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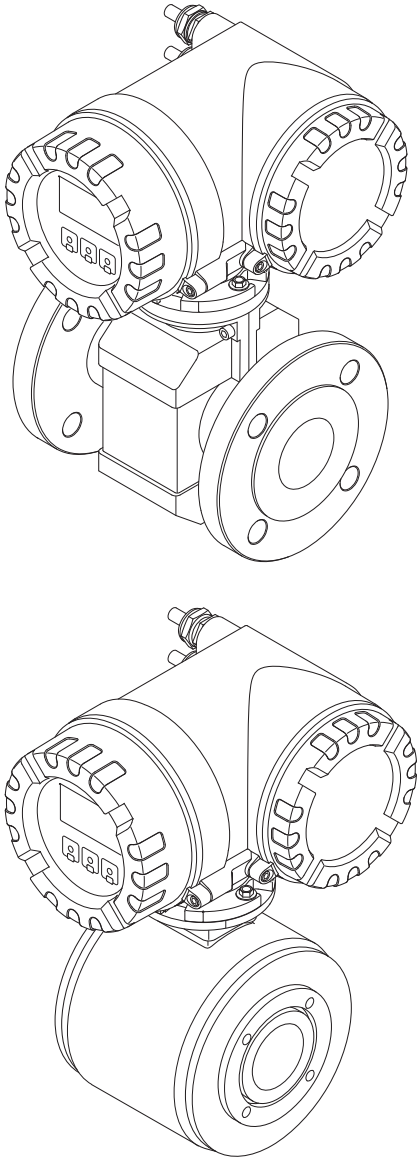
Valid as of version:
PB DP: V 3.04.XX (Device software)
PB PA: V 3.04.XX (Device software)

Operating Manual
Proline Promag 53
PROFIBUS DP/PA

Electromagnetic flowmeter



Endress+Hauser
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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 this Operating Manual and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual 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 of the chemical resistance properties. Therefore, Endress+Hauser can not guarantee or accept liability for the chemical resistance properties of the fluid wetted materials in a specific application. The user is responsible for the choice of fluid wetted materials in regards to their in-process resistance to corrosion.
- If carrying out welding work on the piping, the welding unit must not be grounded by means of the measuring device.
- 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 this 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 this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body (e.g. Ⓔx Europe, Ⓤs USA, Ⓒs Canada)
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326, and 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 this Operating Manual.

1.4 Returns

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 Safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested, and 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 anything other than the designated use.
Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:

Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in 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 sensor

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

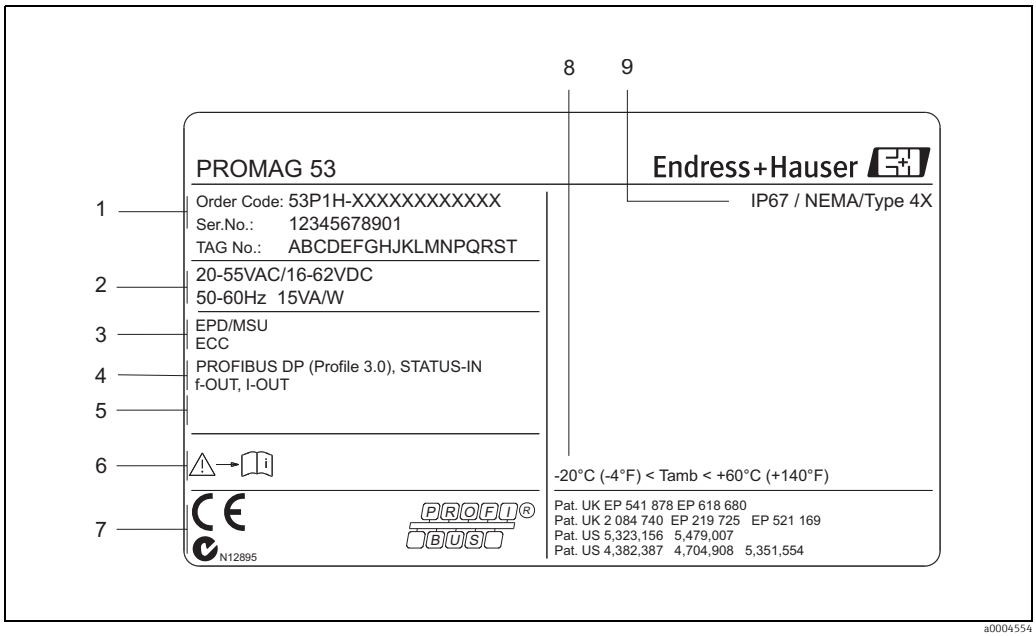

Fig. 1: Nameplate specifications for the "Promag 53" transmitter (example)

1 *Order code/serial number: Refer to 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*
4 *Available inputs and outputs*
5 *Reserved for information on special products*
6 *Please refer to operating instructions / documentation*
7 *Reserved for certificates, approvals and for additional information on device version*
8 *Ambient temperature range*
9 *Degree of protection*

2.1.2 Nameplate of the sensor

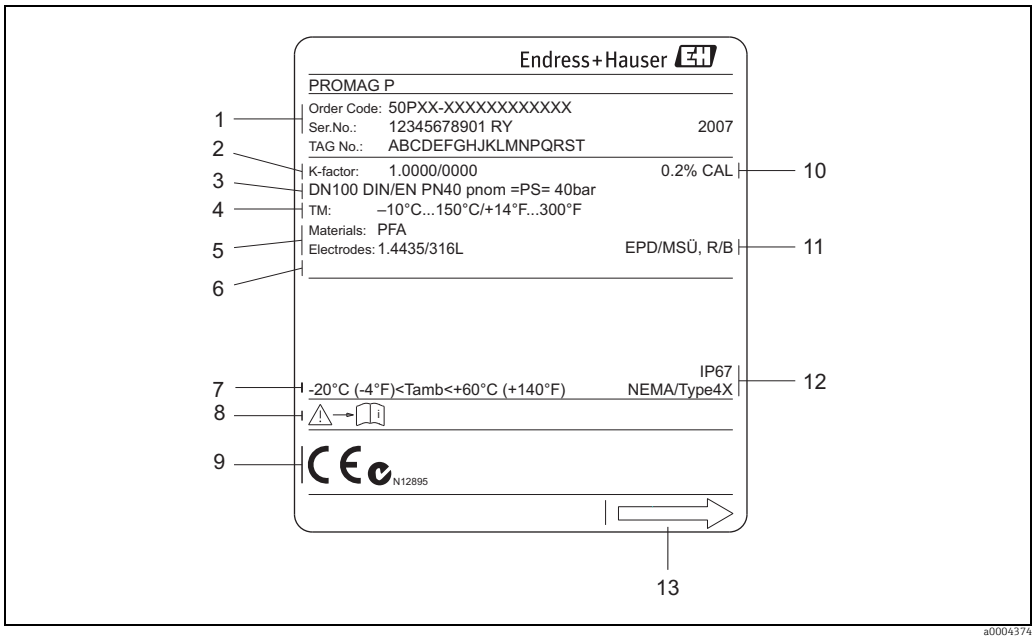

Fig. 2: Nameplate specifications for the "Promag" sensor (example)

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 information on special products*
7 *Permitted ambient temperature range*
8 *Please refer to operating instructions / documentation*
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 (only for Promag P)*

12 *Degree of protection*
13 *Flow direction*

2.1.3 Nameplate for connections

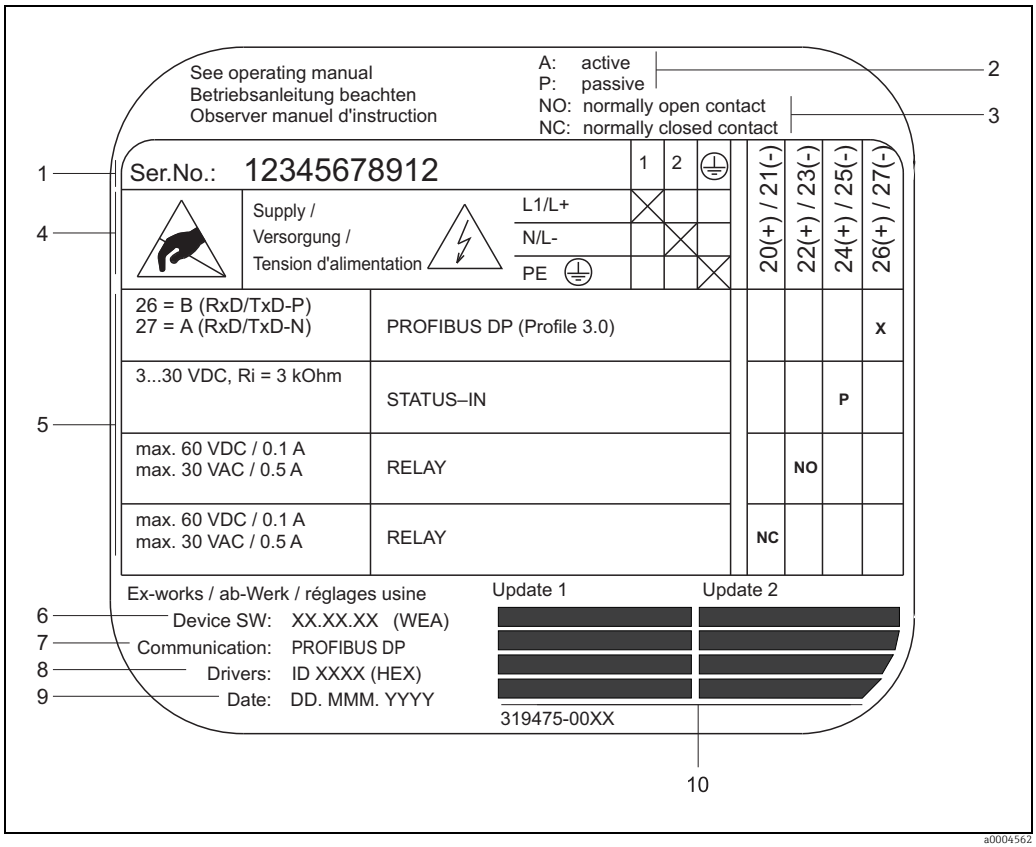

Fig. 3: Nameplate specifications for "Promag" transmitter connections (example)

1 Serial number
2 Possible configuration of current output
3 Possible configuration of relay contacts
4 Terminal assignment, cable for power supply: 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*
5 Pending signals at the inputs and outputs
possible configurations and terminal assignment
6 Version of device software currently installed (inclusive language group)
7 Installed communication type
8 PROFIBUS ID No.
9 Date of installation
10 Current updates to data specified in points 6 to 9

2.2 Certificates and approvals

The devices are designed in accordance with good engineering practice to meet state-of-the-art safety requirements, have been tested, and 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" and with the EMC requirements of IEC/EN 61326.
The measuring system described in this Operating Manual is therefore in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
The measuring system is in conformity with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organization).

The device thus meets all the requirements of the following specifications:
- Certified to PROFIBUS Specification Profile 3.0 version
  (Device certification number: provided upon request)
- The measuring device can also be operated with certified devices of other manufacturers (interoperability).

2.3 Registered trademarks

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

PROFIBUS®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, D

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

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.

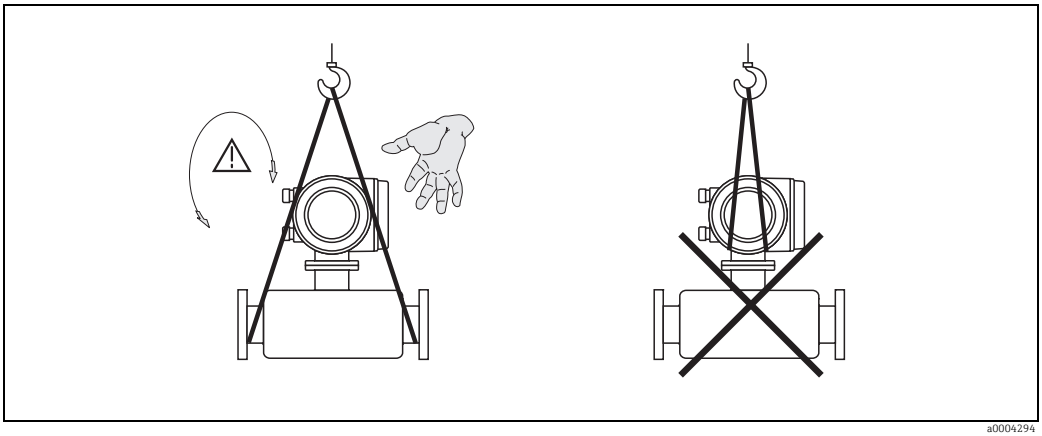

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Fig. 4: Transporting sensors with DN ≤ 300 (12")

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.

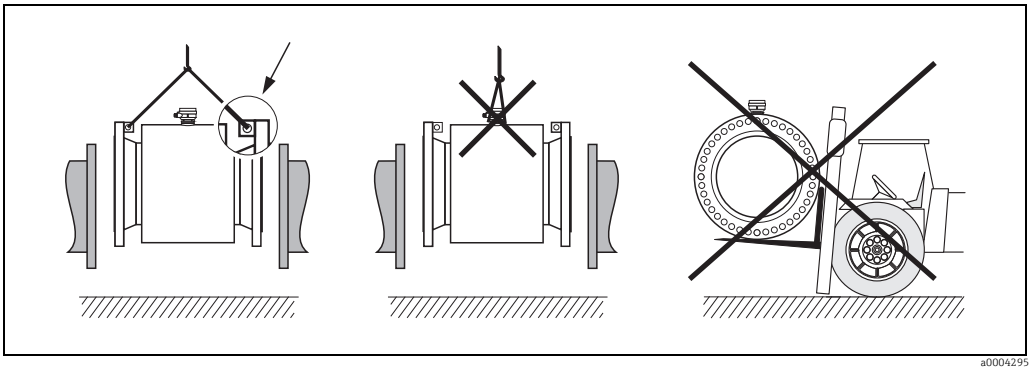

Fig. 5: Transporting sensors with DN > 300 (12")

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 → 160.
- 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 → 184.

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.

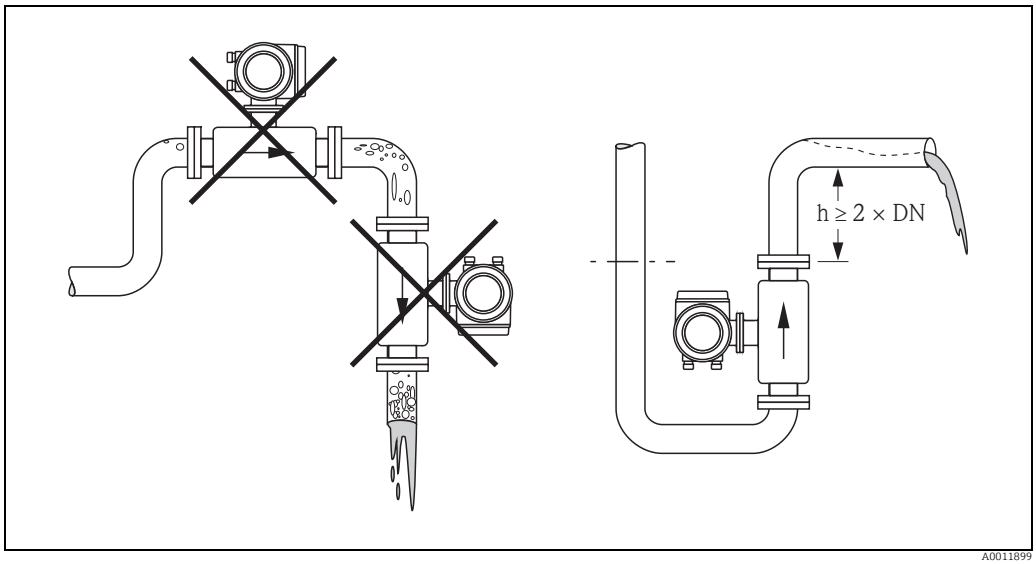

Fig. 6: Mounting location

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 → 165.
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 → 161.

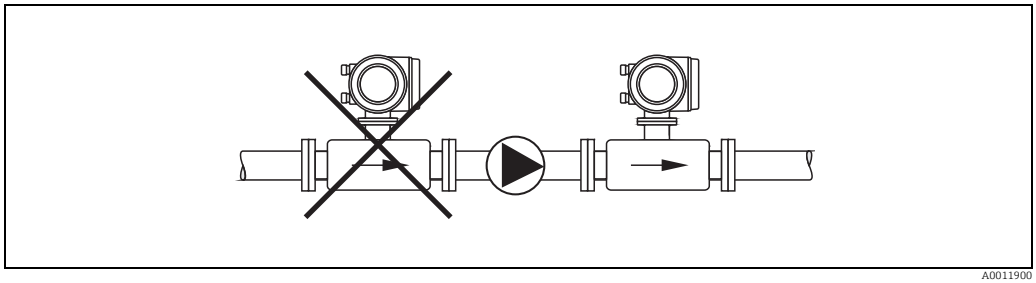

Fig. 7: Installing pumps

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 → 125.

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.

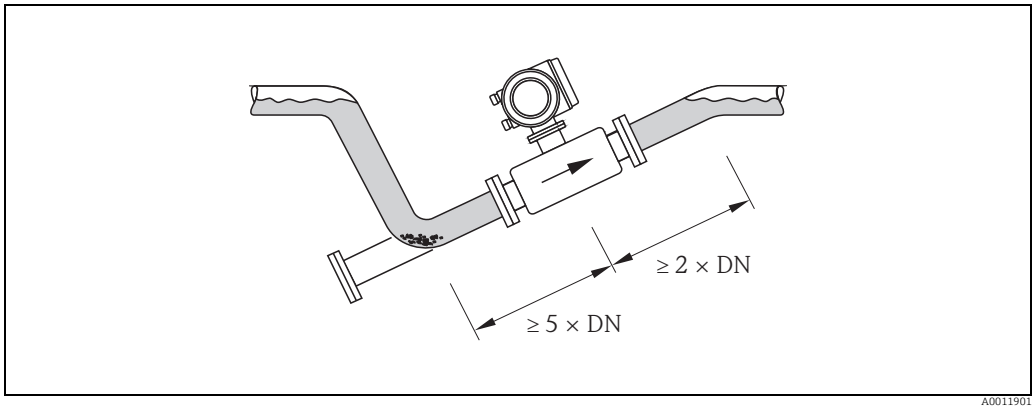

Fig. 8: Installation in partially filled pipe

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters (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 → 165

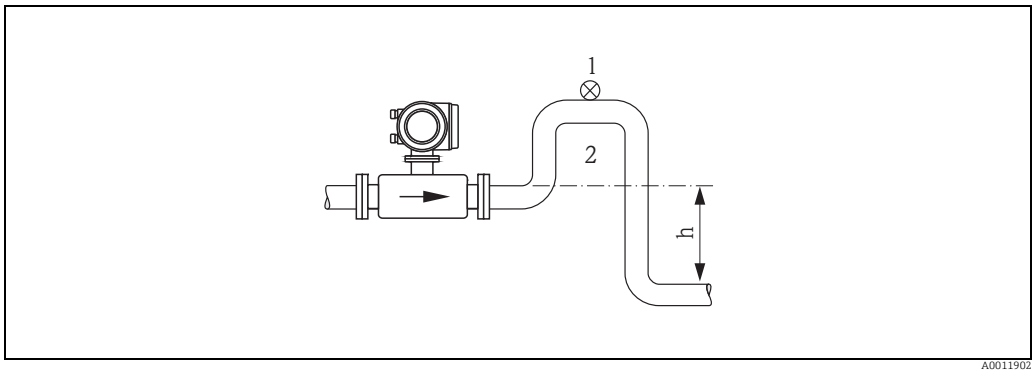

Fig. 9: Measures for installation in a down pipe

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 → 125.

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.

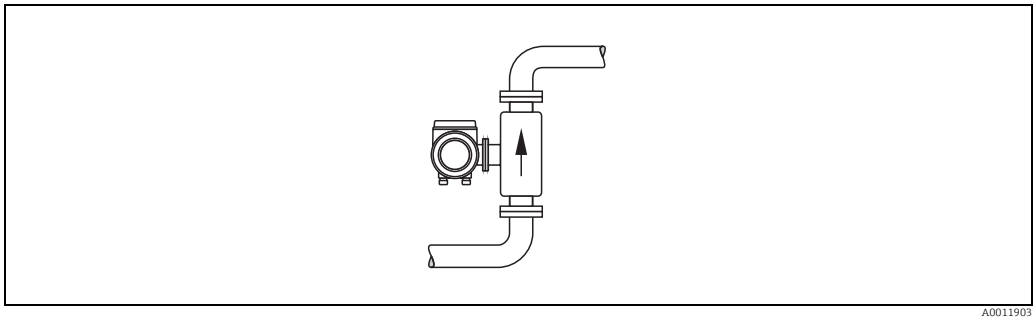

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Fig. 10: Vertical orientation

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.

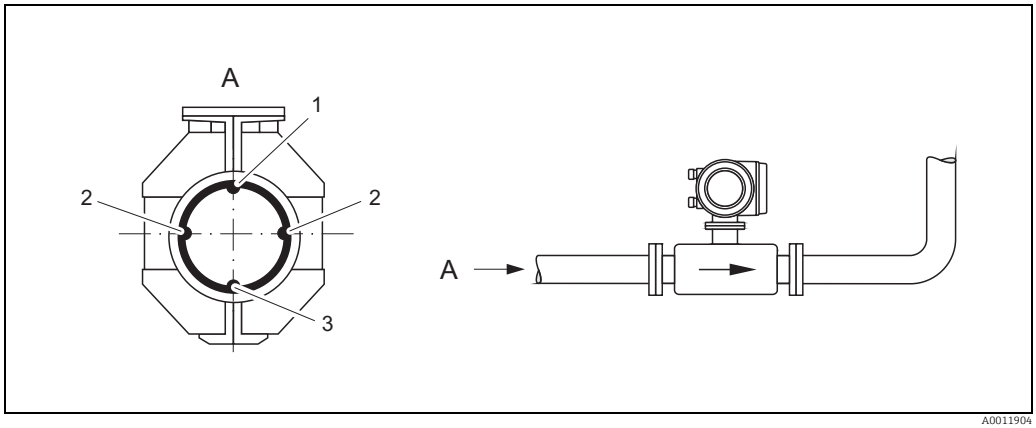

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Fig. 11: Horizontal orientation

1 EPD electrode for empty pipe detection
(not available for "measuring electrode only" option, not in Promag H, DN 2 to 15 (1/12 to ½"))
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

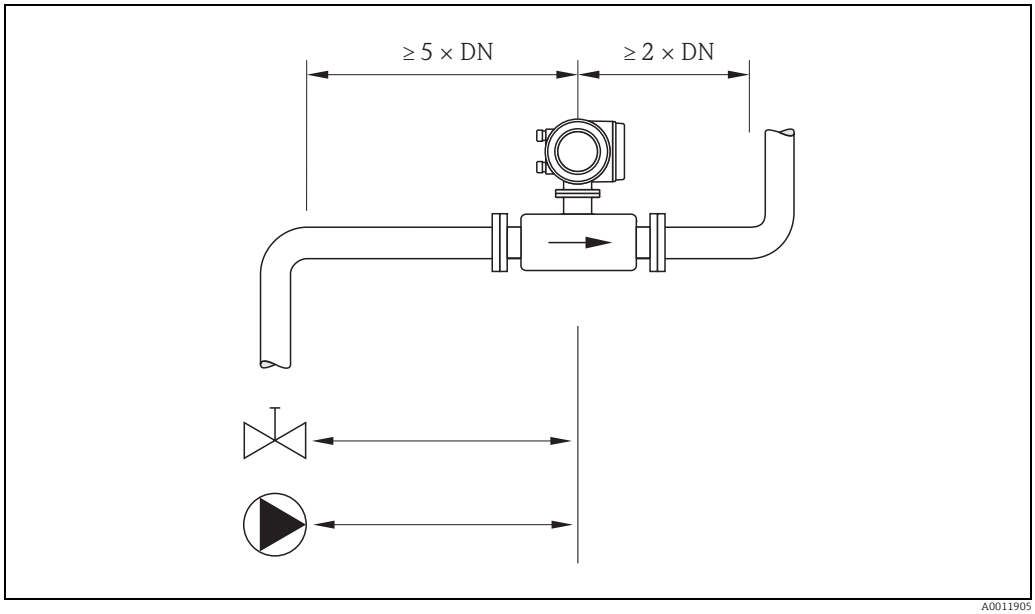


Fig. 12: Inlet and outlet runs

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 → 🖹 161.

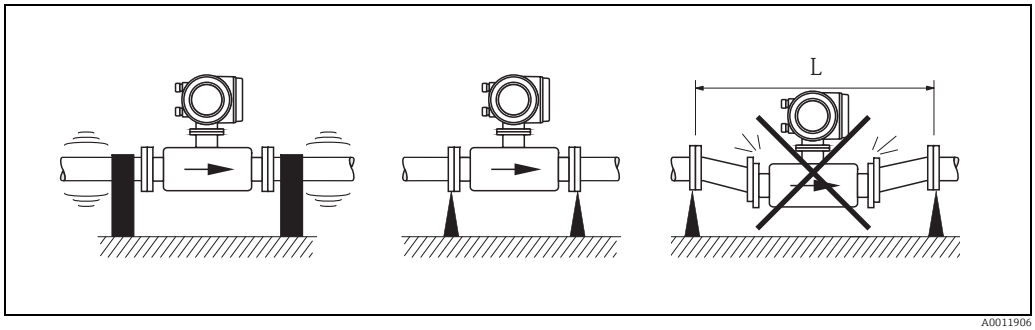


Fig. 13: Measures to prevent vibration of the measuring device (L > 10 m / 33 ft)

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.

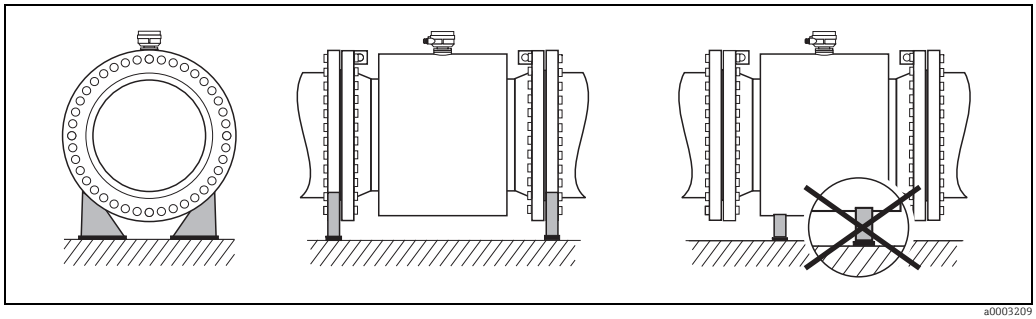


Fig. 14: Correct support for large nominal diameters (DN ≥ 350 / 14")

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.

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.

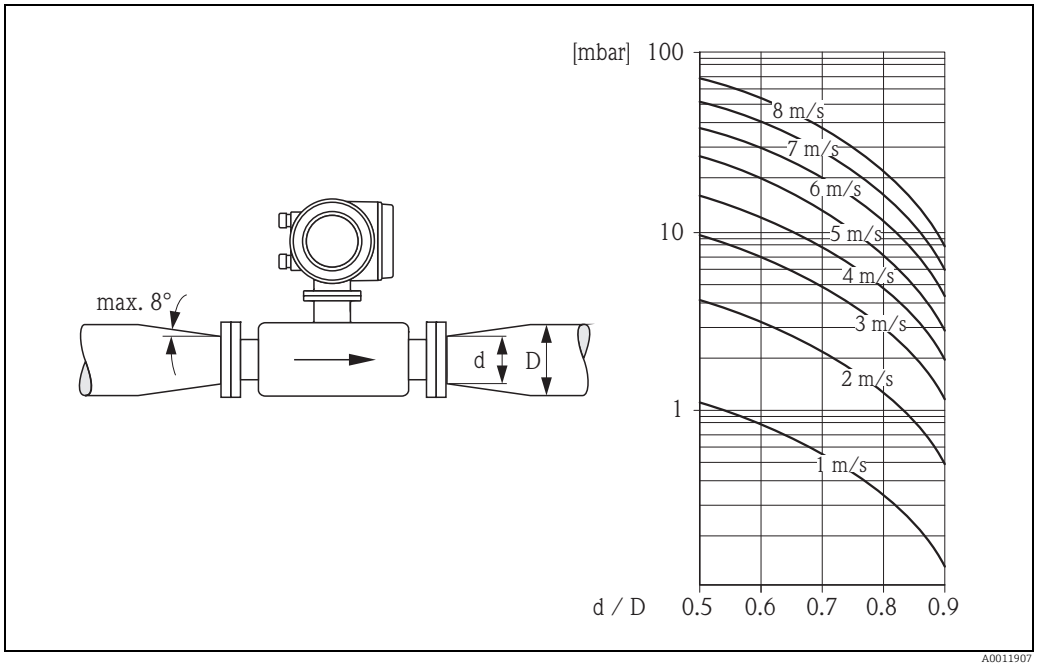


Fig. 15: Pressure loss due to adapters

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 abrasive fluids
- v > 2 m/s (v > 6.5 ft/s): for fluids producing buildup

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (→ 16).

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
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
1600	–	–	–	2200 to 70000
1800	–	–	–	2800 to 90000
2000	–	–	–	3400 to 110000

Recommended flow (US units)

Nominal diameter	Promag E/P	Promag H	Promag L	Promag W
[inch]	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 ¼"	4 to 130	–	–	4 to 130
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
2 ½"	16 to 500	16 to 500	16 to 500	16 to 500
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
5"	60 to 1950	60 to 1950	60 to 1950	60 to 1950
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
60"	–	–	–	12 to 380
66"	–	–	–	14 to 500
72"	–	–	–	16 to 570
78"	–	–	–	18 to 650

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 → 125) is switched on.

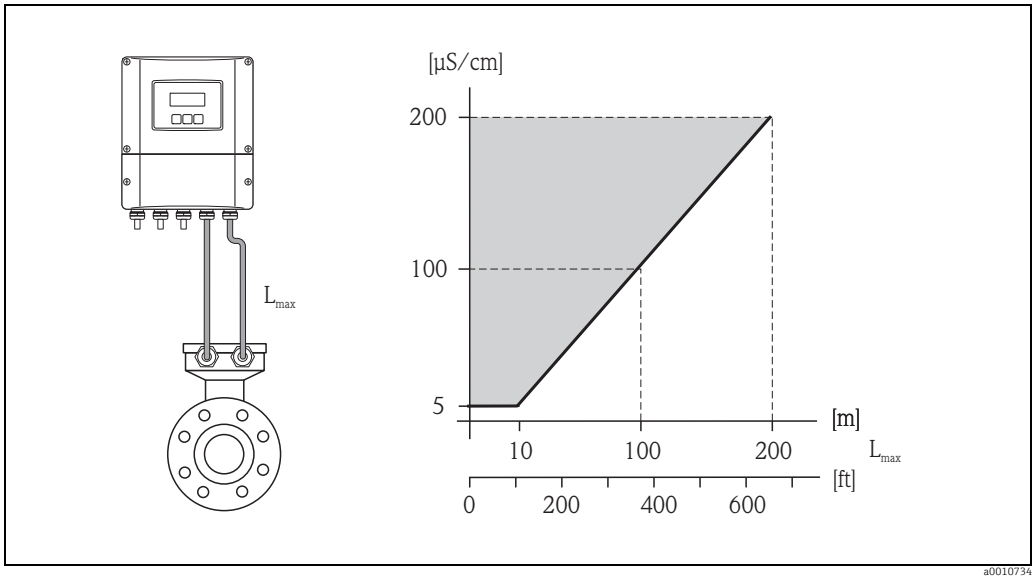


Fig. 16: Permitted lengths for connecting cable in remote version, as a function of the conductivity of the fluid

Gray shaded area = permissible range
Lmax = 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 → 20.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

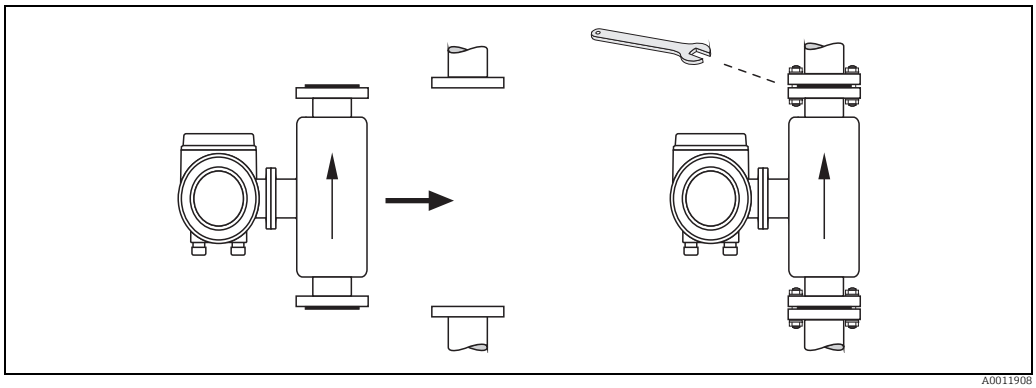


Fig. 17: Installing the Promag E sensor

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, → 128.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 62.

Screw tightening torques (Promag E)

Note the following points:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

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

Promag E tightening torques for EN (DIN)

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

Promag E tightening torques for ASME

Nominal diameter		ASME		Max. tightening torque PTFE	
[mm]	[inch]	Pressure rating [lbs]	Threaded fasteners	[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 1/8"	371	274
500	20"	Class 150	20 × 1 1/8"	341	252
600	24"	Class 150	20 × 1 ¼"	477	352

Promag E tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
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 (→ 128).

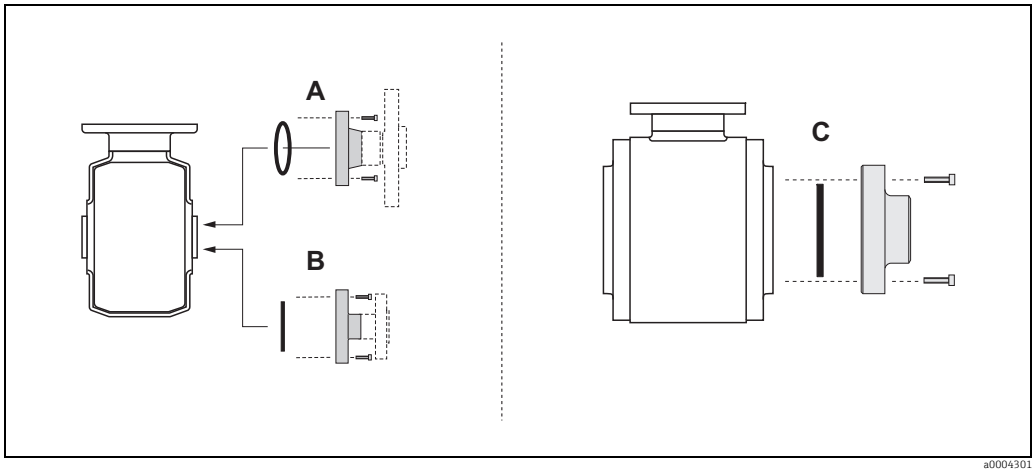


Fig. 18: Promag H process connections; DN 2 to 25 (1/12 to 1"), DN 40 to 100 (1 ½ to 4")

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 (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 100 (1 ½ to 4") / Process connections with aseptic molded seal
Weld nipple (DIN 11850, ODT / SMS), 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 → 128.

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 equalised 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 → 128. 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 → 177.
- 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).

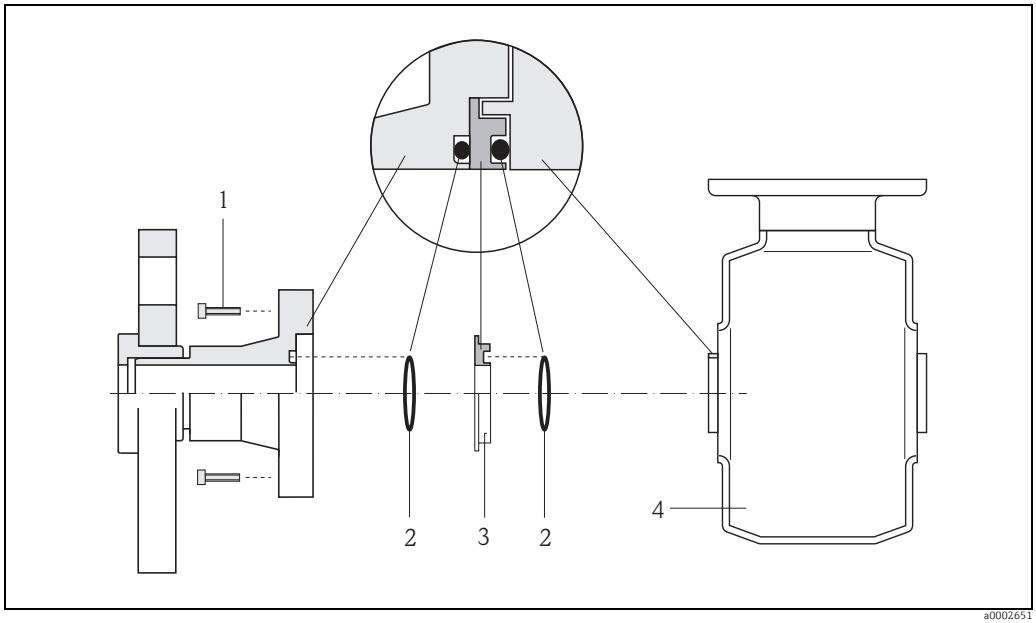


Fig. 19: Installing grounding rings in the Promag H (DN 2 to 25 / 1/12 to 1")

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 → 128.
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" → 184.

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

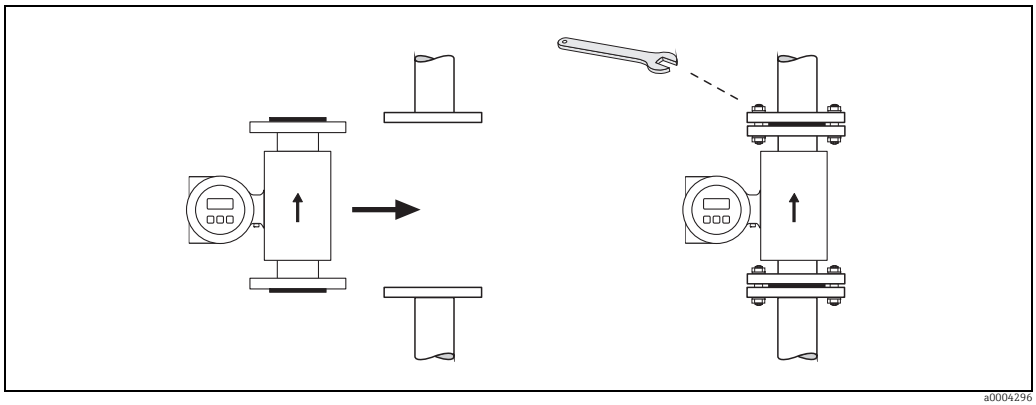


Fig. 20: Installing the Promag L sensor

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 (→ 128).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 62.

