

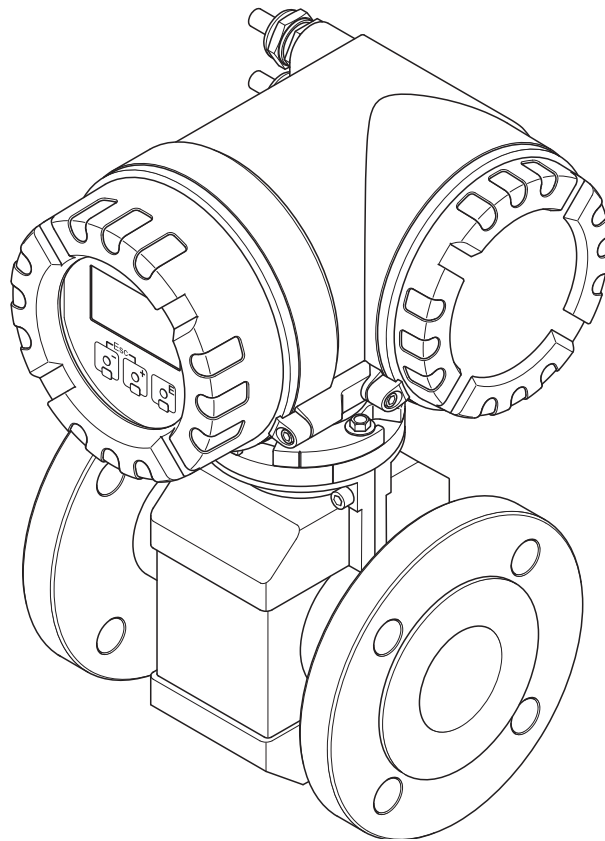
Valid as of software version  
PROFIBUS DP  
V 3.06.XX (Device software)

# Operating Instructions

## Proline Promag 55

### PROFIBUS DP/PA

Electromagnetic Flow Measuring System





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# 1 Safety instructions

## 1.1 Designated use

The measuring device described in these Operating Instructions is to be used only for measuring the flow rate of conductive liquids in closed pipes.

A minimum conductivity of 20  $\mu\text{S}/\text{cm}$  is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5  $\mu\text{S}/\text{cm}$ .

- Acids, alkalis, pastes, paps, pulps, black liquor, green liquor
- Drinking water, wastewater, sewage sludge
- Cement, laitance, ore slurry (containing sand or stone), mud, silt

The operational safety of the measuring devices cannot be guaranteed if the system is used incorrectly or used for purposes other than those intended. The manufacturer accepts no liability for damages being produced from this.




## 1.2 Installation, commissioning, operation

Note the following points:

- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, skilled personnel authorized to perform such work by the facility's owner-operator. The skilled personnel must have read and understood these Operating Instructions and follow the instructions they contain.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Instructions is mandatory.
- Endress+Hauser is willing to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However, small changes in temperature, concentration or in 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 welding work is performed on the piping system, do not ground the welding appliance through the flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, except in cases where special protective measures have been taken (e.g. galvanically isolated power supply SELV or PELV).
- Always note the regulations applicable in your country to the operation, maintenance and repair of electrical devices. Special instructions relating to the device can be found in the relevant sections of the documentation.
- The Promag 55 flow measuring device can also measure extremely abrasive fluids, e.g. ore slurry, cement etc. To protect the measuring tube lining from excessive abrasion, the use of additional liner protection plates is recommended in such cases.

## 1.3 Operational safety

Note the following points:

- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body (e.g.  Europe,  USA,  Canada).
- The measuring device meets the general safety requirements according to EN 61010-1 and the EMC requirements according to IEC/EN 61326 in addition to the NAMUR recommendations NE 21, NE 43 and NE 53.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- Due to the power turnover in the electronic components, the heating of the outer housing surfaces is max. 10 K. When hot media are passed through the measuring tube, the surface temperature of the housing increases. With regard to the sensor, in particular, you should expect temperatures that can be close to the temperature of the medium. If the temperature of the medium is high, ensure staff are protected against burns and scalds.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.

## 1.4 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at [www.services.endress.com/return-material](http://www.services.endress.com/return-material)

## 1.5 Notes on safety conventions and icons

The devices are designed and tested to meet state-of-the-art safety requirements, and have left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". The devices can, however, be a source of danger if used incorrectly or for other than the designated use.

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 55 transmitter
- Promag S and Promag H 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

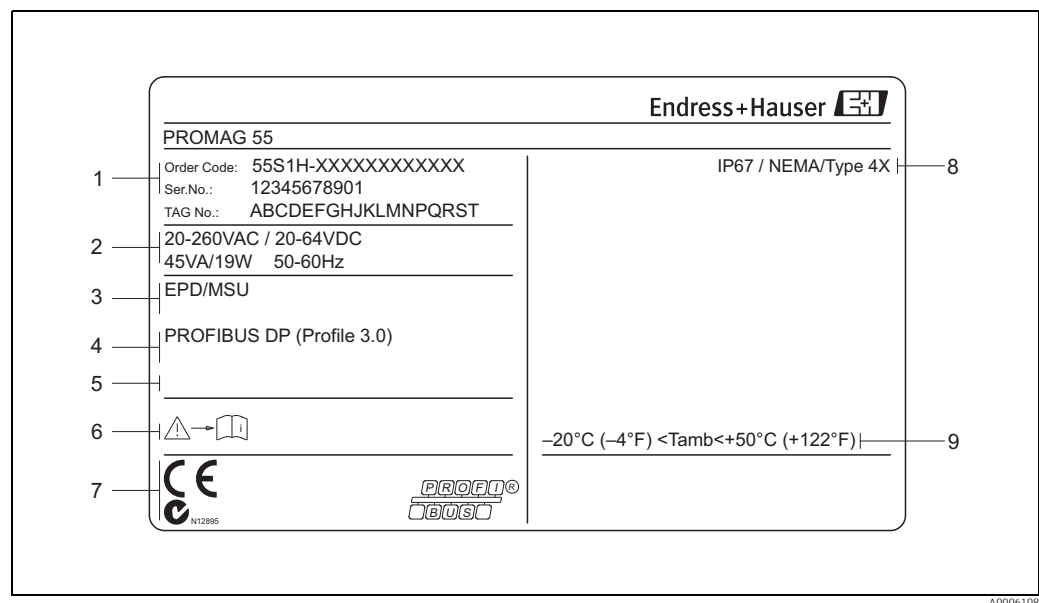


Fig. 1: Nameplate specifications for the "Promag 55" transmitter (example)

- 1 Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits
- 2 Power supply/frequency/Power consumption
- 3 Additional functions and software
- 4 Available inputs and outputs
- 5 Reserved for additional information on special products
- 6 Observe device documentation
- 7 Reserved for certificates, approvals and for additional information on device version
- 8 Degree of protection
- 9 Permitted ambient temperature range

### 2.1.2 Nameplate of the sensor

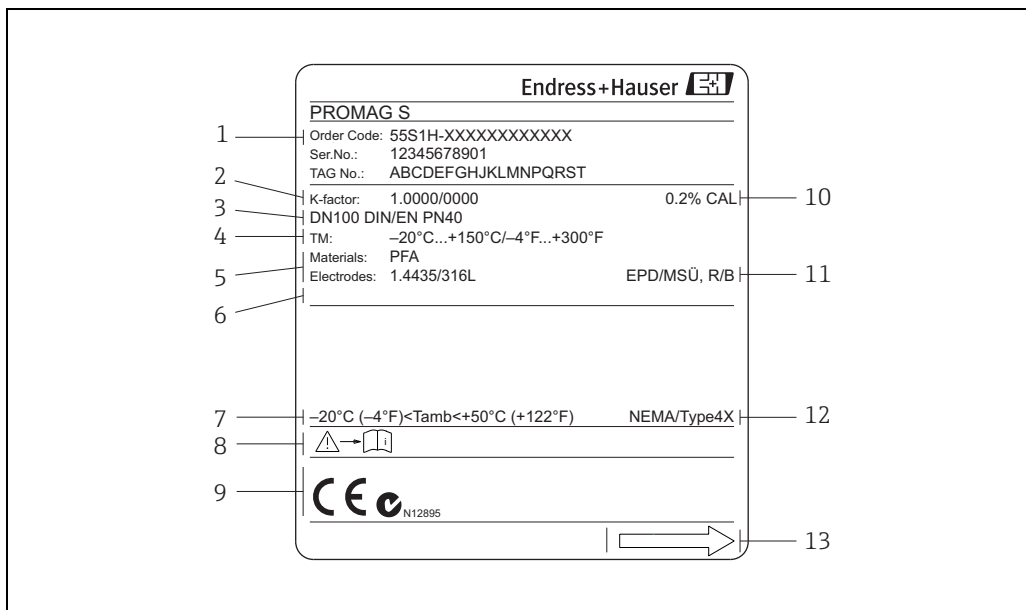


Fig. 2: Nameplate specifications for the "Promag" sensor (example)

- 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 Fluid temperature range
- 5 Materials: lining/measuring electrode
- 6 Reserved for additional information on special products
- 7 Permitted ambient temperature range
- 8 Observe device 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
- 12 Degree of protection
- 13 Flow direction

### 2.1.3 Nameplate for connections

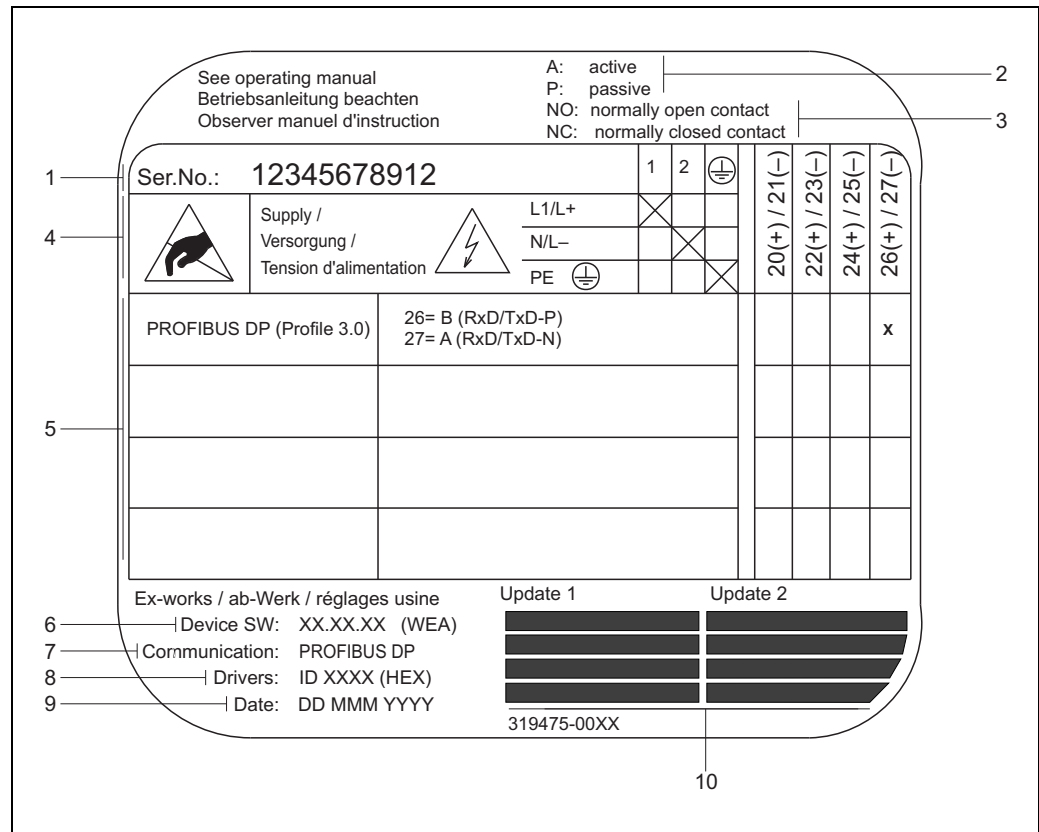


Fig. 3: Nameplate specifications for Proline transmitter connections (example)

- 1 Serial number
- 2 Possible configuration of current output
- 3 Possible configuration of relay contacts
- 4 Terminal assignment, cable for power supply
  - Terminal No. 1: L1 for AC, L+ for DC
  - Terminal No. 2: N for AC, L- for DC
- 5 Signals present at inputs and outputs, possible configurations and terminal assignment
- 6 Version of device software currently installed (incl. language group)
- 7 Type of communication installed
- 8 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 and tested to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have left the factory in a condition in which they are safe to operate. The devices comply with the standards EN 61010 -1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of IEC/EN 61326.

The measuring system described in these Operating Instructions therefore complies with the legal requirements of the EU Directives. Endress+Hauser confirms this by affixing the CE mark to it and by issuing the CE declaration of conformity.

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

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

KALREZ® and VITON®

Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP®

Registered trademark of Ladish & Co., Inc., Kenosha, USA

PROFIBUS®

Registered trademark of the PROFIBUS User Organisation, Karlsruhe, D

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, FieldCare®, Fieldcheck®, Applicator®

Registered or registration-pending trademarks of the Endress+Hauser Group

## 3 Installation

### 3.1 Incoming acceptance, transport and storage

#### 3.1.1 Incoming acceptance

On receipt of the goods, check the following points:

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

#### 3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:

- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until the device is ready to install. 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 the connection housing in the case of the remote version.

*Transporting flanged devices  $DN \leq 300$  (12")*

Use webbing slings slung around 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.

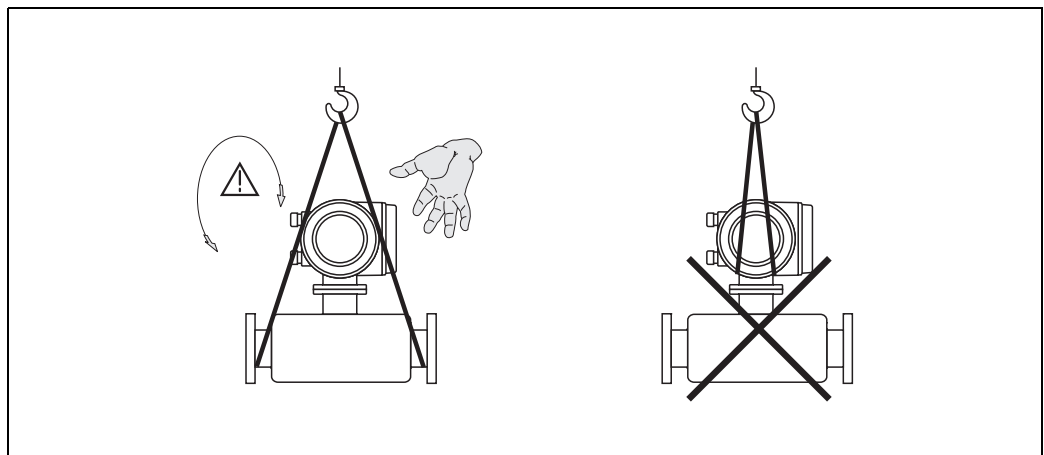


Fig. 4: Transporting sensors with  $DN \leq 300$  (12")

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### 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.

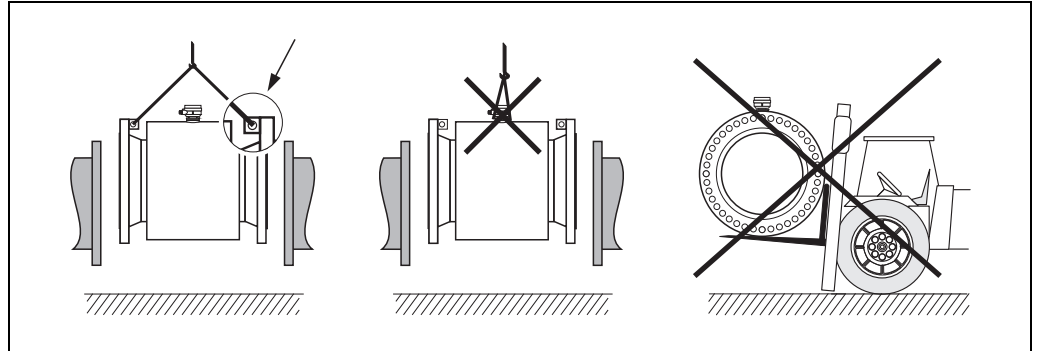


Fig. 5: Transporting sensors with DN > 300 (12")

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### 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 → 143.
- 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 liner.
- Do not remove the protective plates or caps on the process connections until the device is ready to install. 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](http://www.endress.com). A list of the "Technical Information" documents available is provided in the "Documentation" section on → 153.

### 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.

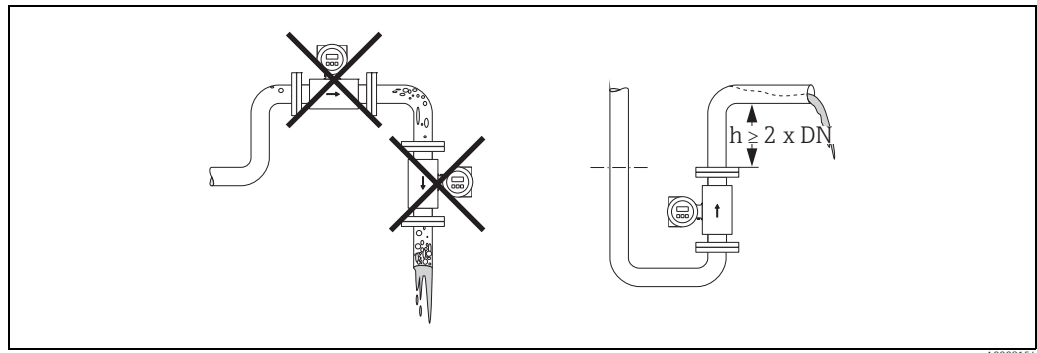


Fig. 6: Mounting location

### 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 pressure tightness → 145.

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 → 143.

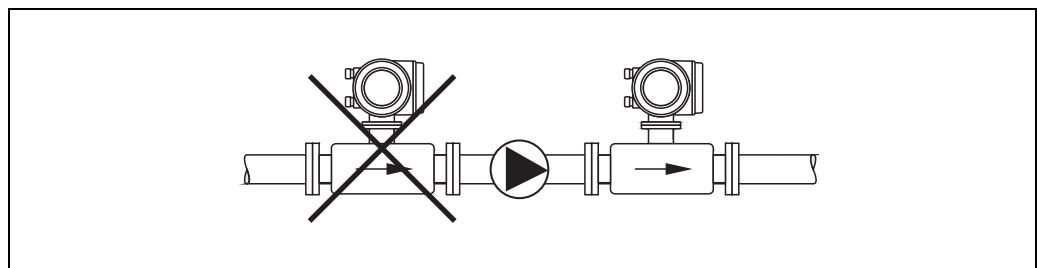



Fig. 7: Installing pumps

### 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 →  114.



#### 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.

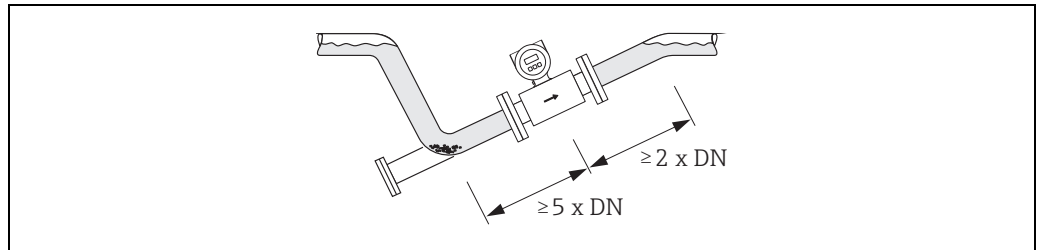


Fig. 8: Installation in partially filled pipe

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### Down pipes

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

Information on the lining's pressure tightness →  145.

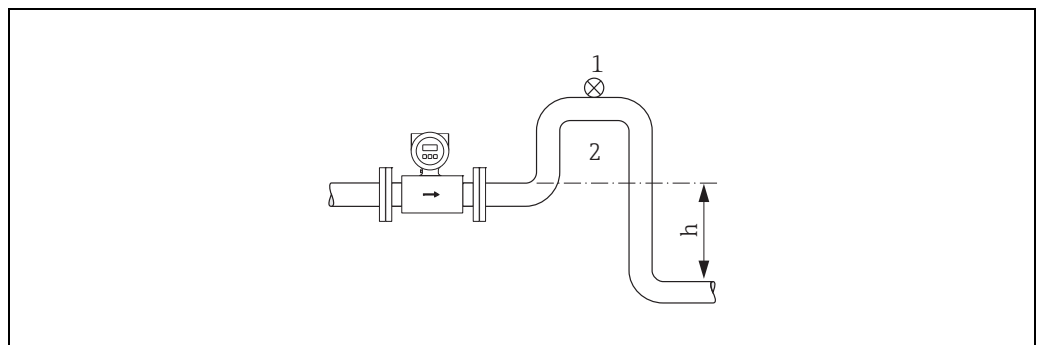


Fig. 9: Measures for installation in a down pipe ( $h > 5 \text{ m} / 16 \text{ ft}$ )

- 1 Vent valve
- 2 Siphon
- h Length of down pipe ( $h \geq 5 \text{ m} (16.3 \text{ ft})$ )

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### 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 Circuit (ECC) for applications with fluids producing buildup, e.g. electrically conductive deposits (→ "Description of Device Functions" manual, BA00125D)
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressures → 114.

#### 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.

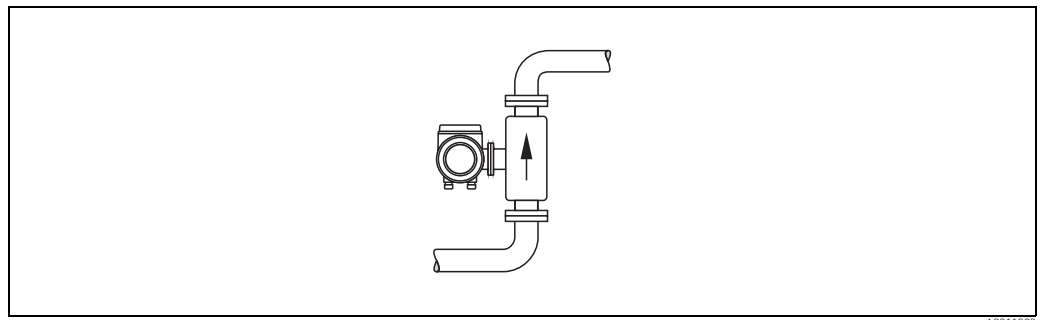


Fig. 10: Vertical orientation

#### 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 or empty.

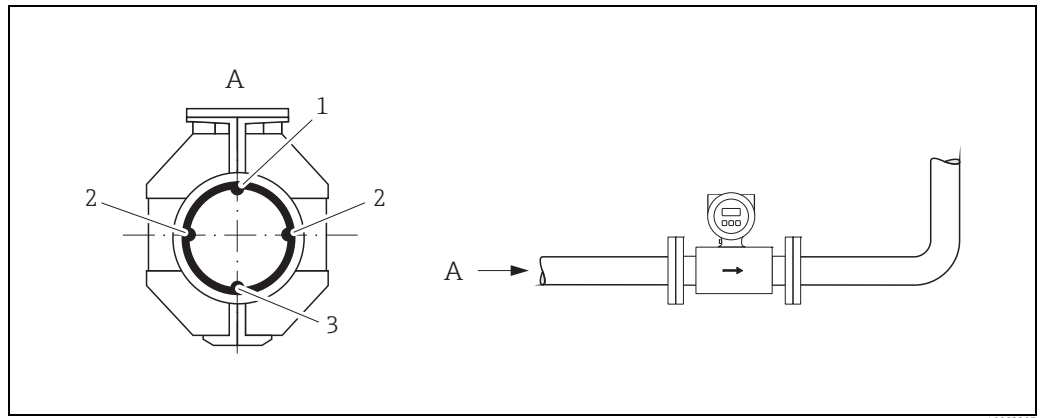


Fig. 11: Horizontal orientation

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

### 3.2.4 Inlet and outlet runs

If possible, install the sensor well clear 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  $\geq 5 \times \text{DN}$
- Outlet run  $\geq 2 \times \text{DN}$

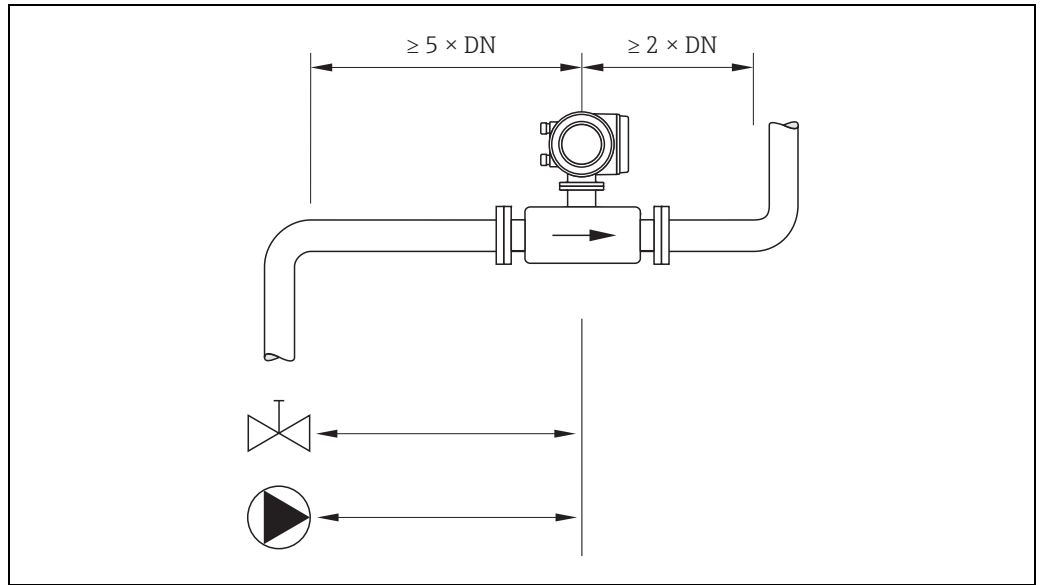


Fig. 12: Inlet and outlet runs

### 3.2.5 Vibrations

Secure the piping and the sensor if vibration is severe.



Caution!

It is advisable to install the sensor and transmitter separately if vibration is excessively severe. Information on the permitted resistance to vibration and shock → 143.

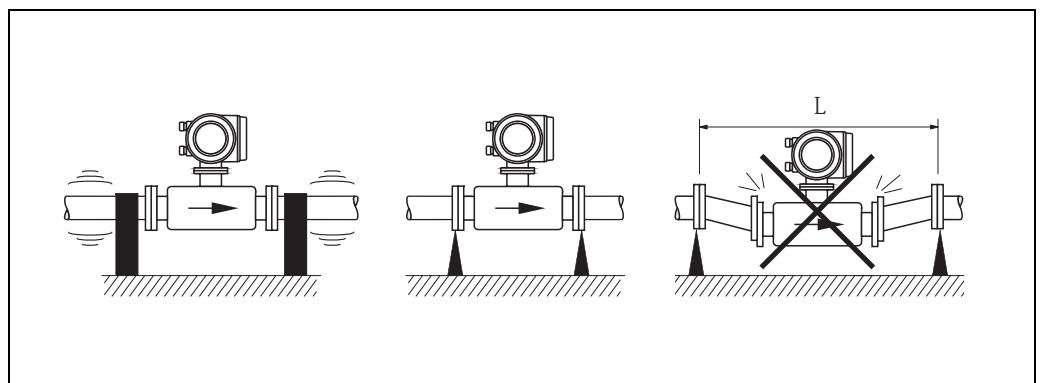


Fig. 13: Measures to prevent vibration of the measuring device ( $L > 10 \text{ m} / 33 \text{ ft}$ )

### 3.2.6 Foundations, supports

If the nominal diameter is  $DN \geq 350$  (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.

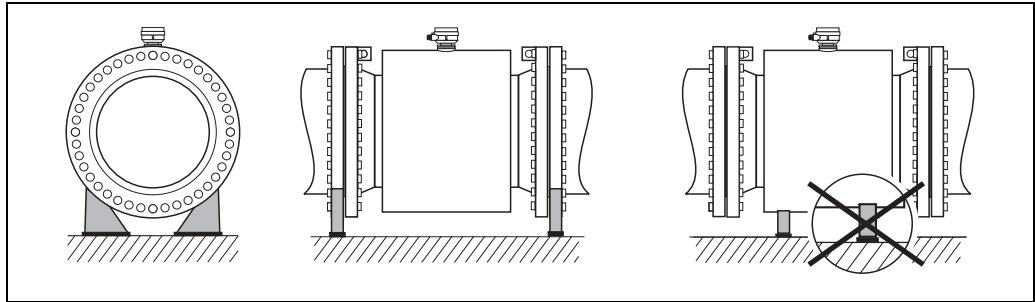


Fig. 14: Correct support for large nominal diameters ( $DN \geq 350 / 14''$ )

### 3.2.7 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by cross-section reduction.



Note!

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

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

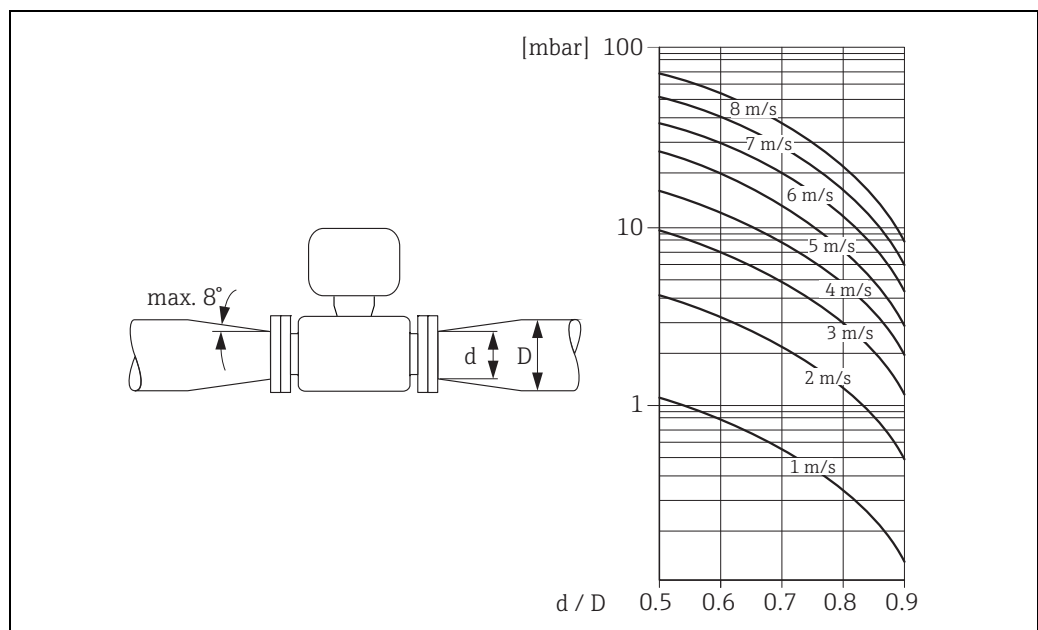


Fig. 15: Pressure loss due to adapters



### 3.2.8 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum flow velocity is between 2 and 3 m/s (6.5...9.8 ft/s). The flow velocity ( $v$ ), moreover, has to be matched to the physical properties of the fluid:

- $v < 2$  m/s (< 6 ft/s): for abrasive fluids where solids do not cause sedimentation (e.g. lime milk)
- $v > 2$  m/s (> 6 ft/s): for fluids producing buildup
- $v > 2$  m/s (> 6 ft/s): for abrasive sludge with a high sand or stone content and where the solids easily cause sedimentation (e.g. ore slurry)



Note!

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

#### Recommended flow (SI units)

Nominal diameter [mm]	Promag S	Promag H	Factory settings Promag S	Factory settings Promag H		
	min./max. full scale value ( $v \approx 0.3$ or 10 m/s) [dm <sup>3</sup> /min]		Low flow cut off ( $v \approx 0.04$ m/s) in [dm <sup>3</sup> /min]	Full scale value ( $v \approx 2.5$ m/s) [dm <sup>3</sup> /min]	Pulse value ( $\approx 2$ Pulse/s) [dm <sup>3</sup> ]	Low flow cut off ( $v \approx 0.04$ m/s) [dm <sup>3</sup> / min]
2	-	0.06 to 1.8	-	0.5	0.005	0.01
4	-	0.25 to 7	-	2	0.025	0.05
8	-	1 to 30	-	8	0.10	0.1
15	4 to 100	4 to 100	0.5	25	0.20	0.5
25	9 to 300	9 to 300	1	75	0.50	1
32	15 to 500	15 to 500	2	125	1.00	2
40	25 to 700	25 to 700	3	200	1.50	3
50	35 to 1100	35 to 1100	5	300	2.50	5
65	60 to 2000	60 to 2000	8	500	5.00	8
80	90 to 3000	90 to 3000	12	750	5.00	12
100	145 to 4700	145 to 4700	20	1200	10.00	20
125	220 to 7500	220 to 7500	30	1850	15	30
[mm]	min./max. full scale value ( $v \approx 0.3$ or 10 m/s) in [m <sup>3</sup> /h]					
150	20 to 600	20 to 600	2.5	150	0.03	2.5
200	35 to 1100	-	5.0	-	-	-
250	55 to 1700	-	7.5	-	-	-
300	80 to 2400	-	10	-	-	-
350	110 to 3300	-	15	-	-	-
400	140 to 4200	-	20	-	-	-
450	180 to 5400	-	25	-	-	-
500	220 to 6600	-	30	-	-	-
600	310 to 9600	-	40	-	-	-

## Recommended flow (US units)

Nominal diameter [inch]	Promag S	Promag H	Factory settings Promag S	Factory settings Promag H		
	min./max. full scale value (v ≈ 1.0 or 33 ft/s) in [gal/min]		Low flow cut off (v ≈ 1.0 ft/s) in [gal/min]	full scale value (v ≈ 2.5 m/s) [gal/min]	Pulse value (≈ 2 Pulse/s) [gal]	Low flow cut off (v ≈ 0.04 m/s) [gal/ min]
1/12"	–	0.015 to 0.5	–	0.1	0.001	0.002
1/8"	–	0.07 to 2	–	0.5	0.005	0.008
3/8"	–	0.25 to 8	–	2	0.02	0.025
1/2"	1.0 to 27	1.0 to 27	0.10	6	0.05	0.10
1"	2.5 to 80	2.5 to 80	0.25	18	0.20	0.25
1 1/2"	7 to 190	7 to 190	0.75	50	0.50	0.75
2"	10 to 300	10 to 300	1.25	75	0.50	1.25
3"	24 to 800	24 to 800	2.5	200	2	2.5
4"	40 to 1250	40 to 1250	4.0	300	2	4.0
6"	90 to 2650	90 to 2650	12	–	–	–
8"	155 to 4850	–	15	–	–	–
10"	250 to 7500	–	30	–	–	–
12"	350 to 10600	–	45	–	–	–
14"	500 to 15000	–	60	–	–	–
16"	600 to 19000	–	60	–	–	–
18"	800 to 24000	–	90	–	–	–
20"	1000 to 30000	–	120	–	–	–
24"	1400 to 44000	–	180	–	–	–

### 3.2.9 Length of connecting cable

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

- Secure the cable run or route the cable in a 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, → 17).
- The maximum connecting cable length is 10 m (32.8 ft) when empty pipe detection (EPD → 114) is switched on.

