



Level



Pressure



Flow



Temperature



Liquid  
Analysis



Registration



Systems  
Components



Services

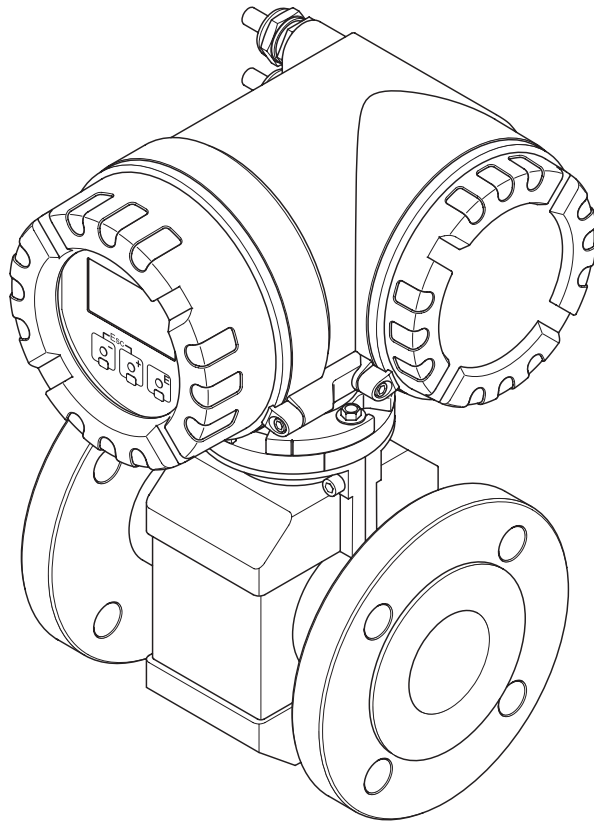


Solutions

## Operating Manual

# Proline Promag 53 PROFIBUS DP/PA

## Electromagnetic Flow Measuring System




## Brief operating instructions

These brief operating instructions show you how to configure your measuring device quickly and easily:


<b>Safety instructions</b>	Page 7
First of all, familiarize yourself with the safety instructions so that you can carry out the following working steps quickly and easily. Here you can find information about such topics as the designated use of the measuring device, operational safety and the safety icons and symbols used in the document.	
▼	
<b>Installation</b>	Page 13
The "Installation" section contains all of the necessary information for incoming acceptance, the installation conditions that have to be observed (orientation, installation site, vibrations etc.), through to the actual installation of the measuring device, including information about seals, grounding and the required tightening torques for the compact and remote versions.	
▼	
<b>Wiring</b>	Page 43
The "Wiring" section describes the electrical connection of the measuring device and the connection of the remote version connecting cable. Additional topics of this chapter include:	
<ul style="list-style-type: none"> <li>■ The specifications of the coil/signal cable and the fieldbus cable</li> <li>■ The terminal assignment</li> <li>■ The potential matching and degree of protection</li> </ul>	
▼	
<b>Display and operating elements</b>	Page 65
The available display and operating elements of the local display and working with the function matrix are presented here.	
▼	
<b>Configuration programs</b>	Page 73 ff.
The measuring device can be configured and operated using the local display and using configuration programs from various manufacturers.	
▼	
<b>Basic configuration (device parameters, automation functions)</b>	Seite 84 ff.
You can commission your measuring device quickly and easily, using the special "Quick Setup" menu. It enables you to directly configure important basic functions using the local display, for example display language, measured variables, units of measure, type of signal, etc.	
The following adjustment is to be made separately as necessary:	
– Empty/full-pipe adjustment for empty pipe detection → Page 124 ff.	
▼	
<b>PROFIBUS interface</b>	Page 95 ff.
Commissioning the PROFIBUS interface.	
▼	
<b>System integration and cyclic data transmission</b>	
Use of the device master files (GSD files) → Page 100 ff.	
Cyclic data transmission → Page 104 ff.	
▼	
<b>Hardware settings</b>	
Information about setting the hardware write protection, the device address, etc. for:	
<ul style="list-style-type: none"> <li>■ PROFIBUS DP → Page 76 ff.</li> <li>■ PROFIBUS PA → Page 81 ff.</li> </ul>	
▼	

<b>Application-specific commissioning</b>	Page 86 ff.
<p>In the "Commissioning" Quick Setup, you have the option of launching other, application-specific Quick Setups, for instance the menu for measuring pulsating flow, etc.</p>	



<b>Customer-specific configuration</b>	Page 70 ff.
<p>Complex measuring operations necessitate additional functions that you can configure as necessary with the aid of the function matrix, and customize to suit your process parameters.</p> <p> <b>Note!</b> All functions are described in detail, as is the function matrix itself, in the "Description of Device Functions" manual which is a separate part of this Operating Manual.</p>	



<b>Data storage</b>	Page 94 ff.
<p>The configuration of the transmitter can be stored on the integrated T-DAT data storage device.</p> <p> <b>Note!</b> For timesaving commissioning, the settings stored in the T-DAT can be transmitted:</p> <ul style="list-style-type: none"> <li>- For equivalent measuring points (equivalent configuration,)</li> <li>- In the event of device/board replacement.</li> </ul>	



<b>Additional configuration (only PROFIBUS DP)</b>	
<p>For flexible-assignment boards, the outputs can be changed by configuring the current output and relay contacts.→ Page 79 ff. The F-CHIP module allows the use of optional software packages for batching and the ECC (Electrode Cleaning Circuit). → Page 125</p>	



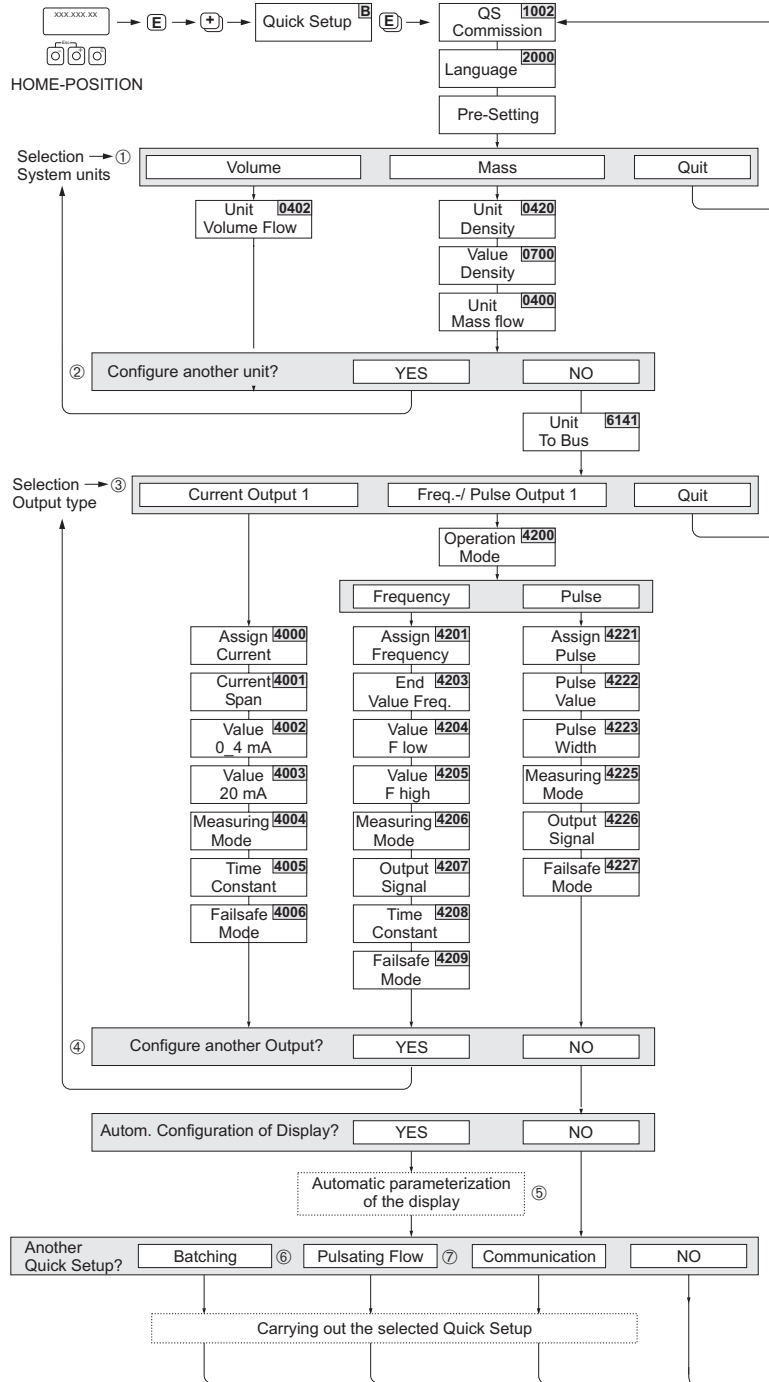
**Note!**  
Always start troubleshooting with the checklist on **Page 130** if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

## QUICK SETUP for fast commissioning



Note!

More detailed information on running Quick Setup menus, especially for devices without a local display, is contained in the "Commissioning" section. → Page 84 ff.



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Fig. 1: Quick Setup for fast commissioning

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# 1 Safety instructions

## 1.1 Designated use

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

A minimum conductivity of 20  $\mu\text{S}/\text{cm}$  is required for measuring demineralized water. Most liquids can be metered, provided they have a minimum conductivity of 5  $\mu\text{S}/\text{cm}$ , for example:

- acids, alkalis, pastes, mashers, pulps,
- drinking water, wastewater, sewage sludge,
- milk, beer, wine, mineral water, yogurt, molasses, etc.

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




## 1.2 Installation, commissioning and operation

Note the following points:

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

## 1.3 Operational safety

Note the following points:

- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body (e.g.  Europe,  USA,  Canada)
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326, and NAMUR recommendations NE 21, NE 43 and NE 53.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.

- Due to the performance rate in the electronic components, the maximum heating of the outer housing surfaces is 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 this Operating Manual.

## 1.4 Returns

The following procedures must be carried out before a flowmeter requiring repair or calibration, for example, is returned to Endress+Hauser:

- Always enclose a duly completed "Declaration of contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.



Note!

You will find a preprinted "Declaration of contamination" form at the back of this Operating Manual.



Warning!

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

## 1.5 Safety conventions and icons

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



Warning!

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



Caution!

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



Note!