Screw tightening torques (Promag L)

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

Promag L tightening torques for EN (DIN)

Nominal diameter	EN (DIN)		Max. tightening torque		
			Hard rubber	Polyurethane	PTFE
[mm]	Pressure rating [bar]	Threaded fasteners	[Nm]	[Nm]	[Nm]
25	PN 10/16	4 × M 12	-	6	11
32	PN 10/16	4 × M 16	-	16	27
40	PN 10/16	4 × M 16	-	16	29
50	PN 10/16	4 × M 16	-	15	40
65*	PN 10/16	8 × M 16	-	10	22
80	PN 10/16	8 × M 16	-	15	30
100	PN 10/16	8 × M 16	-	20	42
125	PN 10/16	8 × M 16	-	30	55
150	PN 10/16	8 × M 20	-	50	90
200	PN 16	12 × M 20	-	65	87
250	PN 16	12 × M 24	-	126	151
300	PN 16	12 × M 24	-	139	177
350	PN 6	12 × M 20	111	120	-
350	PN 10	16 × M 20	112	118	-
400	PN 6	16 × M 20	90	98	-
400	PN 10	16 × M 24	151	167	-
450	PN 6	16 × M 20	112	126	-
450	PN 10	20 × M 24	153	133	-
500	PN 6	20 × M 20	119	123	-
500	PN 10	20 × M 24	155	171	-
600	PN 6	20 × M 24	139	147	-
600	PN 10	20 × M 27	206	219	-
700	PN 6	24 × M 24	148	139	-
700	PN 10	24 × M 27	246	246	-
800	PN 6	24 × M 27	206	182	-
800	PN 10	24 × M 30	331	316	-
900	PN 6	24 × M 27	230	637	-
900	PN 10	28 × M 30	316	307	-
1000	PN 6	28 × M 27	218	208	-
1000	PN 10	28 × M 33	402	405	-
1200	PN 6	32 × M 30	319	299	-
1200	PN 10	32 × M 36	564	568	-

* Designed acc. to EN 1092-1 (not to DIN 2501)

Promag L tightening torques for ASME

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hard rubber		Polyurethane		PTFE	
[mm]	[inch]	[lbs]		[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 1/8"	204	150	234	173	-	-
500	20"	Class 150	20 × 1 1/8"	183	135	217	160	-	-
600	24"	Class 150	20 × 1 ¼"	268	198	307	226	-	-

Promag L tightening torques for AWWA

Nominal diameter		AWWA	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hartgummi		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	-	-
1050	42"	Class D	36 × 1 ½"	528	389	518	382	-	-
1200	48"	Class D	44 × 1 ½"	552	407	531	392	-	-

Promag L tightening torques for AS 2129

Nominal diameter	AS 2129	Threaded fasteners	Max. tightening torque		
	Pressure rating		Hard rubber	Polyurethane	PTFE
[mm]			[Nm]	[Nm]	[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	-	-
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 tightening torques for AS 4087

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 → 31.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

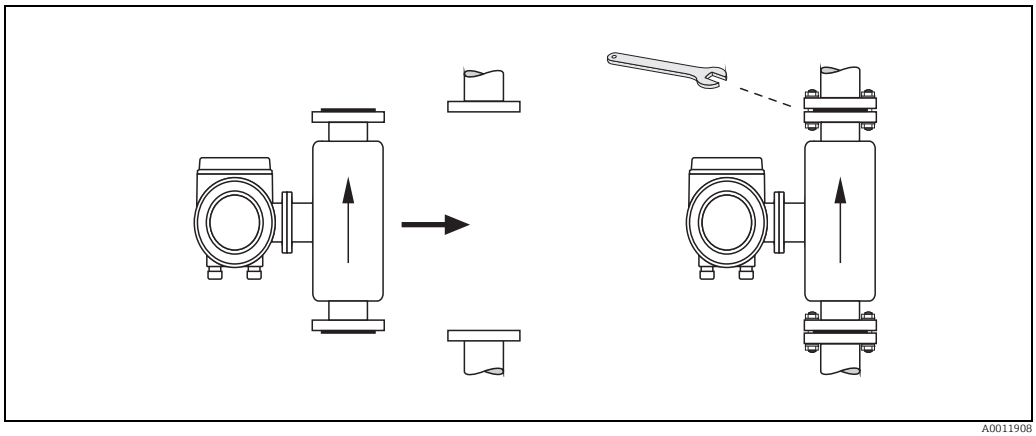


Fig. 21: Installing the Promag P sensor

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, → 128.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 62.

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 → 162.

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.

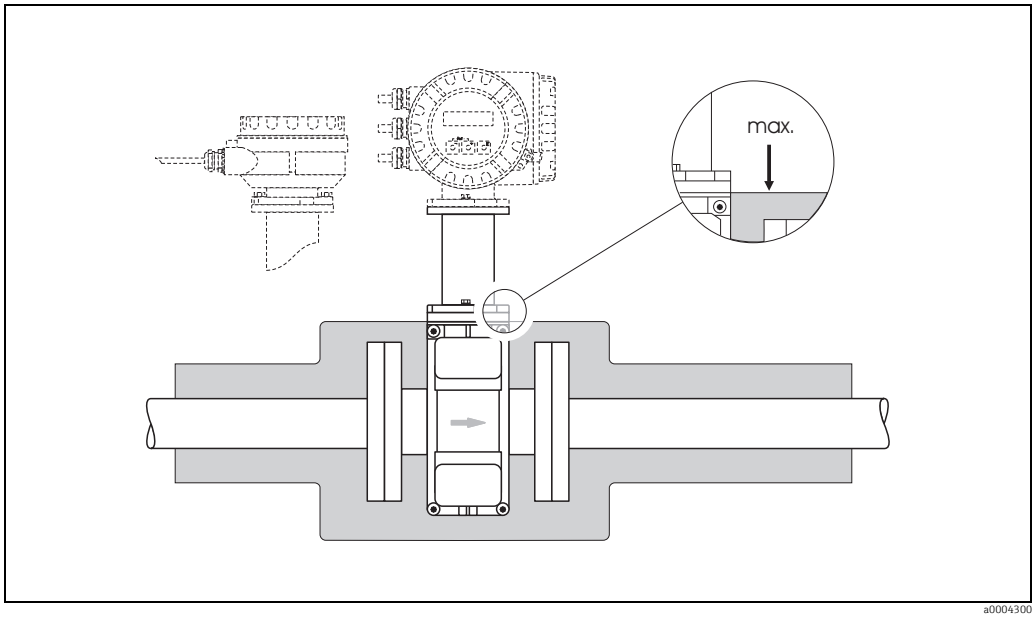


Fig. 22: Promag P sensor (high-temperature version): insulating the pipe

Screw tightening torques (Promag P)

Note the following points:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:
- EN (DIN) → 32
- ASME → 33
- JIS → 33
- AS 2129 → 34
- AS 4087 → 34

Promag P tightening torques for EN (DIN)

Nominal diameter	EN (DIN) Pressure rating	Screws	Max. tightening torque [Nm]	
[mm]	[bar]		PTFE	PFA
15	PN 40	4 × M 12	11	–
25	PN 40	4 × M 12	26	20
32	PN 40	4 × M 16	41	35
40	PN 40	4 × M 16	52	47
50	PN 40	4 × M 16	65	59
65 *	PN 16	8 × M 16	43	40
65	PN 40	8 × M 16	43	40
80	PN 16	8 × M 16	53	48
80	PN 40	8 × M 16	53	48
100	PN 16	8 × M 16	57	51
100	PN 40	8 × M 20	78	70
125	PN 16	8 × M 16	75	67
125	PN 40	8 × M 24	111	99
150	PN 16	8 × M 20	99	85
150	PN 40	8 × M 24	136	120
200	PN 10	8 × M 20	141	101
200	PN 16	12 × M 20	94	67
200	PN 25	12 × M 24	138	105
250	PN 10	12 × M 20	110	–
250	PN 16	12 × M 24	131	–
250	PN 25	12 × M 27	200	–
300	PN 10	12 × M 20	125	–
300	PN 16	12 × M 24	179	–
300	PN 25	16 × M 27	204	–
350	PN 10	16 × M 20	188	–
350	PN 16	16 × M 24	254	–
350	PN 25	16 × M 30	380	–
400	PN 10	16 × M 24	260	–
400	PN 16	16 × M 27	330	–
400	PN 25	16 × M 33	488	–
450	PN 10	20 × M 24	235	–
450	PN 16	20 × M 27	300	–
450	PN 25	20 × M 33	385	–
500	PN 10	20 × M 24	265	–
500	PN 16	20 × M 30	448	–
500	PN 25	20 × M 33	533	–
600	PN 10	20 × M 27	345	–
600 *	PN 16	20 × M 33	658	–
600	PN 25	20 × M 36	731	–

* Designed acc. to EN 1092-1 (not to DIN 2501)

Promag P tightening torques for ASME

Nominal diameter		ASME Pressure rating [lbs]	Screws	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 1/8"	371	274	–	–
500	20"	Class 150	20 × 1 1/8"	341	252	–	–
600	24"	Class 150	20 × 1 ¼"	477	352	–	–

Promag P tightening torques for JIS

Nominal diameter	JIS Pressure rating	Screws	Max. tightening torque [Nm]	
			PTFE	PFA
[mm]				
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	–
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

Nominal diameter [mm]	JIS Pressure rating	Screws	Max. tightening torque [Nm]	
			PTFE	PFA
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 AS 2129

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

Promag P tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm] PTFE
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 → 35.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

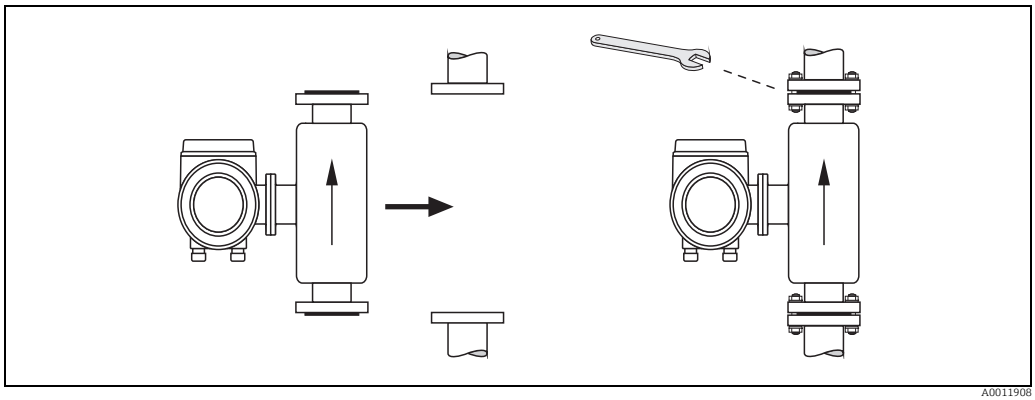


Fig. 23: Installing the Promag W sensor

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, → 128.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 62.

Screw tightening torques (Promag W)

Note the following points:
- The tightening torques listed below are for lubricated threads only.
- Always tighten the screws uniformly and in diagonally opposite sequence.
- Overtightening the screws will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Tightening torques for:

- EN (DIN) → 36
- JIS → 38
- ASME → 38
- AWWA → 39
- AS 2129 → 39
- AS 4087 → 40

Promag W tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm] Hard rubber	Polyurethane
25	PN 40	4 × M 12	-	15
32	PN 40	4 × M 16	-	24
40	PN 40	4 × M 16	-	31
50	PN 40	4 × M 16	-	40
65*	PN 16	8 × M 16	32	27
65	PN 40	8 × M 16	32	27
80	PN 16	8 × M 16	40	34
80	PN 40	8 × M 16	40	34
100	PN 16	8 × M 16	43	36
100	PN 40	8 × M 20	59	50
125	PN 16	8 × M 16	56	48
125	PN 40	8 × M 24	83	71
150	PN 16	8 × M 20	74	63
150	PN 40	8 × M 24	104	88
200	PN 10	8 × M 20	106	91
200	PN 16	12 × M 20	70	61
200	PN 25	12 × M 24	104	92
250	PN 10	12 × M 20	82	71
250	PN 16	12 × M 24	98	85
250	PN 25	12 × M 27	150	134
300	PN 10	12 × M 20	94	81
300	PN 16	12 × M 24	134	118
300	PN 25	16 × M 27	153	138
350	PN 6	12 × M 20	111	120
350	PN 10	16 × M 20	112	118
350	PN 16	16 × M 24	152	165
350	PN 25	16 × M 30	227	252
400	PN 6	16 × M 20	90	98
400	PN 10	16 × M 24	151	167
400	PN 16	16 × M 27	193	215
400	PN 25	16 × M 33	289	326
450	PN 6	16 × M 20	112	126
450	PN 10	20 × M 24	153	133
450	PN 16	20 × M 27	198	196
450	PN 25	20 × M 33	256	253
500	PN 6	20 × M 20	119	123
500	PN 10	20 × M 24	155	171
500	PN 16	20 × M 30	275	300
500	PN 25	20 × M 33	317	360
600	PN 6	20 × M 24	139	147
600	PN 10	20 × M 27	206	219
600 *	PN 16	20 × M 33	415	443
600	PN 25	20 × M 36	431	516
700	PN 6	24 × M 24	148	139
700	PN 10	24 × M 27	246	246
700	PN 16	24 × M 33	278	318
700	PN 25	24 × M 39	449	507
800	PN 6	24 × M 27	206	182
800	PN 10	24 × M 30	331	316
800	PN 16	24 × M 36	369	385
800	PN 25	24 × M 45	664	721
900	PN 6	24 × M 27	230	637
900	PN 10	28 × M 30	316	307

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm] Hard rubber	Polyurethane
900	PN 16	28 × M 36	353	398
900	PN 25	28 × M 45	690	716
1000	PN 6	28 × M 27	218	208
1000	PN 10	28 × M 33	402	405
1000	PN 16	28 × M 39	502	518
1000	PN 25	28 × M 52	970	971
1200	PN 6	32 × M 30	319	299
1200	PN 10	32 × M 36	564	568
1200	PN 16	32 × M 45	701	753
1400	PN 6	36 × M 33	430	398
1400	PN 10	36 × M 39	654	618
1400	PN 16	36 × M 45	729	762
1600	PN 6	40 × M 33	440	417
1600	PN 10	40 × M 45	946	893
1600	PN 16	40 × M 52	1007	1100
1800	PN 6	44 × M 36	547	521
1800	PN 10	44 × M 45	961	895
1800	PN 16	44 × M 52	1108	1003
2000	PN 6	48 × M 39	629	605
2000	PN 10	48 × M 45	1047	1092
2000	PN 16	48 × M 56	1324	1261

* Designed acc. to EN 1092-1 (not to DIN 2501)

Promag W tightening torques for JIS

Sensor Nominal diameter [mm]	JIS Pressure rating	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	10K	4 × M 16	–	19
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	–	33
50	20K	8 × M 16	–	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 tightening torques for ASME

Sensor Nominal diameter [inch]	ASME Pressure rating [lbs]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
1"	Class 150	4 × ½"	–	7
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"	–	22
2"	Class 300	8 × 5/8"	–	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

Sensor Nominal diameter [inch]	ASME Pressure rating [lbs]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
16"	Class 150	16 × 1"	128	150
18"	Class 150	16 × 1 1/8"	204	234
20"	Class 150	20 × 1 1/8"	183	217
24"	Class 150	20 × 1 ¼	268	307

Promag W tightening torques for AWWA

Sensor Nominal diameter [inch]	AWWA Pressure rating	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
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 tightening torques for AS 2129

Sensor Nominal diameter [mm]	AS 2129 Pressure rating	Screws	Max. tightening torque [Nm]
			Hard rubber
80	Table E	4 × M 16	49
100	Table E	8 × M 16	38
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 tightening torques for AS 4087

Sensor Nominal diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm] Hard rubber
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.

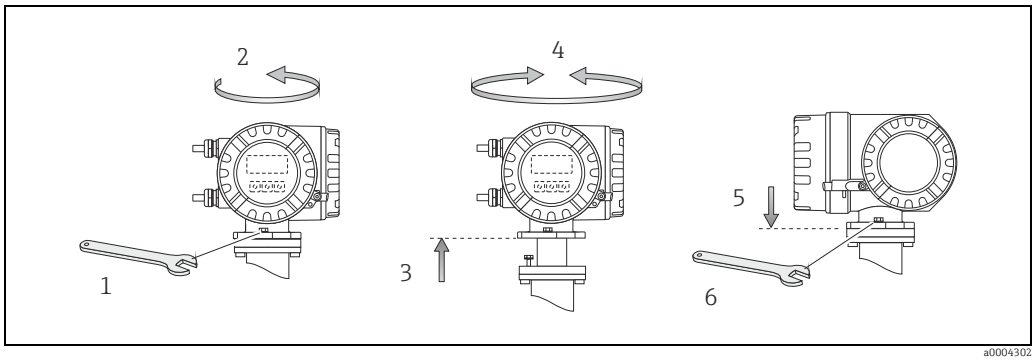


Fig. 24: Turning the transmitter housing (aluminum field housing)

Turning the stainless steel field housing

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

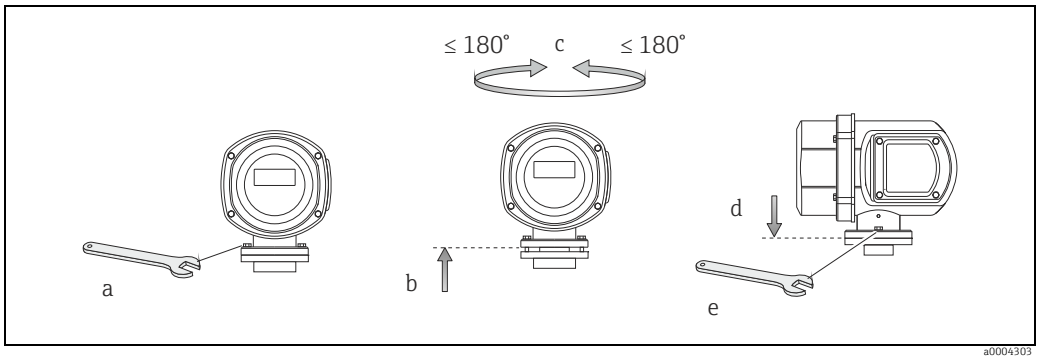


Fig. 25: Turning the transmitter housing (stainless steel field housing)

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.

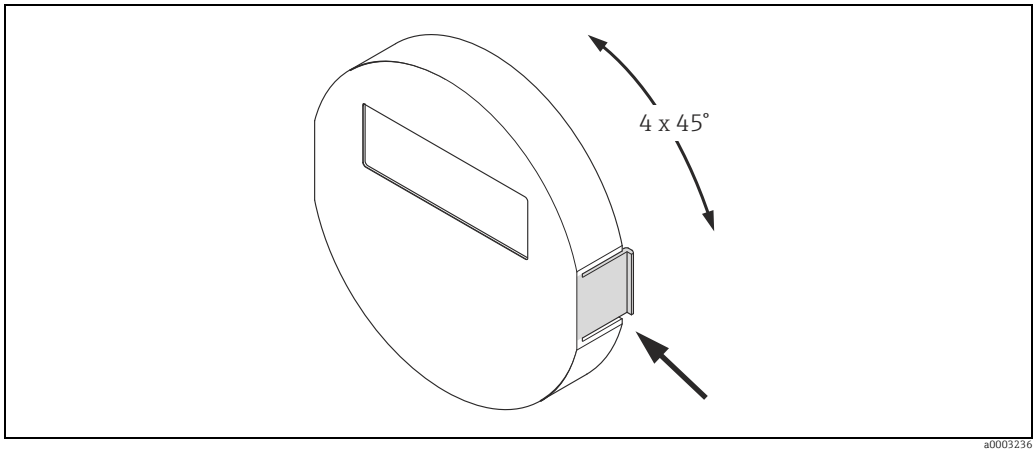


Fig. 26: Turning the local display (field housing)

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) → 📄 44
- Pipe mounting (with separate mounting kit, accessories) → 📄 44

Caution!

- Make sure that the permitted ambient temperature range is observed (see nameplate or → 📄 160). 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 (0.24")
   – 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.

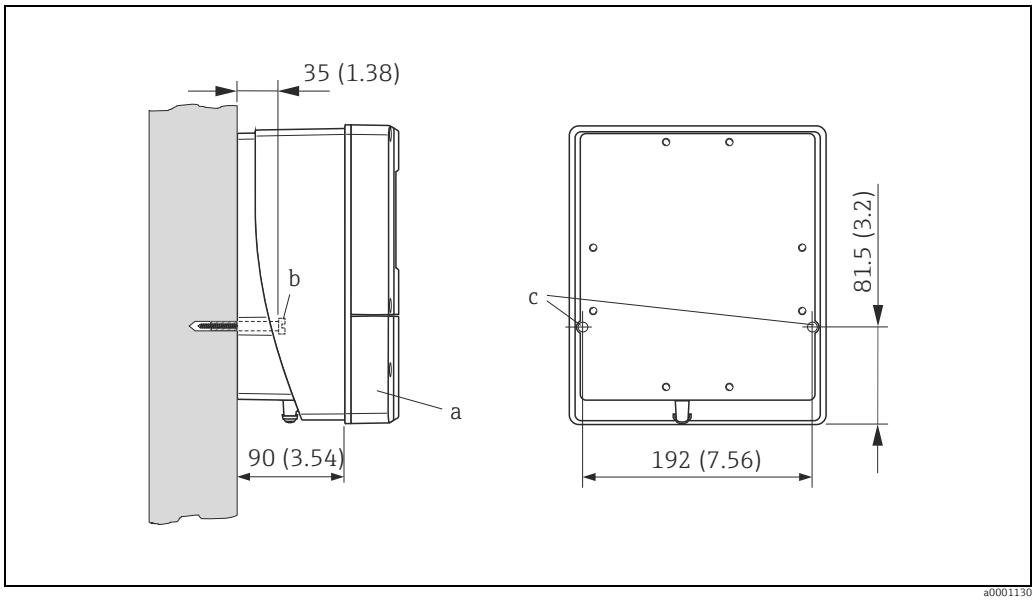


Fig. 27: Mounted directly on the wall

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.

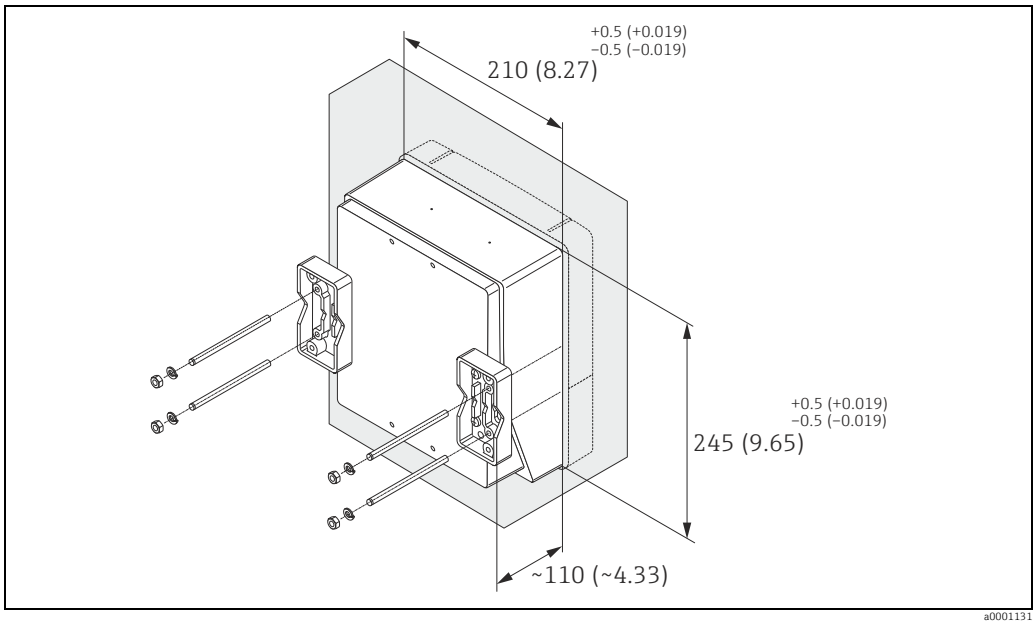


Fig. 28: Panel mounting (wall-mount housing)

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.

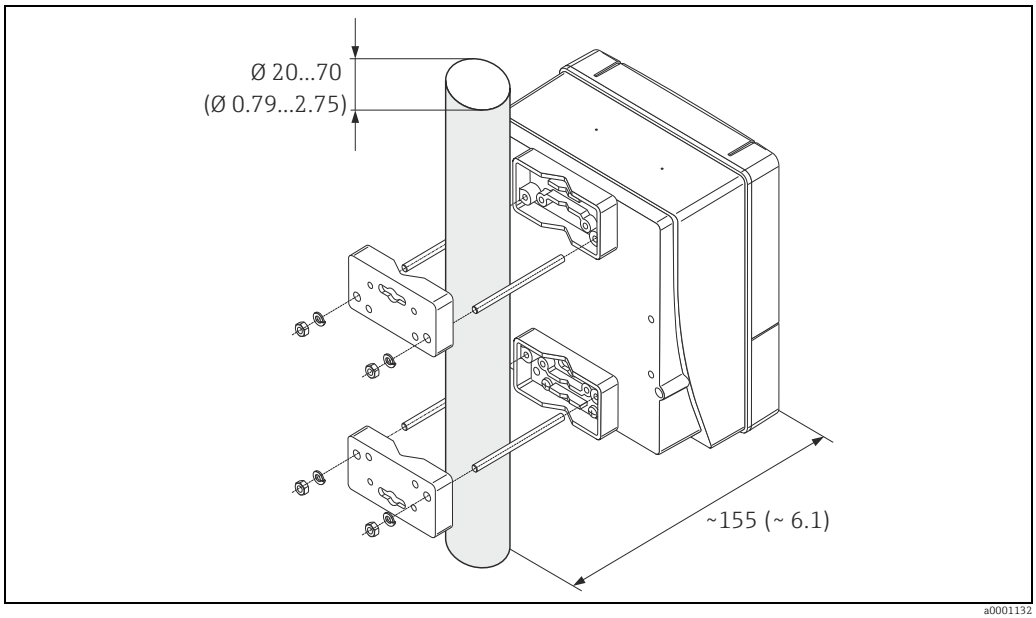


Fig. 29: Pipe mounting (wall-mount housing)

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.?	→ 157
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)?	→ 35
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 → 161

4 Wiring

Warning!
When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to this Operating Manual. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

Note!
The device does not have an internal power switch. For this reason, assign the device a switch or power-circuit breaker which can be used to disconnect the power supply line from the power grid.

4.1 PROFIBUS cable specifications

4.1.1 PROFIBUS DP cable specification

Cable type

Two versions of the bus line are specified in IEC 61158. Cable type A can be used for all transmission rates up to 12 Mbit/s. Please refer to the table for the cable parameters:

Cable type A	
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	< 30 pF/m
Core cross-section	>0.34 mm², corresponds to AWG 22
Cable type	Twisted in pairs, 1 x 2, 2 x 2 or 1 x 4 wire
Loop-resistance	110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable section
Shielding	Copper braided shielding or braided shielding and foil shielding

Bus structure

Note the following points:
- The maximum line length (segment length) depends on the transmission rate. For cable type A, the maximum line length (segment length) is as follows:

Transmission rate [kBit/s]	9.6 to 93.75	187.5	500	1500	300 to 12000
Line length [m] ([inch])	1200 (4000)	1000 (3300)	400 (1300)	200(650)	100(330)

- A maximum of 32 users are permitted per segment.
- Each segment is terminated at either end with a terminating resistor.
- The bus length or the number of users can be increased by introducing a repeater.
- The first and last segment can comprise max. 31 devices. The segments between the repeaters can comprise max. 30 stations.
- The maximum distance between two bus users can be calculated as follows: (NO_REP + 1) x segment length

  Note!
  NO_REP = maximum number of repeaters that may be switched in series depending on the repeater in question.

Example

In accordance with manufacturer specifications, 9 repeaters can be switched in series when using a standard line. The maximum distance between two bus users at a transmission rate of 1.5 MBit/s can be calculated as follows: (9 + 1) x 200 m = 2000 m

Spurs

Note the following points:
- Length of spurs < 6.6 m (21.7 ft) (at max.1.5 MBit/s)
- No spurs should be used for transmission rates >1.5 MBit/s. The line between the connector and the bus driver is described as a spur. Experience has shown that you should proceed with caution when configuring spurs. For this reason, you cannot assume that the sum of all spurs at 1.5 MBit/s will be 6.6 m (21.7 ft). This is affected greatly by the arrangement of the field devices. Therefore, we recommend that if possible, you do not use any spurs at transmission rates >1.5 MBit/s.
- If you cannot avoid using spurs, then they may not include any bus terminators.

Bus termination

It is important to terminate the RS485 line correctly at the start and end of the bus segment, since impedance mismatch results in reflections on the line which can cause faulty data transmission.→ 79

Further information

General information and further notes regarding the wiring are contained in BA034S/04: "Guidelines for planning and commissioning, PROFIBUS DP/PA, field communication."

4.1.2 PROFIBUS PA cable specification

Cable type

Twin-core cables are recommended for connecting the device to the fieldbus. Following IEC 61158-2 (MBP), four different cable types (A, B, C, D) can be used with the fieldbus, only two of which (cable types A and B) are shielded.

- Cable types A or B are particularly preferable for new installations. Only these types have cable shielding that guarantees adequate protection from electromagnetic interference and thus the most reliable data transfer. In the case of type B multi-pair cables, multiple fieldbuses with the same degree of protection may be operated on one cable. No other circuits are permissible in the same cable.
- Practical experience has shown that cable types C and D should not be used due to the lack of shielding, since the freedom from interference generally does not meet the requirements described in the standard.

The electrical data of the fieldbus cable have not been specified but determine important characteristics of the design of the fieldbus, such as distances bridged, number of users, electromagnetic compatibility etc.

	Type A	Type B
Cable structure	Twisted pair, shielded	One or more twisted pairs, fully shielded
Wire cross-section	0.8 mm² (AWG 18)	0.32 mm² (AWG 22)
Loop-resistance (DC)	44 Ω/km	112 Ω/km
Characteristic impedance at 31.25 kHz	100 Ω ± 20%	100 Ω ± 30%
Attenuation constant at 39 kHz	3 dB/km	5 dB/km
Capacitive asymmetry	2 nF/km	2 nF/km

	Type A	Type B
Envelope delay distortion (7.9 to 39 kHz)	1.7 µs/km	*
Shield coverage	90%	*
Max. cable length (incl. spurs >1 m (> 3 ft))	1900 m (6200 ft)	1200 m (4000 ft)

* Not specified

Suitable fieldbus cables from various manufacturers for non-hazardous areas are listed below:
- Siemens: 6XV1 830-5BH10
- Belden: 3076F
- Kerpen: CeL-PE/OSCR/PVC/FRLA FB-02YS(ST)YFL

Maximum overall cable length

The maximum network expASMEon depends on the type of explosion protection and the cable specifications. The overall cable length combines the length of the main cable and the length of all spurs (>1 m) (>3 ft).

Note the following points:
- The maximum permissible overall cable length depends on the cable type used:

Type A	1900 m	6200 ft
Type B	1200 m	4000 ft

- If repeaters are used, the maximum permissible cable length is doubled.
  A maximum of three repeaters are permitted between user and master.

Maximum spur length

The line between the distribution box and field device is described as a spur.
In the case of non-Ex applications, the max. length of a spur depends on the number of spurs (>1 m):

Number of spurs		1 to 12	13 to 14	15 to 18	19 to 24	25 to 32
Max. length per spur	[m]	120	90	60	30	1
	[ft]	400	300	200	100	3

Number of field devices

In systems that meet FISCO with EEx ia type of protection, the line length is limited to max. 1000 m (3280 in) . A maximum of 32 users per segment in non-Ex areas or a maximum of 10 users in an Ex-area (EEx ia IIC) is possible. The actual number of users must be determined during configuration.

Bus termination

The start and end of each fieldbus segment are always to be terminated with a bus terminator. With various junction boxes (non-Ex), the bus termination can be activated via a switch. If this is not the case, a separate bus terminator must be installed.

Note the following points:
- In the case of a branched bus segment, the device furthest from the segment coupler represents the end of the bus.
- If the fieldbus is extended with a repeater then the extension must also be terminated at both ends.

Further information

General information and further notes regarding the wiring are contained in BA034S/04: "Guidelines for planning and commissioning, PROFIBUS DP/PA, field communication."

4.1.3 Shielding and grounding

When planning the shielding and grounding for a fieldbus system, there are three important points to consider:

- Electromagnetic compatibility (EMC)
- Explosion protection
- Safety of the personnel

To ensure the optimum electromagnetic compatibility of systems, it is important that the system components and above all the cables, which connect the components, are shielded and that no portion of the system is unshielded. Ideally, the cable shields are connected to the normally metal housings of the connected field devices. Since these are generally connected to the protective ground, the shield of the bus cable is grounded many times. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.
This approach, which provides the best electromagnetic compatibility and personal safety, can be used without restriction in systems with good potential matching.
In the case of systems without potential matching, a power supply frequency (50 Hz) equalizing current can flow between two grounding points which, in unfavorable cases, e.g. when it exceeds the permissible shield current, may destroy the cable.
To suppress the low frequency equalizing currents on systems without potential matching, it is therefore recommended to connect the cable shield directly to the building ground (or protective ground) at one end only and to use capacitive coupling to connect all other grounding points.

Caution!
The legal EMC requirements are fulfilled **only** when the cable shield is grounded on both sides!

4.2 Connecting the remote version

4.2.1 Connecting Promag E/H/L/P/W

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 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 signal cable (c) and coil current cable (d) through the appropriate cable entries.

   Caution!
   Secure the connecting cable (see "Length of connecting cable" → 19).
4. Terminate the signal and coil current cable in accordance with the table:
   Promag E/L/P/W → Please see the "Cable termination" table → 52
   Promag H → Please see the "Cable termination" table → 53
5. Set up the wiring between the sensor and the transmitter.
   The wiring diagram applicable to your device can be found:
   - in the relevant diagram:
     → 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 using strain relief clamps (please see the "Cable termination" table → 53).

   Caution!
   Insulate the cable shields that are not connected. This eliminates the risk of short-circuits with neighboring cable shields inside the connection housing.
6. Transmitter: Secure the cover on the connection compartment (a).
7. Sensor: Mount the cover on the connection housing (b).