#### Promag S

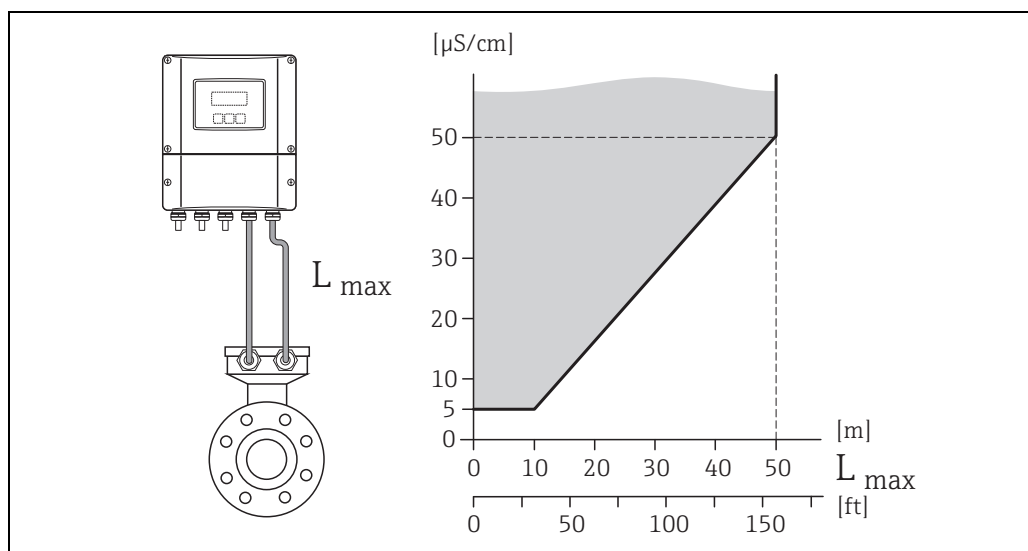


Fig. 16: Permitted lengths for connecting cable in remote version, as a function of the conductivity of the fluid

Gray shaded area = permissible area  
 $L_{max}$  = Length of connecting cable

#### Promag H

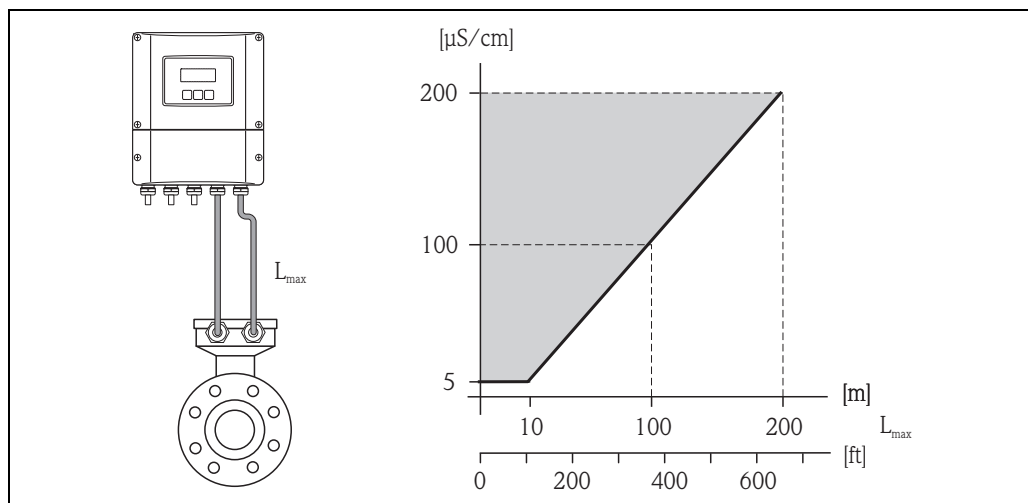


Fig. 17: Permitted lengths for connecting cable in remote version, as a function of the conductivity of the fluid

Gray shaded area = permissible area  
 $L_{max}$  = Length of connecting cable

## 3.3 Installation

### 3.3.1 Installing the Promag S sensor



Note!

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



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.

The sensor is designed for installation between the two piping flanges:

- It is essential that you observe the necessary torques on → 21.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

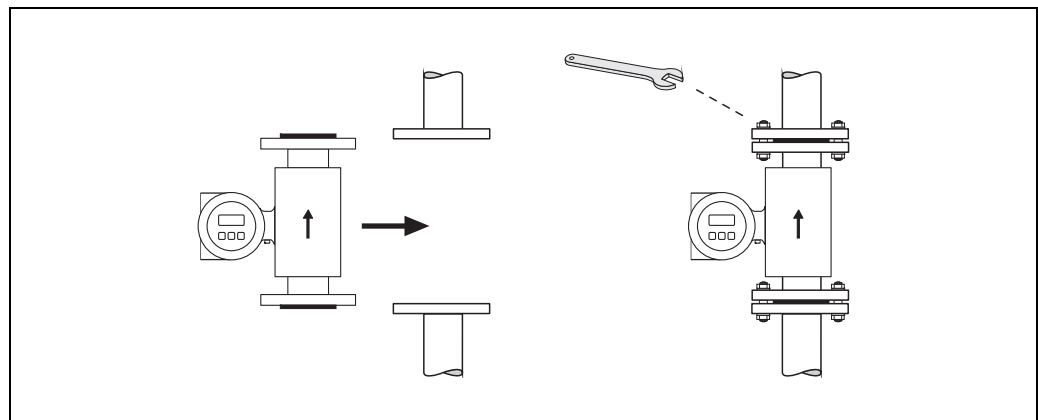


Fig. 18: Installing the Promag S sensor

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#### Seals

Comply with the following instructions when installing seals:

- Hard rubber lining → additional seals are always necessary!
- Natural rubber lining → Seals may **not** be used.
- PFA, PTFE or PU (polyurethane) lining → **No** seals are required.
- 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 (DN 15 to 600 / ½ to 24")

Ground cables are optionally available in different versions from Endress+Hauser:

- Ground cable preinstalled at the flange → Order option (see price list)
- Ground cable (not pre-installed) as an accessory → 117

Detailed assembly instructions → 50

### Screw tightening torques

Please note the following:

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

Tightening torques for:

- EN (DIN) → 21
- ASME → 22
- JIS → 23
- AS 2129 → 24
- AS 4087 → 25

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

Nominal diameter [mm]	EN (DIN) Pressure rating	Threaded fasteners	Flange thickness [mm]	Max. tightening torque				
				Natural rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]	PFA [Nm]	Hard rubber [Nm]
15	PN 40	4 × M 12	16	–	–	11	–	–
25	PN 40	4 × M 12	18	–	15	26	20	–
32	PN 40	4 × M 16	18	–	24	41	35	–
40	PN 40	4 × M 16	18	–	31	52	47	–
50	PN 40	4 × M 16	20	–	40	65	59	48
65 *	PN 16	8 × M 16	18	11	27	43	40	32
65	PN 40	8 × M 16	22	–	27	43	40	32
80	PN 16	8 × M 16	20	13	34	53	48	40
80	PN 40	8 × M 16	24	–	34	53	48	40
100	PN 16	8 × M 16	20	14	36	57	51	43
100	PN 40	8 × M 20	24	–	50	78	70	59
125	PN 16	8 × M 16	22	19	48	75	67	56
125	PN 40	8 × M 24	26	–	71	111	99	83
150	PN 16	8 × M 20	22	27	63	99	85	74
150	PN 40	8 × M 24	28	–	88	136	120	104
200	PN 10	8 × M 20	24	35	91	141	101	106
200	PN 16	12 × M 20	24	28	61	94	67	70
200	PN 25	12 × M 24	30	–	92	138	105	104
250	PN 10	12 × M 20	26	27	71	110	–	82
250	PN 16	12 × M 24	26	48	85	131	–	98
250	PN 25	12 × M 27	32	–	134	200	–	150
300	PN 10	12 × M 20	26	34	81	125	–	94
300	PN 16	12 × M 24	28	67	118	179	–	134
300	PN 25	16 × M 27	34	–	138	204	–	153
350	PN 10	16 × M 20	26	47	118	188	–	112
350	PN 16	16 × M 24	30	68	165	254	–	152
350	PN 25	16 × M 30	–	–	252	380	–	227
400	PN 10	16 × M 24	26	65	167	260	–	151
400	PN 16	16 × M 27	32	95	215	330	–	193
400	PN 25	16 × M 33	–	–	326	488	–	289
450	PN 10	20 × M 24	28	59	133	235	–	153
450	PN 16	20 × M 27	40	96	196	300	–	198

Nominal diameter [mm]	EN (DIN) Pressure rating	Threaded fasteners	Flange thickness [mm]	Max. tightening torque				
				Natural rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]	PFA [Nm]	Hard rubber [Nm]
450	PN 25	20 × M 33	–	–	253	385	–	256
500	PN 10	20 × M 24	28	66	171	265	–	155
500	PN 16	20 × M 30	34	132	300	448	–	275
500	PN 25	20 × M 33	–	–	360	533	–	317
600	PN 10	20 × M 27	28	93	219	345	–	206
600 *	PN 16	20 × M 33	36	202	443	658	–	415
600	PN 25	20 × M 36	–	–	516	731	–	431

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

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

Nominal diameter [mm]	EN (DIN) Pressure rating	Threaded fasteners	Flange thickness	Nom. tightening torque				
				Natural rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]	PFA [Nm]	Hard rubber [Nm]
350	PN 10	16 × M 20	26	80	80	60	–	70
350	PN 16	16 × M 24	30	135	135	115	–	125
350	PN 25	16 × M 30	–	–	235	220	–	230
400	PN 10	16 × M 24	26	110	120	90	–	100
400	PN 16	16 × M 27	32	180	190	155	–	175
400	PN 25	16 × M 33	–	–	325	290	–	315
450	PN 10	20 × M 24	28	105	110	90	–	100
450	PN 16	20 × M 27	34	175	190	155	–	175
450	PN 25	20 × M 33	–	–	310	290	–	300
500	PN 10	20 × M 24	28	120	120	100	–	110
500	PN 16	20 × M 30	36	235	235	205	–	225
500	PN 25	20 × M 33	–	–	370	345	–	370
600	PN 10	20 × M 27	30	172	160	150	–	165
600 *	PN 16	20 × M 33	40	355	340	310	–	340
600	PN 25	20 × M 36	–	–	540	500	–	540

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

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

Nominal diameter [inch]	ASME Pressure rating	Threaded fasteners	Max. torque				
			Natural rubber [lbf · ft]	Polyurethane [lbf · ft]	PTFE [lbf · ft]	PFA [lbf · ft]	Hard rubber [lbf · ft]
½"	Class 150	4 × ½"	–	–	4.4	–	–
½"	Class 300	4 × ½"	–	–	4.4	–	–
1"	Class 150	4 × ½"	–	5.2	8.1	7.4	–
1"	Class 300	4 × 5/8"	–	5.9	10	8.9	–
1½"	Class 150	4 × ½"	–	7.4	18	15	–
1½"	Class 300	4 × ¾"	–	11	25	23	–
2"	Class 150	4 × 5/8"	–	16	35	32	26

Nominal diameter [inch]	ASME Pressure rating	Threaded fasteners	Max. torque				
			Natural rubber [lbf · ft]	Polyurethane [lbf · ft]	PTFE [lbf · ft]	PFA [lbf · ft]	Hard rubber [lbf · ft]
2"	Class 300	8 × 5/8"	–	8.1	17	16	13
3"	Class 150	4 × 5/8"	15	32	58	49	44
3"	Class 300	8 × 3/4"	–	19	35	31	28
4"	Class 150	8 × 5/8"	11	23	41	37	31
4"	Class 300	8 × 3/4"	–	30	49	44	43
6"	Class 150	8 × 3/4"	24	44	78	63	58
6"	Class 300	12 × 3/4"	–	38	54	49	52
8"	Class 150	8 × 3/4"	38	59	105	80	79
10"	Class 150	12 × 7/8"	42	55	100	–	75
12"	Class 150	12 × 7/8"	58	76	131	–	98
14"	Class 150	12 × 1"	77	117	192	–	100
16"	Class 150	16 × 1"	75	111	181	–	94
18"	Class 150	16 × 1 1/8"	108	173	274	–	150
20"	Class 150	20 × 1 1/8"	105	160	252	–	135
24"	Class 150	20 × 1 1/4"	161	226	352	–	198

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

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque				
			Natural rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]	PFA [Nm]	Hard rubber [Nm]
15	10K	4 × M 12	–	–	16	–	–
15	20K	4 × M 12	–	–	16	–	–
25	10K	4 × M 16	–	19	32	27	–
25	20K	4 × M 16	–	19	32	27	–
32	10K	4 × M 16	–	22	38	–	–
32	20K	4 × M 16	–	22	38	–	–
40	10K	4 × M 16	–	24	41	37	–
40	20K	4 × M 16	–	24	41	37	–
50	10K	4 × M 16	–	33	54	46	40
50	20K	8 × M 16	–	17	27	23	20
65	10K	4 × M 16	18	45	74	63	55
65	20K	8 × M 16	–	23	37	31	28
80	10K	8 × M 16	10	23	38	32	29
80	20K	8 × M 20	–	35	57	46	42
100	10K	8 × M 16	12	29	47	38	35
100	20K	8 × M 20	–	48	75	58	56
125	10K	8 × M 20	20	51	80	66	60
125	20K	8 × M 22	–	79	121	103	91
150	10K	8 × M 20	25	63	99	81	75
150	20K	12 × M 22	–	72	108	72	81
200	10K	12 × M 20	23	52	82	54	61
200	20K	12 × M 22	–	80	121	88	91

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque				
			Natural rubber [Nm]	Polyurethane [Nm]	PTFE [Nm]	PFA [Nm]	Hard rubber [Nm]
250	10K	12 × M 22	39	87	133	–	100
250	20K	12 × M 24	–	144	212	–	159
300	10K	16 × M 22	38	63	99	–	74
300	20K	16 × M 24	–	124	183	–	138

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

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Nom. tightening torque	
			Natural rubber [Nm]	Polyurethane [Nm]
350	10K	16 × M 22	109	109
350	20K	16 × M 30×3	217	217
400	10K	16 × M 24	163	163
400	20K	16 × M 30×3	258	258
450	10K	16 × M 24	155	155
450	20K	16 × M 30×3	272	272
500	10K	16 × M 24	183	183
500	20K	16 × M 30×3	315	315
600	10K	16 × M 30	235	235
600	20K	16 × M 36×3	381	381

*Promag S screw tightening torques for AS 2129, Table E*

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque		
			PTFE [Nm]	Natural rubber [Nm]	Hard rubber [Nm]
25	Table E	4 × M 12	21	–	–
50	Table E	4 × M 16	42	–	32
80	Table E	4 × M 16	–	16	49
100	Table E	8 × M 16	–	13	38
150	Table E	8 × M 20	–	22	64
200	Table E	8 × M 20	–	36	96
250	Table E	12 × M 20	–	37	98
300	Table E	12 × M 24	–	57	123
350	Table E	12 × M 24	–	85	203
400	Table E	12 × M 24	–	99	226
450	Table E	16 × M 24	–	96	226
500	Table E	16 × M 24	–	115	271
600	Table E	16 × M 30	–	199	439



Promag S screw tightening torques for AS 4087, PN 16

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque		
			PTFE [Nm]	Natural rubber [Nm]	Hard rubber [Nm]
50	PN 16	4 × M 16	42	–	32
80	PN 16	4 × M 16	–	16	49
100	PN 16	4 × M 16	–	13	76
150	PN 16	8 × M 16	–	20	52
200	PN 16	8 × M 16	–	33	77
250	PN 16	8 × M 20	–	64	147
300	PN 16	12 × M 20	–	55	103
350	PN 16	12 × M 24	–	91	203
400	PN 16	12 × M 24	–	113	226
450	PN 16	12 × M 24	–	144	301
500	PN 16	16 × M 24	–	131	271
600	PN 16	16 × M 27	–	204	393

**Installing the high temperature version Promag S (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 (+302 °F).



Note!

You will find information on permissible temperature ranges on → 144.

*Insulation*

Pipes generally have to be insulated if they carry very hot fluids, in order to avoid energy losses and to 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 measuring 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 shells.

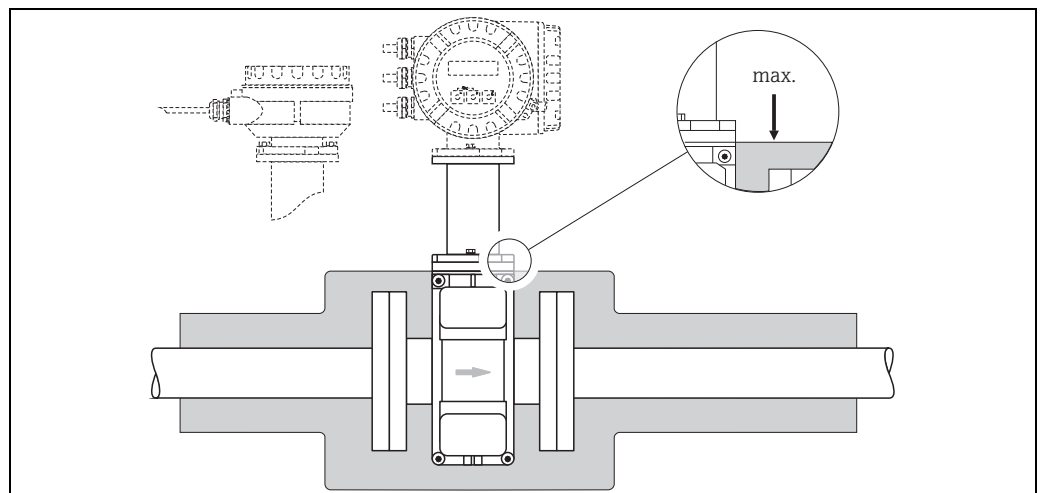


Fig. 19: Promag S (high temperature version): Insulating the pipe

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### 3.3.2 Installing the Promag H sensor

The Promag H sensor is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with hex-head threaded fasteners.



Caution!

- The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory → 117.

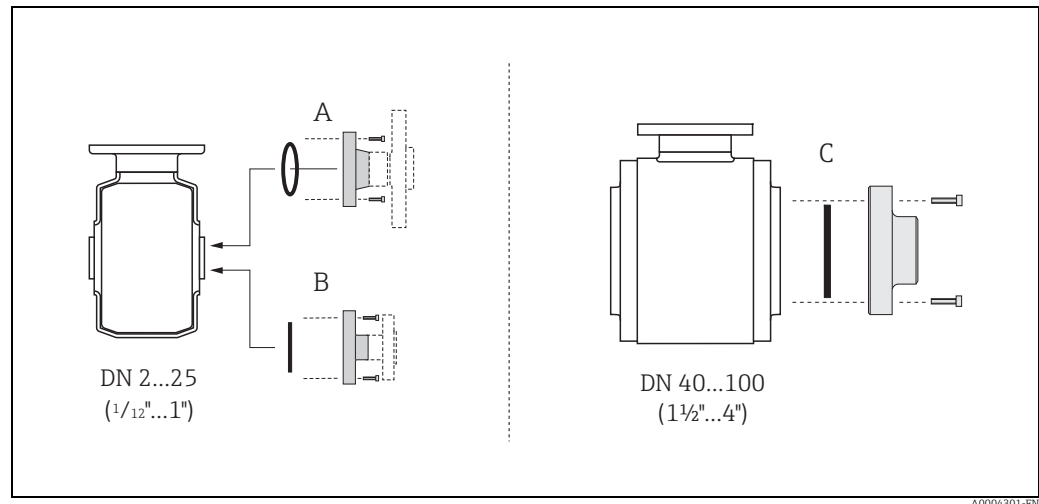


Fig. 20: Promag H process connections

A: DN 2 to 25 ( $\frac{1}{12}$  to 1") / process connections with O-rings:

Welding flanges (DIN EN ISO 1127, ODT / SMS), flange (EN (DIN), ASME, JIS), flange PVDF (EN (DIN), ASME, JIS), external and internal pipe threads, hose connection, PVC adhesive fitting

B: DN 2 to 25 ( $\frac{1}{12}$  to 1") / process connections with aseptic gasket seals:

Welding nozzles (EN 10357 (DIN 11850), ODT / SMS), Clamp (ISO 2852, DIN 32676, L14 AM7), coupling (DIN 11851, DIN 11864-1, SMS 1145), flange DIN 11864-2

C: DN 40 to 100 ( $1\frac{1}{2}$  to 4") / process connections with aseptic gasket seals:

Welding nozzles (EN 10357 (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 installing the process connections, make sure that the seals are clean and correctly centered.



Caution!

- With metallic process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)! The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature. Replacement seals can be ordered as accessories → 117.

### Usage and assembly of ground rings (DN 2 to 25 / 1/12 to 1")

In case the process connections are made of plastic (e.g. flanges or adhesive couplings), the potential between the sensor and the fluid must be matched 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 electrochemical erosion 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 → 117. 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 electrochemical corrosion! Information about the materials can be found on → 149.
- 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).

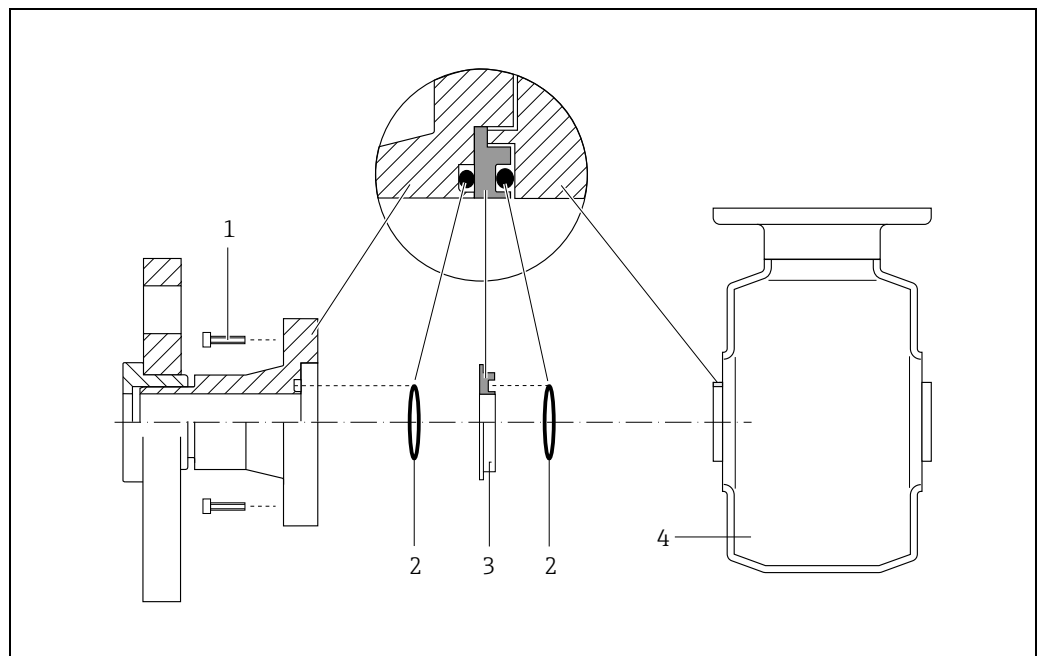


Fig. 21: Installing ground rings with a Promag H (DN 2 to 25 / 1/12 to 1")


- |   |   |
|---|---|
| 1 | Hexagonal headed bolts (process connection) |
| 2 | O-ring seals                                |
| 3 | Ground ring or plastic ring (placeholder)   |
| 4 | Sensor                                      |

### Welding the sensor into the piping (weld nipples)



#### Caution!

Risk of destroying the measuring electronics. Make sure that the welding machine is not grounded via the sensor or the transmitter.

1. Tack-weld the Promag H sensor into the pipe. A suitable welding jig can be ordered separately from Endress+Hauser as an accessory (→  117).
2. Remove the threaded fasteners from the process-connection flange. Remove the sensor complete with seal from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.



#### Note!

- If thin-walled foodstuffs pipes are not welded correctly, the heat could damage the installed seal. It is therefore advisable to remove the sensor and the seal prior to welding.
- The pipe has to be spread approximately 8 mm to permit disassembly.

### Cleaning with pigs

If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube and process connection into account.

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Information".

### 3.3.3 Turning the transmitter housing

#### Turning the aluminum field housing

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.  $2 \times 90^\circ$  in either direction).
5. Lower the housing into position and reengage the bayonet catch.
6. Retighten the two securing screws.

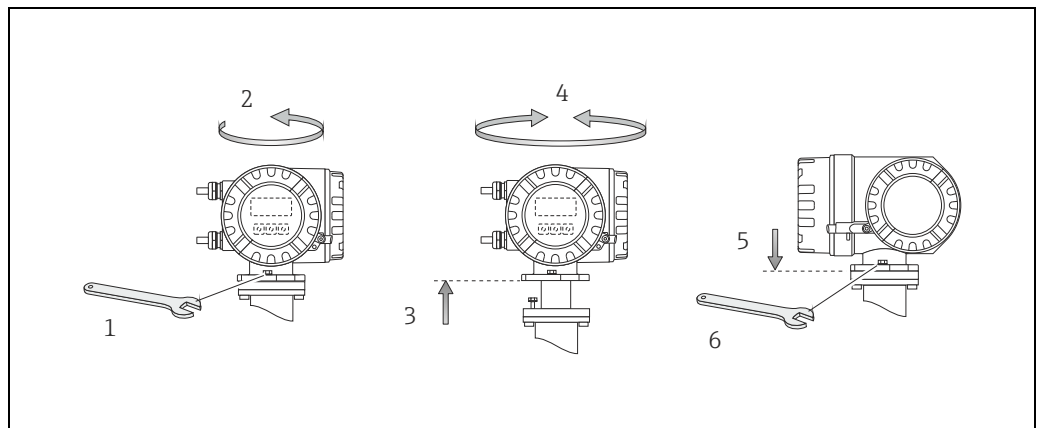


Fig. 22: Turning the transmitter housing (aluminum field housing)

#### Turning the stainless-steel field housing

- a. Loosen the two securing screws.
- b. Carefully lift the transmitter housing as far as it will go.
- c. Turn the transmitter housing to the desired position (max.  $2 \times 90^\circ$  in either direction).
- d. Lower the housing into position.
- e. Retighten the two securing screws.

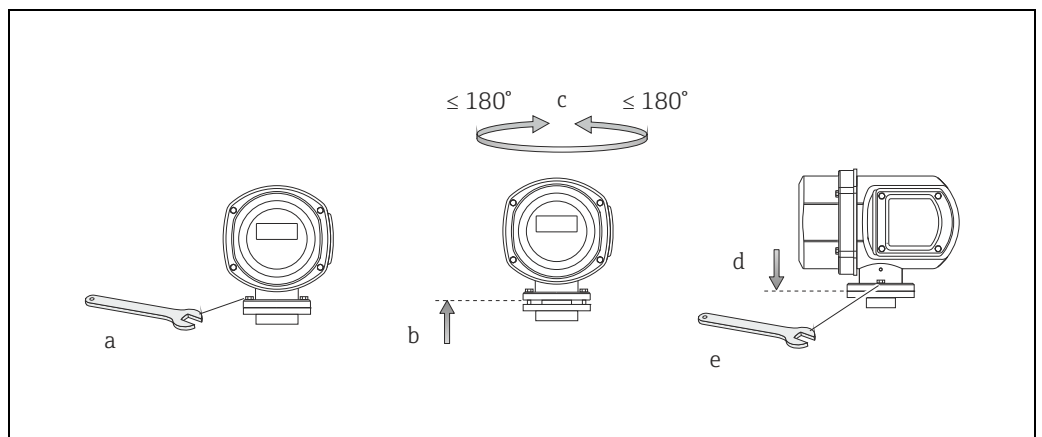
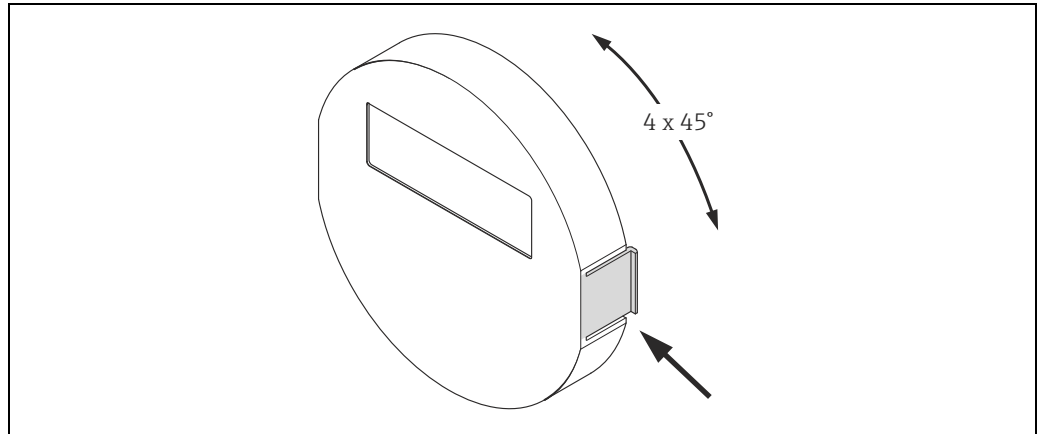


Fig. 22: Turning the transmitter housing (stainless-steel field housing)

### 3.3.4 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.  $4 \times 45^\circ$  in both directions) and position it back on the electronics compartment cover.
4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.



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Fig. 24: Turning the local display (field housing)

### 3.3.5 Installing the wall-mount housing

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

- Mounted directly on the wall
- Installation in control panel (with separate mounting kit, accessories) → 32
- Pipe mounting (with separate mounting kit, accessories) → 32



Caution!

- Make sure that the permitted ambient temperature range is observed (see nameplate or → 143). Install the device at 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.  $\varnothing$  6.5 mm (0.26")
  - Screw head: max.  $\varnothing$  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.

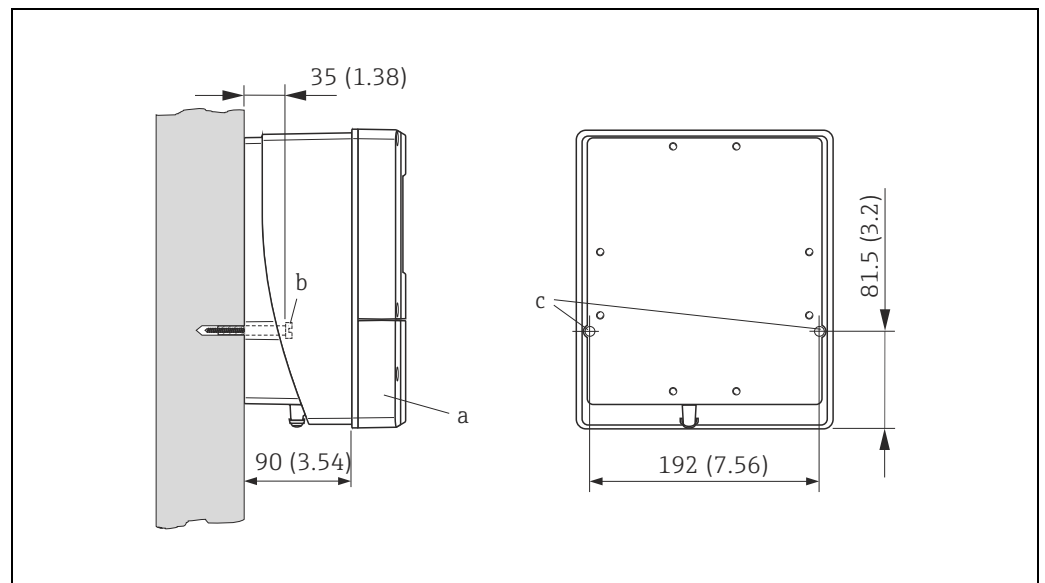


Fig. 25: Mounted directly on the wall. Engineering unit mm (inch)

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### 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. Afterwards, tighten the locking nuts. Additional support is not necessary.

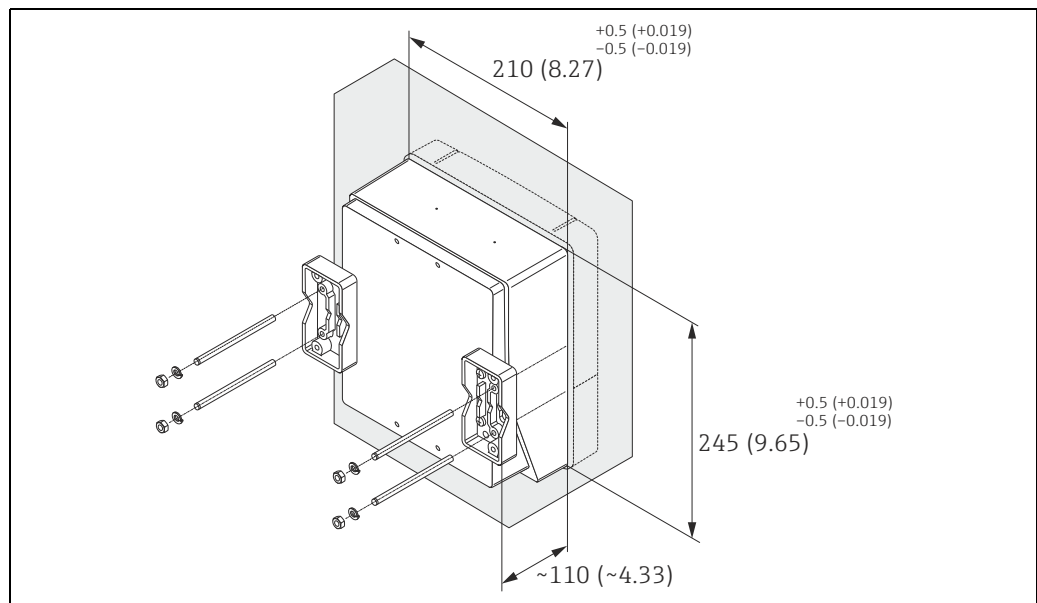


Fig. 26: Panel Installation (wall-mount housing). Engineering unit mm (inch)

### 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  $+60\text{ °C}$  ( $+140\text{ °F}$ ), which is the maximum permissible temperature.