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



## 2 Identification

### 2.1 Device designation

The flow measuring system consists of the following components:

- Promag 53 transmitter
- Promag W, Promag P or 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

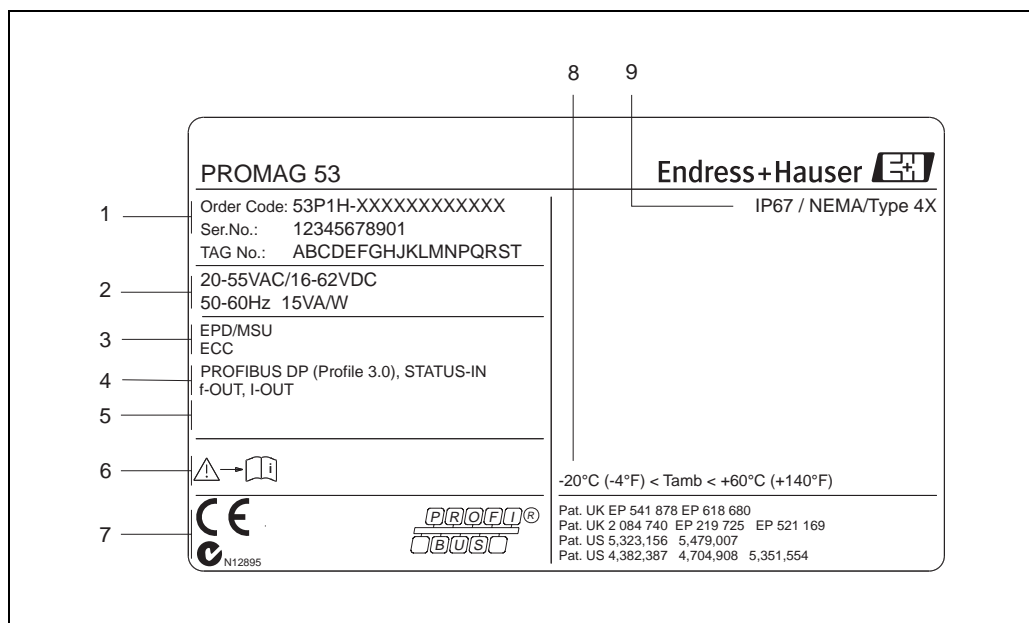


Fig. 2: Nameplate specifications for the "Promag 53" transmitter (example)

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

### 2.1.2 Nameplate of the sensor

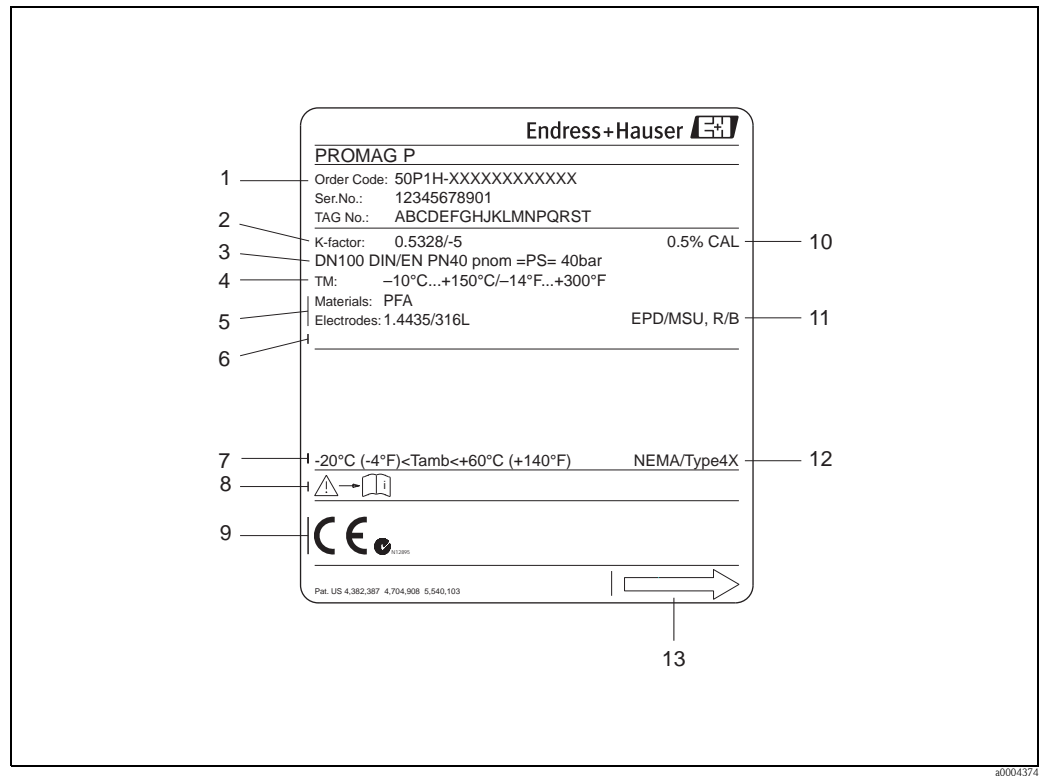


Fig. 3: Nameplate specifications for the "Promag" sensor (example)

- 1 Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
- 2 Calibration factor with zero point
- 3 Nominal diameter/nominal pressure
- 4 Medium temperature range
- 5 Materials: lining/measuring electrode
- 6 Reserved for information on special products
- 7 Permitted ambient temperature range
- 8 Please refer to operating instructions / documentation
- 9 Reserved for additional information on device version (approvals, certificates)
- 10 Calibration tolerance
- 11 Additional information
  - EPD: with empty pipe detection electrode
  - R/B: with reference electrode (only for Promag P)
- 12 Degree of protection
- 13 Flow direction

### 2.1.3 Nameplate for connections

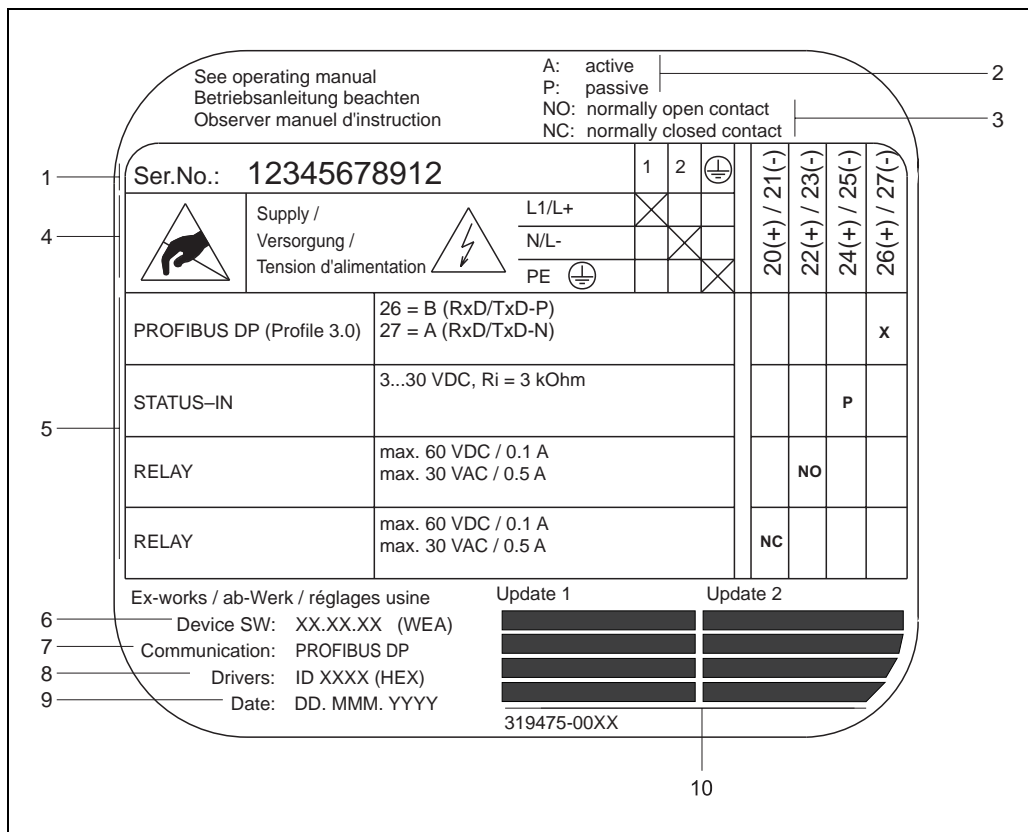


Fig. 4: Nameplate specifications for "Promag" transmitter connections (example)

- 1 Serial number
- 2 Possible configuration of current output
- 3 Possible configuration of relay contacts
- 4 Terminal assignment, cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC  
Terminal **No. 1**: L1 for AC, L+ for DC  
Terminal **No. 2**: N for AC, L- for DC
- 5 Pending signals at the inputs and outputs  
possible configurations and terminal assignment
- 6 Version of device software currently installed (inclusive language group)
- 7 Installed communication type
- 8 PROFIBUS ID No.
- 9 Date of installation
- 10 Current updates to data specified in points 6 to 9

## 2.2 Certificates and approvals

The devices are designed in accordance with good engineering practice to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of IEC/EN 61326.

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

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

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

The device thus meets all the requirements of the following specifications:

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

## 2.3 Registered trademarks

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 Organization, Karlsruhe, D

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, ToF Tool - Fieldtool® Package, FieldCare®, Fieldcheck®, Applicator®

Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

## 3 Installation

### 3.1 Incoming acceptance, transport and storage

#### 3.1.1 Incoming acceptance

On receipt of the goods, check the following points:

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

#### 3.1.2 Transport

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

- Transport the devices in the containers in which they are delivered.
- Do not remove the 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 covers 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  $DN \leq 300$  ( $\leq 12''$ )*

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



Warning!

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

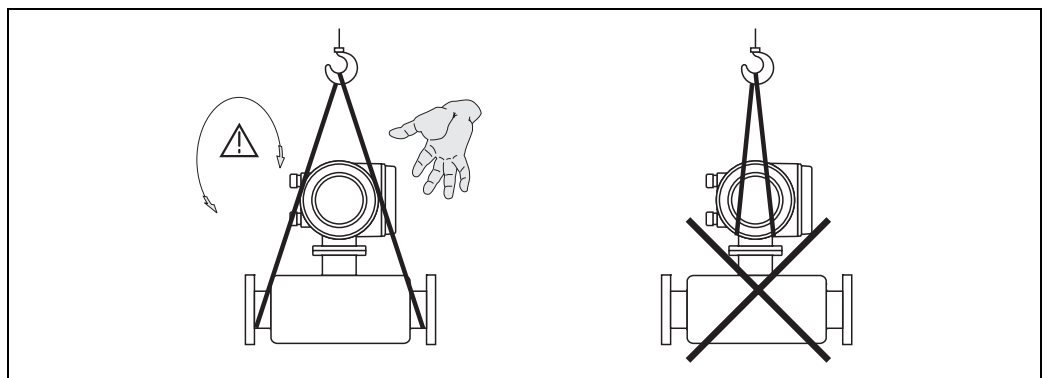


Fig. 5: *Transporting sensors with  $DN \leq 300$  ( $\leq 12''$ )*

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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.

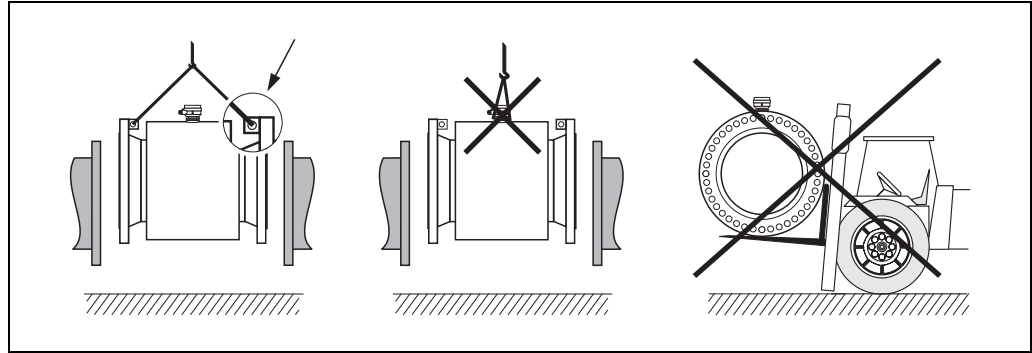


Fig. 6: Transporting sensors with  $DN > 300 (> 12")$

### 3.1.3 Storage

Note the following points:

- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permissible storage temperature corresponds to the ambient temperature range of the measuring transmitter and the appropriate measuring sensors. → Page 160
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the 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

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

### 3.2.2 Mounting location

Entrained air or gas bubbles in the measuring tube can result in an increase in measuring errors.

**Avoid** the following locations:

- Highest point of a pipeline. Risk of air entrainment.
- Directly upstream of a free pipe outlet in a vertical pipeline.