Promag E/L/P/W

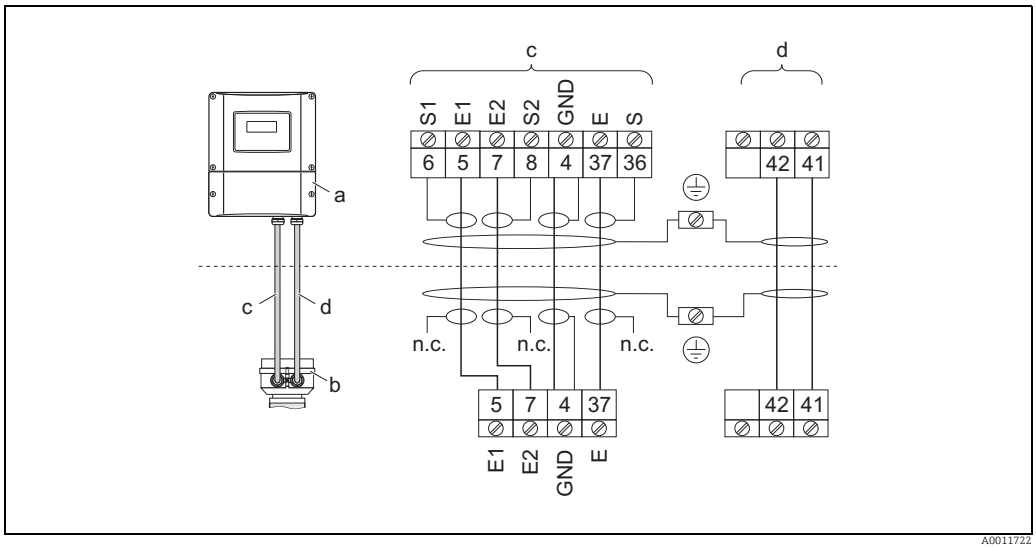


Fig. 30: Connecting the remote version of Promag E/L/P/W

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

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

Promag H

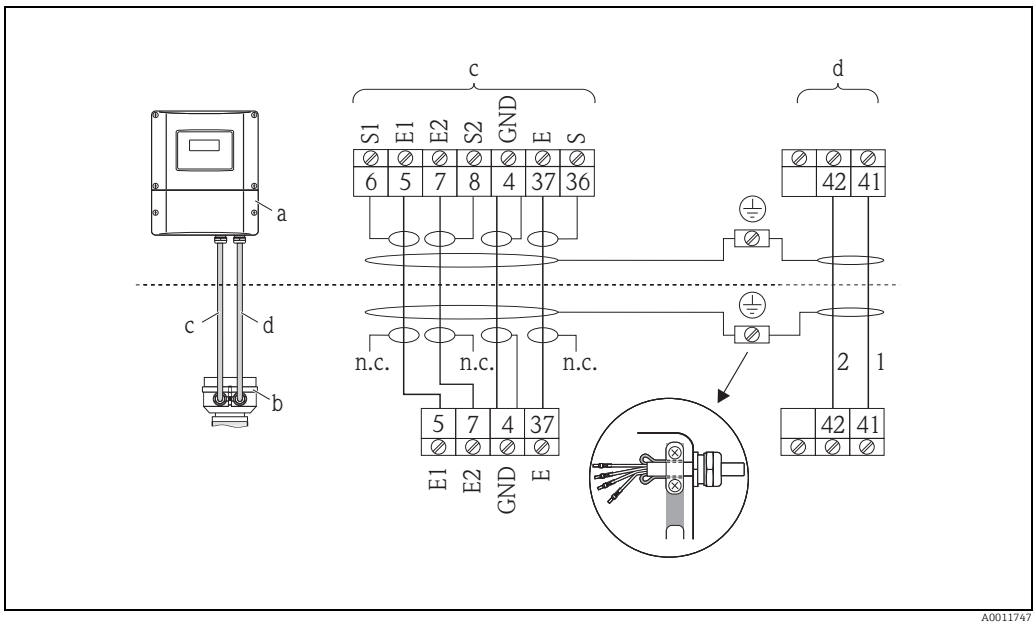


Fig. 31: Connecting the remote version of Promag H

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

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

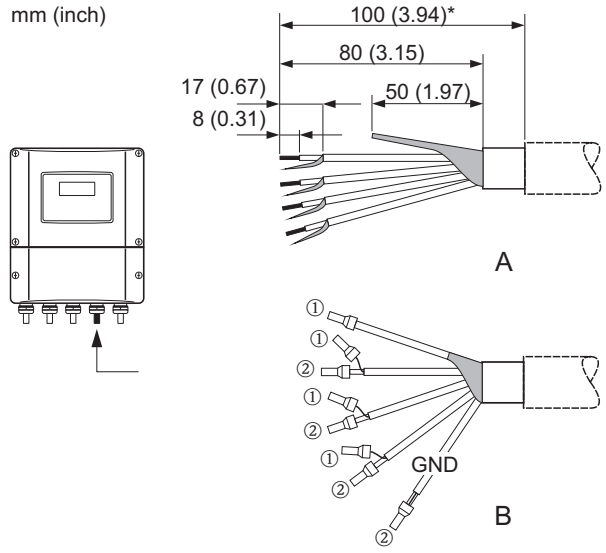
Cable termination in remote version
Promag E/L/P/W

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

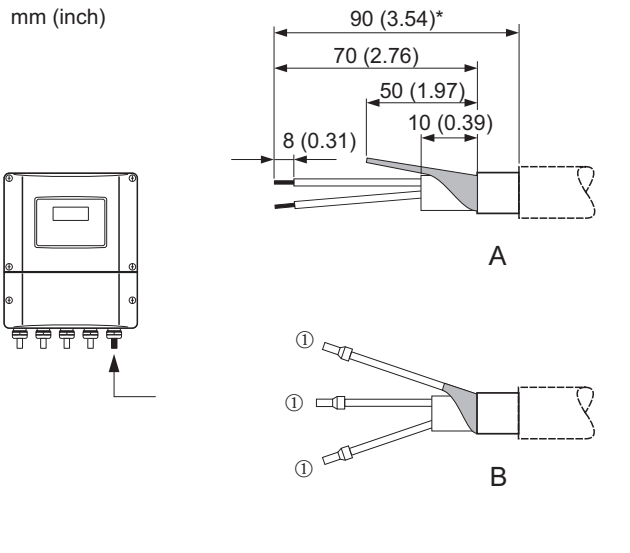
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the wire end ferrules do not touch the wire shields on the sensor side! Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire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

TRANSMITTER

Signal cable

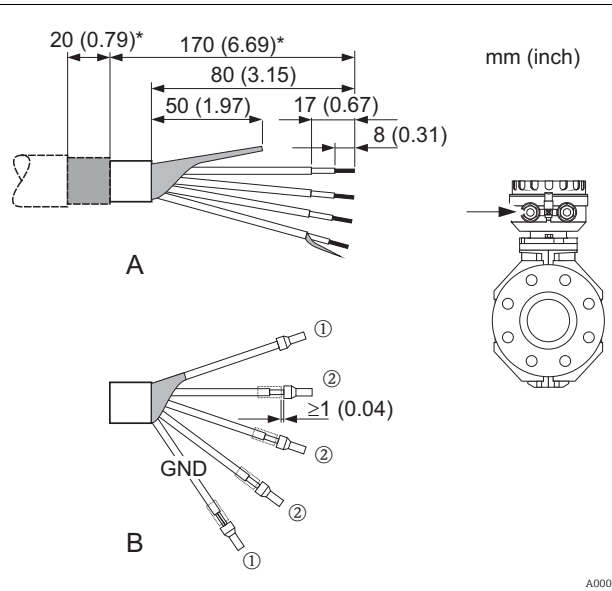


Coil current cable

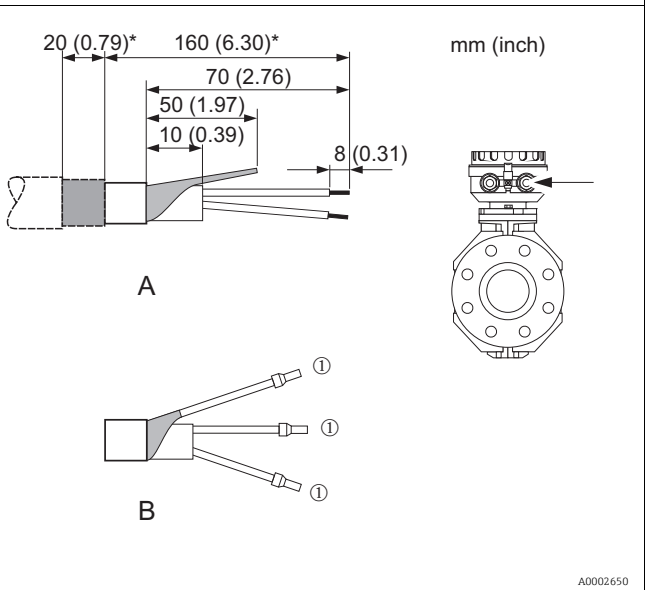


SENSOR

Signal cable



Coil current cable



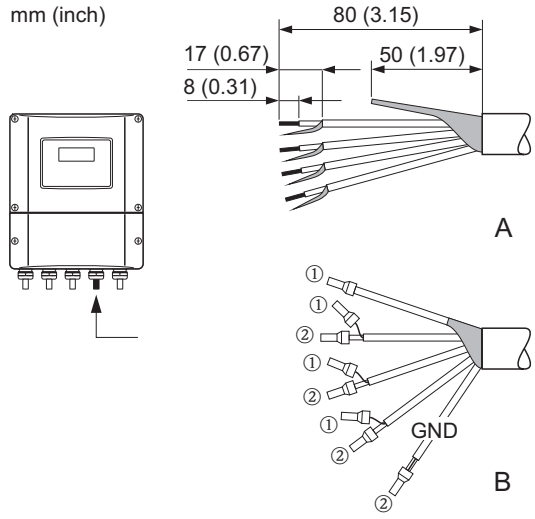
Cable termination in remote version
Promag H

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)

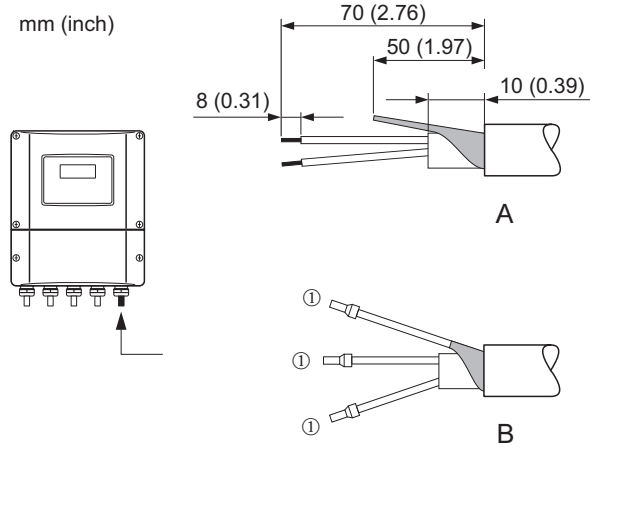
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the wire end ferrules do not touch the wire shields on the sensor side! Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire 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

Signal cable

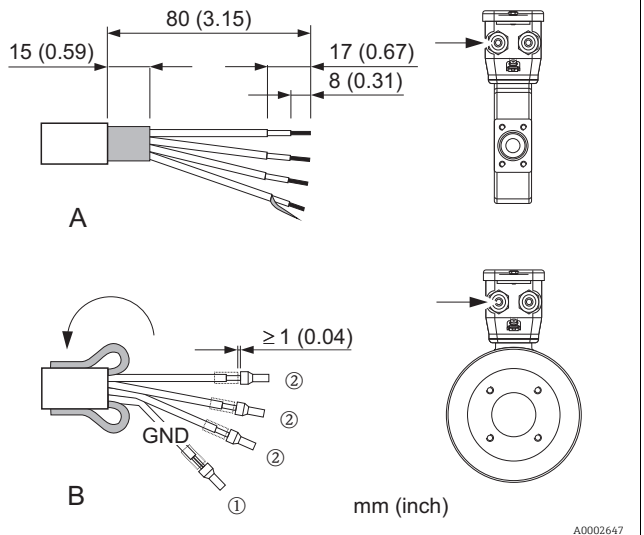


Coil current cable

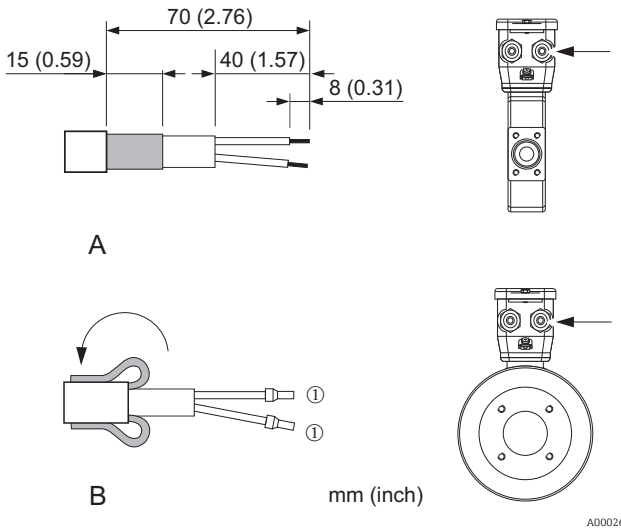


SENSOR

Signal cable



Coil current cable



4.2.2 Cable specifications

Signal cable

- 3 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) 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 cable

- 2 × 0.75 mm² PVC cable with common, braided copper shield (Ø ~ 7 mm)
- 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

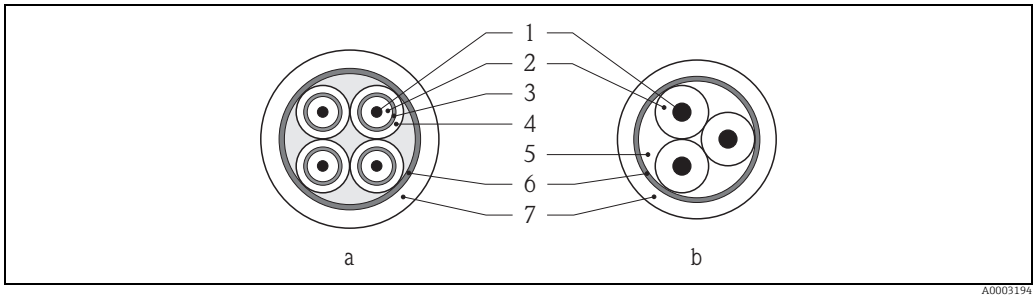


Fig. 32: Cable cross-section

a Signal 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 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.

4.3 Connecting the measuring unit

4.3.1 Terminal assignment

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

PROFIBUS DP

Caution!
Only certain combinations of submodules (see Table) on the I/O board are permissible. The individual slots are also marked and assigned to the following terminals in the connection compartment of the transmitter:
- "INPUT / OUTPUT 3" slot = terminals 22/23
- "INPUT / OUTPUT 4" slot = terminals 20/21

Order version	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-) Submodule on slot No. 4	22 (+) / 23 (-) Submodule on slot No. 3	24 (+) / 25 (-) Fixed on I/O board	26 = B (RxD/TxD-P) 27 = A (RxD/TxD-N) Fixed on I/O board
53***-**********J	-	-	+5V(ext. termination)	PROFIBUS DP
53***-**********V	Relay output 2	Relay output 1	Status input	PROFIBUS DP
53***-**********P	Current output	Frequency output	Status input	PROFIBUS DP

PROFIBUS PA

Order version	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 = PA + [1] 27 = PA - [1]
53***-**********F	-	-	-	PROFIBUS PA, Ex i
53***-**********H	-	-	-	PROFIBUS PA

[1] With integrated reverse polarity protection

4.3.2 Transmitter connection

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 parts of the electronics.
- Risk of electric shock. Connect the protective ground to the ground terminal on the housing before the power supply is applied (not required for galvanically isolated power supply).
- Compare the specifications on the nameplate with the local supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.

1. Unscrew the connection compartment cover (a) from the transmitter housing.
2. Feed the power supply cable (b), the signal cable (d) and the fieldbus cable (e) through the appropriate cable entries.
3. Perform wiring in accordance with the respective terminal assignment and the associated wiring diagram.

   Caution!
   – Risk of damage to the fieldbus cable!
   Observe the information about shielding and grounding the fieldbus cable. → 49
   – We recommend that the fieldbus cable not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.
4. Screw the cover of the connection compartment (a) back onto the transmitter housing.

4.3.3 PROFIBUS DP connection diagram

Permanent assignment board (order version 53*-**********J)**

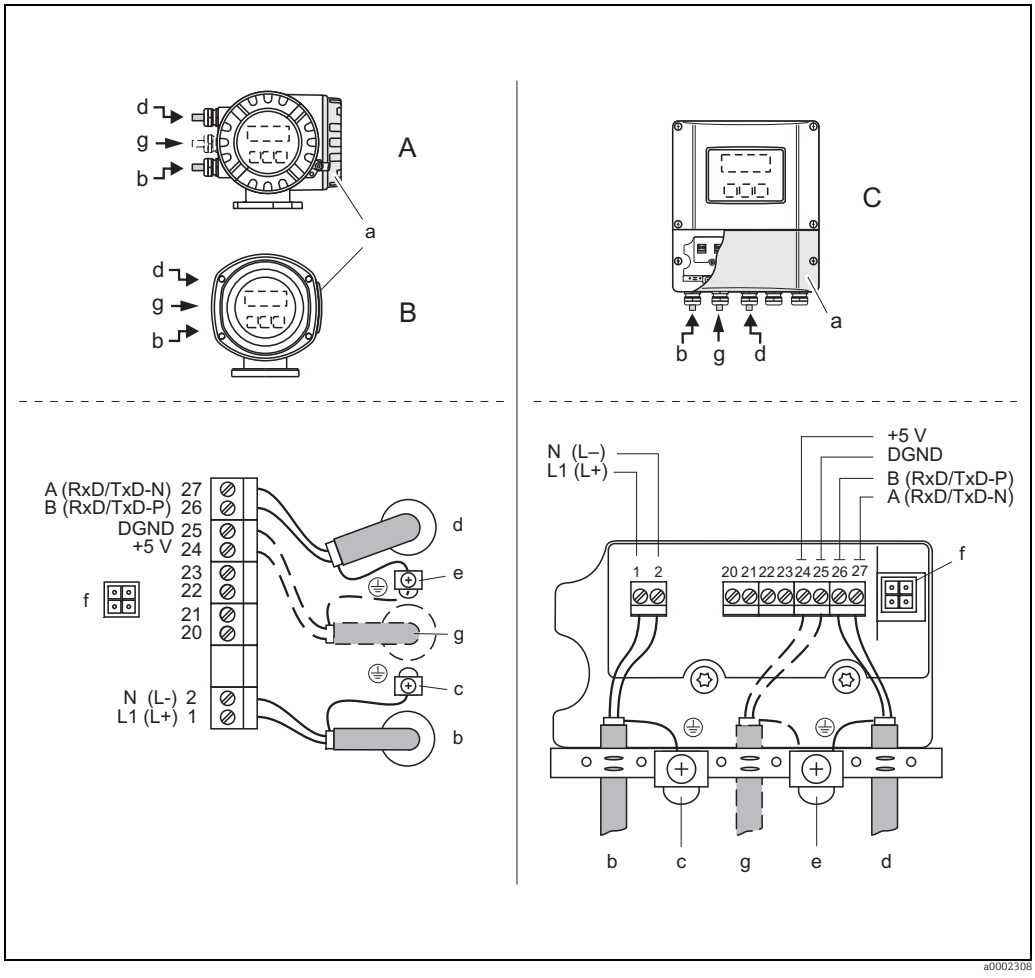


Fig. 33: Connecting the transmitter, cable cross-section: max. 2.5 mm² (14 AWG)

A View A (field housing)
B View B (stainless steel field housing)
C View C (wall-mount housing)

a Connection compartment cover
b 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
c Ground terminal for protective conductor
d Fieldbus cable
Terminal No. 26: B (RxD/TxD-P)
Terminal No. 27: A (RxD/TxD-N)
e Ground terminal for fieldbus cable shield
Observe the following:
– the shielding and grounding of the fieldbus cable → 🖹 49
– that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible
f Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)
g Cable for external termination:
Terminal No. 24: +5 V
Terminal No. 25: DGND

Flexible assignment boards (order version 53***-***********V and 53***-***********P)

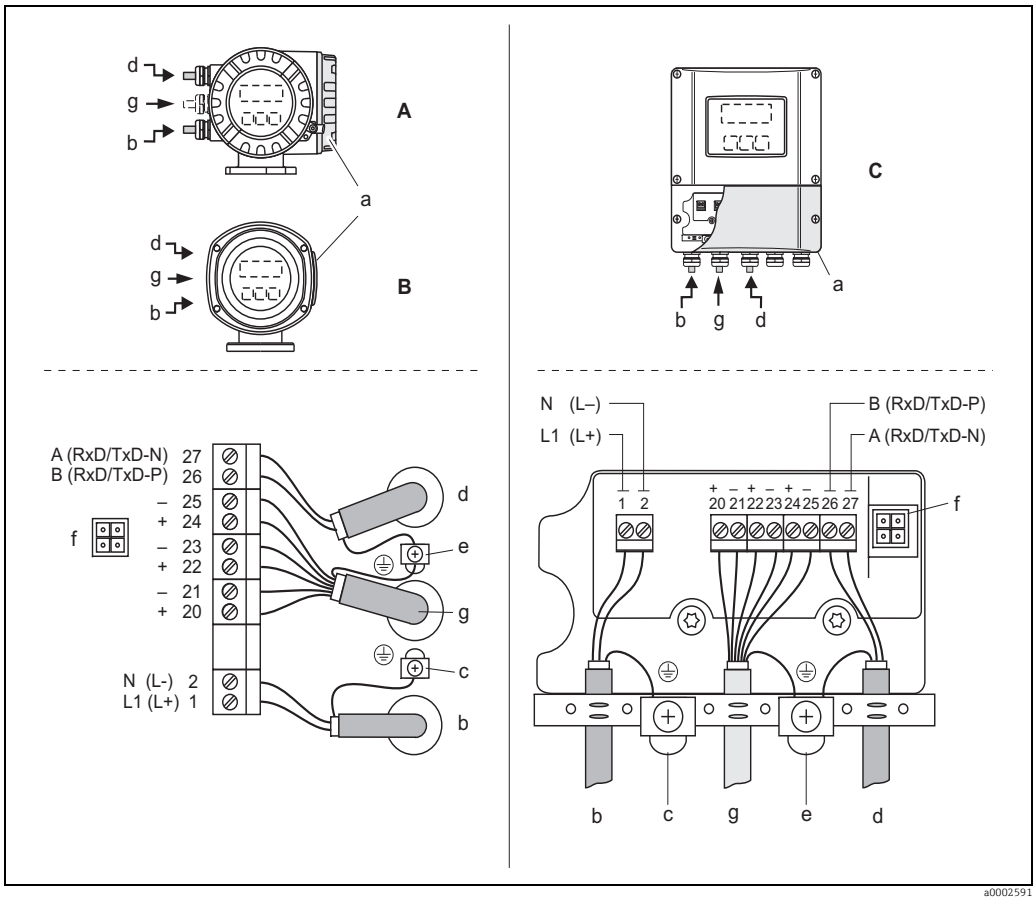


Fig. 34: Connecting the transmitter, cable cross-section: max. 2.5 mm² (14 AWG)

A View A (field housing)
B View B (stainless steel field housing)
C View C (wall-mount housing)

a Connection compartment cover
b 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
c Ground terminal for protective conductor
d Fieldbus cable
Terminal No. 26: B (RxD/TxD-P)
Terminal No. 27: A (RxD/TxD-N)
e Ground terminal for signal cable shield/fieldbus cable shield
Observe the following:
– the shielding and grounding of the fieldbus cable → 🖹 49
– that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible
f Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)
g Signal cable: see Terminal assignment → 🖹 55

4.3.4 PROFIBUS PA connection diagram

Permanent assignment boards (order version 53*-**********F and 53***-**********H)**

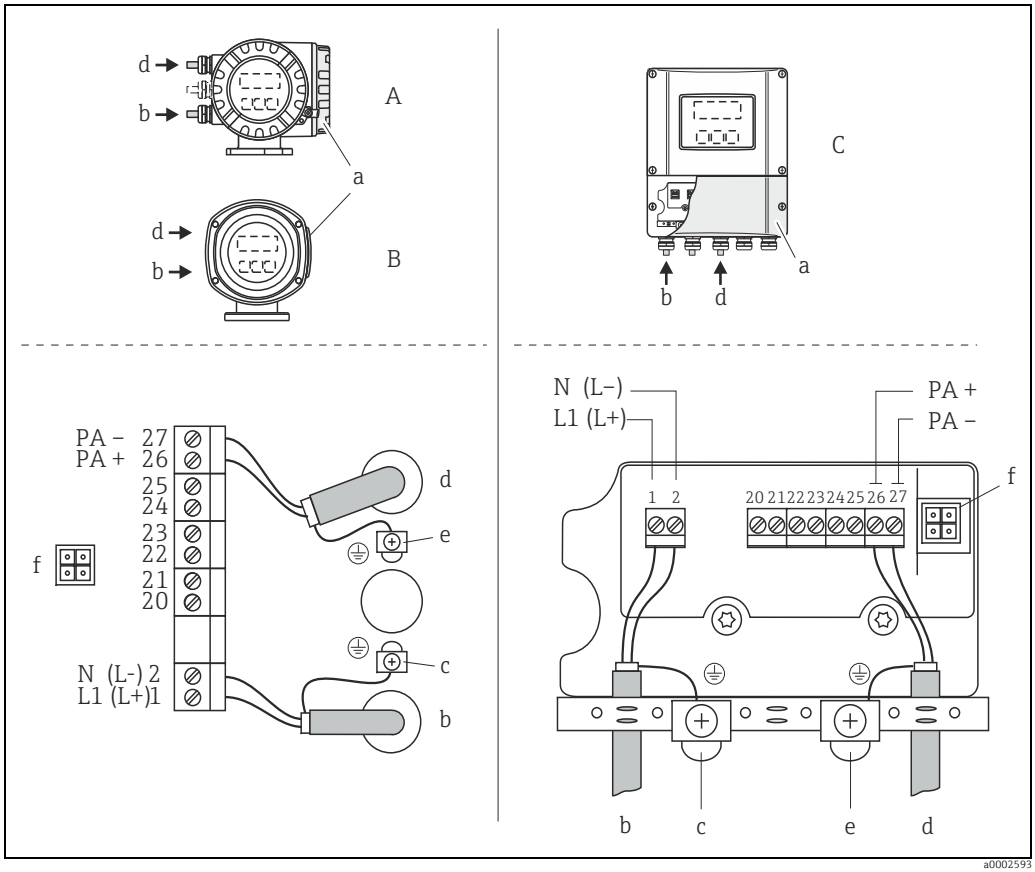


Fig. 35: Connecting the transmitter, cable cross-section: max. 2.5 mm² (14 AWG)

A View A (field housing)
B View B (stainless steel field housing)
C View C (wall-mount housing)

a Connection compartment cover
b 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
c Ground terminal for protective conductor
d Fieldbus cable:
Terminal No. 26: PA + (with reverse polarity protection)
Terminal No. 27: PA - (with reverse polarity protection)
e Ground terminal for fieldbus cable shield
Observe the following:
– the shielding and grounding of the fieldbus cable → 🖹 49
– that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible
f Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)

Fieldbus connector

Note!
The connector can only be used for PROFIBUS PA devices.

The connection technology of PROFIBUS PA allows measuring devices to be connected to the fieldbus via uniform mechanical connections such as T-boxes, distribution modules etc.

This connection technology, which uses prefabricated distribution modules and plug-in connectors, offers substantial advantages over conventional wiring:
- Field devices can be removed, replaced or added at any time during normal operation. Communication is not interrupted.
- Installation and maintenance are significantly easier.
- Existing cable infrastructures can be used and expanded instantly, e.g. when constructing new star distributors using 4-channel or 8-channel distribution modules.

The device can therefore be supplied with the option of a ready-mounted fieldbus connector. Fieldbus connectors for retrofitting can be ordered from Endress+Hauser as a spare part.→ 128

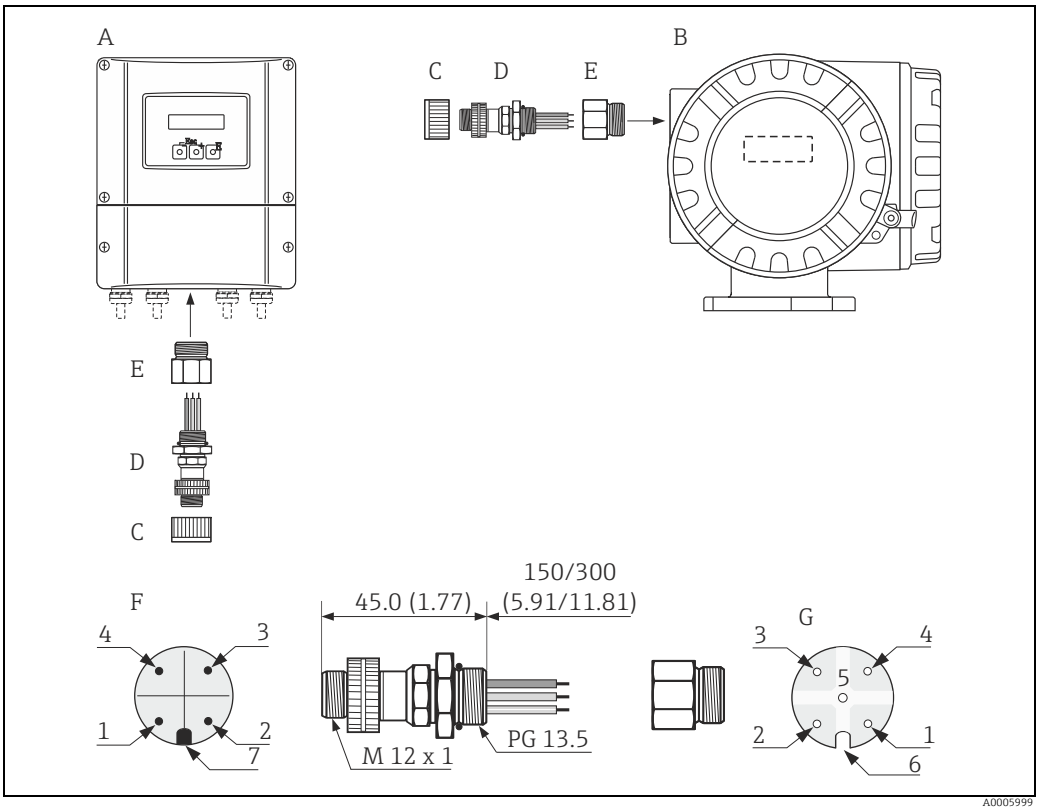


Fig. 36: Connectors for connecting to the PROFIBUS PA

A Aluminum field housing
B Stainless steel field housing
C Protection cap for connector
D Fieldbus connector
E Adapter PG 13.5 / M 20.5
F Connector at housing (male)
G Female connector

Pin assignment/color codes:
1 Brown wire: PA + (terminal 26)
2 Not connected
3 Blue wire: PA - (terminal 27)
4 Black wire: ground (instructions for connection → 57)
5 Middle female connector not assigned
6 Positioning groove
7 Positioning key

Technical data (fieldbus connector):

Connection cross section	0.75 mm^2 (19 AWG)
Connector thread	PG 13.5
Degree of protection	IP 67 in accordance with DIN 40 050 IEC 529
Contact surface	CuZnAu
Housing material	Cu Zn, surface Ni
Flammability	V - 2 in accordance with UL - 94
Operating temperature	−40 to +85 °C, (−40 to +185 °F)
Ambient temperature	−40 to +150 °C, (−40 to +302 °F)
Nominal current per contact	3 A
Nominal voltage	125 to 150 V DC in accordance with the VDE Standard 01 10/ISO Group 10
Resistance to tracking	KC 600
Volume resistance	≤ 8 mΩ in accordance with IEC 512 Part 2
Insulation resistance	≤ 10^{12} Ω in accordance with IEC 512 Part 2

Shielding of the supply line/T-box

Use cable glands with good EMC properties, with surrounding contact of the cable gland (iris spring). This requires small differences in potential, and possibly potential matching.
- Do not interrupt the shielding of the PA cable.
- Always keep the connection of the shielding as short as possible.

Ideally, cable glands with iris springs should be used for the connection of the shielding. The shield is placed on the T-box via the iris spring that is inside the cable gland. The shielding mesh is located under the iris spring. When the PG thread is screwed closed, the iris spring is pressed onto the shield, making a conductive connection between the shielding and the metal housing.

A junction box or connection is to be considered part of the shielding (Faraday cage). This is particularly true for offset boxes when these are connected to a PROFIBUS PA measuring device using a plug-in cable. In such a case, use a metallic plug in which the cable shielding is attached to the plug housing (such as prefabricated cables).

4.4 Potential matching

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)

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

Reference electrode available as standard

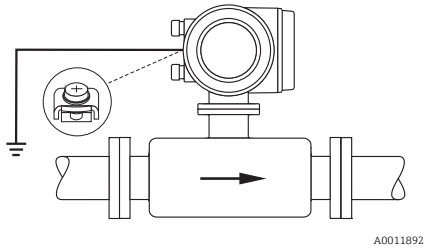
4.4.2 Potential equalization, Promag H

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

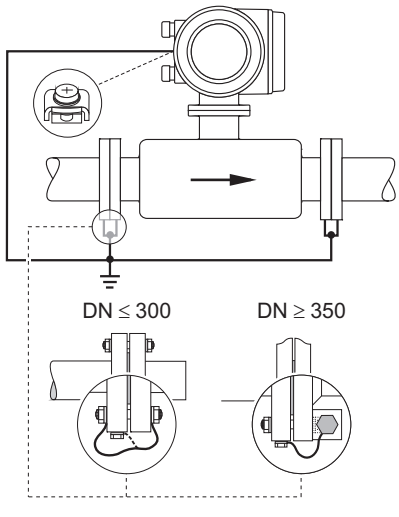
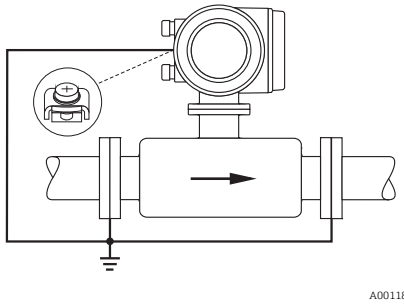
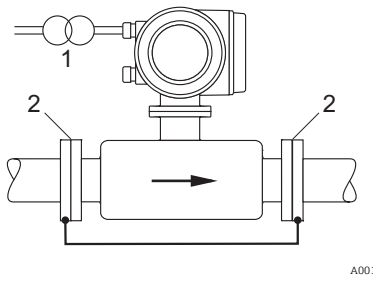
Caution!
When using process connections made of plastic, potential equalization must be guaranteed through the use of grounding rings → 24.
The necessary grounding rings may be ordered separately as an accessory from Endress+Hauser (→ 128).

4.4.3 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. 37: 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. 38: 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. 39: 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 in²)), 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. 40: Potential equalization and cathodic protection* *1 Isolation transformer power supply* *2 Electrically isolated*

4.5 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 → 159.
- 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.

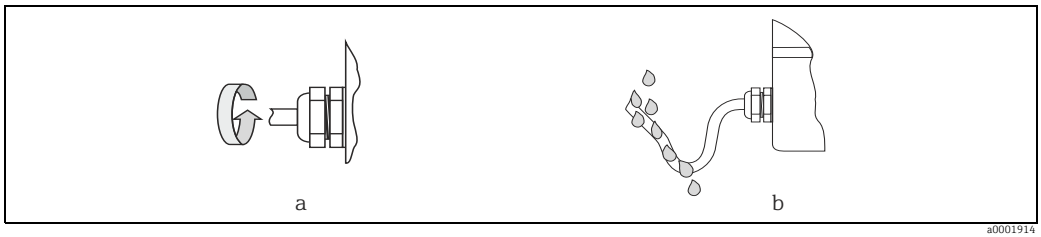


Fig. 41: Installation instructions, cable entries

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 also 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.

4.6 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 260 V AC (45 to 65 Hz) 20 to 55 V AC (45 to 65 Hz) 16 to 62 V DC
Do the cables comply with the specifications?	PROFIBUS DP → 🖹 46 PROFIBUS PA→ 🖹 47 Sensor cable → 🖹 54
Do the cables have adequate strain relief?	–
Cables correctly segregated by type? Without loops and crossovers?	–
Are the power supply and signal cables correctly connected?	See the wiring diagram inside the cover of the connection compartment
Are all screw terminals firmly tightened?	–
Have the measures for grounding and potential matching been correctly implemented?	→ 🖹 62
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 🖹 64
Are all housing covers installed and firmly tightened?	–
Electrical connection of PROFIBUS DP/PA	**Notes**
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected to each other correctly?	–
Has each fieldbus segment been terminated at both ends with a bus terminator?	PROFIBUS DP → 🖹 79
Has the max. length of the fieldbus cable been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → 🖹 46 PROFIBUS PA→ 🖹 48
Has the max. length of the spurs been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → 🖹 47 PROFIBUS PA→ 🖹 48
Is the fieldbus cable fully shielded and correctly grounded?	→ 🖹 49

5 Operation

5.1 Quick operation guide

The user has a number of options for configuring and commissioning the device:

1. **Local display (option) → 67**
   The local display enables you to read all important variables directly at the measuring point, configure device-specific parameters in the field and perform commissioning.
2. **Configuration programs → 74**
   The configuration of profile and device-specific parameters is primarily done via the PROFIBUS interface. You can obtain special configuration and operating programs from various manufacturers for these purposes.
3. **Jumpers/miniature switches for hardware settings**
   – PROFIBUS DP → 77
   – PROFIBUS PA→ 82
   You can make the following hardware settings using a jumper or miniature switches on the I/O board:
   - Address mode configuration (select software or hardware addressing)
   - Device bus address configuration (for hardware addressing)
   - Hardware write protection enabling/disabling

   Note!
   A description of the configuration of the current output (active/passive) and the relay output (NC contact/NO contact) is contained in the "Hardware settings" section. → 80

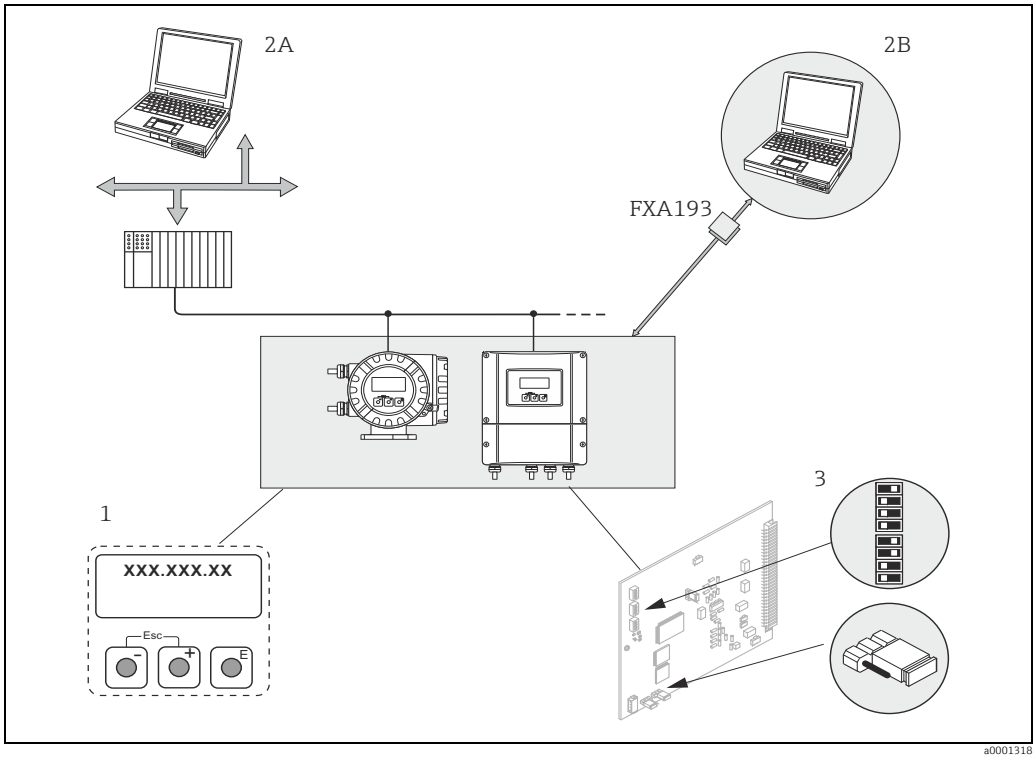


Fig. 42: Methods of operating PROFIBUS PA/DP

1 Local display for device operation in the field (option)
2A Configuration/operating programs (e.g. FieldCare) for operation via PROFIBUS DP/PA
2B Configuration/operating program for operating by means of the FXA193 service interface (e.g. FieldCare)
3 Jumper/miniature switches for hardware settings (write protection, device address, address mode)

5.2 Local display

5.2.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the 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 different variables to suit your needs and preferences (→ see the "Description of Device Functions" manual).