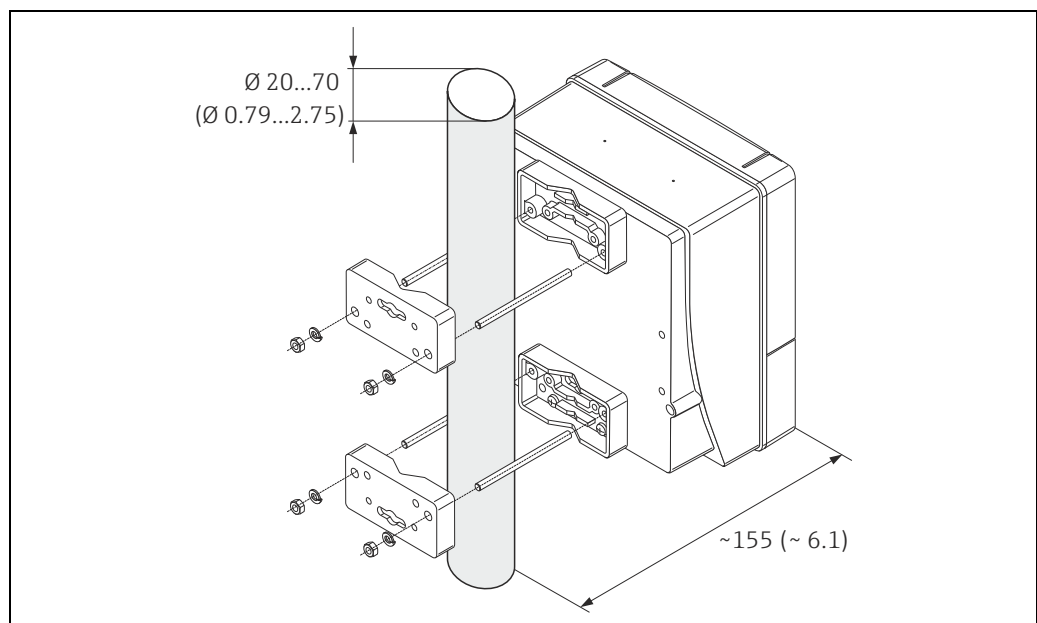


Fig. 27: Pipe mounting (wall-mount housing). Engineering unit mm (inch)



### 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.?	→ 139
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?	→ 21
Were the correct seals installed (type, material, installation)?	→ 20
Are the measuring point number and labeling correct (visual inspection)?	–
Process environment / process conditions	Notes
Are the inlet and outlet runs respected?	Inlet run $\geq 5 \times DN$ Outlet run $\geq 2 \times DN$
Is the measuring device protected against moisture and direct sunlight?	–
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g by analogy with IEC 600 68-2-6 → 143

## 4 Wiring



### Warning!

- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.
- If you use remote versions, connect each sensor *only* to the transmitter having the same serial number. Measuring errors can occur if the devices are not connected in this way.



### 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.

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 mm <sup>2</sup> , corresponds to AWG 22
Cable type	Twisted in pairs, 1 × 2, 2 × 2 or 1 × 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	3000 to 12 000
Line length [m] ([inch])	1200 (4 000)	1000 (3 300)	400 (1 300)	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) × 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:  $(9 + 1) \times 200 \text{ m} = 2000 \text{ m}$

### 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 communication transmission (→  65).

### 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 specifications

### 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, it is permissible to operate multiple fieldbuses with the same degree of protection 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 mm <sup>2</sup> (AWG 18)	0.32 mm <sup>2</sup> (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
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 expansion 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) (> 3 ft):

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 equalization, 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 equalization, 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 the sensor





Warning!

- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective conductor to the ground terminal on the housing before the power supply is applied.
- If you use remote versions, connect sensors **only** to sensors and transmitters that have the same fabrication number. Measuring errors can occur if the devices are not connected in this way.

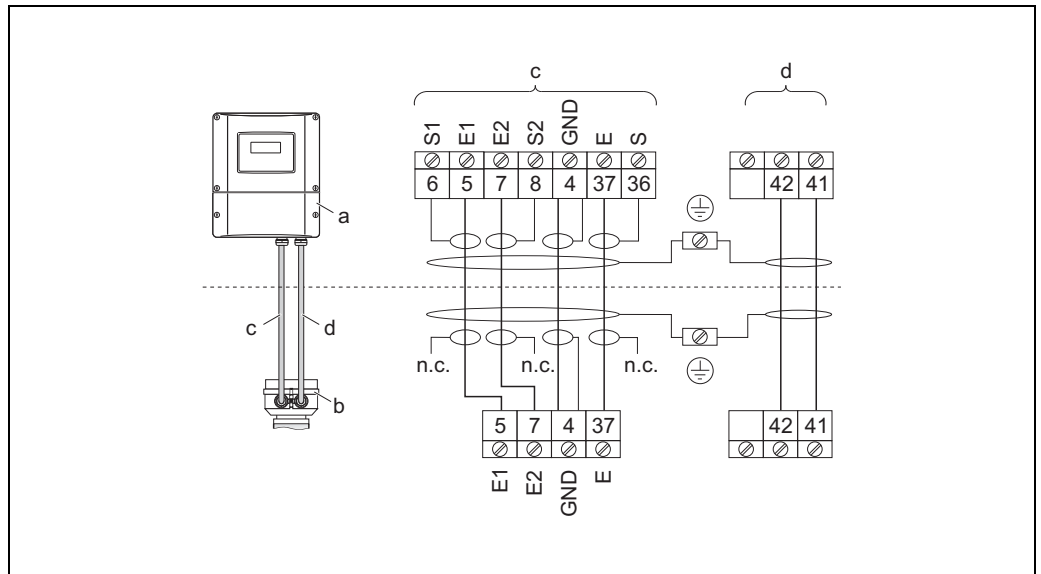
Procedure (→  28, →  29):

1. Transmitter: Loosen the screws and remove the cover (a) from the connection compartment.
2. Sensor: Remove the cover (b) from the connection housing.
3. Feed the electrode cable (c) and coil current cable (d) through the appropriate cable entries.
  -  Caution!
    - Make sure the connecting cables are secured →  19.
    - Risk of damaging the coil driver. Do not connect or remove the coil current cable until the power supply has been switched off.
4. Terminate electrode cable and coil current cable →  40, →  41.
5. Establish the connections between the sensor and transmitter in accordance with the wiring diagram:
  -  28, →  29
  - wiring diagram inside the cover
  -  Note!
 

The cable shields of the Promag H sensor are grounded using strain relief clamps (please refer to the "Cable termination" table →  41).
  -  Caution!
 

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

**Promag S**

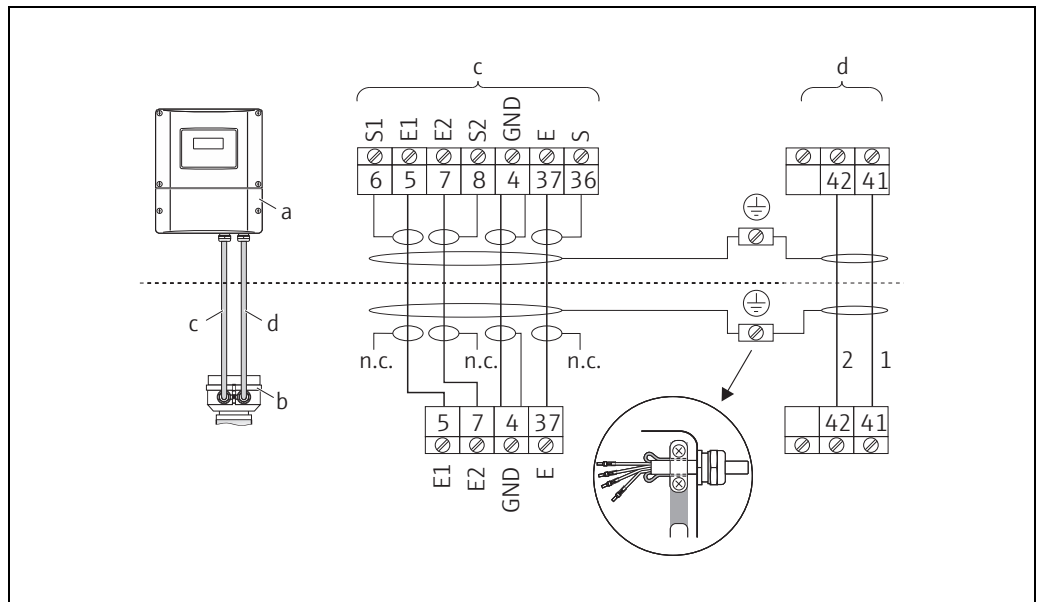


A0011722

Fig. 28: Connecting the remote version of Promag S

- a Connection compartment, wall-mount housing
  - b Cover of connection housing, sensor
  - c Electrode cable
  - d Coil current cable
  - n.c. unconnected, insulated cable shields
- Terminal no. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

**Promag H**



A0011747

Fig. 29: Connecting the remote version of Promag H

- a Connection compartment, wall-mount housing
  - b Cover of connection housing, sensor
  - c Electrode cable
  - d Coil current cable
  - n.c. unconnected, insulated cable shields
- Terminal no. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

**Cable termination in remote version  
Promag S**

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).

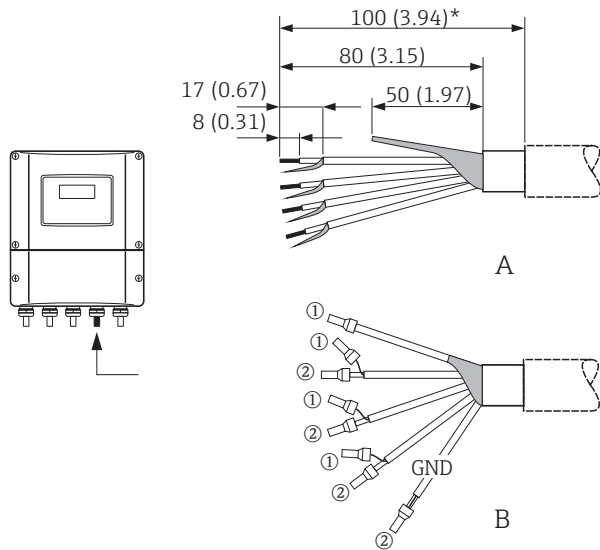
**Caution!**

When fitting the connectors, pay attention to the following points:

- *Electrode cable* → Make sure that the wire end ferrules do not touch the wire shields on the sensor side.  
Minimum distance = 1 mm / 0.04 in (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.

**TRANSMITTER**

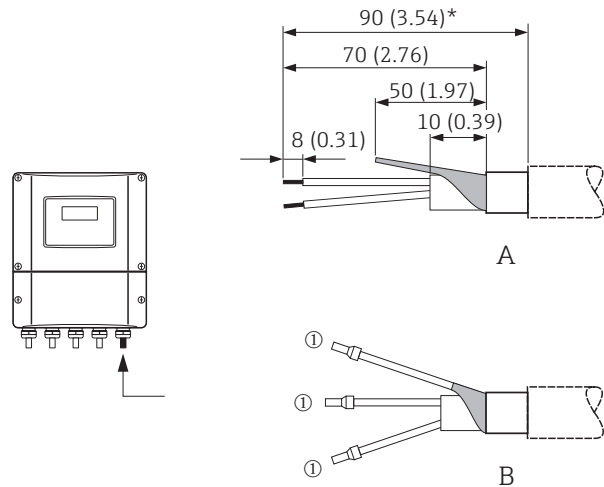
Electrode cable



A0002687

Fig. 30: Engineering unit mm (in)

Coil current cable

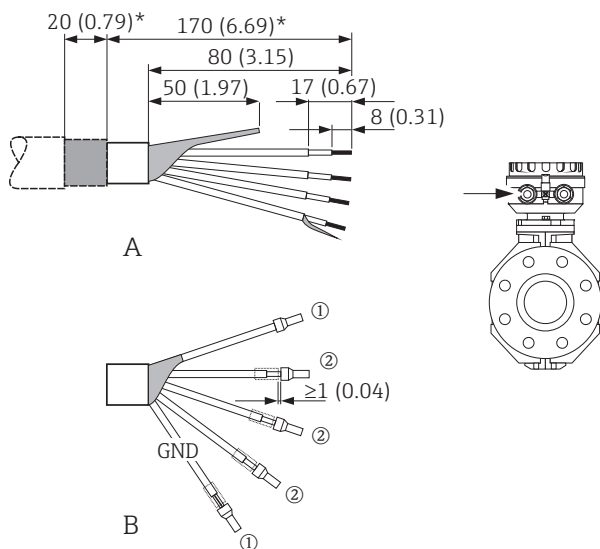


A0002688

Fig. 31: Engineering unit mm (in)

**SENSOR**

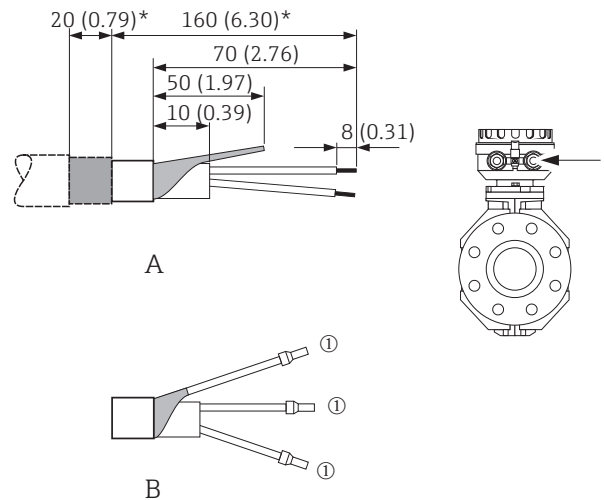
Electrode cable



A0002646

Fig. 32: Engineering unit mm (in)

Coil current cable



A0002650

Fig. 33: Engineering unit mm (in)

- ① = Cable end sleeve red, Ø 1.0 mm (0.04")
- ② = Cable end sleeve white, Ø 0.5 mm (0.02")
- \* = Stripping for armored cables only



**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).

**Caution!**

When fitting the connectors, pay attention to the following points:

- **Electrode cable** → Make sure that the wire end ferrules do not touch the wire shields on the sensor side.  
Minimum distance = 1 mm / 0.04 in (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 (0.59 in) over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

**TRANSMITTER**

**Electrode cable**

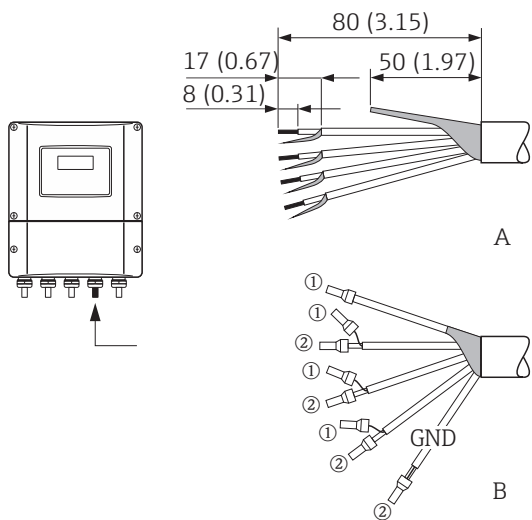


Fig. 34: Engineering unit mm (in)

A0002686

**Coil current cable**

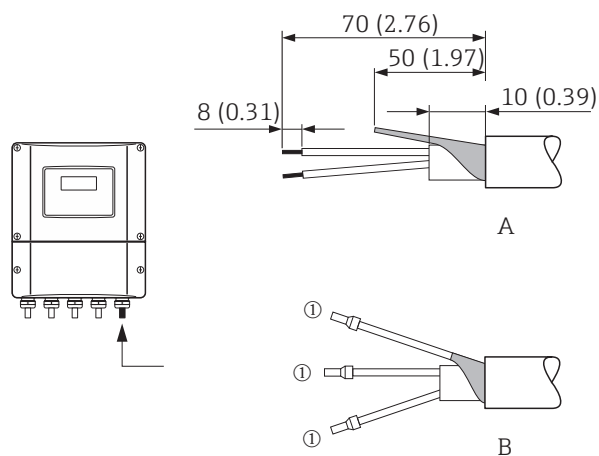


Fig. 35: Engineering unit mm (in)

A0002684

**SENSOR**

**Electrode cable**

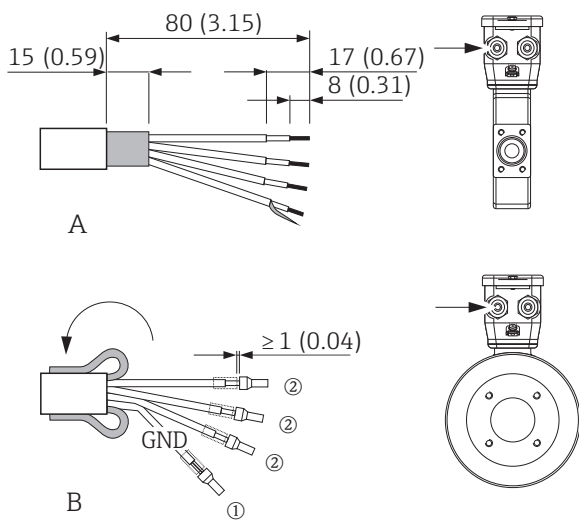


Fig. 36: Engineering unit mm (in)

A0002647

**Coil current cable**

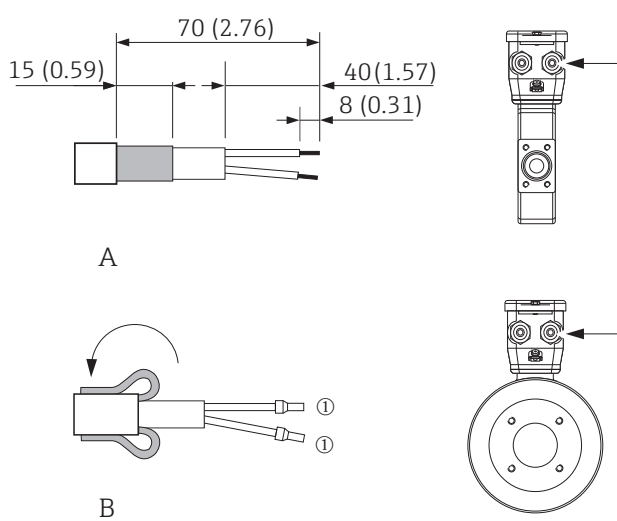


Fig. 37: Engineering unit mm (in)

A0002648

- ① = Cable end sleeve red, Ø 1.0 mm (0.04")
- ② = Cable end sleeve white, Ø 0.5 mm (0.02")
- \* = Stripping for armored cables only

## 4.2.2 Cable specifications

### Coil current cable

- $3 \times 0.75 \text{ mm}^2$  (18 AWG) PVC cable with common, braided copper shield ( $\varnothing \sim 9 \text{ mm}/0.35''$ )
- Conductor resistance:  $\leq 37 \text{ } \Omega/\text{km}$  (0.011  $\Omega/\text{ft}$ )
- Capacitance: core/core, shield grounded:  $\leq 120 \text{ pF/m}$  (37 pF/ft)
- Operating temperature:
  - Cable not permanently routed:  $-20$  to  $+80 \text{ }^\circ\text{C}$  ( $-4$  to  $+176 \text{ }^\circ\text{F}$ )
  - Cable permanently routed:  $-40$  to  $+80 \text{ }^\circ\text{C}$  ( $-40$  to  $+176 \text{ }^\circ\text{F}$ )
- Cable cross-section: max.  $2.5 \text{ mm}^2$  (14 AWG)

### Electrode cable

- $3 \times 0.38 \text{ mm}^2$  (20 AWG) PVC cable with common, braided copper shield ( $\varnothing \sim 9.5 \text{ mm}/0.37''$ ) and individually shielded cores
- With Empty Pipe Detection (EPD):  $4 \times 0.38 \text{ mm}^2$  (20 AWG) PVC cable with common, braided copper shield ( $\varnothing \sim 9.5 \text{ mm}/0.37''$ ) and individually shielded cores
- Conductor resistance:  $\leq 50 \text{ } \Omega/\text{km}$  (0.015  $\Omega/\text{ft}$ )
- Capacitance: core/shield:  $\leq 420 \text{ pF/m}$  (128 pF/ft)
- Operating temperature:
  - Cable not permanently routed:  $-20$  to  $+80 \text{ }^\circ\text{C}$  ( $-4$  to  $+176 \text{ }^\circ\text{F}$ )
  - Cable permanently routed:  $-40$  to  $+80 \text{ }^\circ\text{C}$  ( $-40$  to  $+176 \text{ }^\circ\text{F}$ )
- Cable cross-section: max.  $2.5 \text{ mm}^2$  (14 AWG)

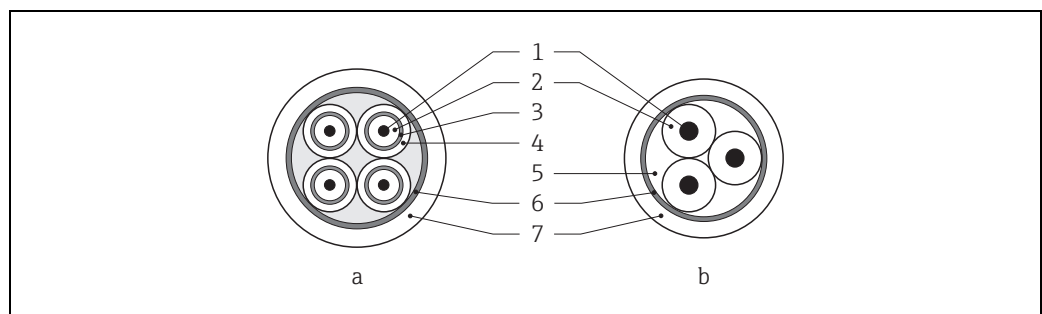


Fig. 38: Cable cross-section

- a Electrode cable  
b Coil current cable

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

### Reinforced connecting cables

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid. We recommend such cables for the following cases:

- Directly buried cable
- Cables endangered by rodents
- Device operation which should comply with the IP 68 (NEMA 6P) standard of protection

### Operation in zones of severe electrical interference

The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 and NAMUR recommendation NE 21.



### Caution!

Grounding of the shield 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 Connecting the transmitter



Warning!

- Risk of electric shock.  
Switch off the power supply before opening the device. Do not install or wire the device while it is 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 ground to the ground terminal on the housing before the power supply is applied (e.g. galvanically isolated power supply SELV or PELV).
- Compare the specifications on the nameplate with the local supply voltage and frequency. Also observe the national regulations governing the installation of electrical equipment.

Procedure

1. Unscrew the connection compartment cover (a) from the transmitter housing.
  2. Feed the power supply cable (b) and fieldbus cable (d) through the appropriate cable entries.
  3. Perform wiring in accordance with the respective terminal assignment and the associated wiring diagram.
    - PROFIBUS DB → 39 (→ 45) or → 40 (→ 46)
    - PROFIBUS PA → 41 (→ 47)
- Caution!
- Risk of damage to the fieldbus cable! Observe the information about shielding and grounding the fieldbus cable → 37.
  - 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.

### 4.3.2 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 code for "Input / Output"	Terminal No.			
	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
J	-	-	+5V (ext. termination)	PROFIBUS DP
V	Relay output 2	Relay output 1	Status input	PROFIBUS DP
P	Current output	Frequency output	Status input	PROFIBUS DP

#### PROFIBUS PA

Order code for "Input / Output"	Terminal No.			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 = PA + <sup>1</sup> 27 = PA - <sup>1</sup>
H	-	-	-	PROFIBUS PA

<sup>1</sup> With integrated reverse polarity protection

### 4.3.3 PROFIBUS DP connection diagram

#### Permanent assignment board (order version J)

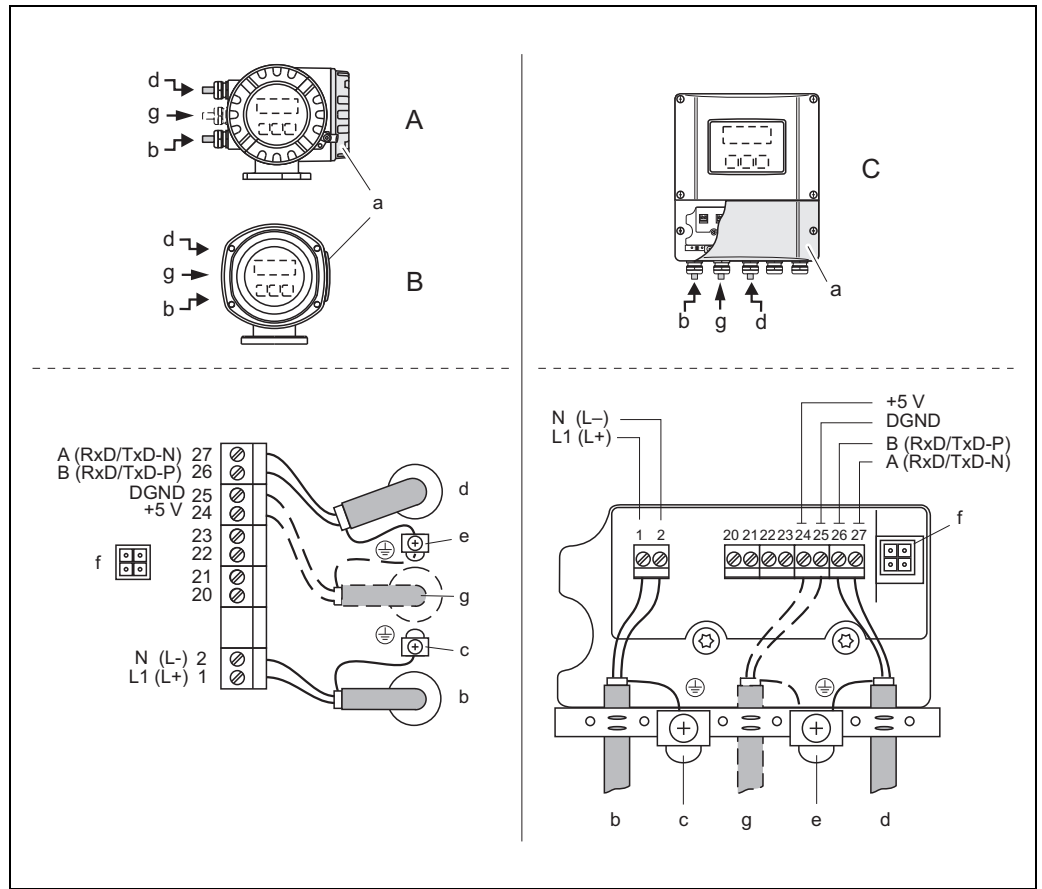
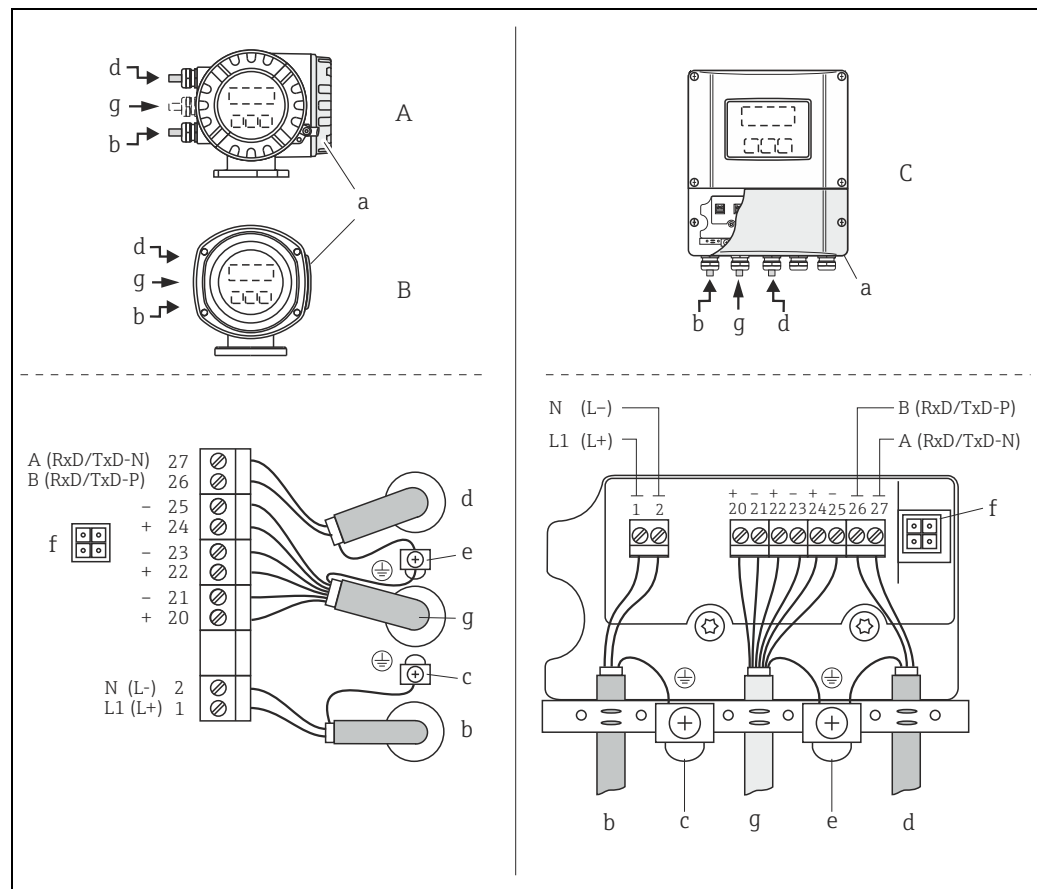


Abb. 39: Connecting the transmitter, cable cross-section: max. 2.5 mm<sup>2</sup> (14 AWG)

- 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 ground
- d Fieldbus cable
  - Terminal No. 26: B (Rx/D/TxD-P)
  - Terminal No. 27: A (Rx/D/TxD-N)
- e Fieldbus cable shield ground terminal
  - Observe the following:
  - the shielding and grounding of the fieldbus cable → 37
  - 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 V and P)



A0002591

Fig. 40: Connecting the transmitter, cable cross-section: max. 2.5 mm<sup>2</sup> (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 ground

d Fieldbus cable

- Terminal No. 26: B (RxD/TxD-P)

- Terminal No. 27: A (RxD/TxD-N)

e Ground terminal for electrode cable shield/fieldbus cable shield

Observe the following:

- the shielding and grounding of the fieldbus cable → 37

- 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 Electrode cable: see Terminal assignment → 44

### 4.3.4 PROFIBUS PA connection diagram

#### Permanent assignment board (order version H)

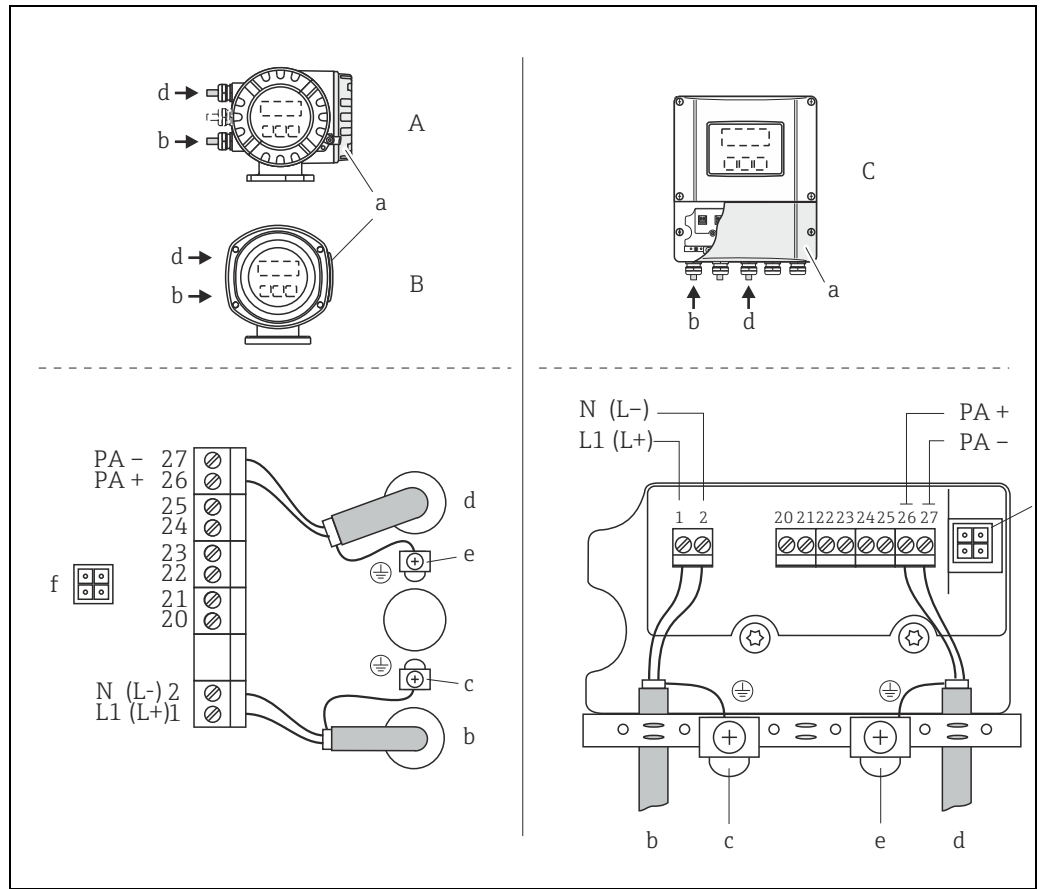


Fig. 41: Connecting the transmitter, cable cross-section: max. 2.5 mm<sup>2</sup> (14 AWG)

- 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 ground
- d Fieldbus cable:
  - Terminal No. 26: PA + (with reverse polarity protection)
  - Terminal No. 27: PA - (with reverse polarity protection)
- e Fieldbus cable shield ground terminal
  - Observe the following:
    - the shielding and grounding of the fieldbus cable → 37
    - 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

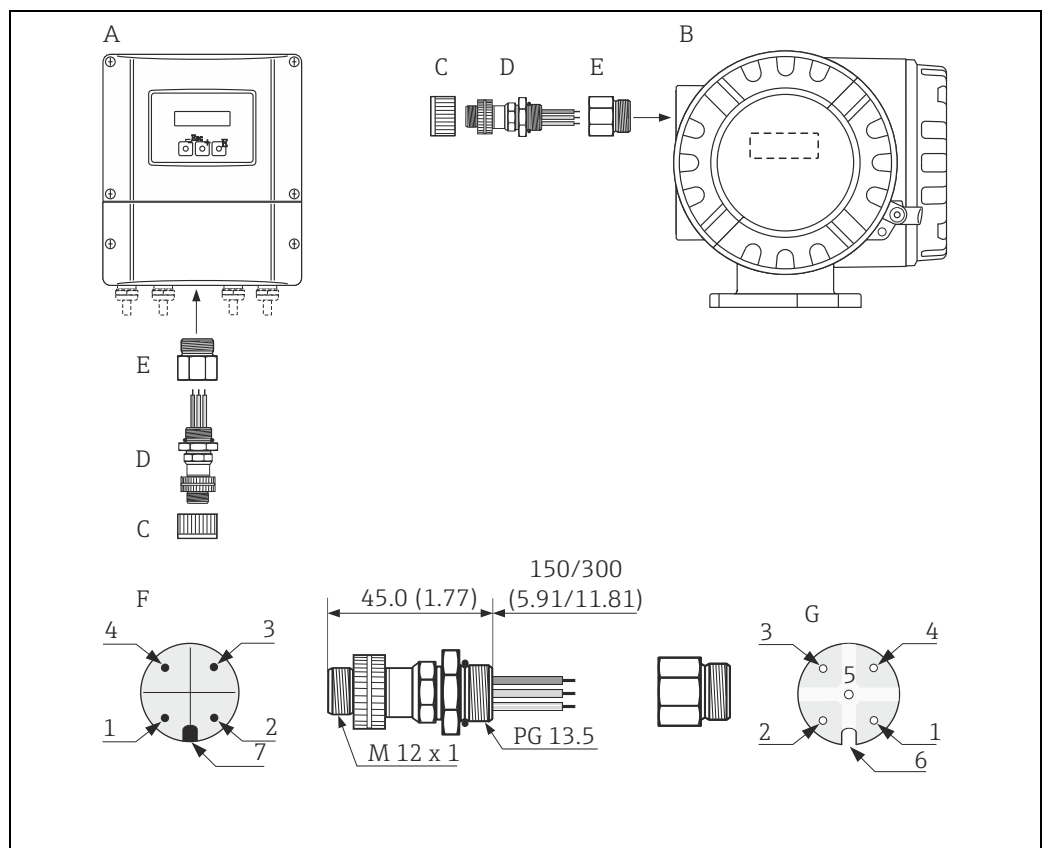
The connection technology of PROFIBUS PA allows measuring devices to be connected to the fieldbus via uniform mechanical connections such as T-boxes, distribution modules etc.