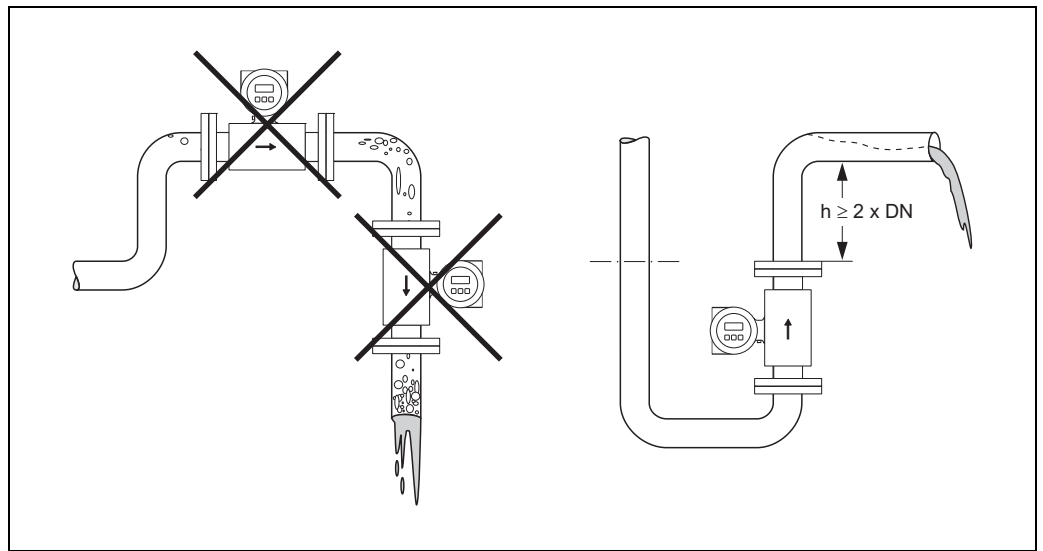


Fig. 7: Mounting location

### Installation of 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 pressure tightness of the measuring tube lining → Page 162

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on vibration and shock resistance of the measuring system → Page 160

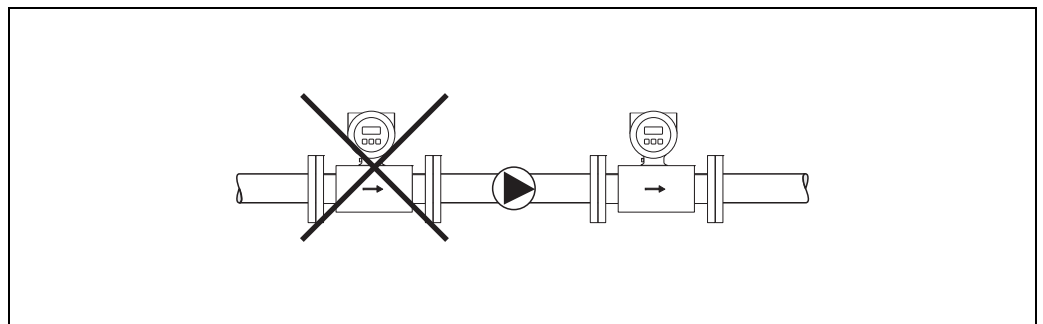


Fig. 8: Installation of pumps

### Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function offers additional certainty in detecting empty or partially filled pipes. (EPD → Page 124)



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.

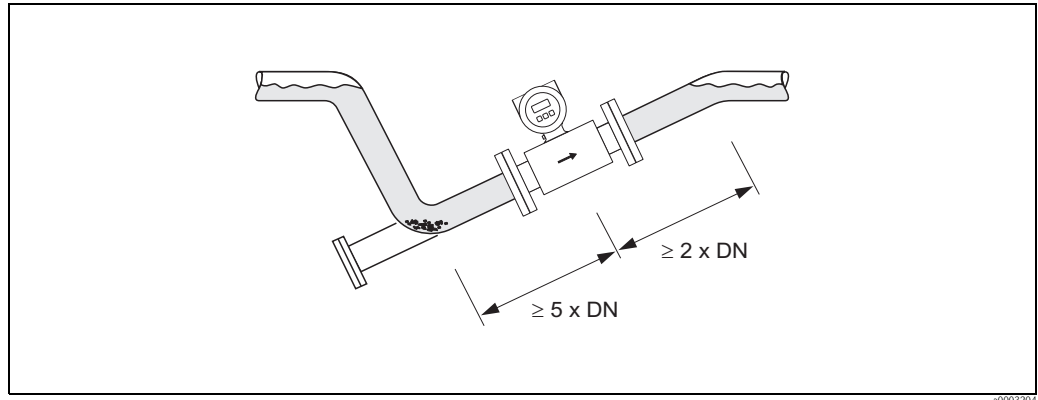


Fig. 9: Installation in partially filled pipe

### Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters (16 in). 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 entrained air.

Information on pressure tightness of the measuring tube lining → Page 162

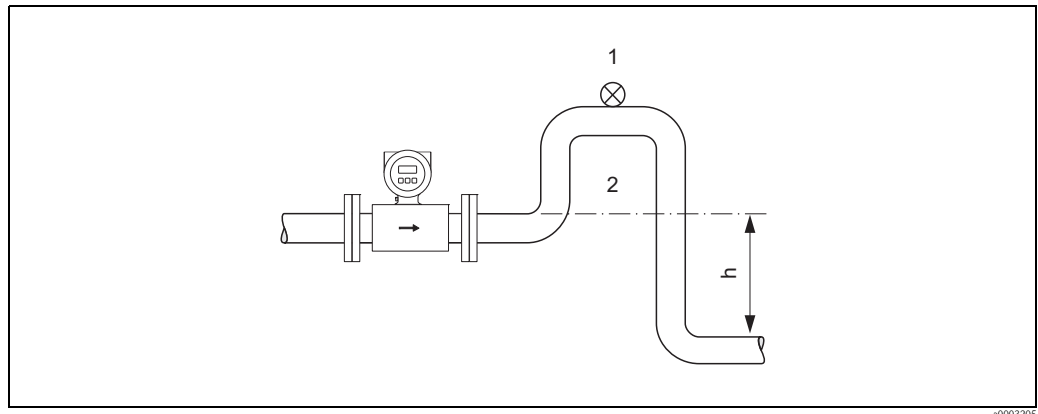


Fig. 10: Measures for installation in a down pipe ( $h > 5 \text{ m} / 16 \text{ ft}$ )

- 1 Vent valve
- 2 Siphon



### 3.2.3 Orientation

An optimum orientation position helps avoid gas and air entrainment 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 accretive fluids, e.g. electrically conductive deposits "Description of Device Functions" manual.
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressures → Page 124
- Exchangeable measuring electrodes for abrasive fluids (only Promag W) → Page 152

#### Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with Empty Pipe Detection (EPD).

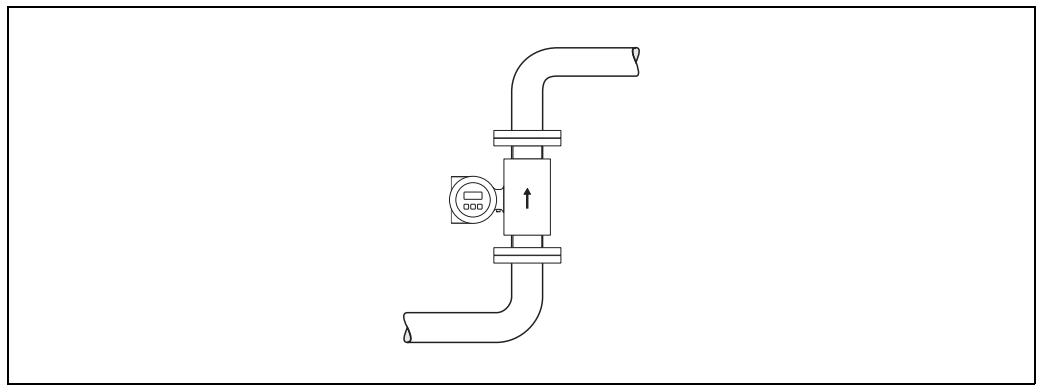


Fig. 11: Vertical orientation

#### Horizontal orientation

The measuring electrode plane should be horizontal. This prevents brief isolation 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 Figure). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.

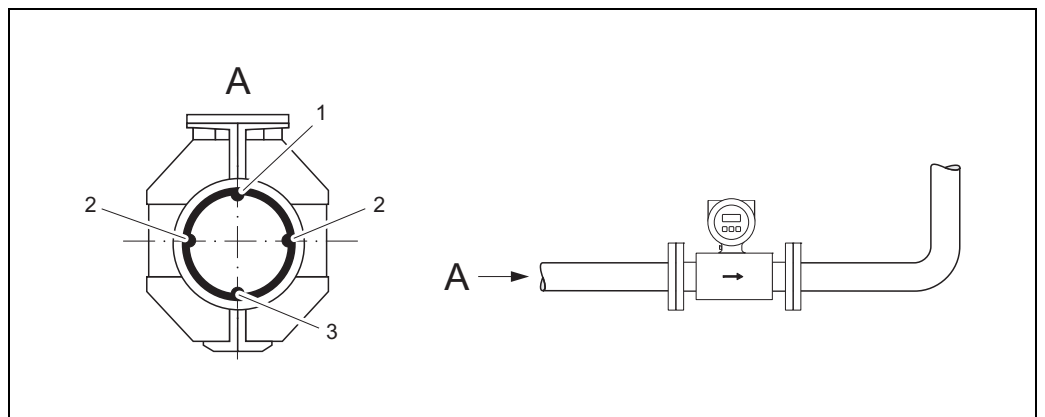


Fig. 12: Horizontal orientation

- 1 EPD electrode for empty pipe detection (not for Promag H, DN 2 to 8, 1/12" to 5/16")
- 2 Measuring electrodes for the signal acquisition
- 3 Reference electrode for potential matching (not for Promag H)

### 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:  $\geq 2 \times \text{DN}$

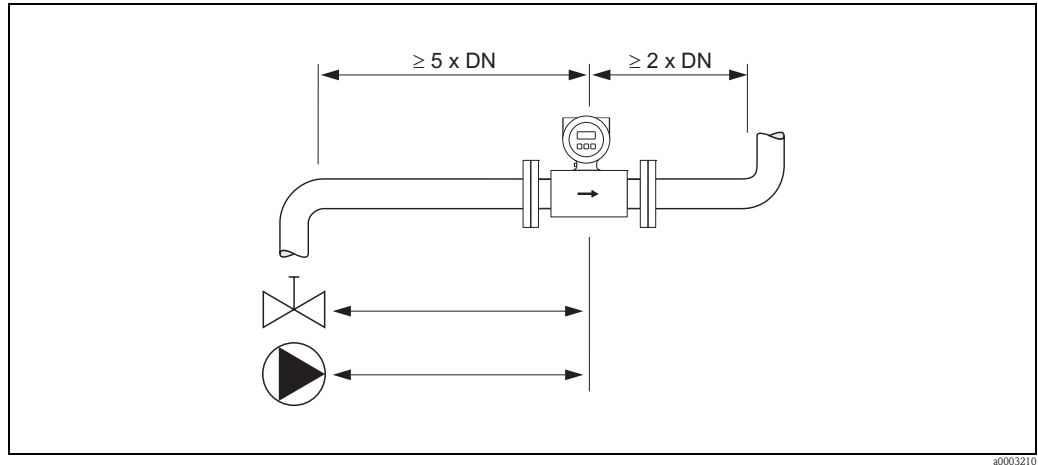


Fig. 13: Inlet and outlet runs

### 3.2.4 Vibrations

Support and secure the both piping and the sensor if vibration is severe.



Caution!

It is advisable to install sensor and transmitter separately if vibration is excessively severe. Information about the permitted shock and vibration resistance → Page 160

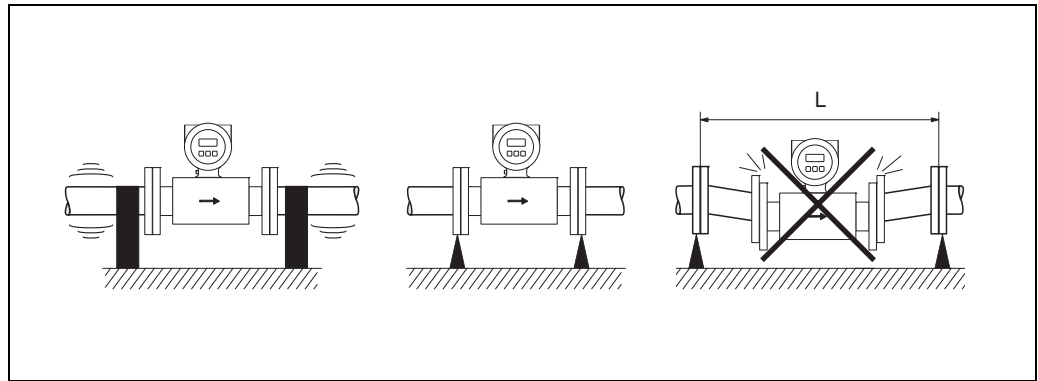


Fig. 14: Measures to prevent vibration of the measuring device ( $L > 10 \text{ m}/33 \text{ ft}$ )

### 3.2.5 Foundations, supports

If the nominal diameter is  $DN \geq 350$  ( $\geq 14''$ ), mount the transmitter 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.