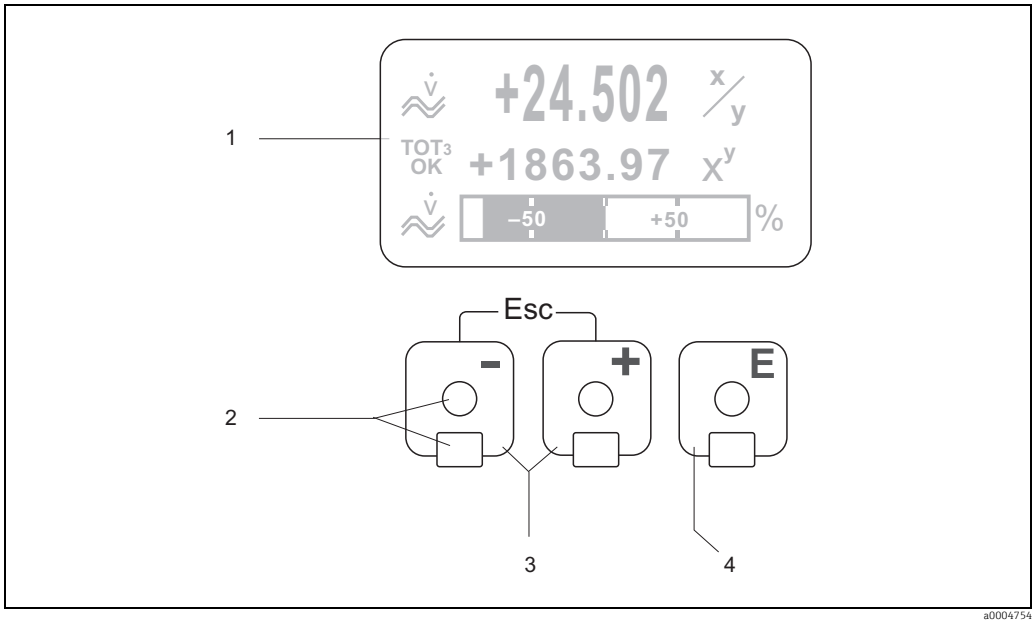


Fig. 43: Display and operating elements

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 ⊟/⊞ 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*

5.2.2 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 different variables 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 → 🖹 73

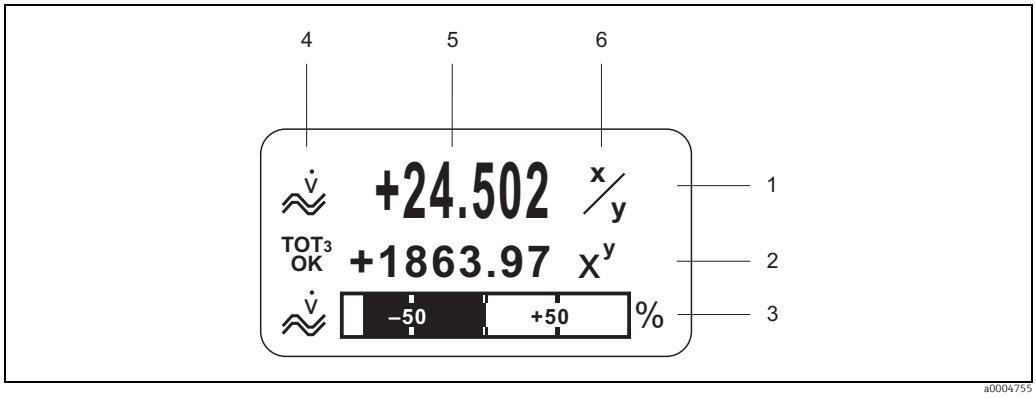


Fig. 44: Typical display for normal operating mode (HOME position)

1 Main display line: shows primary measured values, e.g. mass flow in [kg/h]
2 Additional line: shows measured variables and status variables, e.g. totalizer No. 3 in [t]
3 Information line: shows additional information on the measured variables and status variables, e.g. bar graph display of the full scale value achieved by the mass flow
4 "Info icons" field: icons representing additional information on the measured values are shown in this field. → 🖹 69
5 "Measured values" field: the current measured values appear in this field
6 "Unit of measure" field: the units of measure and time defined for the current measured values appear in this field

5.2.3 Additional display functions

Depending on the order option (F-CHIP → 🖹 126), 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 devices with installed batching software (F-Chip → 🖹 126) and a suitably configured display line, you can carry out filling processes directly using the local display. You will find a detailed description on → 🖹 70.

5.2.4 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	P 1 to n	Pulse output 1 to n
F 1 to n	Frequency output 1 to n	S 1 to n	Status output/relay output 1 to n
 a0001181	Measuring mode: PULSATING FLOW	 a0001182	Measuring mode: SYMMETRY (bidirectional)
 a0001183	Measuring mode: STANDARD		
 a0001188	Volume flow	 a0001195	Mass flow
 a0001201	Batching quantity upwards	 a0001202	Batching quantity downwards
 a0001203	Batching quantity	 a0001204	Batch sum
 a0001205	Batch counter (x times)	← → (scrolling display)	Cyclic communication via PROFIBUS active, for example via PLC (Class 1 master)
 a0001206	Acyclic communication via PROFIBUS active (e.g. via FieldCare)		
 a0002322	Display value (DISPLAY_VALUE module) with status GOOD = good	 a0002321	Display value (DISPLAY_VALUE module) with status UNC = uncertain
 a0002320	Display value (DISPLAY_VALUE module) with status BAD = bad		
 a0004616	Output value OUT, analog input 1 to 2 (AI module) with status GOOD = good	 a0002325	Output value OUT, totalizer 1 to 3 (TOTAL module) with status GOOD = good
 a0004617	Output value OUT, analog input 1 to 2 (AI module) with status UNC = uncertain	 a0002327	Output value OUT, totalizer 1 to 3 (TOTAL module) with status UNC= unclear
 a0004618	Output value OUT, analog input 1 to 2 (AI module) with status BAD = bad	 a0002329	Output value OUT, totalizer 1 to 3 (TOTAL module) with status BAD= bad

5.2.5 Controlling the batching processes using the local display

Filling processes can be carried out directly by means of the local display with the aid of the optional "(Batching)" software package (F-CHIP, accessories → 🖹 128). 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 (→ 🖹 90) or use the function matrix (→ 🖹 71).
   The following "softkeys" then appear on the bottom line of the local display → 🖸 45:
   – 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**	**Settings**
7200	BATCH SELECTOR	OS → Selection of the batching fluid (BATCH #1 to 6)
7203	BATCHING 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 QUANTITY/ TOTALIZER	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. → 🖸 45
   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.

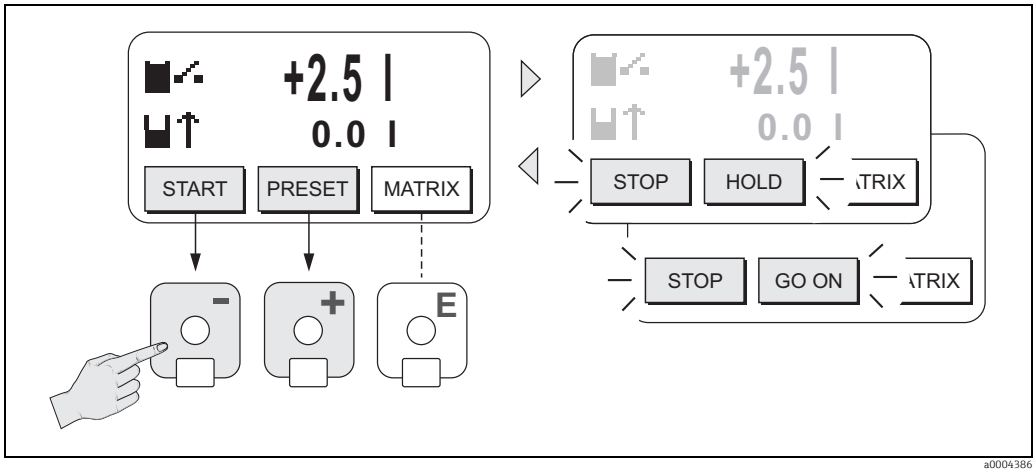


Fig. 45: Controlling batching processes using the local display (softkeys)

5.3 Brief Operating Manual to the function matrix

Note!
- Be certain to observe the general notes → 72
- Function descriptions → see the "Description of Device Functions" manual

1. HOME position → E → Entry into the function matrix
2. +/− → Select a block (e.g. OUTPUTS)
3. +/− → Select a group (e.g. CURRENT OUTPUT 1)
4. +/− → Select a function group (e.g. CONFIGURATION)
5. Select a function (e.g. TIME CONSTANT)
   Change parameter/enter numerical values:
   +/− → Select or enter enable code, parameters, numerical values
   E → Save your entries
6. Exit the function matrix:
   – Press and hold down the Esc key (Esc) for longer than 3 seconds → HOME position
   – Repeatedly press the Esc key (Esc) → Return step-by-step to HOME position

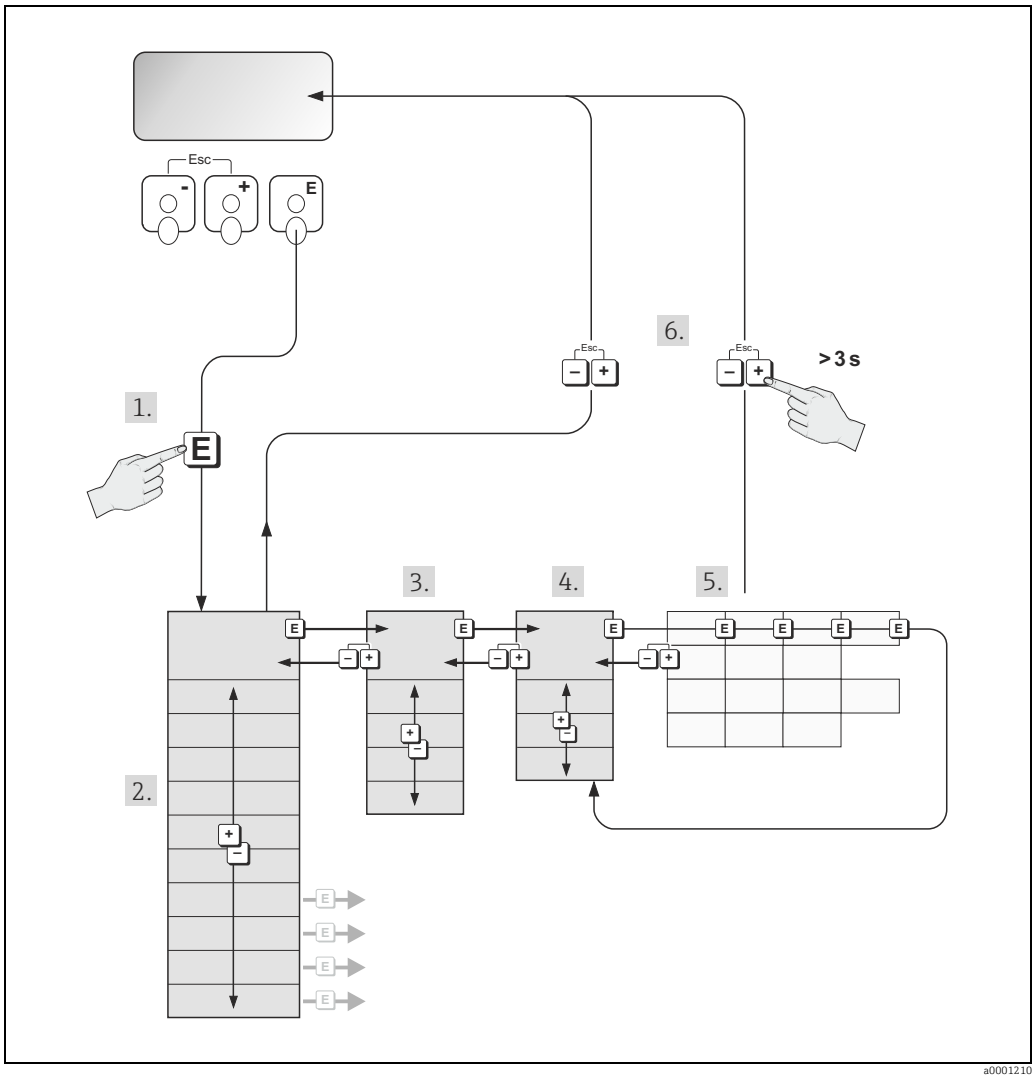


Fig. 46: Selecting functions and configuring parameters (function matrix)

5.3.1 General notes

The Quick Setup menu contains the default settings that are adequate for commissioning. 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 → 71.
  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 E 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 disabled automatically if you do not press a key within 60 seconds following automatic return to the HOME position.

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

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

5.3.2 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 again be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the +− operating elements 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 Endress+Hauser. Please contact your Endress+Hauser service organization if you have any questions.

5.3.3 Disabling the programming mode

Programming mode is again disabled if you do not press an operating element 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).

5.4 Error messages

5.4.1 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 error:* This group includes all device errors, e.g. communication errors, hardware errors, etc. → 132
- *Process error:* This group comprises all application errors, e.g. empty pipe etc. → 141

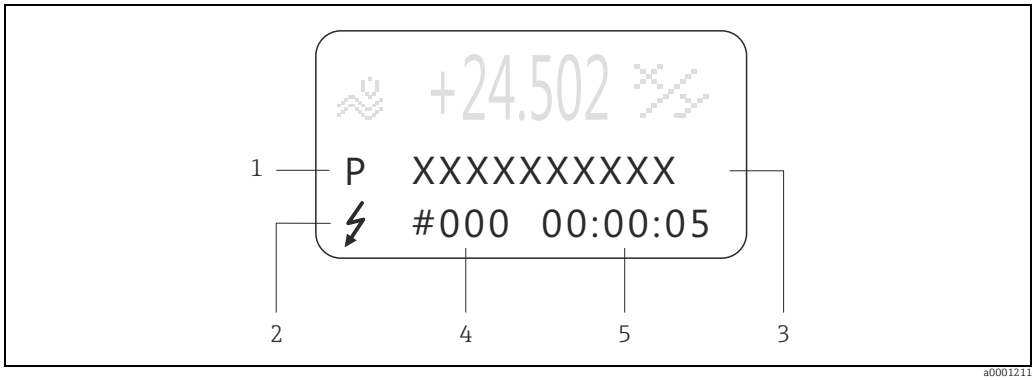


Fig. 47: Error messages on the display (example)

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

5.4.2 Error message type

The measuring device always assigns system and process errors which occur to two types of error messages (**fault** or **notice messages**) resulting in different weightings. → 132 Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)
- The error in question has no effect on the current operation and the outputs of the measuring device.
- Displayed as → Exclamation mark (!), error type (S: system error, P: process error).
- Displaying the device status on PROFIBUS DP/PA→ 132

Fault message (↯)
- The error in question interrupts or stops the current operation and has an immediate effect on the outputs.
- Displayed as → Lightening flash (↯), error type (S: system error, P: process error)
- Displaying the device status on PROFIBUS DP/PA → 132

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

5.5 Operating options

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

5.5.1 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.

5.5.2 Operating program "SIMATIC PDM" (Siemens)

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

5.5.3 Device drivers for operating programs

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

PROFIBUS DP

Valid for device software:	3.04.XX	→ DEVICE SOFTWARE function (8100)
PROFIBUS DP device data:		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promag 53 ID No.:	1526hex	→ DEVICE ID function (6162)
Profile ID No.:	9741hex	
GSD file information:		
Promag 53 GSD file:	Extended Format (recommended):	eh3x1526.gsd
	Standard Format:	eh3_1526.gsd
	Note! Before configuring the PROFIBUS network, read and follow the information for using the GSD file → 101	
Bitmaps:	EH_1526_d.bmp/.dib EH_1526_n.bmp/.dib EH_1526_s.bmp/.dib	
Profile GSD file:	PA039741.gsd	
Software release:	07.2007	

Operating program/Device driver:	Sources for obtaining device drivers/program updates:
Promag 53 GSD file:	▪ www.endress.com → Download ▪ www.profibus.com ▪ CD-ROM (Endress+Hauser order number: 56003894)
FieldCare/DTM	▪ www.endress.com → Download ▪ CD-ROM (Endress+Hauser order number: 56004088) ▪ DVD (Endress+Hauser order number: 70100690)
SIMATIC PDM	▪ www.endress.com → Download

Tester/simulator:	
Device:	**How to acquire:**
Fieldcheck	▪ Update by means of FieldCare via Fieldflash module

Note!
The Fieldcheck tester/simulator is used 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.

PROFIBUS PA

Valid for device software:	3.04.XX	→ DEVICE SOFTWARE function (8100)
PROFIBUS PA device data:		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promag 53 ID No.:	1527hex	→ DEVICE ID function (6162)
Profile ID No.:	9741hex	
GSD file information:		
Promag 53 GSD file:	Extended Format (recommended): Standard Format:	eh3x1527.gsd eh3_1527.gsd
	Note! Before configuring the PROFIBUS network, read and follow the information for using the GSD file → 101	
Bitmaps:	EH_1527_d.bmp/.dib EH_1527_n.bmp/.dib EH_1527_s.bmp/.dib	
Profile GSD file:	PA139741.gsd	
Software release:	07.2007	

Operating program/device driver:	Sources for obtaining device drivers/program updates:
Promag 53 GSD file:	▪ www.endress.com → Download ▪ www.profibus.com ▪ CD-ROM (Endress+Hauser order number: 56003894)
FieldCare/DTM	▪ www.endress.com → Download ▪ CD-ROM (Endress+Hauser order number: 56004088) ▪ DVD (Endress+Hauser order number: 70100690)
SIMATIC PDM	▪ www.endress.com → Download

Tester/simulator:	
Device:	**How to acquire:**
Fieldcheck	▪ Update by means of FieldCare via Fieldflash module

Note!
The Fieldcheck tester/simulator is used 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.

5.6 Hardware PROFIBUS DP settings

5.6.1 Configuring the write protection

A jumper on the I/O board provides the means of switching hardware write protection on or off. When the hardware write protection is switched on, it is **not** possible to write to the device parameters via PROFIBUS (cyclic data transmission, e.g. via FieldCare).

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. → 🖹 148
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

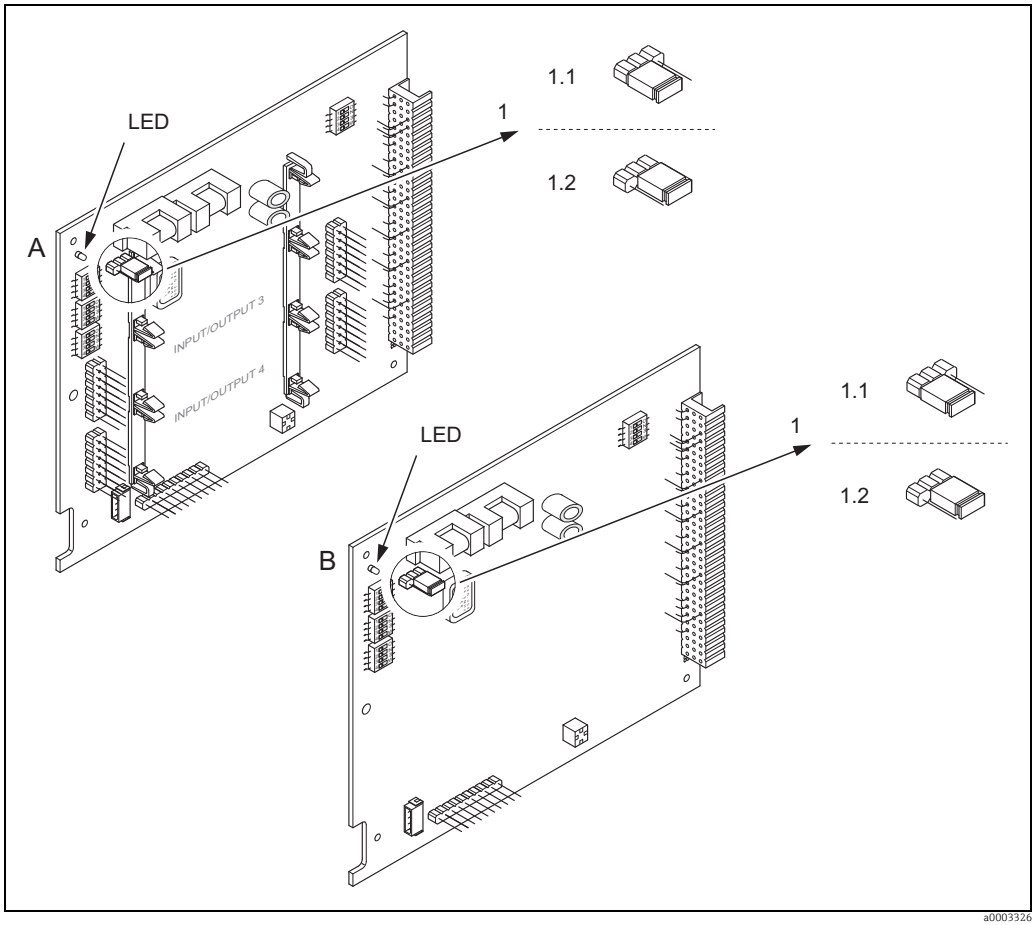


Fig. 48: Switching write protection on and off with the aid of a jumper on the I/O board

A Flexible assignment board
B Permanent assignment board

1 Jumper for switching write protection on and off
*1.1 Write protection switched on = it is **not** possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare)*
1.2 Write protection switched off (factory setting) = it is possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare).

LED Overview of LED states:
- *Lit continuously → Ready for operation*
- *Not lit → Not ready for operation*
- *Flashing → System or process error present → 🖹 130*

5.6.2 Configuring the device address

The address must always be configured for a PROFIBUS DP/PA device. The valid device addresses are in the range from 0 to 126. In a PROFIBUS DP/PA network, each address can only be assigned once. If an address is not configured correctly, the device is not recognized by the master. All measuring devices are delivered from the factory with the address 126 and with software addressing.

Addressing via local operation

Addressing takes place in the FIELDBUS ADDRESS function (6101) → see the "Description of Device Functions" manual.

Addressing via miniature switches

⚠ 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. Loosen the Allen screw (3 mm) of the securing clamp.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Remove the local display (if present) by loosening the set screws of the display module.
4. Set the position of the miniature switches on the I/O board using a sharp pointed object.
5. Installation is the reverse of the removal procedure.

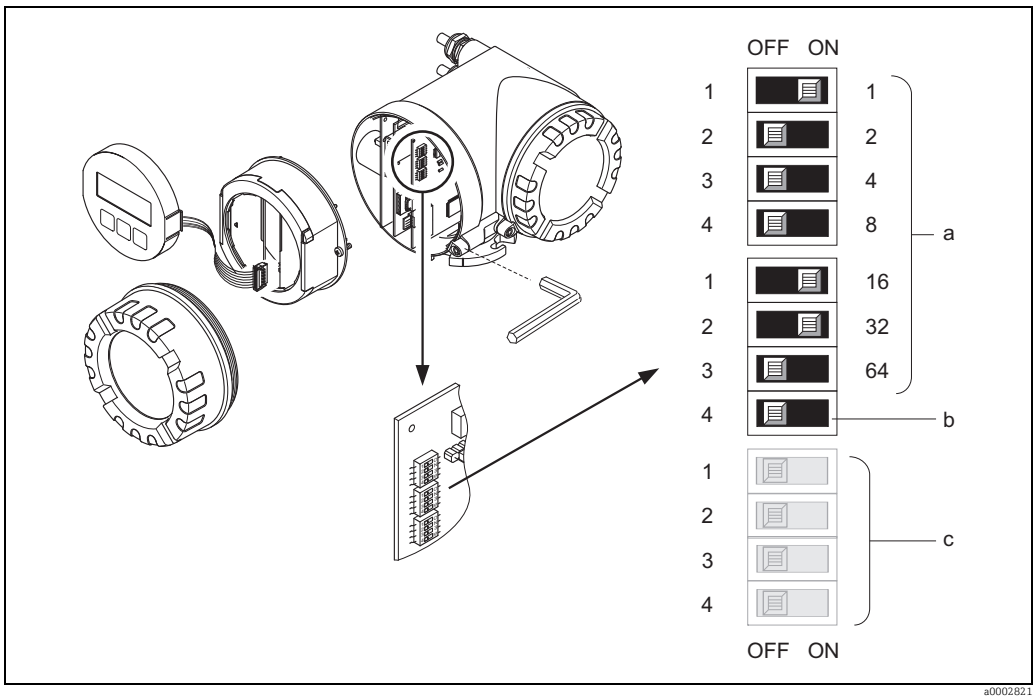


Fig. 49: Addressing with the aid of miniature switches on the I/O board

a Miniature switches for setting the device address (illustrated: 1 + 16 + 32 = device address 49)
b Miniature switches for the address mode (method of addressing):
OFF = software addressing via local operation (factory setting)
ON = hardware addressing via miniature switches
c Miniature switches not assigned

5.6.3 Configuring the terminating resistors

Note!
It is important to terminate the RS485 line correctly at the start and end of the bus segment since impedance mismatch results in reflections on the line which can cause faulty communication transmission.

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.

- For baud rates up to 1.5 MBaud, the termination is set via the terminating switch SW 1 for the last transmitter on the bus: ON - ON - ON - ON.
- Device is operated with a baud rate >1.5 MBaud: due to the capacitive load of the user and the resulting line reflection, make sure that an external termination is used.
  In addition, the signal lines have to be protected (= shielded and grounded) for flexible assignment boards. → 58

The miniature switch for termination is located on the I/O board (see Figure):

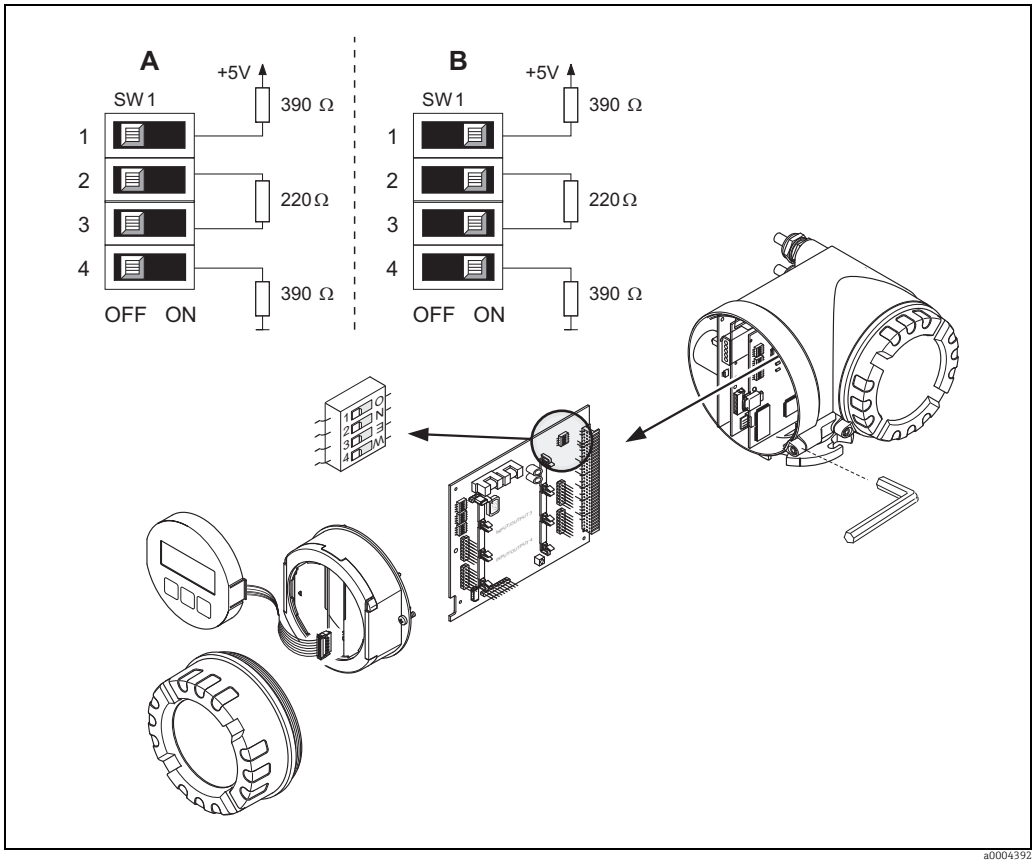


Fig. 50: Configuring the terminating resistors (for baud rates < 1.5 MBaud)

A = Factory setting
B = Setting at the last transmitter

Note!
It is generally recommended to use external termination since if a device that is terminated internally is defect, this can result in the failure of the entire segment.

5.6.4 Current output configuration

The current output is configured as "active" or "passive" by means of various jumpers on the current 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. → 🖹 148
3. Position the jumpers (see Figure).

   ☝ 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.
4. Installation of the I/O board is the reverse of the removal procedure.

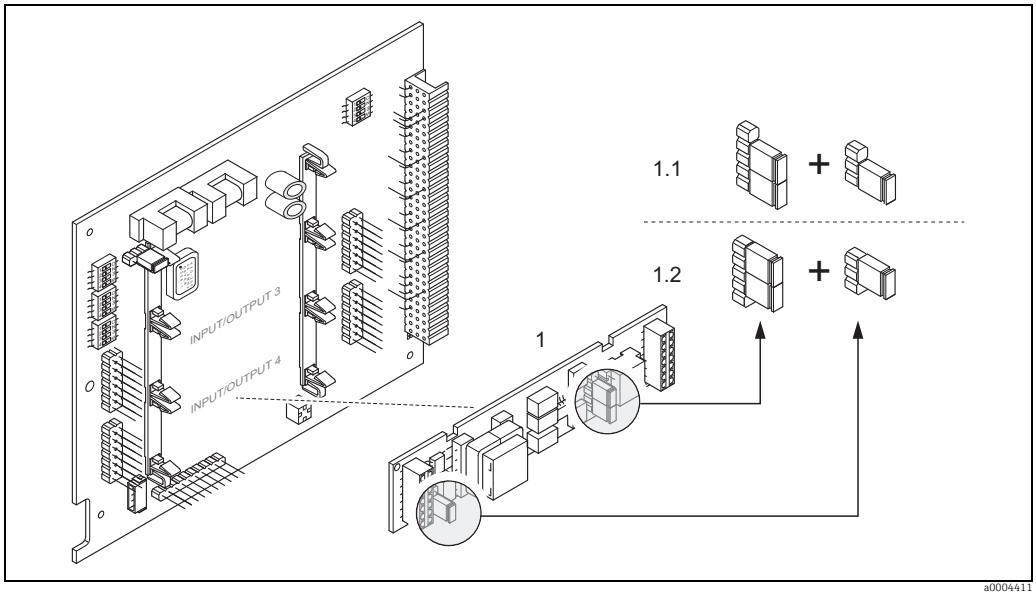


Fig. 51: Configuring the current input with the aid of jumpers (I/O board)

1 Current output
1.1 Active current output (default)
1.2 Passive current output

5.6.5 Relay output configuration

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 pluggable submodule. 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. → 📄 148
3. Position the jumpers (see Figure).

   ☝ Caution!
   If you change the setting, you must always change the positions of **both** jumpers! Note precisely the specified positions of the jumpers.
4. Installation of the I/O board is the reverse of the removal procedure.

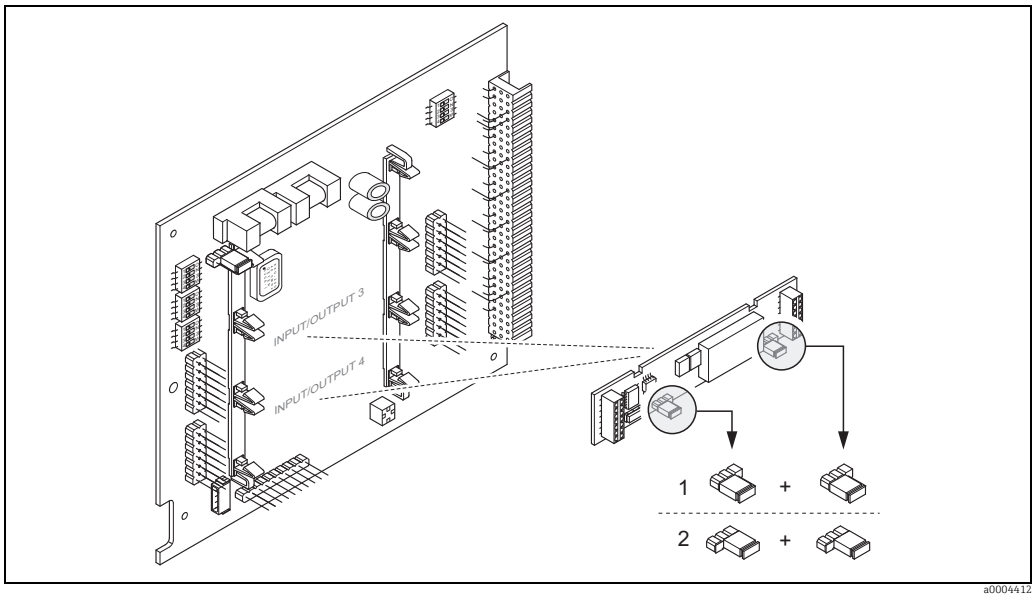


Fig. 52: Configuring relay contacts (NC/NO) on the convertible I/O board (submodule) with the help of jumpers.

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

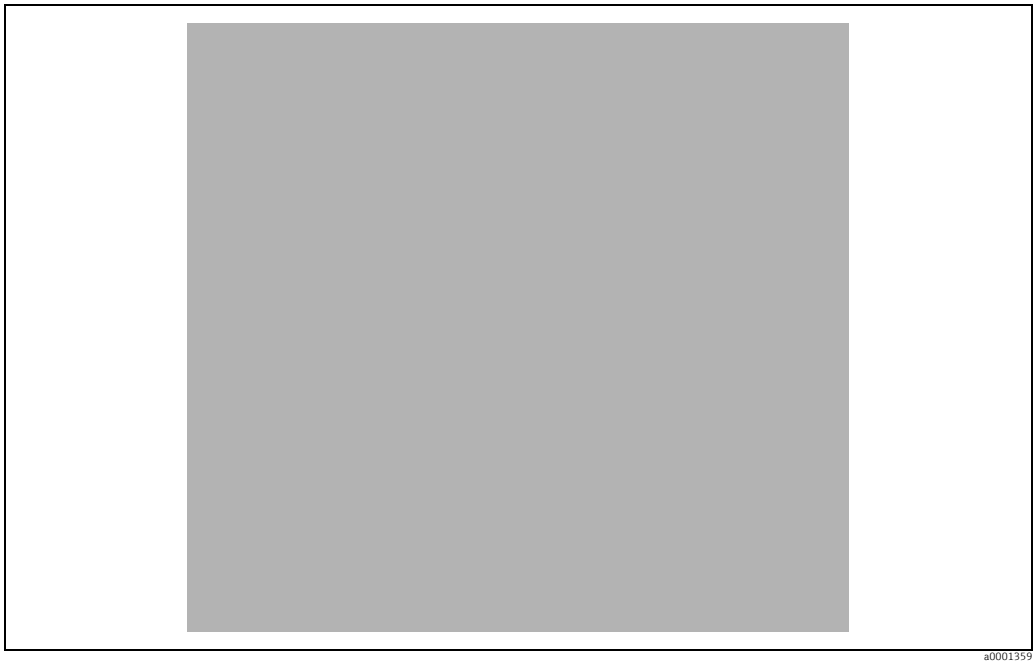
5.7 Hardware PROFIBUS PA settings

5.7.1 Configuring the write protection

A jumper on the I/O board provides the means of switching hardware write protection on or off. When the hardware write protection is switched on, it is **not** possible to write to the device parameters via PROFIBUS (cyclic data transmission, e.g. via FieldCare).

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. → 🖹 148
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.



a0001359

Fig. 53: Switching write protection on and off with the aid of a jumper on the I/O board

1 Jumper for switching write protection on and off
*1.1 Write protection switched on = it is **not** possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare)*
1.2 Write protection switched off (factory setting) = it is possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare).

2 Jumper without function

LED Overview of LED states:
- *Lit continuously → Ready for operation*
- *Not lit → Not ready for operation*
- *Flashing → System or process error present → 🖹 130*

5.7.2 Configuring the device address

The address must always be configured for a PROFIBUS DP/PA device. The valid device addresses are in the range from 1 to 126. In a PROFIBUS DP/PA network, each address can only be assigned once. If an address is not configured correctly, the device is not recognized by the master. All measuring devices are delivered from the factory with the address 126 and with software addressing.

Addressing via local operation

Addressing takes place in the FIELDBUS ADDRESS function (6101) → see the "Description of Device Functions" manual.

Addressing via miniature switches

⚠ 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. Loosen the Allen screw (3 mm) of the securing clamp.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Remove the local display (if present) by loosening the set screws of the display module.
4. Set the position of the miniature switches on the I/O board using a sharp pointed object.
5. Installation is the reverse of the removal procedure.

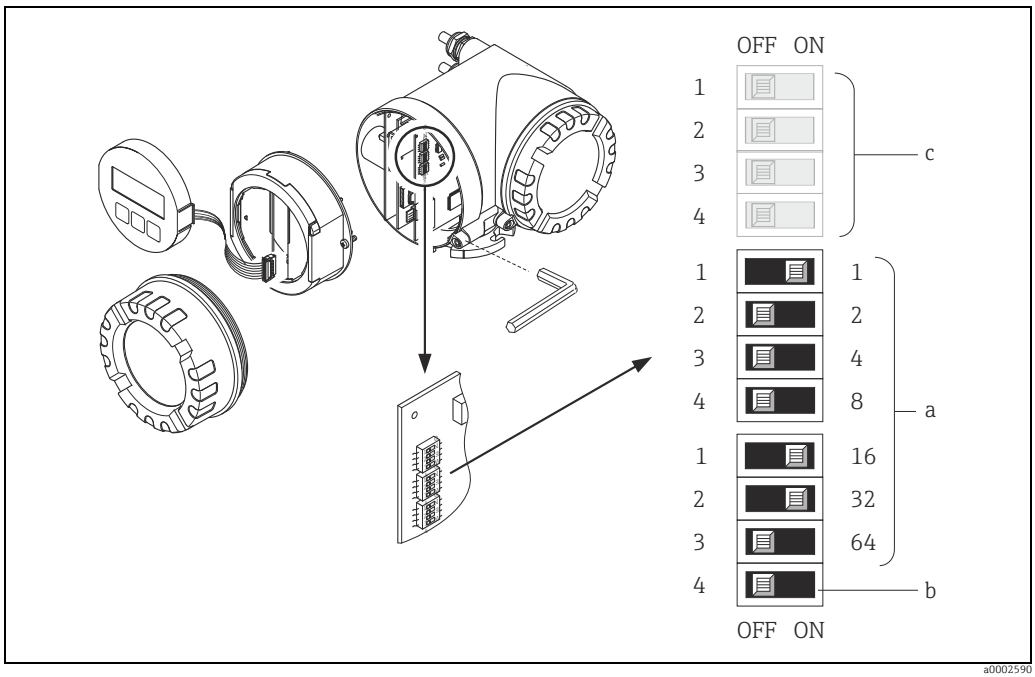


Fig. 54: Addressing with the aid of miniature switches on the I/O board

a Miniature switches for setting the device address (illustrated: 1 + 16 + 32 = device address 49)
b Miniature switches for the address mode (method of addressing):
OFF = software addressing via local operation (factory setting)
ON = hardware addressing via miniature switches
c Miniature switches not assigned

6 Commissioning

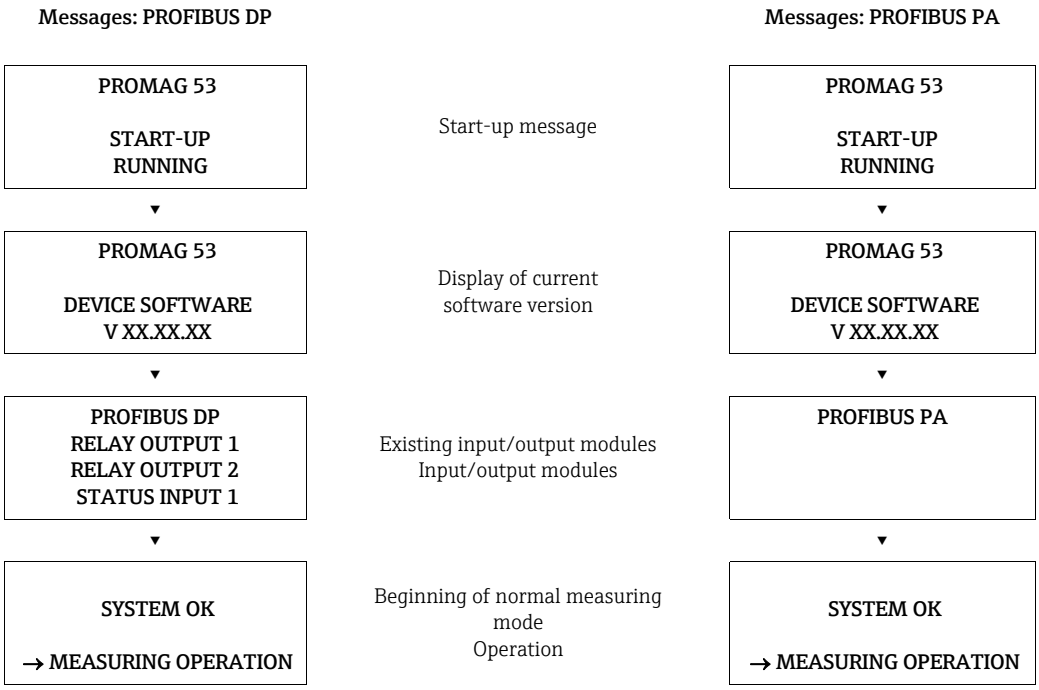
6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist for "Post-installation check" → 📄 45
- Checklist for "Post-connection check" → 📄 65

Note!
When using PROFIBUS PA, please note the following:
- The PROFIBUS interface's technical data must be maintained in accordance with IEC 61158-2 (MBP).
- A normal multimeter can be used to check the bus voltage of 9 to 32 V and the current consumption of 11 mA at the device.