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

→  117.




A0005999

Fig. 42: Connectors for connecting to the PROFIBUS PA

- A Wall-mount housing  
 B Aluminum field housing  
 C Protection cap for connector  
 D Fieldbus connector  
 E Adapter PG 13.5 / M 20.5  
 F Connector on housing (male)  
 G Cable socket (female)

**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 →  47)  
 5 Not connected  
 6 Positioning groove  
 7 Positioning key



*Technical data*

<b>Connection cross section</b>	0.75 mm <sup>2</sup> (AWG 18)
<b>Connector thread</b>	PG 13.5
<b>Degree of protection</b>	IP 67 in accordance with DIN 40 050 IEC 529
<b>Contact surface</b>	CuZnAu
<b>Housing material</b>	Cu Zn, surface Ni
<b>Flammability</b>	V - 2 in accordance with UL - 94
<b>Operating temperature</b>	-40 to +85 °C (-40 to 185 °F)
<b>Ambient temperature</b>	-40 to +150 °C (-40 to 302 °F)
<b>Nominal current per contact</b>	3 A
<b>Nominal voltage</b>	125 to 150 V DC in accordance with the VDE Standard 01 10/ISO Group 10
<b>Resistance to tracking</b>	KC 600
<b>Volume resistance</b>	≤ 8 mΩ in accordance with IEC 512 Part 2
<b>Insulation resistance</b>	≤ 10 <sup>12</sup> Ω in accordance with IEC 512 Part 2

*Supply line/T-box shield*

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 PROFIBUS 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 equalization



Warning!

The potential equalization has to involve the measuring system.

Proper 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 S

- Reference electrode is standard for electrode material 1.4435/316L, Alloy C-22, tantalum, titanium Gr. 2, Duplex 1.4462, tungsten carbide coating (for electrodes made of 1.4435)
- Reference electrode is optional for electrode made of platinum
- Reference electrode not present in measuring tubes with a natural rubber lining in conjunction with brush electrodes.



Caution!

- For sensors without reference electrodes or without metal process connections, carry out potential equalization as per the instructions for special cases → 50. These special measures are particularly important when standard grounding measures cannot be applied or extreme equalizing currents are expected.
- Sensors with brush electrodes do not have a reference electrode. For this reason, ground disks need to be installed in some cases to ensure sufficient potential equalization to the fluid. This applies in particular to isolating lined pipes which are not grounded → 50.

### 4.4.2 Potential equalization, Promag H

- No reference electrode available!

The metallic process connection always establishes an electrical connection to the fluid.




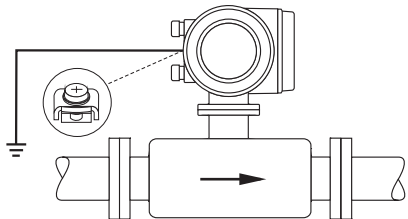
Caution!

When using process connections made of plastic, potential equalization must be guaranteed through the use of grounding rings → 27.


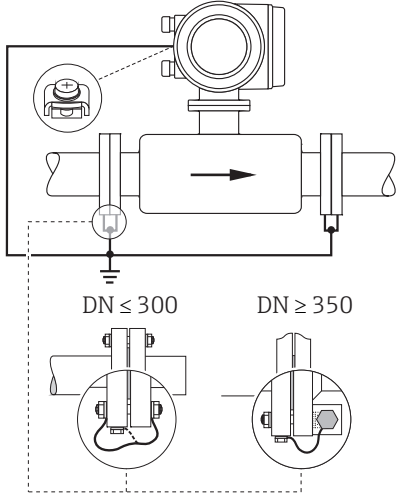
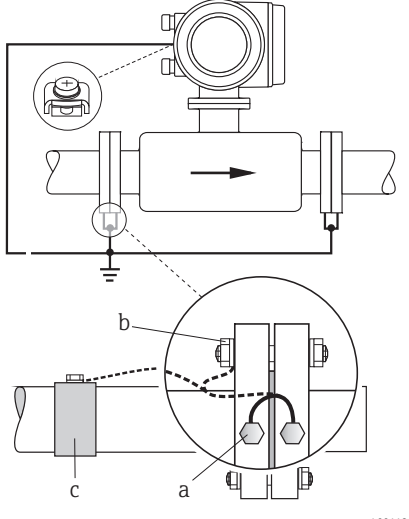
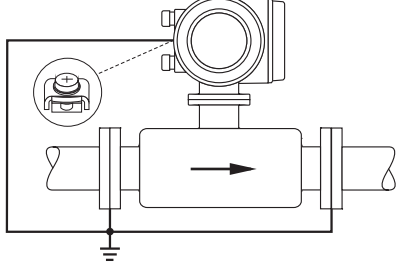
The necessary grounding rings may be ordered separately as an accessory from Endress+Hauser (→ 117).

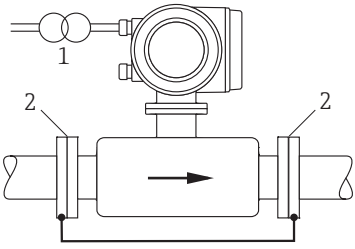
### 4.4.3 Connection examples for potential equalization

#### Standard case

Operating conditions	Potential equalization
<p>When using the measuring device in:</p> <ul style="list-style-type: none"> <li>■ Metallic, grounded piping</li> </ul> <p>Potential equalization is carried out via the ground terminal of the transmitter.</p> <p> Note! For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping.</p>	 <p style="text-align: right; font-size: small;">A0011892</p> <p>Fig. 43: via the transmitter's ground terminal</p>

Special cases

Operating conditions	Potential equalization
<p>When using the measuring device in:</p> <ul style="list-style-type: none"> <li>▪ Metallic, ungrounded piping</li> </ul> <p>This type of connection occurs when:</p> <ul style="list-style-type: none"> <li>▪ The usual potential equalization cannot be guaranteed</li> <li>▪ Extremely high equalizing currents are expected</li> </ul> <p>A ground cable (copper wire, at least 6 mm<sup>2</sup> (0.0093 in<sup>2</sup>)) is used to connect both sensor flanges to the respective pipe flange and to ground them. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for this purpose.</p> <p>The installation of the ground cable depends on the nominal diameter:</p> <ul style="list-style-type: none"> <li>▪ DN ≤ 300 (12"): The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.</li> <li>▪ DN ≥ 350 (14"): The ground cable connects directly to the metal transport bracket.</li> </ul> <p> <b>Note!</b> The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.</p>	 <p style="text-align: right;">A0011893</p> <p>Fig. 44: Via the transmitter's ground terminal and the pipe flanges</p>
<p>Version with pre-installed ground cable for DN £300 (12") (order option)</p> <p>Ground cables (copper wire, min. 6 mm<sup>2</sup> (0.0093 in<sup>2</sup>)), which are pre-installed on the sensor flange, are also optionally available. These ground cables can be secured and connected electrically to the piping in different ways:</p> <ul style="list-style-type: none"> <li>▪ Using a screw on the side of the pipe flange (a)</li> <li>▪ Using the flange screws (b)</li> <li>▪ Using a pipe clip installed around the pipe (c)</li> </ul>	 <p style="text-align: right;">A0011897</p> <p>Fig. 45: Possibilities for connecting and securing preinstalled ground cables</p>
<p>When using the measuring device in:</p> <ul style="list-style-type: none"> <li>▪ Plastic pipes</li> <li>▪ Isolating lined pipes</li> </ul> <p>This type of connection occurs when:</p> <ul style="list-style-type: none"> <li>▪ The usual potential equalization cannot be guaranteed</li> <li>▪ Extremely high equalizing currents are expected</li> </ul> <p>Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, min. 6 mm<sup>2</sup> (0.0093 in<sup>2</sup>)). When installing the ground disks, please comply with the enclosed Installation Instructions.</p>	 <p style="text-align: right;">A0011895</p> <p>Fig. 46: Via the transmitter's ground terminal and the optionally available ground disks</p>

Operating conditions	Potential equalization
<p>When using the measuring device in:</p> <ul style="list-style-type: none"> <li>▪ Pipes with cathodic protection</li> </ul> <p>The device is installed in the pipeline in such a way that it is potential-free.</p> <p>Using a ground cable (copper wire, min. 6 mm<sup>2</sup> (0.0093 in<sup>2</sup>)), only the two pipe flanges are connected. When doing so, the ground cable is mounted directly on the conductive flange coating using flange screws.</p> <p>Please note the following during installation:</p> <ul style="list-style-type: none"> <li>▪ The relevant regulations for potential-free installations must be observed.</li> <li>▪ There must <b>not</b> be an electrically conductive connection between the piping and the device.</li> <li>▪ The mounting material must be able to withstand the relevant torques.</li> </ul>	 <p>Fig. 47: Potential equalization and cathodic protection</p> <p>1 Isolation transformer power supply 2 Electrically isolated</p> <p style="text-align: right;">A0011896</p>

## 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 screws and screw covers must be firmly tightened.
- The cables used for connection must be of the specified external diameter → 14.1.
- 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. 48: Installation instructions, cable entries



### Caution!

Do not loosen the threaded fasteners of the sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.



### Note!

The Promag S sensor can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters). 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
Do the cables comply with the specifications?	PROFIBUS DP → 34 PROFIBUS PA → 35 Sensor cable → 42
Do the cables have adequate strain relief?	–
Is the cable type route completely isolated? Without loops and crossovers?	–
Are the power supply and fieldbus 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/potential equalization been correctly implemented?	→ 50
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 52
Are all housing covers installed and firmly tightened?	–
Electrical connection of PROFIBUS PA	Notes
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected with each other correctly?	–
Has each fieldbus segment been terminated at both ends with a bus terminator?	PROFIBUS DP → 65
Has the max. length of the fieldbus cable been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → 34 PROFIBUS PA → 35
Has the max. length of the spurs been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → 34 PROFIBUS PA → 35
Is the fieldbus cable fully shielded and correctly grounded?	→ 37

## 5 Operation

### 5.1 Quick operation guide


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

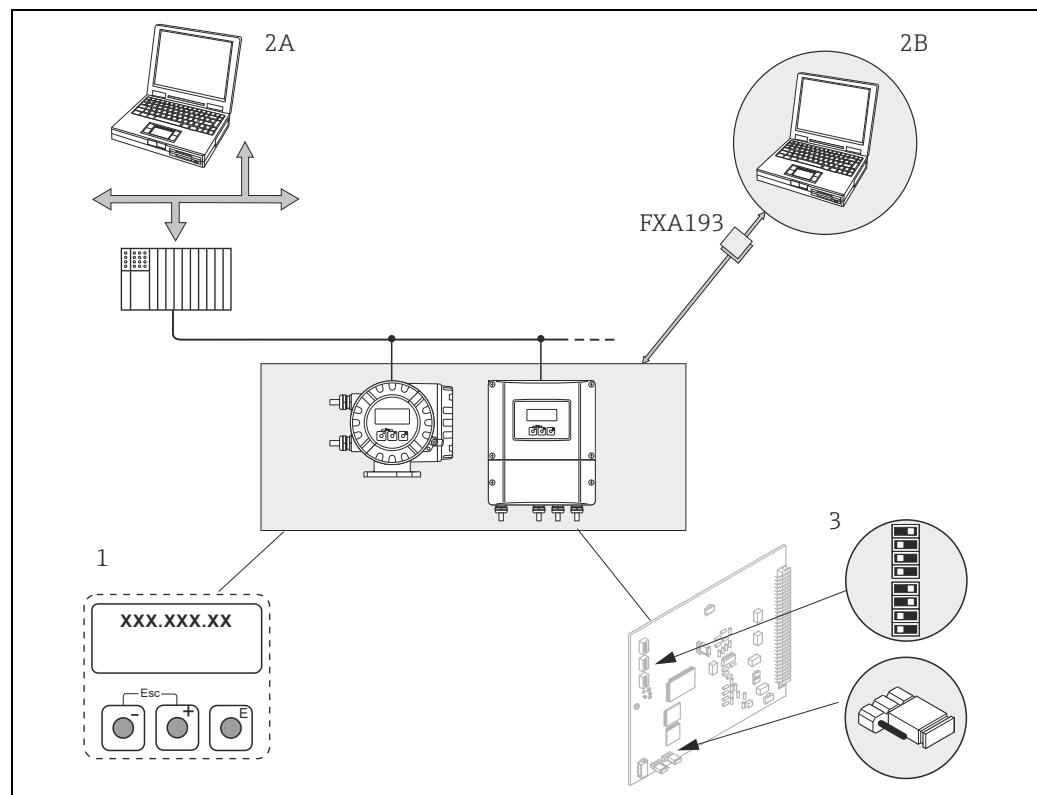
1. **Local display (option)** →  55  
The local display enables you to read all important variables directly at the measuring point, configure device-specific parameters in the field and perform commissioning.
2. **Operating programs** →  61  
The configuration of profile and device-specific parameters 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 →  63
  - PROFIBUS PA →  68

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 →  66.



A0001318

Fig. 49: 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 variables at will in order to customize the display to suit your needs and preferences (→ see the "Description of Device Functions" manual, BA00125D).

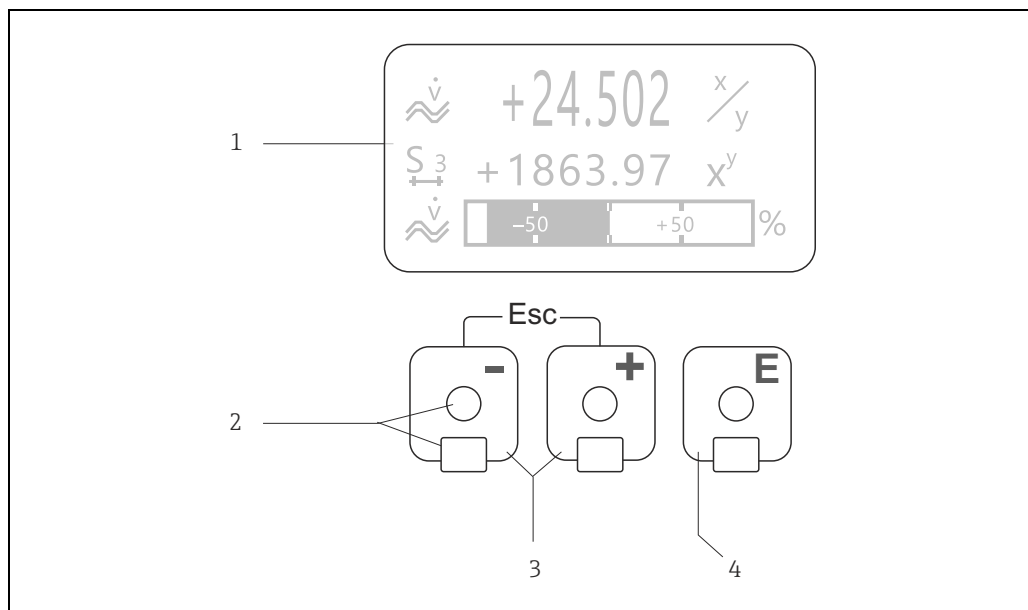


Fig. 50: Display and operating elements

- 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 variables at will in order to customize the display to suit your needs and preferences (→ see the "Description of Device Functions" manual, BA00125D).

#### 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 →  60.

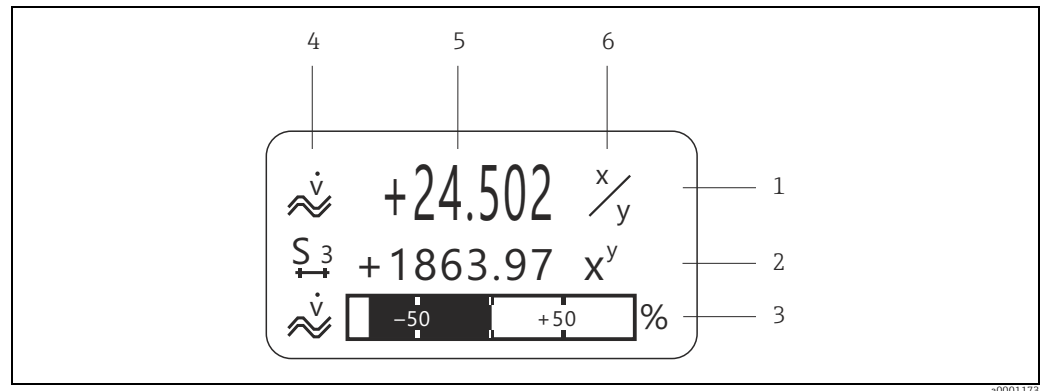




















Fig. 51: Typical display for normal operating mode (HOME position)

- 1 Main line shows main measured values, e.g. flow
- 2 Supplementary line shows supplementary measured or status variables, e.g. totalizer reading.
- 3 Information line shows additional information on measured or status variables, e.g. bar graph display of the full scale value achieved by the mass flow
- 4 "Info icons" field shows additional information in the form of icons on the measured values displayed. See →  57 for a full list of the icons and their meanings.
- 5 "Measured values" field shows the current measured values.
- 6 "Unit of measure" field shows the units of measure and time defined for the current measured values.



### 5.2.3 Icons

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

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
	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
 A0001187	Status input	 A0001182	Measuring mode: SYMMETRY (bidirectional)
 A0001183	Measuring mode: STANDARD	 A0001181	Measuring mode: PULSATING FLOW
 A0001188	Volume flow	 A0001195	Mass Flow
 A0001206	Acyclic communication via PROFIBUS active (e.g. via FieldCare)	← → (scrolling display)	Cyclic communication via PROFIBUS active, for example via PLC (Class 1 master)
 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	 A0002325	Output value OUT, Totalizer 1 to 3 (TOTAL module) with status 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 = uncertain
 A0004618	Output value OUT, Analog Input 1 to 2 (AI module) with status BAD	 A0002329	Output value OUT, Totalizer 1 to 3 (TOTAL module) with status BAD

### 5.3 Brief operating instructions for the function matrix



Note!

- See the general notes → 59
- Function descriptions → See the "Description of Device Functions" manual (BA00125D)

1. HOME position → → Entry into the function matrix.
2. → Select a block (e.g. USER INTERFACE) → .
3. → Select a group (e.g. CONTROL) → .
4. → Select a function group (e.g. BASIC CONFIGURATION) → .
5. Select a function (e.g. LANGUAGE) and change parameter/enter numerical values:
  - Select or enter release code, parameters, numerical values
  - Save entries
6. Exit the function matrix:
  - Press and hold down for longer than 3 seconds → HOME position
  - Repeatedly press → Return step by step to HOME position

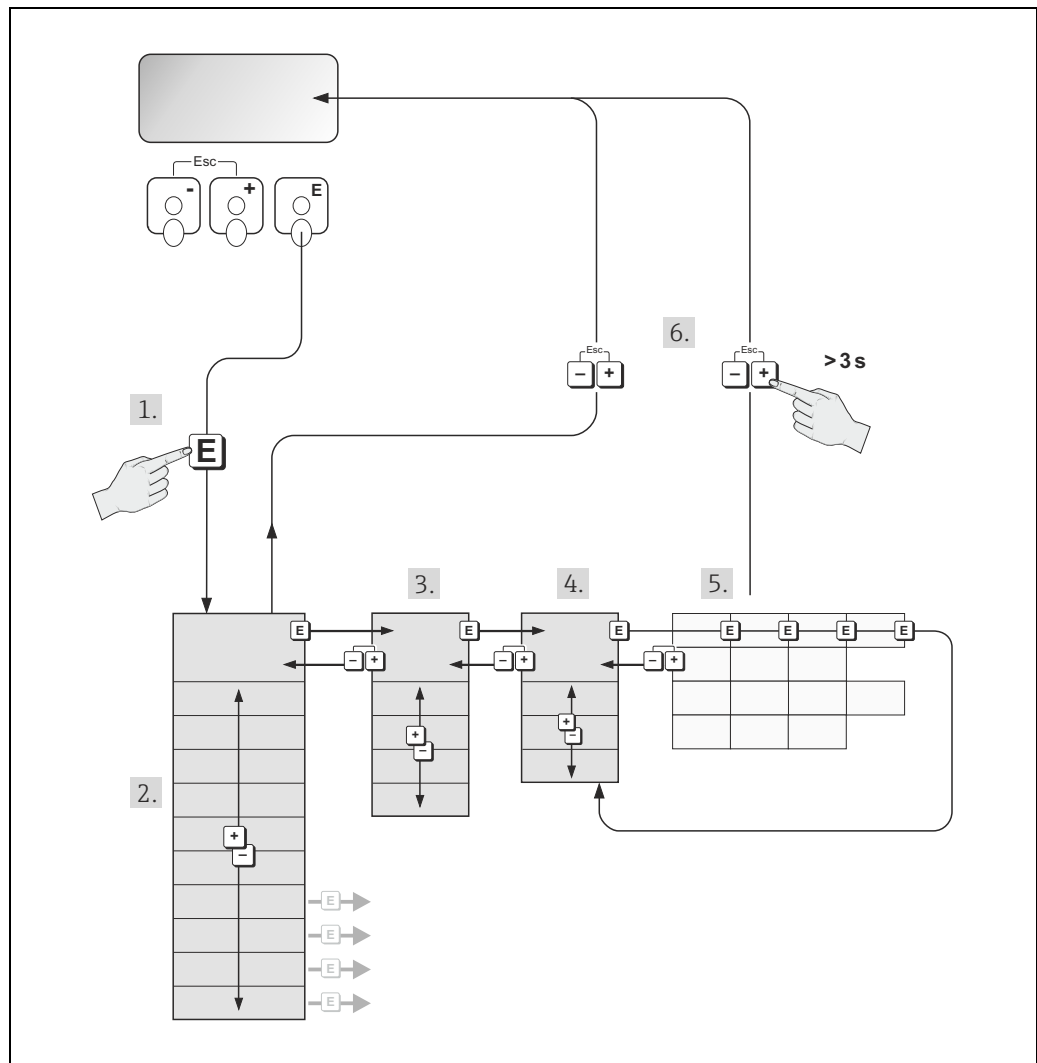



Fig. 52: Selecting functions and configuring parameters (function matrix)

A0001210

### 5.3.1 General notes

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

Comply with the following instructions when configuring functions:

- You select functions as described →  58.  
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 O / S to select "SURE | YES |" and press F to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is automatically disabled if you do not press a key within 60 seconds following automatic return to the HOME position.



Caution!

All functions are described in detail, including the function matrix itself, in the → Description of Device Functions manual (BA00125D), which is a separate part of these Operating Instructions.



Note!



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

### 5.3.2 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 = 55) has to be entered before settings can be changed.

If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ "Description of Device Functions" manual, BA00125D).

Comply with the following instructions when entering codes:

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



Caution!

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

### 5.3.3 Disabling the programming mode

Programming mode is disabled if you do not press a key within 60 seconds following automatic return to the HOME position.

You can also disable programming in the "ACCESS CODE" function by entering any number (other than the customer's code).

## 5.4 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 errors:** This group comprises all device errors, e.g. communication errors, hardware errors, etc. → ☰ 121.
- **Process errors:** This group comprises all application errors, e.g. inhomogeneous fluid, etc. → ☰ 131.

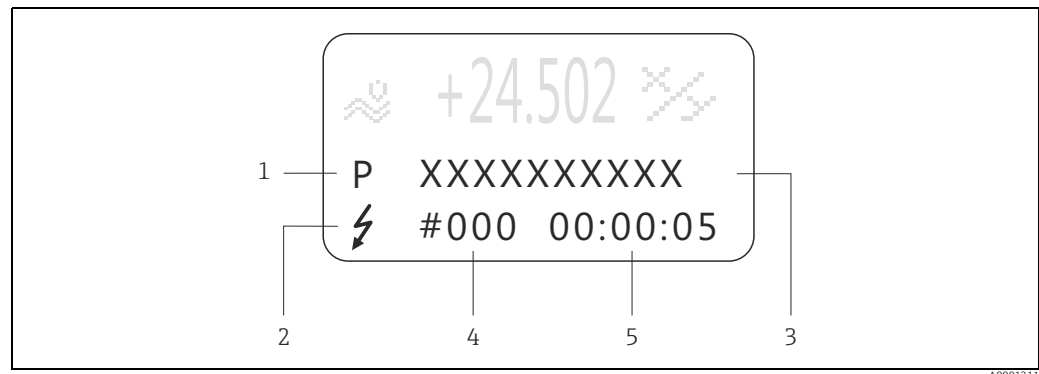


Fig. 53: Error messages on the display (example)

- 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

#### Error message type

The measuring device always assigns system and process errors which occur to two types of error messages (**fault** or **notice message**) resulting in different weightings → ☰ 119. 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.
- Displayed as → exclamation mark (!), error type (S: system error, P: process error).
- Displaying the device status on PROFIBUS DP/PA → ☰ 121.

#### Fault message (⚡)

- The error in question interrupts or stops the current operation.
- Displayed as → lightning flash (⚡), error type (S: system error, P: process error).
- Displaying the device status on PROFIBUS DP/PA → ☰ 121.



#### 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

### 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 flowmeters 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 description files for operating programs

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

#### PROFIBUS DP


<b>Valid for device software:</b>	3.06.XX	→ DEVICE SOFTWARE function (8100)
<b>Device data PROFIBUS PA:</b>		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promag 53/55 ID No.:	1526 (Hex)	→ DEVICE ID function (6162)
Profile ID No.:	9741 (Hex)	
<b>GSD file information:</b>		
Promag 53/55 GSD file:	Extended Format (recommended): Standard Format:	eh3x1526.gsd eh3_1526.gsd
	 <b>Note!</b> Before configuring the PROFIBUS network, read and follow the information for using the GSD file → 89.	
Profile GSD file:	PA139741.gsd	
Bitmaps:	EH_1526_d.bmp/.dib EH_1526_n.bmp/.dib EH_1526_s.bmp/.dib	
Software release:	06.2010	
Operating program/device description:	Sources for obtaining device descriptions/program updates:	
Promag 53/55 GSD file:	<ul style="list-style-type: none"> <li>■ www.endress.com → Download</li> <li>■ www.profibus.com</li> <li>■ CD-ROM (Endress+Hauser order number: 56003894)</li> </ul>	
FieldCare / DTM	<ul style="list-style-type: none"> <li>■ www.endress.com → Download</li> <li>■ CD-ROM (Endress+Hauser order number 56004088)</li> <li>■ DVD (Endress+Hauser order number 70100690)</li> </ul>	
SIMATIC PDM	www.endress.com → Download	
<b>Tester/simulator:</b>	<b>How to acquire:</b>	
Fieldcheck	<ul style="list-style-type: none"> <li>■ Update by means of FieldCare with the Flow Communication FXA193/291 DTM in the Fieldflash Module</li> </ul>	



#### 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**

<b>Valid for device software:</b>	3.06.XX	→ DEVICE SOFTWARE function (8100)
<b>Device data PROFIBUS PA:</b>		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promag 53/55 ID No.:	1527 (Hex)	→ DEVICE ID function (6162)
Profile ID No.:	9741 (Hex)	
<b>GSD file information:</b>		
Promag 53/55 GSD file:	Extended Format (recommended): Standard Format:	eh3x1527.gsd eh3_1527.gsd
	 <b>Note!</b>	
	Before configuring the PROFIBUS network, read and follow the information for using the GSD file → 89.	
Profile GSD file:	PA139741.gsd	
Bitmaps:	EH_1527_d.bmp/.dib EH_1527_n.bmp/.dib EH_1527_s.bmp/.dib	
Software release:	06.2010	
<b>Operating program/device description:</b>	<b>Sources for obtaining device descriptions/program updates:</b>	
Promag 53/55 GSD file:	<ul style="list-style-type: none"> <li>▪ www.endress.com → Download</li> <li>▪ www.profibus.com</li> <li>▪ CD-ROM (Endress+Hauser order number: 56003894)</li> </ul>	
FieldCare / DTM	<ul style="list-style-type: none"> <li>▪ www.endress.com → Download</li> <li>▪ CD-ROM (Endress+Hauser order number 56004088)</li> <li>▪ DVD (Endress+Hauser order number 70100690)</li> </ul>	
SIMATIC PDM	www.endress.com → Download	
<b>Tester/simulator:</b>	<b>How to acquire:</b>	
Fieldcheck	<ul style="list-style-type: none"> <li>▪ Update by means of FieldCare with the Flow Communication FXA193/291 DTM in the Fieldflash Module</li> </ul>	



**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 → 135.
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

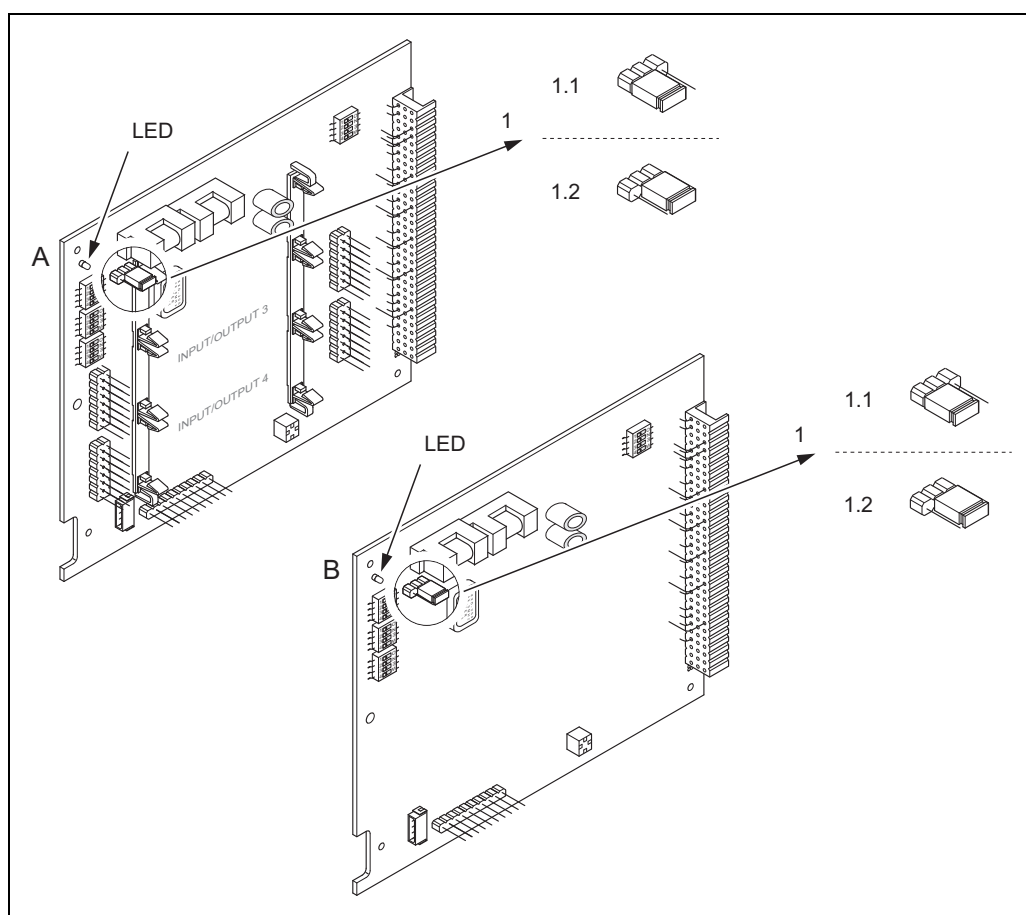


Fig. 54: Switching write protection on and off with the aid of a jumper on the I/O board

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 → 119

### 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 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 securing clamp with an Allen key (3 mm / 0.12 in).
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.

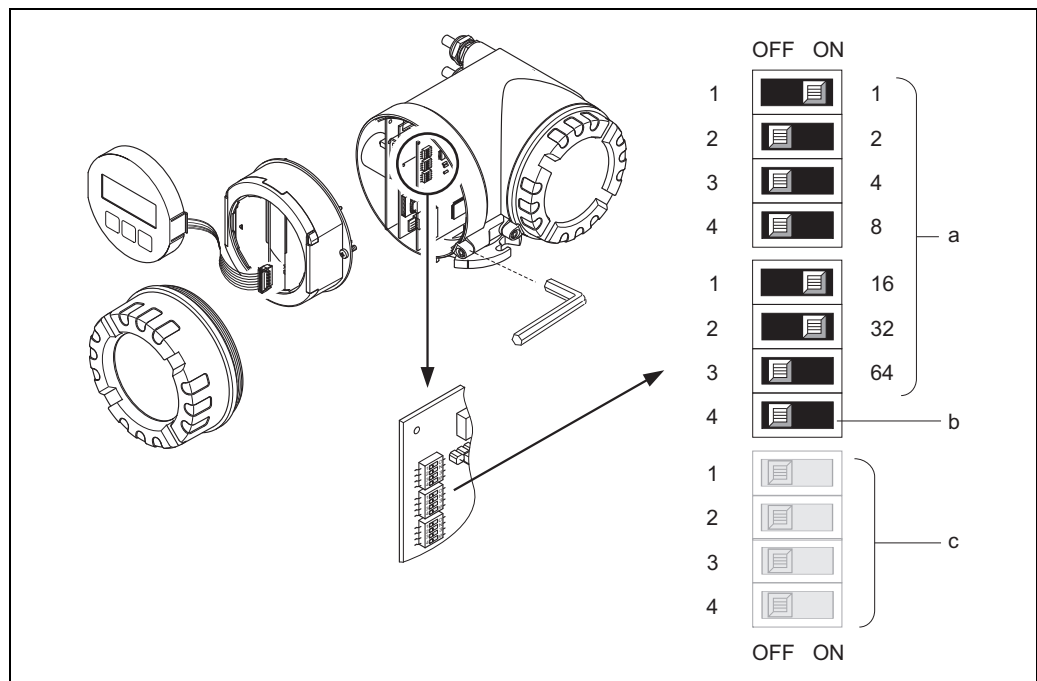


Fig. 55: Addressing with the aid of miniature switches on the I/O board

- 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 data 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. → 46.