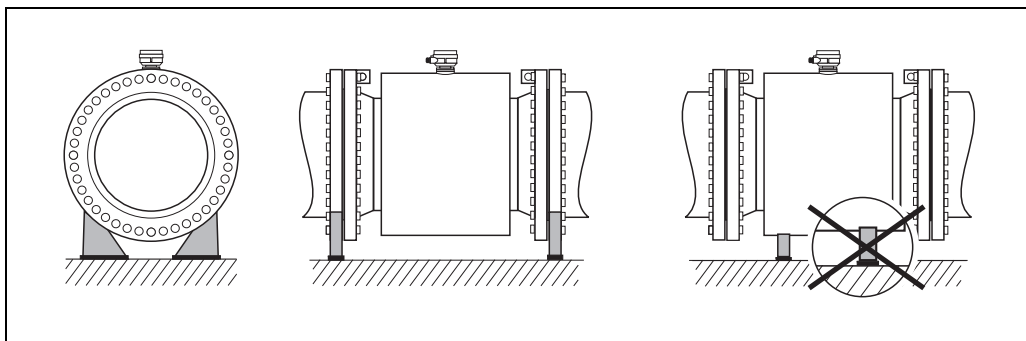


Fig. 15: Correct support for large nominal diameters  $DN \geq 350$  ( $\geq 14''$ )

### 3.2.6 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 applies to liquids of viscosity similar to water.

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

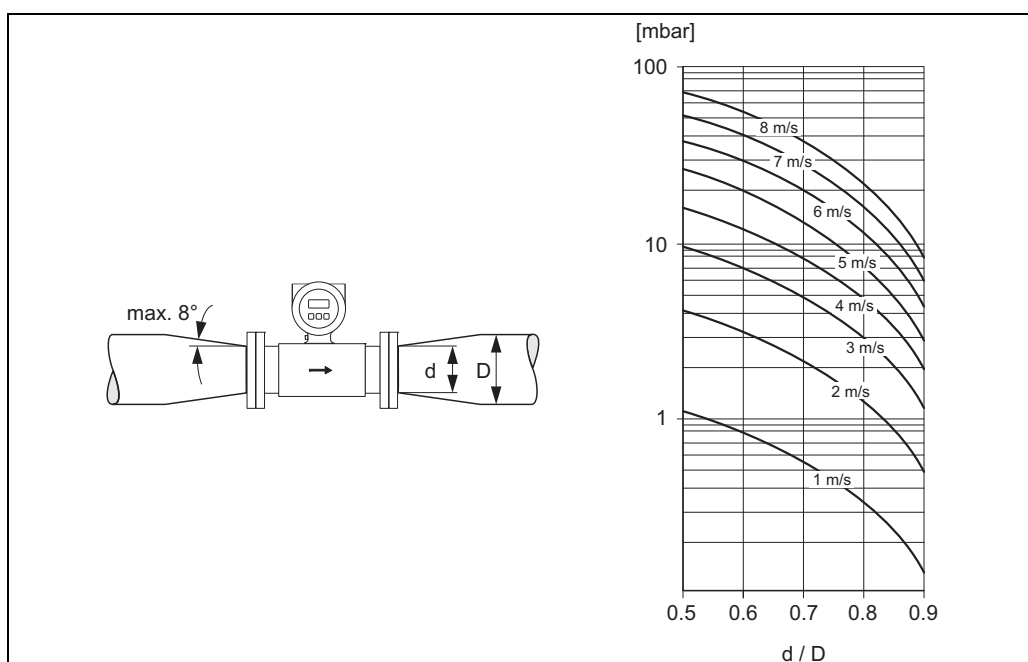


Fig. 16: Pressure loss due to adapters (for pressure losses in US units, please contact Endress+Hauser)

### 3.2.7 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 to 10 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 such as potter's clay, lime milk, ore slurry, etc.
- $v > 2$  m/s (>6 ft/s): for fluids producing buildup such as wastewater sludge, etc.



Note!

Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor through the use of adapters. → Page 19

#### Flow rate characteristic values (SI units)

*Promag W*

Nominal diameter [mm]	Recommended flow rate min./max. full scale value ( $v \approx 0.3$ or $10$ m/s)	Factory settings		
		Full scale value ( $v \approx 2.5$ m/s)	Pulse value ( $\approx 2$ pulse/s)	Low flow ( $v \approx 0.04$ m/s)
25	9 to 300 dm <sup>3</sup> /min	75 dm <sup>3</sup> /min	0.50 dm <sup>3</sup>	1 dm <sup>3</sup> /min
32	15 to 500 dm <sup>3</sup> /min	125 dm <sup>3</sup> /min	1.00 dm <sup>3</sup>	2 dm <sup>3</sup> /min
40	25 to 700 dm <sup>3</sup> /min	200 dm <sup>3</sup> /min	1.50 dm <sup>3</sup>	3 dm <sup>3</sup> /min
50	35 to 1100 dm <sup>3</sup> /min	300 dm <sup>3</sup> /min	2.50 dm <sup>3</sup>	5 dm <sup>3</sup> /min
65	60 to 2000 dm <sup>3</sup> /min	500 dm <sup>3</sup> /min	5.00 dm <sup>3</sup>	8 dm <sup>3</sup> /min
80	90 to 3000 dm <sup>3</sup> /min	750 dm <sup>3</sup> /min	5.00 dm <sup>3</sup>	12 dm <sup>3</sup> /min
100	145 to 4700 dm <sup>3</sup> /min	1200 dm <sup>3</sup> /min	10.00 dm <sup>3</sup>	20 dm <sup>3</sup> /min
125	220 to 7500 dm <sup>3</sup> /min	1850 dm <sup>3</sup> /min	15.00 dm <sup>3</sup>	30 dm <sup>3</sup> /min
150	20 to 600 m <sup>3</sup> /h	150 m <sup>3</sup> /h	0.025 m <sup>3</sup>	2.5 m <sup>3</sup> /h
200	35 to 1100 m <sup>3</sup> /h	300 m <sup>3</sup> /h	0.05 m <sup>3</sup>	5.0 m <sup>3</sup> /h
250	55 to 1700 m <sup>3</sup> /h	500 m <sup>3</sup> /h	0.05 m <sup>3</sup>	7.5 m <sup>3</sup> /h
300	80 to 2400 m <sup>3</sup> /h	750 m <sup>3</sup> /h	0.10 m <sup>3</sup>	10 m <sup>3</sup> /h
350	110 to 3300 m <sup>3</sup> /h	1000 m <sup>3</sup> /h	0.10 m <sup>3</sup>	15 m <sup>3</sup> /h
400	140 to 4200 m <sup>3</sup> /h	1200 m <sup>3</sup> /h	0.15 m <sup>3</sup>	20 m <sup>3</sup> /h
450	180 to 5400 m <sup>3</sup> /h	1500 m <sup>3</sup> /h	0.25 m <sup>3</sup>	25 m <sup>3</sup> /h
500	220 to 6600 m <sup>3</sup> /h	2000 m <sup>3</sup> /h	0.25 m <sup>3</sup>	30 m <sup>3</sup> /h
600	310 to 9600 m <sup>3</sup> /h	2500 m <sup>3</sup> /h	0.30 m <sup>3</sup>	40 m <sup>3</sup> /h
700	420 to 13500 m <sup>3</sup> /h	3500 m <sup>3</sup> /h	0.50 m <sup>3</sup>	50 m <sup>3</sup> /h
800	550 to 18000 m <sup>3</sup> /h	4500 m <sup>3</sup> /h	0.75 m <sup>3</sup>	75 m <sup>3</sup> /h
900	690 to 22500 m <sup>3</sup> /h	6000 m <sup>3</sup> /h	0.75 m <sup>3</sup>	100 m <sup>3</sup> /h
1000	850 to 28000 m <sup>3</sup> /h	7000 m <sup>3</sup> /h	1.00 m <sup>3</sup>	125 m <sup>3</sup> /h
1200	1250 to 40000 m <sup>3</sup> /h	10000 m <sup>3</sup> /h	1.50 m <sup>3</sup>	150 m <sup>3</sup> /h
1400	1700 to 55000 m <sup>3</sup> /h	14000 m <sup>3</sup> /h	2.00 m <sup>3</sup>	225 m <sup>3</sup> /h
1600	2200 to 70000 m <sup>3</sup> /h	18000 m <sup>3</sup> /h	2.50 m <sup>3</sup>	300 m <sup>3</sup> /h
1800	2800 to 90000 m <sup>3</sup> /h	23000 m <sup>3</sup> /h	3.00 m <sup>3</sup>	350 m <sup>3</sup> /h
2000	3400 to 110000 m <sup>3</sup> /h	28500 m <sup>3</sup> /h	3.50 m <sup>3</sup>	450 m <sup>3</sup> /h

*Promag P*

Nominal diameter [mm]	Recommended flow rate min./max. full scale value (v ≈ 0.3 or 10 m/s)	Factory settings		
		Full scale value (v ≈ 2.5 m/s)	Pulse value (≈ 2 pulse/s)	Low flow (v ≈ 0.04 m/s)
15	4 to 100 dm <sup>3</sup> /min	25 dm <sup>3</sup> /min	0.20 dm <sup>3</sup>	0.5 dm <sup>3</sup> /min
25	9 to 300 dm <sup>3</sup> /min	75 dm <sup>3</sup> /min	0.50 dm <sup>3</sup>	1 dm <sup>3</sup> /min
32	15 to 500 dm <sup>3</sup> /min	125 dm <sup>3</sup> /min	1.00 dm <sup>3</sup>	2 dm <sup>3</sup> /min
40	25 to 700 dm <sup>3</sup> /min	200 dm <sup>3</sup> /min	1.50 dm <sup>3</sup>	3 dm <sup>3</sup> /min
50	35 to 1100 dm <sup>3</sup> /min	300 dm <sup>3</sup> /min	2.50 dm <sup>3</sup>	5 dm <sup>3</sup> /min
65	60 to 2000 dm <sup>3</sup> /min	500 dm <sup>3</sup> /min	5.00 dm <sup>3</sup>	8 dm <sup>3</sup> /min
80	90 to 3000 dm <sup>3</sup> /min	750 dm <sup>3</sup> /min	5.00 dm <sup>3</sup>	12 dm <sup>3</sup> /min
100	145 to 4700 dm <sup>3</sup> /min	1200 dm <sup>3</sup> /min	10.00 dm <sup>3</sup>	20 dm <sup>3</sup> /min
125	220 to 7500 dm <sup>3</sup> /min	1850 dm <sup>3</sup> /min	15.00 dm <sup>3</sup>	30 dm <sup>3</sup> /min
150	20 to 600 m <sup>3</sup> /h	150 m <sup>3</sup> /h	0.025 m <sup>3</sup>	2.5 m <sup>3</sup> /h
200	35 to 1100 m <sup>3</sup> /h	300 m <sup>3</sup> /h	0.05 m <sup>3</sup>	5.0 m <sup>3</sup> /h
250	55 to 1700 m <sup>3</sup> /h	500 m <sup>3</sup> /h	0.05 m <sup>3</sup>	7.5 m <sup>3</sup> /h
300	80 to 2400 m <sup>3</sup> /h	750 m <sup>3</sup> /h	0.10 m <sup>3</sup>	10 m <sup>3</sup> /h
350	110 to 3300 m <sup>3</sup> /h	1000 m <sup>3</sup> /h	0.10 m <sup>3</sup>	15 m <sup>3</sup> /h
400	140 to 4200 m <sup>3</sup> /h	1200 m <sup>3</sup> /h	0.15 m <sup>3</sup>	20 m <sup>3</sup> /h
450	180 to 5400 m <sup>3</sup> /h	1500 m <sup>3</sup> /h	0.25 m <sup>3</sup>	25 m <sup>3</sup> /h
500	220 to 6600 m <sup>3</sup> /h	2000 m <sup>3</sup> /h	0.25 m <sup>3</sup>	30 m <sup>3</sup> /h
600	310 to 9600 m <sup>3</sup> /h	2500 m <sup>3</sup> /h	0.30 m <sup>3</sup>	40 m <sup>3</sup> /h

