguese
	EES	Eastern Europe and Scandinavia	English, Russian, Polish, Norwegian, Finnish, Swedish and Czech
	SEA	South and East Asia	English, Japanese, Indonesian
	CN	China	English, Chinese

Valid as of software version 2.07.XX		
Order code	**Option**	**Contents**
Power Supply; Display	P, Q	English, German, Spanish, Italian, French
	R, S	English, Russian, Portuguese, Dutch, Czech
	T, U	English, Japanese, Swedish, Norwegian, Finnish
	4, 5	English, Chinese, Indonesian, Polish

You can change the language group via the operating program "FieldCare".

Remote operation

Operation by means of HART protocol

10.12 Certificates and approvals

CE approval

The measuring system complies with the legal requirements of the EU directives. Endress+Hauser confirms that the device has been tested successfully by affixing the CE mark to it.

C-tick symbol

The measuring system is in conformity with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex approval

Information about currently available Ex versions (ATEX, FM, CSA, TIIS, IECEx, NEPSI etc.) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

Sanitary compatibility

Promag H
- 3A-approval and EHEDG-certified
- Seals: FDA-compliant (except for Kalrez seals)

Promag E/L/P/W
No applicable approvals or certification

Drinking water approval

Promag P
- ACS

Promag W
- WRAS BS 6920
- ACS
- NSF 61
- KTW/W270

Certification HART

The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the HCF (Hart Communication Foundation). The device thus meets all the requirements of the following specifications:
- Certified in accordance with HART Revisions 5 and 7 (device certification number: available on request)
- The measuring device can also be operated with certified devices of other manufacturers (interoperability).

Pressure equipment directive

The devices can be ordered with or without a PED approval. If a device with a PED approval is required, this must be explicitly stated in the order. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary.

- With the PED/G1/x (x = category) marking on the sensor nameplate, Endress+Hauser confirms compliance with the "Essential Safety Requirements" specified in Annex I of the Pressure Equipment Directive 2014/68/EU.
- Devices bearing this marking (PED) are suitable for the following types of medium: Media in Group 1 and 2 with a vapor pressure greater than, or smaller and equal to 0.5 bar (7.3 psi)
- Devices not bearing this marking (PED) are designed and manufactured according to good engineering practice. They meet the requirements of Art.4 Section 3 of the Pressure Equipment Directive 2014/68/EU. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive 2014/68/EU.

Other standards and guidelines

- EN 60529:
  Degrees of protection by housing (IP code)
- EN 61010-1
  Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures
- IEC/EN 61326
  "Emission in accordance with requirements for class A".
  Electromagnetic compatibility (EMC requirements).
- ANSI//ISA-S82.01
  Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements. Pollution degree 2, Installation Category II.
- CAN/CSA-C22.2 (No. 1010.1-92)
  Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category I.
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics.

10.13 Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide



Note!
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data

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

10.14 Accessories

Various accessories are available for the transmitter and the sensor. These can be ordered separately from Endress+Hauser → 📄 102.



Note!
For detailed information on specific order codes, please contact the Endress+Hauser service organization.

10.15 Documentation

- Flow Measurement (FA00005D/06)
- Promag 53E Technical Information (TI01164D/06)
- Promag 53H Technical Information (TI00048D/06)
- Promag 53P Technical Information (TI00047D/06)
- Promag 53W Technical Information (TI00046D/06)
- Promag 53 Description of Device Functions (BA00048D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA

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