6.2 Switching on the measuring device

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



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

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 via the configuration program, e.g. FieldCare.
If the measuring device is equipped with a local display, all the important device parameters for standard operation, as well as additional functions, can be configured quickly and easily by means of the following Quick Setup menus.

6.3.1 Quick Setup "Commissioning"

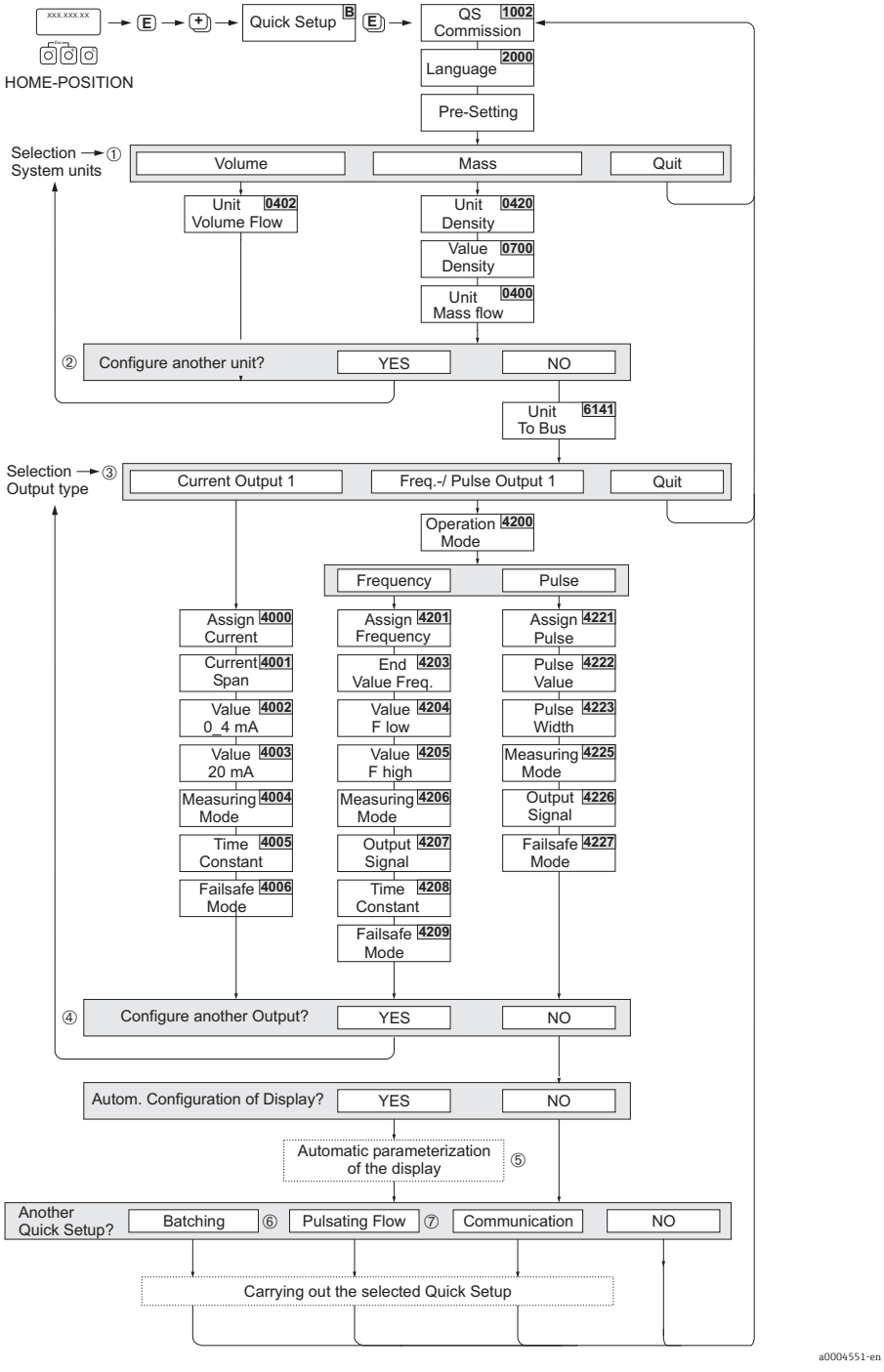


Fig. 55: Quick Setup for fast commissioning

✎ 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 one of the other Quick Setups described in this Operating Manual is run.

① 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.

② The "YES" option remains visible until all the units have been configured.
"NO" is the only option displayed when no further units are available.

③ This prompt only appears if a current output and/or pulse/frequency output is available. 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.

⑤ The "automatic display configuration" option contains the following basic settings/factory settings

YES Main line = volume flow
Additional line = totalizer 1
Information line = operating/system condition

NO The existing (selected) settings remain.

▲ The BATCHING QUICK SETUP is only available when the optional software package BATCHING is installed.

▼ The PULSATING FLOW QUICK SETUP is only available if the device has a current output or a pulse/frequency output.

6.3.2 Quick Setup "Pulsating Flow"

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

Certain types of pump such as reciprocating, peristaltic and cam-type pumps, for example, 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 Quick Setup "Pulsating flow" the Quick Setup "Commissioning" has to be executed.→ 📖 85

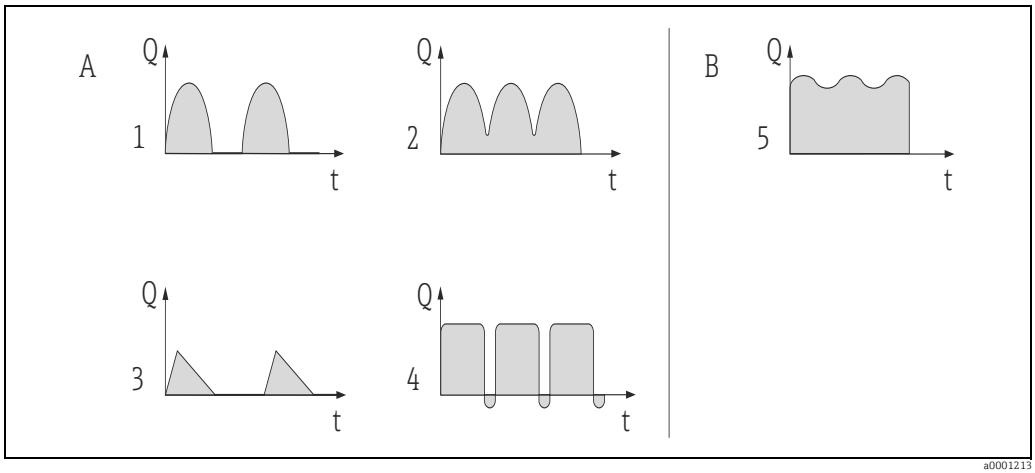


Fig. 56: Flow characteristics of various types of pump

A With severely pulsating flow
B With low pulsating flow

11 -cylinder cam pump
22 -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 of this nature can be compensated over the entire flow range and pulsating liquid flows measured correctly. Below you will find detailed instructions on how to use this Quick Setup menu.

Note!
It is always advisable to work through the "Pulsating flow" Quick Setup menu 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 Quick Setup menu.
In cases of this nature, however, it is advisable to adapt the functions listed below in the function matrix (see the "Description of Device Functions" manual) to suit local process conditions in order to ensure a stable, unvarying output signal:

- Measuring system damping: "FLOW DAMPING" function → increase the value
- Current output damping: "TIME CONSTANT" function → increase the value

Performing the "Pulsating Flow" Quick Setup

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

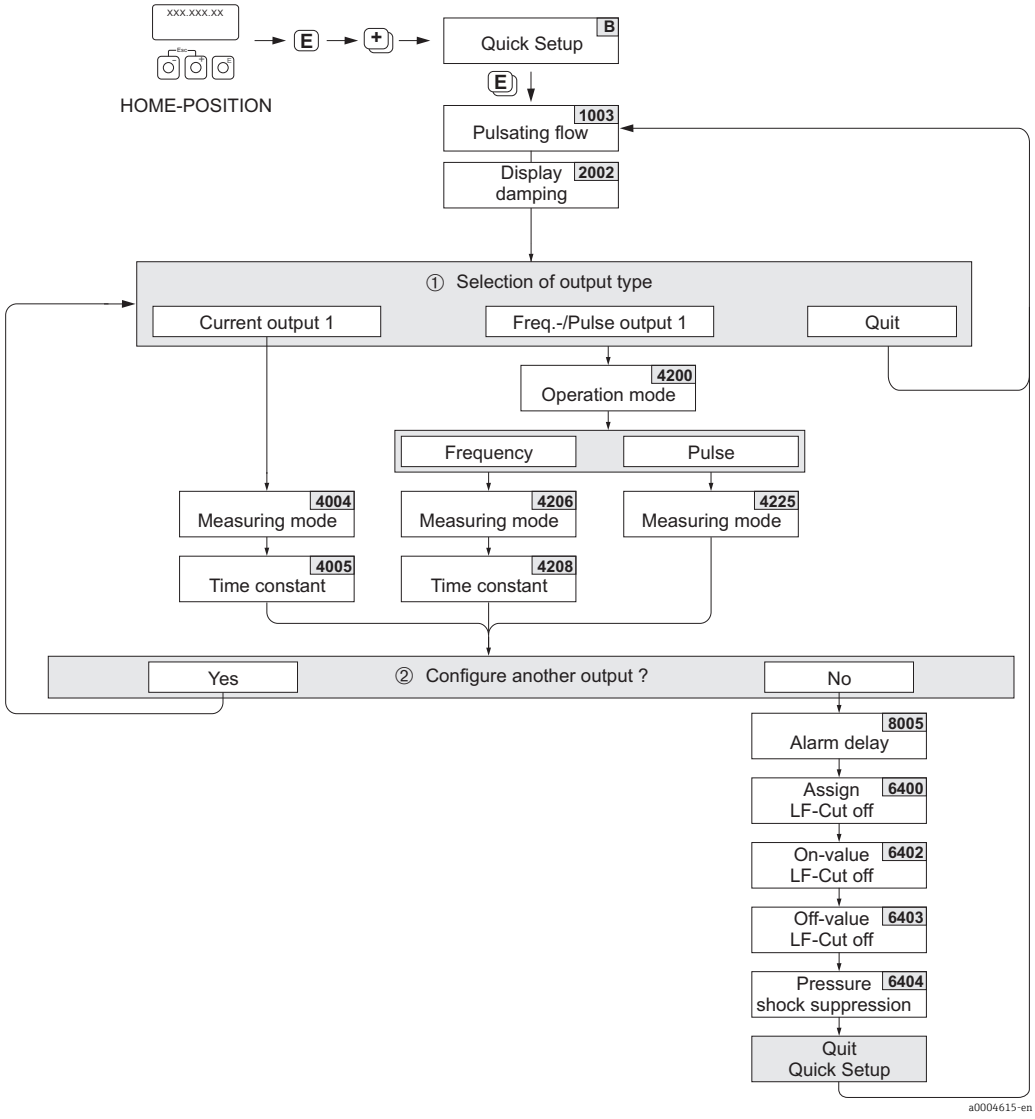


Fig. 57: Quick Setup for measuring severely pulsating flows. Recommended settings see next page

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 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 ⊡ key combination during parameter interrogation.
- You can call up the Setup menu either directly from the "COMMISSIONING" Quick Setup menu or manually by means of the function QUICK SETUP PULSATING FLOW (1003).

Quick Setup "Pulsating Flow"		
HOME position → E → MEASURAND → + → QUICK SETUP → E → QS PULSATING FLOW (1003)		
Function No.	Function name	Selection with + − To the next function with E
1003	QS PULSATING 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
Signal type for "CURRENT OUTPUT 1"		
4004	MEASURING MODE	PULS. FLOW
4005	TIME CONSTANT	3 s
Signal type for "FREQ./PULSE OUTPUT 1" (for FREQUENCY operating mode)		
4206	MEASURING MODE	PULS. FLOW
4208	TIME CONSTANT	0 s
Signal type for "FREQ./PULSE OUTPUT 1" (for PULSE operating mode)		
4225	MEASURING MODE	PULS. FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LOW FLOW CUTOFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUTOFF	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 CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s

▼

Back to the HOME position:
→ Press and hold down the ESC key for longer than three seconds or
→ Repeatedly press and release the ESC key → Exit the function matrix step by step

6.3.3 Quick Setup "Batching"

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. → 128

This Quick Setup menu guides you systematically through the setup procedure for all the device functions that have to be modified and configured for batching operation. These basic settings allow simple (one-step) batching processes.
Additional settings, e.g. for multistage 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 device 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. → 85
- 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, etc.) to the bottom line of the display. These can be directly executed on site using the three operating keys (⊞/⊟/Ⓔ). Therefore, the measuring device can be fully deployed in the field as a "batch controller". → 70
- You can also directly control the filling process using the fieldbus.

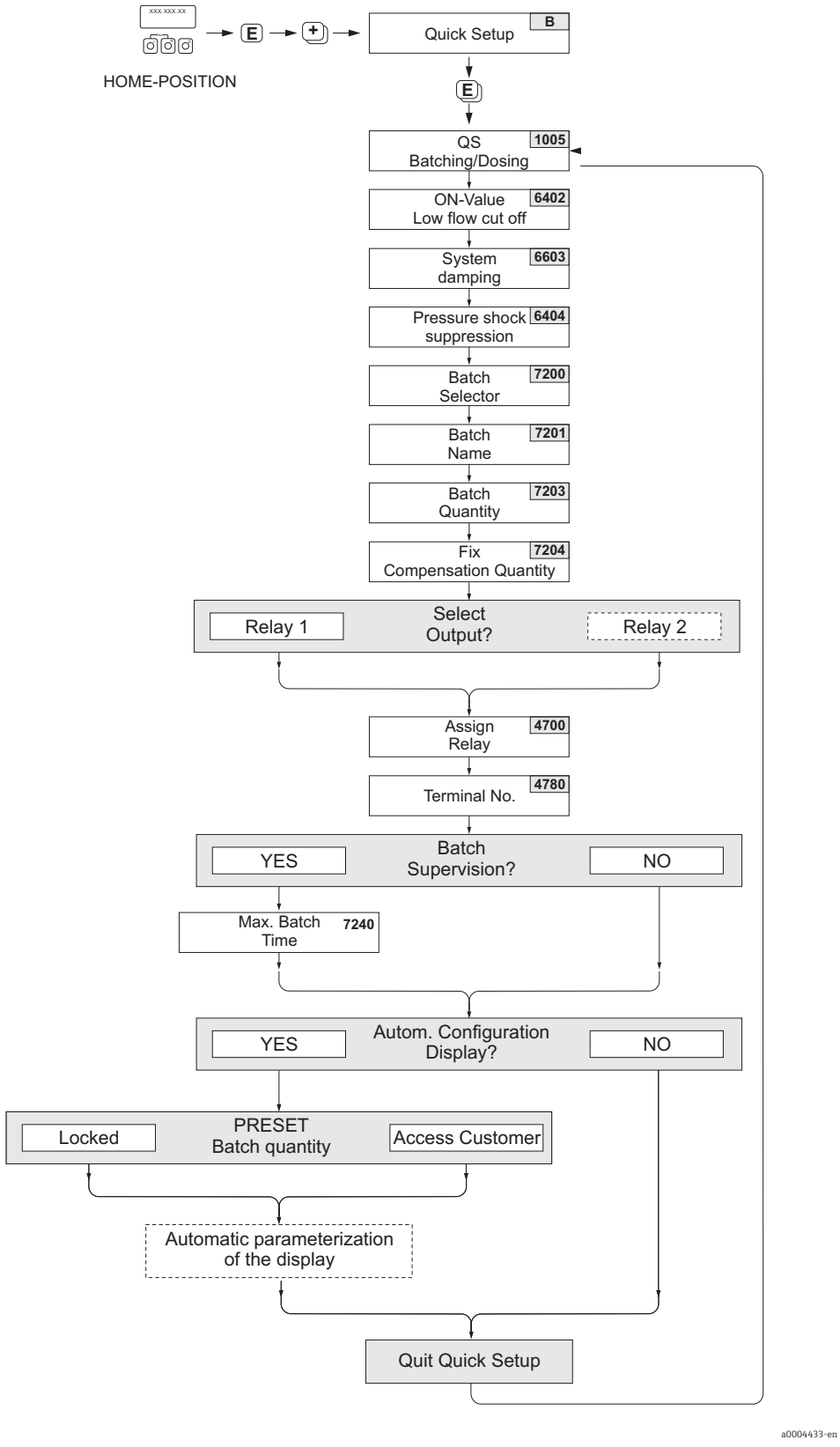


Fig. 58: Quick Setup "Batching". Recommended settings see next page.

Recommended settings

Quick Setup "Batching"		
HOME position → E → MEASURAND → + → QUICK SETUP → E → QUICK SETUP BATCHING (1005)		
Function No.	Function name	Setting to be selected (+/-) (to the 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! Some of the functions listed below (with a gray background) are configured automatically, i.e. by the measuring system.		
6400	ASSIGN LOW FLOW CUTOFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUTOFF	The recommended setting is contained on → 89 in Function No. 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 s
7200	BATCH SELECTOR	BATCH #1
7201	BATCH NAME	BATCH #1
7202	ASSIGN BATCH VARIABLE	Volume
7203	BATCH QUANTITY	0
7204	FIX COMPENSATION QUANTITY	0
7208	BATCH STAGES	1
7209	INPUT FORMAT	Value input
4700	ASSIGN RELAY	BATCHING VALVE 1
4780	TERMINAL NUMBER	Output (display only)
7220	OPEN VALVE 1	0% or 0 [unit]
7240	MAXIMUM BATCH TIME	0 s (= switched off)
7241	MINIMUM BATCH QUANTITY	0
7242	MAXIMUM BATCH QUANTITY	0
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 the ESC key for longer than three seconds or
→ Repeatedly press and release the ESC key → Exit the function matrix step by step

6.3.4 Quick Setup "Communication"

To establish cyclic data transfer, various arrangements between the PROFIBUS master (Class 1) and the measuring device (slave) are required which have to be taken into consideration when configuring various functions. These functions can be configured quickly and easily by means of the "Communication" Quick Setup. The following table explains the parameter configuration options in more detail.

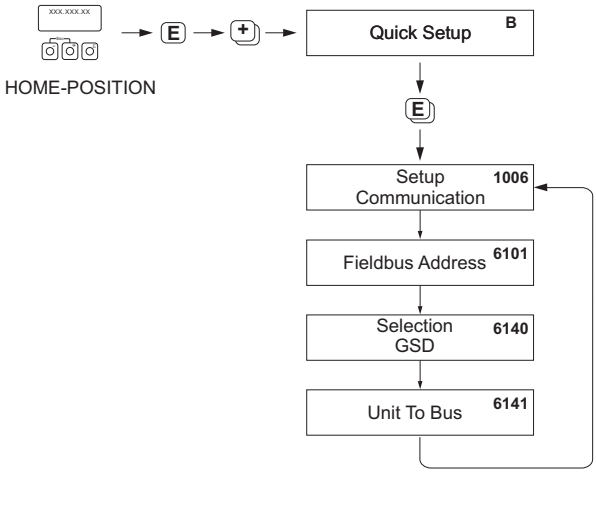


Fig. 59: Quick Setup "Communication"

Quick Setup "Communication"		
HOME position → E → MEASURAND (A)→ + → QUICK SETUP (B) → E → QUICK SETUP COMMUNICATION (1006)		
Function No.	**Function name**	**Setting to be selected** (+ −) (to the next function with E)
1006	QS-COMMUNICATION	After confirmation (YES) by pressing E the subsequent functions are called up in succession.
6101	FIELDBUS ADDRESS	Enter the device address (permitted address range: 1 to 126) **Factory setting:** 126
6140	SELECTION GSD	Select the operating mode (the GSD file) which should be used for cyclic data transmission with the PROFIBUS master. **Options:** MANUFACT. SPEC. → The measuring device is operated with complete device functionality. MANUFACT V2.0 → The measuring device is used as the replacement for the previous Promag 33 model (compatibility mode). PROFILE-GSD → The measuring device is operated in the PROFIBUS Profile mode. **Factory setting:** MANUFACT. SPEC. Note! For PROFIBUS network configuration, make sure that the right device master file (GSD file) of the measuring device is used for the selected operating mode:→ 101

Quick Setup "Communication"		
6141	UNIT TO BUS	If this function is executed, the measured variables are transmitted cyclically to the PROFIBUS master (Class 1) with the system units set in the measuring device. **Options:** OFF SET UNITS (Transmission is started by pressing the E key) Caution! Activating this function can cause a sudden change of the measured variables transmitted to the PROFIBUS master (Class 1); this, in turn, can affect subsequent control routines.

▼

Back to the HOME position:
→ Press and hold down the key for longer than three seconds or
→ Repeatedly press and release the key = Exit the function matrix step by step

6.3.5 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.

Hinweis!
For information on installing and removing the T-DAT → 📄 146

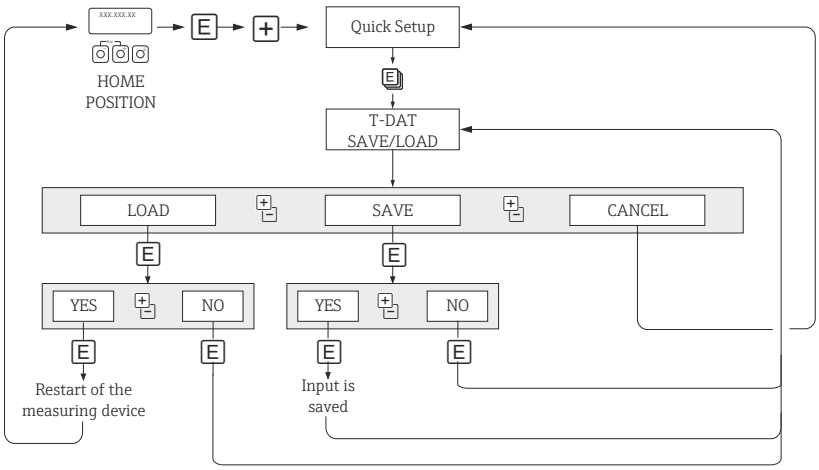


Abb. 60: Data backup/transmission with T-DAT SAVE/LOAD function

Information on the LOAD and SAVE options available:

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

Hinweis!
- 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 Commissioning the PROFIBUS interface

Note!
- All functions required for commissioning are described in detail in the "Description of Device Functions" manual which is a separate part of this Operating Manual.
- A code (factory setting: 53) must be entered to change device functions, numerical values or factory settings. → 72

6.4.1 PROFIBUS DP commissioning

The following steps must be carried out in the sequence specified:

1. **Check the hardware write protection:**
   The WRITE PROTECT (6102) parameter indicates whether it is possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare).

   Note!
   ▶ This check is not needed if operating via the local display.

   BASIC FUNCTION (G) → PROFIBUS DP (GBA) → CONFIGURATION (610) → WRITE PROTECT (6102) → Display of one of the following options:
   – OFF (factory setting) = write access via PROFIBUS possible
   – ON = write access via PROFIBUS not possible

   Deactivate the write protection if necessary. → 77
2. **Enter the tag name (optional):**
   BASIC FUNCTION (G) → PROFIBUS DP (GBA) → CONFIGURATION (610) → TAG NAME (6100)
3. **Configuring the fieldbus address:**
   ▶ Software addressing using the local display:
   BASIC FUNCTION (G) → PROFIBUS DP (GBA) → CONFIGURATION (610) → FIELDBUS ADDRESS (6101)
   ▶ Hardware addressing via miniature switches → 78
4. **Select the system unit:**
   a. Determine the units by means of the system units group:
      MEASURED VARIABLES (A) → SYSTEM UNITS (ACA) → CONFIGURATION (040) →
      UNIT MASS FLOW (0400) / UNIT MASS (0401) / UNIT VOLUME FLOW (0402) / ...
   b. In the function UNIT TO BUS (6141), select the option SET UNITS, so that the measured variables transmitted cyclically to the PROFIBUS master (Class 1) are transmitted with the system units set in the measuring device:
      BASIC FUNCTION (G) → PROFIBUS DP (GBA) → OPERATION (614) → UNIT TO BUS (6141)

   Note!
   – The configuration of the system units for the totalizer is described separately → see step 7
   – If the system unit of a measured variable is changed by means of the local operation or an operating program, this initially does not have any effect on the unit that is used to transmit the measured variable to the PROFIBUS master (Class 1). Changed system units of the measured variables are not transmitted to the PROFIBUS master (Class 1) until the SET UNITS option is activated in the function BASIC FUNCTION (G) → PROFIBUS DP (GBA) → OPERATION (614) → UNIT TO BUS (6141).
5. **Configuration of the Analog Input function blocks 1 to 2:**
   The measuring device has two Analog Input function blocks (AI modules), through which the various measured variables can be cyclically transmitted to the PROFIBUS master (Class 1). The assignment of a measured variable to the Analog Input function block is shown below using the example of Analog Input function block 1 (AI module, slot 1).

Using the CHANNEL function (6123), you can determine the measured variable (e.g. volume flow) to be cyclically transmitted to the PROFIBUS master (Class 1):

a. Select BASIC FUNCTION (G) → PROFIBUS DP (GBA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120).

b. Select the option ANALOG INPUT 1.

c. Select the function CHANNEL (6123).

d. Select the option VOLUME FLOW.

Possible settings:

Measured variable	ID for "CHANNEL" function
VOLUME FLOW (factory setting AI function block 1)	273
MASS FLOW (factory setting AI function block 2)	277
The following measured variables are available when the additional "batching" software is installed (order option)	
BATCH UPWARDS	1346
BATCH DOWNWARDS	1347
BATCH COUNTER	1348
BATCH SUM	1349
BATCHING TIME	1354
✎ Note! If, when the PROFIBUS network configuration, the AI module was integrated in slot 1 or 5, the measured variable selected in the CHANNEL function is transmitted cyclically to the PROFIBUS master (Class 1) for the respective Analog Input function block 1 to 2. → 🖹 107	

6. **Setting the measuring mode:**
In the function MEASURING MODE (6601), select the flow portions to be measured by the measuring device.

BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601) → Selection of one of the following options:
– UNIDIRECTIONAL (factory setting) = only the positive flow portions
– BIDIRECTIONAL = the positive and negative flow components

7. **Configuration of totalizers 1 to 3:**
The measuring device has three totalizers. The following example describes the configuration of the totalizer using totalizer 1 as an example.

▶ Using the CHANNEL function (6133), you can determine the measured variable (e.g. volume flow) to be cyclically transmitted to the PROFIBUS master (Class 1) as a totalizer value:
   a. Select BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → SELECT TOTALIZER (6130).
   b. Select the option TOTALIZER 1.
   c. Go to the function CHANNEL (6133).
   d. Select one of the following options:
      – VOLUME FLOW (CHANNEL = 273, factory setting): the volume flow is totalized.
      – MASS FLOW (CHANNEL = 277): the mass flow is totalized.
      – OFF (CHANNEL = 0): no totalizing, "0" is displayed as the totalizer value.

✎ Note!
If, when the PROFIBUS network configuration, the module or the function "TOTAL" was integrated in slot 2, 3 or 4, the measured variable selected in the CHANNEL function is transmitted cyclically to the PROFIBUS master (Class 1) for the respective totalizer 1 to 3. → 🖹 107

- ▶ Enter the desired unit for the totalizer:
  BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → UNIT TOTALIZER (6134)
- ▶ Configure totalizer status (e.g. totalize):
  BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → SET TOTALIZER (6135) → Select the option TOTALIZE
- ▶ Set the totalizer mode:
  BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → TOTALIZER MODE (6137) → Selection of one of the following options:
  – BALANCE (factory setting): calculates the positive and negative flow portions
  – POSITIVE: calculates the positive flow portions
  – NEGATIVE: calculates the negative flow portions
  – HOLD VALUE: The totalizer remains at the last value

✎ Note!
For the calculation of the positive and negative flow portions (BALANCE) or the negative flow portions (NEGATIVE) to be carried out correctly, the selection BIDIRECTIONAL must be active in the function BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601).

8. **Select the operating mode:**
   Select the operating mode (GSD file) which should be used for cyclic communication with the PROFIBUS master.

   BASIC FUNCTION (G) → PROFIBUS DP (GBA) → OPERATION (614) → SELECTION GSD (6140) → Selection of one of the following options:
   – MANUFACT. SPEC. (factory setting): the complete device functionality is available.
   – MANUFACT V2.0 The device is used as the replacement for the previous Promag 33 model (compatibility mode).
   – PROFILE-GSD: The device is operated in the PROFIBUS Profile mode.

   ✎ Note!
   For PROFIBUS network configuration, make sure that the right device master file (GSD file) of the measuring device is used for the selected operating mode:→ 🖹 101

9. **Configuration of cyclic data transmission in the PROFIBUS master:**
   A detailed description of the cyclic data transmission is contained on → 🖹 105

6.4.2 PROFIBUS PA commissioning

The following steps must be carried out in the sequence specified:

1. **Check the hardware write protection:**
   The WRITE PROTECT (6102) parameter indicates whether it is possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare).

   ✎ Note!
   ▶ This check is not needed if operating via the local display.

   BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → WRITE PROTECT (6102) → Display of one of the following options:
   – OFF (factory setting) = write access via PROFIBUS possible
   – ON = write access via PROFIBUS not possible

   Deactivate the write protection if necessary. → 🖹 77

2. **Enter the tag name (optional):**
   BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → TAG NAME (6100)

3. **Configuring the fieldbus address:**
   ▶ Software addressing using the local display:
   BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → FIELDBUS ADDRESS (6101)
   ▶ Hardware addressing via miniature switches→ 🖹 78

4. **Select the system unit:**
   a. Determine the units by means of the system units group:
      MEASURED VARIABLES (A) → SYSTEM UNITS (ACA) → CONFIGURATION (040) →
      UNIT MASS FLOW (0400) / UNIT MASS (0401) / UNIT VOLUME FLOW (0402) / ...
   b. In the function UNIT TO BUS (6141), select the option SET UNITS, so that the measured variables transmitted cyclically to the PROFIBUS master (Class 1) are transmitted with the system units set in the measuring device:
      BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → UNIT TO BUS (6141)

   ✎ Note!
   – The configuration of the system units for the totalizer is described separately → see step 6
   – If the system unit of a measured variable is changed by means of the local operation or an operating program, this initially does not have any effect on the unit that is used to transmit the measured variable to the PROFIBUS master (Class 1). Changed system units of the measured variables are not transmitted to the PROFIBUS master (Class 1) until the SET UNITS option is activated in the function BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → UNIT TO BUS (6141).

5. **Setting the measuring mode:**
   In the function MEASURING MODE (6601), select the flow portions to be measured by the measuring device.

   BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601) → Selection of one of the following options:
   – UNIDIRECTIONAL (factory setting) = only the positive flow portions
   – BIDIRECTIONAL = the positive and negative flow components

6. **Configuration of totalizers 1 to 3:**
The measuring device has three totalizers. The following example describes the configuration of the totalizer using totalizer 1 as an example.
▶ Using the CHANNEL function (6133), you can determine the measured variable (e.g. volume flow) to be cyclically transmitted to the PROFIBUS master (Class 1) as a totalizer value:
   a. Select BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → SELECT TOTALIZER (6130).
   b. Select the option TOTALIZER 1.
   c. Go to the function CHANNEL (6133).
   d. Select one of the following options:
      – VOLUME FLOW (CHANNEL = 273, factory setting): the volume flow is totalized.
      – MASS FLOW (CHANNEL = 277): the mass flow is totalized.
      – OFF (CHANNEL = 0): no totalizing, "0" is displayed as the totalizer value.

   ✎ Note!
   If, when the PROFIBUS network configuration, the module or the function TOTAL was integrated in slot 2, 3 or 4, the measured variable selected in the CHANNEL function is transmitted cyclically to the PROFIBUS master (Class 1) for the respective totalizer 1 to 3. → 🖹 107

▶ Enter the desired unit for the totalizer:
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → UNIT TOTALIZER (6134)
▶ Configure totalizer status (e.g. totalize):
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → SET TOTALIZER (6135) → Select the option TOTALIZE
▶ Set the totalizer mode:
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → TOTALIZER MODE (6137) → Selection of one of the following options:
– BALANCE (factory setting): calculates the positive and negative flow portions
– POSITIVE: calculates the positive flow portions
– NEGATIVE: calculates the negative flow portions
– HOLD VALUE: The totalizer remains at the last value

   ✎ Note!
   For the calculation of the positive and negative flow portions (BALANCE) or the negative flow portions (NEGATIVE) to be carried out correctly, the selection BIDIRECTIONAL must be active in the function BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → SETTINGS (660) → MEASURING MODE (6601).

7. **Select the operating mode:**
Select the operating mode (GSD file) which should be used for cyclic communication with the PROFIBUS master.
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → SELECTION GSD (6140) → Selection of one of the following options:
– MANUFACT. SPEC. (factory setting): the complete device functionality is available.
– MANUFACT V2.0 The device is used as the replacement for the previous Promag 33 model (compatibility mode).
– PROFILE-GSD: The device is operated in the PROFIBUS Profile mode.

   ✎ Note!
   For PROFIBUS network configuration, make sure that the right device master file (GSD file) of the measuring device is used for the selected operating mode:→ 🖹 101

8. **Configuration of cyclic data transmission in the PROFIBUS master:**
A detailed description of the cyclic data transmission is contained on → 🖹 105

6.5 PROFIBUS DP/PA system integration

6.5.1 Device master file (GSD file)

For PROFIBUS network configuration, the device master file (GSD file) is needed for every bus user (PROFIBUS slave). The GSD file contains a description of the properties of a PROFIBUS device, such as supported data transmission rate and number of input and output data.
Before configuration takes place, a decision should be made as to which GSD file should be used to operate the measuring device in the PROFIBUS DP master system.

The measuring device supports the following GSD files:
- Promag 53 GSD file (manufacturer-specific GSD file, complete device functionality)
- PROFIBUS Profile GSD file:
- Promag 33 GSD file (compatibility to previous model Promag 33)

Below you will find a detailed description of the GSD files supported.

Promag 53 GSD file (manufacturer-specific GSD file, complete device functionality)

Use this GSD file to access the complete functionality of the measuring device. In this way, device-specific measured variables and functions are thus completely available in the PROFIBUS master system. An overview of the modules available (input and output data) is contained on the following pages:
PROFIBUS DP → 📄 105
PROFIBUS PA→ 📄 115

GSD file with standard or extended format:

The GSD file with either the standard or the extended format must be used depending on the configuration software used. When installing the GSD file, the GSD file with the extended format (EH3**x**15xx.gsd) should always be used first.
However, if the installation or the configuration of the measuring device fails with this format, then use the standard GSD (EH3_15xx.gsd). This differentiation is the result of different implementation of the GSD formats in the master systems. Note the specifications of the configuration software.

Name of the Promag 53 GSD file

	ID No.	GSD file	Type file	Bitmaps
PROFIBUS DP	1526 (Hex)	Extended Format (recommended): EH3x1526.gsd Standard Format: EH3_1526.gsd	EH_1526.200	EH_1526_d.bmp/.dib EH_1526_n.bmp/.dib EH_1526_s.bmp/.dib
PROFIBUS PA	1527 (Hex)	Extended Format (recommended): EH3x1527.gsd Standard Format: EH3_1527.gsd	EH_1527.200	EH_1527_d.bmp/.dib EH_1527_n.bmp/.dib EH_1527_s.bmp/.dib

How to acquire:

- Internet (Endress+Hauser) → www.endress.de (→ Download → Software → Drivers)
- CD-ROM with all GSD files for Endress+Hauser devices → Order No.: 56003894

Contents of the downloadfile from the Internet and the CD-ROM:

- All Endress+Hauser GSD files (standard and extended format)
- Endress+Hauser type files
- Endress+Hauser bitmap files
- Useful information relating to the devices

PROFIBUS Profile GSD file:

The function scope of the profile GSD file is defined by the PROFIBUS Profile Specification 3.0. The function scope is restricted compared to the manufacturer-specific GSD file (complete device functionality). However, similar devices from different manufacturers can be interchanged with the profile GSD file without the need to reconfigure (interchangeability).

The following modules are supported with the Profile GSD file:

"AI Flow" module	→	Analog Input function block 1 / output variable: volume flow
"AI Density" module	→	Analog Input function block 2 / output variable: mass flow
"Totalizer" module	→	Totalizer function block 1 / output variable: totalized volume flow

Name of the PROFIBUS Profile GSD file

	ID No.	Profile GSD file
PROFIBUS DP	9741 (Hex)	PA039741.gsd
PROFIBUS PA	9741 (Hex)	PA139741.gsd

Source

Internet (GSD library of the PROFIBUS User Organization) → www.PROFIBUS.com

Promag 33 GSD file:

Promag 33 with Profile Version 2.0 is the precursor to the Promag 53.

If Promag 33 is already being operated in the system and the measuring device has to be replaced, Promag 53 can be used as a replacement device without having to reconfigure the PROFIBUS DP network.

Further information → 🖹 104.