*Promag H*

Nominal diameter [mm]	Recommended flow rate min./max. full scale value (v ≈ 0.3 or 10 m/s)	Factory settings		
		Full scale value (v ≈ 2.5 m/s)	Pulse value (≈ 2 pulse/s)	Low flow (v ≈ 0.04 m/s)
2	0.06 to 1.8 dm <sup>3</sup> /min	0.5 dm <sup>3</sup> /min	0.005 dm <sup>3</sup>	0.01 dm <sup>3</sup> /min
4	0.25 to 7 dm <sup>3</sup> /min	2 dm <sup>3</sup> /min	0.025 dm <sup>3</sup>	0.05 dm <sup>3</sup> /min
8	1 to 30 dm <sup>3</sup> /min	8 dm <sup>3</sup> /min	0.10 dm <sup>3</sup>	0.1 dm <sup>3</sup> /min
15	4 to 100 dm <sup>3</sup> /min	25 dm <sup>3</sup> /min	0.20 dm <sup>3</sup>	0.5 dm <sup>3</sup> /min
25	9 to 300 dm <sup>3</sup> /min	75 dm <sup>3</sup> /min	0.50 dm <sup>3</sup>	1 dm <sup>3</sup> /min
40	25 to 700 dm <sup>3</sup> /min	200 dm <sup>3</sup> /min	1.50 dm <sup>3</sup>	3 dm <sup>3</sup> /min
50	35 to 1100 dm <sup>3</sup> /min	300 dm <sup>3</sup> /min	2.50 dm <sup>3</sup>	5 dm <sup>3</sup> /min
65	60 to 2000 dm <sup>3</sup> /min	500 dm <sup>3</sup> /min	5.00 dm <sup>3</sup>	8 dm <sup>3</sup> /min
80	90 to 3000 dm <sup>3</sup> /min	750 dm <sup>3</sup> /min	5.00 dm <sup>3</sup>	12 dm <sup>3</sup> /min
100	145 to 4700 dm <sup>3</sup> /min	1200 dm <sup>3</sup> /min	10.00 dm <sup>3</sup>	20 dm <sup>3</sup> /min

**Flow rate characteristic values (US units)***Promag W*

Nominal diameter [inch]	Recommended flow rate min./max. full scale value ( $v \approx 1.0$ or $33$ ft/s)	Factory settings		
		Full scale value ( $v \approx 8.2$ ft/s)	Pulse value ( $\approx 2$ pulse/s)	Low flow ( $v \approx 0.01$ ft/s)
1"	2.5 to 80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1¼"	4 to 130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1½"	7 to 190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	10 to 300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2½"	16 to 500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	24 to 800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	40 to 1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	60 to 1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	90 to 2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	155 to 4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250 to 7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	350 to 10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	500 to 15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	600 to 19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	800 to 24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	1000 to 30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	1400 to 44000 gal/min	10500 gal/min	100 gal	180 gal/min
28"	1900 to 60000 gal/min	13500 gal/min	125 gal	210 gal/min
30"	2150 to 67000 gal/min	16500 gal/min	150 gal	270 gal/min
32"	2450 to 80000 gal/min	19500 gal/min	200 gal	300 gal/min
36"	3100 to 100000 gal/min	24000 gal/min	225 gal	360 gal/min
40"	3800 to 125000 gal/min	30000 gal/min	250 gal	480 gal/min
42"	4200 to 135000 gal/min	33000 gal/min	250 gal	600 gal/min
48"	5500 to 175000 gal/min	42000 gal/min	400 gal	600 gal/min
54"	9 to 300 Mgal/d	75 Mgal/d	0.0005 Mgal	1.3 Mgal/d
60"	12 to 380 Mgal/d	95 Mgal/d	0.0005 Mgal	1.3 Mgal/d
66"	14 to 500 Mgal/d	120 Mgal/d	0.0008 Mgal	2.2 Mgal/d
72"	16 to 570 Mgal/d	140 Mgal/d	0.0008 Mgal	2.6 Mgal/d
78"	18 to 650 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d

*Promag P*

Nominal diameter [inch]	Recommended flow rate min./max. full scale value (v ≈ 1.0 or 33 ft/s)	Factory settings		
		Full scale value (v ≈ 8.2 ft/s)	Pulse value (≈ 2 pulse/s)	Low flow (v ≈ 0.01 ft/s)
½"	1.0 to 27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	2.5 to 80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1¼"	4 to 130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1½"	7 to 190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	10 to 300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2½"	16 to 500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	24 to 800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	40 to 1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	60 to 1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	90 to 2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	155 to 4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250 to 7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	350 to 10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	500 to 15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	600 to 19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	800 to 24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	1000 to 30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	1400 to 44000 gal/min	10500 gal/min	100 gal	180 gal/min

*Promag H*

Nominal diameter [inch]	Recommended flow rate min./max. full scale value (v ≈ 1.0 or 33 ft/s)	Factory settings		
		Full scale value (v ≈ 8.2 ft/s)	Pulse value (≈ 2 pulse/s)	Low flow (v ≈ 0.01 ft/s)
1/12"	0.015 to 0.5 gal/min	0.1 gal/min	0.001 gal	0.002 gal/min
5/32"	0.07 to 2 gal/min	0.5 gal/min	0.005 gal	0.008 gal/min
5/16"	0.25 to 8 gal/min	2 gal/min	0.02 gal	0.025 gal/min
½"	1.0 to 27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	2.5 to 80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1½"	7 to 190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	10 to 300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2½"	16 to 500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	24 to 800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	40 to 1250 gal/min	300 gal/min	2 gal	4.0 gal/min

### 3.2.8 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 matching between sensor and transmitter, if necessary.
- The permissible cable length  $L_{max}$  depends on the fluid conductivity (Fig. 17). A minimum conductivity of  $20 \mu\text{S}/\text{cm}$  is required for measuring demineralized water.

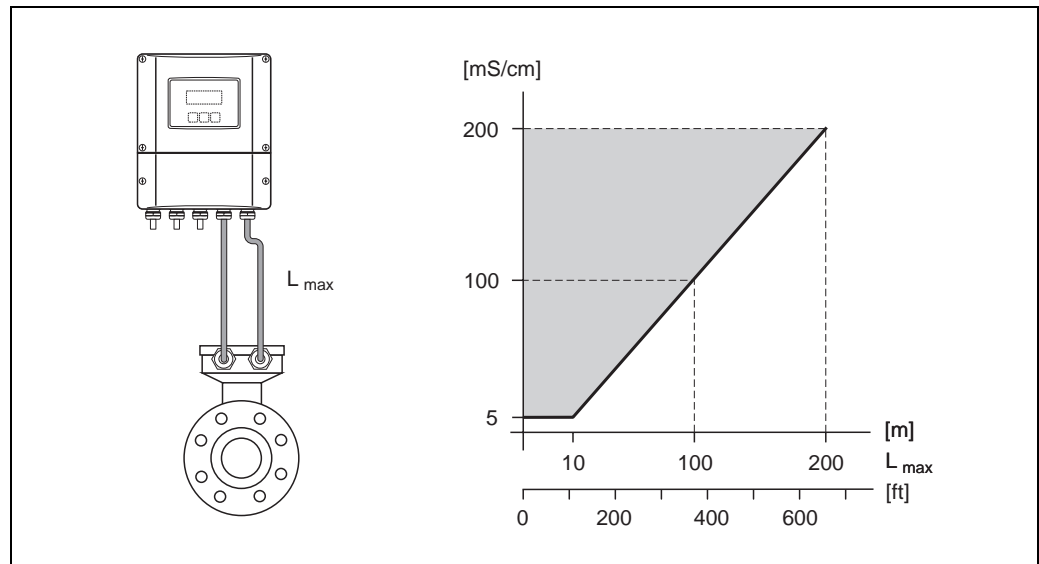


Fig. 17: Permissible cable lengths for the remote version

Gray shaded area = permissible range

$L_{max}$  = Length of connecting cable in [m]

Fluid conductivity in [ $\mu\text{S}/\text{cm}$ ]



## 3.3 Installation

### 3.3.1 Installing the Promag W sensor



Note!

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

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

- Observe in any case the necessary screw tightening torques → Page 26 ff.
- Information on the installation of additional ground disks → Page 25

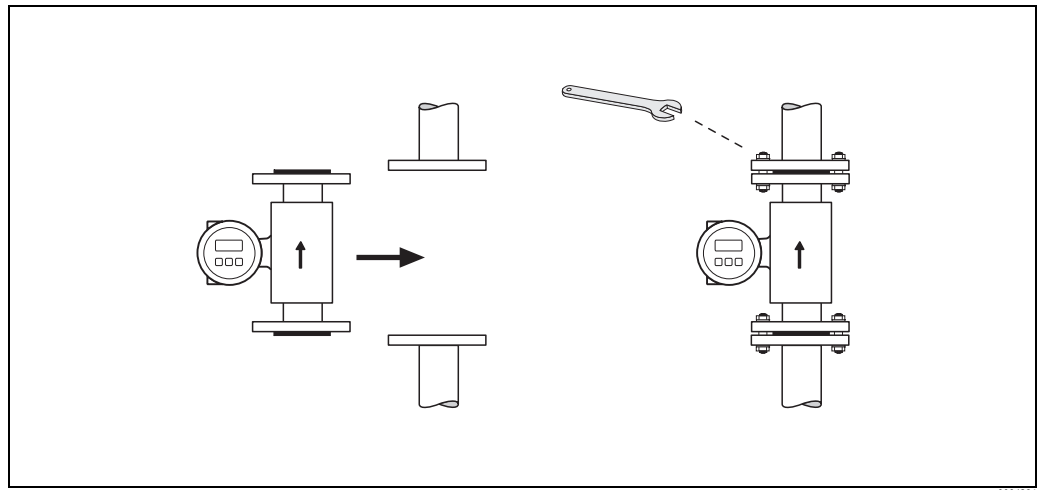


Fig. 18: Installing the sensor

#### Seals

Comply with the following instructions when installing seals:

- Hard rubber lining → additional seals are **always** required!
- Polyurethane lining → additional seals are recommended.
- For DIN flanges, use only seals acc. to DIN EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.



Caution!

Risk of short circuit. Do not use electrically conductive sealing 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 25 to 2000, 1" to 78")

If necessary, a special ground cable for potential matching can be ordered as an accessory (→ Page 128 ff.). Detailed assembly instructions → Page 60 ff.

#### Assembly with ground disks (DN 25 to 300, 1" to 12")

Depending on the application, e.g. with lined or ungrounded pipes (→ Page 60 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for potential matching. Ground disks can be ordered separately as an accessory from Endress+Hauser. → Page 26



Caution!