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

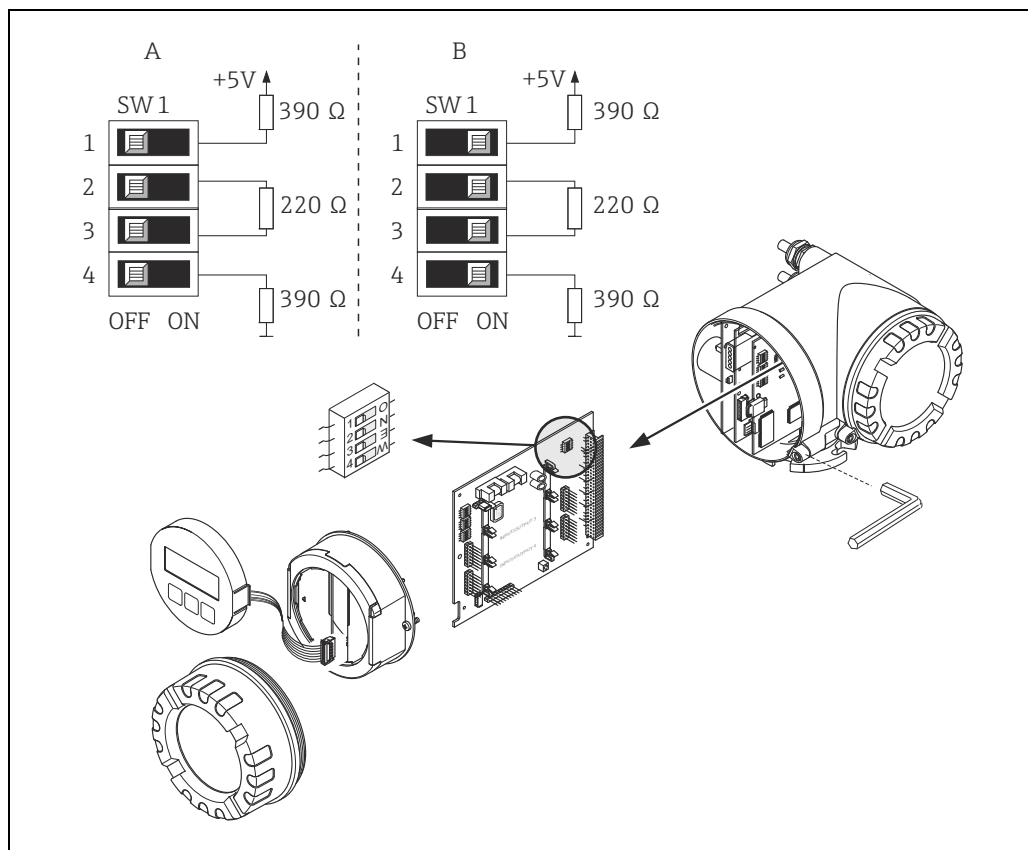


Fig. 56: Configuring the terminating resistors (for baud rates < 1.5 MBaud)

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 → 135.
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.

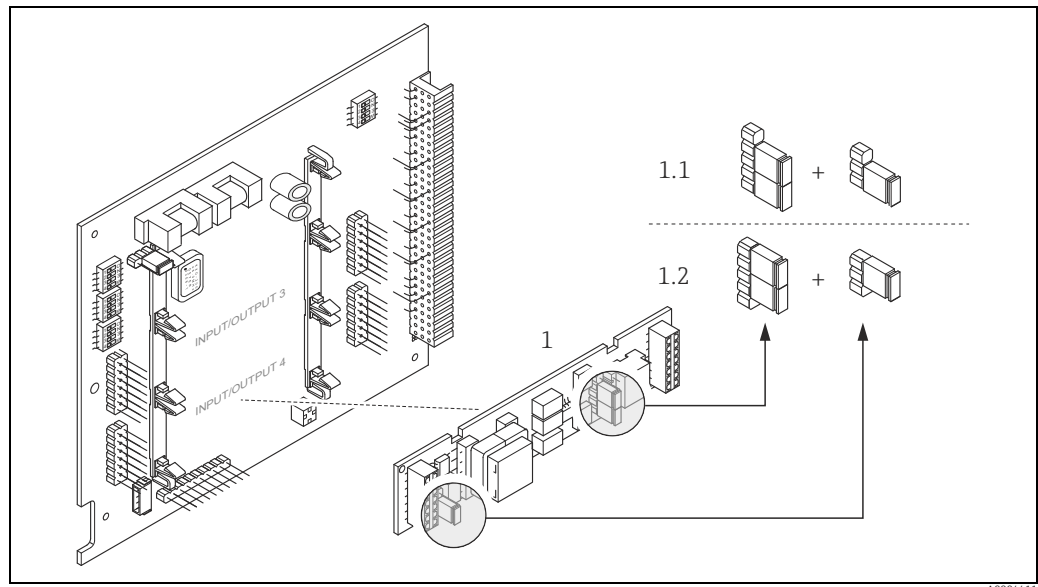


Fig. 57: Configuring the current input with the aid of jumpers (I/O board)

- |     |                                 |
|-----|---------------------------------|
| 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 → 135.
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.

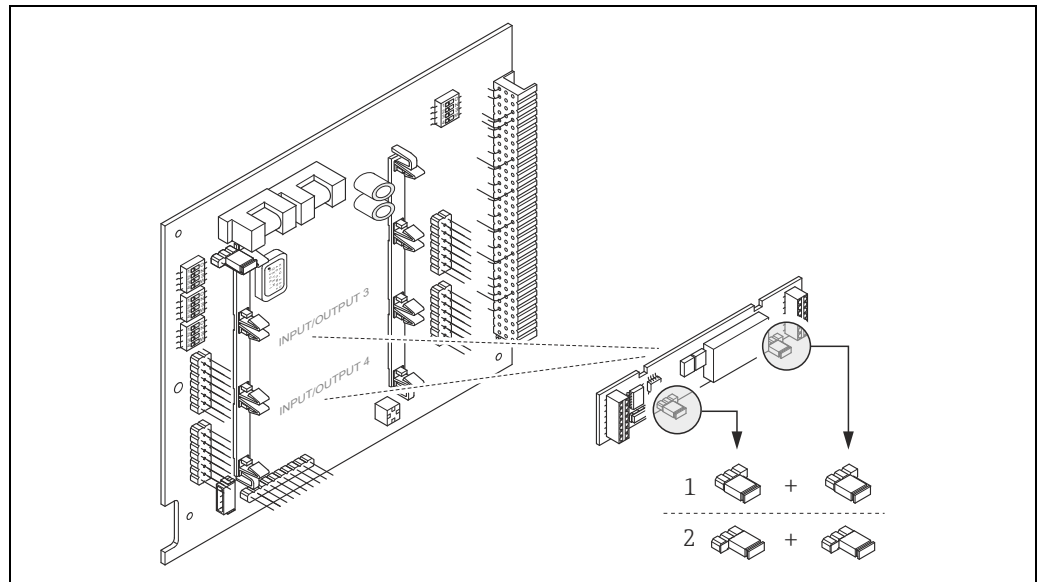


Fig. 58: Configuring relay contacts (NC/NO) on the convertible I/O board (submodule) with the help of jumpers.

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

## 5.7 PROFIBUS PA hardware 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 → 135.
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

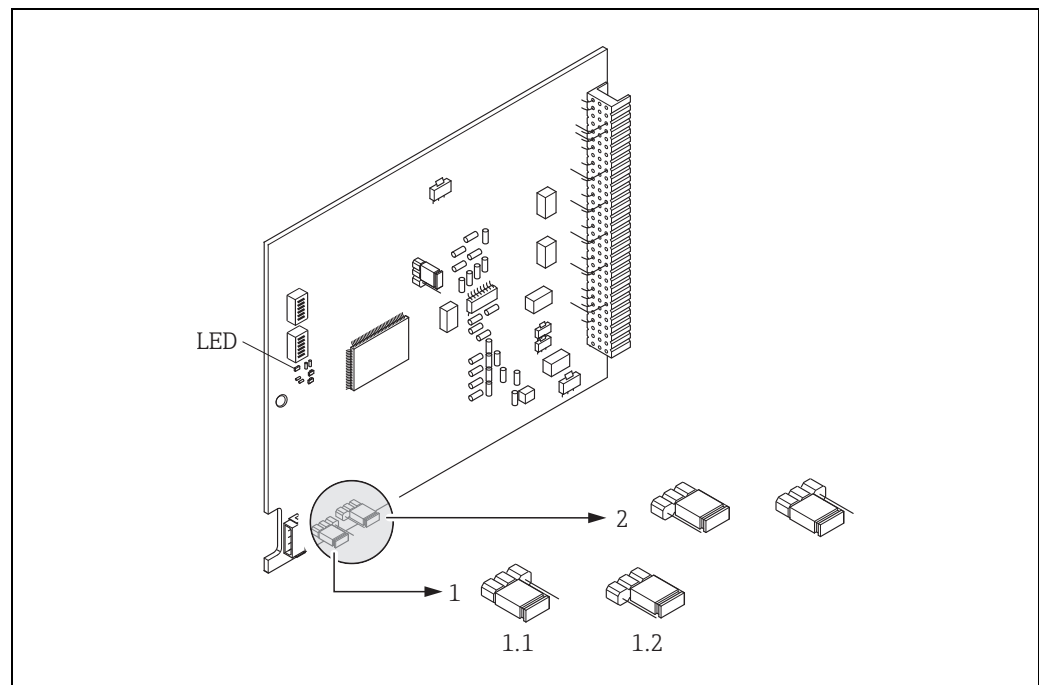


Fig. 59: Switching write protection on and off with the aid of a jumper on the I/O board

- 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 → 119

### 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 securing clamp with an Allen key (3 mm / 0.12 in).
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.

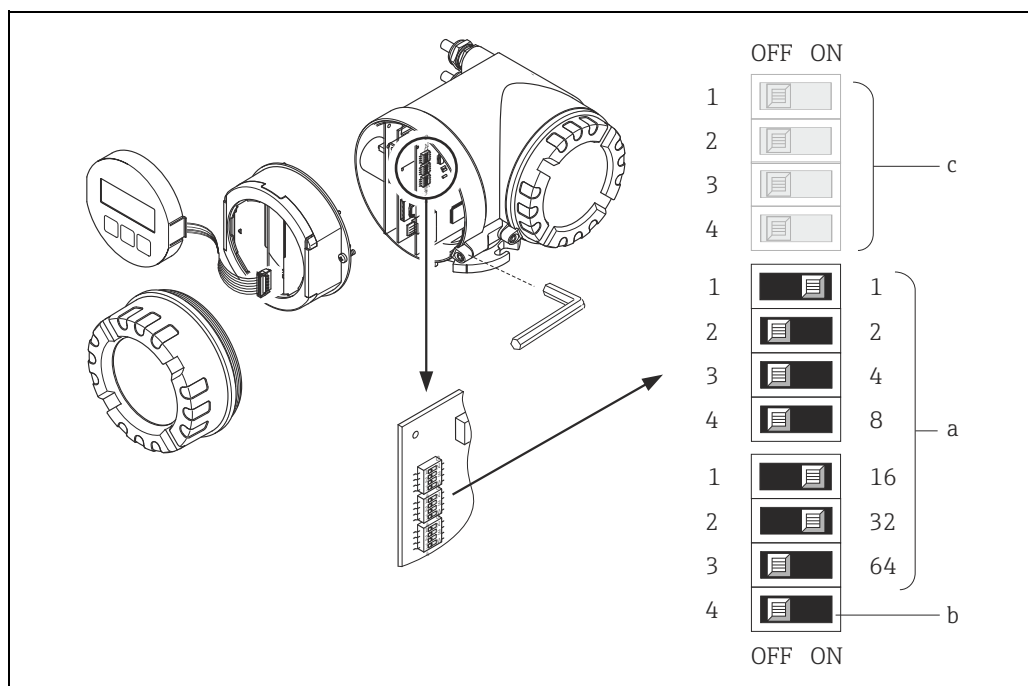


Fig. 60: Addressing with the aid of miniature switches on the I/O board

- 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" →  33
- Checklist for "Post-connection check" →  53



Note!

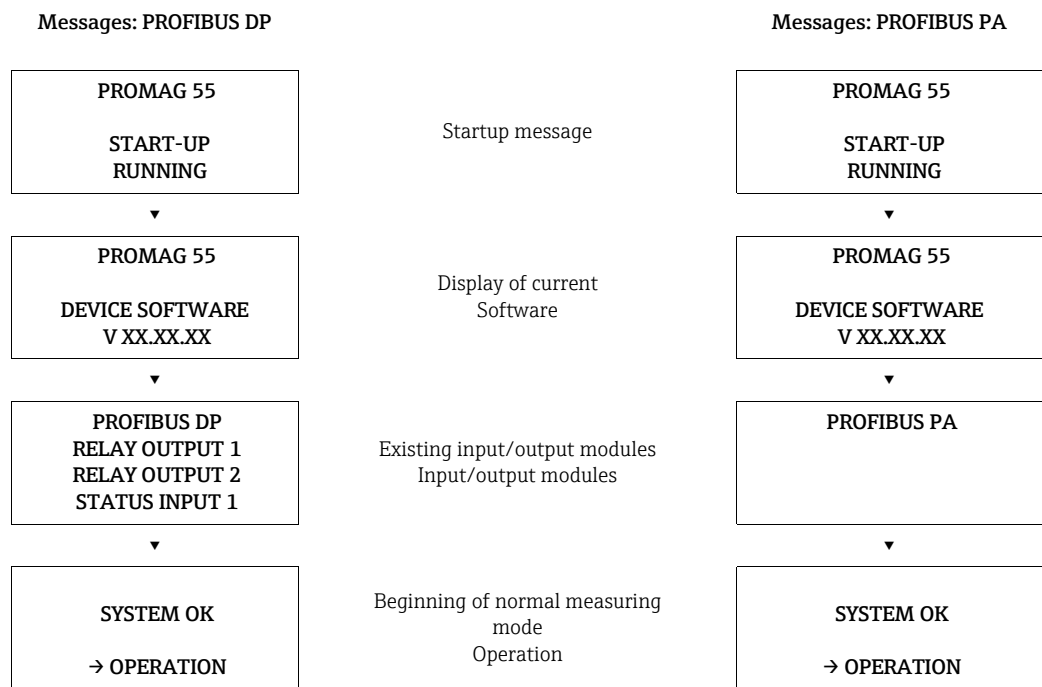
When using PROFIBUS PA, please note the following:

- 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 connection checks have been successfully completed, it is time to switch on the power supply. The device is now operational.

The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:



Normal measuring mode commences as soon as startup completes.

Various measured value and/or status variables appear on the display (HOME position).



Note!

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

### 6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured 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"

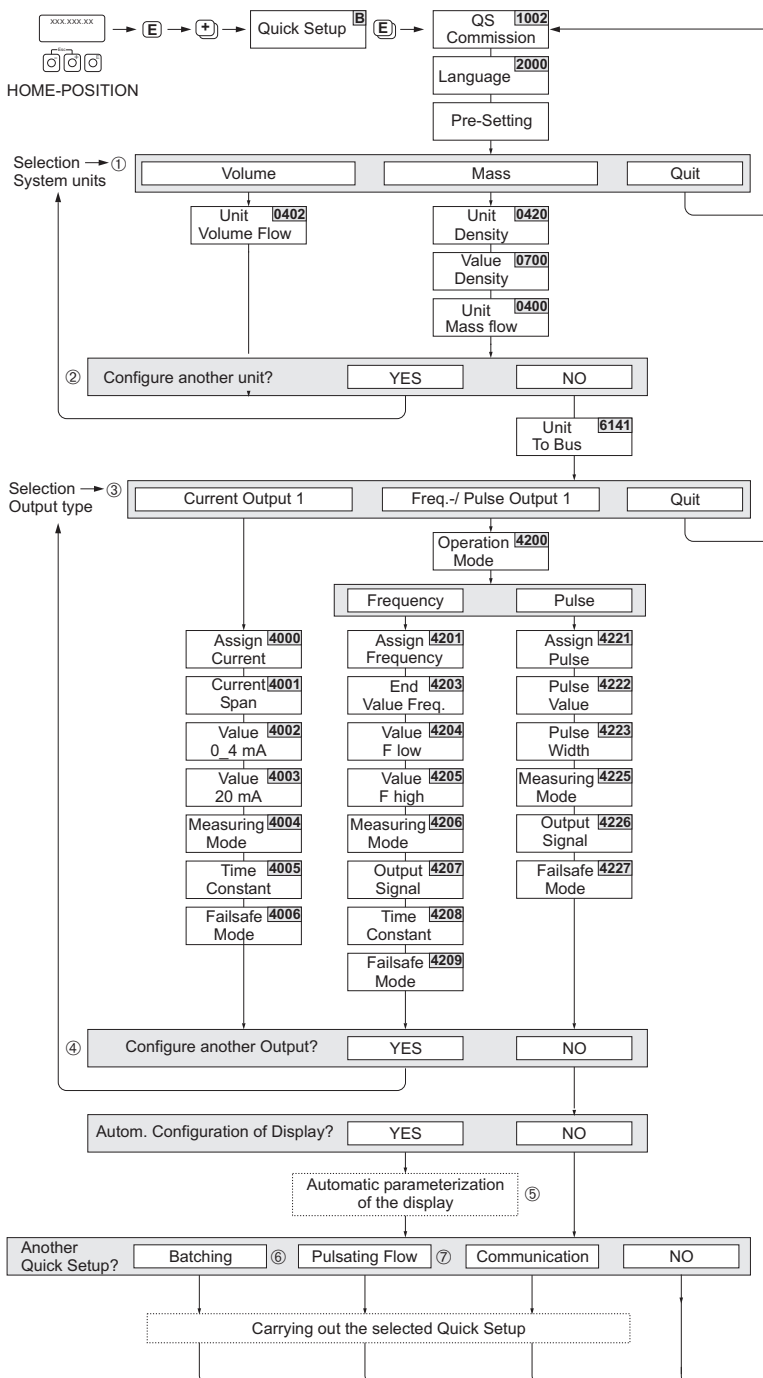


Fig. 61: Quick Setup for straightforward commissioning

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## Note!

- The display returns to the cell SETUP COMMISSIONING (1002) if you press the ESC key combination during parameter interrogation. The stored parameters remain valid.
- The "Commissioning" Quick Setup must be carried out before any of the other Quick Setups described in these Operating Instructions are 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 Conditions
  - 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 → 71.

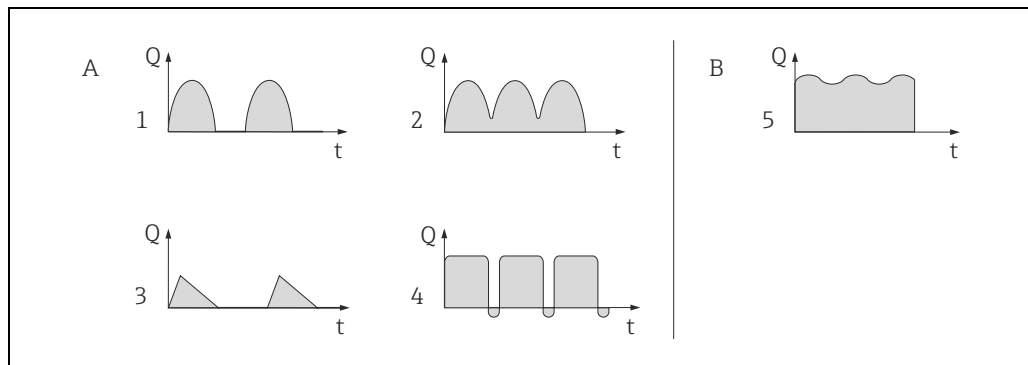


Fig. 62: Flow characteristics of various types of pump

- A With severely pulsating flow
- B With low pulsating flow
- 1 1-cylinder cam pump
- 2 2-cylinder cam pump
- 3 Magnetic pump
- 4 Peristaltic pump, flexible connecting hose
- 5 Multi-cylinder reciprocating pump

#### Severely pulsating flow

Once several device functions have been configured in the "Pulsating flow" Quick Setup menu, flow fluctuations 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.

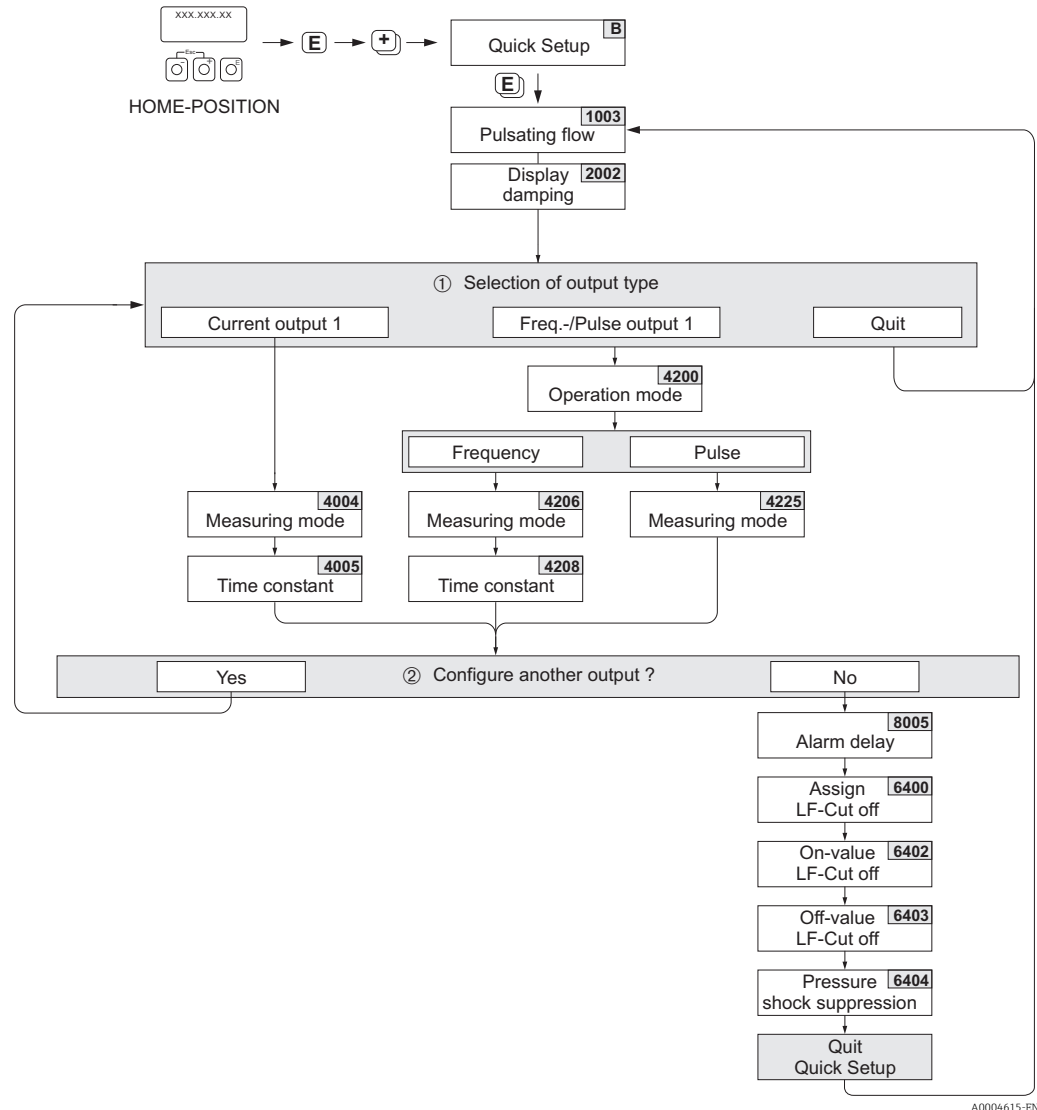


Fig. 63: Quick Setup for measuring severely pulsating flows.  
Recommended settings: see next page.

- 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 PULSATING FLOW QUICK SETUP (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 PULSATING FLOW QUICK SETUP (1003).

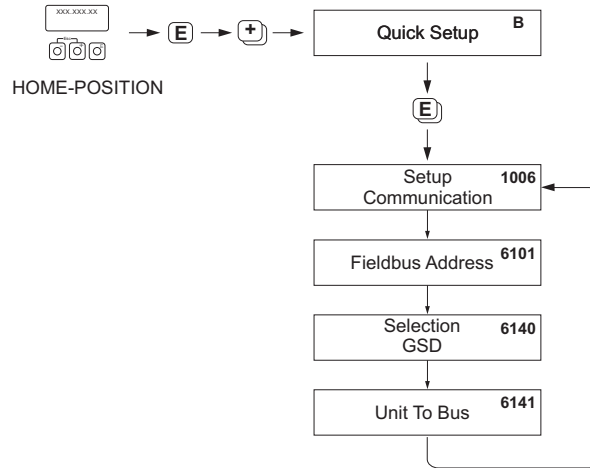
Quick Setup "Pulsating Flow"		
HOME position →  → MEASURAND →  → QUICK SETUP →  → PULSATING FLOW QS (1003)		
Function No.	Function name	Selection with To the next function with
1003	QS PULS. FLOW	YES After  is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions 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:  On-value $\approx \frac{\text{max. full scale (per DN)}^*}{1000}$  <small>*Full scale values →  17</small>
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s

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

### 6.3.3 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 Quick Setup "Communication". The following table explains the parameter configuration options in more detail.



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Fig. 64: Quick Setup communication

Quick Setup "Communication"		
HOME position →  → MEASURED VARIABLE (A)		
MEASURED VARIABLE →  → QUICK SETUP (B)		
QUICK SETUP →  → QUICK SETUP COMMUNICATION (1006)		
Function No.	Function name	Setting to be selected (  ) (to next function with  )
1006	QUICK SETUP COMMUNICATION	YES → After  is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
6101	BUS ADDRESS	Enter the device address (permitted address range: 1 to 126)  <b>Factory setting:</b> 126

Quick Setup "Communication"		
6140	SELECTION GSD	<p>Select the operating mode (GSD file) which should be used for cyclic communication with the PROFIBUS master (Class 1).</p> <p>Options:                      MANUFACT. SPEC. → The measuring device is operated in the manufacturer-specific mode.                      MANUFACT V2.0 → The device is used as the replacement for the previous Promag 35 model (compatibility mode).                      PROFILE-GSD → The measuring device is operated in the PROFIBUS Profile mode.</p> <p><b>Factory setting:</b>                      MANUFACT. SPEC.</p> <p> <b>Note!</b>                      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: → 89.</p>
6141	SET UNIT TO BUS	<p>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.</p> <p><b>Options:</b>                      OFF                      SET UNITS (transmission is started by pressing  key)</p> <p> <b>Caution!</b>                      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.</p>
▼		
<p>Back to the HOME position:                      → Press and hold down Esc keys  for longer than three seconds or                      → Repeatedly press and release Esc keys  → Exit the function matrix step by step</p>		

### 6.3.4 Data backup/transmission

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

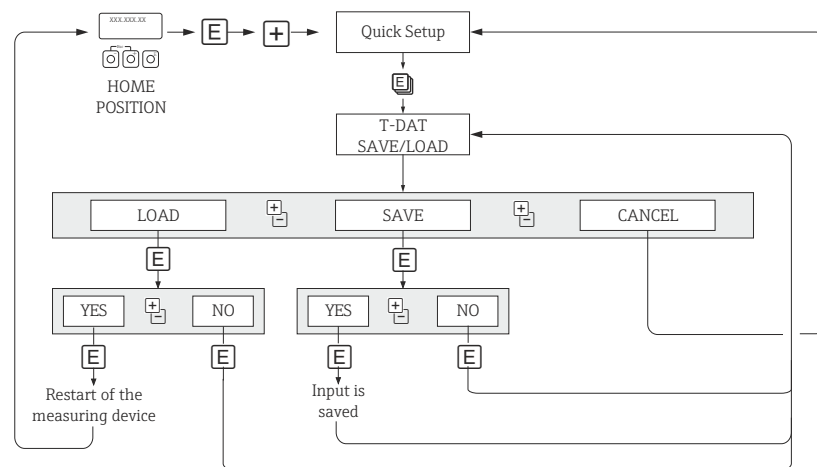
This is required in the following instances:

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



Note!

For information on installing and removing the T-DAT → 135.



A0001221-EN

Fig. 65: Data backup/transmission with T-DAT SAVE/LOAD function

Information on the LOAD and SAVE options available:

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



Note!

- Any settings already saved on the EEPROM are deleted.
- This option is only available, if the T-DAT contains valid data.
- This selection can be made only 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 the restart and the LOAD function is subsequently no longer available.


SAVE:

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

## 6.4 Configuration


### 6.4.1 Measuring solids content flow

In certain industrial sectors, raw materials which are very inhomogeneous or which contain considerable amounts of solids, are transported and processed on a daily basis. Ore slurry, mortar or thick pastes are only some examples of this. However, for flow measurement in the mining industry or, for example, in applications using pump dredgers, it is often not just the volume flow in a pipe which is of interest but also the proportion of solid matter being carried along.

To record this solids flow, an electromagnetic flow measurement is usually combined with a radiometric density measurement (total fluid density). If the total fluid density, solid density (target fluid) and the density of the transport liquid (carrier fluid) are known, e.g. as a result of laboratory tests, both the volume flow and mass flow can be calculated in addition to the proportion of individual components in mass, volume or percentage units (→  66).

#### Solids flow measurements using Promag 55

Promag 55S uses special functions to calculate solids flow. The following preconditions must be met:

- Software option "Solids content flow" (F-CHIP)
- DISPLAY\_VALUE - Option 2 →  99
- A density meter, e.g. "Gammapiilot M" from Endress+Hauser, for recording total fluid density (i.e. including solids)
- Knowledge of solid density e.g. resulting from laboratory tests
- Knowledge of transport fluid's density, e.g. as a result of laboratory tests or based on tables (e.g. for water at 22 °C)

The following process variables can be calculated using Promag 55 and made available as an output signal:

- Volume flow total fluid (transport liquid + solids)
- Volume flow carrier fluid (transport liquid: e.g. water)
- Volume flow target fluid (solids transported: e.g. stone, sand, lime powder, etc.)
- Mass flow total fluid
- Mass flow carrier fluid
- Mass flow target fluid
- Percentage (%) of carrier fluid (volume or mass)
- Percentage (%) of target fluid (volume or mass)

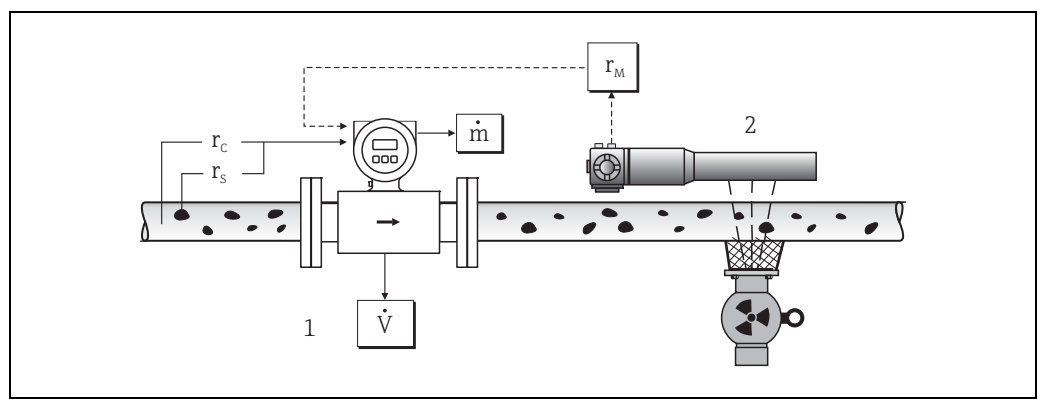


Fig. 66: Solids content flow measurement ( $\dot{m}$ ) with the aid of a density and flow measuring device. If the solid density ( $\rho_S$ ) and the density of the carrier liquid ( $\rho_C$ ) are also known, they can be used to calculate the solids flow.

- 1 Flow measuring device (Promag 55S) → volume flow ( $\dot{V}$ ). The solid density ( $\rho_S$ ) and the density of the transport liquid ( $\rho_C$ ) must be entered in the transmitter.
- 2 Density measuring device (e.g. "Gammapiilot M") → total fluid density ( $\rho_M$ ) (transport liquid and solids)

**Calculation formula (example)**

The mass flow of the target fluid is calculated as follows:

$$m_Z = V \cdot (\rho_M - \rho_C) / (1 - \rho_C / \rho_S)$$

$m_Z$  = Mass flow target fluid (solids), e.g. in kg/h

$V$  = Volume flow (total fluid), e.g. in m<sup>3</sup>/h

$\rho_C$  = Density of carrier fluid (transport liquid: e.g. water)

$\rho_S$  = Density of target fluid (solids transported: e.g. stone, sand, lime powder, etc.)

$\rho_M$  = Total fluid density

**Configuration of the "Solids content flow" function**

Please note the following points when commissioning the solids content flow function:

1. Make sure that the settings in the following functions for the flowmeter and the external density meter are identical:
  - UNIT DENSITY (0420)
2. Then enter the following density values:
  - SPECIAL FUNCTIONS > SOLID CONTENT FLOW > CONFIGURATION > CARRIER DENSITY (7711) and TARGET MAT. DENSITY (7712)
3. Enter the desired density unit:
  - MEASURED VARIABLES > SYSTEM UNITS > ADDITIONAL CONFIGURATION > UNIT DENSITY (0420)
4. If necessary, assign the appropriate solids flow measured variables to a display line or an analog input function block. For process control you can also assign user-definable limit values to the solids flow (→ see the following examples).

**Case study 1:**

You wish to configure the totalizer for totalizing the complete solid mass flow (e.g. in tons).

1. Open the ASSIGN function of the totalizer (> TOTALIZER > CONFIGURATION > ASSIGN).
2. Assign the TARGET MASS FLOW variable to the totalizer.


**Case study 2:**

You would like to issue a warning message via the relay if the solids flow exceeds 60% of the total mass flow (transport liquid + solids).

1. Open the ASSIGN function of the relay output (> OUTPUTS > RELAY OUTPUT > CONFIGURATION > ASSIGN)
2. To do so, assign the LIMIT TARGET MASS FLOW % variable to the relay output.
3. Then, you can use the ON- or OFF-VALUE function to enter the desired percentage value (%) for the maximum permitted solids flow (e.g. switch on if solid content is 65%; switch off if solid content is 55%).



### 6.4.2 Advanced diagnostic functions

With the aid of the optional software package "Advanced Diagnostics" (F-CHIP, accessories →  117), changes in the measuring system can be detected early on, e.g. as a result of build-up (coating) or corrosion at the measuring electrodes. Such factors cause a reduction in accuracy under normal circumstances, or cause system errors in extreme cases. With the aid of diagnostic functions it is possible to record different diagnostic parameters during operation – e.g. electrode potential of measuring electrodes 1 and 2, decay time of test pulses at electrodes 1 and 2 (as a measure of possible build-up) etc. By analyzing general trends in these measuring values, deviations in the measuring system relative to a "reference condition" can be detected early on, and the necessary measures can be taken.



Note!

\*Further information on this can be found in the "Description of Device Functions" manual.BA00125D

#### Reference values as a basis for the analysis of general trends

In order to analyze general trends, reference values for the appropriate diagnostic parameters are required. These values must be obtained under reproducible and constant conditions. Such reference values are first recorded during factory calibration and stored in the device.