6.5.2 Selection of the GSD file in the measuring device

Depending on which GSD file is used in the PROFIBUS master system, the corresponding GSD file has to be configured in the device by means of the SELECTION GSD function.

BASIC FUNCTION (G) → PROFIBUS DP/PA (GBA/GCA) → OPERATION (614) → SELECTION GSD (6140)

Promag 53 GSD file:	→	Select: MANUFACT. SPEC. (factory setting)
Profile GSD file	→	Select: PROFILE-GSD
Promag 33 GSD file:	→	Select: MANUFACT V2.0

Example

Before configuration takes place, a decision should be made as to which GSD file should be used to configure the measuring device in the PROFIBUS master system. Below, the use of the manufacturer-specific GSD file (complete device functionality) is shown using **PROFIBUS PA** as an example:

Select the manufacturer-specific GSD file in the measuring device by means of the SELECTION GSD function.

BASIC FUNCTION (G)→ PROFIBUS PA (GCA) → OPERATION (614) → SELECTION GSD (6140)→ Selection: MANUFACT. SPEC. (factory setting)

1. Before configuring the network, load the corresponding GSD file into the configuration system/master system.

   ✎ Note!
   When installing the GSD file, always first use the GSD file with the extended format (EH3x1527.gsd). However, if the installation or the configuration of the device fails with this format, then use the standard GSD (EH3_1527.gsd).

   Example for the configuration software Siemens STEP 7 of the Siemens PLC family S7-300/400:
   Use the GSD file with the extended format (EH3x1527.gsd). Copy the file to the subdirectory "...siemensstep7s7datagsd". The GSD files also include bitmap files. These bitmap files are used to display the measuring points in image form. The bitmap files must be saved to the directory "...siemensstep7s7datansbmp".

   If you are using configuration software other than that referred to above, ask your PROFIBUS master system manufacturer which directory you should use.

2. The measuring device is a modular PROFIBUS slave, i.e. the desired module configuration (input and output data) must be performed in the next step. This can be done directly by means of the configuration software. A detailed description of the modules supported by the measuring device as follows:
   PROFIBUS DP → 🖹 105
   PROFIBUS PA→ 🖹 115

6.5.3 Compatibility to the previous model Promag 33 (Profile Version 2.0)

Promag 33 with Profile Version 2.0 is the precursor to Promag 53. If Promag 33 is already being operated in the system and if the measuring device has to be replaced, Promag 53 can be used as a replacement device without having to reconfigure the PROFIBUS network.
In the event of a device being replaced, Promag 53 completely supports the compatibility of the cyclic data with the previous Promag 33 model.

The measuring devices can be exchanged as follows:

Existing device:	GSD file used:	→	To be replaced with:
Promag 33 PROFIBUS DP (ID No. 0x1511)	Extended Format: EH3x1511.gsd or Standard Format: EH3_1511.gsd	→	Promag 53 PROFIBUS DP
Promag 33 PROFIBUS PA (ID No. 0x1505)	Extended Format: EH3x1505.gsd or Standard Format: EH3_1505.gsd	→	Promag 53 PROFIBUS PA

Promag 53 is accepted as the replacement device if the MANUFACT V2.0 option is activated in the SELECTION GSD (6140) function.
The measuring device automatically detects that a Promag 33 device was configured in the automation system and makes both suitable input and output data and measured value status information available even though the devices differ in name and ID number. You do not have to adjust the configuration of the PROFIBUS network in the automation system.

Procedure after replacing the measuring devices:

1. Set the same (old) device address → FIELDBUS ADDRESS (6101) function
2. In the SELECTION GSD (6140) function → Select MANUFACT V2.0
3. Restart the measuring device → SYSTEM RESET (8046) function

Note!
If necessary, the following settings have to be configured via an operating program:
- Configuration of the application-specific parameters
- Configuration of the system units for the measured values and totalizers.

6.5.4 Maximum number of writes

If a nonvolatile device parameter is modified via the cyclic or acyclic data transmission, this change is saved in the EEPROM of the measuring device.
The number of writes to the EEPROM is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss and measuring device failure. For this reason, avoid constantly writing nonvolatile device parameters via the PROFIBUS!

6.6 PROFIBUS DP cyclic data transmission

Below is a description of the cyclic data transmission when using the Promag 53 GSD file (complete device functionality).

6.6.1 Block model

The block model illustrated shows which input and output data the measuring device provides for cyclic data transmission via PROFIBUS DP.

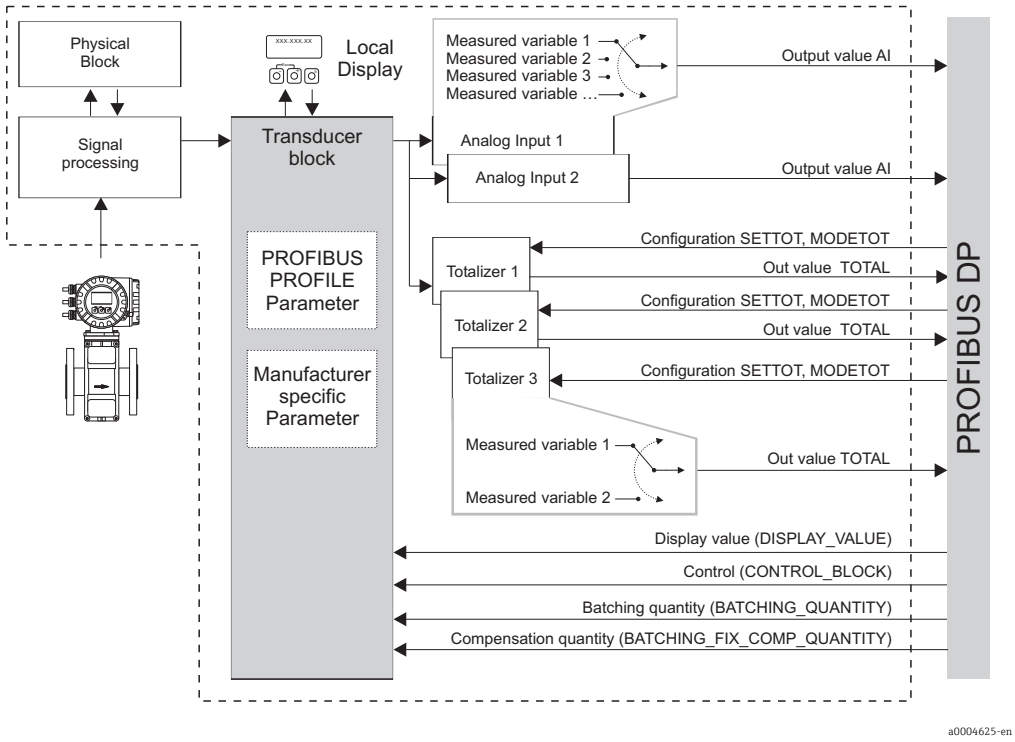


Fig. 61: Block model for Promag 53 PROFIBUS DP Profile 3.0

6.6.2 Modules for cyclic data transmission

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable - it consists of several individual modules. In the GSD file, the individual modules (input and output data) are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules (see following table). Gaps between configured modules have to be assigned the EMPTY_MODULE module. To optimize the data throughput rate of the PROFIBUS network, it is recommended to only configure modules that are processed in the PROFIBUS master system.

It is essential to adhere to the following sequence/assignment when configuring the modules in the PROFIBUS master system:

Slot sequence	Module	Description
1	AI	**Analog Input function block 1** Output variable → volume flow (factory setting)
2	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	**Totalizer function block 1** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration

Slot sequence	Module	Description
3	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	**Totalizer function block 2** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
4	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	**Totalizer function block 3** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	**Analog Input function block 2** Output variable → mass flow (factory setting)
6	DISPLAY_VALUE	Value for local display
7	CONTROL_BLOCK	Control of device functions
8	BATCHING_QUANTITY	Batching quantity
9	BATCHING_FIX_COMP_QUANTITY	Fixed correction quantity

Note!
- The assignment of the measured variables for the Analog Input function blocks (1 to 2) and the totalizer function blocks (1 to 3) can be changed by means of the CHANNEL function. A detailed description of the individual modules is contained in the following section.
- The device has to be reset once a new configuration has been loaded to the automation system. This can be effected as follows:
  – By means of the local display
  – By means of an operating program (e.g. FieldCare)
  – By switching the supply voltage off and on again.

6.6.3 Description of the modules

AI (Analog Input) module

The AI module (slots 1, 5) cyclically transmits the corresponding measured variable, including the status, to the PROFIBUS master (Class 1). The measured variable is represented in the first four bytes in the form of floating point numbers in accordance with the IEEE 754 standard. The fifth byte contains standardized status information corresponding to the measured variable.
Further information on the device status → 📄 132

Input data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
measured variable (IEEE 754 floating point number)				Status

Assignment of the measured variables to the AI module

The AI module can transmit different measured variables to the PROFIBUS master (Class 1). The measured variables are assigned to the Analog Input function blocks 1 to 2 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the CHANNEL function:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → FUNCTION BLOCKS (612) → BLOCK SELECTION (6120): Selection of an Analog Input function block → CHANNEL (6123): Selection of a measured variable

Possible settings

Measured variable	ID for CHANNEL function
VOLUME FLOW	273
MASS FLOW	277
The following measured variables are available when the additional "batching" software is installed (order option)	
BATCH UPWARDS	1346
BATCH DOWNWARDS	1347
BATCH COUNTER	1348
BATCH SUM	1349
BATCHING TIME	1354

Note!
The measured variables for the additional "batching" software are available only when they are installed in the measuring device. If the measured variable is selected even if the additional software is not installed, the value "0" is transmitted to the PROFIBUS master (Class 1) for the measured variable.

Factory setting

Module	Analog Input function block	Measured variable	ID for CHANNEL function
AI (slot 1)	1	VOLUME FLOW	273
AI (slot 5)	2	MASS FLOW	277

TOTAL module

The measuring device has three totalizer function blocks. The totalizer values can be cyclically transmitted to the PROFIBUS (Class 1) via the TOTAL module (slots 2 to 4). The totalizer value is represented in the first four bytes in the form of a floating point number in accordance with the IEEE 754 standard. The fifth byte contains standardized status information corresponding to the totalizer value.
Further information on the device status → 132

Input data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Totalizer value (IEEE 754 floating point number)				Status

Assignment of the measured variables to the TOTAL module

The TOTAL module can transmit different totalizer variables to the PROFIBUS master (Class 1).
The measured variables are assigned to the totalizer function blocks 1 to 3 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the CHANNEL function:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) →
SELECT TOTALIZER (6130): Selection of a totalizer →
CHANNEL (6133): Selection of measured variable

Possible settings

Totalizer value/measured variable	ID for CHANNEL function
VOLUME FLOW	273
MASS FLOW	277
OFF	0

Factory setting

Module	Totalizer function block	Totalizer value/ Measured variable	Unit	ID for CHANNEL function
TOTAL (slot 2)	1	VOLUME FLOW	m^3	273
TOTAL (slot 3)	2	VOLUME FLOW	m^3	273
TOTAL (slot 4)	3	VOLUME FLOW	m^3	273

SETTOT_TOTAL module

The module combination SETTOT_TOTAL (slots 2 to 4) consists of the functions SETTOT and TOTAL.
With this module combination:
- The totalizer can be controlled via the automation system (SETTOT).
- The totalizer value, is transmitted, including the status (TOTAL)

SETTOT function

In the SETTOT function, the totalizer can be controlled via control variables.
The following control variables are supported:
- 0 = Totalize (factory setting)
- 1 = Reset totalizer (the totalizer value is reset to 0)
- 2 = Accept totalizer preset

Note!
After the totalizer value has been reset to 0 or set to the preset value, the totalizing continues automatically. The control variable does not have to be changed to 0 again to restart totalizing.
Stopping totalizing is controlled in the SETTOT_MODETOT_TOTAL module via the MODETOT function. → 109

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 107

Data structure of the SETTOT_TOTAL module combination

Output data

SETTOT
Byte 1
Control

Input data

TOTAL				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Totalizer value (IEEE 754 floating point number)				Status

SETTOT_MODETOT_TOTAL module

The module combination SETTOT_MODETOT_TOTAL (slots 2 to 4) consists of the functions SETTOT, MODETOT and TOTAL.
With this module combination:
- The totalizer can be controlled via the automation system (SETTOT).
- The totalizer can be configured via the automation system (MODETOT).
- The totalizer value, is transmitted, including the status (TOTAL)

SETTOT function

For a description of the SETTOT function, refer to SETOT_TOTAL module → 🖹 108

MODETOT function

In the MODETOT function, the totalizer can be configured via control variables.
The following settings are possible:
- 0 = Balance (factory setting), calculates the positive and negative flow portions
- 1 = calculates the positive flow portions
- 2 = calculates the negative flow portions
- 3 = Totalizing is stopped

Note!
For the calculation of the positive and negative flow portions (control variable 0) or the negative flow portions only (control variable 2) to be carried out correctly, the option BIDIRECTIONAL must be active in the MEASURING MODE (6601) function.

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 🖹 107

Data structure of the SETTOT_MODETOT_TOTAL module combination

Output data

SETTOT	MODETOT
Byte 1	Byte 2
Control	Configuration

Input data

TOTAL				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Totalizer value (IEEE 754 floating point number)				Status

Example of using the SETTOT_MODETOT_TOTAL module

If the SETTOT function is set to 1 (= reset the totalizer), the value for the aggregated total is reset to 0.
If the aggregated total of the totalizer should constantly retain the value 0, the MODETOT function must first be set to 3 (= totalizing is stopped) and then the SETTOT function must be set to 1 (= reset the totalizer).

DISPLAY_VALUE module

Any value (IEEE 754 floating point number), including status, can be cyclically transmitted via the PROFIBUS master (Class 1) directly to the local display using the DISPLAY_VALUE module (slot 6). Display value assignment to the main line, additional line or information line can be configured via the local display itself or an operating program (e.g. FieldCare).

Output data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Display value (IEEE 754 floating point number)				Status

Status

The measuring device interprets the status in accordance with PROFIBUS Profile Specification Version 3.0. The statuses OK, BAD and UNCERTAIN are indicated on the local display by a corresponding symbol. → 🖹 69

CONTROL_BLOCK module

By means of the CONTROL_BLOCK module (slot 7), the measuring device is able to process device-specific control variables from the PROFIBUS master (Class 1) in cyclic data transmission (e.g. switching on positive zero return).

Supported control variables of the CONTROL_BLOCK module

The following device-specific control variables can be activated by changing the output byte from 0 → x:

Module	Control variables
CONTROL_BLOCK	0 → 2: Positive zero return ON 0 → 3: Positive zero return OFF 0 → 8: UNIDIRECTIONAL measuring mode 0 → 9: BIDIRECTIONAL measuring mode 0 → 24: Run UNIT TO BUS function
	Control variables that are executed only if the measuring device is equipped with the optional Electrode Cleaning Circuit (ECC)
	0 → 5: ECC OFF 0 → 6: ECC ON
	The following control variables are only executed if the measuring device has a relay output.
	0 → 50: Relay output 1 OFF 0 → 51: Relay output 1 ON 0 → 55: Relay output 2 OFF 0 → 56: Relay output 2 ON
	Control variables that are executed only if the "Batching" software plug-in is installed in the measuring device
	0 → 30: Select batching specification 1 0 → 31: Select batching specification 2 0 → 32: Select batching specification 3 0 → 33: Select batching specification 4 0 → 34: Select batching specification 5 0 → 35: Select batching specification 6 0 → 40: Stop batching 0 → 41: Start batching 0 → 42: Interrupt (pause) batching 0 → 43: Continue batching 0 → 44: Reset the fault message (affects the following batching fault messages: # 471, 472, 473, 474) 0 → 46: Reset batching counter and total batching quantity to 0

Note!
The control (e.g. switching on positive zero return) is executed by cyclic data transmission if the output byte switches from "0 to the bit pattern in question. The output byte must always switch from "0". A switchback to "0" does not have any effect.

Example (change the output byte)

From	→	To	Result
0	→	2	Positive zero return is switched on.
2	→	0	No effect
0	→	3	Positive zero return is switched off.
3	→	2	No effect

Output data

Byte 1
Control

BATCHING_QUANTITY module

The value of the quantity to be batched (IEEE 754 floating point number), including status, can be cyclically transmitted by the PROFIBUS master (Class 1) to the measuring device using the BATCHING_QUANTITY module (slot 8). If the batch quantity specified here is achieved, the closing contact for valve 1 is activated. The unit selected in the measuring device is used as the unit.

Caution!
The batching quantity is a nonvolatile device parameter. For this reason, avoid constantly writing this device parameter via PROFIBUS! → 🖹 104

Note!
- This module is only evaluated by the measuring device if the additional "batching" software is installed in the measuring device (order option).
- Further explanation of the parameter BATCH QUANTITY (7203) is contained in the "Description of Device Functions" manual, which is a separate part of this Operating Manual.

Output data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Batch quantity (IEEE 754 floating point number)				Status

Note!
The status is not evaluated by the device.

BATCHING_FIX_COMP_QUANTITY module

A positive or negative correction value (IEEE 754 floating point number), including status, can be cyclically transmitted by the PROFIBUS master (Class 1) to the measuring device using the BATCHING_FIX_COMP_QUANTITY module (slot 9). The correction quantity balances out a constant, system-related incorrect quantity. This can be caused, for example, by a pump over-running or by the closing time of a valve. The correction quantity is determined by the system operator. A negative compensation quantity must be specified for overbatching and a positive correction quantity for underbatching. The permitted input range is ±10% of the batch quantity. The unit selected in the measuring device is used as the unit.

Caution!
The batching quantity is a nonvolatile device parameter. For this reason, avoid constantly writing this device parameter via PROFIBUS!→ 🖹 104

Note!
- This module is only evaluated by the measuring device if the additional "batching" software is installed in the measuring device (order option).
- If the input range is not sufficient for the correction quantity, the batching quantity may have to be adjusted.
- Further explanation of the parameter FIX COMPENSATION QUANTITY (7204) is contained in the "Description of Device Functions" manual, which is a separate part of this Operating Manual.

Output data:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Fixed correction quantity (IEEE 754 floating point number)				Status

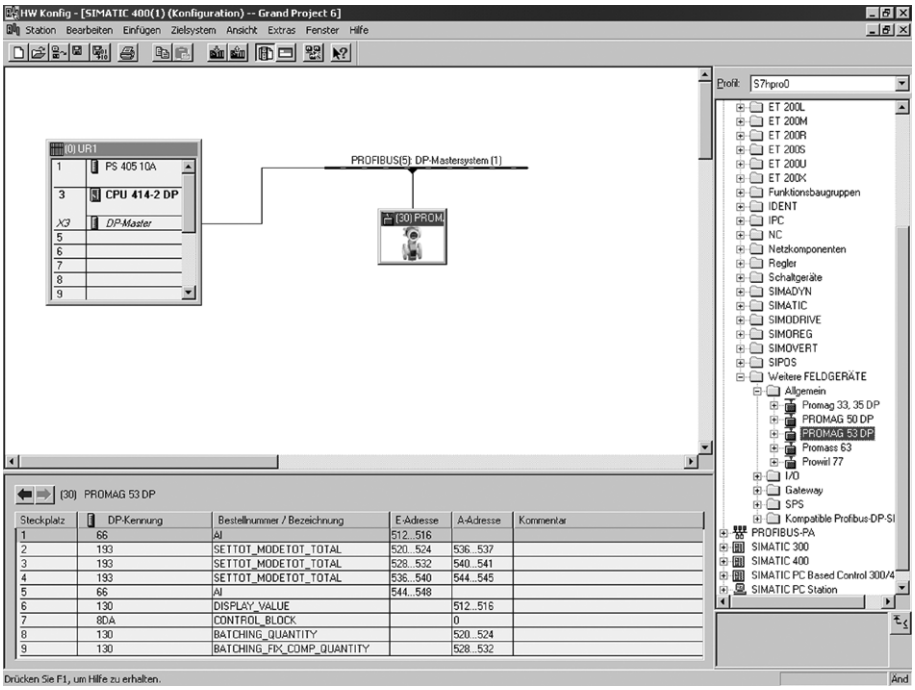
Note!
The status is not evaluated by the device.

EMPTY_MODULE module

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable - it consists of several individual modules. In the GSD file, the individual modules are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules. Gaps between configured modules have to be assigned the EMPTY_MODULE module.
For a more detailed description, see → 105

6.6.4 Configuration examples with Simatic S7 HW-Konfig

Example 1



a0004787

Fig. 62: Complete configuration using the Promag 53 GSD file (complete device functionality)

It is essential to adhere to the following sequence when configuring the modules in the PROFIBUS master (Class 1):

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	**Analog Input function block 1** Output variable → volume flow (factory setting)
2	SETTOT_MODETOT_TOTAL	5	2	**Totalizer function block 1** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
3	SETTOT_MODETOT_TOTAL	5	2	**Totalizer function block 2** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
4	SETTOT_MODETOT_TOTAL	5	2	**Totalizer function block 3** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	5	-	**Analog Input function block 2** Output variable → mass flow (factory setting)
6	DISPLAY_VALUE	-	5	Value for local display
7	CONTROL_BLOCK	-	1	Control of device functions
8	BATCHING_QUANTITY	-	5	Batching quantity
9	BATCHING_FIX_COMP_QUANTITY	-	5	Fixed correction quantity

Example 2

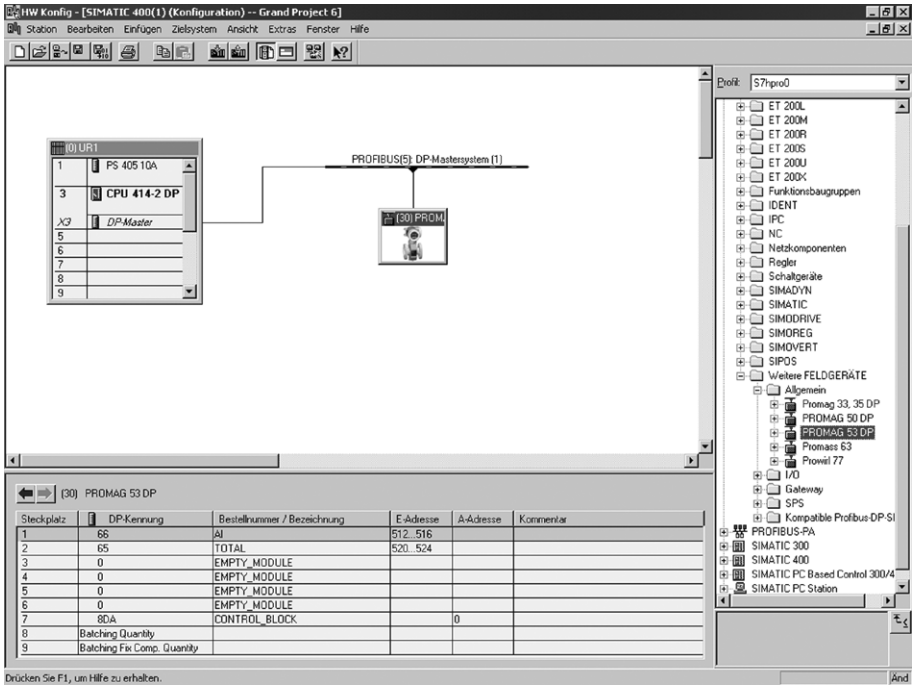


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Fig. 63: In this example, modules that are not needed are replaced by the module EMPTY_MODULE. The Promag 53 GSD file is used (manufacturer-specific GSD file, complete device functionality)

With this configuration, the Analog Input function block 1 (slot 1), the totalizer value TOTAL (slot 2) and the cyclic control of device functions CONTROL_BLOCK (slot 7) are activated. The volume flow (factory setting) is read out cyclically by the measuring device by means of Analog Input function block 1. The totalizer is configured "without configuration". In other words, in this example it only returns the totalizer value for the volume flow by means of the TOTAL module and cannot be controlled by the PROFIBUS master (Class 1).

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	**Analog Input function block 1** Output variable → volume flow (factory setting)
2	TOTAL	5	-	**Totalizer function block 1** TOTAL → output variable = volume flow (factory setting)
3	EMPTY_MODULE	-	-	Empty
4	EMPTY_MODULE	-	-	Empty
5	EMPTY_MODULE	-	-	Empty
6	EMPTY_MODULE	-	-	Empty
7	CONTROL_BLOCK	-	1	Control of device functions

6.7 PROFIBUS PA cyclic data transmission

Below is a description of the cyclic data transmission when using the Promag 53 GSD file (complete device functionality).

6.7.1 Block model

The block model illustrated shows which input and output data the measuring device provides for cyclic data transmission via PROFIBUS PA.

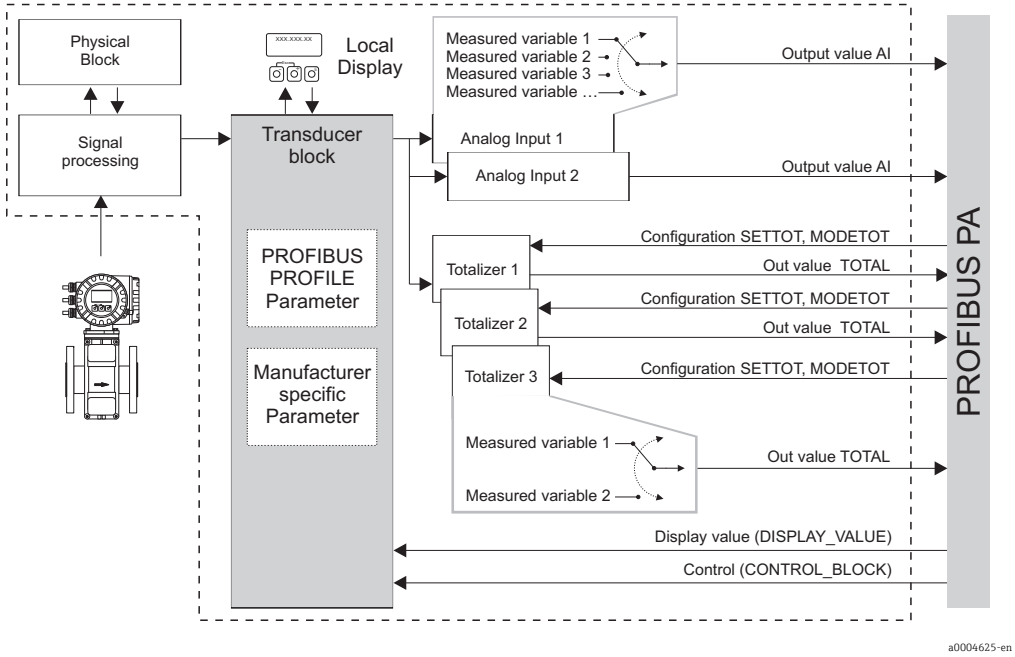

Fig. 64: Block model for Promag 53 PROFIBUS PA Profile 3.0

6.7.2 Modules for cyclic data transmission

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable - it consists of several individual modules. In the GSD file, the individual modules (input and output data) are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules (see following table). Gaps between configured modules have to be assigned the EMPTY_MODULE module. To optimize the data throughput rate of the PROFIBUS network, it is recommended to only configure modules that are processed in the PROFIBUS master system.

It is essential to adhere to the following sequence/assignment when configuring the modules in the PROFIBUS master system:

Slot sequence	Module	Description
1	AI	**Analog Input function block 1** Output variable → volume flow (factory setting)
2	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	**Totalizer function block 1** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
3	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	**Totalizer function block 2** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration

Slot sequence	Module	Description
4	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	**Totalizer function block 3** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	**Analog Input function block 2** Output variable → mass flow (factory setting)
6	DISPLAY_VALUE	Value for local display
7	CONTROL_BLOCK	Control of device functions

Note!
- The assignment of the measured variables for the Analog Input function blocks (1 to 2) and the totalizer function blocks (1 to 3) can be changed by means of the CHANNEL function. A detailed description of the individual modules is contained in the following section.
- The device has to be reset once a new configuration has been loaded to the automation system. This can be effected as follows:
  – By means of the local display
  – By means of an operating program (e.g. FieldCare)
  – By switching the supply voltage off and on again.

6.7.3 Description of the modules

AI (Analog Input) module

The AI module (slots 1, 5) cyclically transmits the corresponding measured variable, including the status, to the PROFIBUS master (Class 1). The measured variable is represented in the first four bytes in the form of floating point numbers in accordance with the IEEE 754 standard. The fifth byte contains standardized status information corresponding to the measured variable.
Further information on the device status → 132

Input data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
measured variable (IEEE 754 floating point number)				Status

Assignment of the measured variables to the AI module

The AI module can transmit different measured variables to the PROFIBUS master (Class 1). The measured variables are assigned to the Analog Input function blocks 1 to 2 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the CHANNEL function:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → FUNCTION BLOCKS (612) → BLOCK SELECTION (6120): Selection of an Analog Input function block → CHANNEL (6123): Selection of a measured variable

Possible settings

Measured variable	ID for CHANNEL function
VOLUME FLOW	273
MASS FLOW	277

Note!
The measured variables for the additional "batching" software are available only when they are installed in the measuring device. If the measured variable is selected even if the additional software is not installed, the value "0" is transmitted to the PROFIBUS master (Class 1) for the measured variable.

Factory setting

Module	Analog Input function block	Measured variable	ID for CHANNEL function
AI (slot 1)	1	VOLUME FLOW	273
AI (slot 5)	2	MASS FLOW	277

TOTAL module

The measuring device has three totalizer function blocks. The totalizer values can be cyclically transmitted to the PROFIBUS (Class 1) via the TOTAL module (slots 2 to 4). The totalizer value is represented in the first four bytes in the form of a floating point number in accordance with the IEEE 754 standard. The fifth byte contains standardized status information corresponding to the totalizer value.
Further information on the device status → 🖹 132

Input data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Totalizer value (IEEE 754 floating point number)				Status

Assignment of the measured variables to the TOTAL module

The TOTAL module can transmit different totalizer variables to the PROFIBUS master (Class 1).
The measured variables are assigned to the totalizer function blocks 1 to 3 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the CHANNEL function:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) →
SELECT TOTALIZER (6130): Selection of a totalizer →
CHANNEL (6133): Selection of measured variable

Possible settings

Totalizer value/measured variable	ID for CHANNEL function
VOLUME FLOW	273
MASS FLOW	277
OFF	0

Factory setting

Module	Totalizer function block	Totalizer value/ Measured variable	Unit	ID for CHANNEL function
TOTAL (slot 2)	1	VOLUME FLOW	m^3	273
TOTAL (slot 3)	2	VOLUME FLOW	m^3	273
TOTAL (slot 4)	3	VOLUME FLOW	m^3	273

Example:

You want to cyclically transmit the totalized volume flow as totalizer value 1 to the PROFIBUS master (Class 1) by means of the TOTAL module (slot 7):

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) →
select TOTALIZER (6130): Select TOTALIZER 1, then select CHANNEL (6133) = VOLUME FLOW

SETTOT_TOTAL module

The module combination SETTOT_TOTAL (slots 2 to 4) consists of the functions SETTOT and TOTAL.
With this module combination:
- The totalizer can be controlled via the automation system (SETTOT).
- The totalizer value, is transmitted, including the status (TOTAL)

SETTOT function

In the SETTOT function, the totalizer can be controlled via control variables.
The following control variables are supported:
- 0 = Totalize (factory setting)
- 1 = Reset totalizer (the totalizer value is reset to 0)
- 2 = Accept totalizer preset

Note!
After the totalizer value has been reset to 0 or set to the preset value, the totalizing continues automatically. The control variable does not have to be changed to 0 again to restart totalizing.
Stopping totalizing is controlled in the SETTOT_MODETOT_TOTAL module via the MODETOT function. → 109

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 107

Data structure of the SETTOT_TOTAL module combination

Output data

SETTOT
Byte 1
Control

Input data

TOTAL				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Totalizer value (IEEE 754 floating point number)				Status

SETTOT_MODETOT_TOTAL module

The module combination SETTOT_MODETOT_TOTAL (slots 2 to 4) consists of the functions SETTOT, MODETOT and TOTAL.
With this module combination:
- The totalizer can be controlled via the automation system (SETTOT).
- The totalizer can be configured via the automation system (MODETOT).
- The totalizer value, is transmitted, including the status (TOTAL)

SETTOT function

For a description of the SETTOT function, refer to SETOT_TOTAL module → 🖹 108

MODETOT function

In the MODETOT function, the totalizer can be configured via control variables.
The following settings are possible:
- 0 = Balance (factory setting), calculates the positive and negative flow portions
- 1 = calculates the positive flow portions
- 2 = calculates the negative flow portions
- 3 = Totalizing is stopped

Note!
For the calculation of the positive and negative flow portions (control variable 0) or the negative flow portions only (control variable 2) to be carried out correctly, the option BIDIRECTIONAL must be active in the MEASURING MODE (6601) function.

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 🖹 107

Data structure of the SETTOT_MODETOT_TOTAL module combination

Output data

SETTOT	MODETOT
Byte 1	Byte 2
Control	Configuration

Input data

TOTAL				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Totalizer value (IEEE 754 floating point number)				Status

Example of using the SETTOT_MODETOT_TOTAL module

If the SETTOT function is set to 1 (= reset the totalizer), the value for the aggregated total is reset to 0.
If the aggregated total of the totalizer should constantly retain the value 0, the MODETOT function must first be set to 3 (= totalizing is stopped) and then the SETTOT function must be set to 1 (= reset the totalizer).

DISPLAY_VALUE module

Any value (IEEE 754 floating point number), including status, can be cyclically transmitted via the PROFIBUS master (Class 1) directly to the local display using the DISPLAY_VALUE module (slot 6). Display value assignment to the main line, additional line or information line can be configured via the local display itself or an operating program (e.g. FieldCare).

Output data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Display value (IEEE 754 floating point number)				Status

Status

The measuring device interprets the status in accordance with PROFIBUS Profile Specification Version 3.0. The statuses OK, BAD and UNCERTAIN are indicated on the local display by a corresponding symbol. → 🖹 69

CONTROL_BLOCK module

By means of the CONTROL_BLOCK module (slot 7), the measuring device is able to process device-specific control variables from the PROFIBUS master (Class 1) in cyclic data transmission (e.g. switching on positive zero return).

Supported control variables of the CONTROL_BLOCK module

The following device-specific control variables can be activated by changing the output byte from 0 → x:

Module	Control variables
CONTROL_BLOCK	0 → 2: Positive zero return ON 0 → 3: Positive zero return OFF 0 → 8: UNIDIRECTIONAL measuring mode 0 → 9: BIDIRECTIONAL measuring mode 0 → 24: Run UNIT TO BUS function
	Control variables that are executed only if the measuring device is equipped with the optional Electrode Cleaning Circuit (ECC)
	0 → 5: ECC OFF 0 → 6: ECC ON

Note!
The control (e.g. switching on positive zero return) is executed by cyclic data transmission if the output byte switches from "0 to the bit pattern in question. The output byte must always switch from "0". A switchback to "0" does not have any effect.

Example (change the output byte)

From	→	To	Result
0	→	2	Positive zero return is switched on.
2	→	0	No effect
0	→	3	Positive zero return is switched off.
3	→	2	No effect

Output data

Byte 1
Control

EMPTY_MODULE module

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable - it consists of several individual modules. In the GSD file, the individual modules are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules. Gaps between configured modules have to be assigned the EMPTY_MODULE module.
For a more detailed description, see → 105

6.7.4 Configuration examples with Simatic S7 HW-Konfig

Example 1

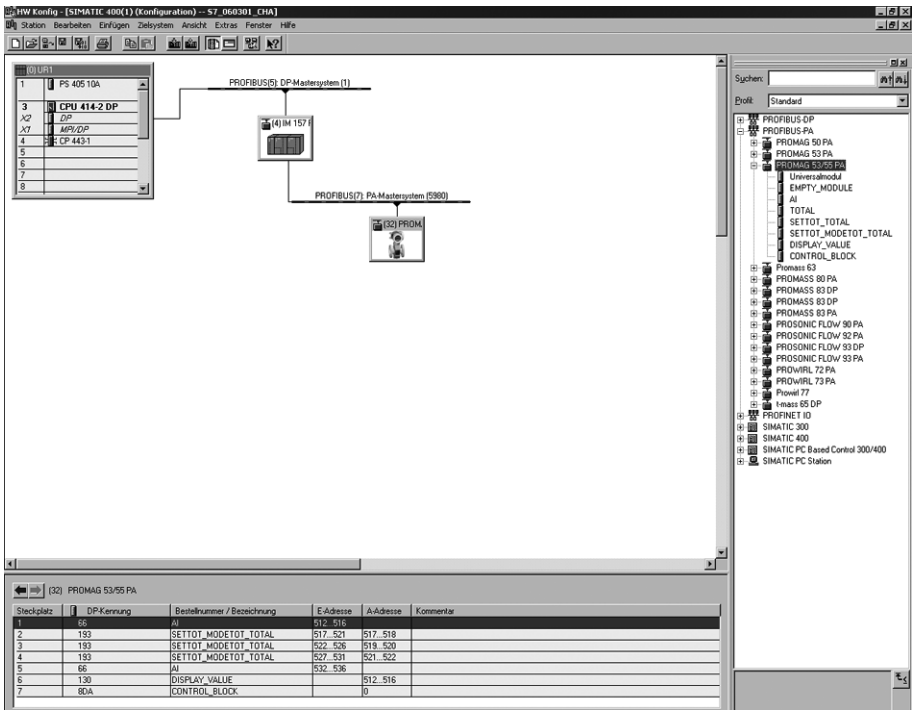

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Fig. 65: Complete configuration using the Promag 53 GSD file (complete device functionality)

It is essential to adhere to the following sequence when configuring the modules in the PROFIBUS master (Class 1):

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	**Analog Input function block 1** Output variable → volume flow (factory setting)
2	SETTOT_MODETOT_TOTAL	5	2	**Totalizer function block 1** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
3	SETTOT_MODETOT_TOTAL	5	2	**Totalizer function block 2** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
4	SETTOT_MODETOT_TOTAL	5	2	**Totalizer function block 3** TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	5	-	**Analog Input function block 2** Output variable → mass flow (factory setting)
6	DISPLAY_VALUE	-	5	Value for local display
7	CONTROL_BLOCK	-	1	Control of device functions

Example 2

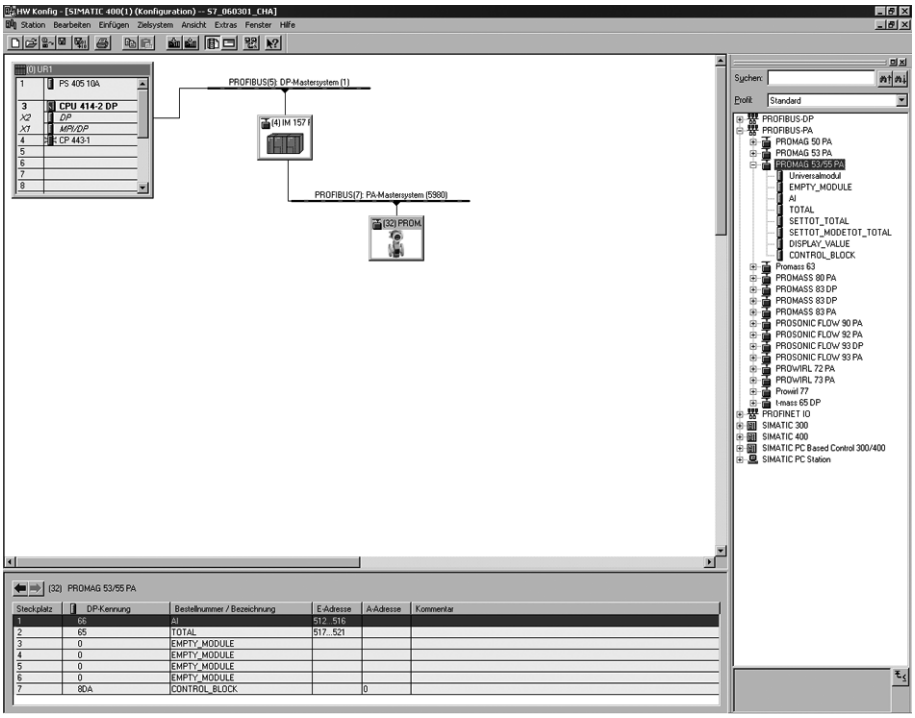

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Fig. 66: In this example, modules that are not needed are replaced by the module EMPTY_MODULE. The Promag 53 GSD file is used (manufacturer-specific GSD file, complete device functionality)

With this configuration, the Analog Input function block 1 (slot 1), the totalizer value TOTAL (slot 2) and the cyclic control of device functions CONTROL_BLOCK (slot 7) are activated. The volume flow (factory setting) is read out cyclically by the measuring device by means of Analog Input function block 1. The totalizer is configured "without configuration". In other words, in this example it only returns the totalizer value for the volume flow by means of the TOTAL module and cannot be controlled by the PROFIBUS master (Class 1).