- In this case, when using ground disks (including seals) the total fitting length increases! The dimensions are provided in the separate documentation "Technical information".
- Hard rubber lining → install additional seals between the sensor and ground disk and between the ground disk and pipe flange.
- Polyurethane lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and additional seal(s) between the instrument and the pipe flange (see Figure).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in Fig. 1 until the handle strikes the bolts. This will center the ground disk automatically.
4. Tighten the bolts to the required torque. → Page 128
5. Connect the ground disk to ground potential. → Page 61

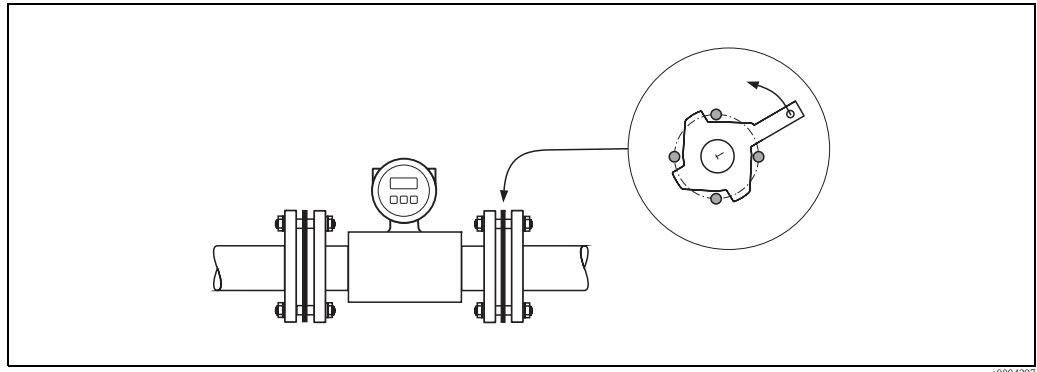


Fig. 19: Assembly with ground disks (Promag W, DN 25 to 300, 1" to 12")

### Screw tightening torques (Promag W)

Note the following points:

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

Promag W Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	PN 40	4 x M 12	-	15
32	PN 40	4 x M 16	-	24
40	PN 40	4 x M 16	-	31
50	PN 40	4 x M 16	-	40
65 *	PN 16	8 x M 16	32	27
65	PN 40	8 x M 16	32	27
80	PN 16	8 x M 16	40	34
80	PN 40	8 x M 16	40	34
100	PN 16	8 x M 16	43	36
100	PN 40	8 x M 20	59	50
125	PN 16	8 x M 16	56	48
125	PN 40	8 x M 24	83	71
150	PN 16	8 x M 20	74	63
150	PN 40	8 x M 24	104	88
200	PN 10	8 x M 20	106	91
200	PN 16	12 x M 20	70	61
200	PN 25	12 x M 24	104	92

Promag W Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
250	PN 10	12 x M 20	82	71
250	PN 16	12 x M 24	98	85
250	PN 25	12 x M 27	150	134
300	PN 10	12 x M 20	94	81
300	PN 16	12 x M 24	134	118
300	PN 25	16 x M 27	153	138
350	PN 10	16 x M 20	112	118
350	PN 16	16 x M 24	152	165
350	PN 25	16 x M 30	227	252
400	PN 10	16 x M 24	151	167
400	PN 16	16 x M 27	193	215
400	PN 25	16 x M 33	289	326
450	PN 10	20 x M 24	153	133
450	PN 16	20 x M 27	198	196
450	PN 25	20 x M 33	256	253
500	PN 10	20 x M 24	155	171
500	PN 16	20 x M 30	275	300
500	PN 25	20 x M 33	317	360
600	PN 10	20 x M 27	206	219
600 *	PN 16	20 x M 33	415	443
600	PN 25	20 x M 36	431	516
700	PN 10	24 x M 27	246	246
700	PN 16	24 x M 33	278	318
700	PN 25	24 x M 39	449	507
800	PN 10	24 x M 30	331	316
800	PN 16	24 x M 36	369	385
800	PN 25	24 x M 45	664	721
900	PN 10	28 x M 30	316	307
900	PN 16	28 x M 36	353	398
900	PN 25	28 x M 45	690	716
1000	PN 10	28 x M 33	402	405
1000	PN 16	28 x M 39	502	518
1000	PN 25	28 x M 52	970	971
1200	PN 6	32 x M 30	319	299
1200	PN 10	32 x M 36	564	568
1200	PN 16	32 x M 45	701	753
1400	PN 6	36 x M 33	430	398
1400	PN 10	36 x M 39	654	618
1400	PN 16	36 x M 45	729	762
1600	PN 6	40 x M 33	440	417
1600	PN 10	40 x M 45	946	893
1600	PN 16	40 x M 52	1007	1100

Promag W Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
1800	PN 6	44 x M 36	547	521
1800	PN 10	44 x M 45	961	895
1800	PN 16	44 x M 52	1108	1003
2000	PN 6	48 x M 39	629	605
2000	PN 10	48 x M 45	1047	1092
2000	PN 16	48 x M 56	1324	1261

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

Promag W Nominal diameter		ANSI Pressure rating [lbs]	Screws	Max. tightening torque [lbf ft]	
[mm]	[inch]			Hard rubber	Polyurethane
25	1"	Class 150	4 x ½"	–	5.2
25	1"	Class 300	4 x 5/8"	–	5.9
40	1½"	Class 150	4 x ½"	–	7.4
40	1½"	Class 300	4 x ¾"	–	11
50	2"	Class 150	4 x 5/8"	–	16
50	2"	Class 300	8 x 5/8"	–	8
80	3"	Class 150	4 x 5/8"	44	32
80	3"	Class 300	8 x ¾"	28	19
100	4"	Class 150	8 x 5/8"	31	23
100	4"	Class 300	8 x ¾"	43	30
150	6"	Class 150	8 x ¾"	58	44
150	6"	Class 300	12 x ¾"	52	38
200	8"	Class 150	8 x ¾"	79	59
250	10"	Class 150	12 x 7/8"	74	55
300	12"	Class 150	12 x 7/8"	98	76
350	14"	Class 150	12 x 1"	100	117
400	16"	Class 150	16 x 1"	94	111
450	18"	Class 150	16 x 1 1/8"	150	173
500	20"	Class 150	20 x 1 1/8"	135	160
600	24"	Class 150	20 x 1 ¼"	198	226

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

Promag W Nominal diameter		AWWA Pressure rating	Screws	Max. tightening torque [lbf ft]	
[mm]	[inch]			Hard rubber	Polyurethane
700	28"	Class D	28 x 1¼"	182	215
750	30"	Class D	28 x 1¼"	212	223
800	32"	Class D	28 x 1½"	291	311
900	36"	Class D	32 x 1½"	309	317
1000	40"	Class D	36 x 1½"	310	352
1050	42"	Class D	36 x 1½"	389	382
1200	48"	Class D	44 x 1½"	407	392
1350	54"	Class D	44 x 1¾"	538	467
1500	60"	Class D	52 x 1¾"	559	614
1650	66"	Class D	52 x 1¾"	698	704
1800	72"	Class D	60 x 1¾"	719	802
2000	78"	Class D	64 x 2"	629	580

Promag W Nominal diameter [mm]	AS 2129 Pressure rating	Screws	Max. tightening torque [Nm]
			Hard rubber
80	Table E	4 x M 16	49
100	Table E	8 x M 16	38
150	Table E	8 x M 20	64
200	Table E	8 x M 20	96
250	Table E	8 x M 20	98
300	Table E	12 x M 24	123
350	Table E	12 x M 24	203
400	Table E	12 x M 24	226
500	Table E	16 x M 24	271
600	Table E	16 x M 30	439

Promag W Nominal diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm]
			Hard rubber
80	Cl.14	4 x M 16	49
100	Cl.14	8 x M 16	76
150	Cl.14	8 x M 20	52
200	Cl.14	8 x M 20	77
250	Cl.14	8 x M 20	147
300	Cl.14	12 x M 24	103
350	Cl.14	12 x M 24	203
400	Cl.14	12 x M 24	226
500	Cl.14	16 x M 24	271
600	Cl.14	16 x M 30	393

### 3.3.2 Installing the Promag P sensor



#### Caution!

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



#### Note!

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

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

- Observe in any case the necessary screw tightening torques → Page 33 ff.
- Information on the installation of additional ground disks → Page 31

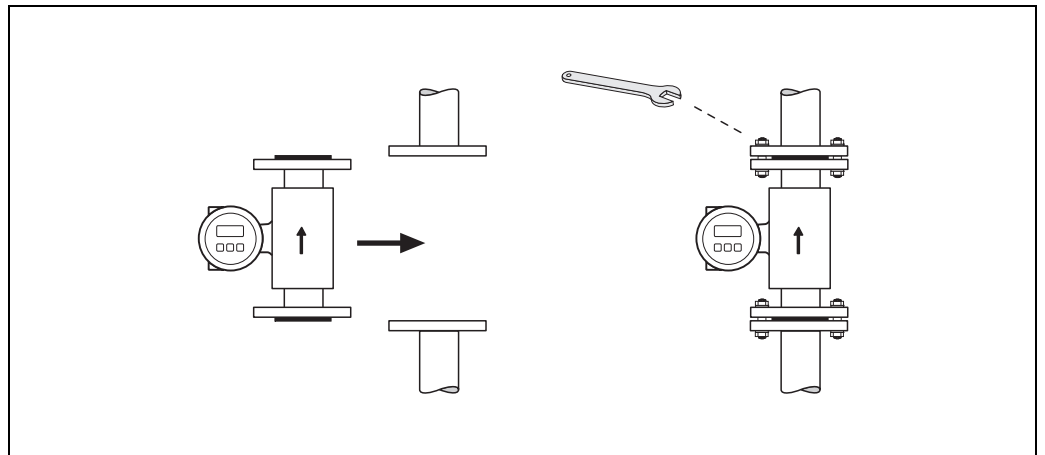


Fig. 20: Installing the sensor

#### Seals

Comply with the following instructions when installing seals:

- Measuring tubes lined with PFA or PTFE → **No** seals are required.
- In case you use seals with DIN flanges, use only seals according to DIN EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.



#### Caution!

Risk of short circuit. Do not use electrically conductive sealing 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")

If necessary, a special ground cable for potential matching can be ordered as an accessory (→ Page 128 ff.). Detailed assembly instructions → Page 60 ff.

#### Installation of ground disks (DN 15 to 300, ½" to 12")

Depending on the application, e.g. with lined or ungrounded pipes (→ Page 60 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for potential matching. Ground disks can be ordered separately as an accessory from Endress+Hauser → Page 26



#### Caution!

- In this case, when using ground disks (including seals) the total fitting length increases! All the dimensions are provided in the separate documentation "Technical information".
- PTFE and PFA lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and additional seal(s) between the instrument and the pipe flange (see Figure).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in the Figure until the handle strikes the bolts. This will center the ground disk automatically.
4. Tighten the bolts to the required torque. → Page 33 ff.
5. Connect the ground disk to ground potential. → Page 61

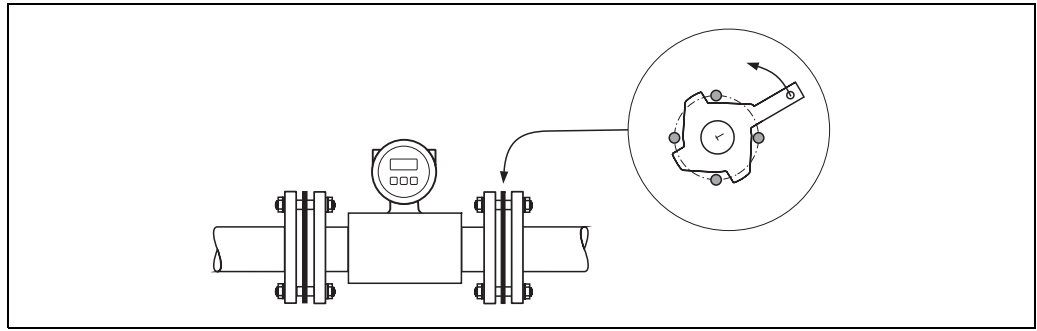


Fig. 21: Assembly with ground disks (Promag P, DN 15 to 300, 1/2" to 12")

### Installing the high-temperature version (with PFA lining)

The high-temperature version has a housing support for the thermal separation of sensor and transmitter. The high-temperature version is always used for applications in which high ambient temperatures are encountered *simultaneously* with high fluid temperatures. The high-temperature version is obligatory if the fluid temperature exceeds +150 °C (+302 °F)!