However, reference data should also be collected under customized process conditions, e.g. during commissioning or immediately afterwards. The reference values are always recorded and saved in the measuring system via the REFERENCE STATUS USER (7501) function.



Caution!

It is not possible to analyze general trends in diagnostic parameters without reference values. Reference values should always be obtained immediately after commissioning. This ensures that the reference values saved are values pertaining to the "original condition" of the measuring system i.e. without the influence of any build-up or corrosion.

#### Type of data collection

Diagnostic parameters can be recorded in two different ways which you can set using the ACQUISITION MODE (7510) function:

- Selection PERIODICAL: Data acquisition is performed periodically by the device. The ACQUISITION PERIOD (7511) function is used to enter the desired time interval.
- Selection MANUAL: Data is collected manually by the user at any chosen points in time.



Note!

The last 10 (via display) or 100 (via FieldCare with the Flow Communication FXA193/291 DTM and Fieldsafe Module) recorded diagnostic parameter values are saved chronologically in the measuring system. The "history" of these parameter values can be retrieved using the following functions:

Diagnostic parameters of the function groups*	Saved data records (for each diagnostic parameter)
COATING 1 COATING 2 ELECTRODE POTENTIAL 1 ELECTRODE POTENTIAL 2 VOLUME FLOW NOISE VALUE	Reference value → REFERENCE VALUE function Actual value → ACTUAL VALUE function Lowest measured value → MINIMUM VALUE function Highest measured value → MAXIMUM VALUE function List of the last 10 (or 100) measured values → HISTORY function Measured/reference value deviation → ACTUAL DEVIATION function
*Further information on this can be found in the "Description of Device Functions" manual.	

### Triggering warning messages

A limit value may be assigned to all diagnostic parameters if necessary. If this limit value is exceeded, a warning message is triggered → WARNING MODE function (7503).

The limit value is entered into the measuring system as an absolute (+/-) or relative deviation compared to the reference value → WARNING function (75...).

Deviations which occur and which are recorded by the measuring system can also be output via the current or relay outputs.

### Data interpretation

The interpretation of the data recorded by the measuring system depends greatly on the application in question. This requires an exact knowledge of the process conditions and the associated deviation tolerances in the process which must be determined individually by the user.

For example, to apply the limit value function (ACTUAL DEVIATION), a knowledge of the permitted minimum and maximum deviation tolerances is particularly important.

Otherwise, there is a risk that a warning message could be triggered unintentionally in the event of "normal" process fluctuations.

Deviations from the reference condition may be caused by different factors. The following table shows examples and notes for each of the six recorded diagnostic parameters:

Function group (diagnostic parameters)	Possible causes in the event of deviations from the reference value
COATING 1	A deviation from the reference value may be caused by the following: <ul style="list-style-type: none"> <li>■ Build-up on measuring electrode 1</li> <li>■ Electrical outage</li> <li>■ Short-circuit</li> </ul>
COATING 2	A deviation from the reference value may be caused by the following: <ul style="list-style-type: none"> <li>■ Build-up on measuring electrode 2</li> <li>■ Electrical outage</li> <li>■ Short-circuit</li> </ul>
ELECTRODE POTENTIAL 1	A change in the electrode potential may be caused by the following: <ul style="list-style-type: none"> <li>■ Corrosion at measuring electrode 1</li> <li>■ Greater pH fluctuations in the fluid</li> <li>■ Presence of air bubbles at measuring electrode 1</li> <li>■ Mechanical shock effect on the measuring electrode due to solids</li> <li>■ Electrical outage</li> <li>■ Short-circuit</li> </ul>
ELECTRODE POTENTIAL 2	A change in the electrode potential may be caused by the following: <ul style="list-style-type: none"> <li>■ Corrosion at measuring electrode 2</li> <li>■ Greater pH fluctuations in the fluid</li> <li>■ Presence of air bubbles at measuring electrode 2</li> <li>■ Mechanical shock effect on the measuring electrode due to solids</li> <li>■ Electrical outage</li> <li>■ Short-circuit</li> </ul>
VOLUME FLOW	The volume flow is additional information that is needed to assess the other diagnostic parameters sufficiently.
NOISE VALUE	A change in the noise value may be caused by the following: <ul style="list-style-type: none"> <li>■ Corrosion at the measuring or reference electrode</li> <li>■ Presence of air bubbles</li> <li>■ Mechanical shock effect on the measuring electrodes due to solids</li> </ul>



#### Note!

To assess possible build-up, the diagnostic parameters of the COATING 1 and COATING 2 function groups should be interpreted only in combination with those of ELECTRODE POTENTIAL 1 and 2 and VOLUME FLOW. As build-up typically develops over a period of months, it is useful to present and analyze the relevant measurement data and parameters using appropriate software, for example using the Endress+Hauser software packages FieldCare with the Flow Communication FXA193/291 DTM and Fieldsafe Module.

## 6.5 Commissioning the PROFIBUS interface



Note!

- All functions required for commissioning are described in detail in the "Description of Device Functions" → manual (BA00125D) which is a separate part of these Operating Instructions.
- A code (factory setting: 55) must be entered to change device functions, numerical values or factory settings → 59.

### 6.5.1 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 → 63.

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 → 64

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 SET 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 totalizers 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
<b>The following measured variables are available when the additional "solids flow" software is installed in the device (order option)</b>	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
<b>The following measured variables are available when the additional "advanced diagnostic" software is installed (order option)</b>	
DEVIATION COATING 1	2341
DEVIATION COATING 2	2358
DEVIATION ELECTRODE POTENTIAL 1	2375
DEVIATION ELECTRODE POTENTIAL 2	2392
DEVIATION VOLUME FLOW	2419
DEVIATION NOISE VALUE	2443
 <b>Note!</b> 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 → 96.	

### 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, during 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 →  96.

- 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 components
  - POSITIVE: calculates the positive flow components
  - NEGATIVE: calculates the negative flow components
  - HOLD VALUE: the totalizer remains at the last value


 **Note!**


For the calculation of the positive and negative flow components (BALANCE) or the negative flow components only (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 →  89.

### 9. Configuration of cyclic data transmission in the PROFIBUS master:


A detailed description of the cyclic data transmission is contained on →  93.

## 6.5.2 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" operating program).

 Note!

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

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → WRITE PROTECT (6102) → One of the following options is displayed:

- OFF (factory setting) = write access via PROFIBUS possible
- ON = write access via PROFIBUS not possible

Deactivate the write protection if necessary →  68.

### 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/operating program:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → FIELDBUS ADDRESS (6101)

Hardware addressing via miniature switches →  69.


### 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 SET 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 totalizers 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. 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 PA (GCA) → 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
<b>The following measured variables are available when the additional "solids flow" software is installed in the device (order option)</b>	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
<b>The following measured variables are available when the additional "advanced diagnostic" software is installed (order option)</b>	
DEVIATION COATING 1	2341
DEVIATION COATING 2	2358
DEVIATION ELECTRODE POTENTIAL 1	2375
DEVIATION ELECTRODE POTENTIAL 2	2392
DEVIATION VOLUME FLOW	2419
DEVIATION NOISE VALUE	2443
 <b>Note!</b> 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 → 96.	

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. Mass 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 the option MASS FLOW.

Possible settings → See following table

- 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 TOT (6135) → Select the option TOTALIZE
- Set the totalizer mode:  
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → TOTALIZER MODE (6137) → Select one of the following options:
  - BALANCE (factory setting): calculates the positive and negative flow components
  - POSITIVE: calculates the positive flow components
  - NEGATIVE: calculates the negative flow components
  - HOLD VALUE: the totalizer remains at the last value


 **Note!**

For the calculation of the positive and negative flow components (BALANCE) or the negative flow components only (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).

*Possible settings:*

Totalizer value/measured variable	ID for CHANNEL function
VOLUME FLOW (factory setting Totalizers 1 to 3)	273
MASS FLOW	277
OFF	0

 **Note!**


If, during 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 →  96.


## 8. Select the operating mode

Select the operating mode (GSD file) which should be used for cyclic communication with the PROFIBUS master (Class 1).


BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → SELECTION GSD (6140) → Select:

- MANUFACT. SPEC. (factory setting) The complete device functionality is available.
- MANUFACT V2.0 The device is used as the replacement for the previous Promag 35 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 →  89.

## 9. Configuration of cyclic data transmission in the PROFIBUS master

A detailed description of the cyclic data transmission is contained on →  93.



## 6.6 PROFIBUS DP/PA system integration

### 6.6.1 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 PA master system.

The measuring device supports the following GSD files:

- Promag 53/55 GSD file (manufacturer-specific GSD file, complete device functionality)
- PROFIBUS Profile GSD file:
- Promag 35 GSD file (compatibility to previous model Promag 35)

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

#### Promag 53/55 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 functionalities 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 → 93

PROFIBUS PA → 103

*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 (EH3x15xx.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 53/55 GSD file*

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

*How to acquire:*

- Internet (Endress+Hauser) → [www.endress.com](http://www.endress.com) (→ Download)
- CD-ROM with all GSD files for Endress+Hauser devices → Order No.: 56003894

*Contents of the download file from the Internet and the CD-ROM:*

- All Endress+Hauser GSD files (standard and extended format)
- Endress+Hauser type files
- Endress+Hauser bitmap files
- Information on the devices

**PROFIBUS Profile GSD file:**

The function of the profile GSD file is defined by the PROFIBUS Profile Specification 3.0. The function 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).

**Profile GSD (multi-variable)** with the ID number 9760Hex: this GSD contains all function blocks such as AI, DO, DI etc. This GSD is not supported by Promag.



Note!

- Before configuration takes place, a decision should be made as to which GSD is to be used to operate the system.
- It is possible to change the setting via the onsite display or via a Class 2 master. For adjustment via the onsite display, refer to → 83.

Supported GSD files: → 61

Each device receives an identification number (IDNo.) from the Profibus User Organization (PNO). The name of the Device Master File (GSD file) is derived from this.

For Endress+Hauser, this ID No. starts with the manufacturer ID 15xx.

In order to ensure clarity and make assignment easier, the GSD names (with the exception of type files) at Endress+Hauser are as follows:

EH3_15xx	EH = Endress+Hauser 3 = Profile 3.0 _ = Standard ID 15xx = ID No.
EH3x15xx	EH = Endress+Hauser 3 = Profile 3.0 x = Extended ID 15xx = ID No.

*Name of the PROFIBUS Profile GSD file*

	ID No.	Profile GSD file
<b>PROFIBUS DP</b>	9742 (Hex)	PA039742.gsd
<b>PROFIBUS PA</b>	9742 (Hex)	PA139742.gsd

*Source*

Internet (GSD library of the PROFIBUS User Organization) → [www.PROFIBUS.com](http://www.PROFIBUS.com)

**Promag 35 GSD file:**

Promag 35 with Profile Version 2.0 is the precursor to the Promag 55. If Promag 35 is already being operated in the system and the measuring device has to be replaced, Promag 55 can be used as a replacement device without having to reconfigure the PROFIBUS DP network.

Further information → 92.

## 6.6.2 Selecting 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 53/55 GSD file: → Select: MANUFACT. SPEC. (factory setting)

Profile GSD file → Select: PROFILE-GSD

Promag 35 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) → Select: 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 "...\\siemens\\step7\\s7data\\gsd". 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 "...\\siemens\\step7\\s7data\\nsbmp".

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 can be found as follows:

PROFIBUS DP →  93

PROFIBUS PA →  103

### 6.6.3 Compatibility to the previous model Promag 35 (Profile Version 2.0)

Promag 35 with Profile Version 2.0 is the precursor to the Promag 55. If Promag 35 is already being operated in the system and the measuring device has to be replaced, Promag 55 can be used as a replacement device without having to reconfigure the PROFIBUS network. In the event of a device being replaced, Promag 55 completely supports the compatibility of the cyclic data with the previous Promag 35 model.

The measuring devices can be exchanged as follows:

Existing device:	GSD file used:	→	To be replaced with:
Promag 35 PROFIBUS PA (ID No.: 0x1505)	Extended Format: EH3x1505.gsd or Standard Format: EH3_1505.gsd	→	Promag 55 PROFIBUS PA

Promag 55 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 35 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 → FIELD BUS 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.

### 6.6.4 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.

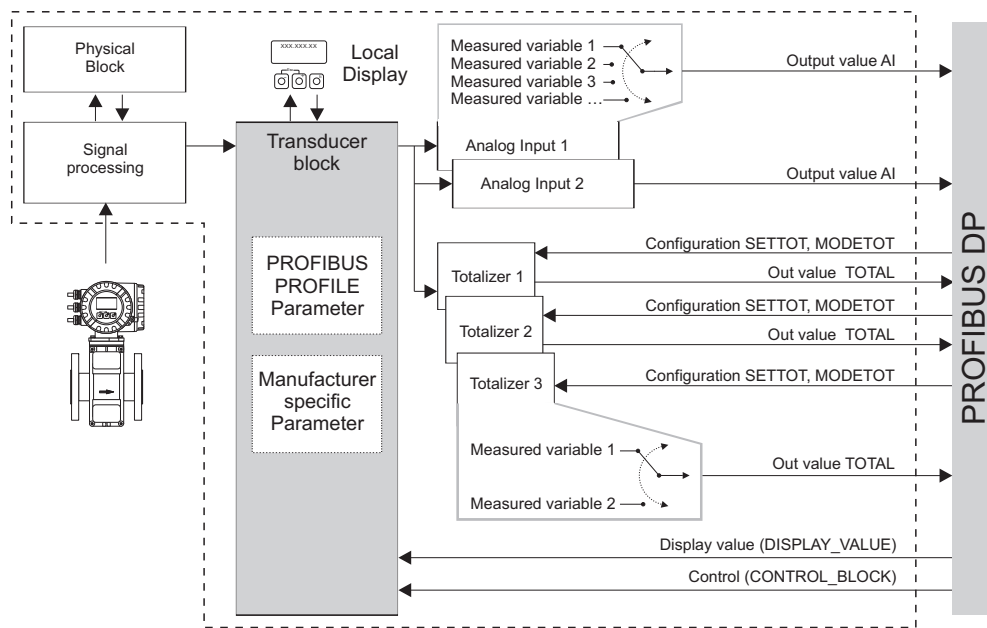
The number of writes to the EEPROM is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss and measuring device failure. For this reason, avoid constantly writing nonvolatile device parameters via the PROFIBUS network!

## 6.7 PROFIBUS DP cyclic data transmission

Below is a description of the cyclic data transmission when using the Promag 55 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 DP.



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Fig. 67: Block model for Promag 55 PROFIBUS DP 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	<b>Analog Input function block 1</b> Output variable → volume flow (factory setting)
2	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	<b>Totalizer function block 1</b> 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	<b>Totalizer function block 2</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
4	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	<b>Totalizer function block 3</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	<b>Analog Input function block 2</b> 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 → 121.

#### 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
<b>The following measured variables are available when the additional "solids flow" software is installed in the device (order option)</b>	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
<b>The following measured variables are available when the additional "advanced diagnostic" software is installed (order option)</b>	
DEVIATION COATING 1	2341
DEVIATION COATING 2	2358
DEVIATION ELECTRODE POTENTIAL 1	2375
DEVIATION ELECTRODE POTENTIAL 2	2392
DEVIATION VOLUME FLOW	2419
DEVIATION NOISE VALUE	2443

**Note!**


The measured variables for the additional "advanced diagnostic" 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 →  121.

#### 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 <sup>3</sup>	273
TOTAL (slot 3)	2	VOLUME FLOW	m <sup>3</sup>	273
TOTAL (slot 4)	3	VOLUME FLOW	m <sup>3</sup>	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 → 98.

*TOTAL function*

For a description of the TOTAL function, refer to TOTAL module → 96.

*Data structure of the SETTOT\_TOTAL module combination*

Output data	Input data				
<b>SETTOT</b>	<b>TOTAL</b>				
Byte 1	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Control	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 SETTOT\_TOTAL module →  97.

#### 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 →  96.

#### Data structure of the SETTOT\_MODETOT\_TOTAL module combination

Output data		Input data				
<b>SETTOT</b>	<b>MODETOT</b>	<b>TOTAL</b>				
<b>Byte 1</b>	<b>Byte 2</b>	<b>Byte 1</b>	<b>Byte 2</b>	<b>Byte 3</b>	<b>Byte 4</b>	<b>Byte 5</b>
Control	Configuration	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

Using the DISPLAY\_VALUE module (slot 6), the PROFIBUS Master (Class 1) can transmit a cyclical value to the measuring device, which can be used either as a display value for the onsite display or as a density value for calculating mass flow. The assignment of the transmitted value to the device function is done using the CONTROL\_BLOCK (slot 7).

#### Option 1 → Display value

If the value transmitted to the device is to be displayed on the onsite display, the output byte of the CONTROL\_BLOCK (slot 7) must be changed from 0 → 61. The assignment of the display value to the main, additional or info line can be configured using the onsite display itself or using 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


#### Option 2 → Density value for calculation of mass flow

If the density value transmitted to the device is to be used for the continuous calculation of mass flow, the output byte of the CONTROL\_BLOCK (slot 7) must be changed from 0 → 60.

#### 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 →  57.

### 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
	<b>Control variables that are executed only if the measuring device is equipped with the optional Electrode Cleaning Circuit (ECC)</b>
	0 → 5: ECC OFF 0 → 6: ECC ON
	<b>Control variables that are executed only if additional "Advanced diagnostics" software is installed in the measuring device.</b>
	0 → 25: Warning mode "Advanced Diagnostics" OFF 0 → 26: Warning mode "Advanced Diagnosis" ON 0 → 60: DISPLAY_VALUE assignment density ON 0 → 61: DISPLAY_VALUE assignment density OFF 0 → 70: Start determining the user reference status 0 → 74: Acquisition mode OFF 0 → 75: Acquisition mode, PERIODICAL 0 → 76: Acquisition mode, MANUAL (SINGLE SHOT) 0 → 78: Start manual determination of the advanced diagnostics parameters

**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 → 93.

### 6.7.4 Configuration examples with Simatic S7 HW-Konfig

#### Example 1

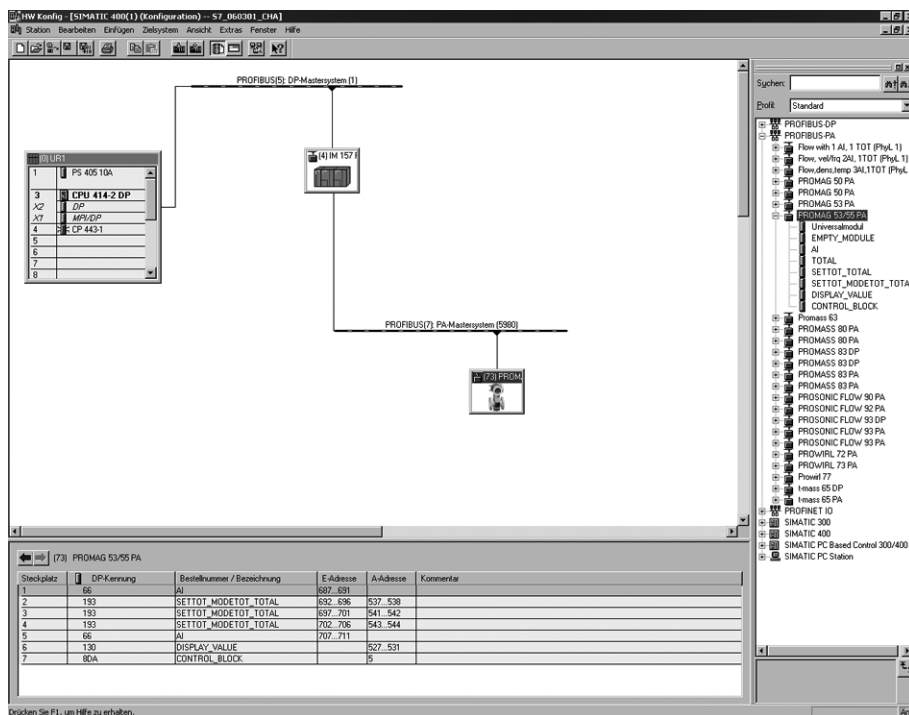


Fig. 68: Complete configuration using the Promag 55 GSD file (complete device functionality)

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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	-	<b>Analog Input function block 1</b> Output variable → volume flow (factory setting)
2	SETTOT_MODETOT_TOTAL	5	2	<b>Totalizer function block 1</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
3	SETTOT_MODETOT_TOTAL	5	2	<b>Totalizer function block 2</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
4	SETTOT_MODETOT_TOTAL	5	2	<b>Totalizer function block 3</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	5	-	<b>Analog Input function block 2</b> Output variable → mass flow (factory setting)
6	DISPLAY_VALUE	-	5	Value for local display
7	CONTROL_BLOCK	-	1	Control of device functions

## Example 2

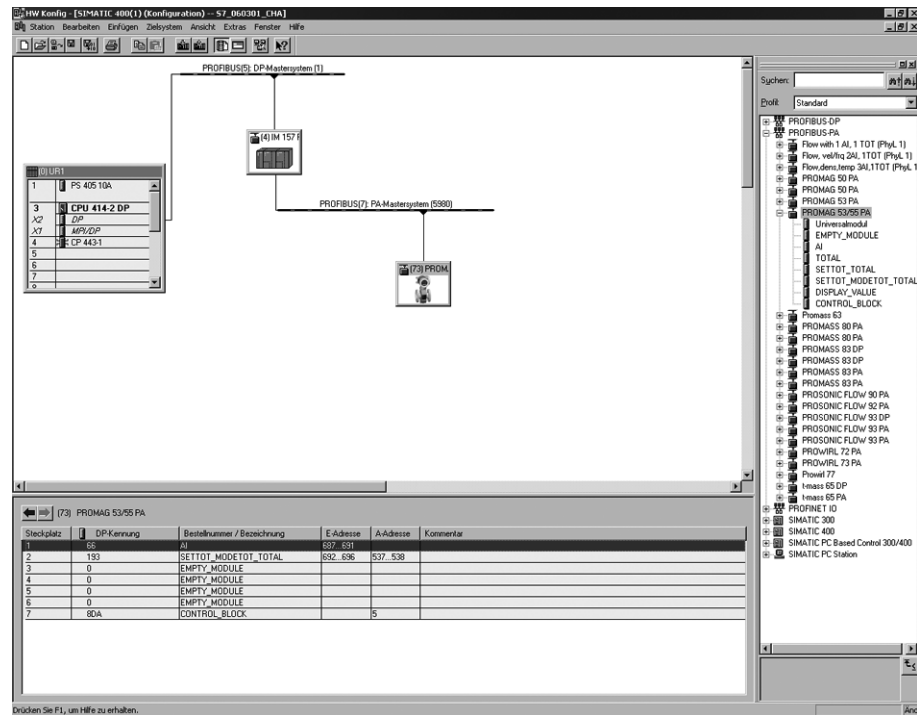


Fig. 69: In this example, modules that are not needed are replaced by the module `EMPTY_MODULE`.  
The Promag 55 GSD file is used (manufacturer-specific GSD file, complete device functionality)

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	-	<b>Analog Input function block 1</b> Output variable → volume flow (factory setting)
2	TOTAL	5	-	<b>Totalizer function block 1</b> 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 PA cyclic data transmission

Below is a description of the cyclic data transmission when using the Promag 55 GSD file (complete device functionality).

### 6.8.1 Block model

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

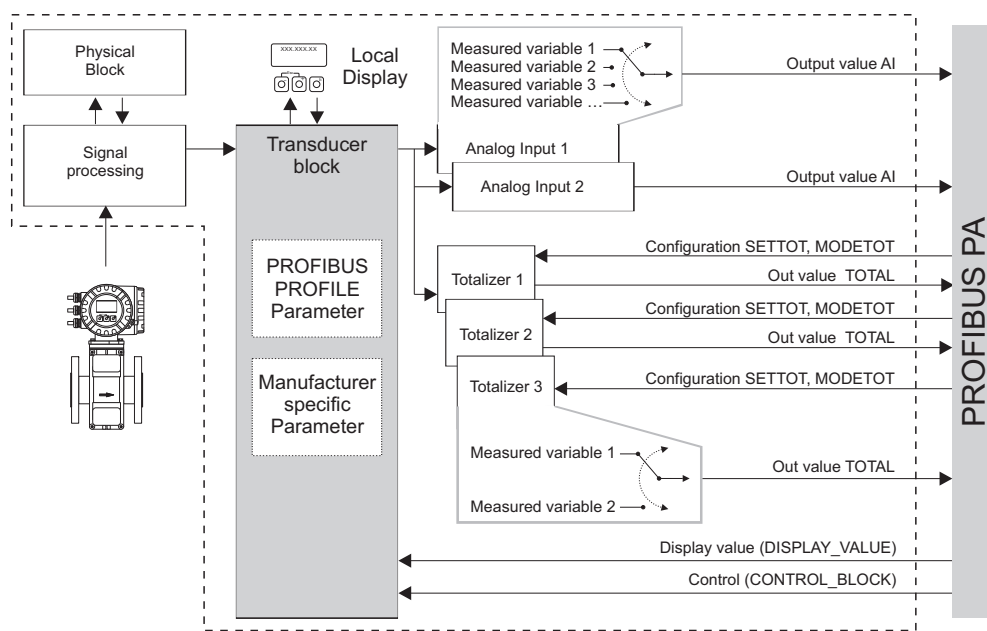


Fig. 70: Block model for Promag 55 PROFIBUS PA Profile 3.0

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### 6.8.2 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	<b>Analog Input function block 1</b> Output variable → volume flow (factory setting)
2	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	<b>Totalizer function block 1</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
3	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	<b>Totalizer function block 2</b> 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	<b>Totalizer function block 3</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	<b>Analog Input function block 2</b> 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.

### 6.8.3 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 → 121.

#### 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
<b>The following measured variables are available when the additional "solids flow" software is installed in the device (order option)</b>	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
<b>The following measured variables are available when the additional "advanced diagnostic" software is installed (order option)</b>	
DEVIATION COATING 1	2341
DEVIATION COATING 2	2358
DEVIATION ELECTRODE POTENTIAL 1	2375
DEVIATION ELECTRODE POTENTIAL 2	2392
DEVIATION VOLUME FLOW	2419
DEVIATION NOISE VALUE	2443

**Note!**


The measured variables for the additional "advanced diagnostic" 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 →  121.

#### 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 <sup>3</sup>	273
TOTAL (slot 3)	2	VOLUME FLOW	m <sup>3</sup>	273
TOTAL (slot 4)	3	VOLUME FLOW	m <sup>3</sup>	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 → 98.

#### TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 96.

#### Data structure of the SETTOT\_TOTAL module combination

Output data	Input data				
<b>SETTOT</b>	<b>TOTAL</b>				
Byte 1	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Control	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 SETTOT\_TOTAL module → 97.

#### 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 → 96.

*Data structure of the SETTOT\_MODETOT\_TOTAL module combination*

Output data		Input data				
<b>SETTOT</b>	<b>MODETOT</b>	<b>TOTAL</b>				
<b>Byte 1</b>	<b>Byte 2</b>	<b>Byte 1</b>	<b>Byte 2</b>	<b>Byte 3</b>	<b>Byte 4</b>	<b>Byte 5</b>
Control	Configuration	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**

Using the DISPLAY\_VALUE module (slot 6), the PROFIBUS Master (Class 1) can transmit a cyclical value to the measuring device, which can be used either as a display value for the onsite display or as a density value for calculating mass flow. The assignment of the transmitted value to the device function is done using the CONTROL\_BLOCK (slot 7).

*Option 1 → Display value*

If the value transmitted to the device is to be displayed on the onsite display, the output byte of the CONTROL\_BLOCK (slot 7) must be changed from 0 → 61. The assignment of the display value to the main, additional or info line can be configured using the onsite display itself or using 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

*Option 2 → Density value for calculation of mass flow*

If the density value transmitted to the device is to be used for the continuous calculation of mass flow, the output byte of the CONTROL\_BLOCK (slot 7) must be changed from 0 → 60.

## Output data

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

### Status

- **General:**  
Implementation in accordance with PROFIBUS PA profile specifications, version 3.0.
- **Behavior when status condition is GOOD:**  
If a density value with the status GOOD is transmitted, this value is converted into the current system unit and processed in the measuring device.
- **Behavior when status condition is BAD and UNCERTAIN:**  
If a density value with the status condition BAD or UNCERTAIN is transmitted to the device, a density value of 0 is used to calculate mass flow. If a measured variable (e.g. mass flow), which has been calculated using the density value, is transmitted cyclically to the PROFIBUS Master using the AI module, then the status information of the quality byte is dependent on the fault behavior configured in the FAILSAFE\_TYPE function of the analog input function block.

### 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
	<b>Control variables that are executed only if the measuring device is equipped with the optional Electrode Cleaning Circuit (ECC)</b>
	0 → 5: ECC OFF 0 → 6: ECC ON
	<b>Control variables that are executed only if additional "Advanced diagnostics" software is installed in the measuring device.</b>
	0 → 25: Warning mode "Advanced Diagnostics" OFF 0 → 26: Warning mode "Advanced Diagnosis" ON 0 → 60: DISPLAY_VALUE assignment density ON 0 → 61: DISPLAY_VALUE assignment density OFF 0 → 70: Start determining the user reference status 0 → 74: Acquisition mode OFF 0 → 75: Acquisition mode, PERIODICAL 0 → 76: Acquisition mode, MANUAL (SINGLE SHOT) 0 → 78: Start manual determination of the advanced diagnostics parameters



#### 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 →  93.

### 6.8.4 Configuration examples with Simatic S7 HW-Konfig

#### Example 1

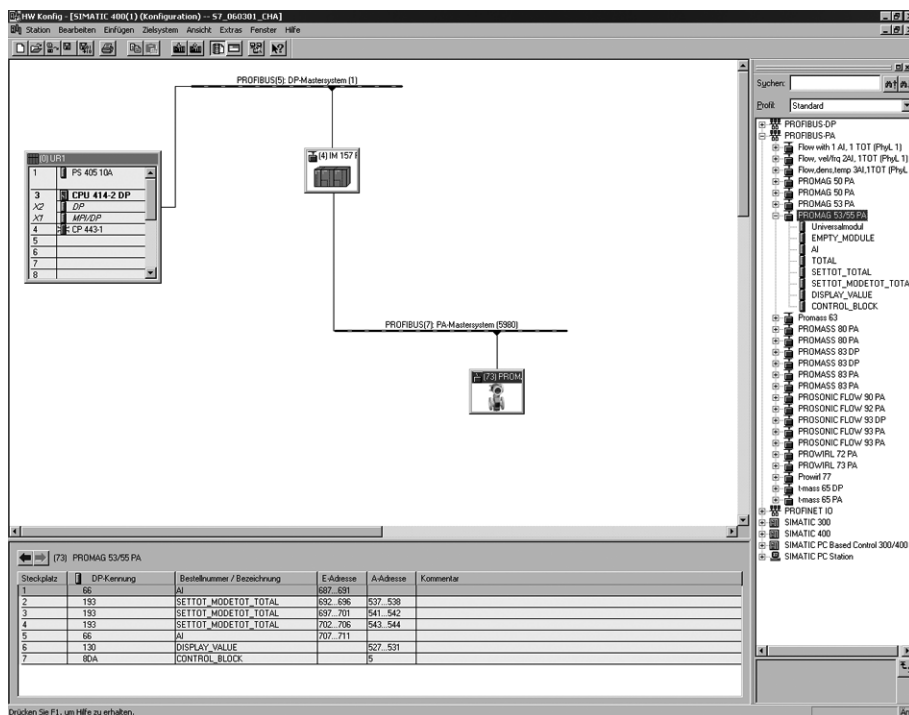


Fig. 71: Complete configuration using the Promag 55 GSD file (complete device functionality)

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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	-	<b>Analog Input function block 1</b> Output variable → volume flow (factory setting)
2	SETTOT_MODETOT_TOTAL	5	2	<b>Totalizer function block 1</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
3	SETTOT_MODETOT_TOTAL	5	2	<b>Totalizer function block 2</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
4	SETTOT_MODETOT_TOTAL	5	2	<b>Totalizer function block 3</b> TOTAL → output variable = volume flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
5	AI	5	-	<b>Analog Input function block 2</b> Output variable → mass flow (factory setting)
6	DISPLAY_VALUE	-	5	Value for local display
7	CONTROL_BLOCK	-	1	Control of device functions

## Example 2

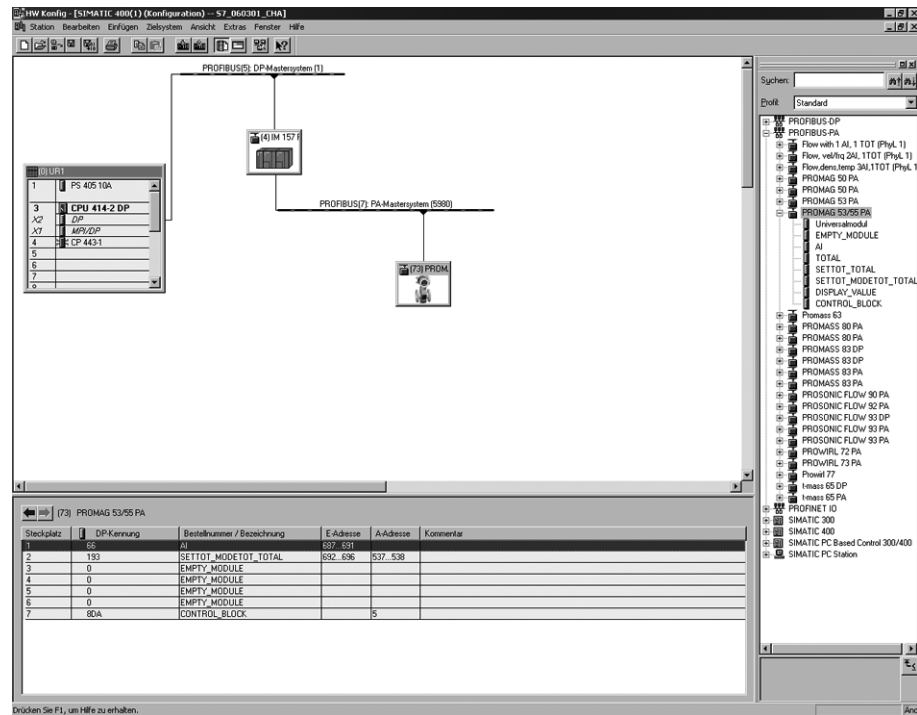


Fig. 72: In this example, modules that are not needed are replaced by the module `EMPTY_MODULE`.  
The Promag 55 GSD file is used (manufacturer-specific GSD file, complete device functionality)

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	-	<b>Analog Input function block 1</b> Output variable → volume flow (factory setting)
2	TOTAL	5	-	<b>Totalizer function block 1</b> 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




## 6.9 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 SAPs
- MS1AC communication

### 6.9.1 Master class 2 acyclic (MS2AC)

MS2AC is acyclic data transmission between a field device and a Class 2 master (eg. FieldCare, Siemens PDM etc. →  61). 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 SAPs. 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.

### 6.9.2 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 device is designed for one million writes.

## 6.10 Adjustment

### 6.10.1 Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is full. This state can be permanently monitored by means of empty pipe detection (EPD).



Caution!