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	**Analog Input function block 1** Output variable → volume flow (factory setting)
2	TOTAL	5	-	**Totalizer function block 1** TOTAL → output variable = volume flow (factory setting)
3	EMPTY_MODULE	-	-	Empty
4	EMPTY_MODULE	-	-	Empty
5	EMPTY_MODULE	-	-	Empty
6	EMPTY_MODULE	-	-	Empty
7	CONTROL_BLOCK	-	1	Control of device functions

6.8 PROFIBUS DP/PA acyclic data transmission

Acyclic data transmission is used to transmit parameters during commissioning or maintenance, or to display additional measured variables that are not included in cyclic data traffic. Thus parameters for identification, control or adjustment in the various blocks (physical block, transducer block, function block) can be changed while the device is in the process of cyclic data transmission with a PLC.

The measuring device supports the two basic types of acyclic data transmission:
- MS2AC communication with 2 available SAP´s
- MS1AC communication

6.8.1 Master class 2 acyclic (MS2AC)

MS2AC is acyclic data transmission between a field device and a Class 2 master (z.B. FieldCare, Siemens PDM etc. → 📄 74). During this process, the master opens a communication channel via an SAP (Service Access Point) to access the device.
All parameters to be exchanged with a device via PROFIBUS must be made known to a Class 2 master. This assignment to each individual parameter takes place either in a device description (DD), a DTM (Device Type Manager), or inside a software component in the master via slot and index addressing.

When using MS2AC communication, note the following:
- As described above, a Class 2 master accesses a device via special SAP´s. Therefore, the number of Class 2 masters that can communicate with a device simultaneously is limited to the number of SAPs available for this data transmission.
- The use of a Class 2 master increases the cycle time of the bus system. This must be taken into account when programming the control system used.

6.8.2 Master class 1 acyclic (MS1AC)

In MS1AC, a cyclic master, that is already reading the cyclic data from the device or writing to the device opens the communication channel via the SAP 0x33 (special Service Access Point for MS1AC) and can then read or write a parameter acyclically like a Class 2 master via the slot and the index (if supported).
When using MS1AC communication, note the following:
- Currently, few PROFIBUS masters on the market support this data transmission.
- MS1AC is not supported by all PROFIBUS devices.
- In the user program, note that constant writing of parameters (for example, at every cycle of the program) can drastically reduce the service life of a device. Acyclically written parameters are written to voltage-resistant memory modules (EEPROM, Flash etc.). These memory modules are designed for a limited number of write operations. In normal operation without MS1AC (during parameter configuration), the number of write operations does not even come close to this number. If programming is incorrect, this maximum number can be reached quickly, drastically reducing a device's service life.

✎ Note!
The memory module of the measuring device is designed for one million write operations.

6.9 Adjustment

6.9.1 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 are contained 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 → ± → PROCESSPARAMETERS → 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 cases, the empty-pipe/full-pipe adjustment **must** be repeated!
- ADJUSTMENT NOT OK
  Adjustment is not possible because the fluid's conductivity is out of range.

6.10 Data storage device

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

6.10.1 HistoROM/S-DAT (Sensor DAT)

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

6.10.2 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 has to be carried out by the user (= manual save function). Detailed information about the procedure → 95

6.10.3 F-CHIP (Function Chip)

The F-Chip is a microprocessor chip that contains additional software packages that extend the functionality and application possibilities of the transmitter.
In the case of a later upgrade, the F-CHIP can be ordered as an accessory and can simply be plugged on to the I/O board. After start up, the software is immediately made available to the transmitter.
Accessories → 128
Plugging on to the I/O board → 146

Caution!
To ensure an unambiguous assignment, the F-CHIP is coded with the transmitter serial number once it is plugged in. Thus, it can not be reused with other measuring devices.

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 and the seals.

7.2 Seals

The seals of the Promag H sensor must be replaced cyclically, particularly in the case of molded seals (aseptic version). The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessories)→ 128

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. The Endress+Hauser service organization can provide detailed information on the order code of your choice.

8.1 Device-specific accessories

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

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for Promag 53 transmitter	Mounting kit for wall-mounted housing (remote version). Suitable for: ▪ Wall mounting ▪ Pipe mounting ▪ Panel mounting Mounting set for aluminum housings. Suitable for: ▪ Pipe mounting	DK5WM - *
Cable for remote version	Coil and signal 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 matching	DK5GD * * *
Mounting kit for Promag H	Mounting kit for Promag H, comprising: – 2 process connections – Screws – Seals	DKH * * - * * * *
Adapter connection for Promag A, H	Adapter connections for installing Promag 53 H instead of Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA - * * * * * *
Ground 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 - * * * *
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS - * * *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor.	DK5HM - * *
Welding jig for Promag H	Weld nipples as process connection: Welding jig for installation in pipes.	DK5HW - * * *

8.3 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.	DKA80 - *
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 the intelligent field units in your system and helps you manage these units. By providing status information, it is also a simple but effective method of controlling the units' status.	See the product page on the Endress+Hauser website: www.endress.com
FXA193	The FXA193 service interface connects the device to the PC for configuration via FieldCare.	FXA193 – *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick. Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.	RSG40-**********

9 Troubleshooting

9.1 Troubleshooting instructions

Always start troubleshooting with the following checklist if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → Terminals 1, 2 2. Check device fuse → 🖹 152 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 3. Measuring electronics defective → order spare parts → 🖹 146
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 → 🖹 146 2. Display module defective → order spare parts → 🖹 146 3. Measuring electronics defective → order spare parts → 🖹 146
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ± keys 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	Measuring electronics defective → order spare parts → 🖹 146

▼

Error messages on display
Errors which occur during commissioning or measuring 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: ϟ = fault message, ! = notice message – **EMPTY TUBE** = 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 refer to the information on → 🖹 73 ▪ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.
System error (device error) has occurred→ 🖹 132
Process error (application error) has occurred→ 🖹 141

▼

Faulty connection to control system	
No connection can be made between the control system and the device. Check the following points:	
Supply voltage Transmitter	Check the Supply voltage → Terminals 1/2
Device fuse	Check device fuse → 🖹 152 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
Fieldbus connection	PROFIBUS PA: Check data line Terminal 26 = PA + Terminal 27 = PA - PROFIBUS DP: Check data line Terminal 26 = B (RxD/TxD-P) Terminal 27 = A (RxD/TxD-N)

▼

Faulty connection to control system (continued)	
Fieldbus connector (only for PROFIBUS PA)	▪ Check pin assignment/wiring ▪ Check connection between connector/fieldbus port. Is the coupling ring tightened correctly?
Fieldbus voltage (only for PROFIBUS PA)	Check that a min. bus voltage of 9 V DC is present at terminals 26/27. Permissible range: 9 to 32 V DC
Network structure	Check permissible fieldbus length and number of spurs.
Basic current (only for PROFIBUS PA)	Is there a basic current of min. 11 mA?
Bus address	Check bus address: make sure there are no double assignments
Bus termination	Has the PROFIBUS network been terminated correctly? Each bus segment must always be terminated with a bus terminator at both ends (start and finish). Otherwise there may be interference in communication.
Power consumption, permitted feed current (only for PROFIBUS PA)	Check the current consumption of the bus segment: The current consumption of the bus segment in question (= total of basic currents of all bus users) must not exceed the max. permissible feed current of the bus power supply.

▼

System or process error messages
System or process errors which occur during commissioning or operation can also be displayed in the manufacturer-specific device controls using the FieldCare operating program.

▼

Other error (without error message)	
Other errors are present	Diagnosis and rectification → 🖹 144

9.2 System error messages

Serious system errors are **always** recognized by the measuring device as a "fault message" and shown as a lightning flash symbol (ϟ) on the display! Fault messages immediately affect the inputs and outputs. Simulations and positive zero return, on the other hand, are classed and displayed as "Notice messages".

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. Important procedures must be carried out before you return a flowmeter to Endress+Hauser. → 155
Always enclose a duly completed "Declaration of contamination" form. You will find a preprinted blank of this form at the back of this manual.

Note!
- The error types listed in the following correspond to the factory settings.
- See the information on → 73

9.2.1 Displaying the device status on PROFIBUS DP/PA

Display in the operating program (acyclic data transmission)

The device status can be queried using an operating program (e.g. FieldCare):
Function block SUPERVISION → SYSTEM → OPERATION → ACTUAL SYSTEM CONDITION

Display in the PROFIBUS master system (cyclic data transmission)

If the AI or TOTAL modules are configured for cyclic data transmission, the device status is coded in accordance with PROFIBUS Profile Specification 3.0 and transmitted with the measured value to the PROFIBUS master by means of the quality byte (byte 5). The quality byte is split into the "quality status", "quality substatus" and "limits" segments.

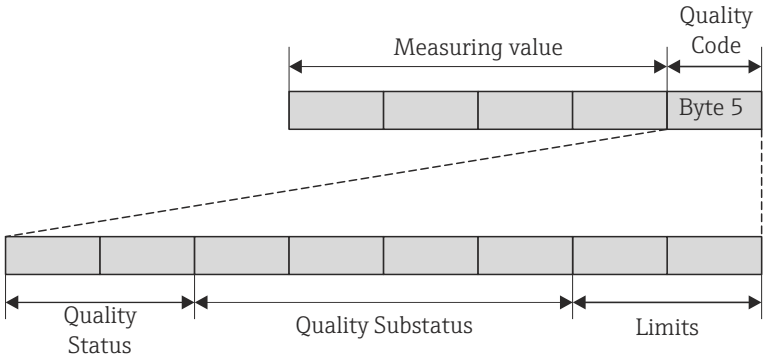

Fig. 67: Structure of the quality byte

The content of the quality byte depends on the failsafe mode error behavior configured in the corresponding Analog Input function block. Depending on which failsafe mode has been set in the FAILSAFE_TYPE function, the following status information is transmitted to the PROFIBUS master via the quality byte:

- For the selection FAILSAFE_TYPE → FSAFE VALUE :

Quality code (HEX)	Quality status	Quality substatus	Limits
0x48 0x49 0x4A	UNCERTAIN	Substitute set	OK Low High

- For the selection FAILSAFE_TYPE → LAST GOOD VALUE (factory setting):

If a valid output value was available before the failure:

Quality code (HEX)	Quality status	Quality substatus	Limits
0x44 0x45 0x46	UNCERTAIN	Last usable value	OK Low High

If no valid output value was available before the failure:

Quality code (HEX)	Quality status	Quality substatus	Limits
0x4C 0x4D 0x4E	UNCERTAIN	Initial Value	OK Low High

- For FAILSAFE_TYPE → WRONG VALUE:
  For status information, see the table in the following section.

9.2.2 List of system error messages

No.	Device status message (local display)	PROFIBUS measured value status: Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 🖹 146)
Depicted on the local display: S = System error ϟ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)							
No. # 0xx → Hardware error							
001	S: CRITICAL FAILURE ϟ: # 001	0x0F	BAD	Device Failure	Constant	ROM/RAM failure	*Cause:* ROM/RAM error. Error when accessing the program memory (ROM) or random access memory (RAM) of the processor. *Remedy:* Replace the amplifier board.
011	S: AMP HW EEPROM ϟ: # 011	0x0F	BAD	Device Failure	Constant	Amplifier EEPROM failure	*Cause:* Amplifier with faulty EEPROM *Remedy:* Replace the amplifier board.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 📄 146)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
012	S: AMP SW EEPROM ϟ: # 012	0x0F	BAD	Device Failure	Constant	Amplifier EEPROM data inconsistent	*Cause:* Error when accessing data of the measuring amplifier EEPROM *Remedy:* The EEPROM data blocks in which an error has occurred are displayed in the TROUBLESHOOTING function (No. 8047). 1. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the faulty parameter values. 2. The measuring device must be restarted after fault elimination. *Access:* SUPERVISION → SYSTEM → OPERATION → SYSTEM RESET (→ RESTART)
031	S: SENSOR HW DAT ϟ: # 031	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	S-DAT failure / S-DAT not inserted	*Cause:* 1. S-DAT is not correctly plugged into the amplifier board (or is missing). 2. S-DAT is defective. *Remedy:* 1. Check whether the S-DAT is correctly plugged into the amplifier board. 2. Replace the S-DAT if it is defective. Check whether the new replacement DAT is compatible with the existing 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 ϟ: # 032	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	S-DAT data inconsistent	
041	S: TRANSM. HW-DAT ϟ: # 041	0x0F	BAD	Device Failure	Constant	T-DAT failure	*Cause*: 1. T-DAT is not correctly plugged into the amplifier board (or is missing). 2. T-DAT is defective. *Remedy:* 1. Check whether the T-DAT is correctly plugged into the amplifier board. 2. Replace the T-DAT if it is defective. Check whether the new replacement DAT is compatible with the existing 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 ϟ: # 042	0x0F	BAD	Device Failure	Constant	T-DAT data inconsistent	

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 🖹 146)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
061	S: HW F-CHIP ϟ: # 061	0x0F	BAD	Device Failure	Constant	F-CHIP defect/not plugged	*Cause:* Transmitter F-Chip: – F-Chip is defective – F-Chip is not plugged into the I/O board or is missing. *Remedy:* 1. Replace the F-CHIP. 2. Plug the F-CHIP into the I/O board.
No. # 1xx → Software error							
101	S: GAIN ERROR AMP ϟ: # 101	0x0F	BAD	Device Failure	Constant	Gain Error Amplifier	*Cause:* Gain deviation compared to reference gain is greater than 2%. *Remedy:* Replace the amplifier board.
121	S: A/C COMPATIB. !: # 121	0x0F	BAD	Device Failure	Constant	Amplifier and I/O board only partially compatible	*Cause:* 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. *Remedy:* 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	0x0F	BAD	Device Failure	Constant	Save to T-DAT failed	*Cause:* Data backup (downloading) to T–DAT failed, or error when accessing (uploading) the calibration values stored in the T–DAT. *Remedy:* 1. Check whether the T-DAT is correctly plugged into the amplifier board. 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	0x0F	BAD	Device Failure	Constant	Restore from T-DAT failed	

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 🖹 146)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
261	S: COMMUNICAT. I/O ϟ: # 261	0x18 0x19 0x1A	BAD	No Communication	O.K. Low High	Communication failure	*Cause:* Communication error. No data reception between amplifier and I/O board or faulty internal data transfer. *Remedy:* Check whether the electronics boards are correctly inserted in their holders
No. # 3xx → System limits exceeded							
321	S: TOL. COIL CURR. ϟ: # 321	0x0F	BAD	Device Failure	Constant	Coil current out of tolerance	*Cause:* The coil current of the sensor is out of tolerance. *Remedy:* ⚠ 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 → 🖹 50 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 ϟ: # 339 to 342	0x0F	BAD	Device Failure	Constant	Temp. Buf. not cleared	*Cause:* The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. *Remedy:* 1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. *Recommendation:* – 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 ϟ: # 343 to 346	0x0F	BAD	Device Failure	Constant	Temp. Buf. not cleared	

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 🖹 146)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
347 to 350	S: STACK PULSE OUT n !: # 347 to 350	0x0F	BAD	Device Failure	Constant	Temp. Buf. not cleared	*Cause:* The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds. *Remedy:* 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. *Recommendation:* – 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	0x54 0x55 0x56	UNCERTAIN	Engineering Unit Range Violation	O.K. Low High	Flow is Out of Range	*Cause:* Current output: The actual value for the flow lies outside the set limits. *Remedy:* 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	0x54 0x55 0x56	UNCERTAIN	Engineering Unit Range Violation	O.K. Low High	Flow is Out of Range	*Cause:* Frequency output: The actual value for the flow lies outside the set limits. *Remedy:* 1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 📄 146)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
359 to 362	S: PULSE RANGE !: # 359 to 362	0x54 0x55 0x56	UNCERTAIN	Engineering Unit Range Violation	O.K. Low High	Flow is Out of Range	*Cause:* Pulse output: The pulse output frequency is out of range. *Remedy:* 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: – Version 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
No. # 5xx → Application error							
501	S: SW.-UPDATE ACT. !: # 501	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	New amplifier software loaded	*Cause:* New amplifier or communication software version is loaded. Currently no other functions are possible. *Remedy:* Wait until process is finished. The device will restart automatically.
502	S: UP-/DOWNLO. ACT. !: # 502	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	Upload/download of device data active	*Cause:* Up- or downloading the device data via configuration program. Currently no other functions are possible. *Remedy:* Wait until process is finished.
571	P: RUN BATCHING !: # 571	0x80	GOOD	O.K.	O.K.	Batch running	*Cause:* Batching is started and active (valves are open) *Remedy:* No measures needed (during the batching process some other functions may not be activated).

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 🖹 146)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
572	P: HOLD BATCHING !: # 572	0x80	GOOD	O.K.	O.K.	Batch hold	*Cause:* Batching has been interrupted (valves are closed) *Remedy:* Using either: ▪ PROFIBUS DP/PA ▪ Local display: – Continue batching with "GO ON". – Interrupt batching with "STOP".
No. # 6xx → Simulation mode active							
601	S: POS. ZERO-RETURN ! # 601	0x53	UNCERTAIN	Sensor conversion not accurate (measured value from sensor not accurate)	Constant	Positive zero return active	*Cause:* Positive zero return is active. ✎ Note! This message has the highest display priority! *Remedy:* Switch off positive zero return. *Access:* BASIC FUNCTION → SYSTEM PARAMETER → CONFIGURATION → POS. ZERO RETURN (→ OFF)
611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	0x80	GOOD	O.K.	O.K.	Simulation IO active	*Cause:* Simulation current output is active. *Remedy:* Switch off simulation.
621 to 624	S: SIM. FREQ. OUT. n !: # 621 to 624	0x80	GOOD	O.K.	O.K.	Simulation IO active	*Cause:* Simulation frequency output is active. *Remedy:* Switch off simulation.
631 to 634	S: SIM. PULSE n !: # 631 to 634	0x80	GOOD	O.K.	O.K.	Simulation IO active	*Cause:* Simulation pulse output is active. *Remedy:* Switch off simulation.
641 to 644	S: SIM. STAT. OUT n !: # 641 to 644	0x80	GOOD	O.K.	O.K.	Simulation IO active	*Cause:* Simulation status output is active. *Remedy:* Switch off simulation.
651 to 654	S: SIM. RELAY n !: # 651 to 654	0x80	GOOD	O.K.	O.K.	Simulation IO active	*Cause:* Simulation relay output is active. *Remedy:* Switch off simulation.
671 to 674	S: SIM. STATUS IN n !: # 671 to 674	0x80	GOOD	O.K.	O.K.	Simulation IO active	*Cause:* Simulation status output is active. *Remedy:* Switch off simulation.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 146)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
691	S: SIM. FAILSAFE !: # 691	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	Simulation failsafe active	*Cause:* Simulation of failsafe mode (outputs) is active. *Remedy:* Switch off simulation. *Access:* SUPERVISION → SYSTEM → OPERATION → SIM. FAILSAFE MODE (→ OFF)
692	S: SIM. MEASURAND !: # 692	0x60 0x61 0x62	UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Simulation measured value active	*Cause:* Simulation of the measured value is active. *Remedy:* Switch off simulation. *Access:* SUPERVISION → SYSTEM → OPERATION → SIM. MEASURAND (→ OFF)
698	S: DEV. TEST ACT. !: # 698	0x60 0x61 0x62	UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Device test via Fieldcheck active	*Cause:* The measuring device is being checked on site via the test and simulation device.

9.3 Process error messages

Note!
Also note the versions on → 🖹 73 and → 🖹 145.

9.3.1 Displaying the device status on PROFIBUS DP/PA

For more information, refer to → 🖹 132

9.3.2 List of process error messages

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
P = Process error ϟ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)							
401	P: EMPTY PIPE ϟ: # 401	0x03	BAD	Non specific (uncertain status)	Constant	Empty Pipe detected	*Cause:* Measuring tube partially filled or empty. *Remedy:* 1. Check the process conditions of the plant. 2. Fill the measuring tube.
461	P: ADJ N. OK !: # 461	0x40 0x41 0x42	UNCERT AIN	Non specific (uncertain status)	O.K. Low High	EPD adjustment not possible	*Cause:* EPD/OED adjustment not possible because the fluid's conductivity is either too low or too high. *Remedy:* The EPD/OED function cannot be used with fluids of this nature.
463	P: FULL = EMPTY ϟ: # 463	0x40 0x41 0x42	UNCERT AIN	Non specific (uncertain status)	O.K. Low High	EPD adjustment wrong	*Cause:* The EPD/OED adjustment values for empty pipe and full pipe are identical, therefore incorrect. *Remedy:* Repeat adjustment, making sure procedure is correct. → 🖹 125

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
471	P: > BATCH TIME ϟ: # 471	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Batch Time	*Cause:* The maximum permitted batching time was exceeded. *Remedy:* 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 [+] [−] key and then the [E] 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	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Batch Quantity	*Cause:* EPD calibration not possible as the fluid conductivity is either too low or too high. – Underbatching: The minimum quantity was not reached. – Overbatching: The maximum permitted batching quantity was exceeded. *Remedy:* Underbatching: 1. Increase fixed correction quantity. 2. If the batching quantity changes, the minimum batching quantity must be adjusted. Overbatching: 1. Reduce fixed correction quantity. 2. If the batching quantity changes, the maximum batching quantity must be adjusted. ✎ Note! Please observe Note in error message No. 471

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
473	P: PROGRESS NOTE ϟ: # 473	0x80	GOOD	O.K.	O.K.	Progress Note	*Cause:* End of filling process approaching. The running filling process has exceeded the predefined batch quantity point for the display warning message. *Remedy:* No measures required (if necessary prepare to replace container).
474	P: MAX. FLOW RATE !: # 474	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Flow Rate	*Cause:* Maximum flow value entered is exceeded. *Remedy:* Reduce the flow value. ✎ Note! Please observe Note in error message No. 471

9.4 Process errors without messages

Symptoms	Rectification
✎ Note! You may have to change or correct certain settings of the function matrix in order to rectify faults. The functions outlined below, such as DISPLAY DAMPING, for example, 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 → 🖹 50 – 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 matching. → 🖹 62 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 the value (→ OUTPUTS/CURRENT OUTPUT/CONFIGURATION) 5. DISPLAY DAMPING function → increase the 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.	Perform the "Pulsating Flow" Quick Setup (only possible if a pulse/frequency output is available). → 🖹 87 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. The problem can be solved as follows: Allow for flow in both directions. 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 matching → 🖹 62 2. Check the fluid for presence of gas bubbles. 3. Activate the ON-VALUE LOW FLOW CUT OFF function, i.e. enter or increase the value for the low flow cut off (→ BASIC FUNCTIONS / PROCESS PARAMETERS / 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 → 🖹 125 2. Remote version: Check the terminals of the EPD cable → 🖹 50 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	Value for creepage too high: Reduce the corresponding value in the ON-VALUE LOW FLOW CUT OFF function.
The fault cannot be rectified or some other fault not described above has occurred. 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: order code, serial number → 🖹 6 ▪ **Returning devices to Endress+Hauser** The required procedures must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. → 🖹 155 Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted form at the back of this Operating Manual. ▪ **Replace transmitter electronics** Components in the measuring electronics defective → order spare parts → 🖹 146

9.5 Failsafe mode of outputs

Note!
The failsafe mode of the 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, or reset measured value transmission via fieldbus to "0", 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.

Failsafe mode of outputs		
	System/process error is present	**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 → 🖹 73		
Current output	MINIMUM VALUE 0–20 mA → 0 mA 4–20 mA → 2 mA 4–20 mA NAMUR →3.5 mA 4–20 mA US → 3.75 mA 0–20 mA (25 mA) → 0 mA 4–20 mA (25 mA) → 2 mA MAXIMUM VALUE 0–20 mA → 22 mA 4–20 mA → 22 mA 4–20 mA NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 0–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) → 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"
Frequency output	FALLBACK VALUE Signal output → 0 Hz FAILSAFE LEVEL Output of the frequency specified in the FAILSAFE VALUE function. 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"
Relay output	In the event of a fault or power supply failure: Relay → deenergized The "Description of Device Functions" manual contains detailed information on relay switching response for various configurations such as error message, flow direction, EPD, limit value, etc.	No effect on relay output
PROFIBUS	→ 🖹 132	-

9.6 Spare parts

The previous sections contain a detailed troubleshooting guide.→ 130
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's nameplate. → 6

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

9.6.1 PROFIBUS DP

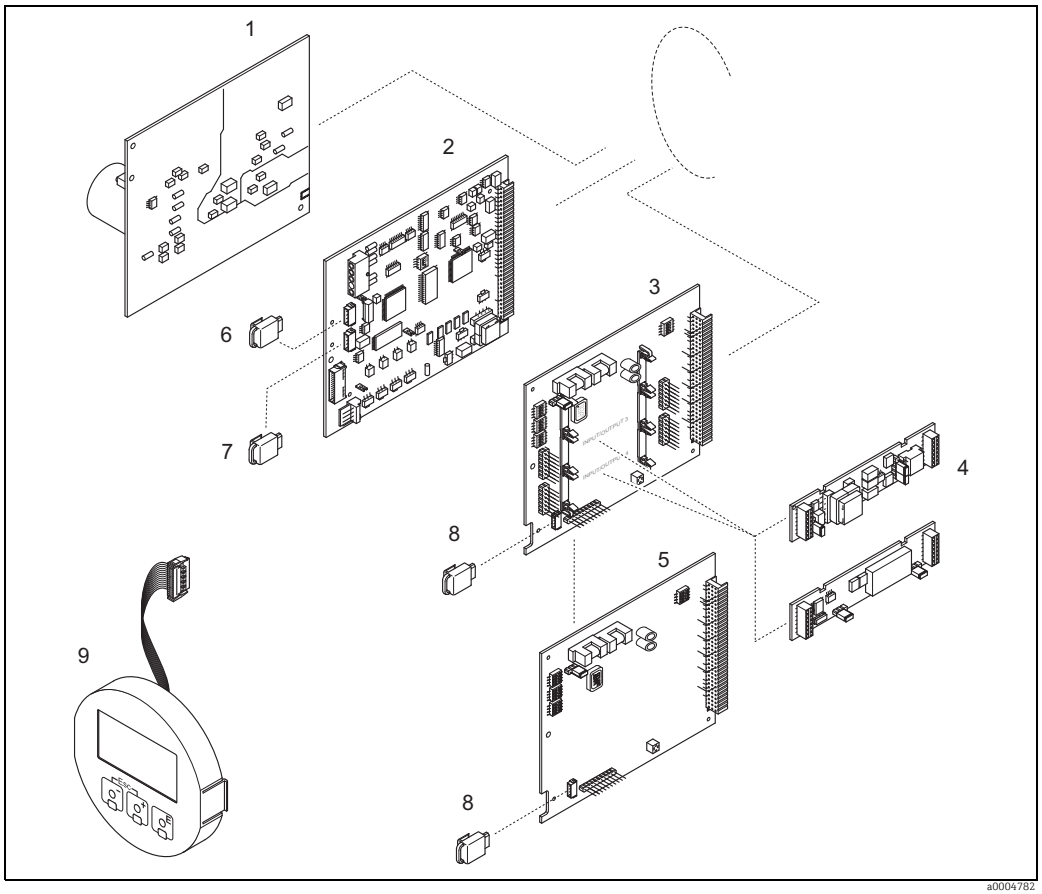

Fig. 68: Spare parts for PROFIBUS DP transmitters (field and wall-mount housing)

1 Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
2 Amplifier board
3 I/O board (COM module), flexible
4 Pluggable input/output submodules; ordering structure → 128
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

9.6.2 PROFIBUS PA

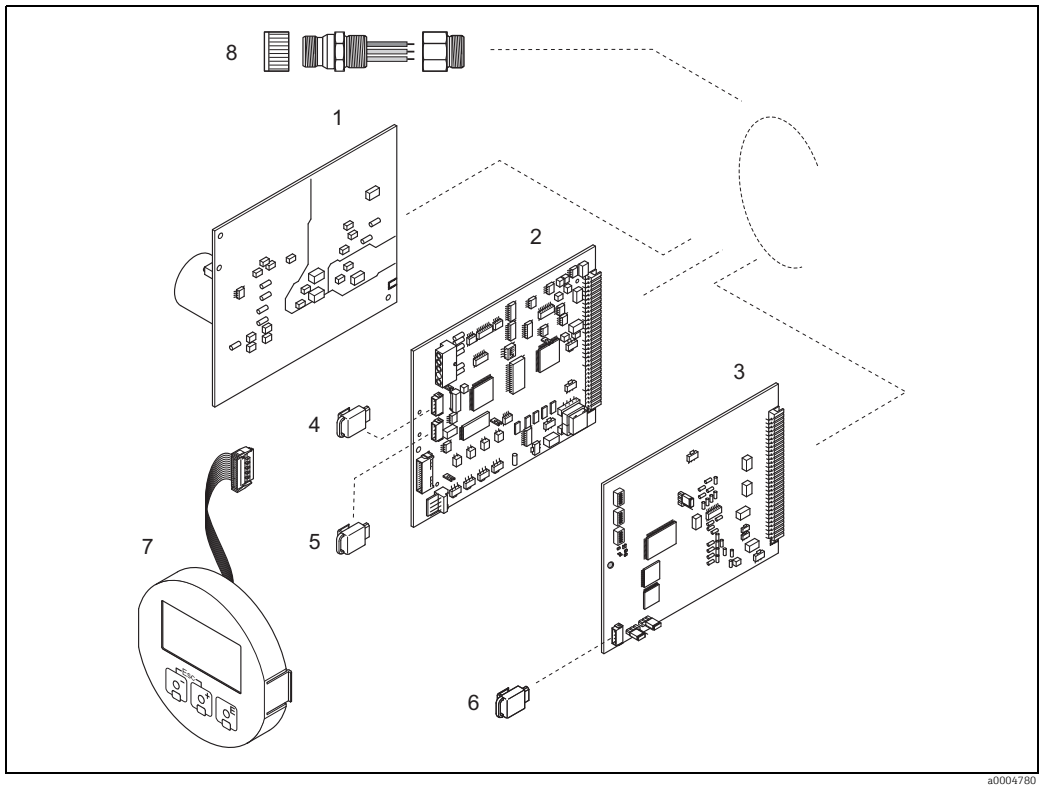

Fig. 69: Spare parts for PROFIBUS PA transmitters (field and wall-mount housing)

1 Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
2 Amplifier board
3 I/O board (COM module), permanent assignment
4 S-DAT (sensor data storage device)
5 T-DAT (transmitter data storage device)
6 F-CHIP (function chip for optional software)
7 Display module
8 Fieldbus connector consisting of protection cap, connector, adapter PG 13.5/M20.5 (only for PROFIBUS-PA, order No. 50098037)

9.6.3 Removing and installing printed circuit 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.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to this Operating Manual.

Caution!
Use only original Endress+Hauser parts.

Installing and removing the circuit boards → 70:

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. Remove power unit board (4) and I/O board (6):
   Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
5. Removing sub-modules (6.2, only for measuring devices with convertible I/O board):
   No tools are required for removing the submodules (inputs/outputs) from the I/O board. Installation is also a no-tools operation.

   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:
   – "INPUT / OUTPUT 3" slot = terminals 22/23
   – "INPUT / OUTPUT 4" slot = terminals 20/21
6. Remove amplifier board (5):
   – Disconnect the plug of the electrode signal 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 back and forward.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

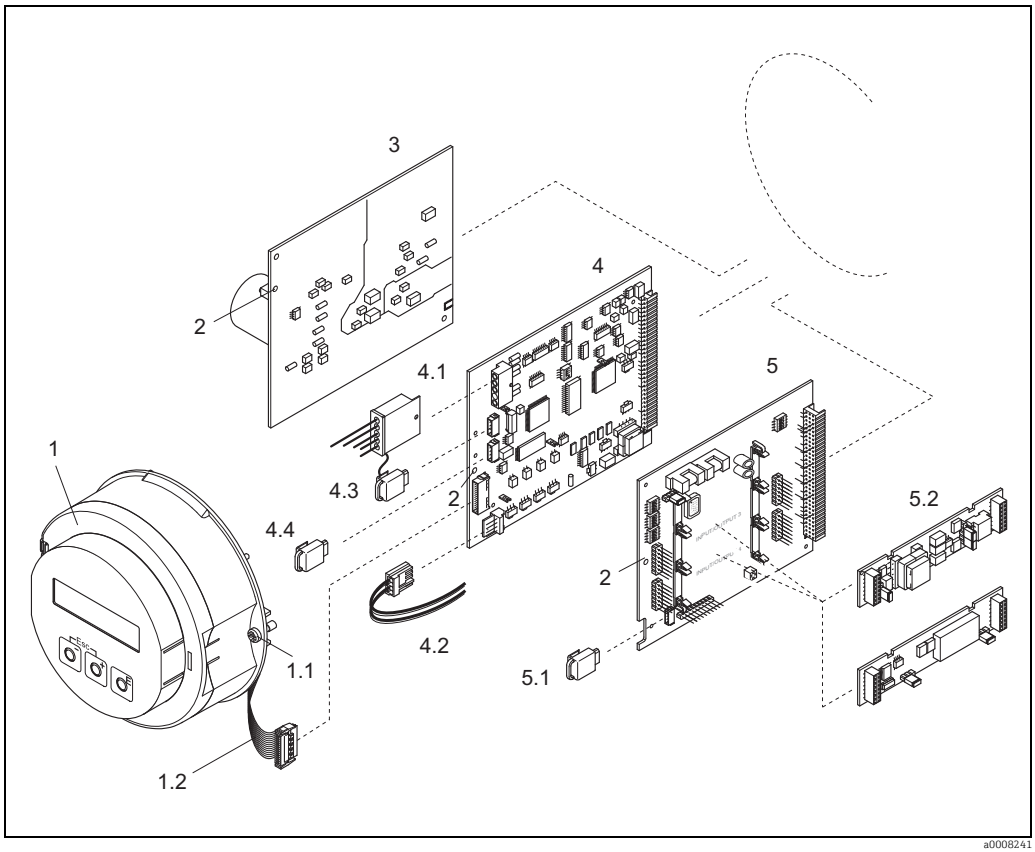

Fig. 70: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Screws of electronics compartment cover
1.2 Ribbon cable (display module)
2 Aperture for installing/removing boards
3 Power unit board
4 Amplifier board
4.1 Electrode signal cable (sensor)
4.2 Coil current cable (sensor)
4.3 S-DAT (sensor data storage device)
4.4 T-DAT (transmitter data storage device)
5 I/O board (flexible assignment)
5.1 F-CHIP (function chip for optional software)
5.2 Pluggable sub-modules (current, pulse/frequency and relay output)

Wall-mounted 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 purposely 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.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to this Operating Manual.

Caution!
Use only original Endress+Hauser parts.

Installing and removing the circuit boards → 71: Wall-mount housing

1. Remove the screws and open the hinged cover (1) of the housing.
2. Remove the screws securing the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mount housing.
3. Disconnect the following cable plugs from amplifier board (7):
   – Electrode signal cable plug (7.1) including S-DAT (7.3)
   – Plug of coil current cable (7.2):
     Loosen the plug locking and gently disconnect the plug from the board, i.e. without moving it back and forward.
   – Ribbon cable plug (3) of the display module
4. Remove the cover (4) from the electronics compartment by loosening the screws.
5. Remove the boards (6, 7, 8):
   (5) Insert a thin pin into the hole provided for the purpose and pull the board clear of its holder.
6. Removing sub-modules (8.2, only for measuring devices with convertible I/O board):
   No tools are required for removing the submodules (inputs/outputs) from the I/O board. Installation is also a no-tools operation.

   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:

   "INPUT / OUTPUT 3" slot = terminals 22/23
   "INPUT / OUTPUT 4" slot = terminals 20/21
7. Installation is the reverse of the removal procedure.