Note!

Information on permissible temperature ranges → Page 160

#### Insulation

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



Caution!

Risk of 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 half-shells.

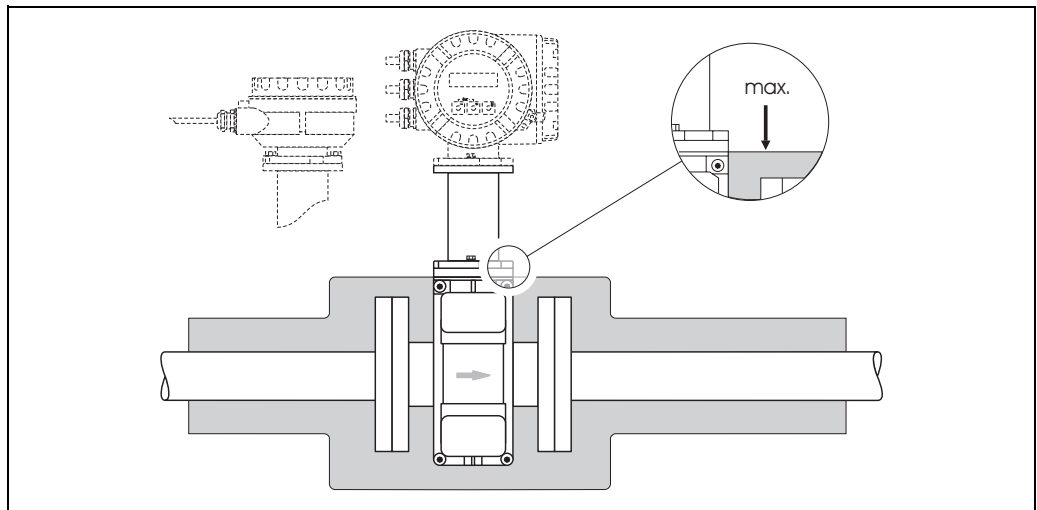


Fig. 22: Promag P (high-temperature version): Insulating the pipe



**Screw tightening torques (Promag P)**

Note the following points:

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

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

Promag P Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			PTFE	PFA
600	PN 10	20 x M 27	345	-
600 *	PN 16	20 x M 33	658	-
600	PN 25	20 x M 36	731	-
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag P Nominal diameter		ANSI Pressure rating [lbs]	Screws	Max. tightening torque [lbf ft]	
[mm]	[inch]			PTFE	PFA
15	½"	Class 150	4 x ½"	4.4	-
15	½"	Class 300	4 x ½"	4.4	-
25	1"	Class 150	4 x ½"	8.1	7.4
25	1"	Class 300	4 x 5/8"	10	8.9
40	1½"	Class 150	4 x ½"	18	15
40	1½"	Class 300	4 x ¾"	25	23
50	2"	Class 150	4 x 5/8"	35	32
50	2"	Class 300	8 x 5/8"	17	16
80	3"	Class 150	4 x 5/8"	58	49
80	3"	Class 300	8 x ¾"	35	31
100	4"	Class 150	8 x 5/8"	41	37
100	4"	Class 300	8 x ¾"	49	44
150	6"	Class 150	8 x ¾"	78	63
150	6"	Class 300	12 x ¾"	54	49
200	8"	Class 150	8 x ¾"	105	80
250	10"	Class 150	12 x 7/8"	100	-
300	12"	Class 150	12 x 7/8"	131	-
350	14"	Class 150	12 x 1"	192	-
400	16"	Class 150	16 x 1"	181	-
450	18"	Class 150	16 x 1 1/8"	274	-
500	20"	Class 150	20 x 1 1/8"	252	-
600	24"	Class 150	20 x 1 1/4"	352	-

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

Promag P Nominal diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm]
			PTFE
50	Cl.14	4 x M 16	42

Promag P Nominal diameter [mm]	JIS Pressure rating	Screws	Max. tightening torque [Nm]	
			PTFE	PFA
15	10K	4 x M 12	16	-
15	20K	4 x M 12	16	-
25	10K	4 x M 16	32	-
25	20K	4 x M 16	32	-
32	10K	4 x M 16	38	-
32	20K	4 x M 16	38	-
40	10K	4 x M 16	41	-
40	20K	4 x M 16	41	-
50	10K	4 x M 16	54	-
50	20K	8 x M 16	27	-
65	10K	4 x M 16	74	-
65	20K	8 x M 16	37	-
80	10K	8 x M 16	38	-
80	20K	8 x M 20	57	-
100	10K	8 x M 16	47	-
100	20K	8 x M 20	75	-
125	10K	8 x M 20	80	-
125	20K	8 x M 22	121	-
150	10K	8 x M 20	99	-
150	20K	12 x M 22	108	-
200	10K	12 x M 20	82	-
200	20K	12 x M 22	121	-
250	10K	12 x M 22	133	-
250	20K	12 x M 24	212	-
300	10K	16 x M 22	99	-
300	20K	16 x M 24	183	-

### 3.3.3 Installing the Promag H sensor

The Promag H is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with 4 hex-head screws.



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. → Page 128

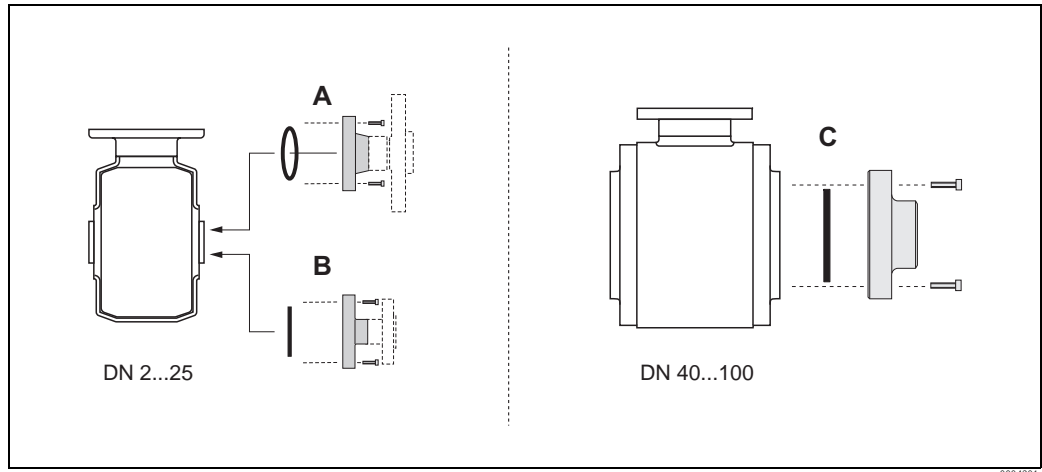


Fig. 23: Promag H process connections (DN 2 to 25, DN 40 to 100, 1/12" to 1" / DN 1½" to 4")

**A = DN 2 to 25, 1/12" to 1" / process connections with O-ring**

Weld nipples (DIN EN ISO 1127, ODT/SMS), flange (EN (DIN), ANSI, JIS), flange PVDF (EN (DIN), ANSI, JIS), external and internal pipe threads (ISO/DIN), hose connection, PVC adhesive coupling

**B = DN 2 to 25, 1/12" to 1" / process connections with aseptic molded seal**

Weld nipples (DIN 11850, ODT/SMS), Clamp (ISO 2852, DIN 32676, L14 AM7), threaded connection (DIN 11851, DIN 11864-1, SMS 1145), flange DIN 11864-2

**C = DN 40 to 100, 1½" to 4" / process connections with aseptic molded seal**

Weld nipples (DIN 11850, ODT/SMS), Clamp (ISO 2852, DIN 32676, L14 AM7), threaded connection (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 molded 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. → Page 128

### Use and installation of ground rings (DN 2 to 25, 1/12" to 1")

If 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 disks may be installed at the process connections instead of ground rings. These plastic disks serve only as spacers and have no potential matching 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 disks/seals must not be removed, or must always be installed.
  - Ground rings can be ordered separately from Endress+Hauser as accessories (→ Page 128). When placing the order, make certain that the ground rings are compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information on materials → Page 170
  - Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected.
1. Loosen the four hexagon head bolts (1) and remove the process connection from the sensor (4).
  2. Remove the plastic disk (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).

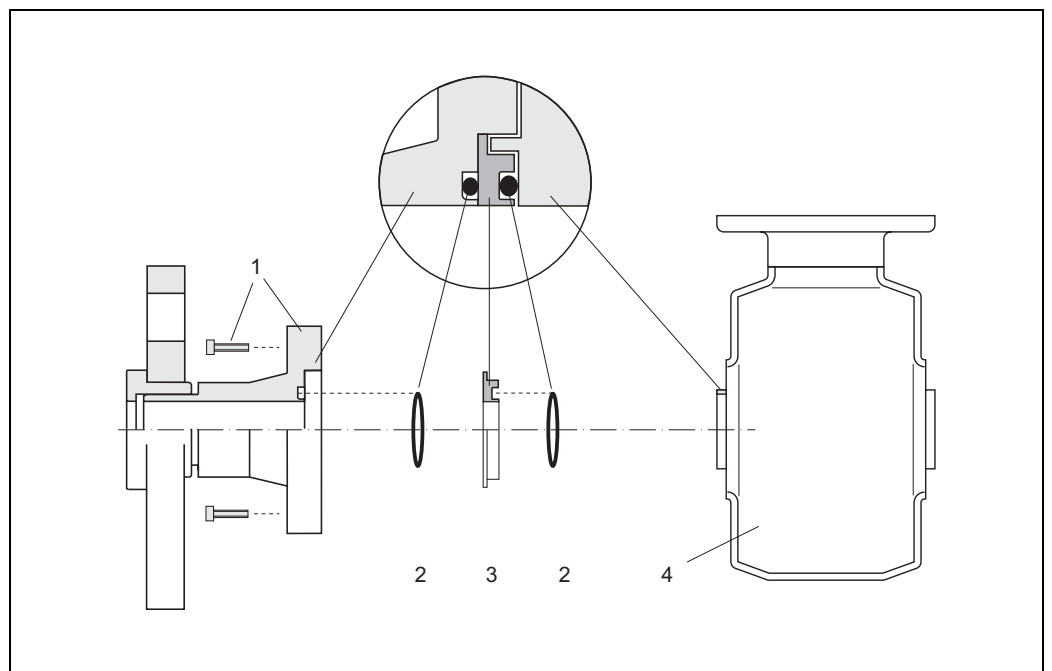


Fig. 24: Installing ground rings with a Promag H (DN 2 to 25, 1/12" to 1")

- 1 Hexagon head bolts of the process connection
- 2 O-ring seals
- 3 Plastic washer (spacer) or ground ring
- 4 Sensor

### Welding the transmitter 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. → Page 128
2. Loosen the screws on the process connection flange and remove the sensor including the seal from the piping.
3. Weld the process connection into 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 (0.31 in) to permit disassembly.

### Cleaning with pigs

When using pigs for cleaning, it is essential to take the inside diameters of the 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".

## 3.3.4 Turning the transmitterhousing

### Turning the aluminum field housing



#### Warning!

The turning mechanism in devices with EEx d/de or FM/CSA Cl. I Div. 1 classification is not the same as that described here. The procedure for turning these housings is described in the Ex-specific documentation.