A **detailed** description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found in the separate "Description of Device Functions" manual (BA00125D):

- EPD ADJUSTMENT (6481) → Carrying out the adjustment.
- EPD (6420) → Switching on and off EPD
- EPD RESPONSE TIME (6425) → Input of the response time for EPD



Note!

- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory using 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 the EPD function when the devices are delivered is OFF; the function must be activated if required.

#### Performing empty-pipe and full-pipe adjustment (EPD)

1. Select the appropriate function in the function matrix:  
HOME → → → BASIC FUNCTION → → → PROCESSPARAMETER  
→ → → ADJUSTMENT → → EPD ADJUSTMENT
2. Empty the piping. For EPD empty-pipe adjustment, the wall of the measuring tube should be wetted with fluid.
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" and confirm by pressing .
4. After empty-pipe adjustment, fill the piping with fluid.
5. Start full-pipe adjustment: Select "FULL PIPE ADJUST" and confirm by pressing .
6. Having completed the full-pipe adjustment, select the "OFF" setting and exit the function by pressing .
7. Now select the "EPD" function (6420). Switch on the empty-pipe detection by selecting "ON STANDARD" and confirm by pressing .



Caution!

The adjustment coefficients must be valid before you can activate the EPD function. If adjustment is incorrect the following messages might appear on the display:

- ADJUSTMENT FULL = EMPTY  
The calibration values for empty pipe and full pipe are identical. In such cases you **must** repeat empty-pipe or full-pipe adjustment.
- ADJUSTMENT NOT OK  
Adjustment is not possible because the fluid's conductivity is out of range.

## 6.11 Data storage devices


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

### 6.11.1 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.

### 6.11.2 HistoROM/T-DAT (transmitter-DAT)


The T-DAT is an exchangeable data storage device in which all transmitter parameters and settings are stored.

Storing of specific parameter settings from the device memory (EEPROM) to the T-DAT module and vice versa must be carried out by the user (= manual save function). Detailed instructions regarding this can be found on →  78.

### 6.11.3 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 →  117

Plugging into the I/O board →  133



Caution!

To ensure an unambiguous assignment, the F-CHIP is coded with the transmitter serial number once it is plugged into the I/O board. This means that the F-CHIP 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 in the Promag H sensor should be replaced periodically, particularly when molded seals (aseptic version) are used.

The interval between replacements depends on the frequency of the cleaning cycles and on the temperature of the fluid and of the cleaning process.

Replacement seals (accessory) →  117.

## 8 Accessories

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

### 8.1 Device-specific accessories

Accessory	Description	Order code
Promag 55 transmitter	Transmitter for replacement or for stock. Use the order code to define the following specifications: <ul style="list-style-type: none"> <li>▪ Approvals</li> <li>▪ Degree of protection / version</li> <li>▪ Cable type for the remote version</li> <li>▪ Cable entries</li> <li>▪ Display / power supply / operation</li> <li>▪ Software</li> <li>▪ Outputs / inputs</li> </ul>	55XXX - XXXXX * * * * * * * *
Software packages for Promag 55 PROFIBUS PA	Software add-ons on F-CHIP - can be ordered individually: <ul style="list-style-type: none"> <li>▪ Electrode Cleaning Circuitry (ECC)</li> <li>▪ Advanced diagnostics</li> <li>▪ Solids flow</li> </ul>	DK5SO-X

### 8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for Promag 55 transmitter	Mounting kit for wall-mounted housing (remote version). Suitable for: <ul style="list-style-type: none"> <li>▪ Wall mounting</li> <li>▪ Pipe mounting</li> <li>▪ Panel mounting</li> </ul> Mounting set for aluminum housings. Suitable for: <ul style="list-style-type: none"> <li>▪ Pipe mounting</li> </ul>	DK5WM - *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor	DK5HM - **
Cable for remote version	Coil and signal cables, various lengths. Reinforced cable on request.	DK5CA - **
Ground cable for Promag S	A set consists of two ground cables.	DK5GC - ***
Ground disk /liner protection plate for Promag S	Metal disk for potential equalization and/or for protecting liner of measuring tube lining.	DK5GD - *****
Mounting kit for Promag H	Mounting kit for Promag H, comprising: <ul style="list-style-type: none"> <li>▪ 2 process connections</li> <li>▪ Threaded fasteners</li> <li>▪ Seals</li> </ul>	DKH ** - *****
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS - ***
Welding jig for Promag H	Welding nozzle as process connection: welding jig for installation in pipe.	DK5HW - ***
Adapter connection for Promag H	Adapter connections for installing Promag 55H instead of Promag 30/33A or Promag 30/33H / DN 25.	DK5HA - *****

Accessory	Description	Order code
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. Set of ground rings, comprising: 2 ground rings	DK5HR - * * * *

### 8.3 Communication-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: <a href="http://www.endress.com">www.endress.com</a>
FXA193	Service interface of device to the PC for operation via FieldCare.	FXA193 - *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all relevant process variables: Measuring values are recorded reliably, limit values monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on an SD card or USB stick. The PC software package ReadWin® 2000, which is supplied as standard, is used for configuration, visualization and storage of the recorded data.	RSG40 - * * * * * * * * * *

## 9 Troubleshooting

### 9.1 Troubleshooting instructions

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



Caution!

In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The necessary procedures must be carried out before you return the device to Endress+Hauser → 5.

Always enclose a duly completed "Declaration of Contamination" form. You will find a preprinted blank of this form at the back of this manual.

Check the display	
No display visible and no output signals present.	<ol style="list-style-type: none"> <li>1. Check the supply voltage → Terminals 1, 2.</li> <li>2. Check device fuse →  137. 20 to 260 V AC and 20 to 64 V DC: 2 A slow-blow / 250 V.</li> <li>3. Measuring electronics defective → Order spare parts →  133.</li> </ol>
No display visible, but output signals are present.	<ol style="list-style-type: none"> <li>1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board →  133.</li> <li>2. Display module defective → Order spare parts →  133.</li> <li>3. Measuring electronics defective → Order spare parts →  133.</li> </ol>
Display texts are in a foreign language.	Switch off power supply. Then press the   keys simultaneously to switch the device back on. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal	Measuring electronics defective → Order spare parts →  133.

Error messages on display	
<p>Errors that 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):</p> <ul style="list-style-type: none"> <li>▪ Error type: <b>S</b> = system error, <b>P</b> = process error</li> <li>▪ Error message type:  = fault message, <b>!</b> = notice message</li> <li>▪ <b>EMPTY PIPE</b> = Type of error, e.g. measuring tube is only partly filled or completely empty</li> <li>▪ <b>03:00:05</b> = duration of error occurrence (in hours, minutes and seconds)</li> <li>▪ <b>#401</b> = error number</li> </ul> <p> Caution!</p> <ul style="list-style-type: none"> <li>▪ Also observe the information on →  60.</li> <li>▪ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.</li> </ul>	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred →  121.
Error number: No. 401 – 499	Process error (application error) has occurred →  130.

Incorrect connection to the PROFIBUS master	
<p>No connection can be made between the control system and the device. Check the following points:</p>	
Supply voltage Transmitter	Check the supply voltage → Terminals 1/2
Device fuse	Check device fuse →  137 20 to 260 V AC and 20 to 64 V DC: 2 A slow-blow / 250 V

Fieldbus connection	<p>PROFIBUS PA: Check data line Terminal 26 = PA + Terminal 27 = PA -</p> <p>PROFIBUS DP: Check data line Terminal 26 = B (RxD/TxD-P) Terminal 27 = A (RxD/TxD-N)</p>
Fieldbus connector	<ul style="list-style-type: none"> <li>▪ Check pin assignment/wiring → 48</li> <li>▪ Check connection between connector/fieldbus port. Is the coupling ring tightened correctly?</li> </ul>
Fieldbus voltage	<p>Check that a min. bus voltage of 9 V DC is present at terminals 26/27. Permissible range: 9 to 32 V DC</p>
Network structure	<p>PROFIBUS DP → 34 PROFIBUS PA → 35</p>
Basic current	<p>Is there a basic current of min. 11 mA?</p>
Bus address	<p>Check bus address: make sure there are no double assignments</p>
Bus termination (Termination)	<p>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.</p>
Current consumption, permitted feed current	<p>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.</p>
▼	
<b>System or process error messages</b>	
<p>System or process errors which occur during commissioning or operation can be displayed in the ACTUAL SYSTEM CONDITION function via the local display or an operating program (e.g. FieldCare).</p>	
▼	
<b>Other error (without error message)</b>	
Some other error has occurred.	<p>Diagnosis and rectification → 131</p>



## 9.2 System error messages

Serious system errors are **always** recognized by the instrument as "Fault messages", and are indicated on the display with a lightning flash (⚡). Fault messages immediately affect operation. 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 → 138.

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!**

- See the information on → 60.

### 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.

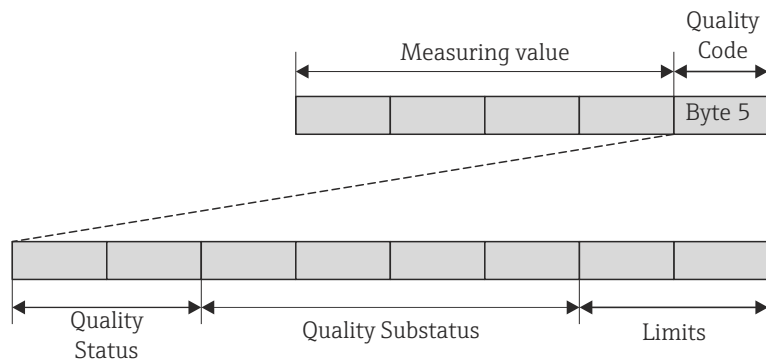


Fig. 73: Structure of the quality byte

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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 FAILSAFE\_TYPE → FSAFE VALUE:

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

- For FAILSAFE\_TYPE → LAST GOOD VALUE (factory settings):

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.




Note!


By means of an operating program (e.g. FieldCare), the FAILSAFE\_TYPE function can be configured in the Analog Input function block 1 to 2 or the Totalizer function block 1 to 3.

### 9.2.2 List of system error messages

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
Depicted on the local display: S = System error ⚡ = Fault message (with an effect on operation) ! = Notice message (without an effect on operation)							
<b>No. # 0xx → Hardware error</b>							
001	S:CRITICAL FAILURE ⚡: # 001	0x0F	BAD BAD	Device Failure 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 ⚡: # 011	0x0F	BAD BAD	Device Failure 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				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
012	S:AMP SW EEPROM / #: # 012	0x0F	BAD BAD	Device Failure Device Failure	Constant	Amplifier EEPROM data inconsistent	<p><i>Cause:</i> Error when accessing data of the measuring amplifier EEPROM</p> <p><i>Remedy:</i> The EEPROM data blocks in which an error has occurred are displayed in the TROUBLESHOOTING function (No. 8047).</p> <ol style="list-style-type: none"> <li>Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the faulty parameter values.</li> <li>The measuring device must be restarted after fault elimination.</li> </ol> <p><i>Access:</i> SUPERVISION → SYSTEM → OPERATION → SYSTEM RESET (→ RESTART)</p>	
031	S:SENSOR HW-DAT / #: # 031	0x10 0x11 0x12	BAD BAD	Sensor Failure Sensor Failure	O.K. Low High	S-DAT failure / S-DAT not inserted	<p><i>Cause:</i></p> <ol style="list-style-type: none"> <li>S-DAT is not correctly plugged into the amplifier board (or is missing).</li> <li>S-DAT is defective.</li> </ol> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>Check whether the S-DAT is correctly plugged into the amplifier board.</li> <li>Replace the S-DAT if it is defective. Spare parts → 133. Check whether the new replacement DAT is compatible with the existing electronics. Check the: - Spare part set number - Hardware revision code</li> <li>Replace measuring electronics boards if necessary. Spare parts → 133</li> <li>Plug the S-DAT into the amplifier board.</li> </ol>	
032	S: SENSOR SW-DAT / #: # 032	0x10 0x11 0x12	BAD BAD	Sensor Failure Sensor Failure	O.K. Low High	S-DAT data inconsistent	<ol style="list-style-type: none"> <li>Replace measuring electronics boards if necessary. Spare parts → 133</li> <li>Plug the S-DAT into the amplifier board.</li> </ol>	
041	S: TRANSM. HW-DAT / #: # 041	0x0F	BAD BAD	Device Failure Device Failure	Constant	T-DAT failure	<p><i>Cause:</i></p> <ol style="list-style-type: none"> <li>T-DAT is not correctly plugged into the amplifier board (or is missing).</li> <li>T-DAT is defective.</li> </ol> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>Check whether the T-DAT is correctly plugged into the amplifier board.</li> <li>Replace the T-DAT if it is defective. Spare parts → 133 Check whether the new replacement DAT is compatible with the existing electronics. Check the: - Spare part set number - Hardware revision code</li> <li>Replace measuring electronics boards if necessary. Spare parts → 133</li> <li>Plug the T-DAT into the amplifier board.</li> </ol>	
042	S: TRANSM. SW-DAT / #: # 042	0x0F	BAD BAD	Device Failure Device Failure	Constant	T-DAT data inconsistent	<ol style="list-style-type: none"> <li>Replace measuring electronics boards if necessary. Spare parts → 133</li> <li>Plug the T-DAT into the amplifier board.</li> </ol>	


No.	Device status message (local display)	PROFIBUS measured value status				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
061	S: HW F-CHIP !:# 061	0x0F	BAD BAD	Device Failure Device Failure	Constant	F-CHIP defect/not plugged	<p><i>Cause:</i></p> <ul style="list-style-type: none"> <li>F-Chip is not plugged into the I/O board or is missing.</li> <li>F-Chip is defective.</li> </ul> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>Check whether the F-Chip is correctly plugged into the I/O board.</li> <li>Replace the F-CHIP.</li> <li>Plug the F-CHIP into the I/O board.</li> </ol>	
<b>No. # 1xx → Software error</b>								
101	S: GAIN ERROR AMP. !:# 101	0x0F	BAD BAD	Device Failure Device Failure	Constant	Gain Error Amplifier	<p><i>Cause:</i></p> <p>Gain deviation compared to reference gain is greater than 2%.</p> <p><i>Remedy:</i></p> <p>Replace the amplifier board → 133.</p>	
121	S: A/C COMPATIB. !:# 121	0x0F	BAD BAD	Device Failure Device Failure	Constant	Amplifier and I/O board only partially compatible	<p><i>Cause:</i></p> <p>Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality).</p> <p> <b>Note!</b></p> <ul style="list-style-type: none"> <li>The indication on the display as notice message appears only for 30 seconds (with listing in "Previous system condition" function).</li> <li>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.</li> </ul> <p><i>Remedy:</i></p> <p>Module with lower software version must either be updated by FieldCare using the required (recommended) software version, or the module must be replaced → 133.</p>	
<b>No. # 2xx → Error in DAT / no communication</b>								
205	S: LOAD T-DAT !:# 205	0x0F	BAD BAD	Device Failure Device Failure	Constant	Save to T-DAT failed	<p><i>Cause:</i></p> <p>Data backup (downloading) to T-DAT failed, or error when accessing (uploading) the calibration values stored in the T-DAT.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>Check whether the T-DAT is correctly plugged into the amplifier board.</li> </ol>	
206	S: SAVE T-DAT !:# 206	0x0F	BAD BAD	Device Failure Device Failure	Constant	Restore from T-DAT failed	<ol style="list-style-type: none"> <li>Replace the T-DAT if it is defective → 133. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: <ul style="list-style-type: none"> <li>Spare part set number</li> <li>Hardware revision code</li> </ul> </li> <li>Replace measuring electronics boards if necessary → 133.</li> </ol>	

No.	Device status message (local display)	PROFIBUS measured value status				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
261	S: COMMUNICAT. I/O V: # 261	0x18 0x19 0x1A	BAD BAD	No Communica- tion	O.K. Low High	Communication failure	<p><i>Cause:</i> Communication error. No data reception between amplifier and I/O board or faulty internal data transfer.</p> <p><i>Remedy:</i> Check whether the electronics boards are correctly inserted in their holders → 135.</p>	
<b>No. # 3xx → System limits exceeded</b>								
321	S: TOL. COIL CURR. V: # 321	0x0F	BAD BAD	Device Failure Device Failure	Constant	Coil current out of tolerance	<p><i>Cause:</i> The coil current of the sensor is out of tolerance.</p> <p><i>Remedy:</i>  Warning! Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards!</p> <p>Remote version: 1. Check wiring of terminals 41/42 → 38. 2. Check coil current cable connector.</p> <p>Compact and remote version: Replace measuring electronics boards if necessary</p>	
339 to 342	S: STACK CUR OUT n V: # 339 to 342	0x0F	BAD BAD	Device Failure Device Failure	Constant	Temp. Buf. not cleared	<p><i>Cause:</i> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.</p> <p><i>Remedy:</i> 1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.</p>	
343 to 346	S: STACK FREQ. OUT n V: # 343 to 346	0x0F	BAD BAD	Device Failure Device Failure	Constant	Temp. Buf. not cleared	<p><i>Recommendation:</i> – 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.</p>	

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
347 to 350	S: STACK PULSE OUT n !: # 347 to 350	0x0F	BAD BAD	Device Failure Device Failure	Constant	Temp. Buf. not cleared	<p><i>Cause:</i> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>1. Increase the setting for pulse weighting.</li> <li>2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses.</li> <li>3. Increase or reduce flow, as applicable.</li> </ol> <p><i>Recommendation:</i></p> <ul style="list-style-type: none"> <li>▪ Configure the fault response of the output to ACTUAL VALUE, so that the temporary buffer can be cleared.</li> <li>▪ Clear the temporary buffer by the measures described under Item 1.</li> </ul>
351 to 354	S: CURRENT SPAN n !: # 351 to 354	0x54 0x55 0x56	UNCERTAIN UNCERTAIN	Engineering Unit Range Violation Engineering Unit Range Violation	O.K. Low High	Flow is Out of Range	<p><i>Cause:</i> Current output: The actual value for the flow lies outside the set limits.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>1. Change the upper or lower limit setting, as applicable.</li> <li>2. Increase or reduce flow, as applicable.</li> </ol>
355 to 358	S: FREQ. RANGE n !: # 355 to 358	0x54 0x55 0x56	UNCERTAIN UNCERTAIN	Engineering Unit Range Violation Engineering Unit Range Violation	O.K. Low High	Flow is Out of Range	<p><i>Cause:</i> Frequency output: The actual value for the flow lies outside the set limits.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>1. Change the upper or lower limit setting, as applicable.</li> <li>2. Increase or reduce flow, as applicable.</li> </ol>

No.	Device status message (local display)	PROFIBUS measured value status				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
359 to 362	S: PULSE RANGE !: # 359 to 362	0x54 0x55 0x56	UNCERTAIN UNCERTAIN	Engineering Unit Range Violation Engineering Unit Range Violation	O.K. Low High	Flow is Out of Range	<p><i>Cause:</i> Pulse output: The pulse output frequency is out of range.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>Increase the setting for pulse weighting.</li> <li>When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC, etc.).</li> </ol> <p>Determine the pulse width:</p> <ul style="list-style-type: none"> <li>Version 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration.</li> <li>Variation 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.</li> </ul> <p>Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is:</p> $\frac{1}{2 \cdot 10 \text{ Hz}} = 50 \text{ ms}$ <p>3. Reduce flow</p>	
<b>No. # 5xx → Application error</b>								
501	S: SW.-UPDATE ACT. !: # 501	0x48 0x49 0x4A	UNCERTAIN UNCERTAIN	Substitute set (substitute set of failsafe status)	O.K. Low High	New amplifier software loaded	<p><i>Cause:</i> New amplifier or communication software version is loaded. Currently no other functions are possible.</p> <p><i>Remedy:</i> Wait until the procedure is finished. The device will restart automatically.</p>	
502	S: UP-/DOWNLO. ACT. !: # 502	0x48 0x49 0x4A	UNCERTAIN UNCERTAIN	Substitute set (substitute set of failsafe status)	O.K. Low High	Upload/download of device data active	<p><i>Cause:</i> Uploading or downloading the device data via configuration program. Currently no other functions are possible.</p> <p><i>Remedy:</i> Wait until the procedure is finished.</p>	

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No.	Device status message (local display)	PROFIBUS measured value status				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
<b>No. # 6xx → Simulation mode active</b>								
601	S: POS. ZERO RETURN ! # 601	0x53	UNCERTAIN UNCERTAIN	Sensor conversion not accurate (measured value from sensor not accurate)	Constant	Positive zero return active	<p><i>Cause:</i> Positive zero return is active.</p> <p> <i>Note!</i> This message has the highest display priority!</p> <p><i>Remedy:</i> Switch off positive zero return.</p> <p><i>Access:</i> BASIC FUNCTIONS → SYSTEM PARAMETER → CONFIGURATION → POS. ZERO RETURN (→ OFF)</p>	
611 to 614	S: SIM. CURR. OUT. n ! : # 611 to 614	0x80	GOOD .	O.K.	O.K.	Simulation IO active	<p><i>Cause:</i> Simulation current output is active.</p> <p><i>Remedy:</i> Switch off simulation.</p>	
621 to 624	S: SIM. FREQ. OUT. n ! : # 621 to 624	0x80	GOOD .	O.K.	O.K.	Simulation IO active	<p><i>Cause:</i> Simulation frequency output is active.</p> <p><i>Remedy:</i> Switch off simulation.</p>	
631 to 634	S: SIM. PULSE n ! : # 631 to 634	0x80	GOOD .	O.K.	O.K.	Simulation IO active	<p><i>Cause:</i> Simulation pulse output is active.</p> <p><i>Remedy:</i> Switch off simulation.</p>	
641 to 644	S: SIM. STAT. OUT n ! : # 641 to 644	0x80	GOOD .	O.K.	O.K.	Simulation IO active	<p><i>Cause:</i> Simulation status output is active.</p> <p><i>Remedy:</i> Switch off simulation.</p>	
651 to 654	S: SIM. RELAY n ! : # 651 to 654	0x80	GOOD .	O.K.	O.K.	Simulation IO active	<p><i>Cause:</i> Simulation relay output is active.</p> <p><i>Remedy:</i> Switch off simulation.</p>	
671 to 674	S: SIM. STATUS IN n ! : # 671 to 674	0x80	GOOD .	O.K.	O.K.	Simulation IO active	<p><i>Cause:</i> Simulation status output is active.</p> <p><i>Remedy:</i> Switch off simulation.</p>	
691	S: SIM. FAILSAFE ! : # 691	0x48 0x49 0x4A	UNCERTAIN UNCERTAIN	Substitute set (substitute set of failsafe status)	O.K. Low High	Simulation failsafe active	<p><i>Cause:</i> Simulation of failsafe mode (outputs) is active.</p> <p><i>Remedy:</i> Switch off simulation.</p> <p><i>Access:</i> SUPERVISION → SYSTEM → OPERATION → SIM. FAILSAFE MODE (→ OFF)</p>	
692	S: SIM. MEASURAND ! : # 692	0x60 0x61 0x62	UNCERTAIN UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Simulation measured value active	<p><i>Cause:</i> Simulation of the measured value is active.</p> <p><i>Remedy:</i> Switch off simulation.</p> <p><i>Access:</i> SUPERVISION → SYSTEM → OPERATION → SIM. MEASURAND (→ OFF)</p>	



No.	Device status message (local display)	PROFIBUS measured value status				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → 133 ff)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
698	S: DEV. TEST ACT. !: # 698	0x60 0x61 0x62	UNCERTAIN UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Device test via Fieldcheck active	<i>Cause:</i> The measuring device is being checked on site via the test and simulation device.	
<b>No. # 8xx → Software option errors</b>								
840	S: COAT.E1DEVLM !: # 840	0x40 0x41 0x42	UNCERTAIN UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Delay time outside the limit	<i>Cause:</i> The measured error of the decay time constant is outside the range defined in the WARNING (7546) function. <i>Remedy:</i> Remove the sensor from the pipe and check whether the inside wall of the measuring tube has to be cleaned.	
841	S: COAT.E2DEVLM !: # 841	0x40 0x41 0x42	UNCERTAIN UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Delay time outside the limit	<i>Cause:</i> The measured error of the decay time constant is outside the range defined in the WARNING (7546) function. <i>Remedy:</i> Remove the sensor from the pipe and check whether the inside wall of the measuring tube has to be cleaned.	
845	S: COATING FAILURE !: # 845	0x40 0x41 0x42	UNCERTAIN UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Coating detection not possible	<i>Cause:</i> Coating detection not possible: 1. The recovery time entered for this is too small. 2. The measuring tube is empty or not filled completely. <i>Remedy:</i> 1. Increase the value for the recovery time (→ RECOVERY TIME function, 7523). 2. Fill the measuring tube (if necessary, check the process conditions of the facility).	
846	S: NOI.VAL.DEVLIM !: # 846	0x40 0x41 0x42	UNCERTAIN UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Noise valve outside the limit	<i>Cause:</i> The measured error of the decay time constant is outside the range defined in the WARNING (7546) function. <i>Remedy:</i> Check the application for process change (pressure, air bubbles, inhomogeneity etc.).	

### 9.3 Process error messages



Note!

Also observe the information on → 60 and → 131.


#### 9.3.1 Displaying the device status on PROFIBUS DP/PA

For more information, refer to → 121.

#### 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 ⚡ = Fault message (with and effect on operation) ! = Notice message (without an effect on operation)							
401	P: EMPTY PIPE ⚡: # 401	0x03	BAD 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. NOT OK !: # 461	0x40 0x41 0x42	UNCERT AIN UNCERT AIN	Non specific (uncertain status)	O.K. Low High	EPD adjustment not possible	Cause: EPD adjustment not possible because the fluid's conductivity is either too low or too high.  Remedy: The EPD function cannot be used with fluids of this nature.
463	P: FULL = EMPTY ⚡: # 463	0x40 0x41 0x42	UNCERT AIN UNCERT AIN	Non specific (uncertain status)	O.K. Low High	EPD adjustment wrong	Cause: The EPD calibration values for empty pipe and full pipe are identical and therefore incorrect.  Remedy: Repeat adjustment, making sure procedure is correct → 114.
467	S: AO-Block Error ⚡: # 467	0x0F	BAD BAD	Device Failure Device Failure	Constant	AO-Block Error	Cause: The value imported cyclically using the AO block is invalid (status = BAD).  Remedy: Ensure that the status of the imported value = GOOD.  Process variables affected <ul style="list-style-type: none"> <li>▪ calculated mass flow</li> <li>▪ target mass flow</li> <li>▪ % target mass flow</li> <li>▪ carrier mass flow</li> <li>▪ % carrier mass flow</li> <li>▪ totalizer (mass)</li> </ul>

## 9.4 Process errors without messages

Symptoms	Rectification
 <b>Note!</b> You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault. The functions outlined below, such as DISPLAY DAMPING, are described in detail in the "Description of Device Functions" manual (BA00125D).	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	<ol style="list-style-type: none"> <li>Remote version:               <ul style="list-style-type: none"> <li>Switch off the power supply and check the wiring →  38</li> <li>If necessary, reverse the connections at terminals 41 and 42</li> </ul> </li> <li>Change the setting in the INSTALLATION DIRECTION SENSOR function accordingly</li> </ol>
Measured value reading fluctuates even though flow is steady.	<ol style="list-style-type: none"> <li>Check grounding and potential matching →  50.</li> <li>The medium is too inhomogeneous. Check the following medium characteristics:               <ul style="list-style-type: none"> <li>Gas bubble percentage too high?</li> <li>Solids percentage too high?</li> <li>Conductivity fluctuations too high?</li> </ul> </li> <li>SYSTEM DAMPING function → increase value (→ BASIC FUNCTION/SYSTEMPARAMETER/CONFIGURATION)</li> <li>TIME CONSTANT function → increase the value (→ OUTPUTS/CURRENT OUTPUT/CONFIGURATION)</li> <li>DISPLAY DAMPING function → increase the value (→ USER INTERFACE/CONTROL/BASIC CONFIGURATION)</li> </ol>
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) →  73. 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 flowmeters 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.	<ol style="list-style-type: none"> <li>Check grounding and potential equalization →  50.</li> <li>Check the fluid for presence of gas bubbles.</li> <li>Activate ON-VALUE LOW FLOW function, i.e. enter or increase on value (→ BASIC FUNCTION/PROCESSPARAMETER/CONFIGURATION).</li> </ol>
Measured-value reading on display, even though measuring tube is empty.	<ol style="list-style-type: none"> <li>Perform empty-pipe/full-pipe adjustment and then switch on empty pipe detection →  114.</li> <li>Remote version: Check the terminals of the EPD cable →  38.</li> <li>Fill the measuring tube.</li> </ol>
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 arisen. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: <ul style="list-style-type: none"> <li> <b>Request the services of an Endress+Hauser service technician</b>                If you contact our service organization to have a service technician sent out, please be ready to quote the following information:               <ul style="list-style-type: none"> <li>Brief description of the fault</li> <li>Nameplate specifications: order code and serial number →  6.</li> </ul> </li> <li> <b>Returning devices to Endress+Hauser</b>                The required procedures must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser →  138.                Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted blank of this form at the back of this manual.             </li> <li> <b>Replace transmitter electronics</b>                Components in the measuring electronics defective → Order spare parts →  133.             </li> </ul>

## 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
<b>Caution!</b> System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on →  60.		
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	→  121	-

## 9.6 Spare parts

The previous sections contain a detailed troubleshooting guide → 119.

The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.

Fault rectification can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.



Note!

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

Spare parts are shipped as sets comprising the following parts:

- Spare part
- Additional parts, small items (screws etc.)
- Mounting instructions
- Packaging

### 9.6.1 PROFIBUS DP

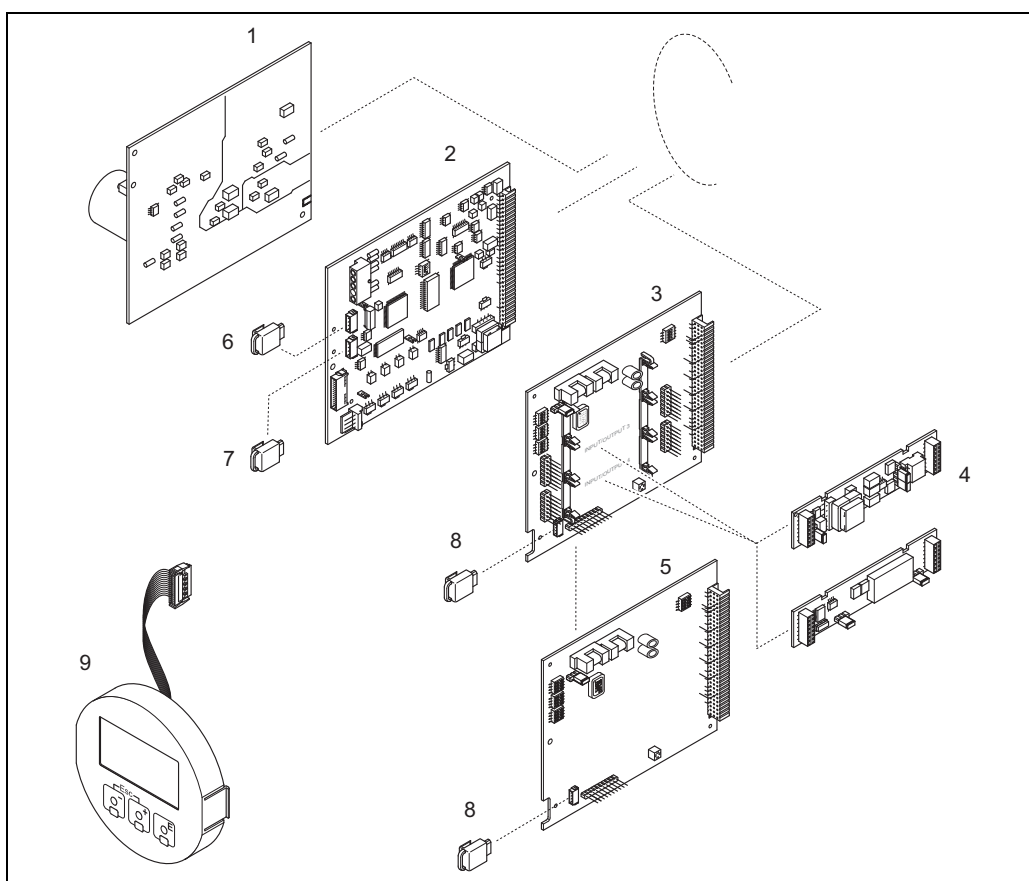
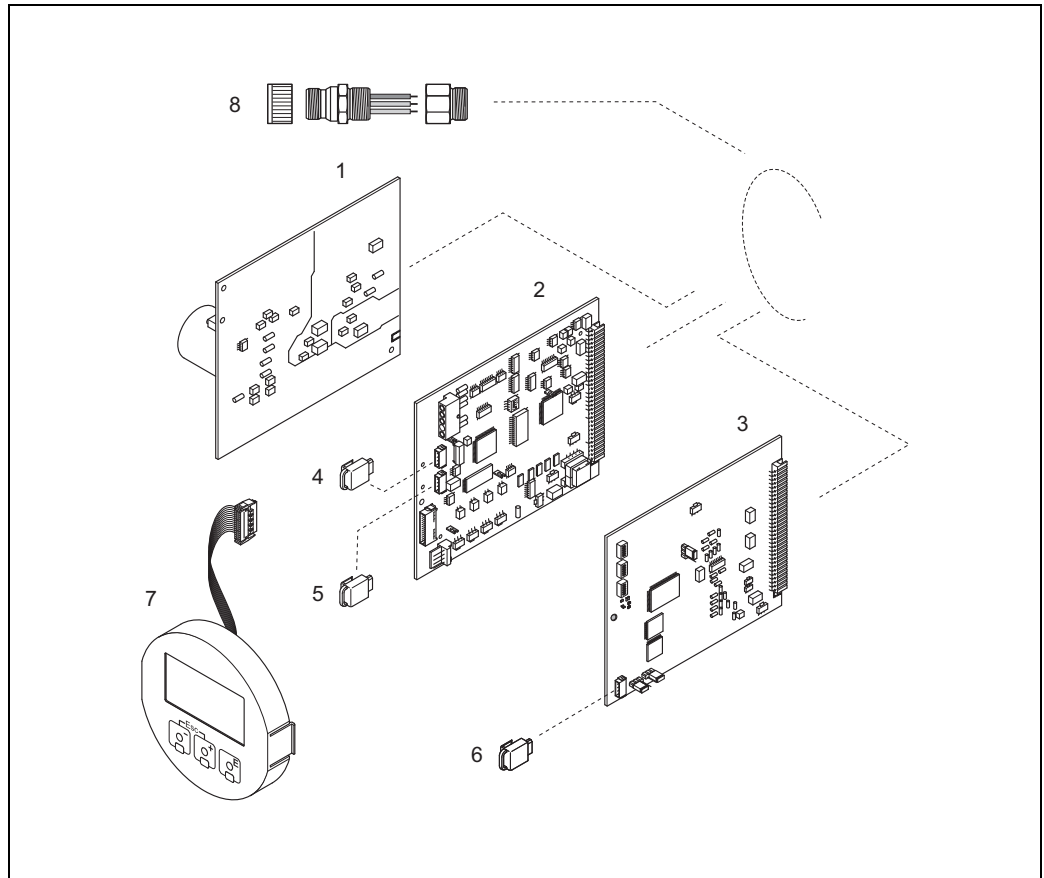


Fig. 74: Spare parts for PROFIBUS DP transmitters (field and wall-mount housing)

- 1 Power unit board (20 to 260 V AC, 20 to 64 V DC)
- 2 Amplifier board
- 3 I/O board (COM module), flexible
- 4 Pluggable input/output submodules; ordering structure → 117
- 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

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### 9.6.2 PROFIBUS PA



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Fig. 75: Spare parts for PROFIBUS PA transmitters (field and wall-mount housing)

- 1 Power unit board (20 to 260 V AC, 20 to 64 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 these Operating Instructions.