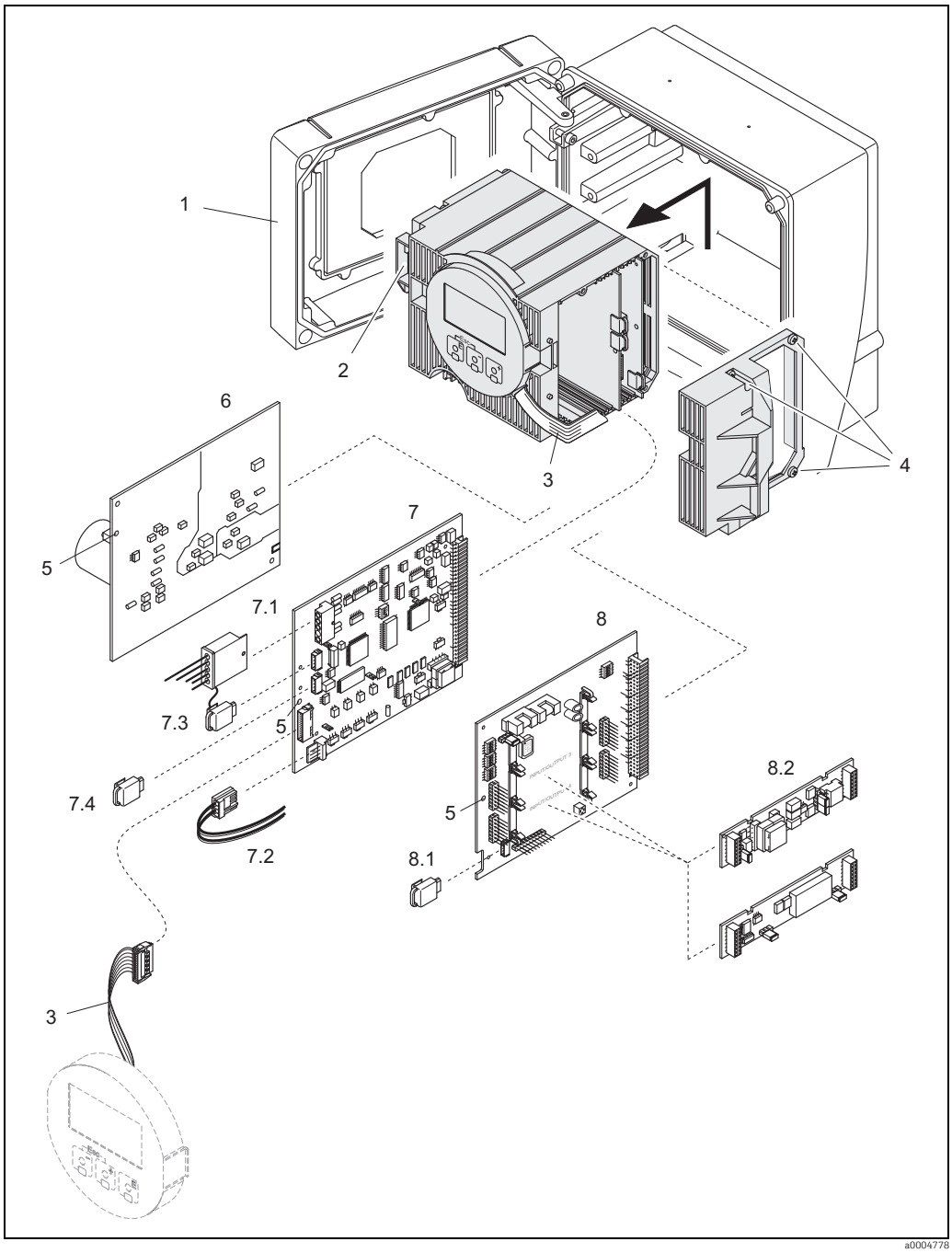

Fig. 71: Wall-mount housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Screws of electronics compartment cover
5 Aperture for installing/removing boards
6 Power unit board
7 Amplifier board
7.1 Electrode signal 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 sub-modules (current, pulse/frequency and relay output)

9.6.4 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 unit board. → 72
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power unit board. → 148
3. Remove the protection cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 x 20 mm
   – Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 x 20 mm
   – Ex-rated devices → see the Ex documentation
4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

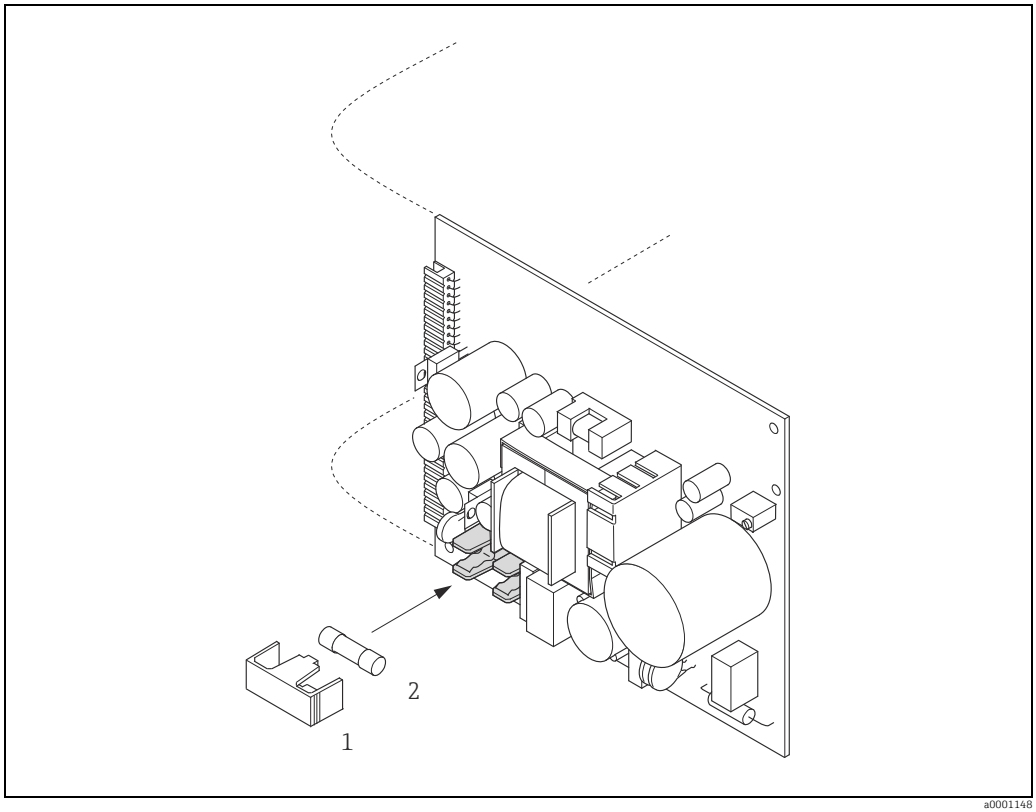

Fig. 72: Replacing the device fuse on the power unit board

1 Protective cap
2 Device fuse

9.6.5 Replacing exchangeable measuring electrodes

The Promag W sensor (DN 350 to 2000 / 14 to 78") is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions. → 154

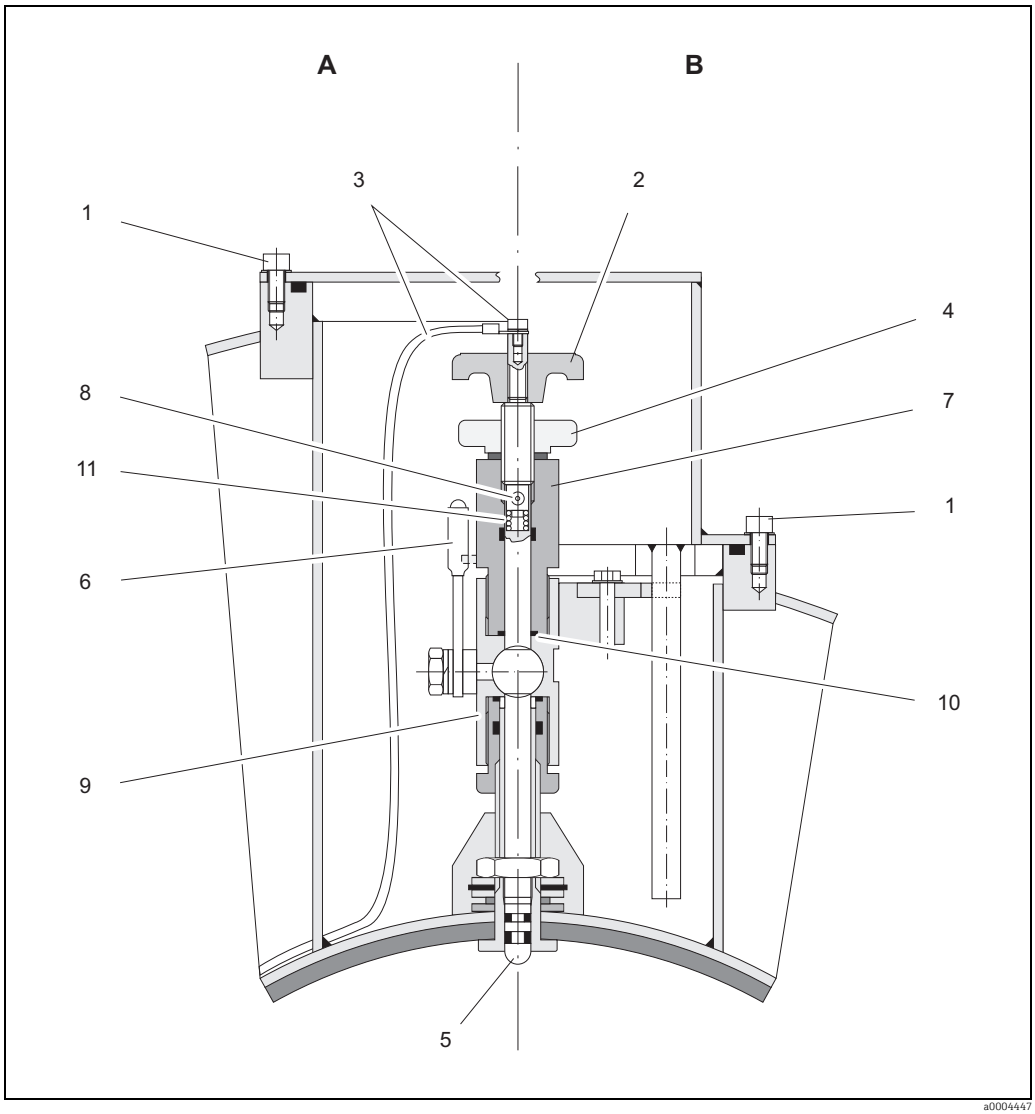

Fig. 73: Apparatus for replacing exchangeable measuring electrodes

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

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

1 Allen screw
2 Handle
3 Electrode cable
4 Knurled nut (locknut)
5 Measuring electrode
6 Stop cock
7 Retaining cylinder
8 Locking pin (for handle)
9 Ball valve housing
10 Seal (retaining cylinder)
11 Coil spring

Removing the electrode		Installing the electrode	
1st	Loosen the Allen screw (1) and remove the cover.	1st	Insert the new electrode (5) into the retaining cylinder (7) from below. Make sure that the seals at the tip of the electrode are clean.
2nd	Remove the electrode cable (2) secured to handle (3).	2nd	Mount the handle (2) on the electrode and insert the locking pin (8) to secure it in position. Caution! Make sure that coil spring (11) is inserted. This is essential to ensure correct electrical contact and correct measuring signals.
3rd	Loosen knurled nut (4) by hand. This knurled nut acts as a locknut.	3rd	Pull the electrode back until the tip of the electrode no longer protrudes from retaining cylinder (7).
4th	Remove the electrode (5) by turning the handle (2). The electrode can now be pulled out of the retaining cylinder (7) as far as a defined stop. Warning! Risk of injury. Under process conditions (pressure in the piping system) the electrode can recoil suddenly against its stop. Apply counter-pressure while releasing the electrode.	4th	Screw the retaining cylinder (7) onto the ball-valve housing (9) and tighten it by hand. The seal (10) on the cylinder must be correctly seated and clean. Note! Make sure that the rubber hoses on the retaining cylinder (7) and stop cock (6) are of the same color (red or blue).
5.	Close the stop cock (6) after pulling out the electrode as far as it will go. Warning! Do not subsequently open the stop cock, in order to prevent fluid escaping.	5.	Open the stop cock (6) and turn the handle (2) to screw the electrode all the way into the retaining cylinder.
6.	Remove the electrode complete with retaining cylinder (7).	6.	Screw the knurled nut (4) onto the retaining cylinder. This firmly locates the electrode in position.
7.	Remove the handle (2) from the electrode (5) by pressing out the locking pin (8). Take care not to lose the coil spring (11).	7.	Use the Allen screw to secure the electrode cable (3) to the handle (2). Caution! Make sure that the machine screw securing the electrode cable is firmly tightened. This is essential to ensure correct electrical contact and correct measuring signals.
8.	Remove the old electrode and insert the new electrode. Replacement electrodes can be ordered separately from Endress+Hauser.	8.	Reinstall the cover and tighten the Allen screw (1).

9.7 Return

Caution!
Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

The following steps must be taken before returning a flow measuring device to Endress+Hauser, e.g. for repair or calibration:
- Always enclose a duly completed "Declaration of contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EC REACH Regulation No. 1907/2006.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
You will find a preprinted "Declaration of contamination" form at the back of these Operating Instructions.

9.8 Disposal

Observe the regulations applicable in your country!

9.9 SoftwareHistory

Date	Software version	Changes to software	Operating Manual
12.2009	PROFIBUS DP/PA 3.04.XX	Introduction of Calf history	71108007/12.09
08.2007	PROFIBUS PA 3.04.XX	Introduction of a new PROFIBUS PA I/O board	71060107/08.07
07.2007	PROFIBUS DP 3.04.XX	Software adjustment	
10.2006	PROFIBUS DP 3.04.00	Software adjustment	
12.2005			
10.2005	PROFIBUS DP 3.01.XX	Introduction of a new PROFIBUS DP I/O-board: – Support of additional output signals (current, frequency etc.) Software expASMEon: – Batching	50099246/10.05

Date	Software version	Changes to software	Operating Manual
03.2005	PROFIBUS PA 2.03.XX	Software expASMEon: – New, improved functions New functions: – DEVICE SOFTWARE → Display of the device software (NAMUR recommendation 53) – US unit Kgal	50099246/10.03
10.2003	Amplifier: 1.06.XX Communication module: 2.03.XX	Software expASMEon: – Language groups – New error messages – SIL 2 – The totalizer values are also updated without integration into the cyclic data transmission – Support of compatibility with previous PROFIBUS model Promag 33 with Profile Version 2.0 New functions: – Operation hours counter – Intensity of background illumination adjustable – Counter for access code – Upload/download via ToF Tool - Fieldtool Package Compatible with service protocol: – ToF-Tool FieldTool Package (the latest SW version can be downloaded under: www.tof-fieldtool.endress.com)	
12.2002	Communication module: 2.02.XX	Software adjustment	
09.2002	Amplifier: 1.04.XX Communication module: 2.01.XX	Software expASMEon: – Data length of advanced diagnosis adjusted in the cyclic data transmission ✎ Note! As of this software version, a new device master file (GSD) must be used when replacing the device!	
03.2002	Amplifier: 1.03.XX Communication module: 2.00.01	Software expASMEon: – Communication software can be updated via service protocol	50099246/10.03
07.2001	Com. module: 1.01.00	Software adjustment	
06.2001	Amplifier: 1.02.00	Software adjustment	
04.2001	Com. module: 1.00.00	Original software	50099246/04.01
09.2000	Amplifier: 1.01.01	Software adjustment	
08.2000	Amplifier: 1.01.00	Software enhancement (functional adaptations)	
04.2000	Amplifier: 1.00.00	Original software	

10 Technical data

10.1 Technical data at a glance

10.1.1 Applications

→ 📄 4

10.1.2 Function and system design

Measuring principle

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

Measuring system

→ 📄 6

10.1.3 Input variables

Measured variable

Flow rate (proportional to induced voltage)

Measuring range

Typically v = 0.01 to 10 m/s (0.03 to 0.33 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 = 3 kΩ, galvanically isolated.
Switch level: ±3 to ±30 VDC, independent of polarity

10.1.4 Output variables

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.r./°C, resolution: 0.5 µA

- Active: 0/4 to 20 mA, R_L max. 700 Ω
- Passive: 4 to 20 mA; supply voltage V_S 18 to 30 V DC; R_i ≥ 150 Ω

Pulse/frequency output:

Active/passive selectable, galvanically isolated
- Active: 24 V DC, 25 mA (max. 250 mA during 20 ms), R_L > 100 Ω
- Passive: open collector, 30 V DC, 250 mA

- Frequency output: full scale 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 configur. (0.05 to 2000 ms)

PROFIBUS DP interface:

- PROFIBUS DP in accordance with IEC 61158, galvanically isolated
- Profile Version 3.0
- Data transmission rate: 9.6 kBaud to 12 MBaud
- Automatic identification of data transmission rate
- Signal coding: NRZ code
- Bus address can be configured via miniature switches or via the local display (optional)

PROFIBUS PA interface:

- PROFIBUS PA in accordance with IEC 61158 (MBP), galvanically isolated
- Profile Version 3.0
- Data transmission rate: 31.25 kBaud
- Current consumption: 11 mA
- Permitted supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Signal coding: Manchester II
- Bus address can be configured via miniature switches or via the local display (optional)

Signal on alarm

Current output:
Failsafe mode selectable (e.g. in accordance with NAMUR recommendation NE 43)

Pulse/frequency output:
Failsafe mode selectable

Relay output:
De-energized by fault or power supply failure

PROFIBUS DP/PA
Status and alarm messages in accordance with PROFIBUS Profile Version 3.0

Load

See "Output signal"

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.

Low flow cut off

Switch points for low flow are selectable.

Galvanic isolation

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

10.1.5 Power supply

Electrical connections

→ 🖹 46

Supply voltage

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

Cable entries

Power supply and signal cables (inputs/outputs):
- Cable entry M20 x 1.5 (8 to 12 mm; 0.31 to 0.47 in)
- Sensor cable entry for armored cables M20 x 1.5 (9.5 to 16 mm; 0.37 to 0.63 in)
- Threads for cable entries, ½" NPT, G ½"

Connecting cable for remote version:
- Cable entry M20 x 1.5 (8 to 12 mm; 0.31 to 0.47 in)
- Sensor cable entry for armored cables M20 x 1.5 (9.5 to 16 mm; 0.37 to 0.63 in)
- Threads for cable entries, ½" NPT, G ½"

Cable specifications (remote version)

→ 🖹 54

Power consumption

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

Switch-on current:
- max. 13.5 A (< 50 ms) at 24 V DC
- max. 3 A (< 5 ms) at 260 V AC

Power supply failure

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

Potential matching

→ 🖹 62

10.1.6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:
- Fluid temperature: +28 ± 2 °C (+82 ± 4 °F)
- Ambient temperature: +22 ± 2 °C (+72 ± 4 °F)
- Warm-up period: 30 minutes

Installation:
- Inlet run >10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- Sensor centered relative to the pipe.

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.

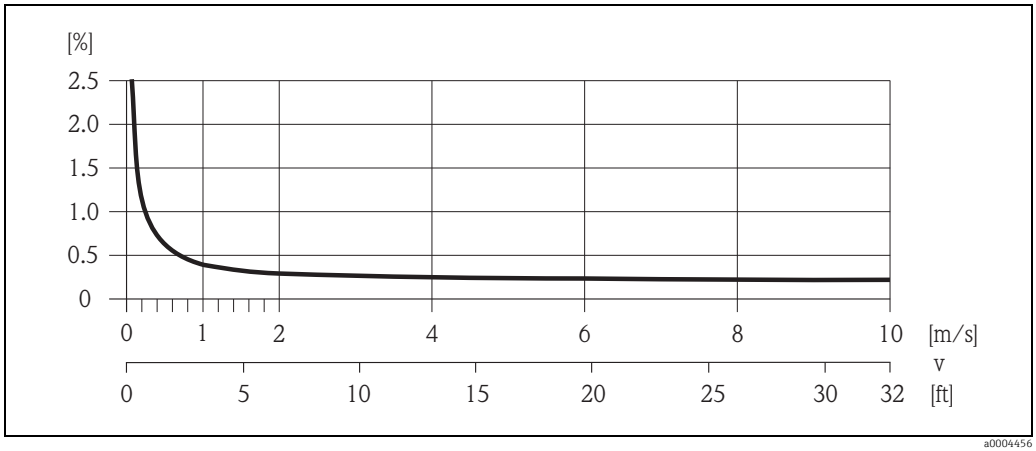

Fig. 74: Max. measured error in % of reading

Repeatability

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

10.1.7 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.

10.1.8 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

- Standard: IP 67 (NEMA 4X) for transmitter and sensor
- Optional: IP 68 (NEMA 6P) for remote version of Promag W and Promag P sensors

Shock and vibration resistance

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

CIP 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

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

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

10.1.9 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)

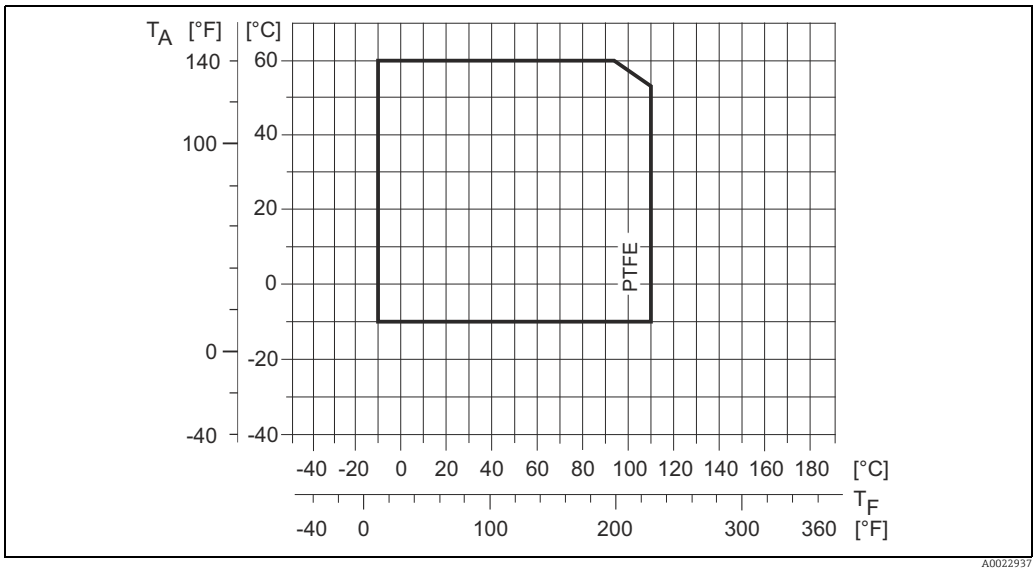

Abb. 75: Compact and remote version (T_A = Ambient temperature, T_F = Fluid temperature)

Promag H

Sensor:
- DN 2 to 25 (1/12 to 1"): −20 to +150 °C (−4 to +302 °F)
- DN 40 to 100 (1 ½ to 4"): −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")

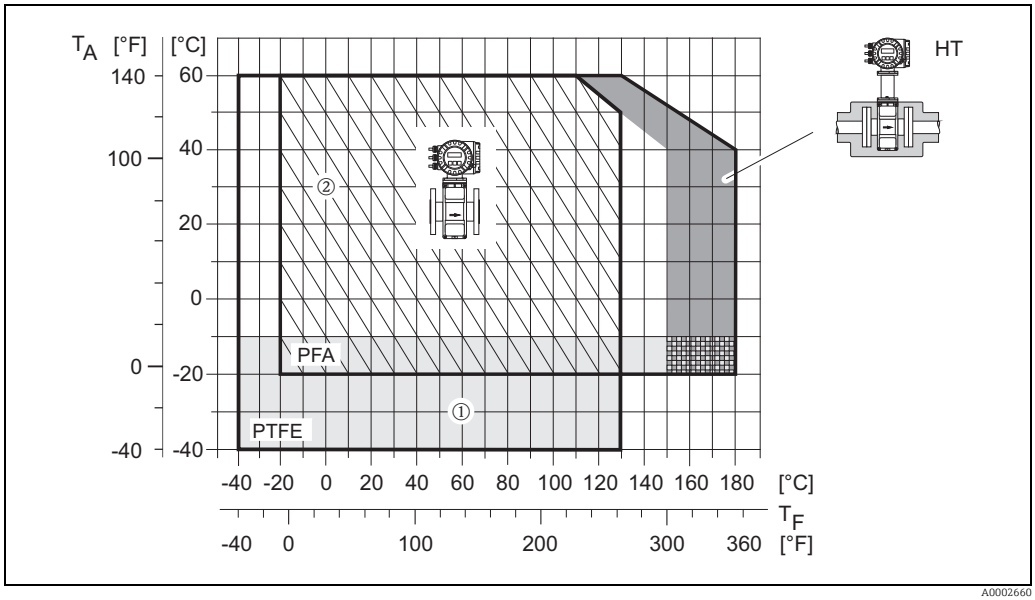

Fig. 76: Promag P compact version (with PFA or PTFE lining)

TA = ambient temperature; TF = 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)

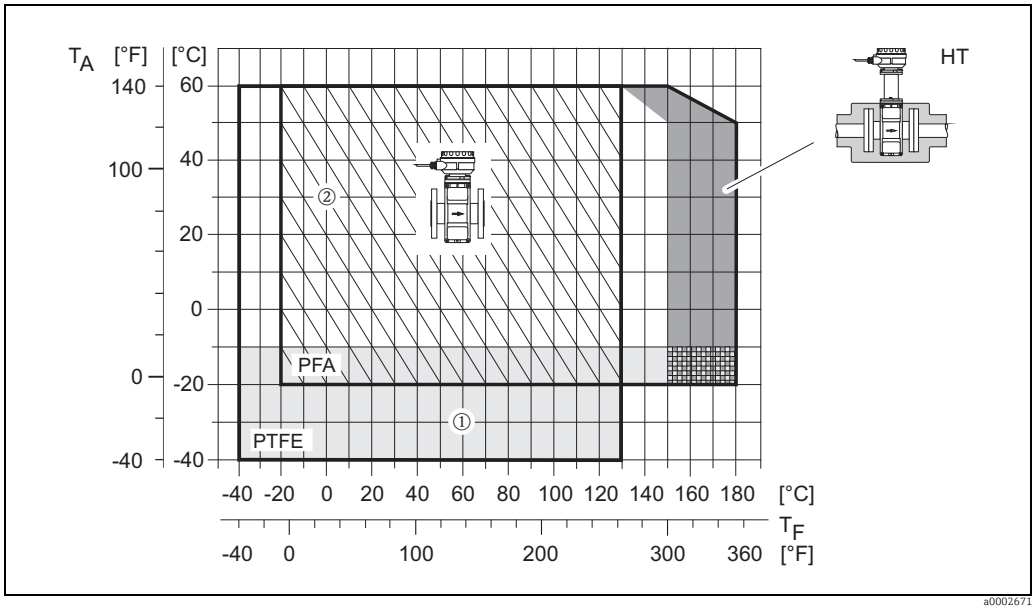

Fig. 77: Remote versions (with PFA or PTFE lining)

TA = ambient temperature; TF = 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 demineralized water ≥ 20 µS/cm)

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

Limiting medium pressure range (nominal pressure)

Promag E

- EN 1092-1 (DIN 2501)
  - 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 and the seal:
- 40 bar → flange, weld nipple (with O-ring seal)
- 16 bar → all other process connections

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 300 / 1 to 12")
- 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
  - 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 / 2 to 12")
  - 20K (DN 25 to 300 / 1 to 12")
- 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 300 / 2 to 12")
  - 20K (DN 25 to 300 / 1 to 12")
- 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 100	1/12 to 4"	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

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
200	8"	0	*	0	0	0	0
* 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 DN8).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → 16.

10.1.10 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" → 📄 184 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	99.4	–	137.4	–
400	16"	89.4	104.4	120.4	–	168.4	–
450	18"	99.4	112.4	133.4	–	191.4	–
500	20"	114.4	132.4	182.4	–	228.4	–
600	24"	155.4	162.4	260.4	–	302.4	–

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

Weight data in kg								
Nominal diameter		Remote version (without cable)						
		Sensor						Transmitter
		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	
32	–	–	–	–	6.0	–	5.3	
40	1½"	–	–	–	7.4	7.4	6.3	
50	2"	–	–	–	8.6	8.6	7.3	
65	–	–	–	10.0	–	–	9.1	
80	3"	–	–	12.0	–	12.0	10.5	
100	4"	–	–	14.0	–	14.0	12.7	
125	–	–	–	19.5	–	–	19.0	
150	6"	–	–	23.5	–	23.5	22.5	
200	8"	–	43.0	44.0	–	43.0	39.9	
250	10"	–	63.0	68.0	–	73.0	67.4	
300	12"	–	68.0	79.0	–	108.0	70.3	
350	14"	73.1	84.1	95.1	–	133.1		
400	16"	85.1	100.1	116.1	–	164.1		
450	18"	95.1	108.1	129.1	–	187.1		
500	20"	110.1	128.1	178.1	–	224.1		
600	24"	158.1	158.1	256.1	–	298.1		

- 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	Weights in [kg]		
DIN	Compact version	Remote version (without cable)	
[mm]		Sensor	Transmitter
2	5.2	2.0	6.0
4	5.2	2.0	6.0
8	5.3	2.0	6.0
15	5.4	1.9	6.0
25	5.5	2.8	6.0
40	6.5	4.5	6.0
50	9.0	7.0	6.0
65	9.5	7.5	6.0
80	19.0	17.0	6.0
100	18.5	16.5	6.0
Promag 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	1 ¼"		–		–		8.0		–		–		–
40	1 ½"		–		–		9.0		7.5		–		–
50	2"		–		–		9.4		7.6		–		–
65	2 ½"		–		–		10.4		–		–		–
80	3"		–		–		12.4		12.8		–		–
100	4"		–		–		14.4		16.1		–		–
125	5"		–		–		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		103		137		99.4		99.4
375	15"		–		–		–		–		105		–
400	16"		89.4		104		124		168		120		120
450	18"		99.4		112		139		191		133		143
500	20"		114		132		174		228		182		182
600	24"		155		162		303		302		260		260
700	28"		190		240		288	AWWA / Class D	266		367		346
750	30"		–		–		–		318		445		433
800	32"		240		315		364		383		503		493
900	36"		308		393		456		470		702		690
1000	40"		359		468		579		587		759		761
1050	42"		–		–		–		670		–		–
1200	48"		529		717		866		901		–		1237
–	54"		–		–		–		1273		–		–
1400	–		784		1114		1274		–		–		–
–	60"		–		–		–		1594		–		–
1600	–		1058		1624		1872		–		–		–
1650	66"		–		–		–		2131		–		–
1800	72"		1418		2107		2409		2568		–		–
2000	78"		1877		2630		2997		3113		–		–
–	84"		–		–		–		3755		–		–
2200	–		2512		3422		–		–		–		–
–	90"		–		–		–		4797		–		–
2400	–		2996		4094		–		–		–		–
Transmitter Promag (compact version): 3.1 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]											
		EN (DIN)						ASME/ AWWA		AS			
[mm]	[inch]												
25	1"	PN 6	–	PN 10	–	PN 16	5.3	ASME / Class 150	5.9	PN 16	–	Tabelle E	–
32	1 ¼"		–		–		6.0		–		–		–
40	1 ½"		–		–		7.0		5.5		–		–
50	2"		–		–		7.4		5.6		–		–
65	2 ½"		–		–		8.4		–		–		–
80	3"		–		–		10.4		10.8		–		–
100	4"		–		–		12.4		14.1		–		–
125	5"		–		–		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		135		97.4		97.4
375	15"		–		102		–		–		103		–
400	16"		87.4		102		124		166		118		118
450	18"		97.4		110		139		189		131		141
500	20"		112		130		174		226		180		180
600	24"		153		160		303		300		258		258
700	28"		188		238		288	AWWA / Class D	264		365		344
750	30"		–		–		–		316		443		431
800	32"		238		313		364		381		501		491
900	36"		306		391		456		468		700		688
1000	40"		357		466		579		585		757		759
1050	42"		–		–		–		668		–		–
1200	48"		527		715		866		899				1235
–	54"		–		–		–		1271		–		–
1400	–		782		1112		1274		–		–		–
–	60"		–		–		–		1592		–		–
1600	–		1056		1622		1872		–		–		–
1650	66"		–		–		–		2129		–		–
1800	72"		1416		2105		2409		2566		–		–
2000	78"		1875		2628		2997		3111		–		–
–	84"		–		–		–		3753		–		–
2200	–		2510		3420		–		–		–		–
–	90"		–		–		–		4795		–		–
2400	–		2994		4092		–		–		–		–

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	1 ¼"		5.4		3.4	4.2
40	1 ½"		6.3		4.7	4.2
50	2"		5.4		3.4	4.2
65	2 ½"		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): 1.8 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	Weights 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				113			6.0
400		135				133			6.0
450		175				173			6.0
500		175				173			6.0
600		235				233			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	Weights 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		115				113			6.0
375		134				133			6.0
400		135				133			6.0
450		175				173			6.0
500		175				173			6.0
600		235				233			6.0
700		355				353			6.0
800		435				433			6.0
900		575				573			6.0
1000		700				698			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"	422.0	412.6	
500	20"	503.6	494.1	
600	24"	666.8	657.3	

- 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	**Weights in [lbs]**		
	Compact version	**Remote version (without cable)**	
[inch]		**Sensor**	**Transmitter**
1/12"	11.5	4.4	13.5
1/8"	11.5	4.4	13.5
3/8"	11.7	4.4	13.5
½"	11.9	4.2	13.5
1"	12.1	6.2	13.5
1½"	14.3	9.9	13.2
2"	19.8	15.5	13.2
3"	41.9	37.5	13.2
4"	40.8	36.5	13.2
Promag transmitter (compact version): 7.5 lbs			

Promag L (ASME/AWWA)

Weight data in lbs					
Nominal diameter		Compact version[1]		Remote version[1]	
[mm]	[inch]	ASME/AWWA		ASME/AWWA	
25	1"	ASME / Class 150	17.4	ASME / Class 150	13
32	1 ¼"		–		–
40	1 ½"		16.5		12.1
50	2"		16.8		12.3
65	2 ½"		–		–
80	3"		28.2		23.8
100	4"		35.5		31.1
125	5"		–		–
150	6"		53.8		49.4
200	8"		109		105
250	10"		166		161
300	12"		221		216
350	14"		302		298
375	15"		–		–
400	16"		370		366
450	18"		421		417
500	20"		503		498
600	24"		666		662
700	28"	AWWA / Class D	587	AWWA / Class D	582
750	30"		701		697
800	32"		845		840
900	36"		1036		1032
1000	40"		1294		1290
1050	42"		1477		1473
1200	48"		1987		1982
–	54"		2807		2803
1400	–		–		–
–	60"		3515		3510
1600	–		–		–
1650	66"		4699		4694
1800	72"		5662		5658
2000	78"		6864		6860
–	84"		8280		8275
2200	–		–		–
–	90"		10577		10573
2400	–		–		–
Transmitter Promag (compact version): 4.0 lbs Transmitter Promag (remote version): 6.8 lbs (Weight data valid without packaging material)					

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

Promag P

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

Nominal diameter [inch]	Weights in [lbs]				
	Compact version		Remote version (without cable)		
			Sensor		Transmitter
	ASME/AWWA		ASME/AWWA		
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]	Weights in [lbs]				
	Compact version		Remote version (without cable)		
			Sensor		Transmitter
	ASME/AWWA		ASME/AWWA		
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	Weights in [lbs]				
	Compact version		Remote version (without cable)		
			Sensor		Transmitter
[inch]	ASME/AWWA		ASME/AWWA		
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					

Material

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): RSt37-2 (S235JRG2); Alloy C22; Fe 410W B
  - ANSI: A105
  - JIS: RSt37-2 (S235JRG2); HII
- Seals: to DIN EN 1514-1
- 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 (304))
  - Wall-mounted housing: powder-coated die-cast aluminum
  - Window material: glas 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 (316L)
  - 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 100 (1½ to 4"): 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 ≤ 300 (12"); stainless steel 1.4301 (304) or 1.4306 (304L)
  - DN ≥ 350 (14"); stainless steel 202 or 304
- Electrodes: 1.4435 (316, 316L), Alloy C22
- Flange
  - EN 1092-1 (DIN 2501): DN ≤ 300: 1.4306; 1.4307; 1.4301 (304); 1.0038 (S235JRG2)
  - EN 1092-1 (DIN 2501): DN ≥ 350: A105; 1.0038 (S235JRG2)
  - AWWA: A181/A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
  - AS 2129: A105; 1.0345 (P235GH); 1.0425 (316L) (P265GH); 1.0038 (S235JRG2); FE 410 WB
  - AS 4087: A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 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): 1.4571 (316L); RSt37-2 (S235JRG2); Alloy C22; FE 410W B

(DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
- ASME: A105; F316L
(DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
- AWWA: 1.0425 (316L)
- JIS: RSt37-2 (S235JRG2); HII; 1.0425 (316L)
(DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
- AS 2129
  - DN 25 (1"): A105 or RSt37-2 (S235JRG2)
  - DN 40 (1½"): A105 or St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)

- Seals: to DIN EN 1514-1
- 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 (304L)
(for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435 (316, 316L) or Alloy C22, Tantalum
- Flange
  - EN 1092-1 (DIN2501): 1.4571 (316L); RSt37-2 (S235JRG2); CAlloy C22; FE 410 WB
(DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ASME: A105; F316L
(DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AWWA: 1.0425 (316L)
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425 (316L)
(DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129
    - DN 150 to 300 (6 to 12"), DN 600 (24"): A105 or RSt37-2 (S235JRG2)
    - DN 80 to 100 (3 to 4"), 350 to 500 (14 to 20"): A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L), Alloy C22, Titanium, Tantalum

Material load diagrams

The material load diagrams (pressure-temperature diagrams) for the process connections can be found in the separate "Technical Information" documentation, which you can download in PDF format from www.endress.com.
A list of available "Technical Information" documentation can be found in the "Documentation" → 🖹 184 section.

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 15 (1/12" to ½")

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
- JIS

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 DIN 11850, ODT/SMS
- 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
- ASME B16.5
- AWWA C207
- AS

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
- AWWA (Promag W only)
- JIS
- AS

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)

10.1.11 Human interface

Display elements

- Liquid crystal display: illuminated, four lines with 16 characters per line
- Selectable display of different measured values and status variables
- 3 totalizers
- At ambient temperatures below -20 °C (−15 °F) the readability of the display may be impaired.

Operating elements

- Local operation with three optical keys (−/+/E)
- Application-specific Quick Setup menus for straightforward commissioning

Language groups

Language groups available for operation in different countries:

- Western Europe and America (WEA):
  English, German, Spanish, Italian, French, Dutch and Portuguese
- Eastern Europe and Scandinavia (EES):
  English, Russian, Polish, Norwegian, Finnish, Swedish and Czech.
- South and east Asia (SEA):
  English, Japanese, Indonesian
- China (CN):
  English, Chinese

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

10.1.12 Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

C-Tick symbol

The measuring system complies 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

PROFIBUS DP/PA certification

The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organization). The device thus meets all the requirements of the following specifications:

- Certified in accordance with PROFIBUS Profile Version 3.0 (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 97/23/EC.

- 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.3 Section 3 of the Pressure Equipment Directive 97/23/EC. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive.

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).
- ASME/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.

10.1.13 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

10.1.14 Accessories

Various accessories are available for the transmitter and the sensor. These can be ordered separately from Endress+Hauser → 128.

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

10.1.15 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)
- Description of device functions Promag 53, PROFIBUS DP/PA (BA00064D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA

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