##### Caution!

Use only original Endress+Hauser parts.

Removing and installing the boards → 76:

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 provided (3) 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.

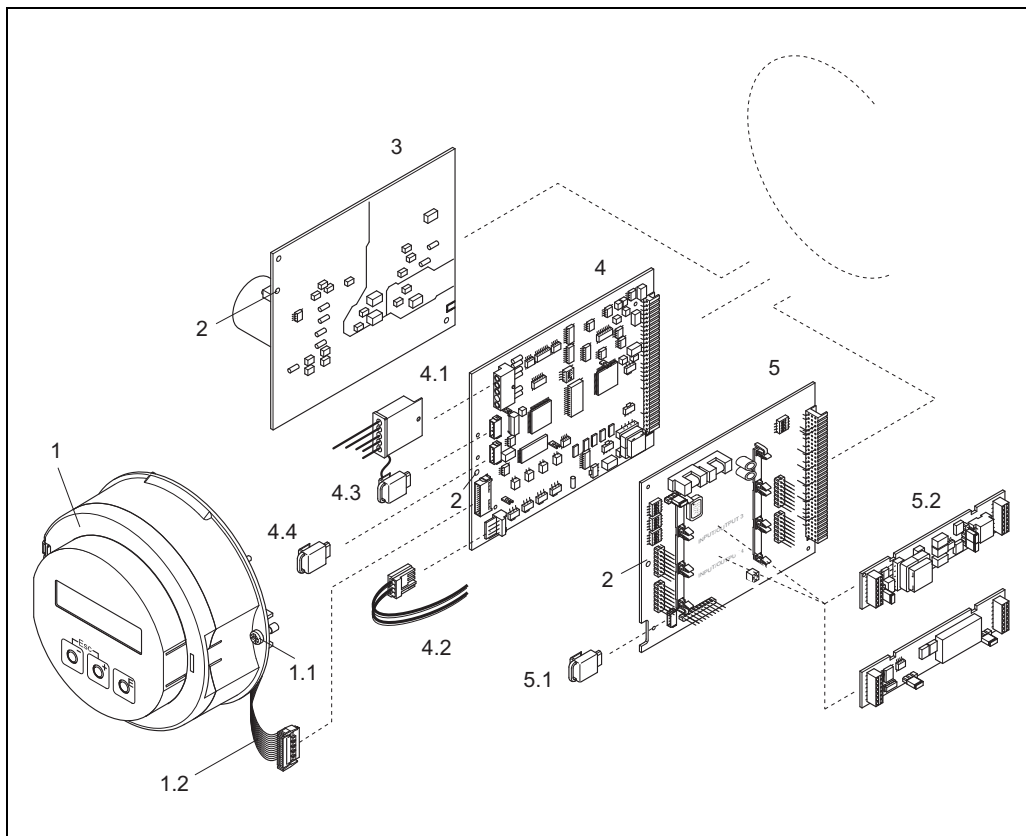


##### Caution!

Only certain combinations of submodules on the I/O board are permissible → 44.  
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 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 provided (3) and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.



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Fig. 76: Field housing: removing and installing printed circuit boards

- 1 Local display
- 1.1 Screws for 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 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)



### 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 supply board → 77.

The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove power unit board → 135.
3. Remove the protection cap (1) and replace the device fuse (2).  
Use only fuses of the following type:
  - 20 to 260 V AC / 20 to 64 V DC → 2.0 A slow-blow /250 V; 5.2 × 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.

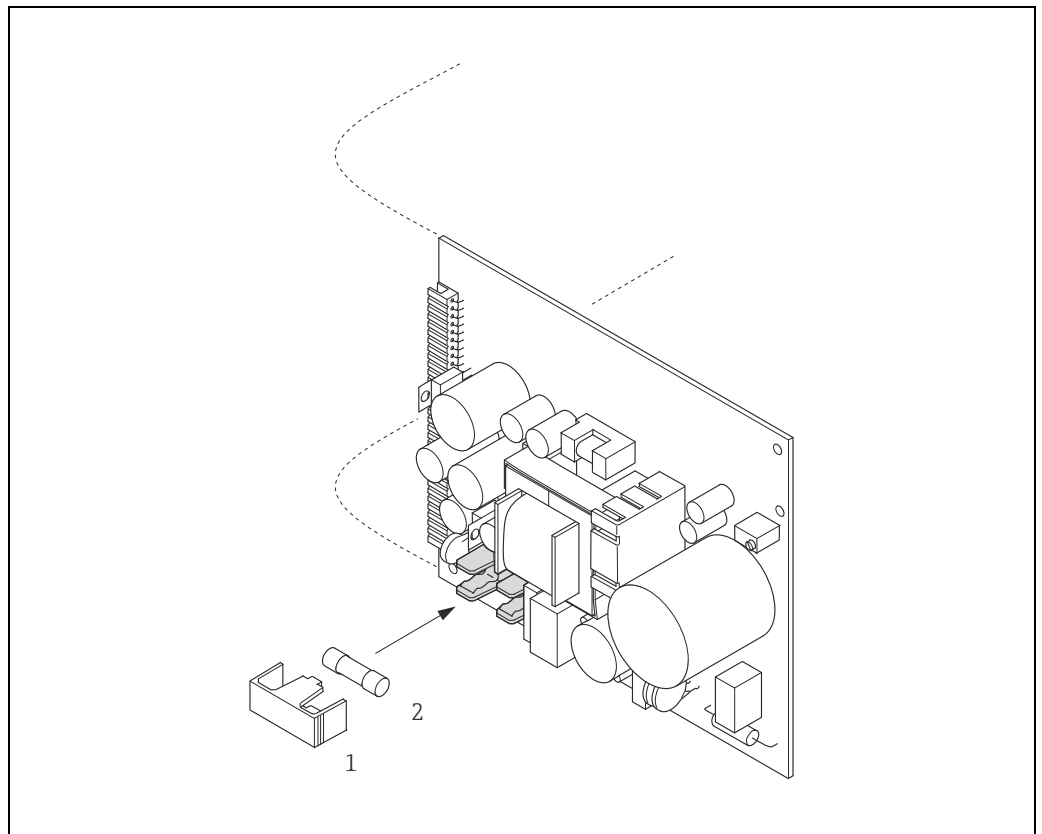


Fig. 77: Replacing the device fuse on the power unit board

- 1 Protection cap
- 2 Device fuse

## 9.7 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at [www.services.endress.com/return-material](http://www.services.endress.com/return-material)

## 9.8 Disposal

Please observe the regulations applicable in your country or region.

## 9.9 Software history

Date	Software version	Changes to software	Documentation
02.2011	PROFIBUS DP/PA 3.06.XX	–	71130401/13.11
06.2010	PROFIBUS DP/PA 3.06.XX	Introduction of a new PROFIBUS DP I/O board	71116509/06.10
12.2007	PROFIBUS PA 3.05.XX	Introduction of a new PROFIBUS PA I/O board	71065431/12.07
09.2006	PROFIBUS PA 2.03.XX	Original software	71028542/09.06

## 10 Technical data

### 10.1 Applications


→  4

### 10.2 Function and system design

---

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

---

**Measuring system** →  6

### 10.3 Input

---

**Measured variable**

- Flow rate (proportional to induced voltage)
- Conductivity (without temperature compensation)

---

**Measuring range**

- Flow rate: Typical  $v = 0.01$  to  $10$  m/s ( $0.03$  to  $33$  ft/s) with the specified measuring accuracy
- Conductivity  $s = 5$  to  $2000$   $\mu\text{S}/\text{cm}$  not for sensors without reference electrode (Promag H, Promag S with brush electrodes)

---

**Operable flow range** Over 1000 : 1

---

**Input signal** **Status input (auxiliary input):**  
 $U = 3$  to  $30$  V DC,  $R_i = 3$  k $\Omega$ , galvanically isolated.  
 Switch level:  $\pm 3$  to  $\pm 30$  VDC, independent of polarity

### 10.4 Output

---

**Output signal** **Current output**  
 Active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s), Full scale value adjustable, temperature coefficient: typically 0.005% o.r./ $^{\circ}\text{C}$ , resolution: 0.5  $\mu\text{A}$

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

**Pulse/frequency output:**  
 Active/passive selectable (Ex i version passive only), galvanically isolated

- Active: 24 V DC, 25 mA (max. 250 mA during 20 ms),  $R_L > 100$   $\Omega$
- Passive: open collector, 30 V DC, 250 mA
- Frequency output: full scale frequency 2 to 10000 Hz ( $f_{\text{max}} = 12500$  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**

- Transmission technology (Physical Layer): RS485 according to ASME/TIA/EIA-485-A: 1998, galvanically isolated
- Profile Version 3.0
- Data transmission rate: 9.6 kBaud to 12 MBaud
- Automatic identification of data transmission rate
- Function blocks: 2 × analog input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 35S
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

**PROFIBUS PA interface**

- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profile version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 2 × analog input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 35S
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

**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"

**Low flow cut off**

Switch points for low flow freely selectable.




**Galvanic isolation**

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


**Switching output**

Relay output: Normally closed (NC or break) or normally open (NO or make) contacts available (default: relay 1 = NO, relay 2 = NC), max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated

## 10.5 Power supply

<b>Terminal assignment</b>	→  34
<b>Supply voltage</b>	20 to 260 V AC, 45 to 65 Hz 20 to 64 V DC
<b>Power consumption</b>	AC: < 45 VA at 260 V AC; < 30 VA at 110 V AC (incl. sensor) DC: < 19 W (including sensor)  Switch-on current: <ul style="list-style-type: none"> <li>■ Max. 2.5 A (&lt; 200 ms) at 24 V DC</li> <li>■ Max. 2.5 A (&lt; 5 ms) at 110 V AC</li> <li>■ Max. 5.5 A (&lt; 5 ms) at 260 V AC</li> </ul>
<b>Power supply failure</b>	Lasting min. 1 power cycle: <ul style="list-style-type: none"> <li>■ EEPROM or HistoROM/T-DAT saves measuring system data if power supply fails</li> <li>■ HistoROM/S-DAT: exchangeable data storage device which stores sensor characteristic data (nominal diameter, serial number, calibration factor, zero point etc.)</li> </ul>
<b>Potential equalization</b>	→  50
<b>Cable entries</b>	Power supply and signal cables (inputs/outputs): <ul style="list-style-type: none"> <li>■ Cable gland M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 in)</li> <li>■ Sensor cable gland for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 in)</li> <li>■ Cable entries for thread ½" NPT, G ½"</li> </ul> Connecting cable for remote version: <ul style="list-style-type: none"> <li>■ Cable gland M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 in)</li> <li>■ Sensor cable gland for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 in)</li> <li>■ Cable entries for thread ½" NPT, G ½"</li> </ul>
<b>Cable specifications (remote version)</b>	→  42

## 10.6 Performance characteristics

<b>Reference operating conditions</b>	<ul style="list-style-type: none"> <li>■ Error limits following DIN EN 29104, future ISO 20456</li> <li>■ Water, typically +15 to +45°C (+59 to +113 °F); 0.5 to 7 bar (73 to 101 psi)</li> <li>■ Specification as per calibration protocol</li> <li>■ Data on the measured error based on accredited calibration rigs traced back to ISO 17025</li> </ul>
<b>Maximum measured error</b>	<p><b>Volume flow</b></p> <p>Pulse output:</p> <ul style="list-style-type: none"> <li>■ Standard: ±0.2% o.r. ± 2 mm/s (o.r. = of reading)</li> <li>■ With option brush electrodes: ±0.5% o.r. ± 2 mm/s (o.r. = of reading)</li> </ul> <p>Current output: in addition typically ±5 µA</p> <p> Note! Supply-voltage fluctuations have no effect within the specified range.</p>

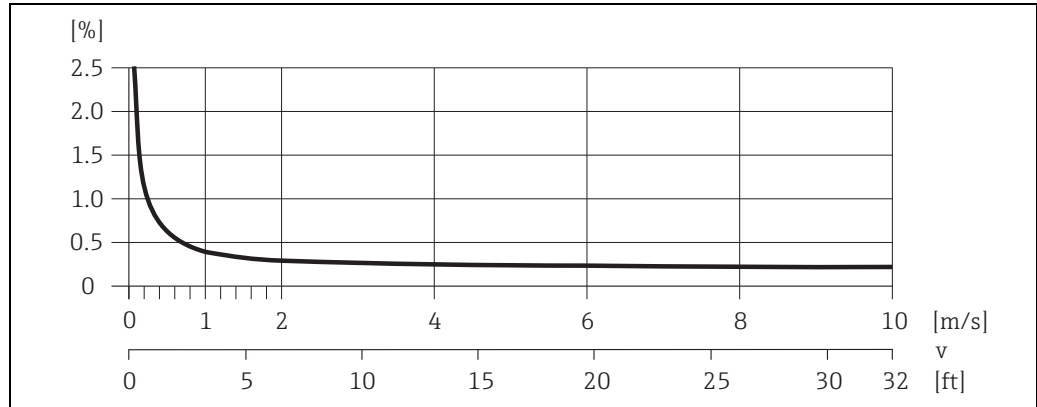


Fig. 78: Max. measured error in % of reading

**Conductivity**

- Max. measuring error not specified
- Without temperature compensation

**Repeatability**

**Volume flow**

- Standard: max.  $\pm 0.1\%$  o.r.  $\pm 0.5$  mm/s (o.r. = of reading)
- With brush electrodes (Option): max.  $\pm 0.2\%$  o.r.  $\pm 0.5$  mm/s (o.r. = of reading)

**Conductivity**

- Max.  $\pm 5\%$  o.r. (o.r. = of reading)

**10.7 Installation**

**Installation instructions**

→ 12

**Inlet and outlet runs**

Inlet run: typically  $\geq 5 \times DN$   
 Outlet run: typically  $\geq 2 \times DN$

**Length of connecting cable**

The permissible cable length  $L_{max}$  for the remote version depends on the conductivity of the medium → 19

## 10.8 Environment

### Ambient temperature range

Transmitter:

- Standard:
  - Compact version: -20 to +50 °C (-4 to +122 °F)
  - Remote version: -20 to +60 °C (-4 to +140 °F)
- Optional:
  - Compact version: -40 to +50 °C (-40 to +122 °F)
  - Remote version: -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.

### Degree of protection

**Transmitter**

- As standard: IP 67, type 4X enclosure

**Sensor**

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

### Shock and vibration resistance

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

### Interior cleaning



Caution!

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

CIP/SIP cleaning possible:

Promag S (with PFA), Promag H

CIP/SIP cleaning not possible:

Promag S (with PU, PTFE, hard rubber, natural rubber)

### Electromagnetic compatibility (EMC)

According to IEC/EN 61326 and NAMUR recommendation NE 21

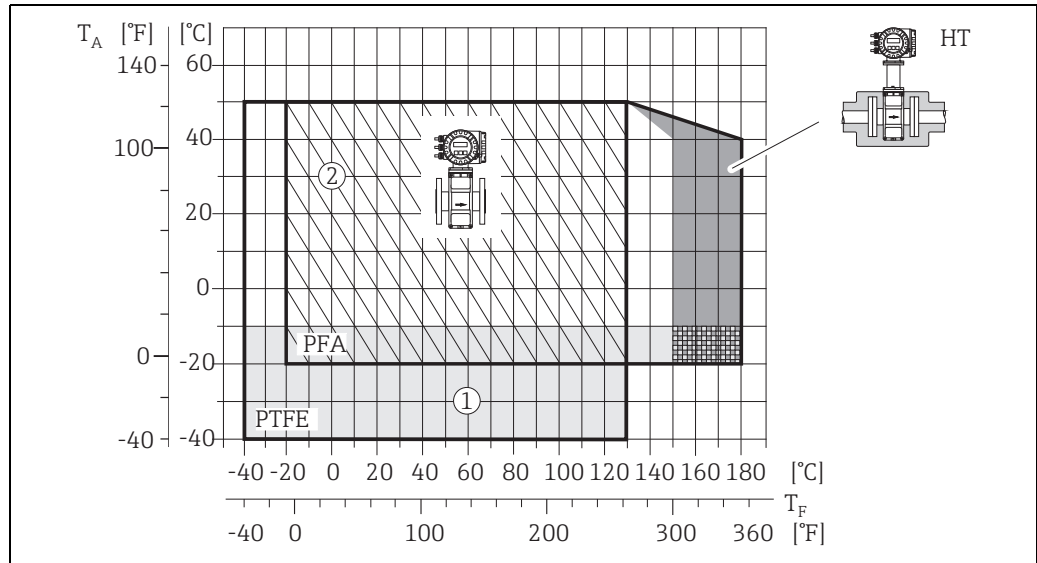
## 10.9 Process

### Medium temperature range

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

#### Promag S

- Hard rubber: 0 to +80 °C (+32 to +176 °F)
- Natural rubber: 0 to +60 °C (+32 to +140 °F)
- Polyurethane: -20 to +50 °C (-4 to +122 °F)
- PFA: -20 to +180 °C (-4 to +356 °F), restrictions → see diagrams
- PTFE: -40 to +130 °C (-40 to +266 °F), restrictions → see diagrams

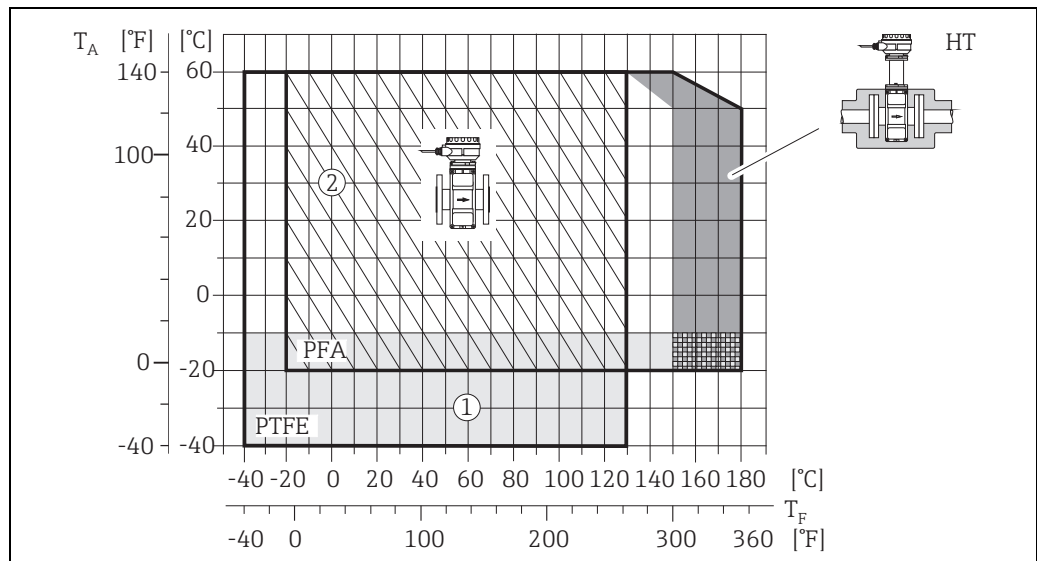


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Fig. 79: Compact versions of Promag S (with PFA or PTFE lining)

$T_A$  = ambient temperature;  $T_F$  = fluid temperature; HT = high-temperature version with insulation

- ① = Light gray area → Temperature range from -10 to 40 °C (-14 to -40 °F) applies only to stainless steel flanges
- ② = Diagonally hatched area → foam lining (HE) + degree of protection IP68 = fluid temperature max. 130 °C (266 °F)



A0002671

Fig. 80: Remote versions (with PFA or PTFE lining)

$T_A$  = ambient temperature;  $T_F$  = fluid temperature; HT = high-temperature version with insulation

- ① = Light gray area → Temperature range from -10 to 40 °C (-14 to -40 °F) applies only to stainless steel flanges
- ② = Diagonally hatched area → foam lining (HE) + degree of protection IP68 = fluid temperature max. 130 °C (266 °F)



**Promag H**

Sensor:

- DN 2 to 25: -20 to +150 °C (-4 to +302 °F)
- DN 40 to 100: -20 to +150 °C (-4 to +302 °F)

Seals:

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

**Conductivity**

The minimum conductivity is:

- $\geq 5 \mu\text{S/cm}$  for fluids in general



Note!

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

**Pressure-temperature ratings**

An overview of the pressure-temperature ratings for the process connections are to be found in the "Technical Information" documents of the device in question.

List of supplementary documentation → 153 section.

**Limiting medium pressure range (nominal pressure)**

Promag S:

- EN 1092-1 (DIN 2501): PN 10 (DN 200 to 600 / 8 to 24"), PN 16 (DN 65 to 600 / 2½ to 24"), PN 25 (DN 200 to 600 / 8 to 24"), PN 40 (DN 15 to 150 / ½ to 6")
- ASME B16.5: Class 150 (DN ½ to 24"), Class 300 (DN ½ to 6")
- JIS B2220: 10 K (DN 50 to 600 / 2 to 24"), 20 K (DN 15 to 600 / ½ to 24")
- AS 2129: Table E (DN 25/1", DN 50/2")
- AS 4087: Cl. 14 (DN 50/2")

Promag H:

The permissible nominal pressure depends on the process connection, the seal and the nominal diameter.

Details are provided in the separate documentation "Technical Information" → 153.

**Pressure tightness (liner)****Promag S (SI units)**

Nominal diameter [mm]	Measuring tube lining	Pressure tightness of measuring tube lining (SI units)						
		Limit values for abs. pressure [mbar] at various fluid temperatures						
		25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
25 to 600	Polyurethane	0	0	-	-	-	-	-
65 to 600	Natural rubber	0	0	-	-	-	-	-
50 to 600	Hard rubber	0	0	0	-	-	-	-

Nominal diameter [mm]	Measuring tube lining	Pressure tightness of measuring tube lining (SI units)					
		Limit values for abs. pressure [mbar] at various fluid temperatures					
		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
15	PTFE	0	0	0	100	-	-
25	PTFE / PFA	0/0	0/0	0/0	100/0	-/0	-/0
32	PTFE / PFA	0/0	0/0	0/0	100/0	-/0	-/0
40	PTFE / PFA	0/0	0/0	0/0	100/0	-/0	-/0
50	PTFE / PFA	0/0	0/0	0/0	100/0	-/0	-/0
65	PTFE / PFA	0/0	*	40/0	130/0	-/0	-/0
80	PTFE / PFA	0/0	*	40/0	130/0	-/0	-/0
100	PTFE / PFA	0/0	*	135/0	170/0	-/0	-/0
125	PTFE / PFA	135/0	*	240/0	385/0	-/0	-/0

150	PTFE / PFA	135/0	*	240/0	385/0	-/0	-/0
200	PTFE / PFA	200/0	*	290/0	410/0	-/0	-/0
250	PTFE	330	*	400	530	-	-
300	PTFE	400	*	500	630	-	-
350	PTFE	470	*	600	730	-	-
400	PTFE	540	*	670	800	-	-
450	PTFE	Partial vacuum is impermissible					
500	PTFE						
600	PTFE						
* No value can be quoted.							

**Promag H (SI units)**

Nominal diameter [mm]	Measuring tube lining	Pressure tightness of measuring tube lining (SI units) Limit values for abs. pressure [mbar] at various fluid temperatures					
		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
2 to 150	PFA	0	0	0	0	0	0

**Promag S (US units)**

Nominal diameter [inch]	Measuring tube lining	Pressure tightness of measuring tube lining (US units) Limit values for abs. pressure [psi] at various fluid temperatures						
		77 °F	122 °F	176 °F	212 °F	266 °F	302 °F	356 °F
1 to 24"	Polyurethane	0	0	-	-	-	-	-
3 to 24"	Natural rubber	0	0	-	-	-	-	-
2 to 24"	Hard rubber	0	0	0	-	-	-	-

Nominal diameter [inch]	Measuring tube lining	Pressure tightness of measuring tube lining (US units) Limit values for abs. pressure [psi] at various fluid temperatures					
		77 °F	176 °F	212 °F	266 °F	302 °F	356 °F
½"	PTFE	0	0	0	1.5	-	-
1"	PTFE / PFA	0/0	0/0	0/0	1.5/0	-/0	-/0
-	PTFE / PFA	0/0	0/0	0/0	1.5/0	-/0	-/0
1 ½"	PTFE / PFA	0/0	0/0	0/0	1.5/0	-/0	-/0
2"	PTFE / PFA	0/0	0/0	0/0	1.5/0	-/0	-/0
-	PTFE / PFA	0/0	*	0.6/0	1.9/0	-/0	-/0
3"	PTFE / PFA	0/0	*	0.6/0	1.9/0	-/0	-/0
4"	PTFE / PFA	0/0	*	2.0/0	2.5/0	-/0	-/0
-	PTFE / PFA	2.0/0	*	3.5/0	5.6/0	-/0	-/0
6"	PTFE / PFA	2.0/0	*	3.5/0	5.6/0	-/0	-/0
8"	PTFE / PFA	2.9/0	*	4.2/0	5.9/0	-/0	-/0
10"	PTFE	4.8	*	5.8	7.7	-	-
12"	PTFE	5.8	*	7.3	9.1	-	-
14"	PTFE	6.8	*	8.7	10.6	-	-
16"	PTFE	7.8	*	9.7	11.6	-	-
18"	PTFE	Partial vacuum is impermissible					
20"	PTFE						
24"	PTFE						
* No value can be quoted.							

**Promag H (US units)**

Nominal diameter [inch]	Measuring tube lining	Pressure tightness of measuring tube lining (US units) Limit values for abs. pressure [psi] at various fluid temperatures					
		77 °F	176 °F	212 °F	266 °F	302 °F	356 °F
1/12 to 6"	PFA	0	0	0	0	0	0

**Limiting flow**

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

**Pressure loss**

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → 16.

## 10.10 Mechanical construction

**Design, dimensions**

The dimensions and face-to-face length of the sensor and transmitter can be found in the separate "Technical Information" for each device which can be downloaded in PDF format from [www.endress.com](http://www.endress.com). A list of the available "Technical information" documents can be found in the "Supplementary documentation" section → 153.

**Weight (SI units)**



**Promag S**

Note!

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

Nominal diameter [mm]	Weight in kilograms [kg]								
	Compact version			Remote version (without cable)					
	EN (DIN) / AS*	JIS	Sensor		Transmitter (Wall-mount housing)				
	EN (DIN) / AS*	JIS	EN (DIN) / AS*	JIS					
15	PN 40	10K	PN 40	10K	6.5	6.5	4.5	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	10K	PN 16	10K	12.0	11.1	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	10K	PN 10	10K	45	41.9	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	79	113	77	6.0
400					135	100	133	98	6.0
450					175	128	173	126	6.0
500					175	142	173	140	6.0
600	235	188	233	186	6.0				

Transmitter (compact version): 3.4 kg  
 High-temperature version: +1.5 kg  
 \* Only DN 25 and 50 are available for flanges according to AS

**Promag H**



Note!

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

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

Transmitter (compact version): 3.4 kg

**Weight (US units)**



**Promag S**

Note!

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

Nominal diameter [inch]	Weight in pounds [lbs]				
	Compact version		Remote version (without cable)		
	ASME		Sensor ASME	Transmitter (Wall-mount housing)	
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

Transmitter (compact version): 7.5 lbs  
High-temperature version: +3.3 lbs

**Promag H**

Note!

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

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

Transmitter (compact version): 7.5 lbs

**Materials****Promag S**

Transmitter housing:

- Compact and remote version: Powder-coated die-cast aluminum
- Window material: glass or polycarbonate

Sensor housing:

- DN 15 to 300 (1/2 to 12"): powder-coated die-cast aluminum
- DN 350 to 600 (14 to 24"): painted steel

Measuring tube:

- DN < 350 (14"): stainless steel 1.4301 or 1.4306 (304L)  
Non-stainless flange material with Al/Zn protective coating.
- DN > 300 (12"): stainless steel 1.4301 (304)  
For flanges made of carbon steel with protective varnish.

Flanges:

- EN 1092-1 (DIN 2501): EN 1092-1 (DIN 2501): S235JRG2, S2345JR+N, P250GH, P245GH, A105, E250C, 1.4571, F316L (DN < 350/14": with Al/Zn protective coating; DN > 300/12" with protective varnish)
- ASME B16.5: A105, F316L  
(DN < 350/14" with Al/Zn protective coating; DN > 300/12" with protective varnish)
- JIS B2220: A105, A350 LF2, F316L  
(DN < 350/14" with Al/Zn protective coating; DN > 300/12" with protective varnish)
- AS 2129: A105, P235GH, P265GH, S235JRG2, E250C, with Al/Zn protective coating
- AS 4087: A105, P265GH, S275JR, E250C, with Al/Zn protective coating

Ground disks:

- 1.4435(316L)
- Alloy C-22

Electrodes:

- 1.4435 (with tungsten carbide coating)
- Platinum
- Alloy C-22
- Tantalum
- Titanium Gr. 2
- Duplex 1.4462

- For brush electrodes:
  - 1.4310 (302)
  - Alloy X750

Seals:

- According to DIN EN 1514-1 form IBC

### Promag H

Transmitter housing:

- Compact housing: Powder-coated die-cast aluminum or stainless steel field housing (1.4301 (316L))
- Wall-mount housing: Powder-coated die-cast aluminum
- Window material: glass or polycarbonate
- Sensor housing: stainless steel 1.4301
- Wall mounting kit (holder panel): stainless steel 1.4301
- Measuring tube: stainless steel 1.4301
- Liner material: PFA\*

Flanges:

- Connection generally made of stainless steel 1.4404, F316L
- Flanges (EN (DIN), ASME B16.5, JIS) also in PVDF
- Adhesive fitting made of PVC

Electrodes:

- Standard: 1.4435
- Optional: Alloy C-22, tantalum, platinum (only up to DN 25 (1"))

Seals:

- DN 2 to 25: O-ring (EPDM, Viton, Kalrez) or molded seal (EPDM\*, silicone\*, Viton)
- DN 40 to 150: molded seal (EPDM\*, silicone\*)

Grounding rings:

- Standard: 1.4435 (316L),
- Optional: Alloy C-22, tantalum

\* According to approval: USP Class VI; FDA 21 CFR 177.2600; 3A

### Fitted electrodes

#### Promag S

Available as standard:

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

Optionally available for measuring electrodes made of platinum:

- 1 EPD electrode for empty pipe detection
- 1 Reference electrode for potential equalization

For measuring tube with natural rubber lining in combination with brush electrodes:

- 2 brush electrodes for signal detection

#### Promag H

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

**Process connections****Promag S**

Flange connection:

- EN 1092-1 (DIN 2501)
  - DN < 300 (12"): form A
  - DN > 300 (12"): form B
  - DN 65 (2½") PN 16 and DN 600 (24") PN 16 exclusively according to EN 1092-1
- ASME
- JIS B2220
- AS 2129
- AS 4087

**Promag H**

With O-ring:

- Welding nozzle 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:

- Welding nozzle EN 10357 (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

**Surface roughness**

All data relate to parts in contact with fluid.

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

## 10.11 Operability

**Display elements**

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

**Operating elements**

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

**Language packages**

Language groups available for operation in different countries:

- Western Europe and America (WEA):  
English, German, Spanish, Italian, French, Dutch and Portuguese
- Eastern Europe/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".

## 10.12 Certificates and approvals

<b>CE approval</b>	The measuring system described in these Operating Instructions therefore complies with the legal requirements of the EU Directives. Endress+Hauser confirms this by affixing the CE mark to it and by issuing the CE declaration of conformity.
<b>C-tick symbol</b>	The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
<b>Ex approval</b>	Information on the currently available Ex-rated versions (ATEX, FM, CSA, etc.) is available on request from your Endress+Hauser sales outlet. All explosion protection data are given in a separate documentation which is available upon request.
<b>Sanitary compatibility</b>	<p><b>Promag S</b> no applicable approvals or certification</p> <p><b>Promag H</b></p> <ul style="list-style-type: none"> <li>■ 3A authorization and EHEDG-certified</li> <li>■ Seals in conformity with FDA (except Kalrez seals)</li> </ul>
<b>Pressure equipment directive</b>	<p>The measuring devices can be ordered with or without PED (Pressure Equipment Directive). If a device with PED is required, this must be ordered explicitly. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary.</p> <ul style="list-style-type: none"> <li>■ With the identification PED/G1/III on the sensor nameplate, Endress+Hauser confirms conformity with the "Basic safety requirements" of Appendix I of the Pressure Equipment Directive 2014/68/EU.</li> <li>■ Devices with this identification (with PED) are suitable for the following types of fluid: <ul style="list-style-type: none"> <li>– Fluids of Group 1 and 2 with a steam pressure of greater than, or smaller and equal to 0.5 bar (7.3 psi)</li> <li>– Unstable gases</li> </ul> </li> <li>■ Devices without this identification (without PED) are designed and manufactured according to good engineering practice. They correspond to the requirements of Art.4, Section 3 of the Pressure Equipment Directive 2014/68/EU. Their application is illustrated in Diagrams 6 to 9 in Appendix II of the Pressure Equipment Directive 2014/68/EU.</li> </ul>
<b>Certification PROFIBUS</b>	<p>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:</p> <ul style="list-style-type: none"> <li>■ Certified in accordance with PROFIBUS Profile Version 3.0 (device certification number: available on request)</li> <li>■ The measuring device can also be operated with certified devices of other manufacturers (interoperability).</li> </ul>
<b>Other standards and guidelines</b>	<ul style="list-style-type: none"> <li>■ EN 60529 Degrees of protection by housing (IP code)</li> <li>■ EN 61010-1 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.</li> <li>■ IEC/EN 61326</li> </ul>



"Emission in accordance with requirements for class A".  
Electromagnetic compatibility (EMC requirements).

- ANSI/ISA-S82.01  
Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements. Pollution degree 2, Installation Category II.
- CAN/CSA-C22.2 (No. 1010.1-92)  
Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category I.
- NAMUR NE 21  
Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43  
Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53  
Software of field devices and signal-processing devices with digital electronics.

## 10.13 Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: [www.endress.com/worldwide](http://www.endress.com/worldwide)




Note!

### **Product Configurator - the tool for individual product configuration**

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

## 10.14 Accessories

Various accessories are available for the transmitter and the sensor. These can be ordered separately from Endress+Hauser →  117.



Note!

The Endress+Hauser service organization can provide detailed information on the order codes of your choice.

## 10.15 Documentation

- Flow Measurement (FA00005D/06)
- Promag 55S Technical Information (TI00071D/06)
- Promag 55H Technical Information (TI00096D/06)
- Promag 55 Description of Device Functions (BA00125D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA

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