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

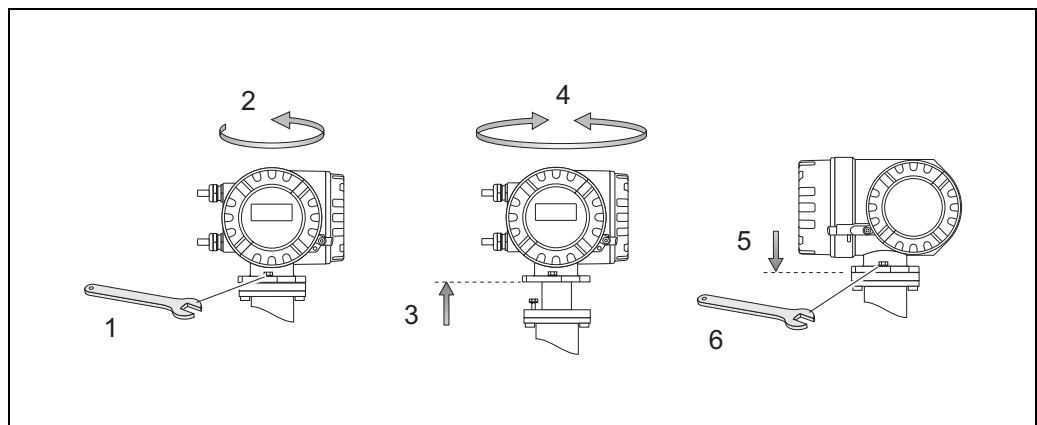


Fig. 25: Turning the transmitter housing (aluminum field housing)

### Turning the stainless steel field housing

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

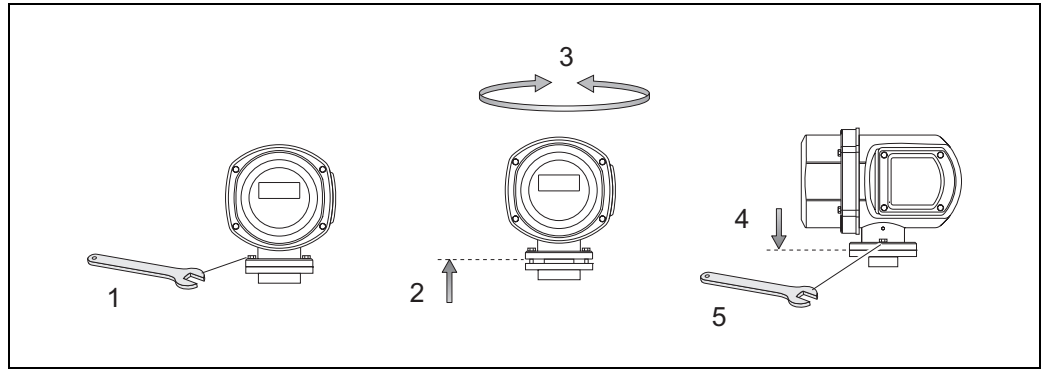


Fig. 26: Turning the transmitter housing (stainless steel field housing)

### 3.3.5 Turning the local display

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

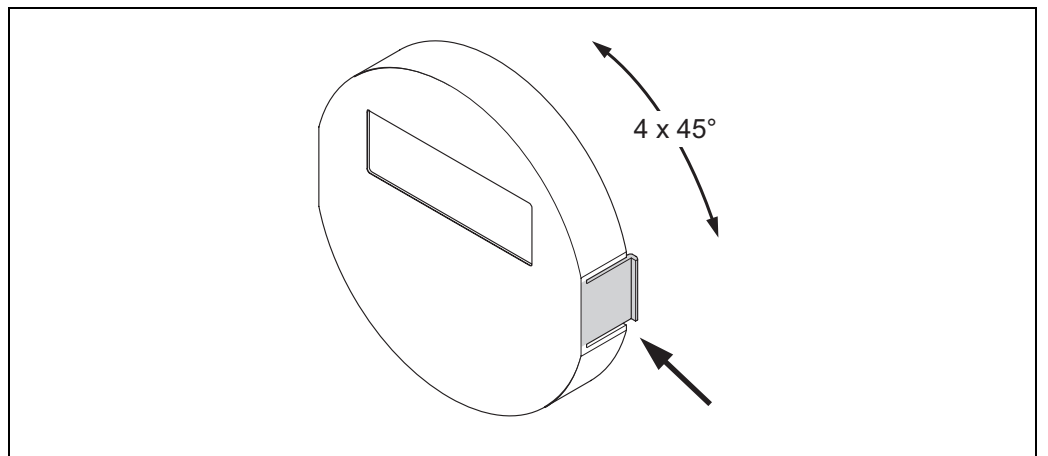


Fig. 27: Turning the local display (field housing)

### 3.3.6 Installing the wall-mount housing

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

- Mounted directly on the wall
- Installation in control panel (separate mounting set, accessories) → Page 41
- Pipe mounting (separate mounting set, accessories) → Page 41



Caution!

- Make sure that ambient temperature does not exceed the permissible range (-20 to +60°C, optional: -40 to +60°C). Install the device in a location that is in the shade. 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 in the diagram.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
  - Securing screws (M6): max. Ø 6.5 mm (0.26 in)
  - Screw head: max. Ø 10.5 mm (0.41 in)
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

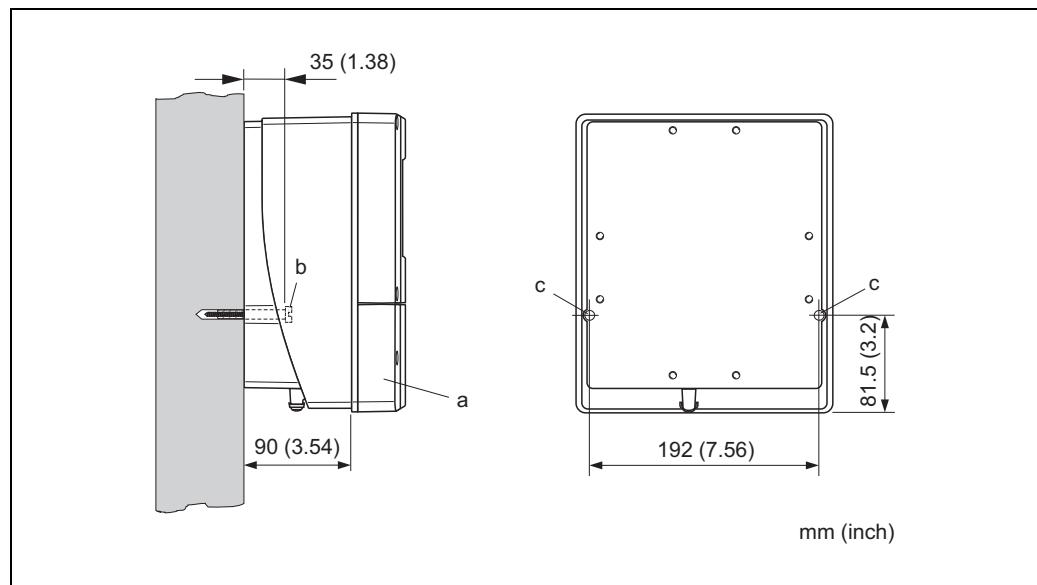


Fig. 28: Mounted directly on the wall

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**Panel mounting**

1. Prepare the opening in the panel as illustrated in the diagram.
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Screw threaded rods into holders and tighten until the housing is solidly seated on the panel wall. Afterwards, tighten the locking nuts. Additional support is not necessary.

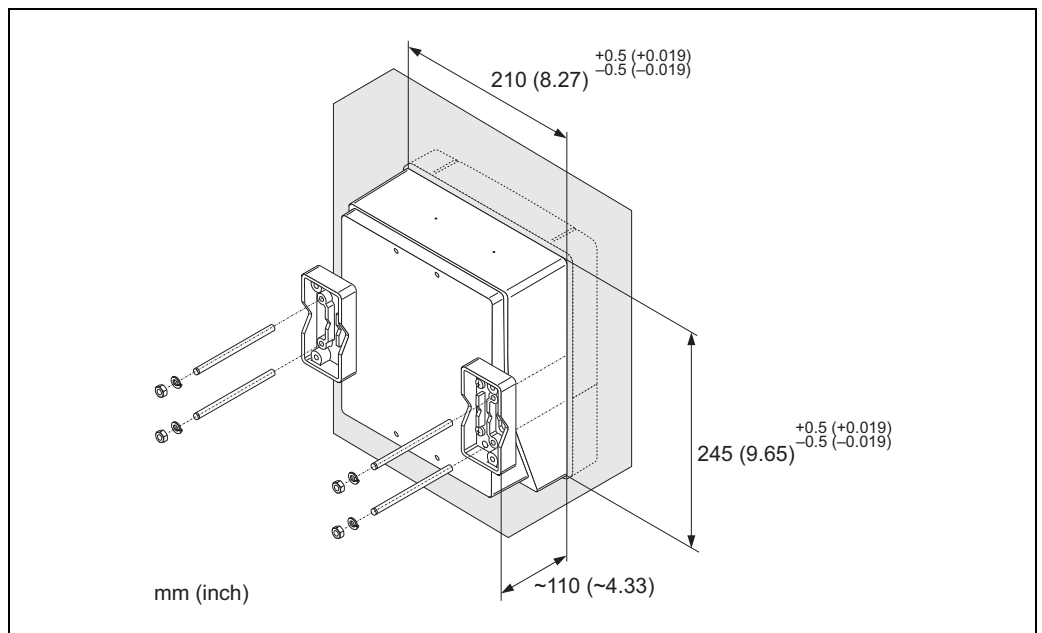


Fig. 29: Panel mounting (wall-mount housing)

**Pipe mounting**

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



Caution!

If a warm pipe is used for installation, make sure that the housing temperature does not exceed the max. permitted value of +60 °C (+140 °F).

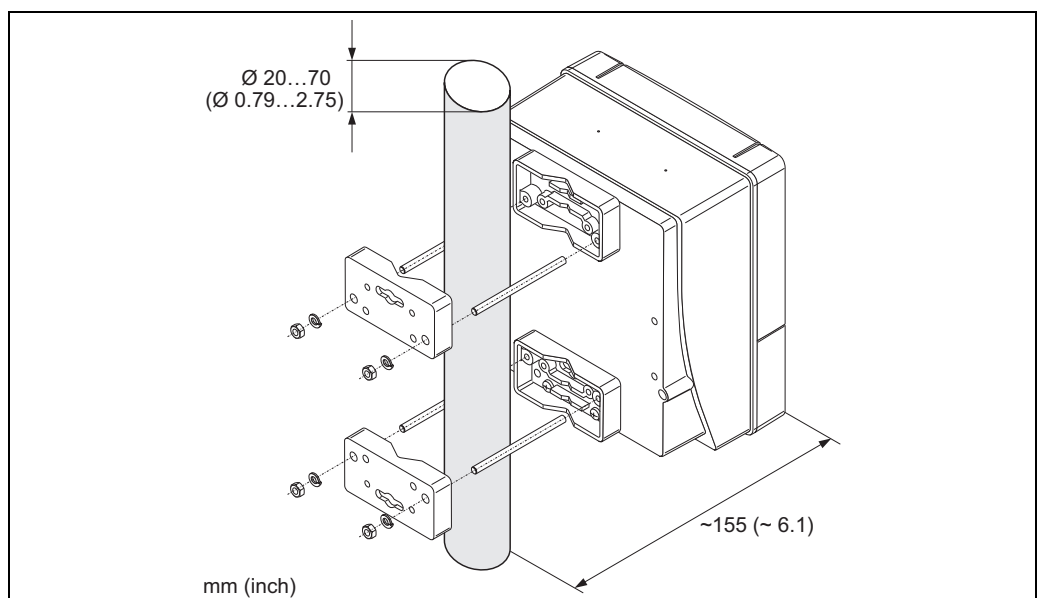


Fig. 30: Pipe mounting (wall-mount housing)

### 3.4 Post-installation check

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

Device condition/specifications	Notes
Is the device damaged (visual inspection)?	-
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	→ Page 156 ff.
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?	level?
Is the position of the Empty Pipe Detection (EPD) electrode correct?	→ Page 17
Were all screws tightened to the specified torques when the sensor was installed?	→ Chap. 3.3
Were the correct seals installed (type, material, installation)?	Promag W→ Page 25 Promag P→ Page 31 Promag H→ Page 36
Are the measuring point number and labeling correct (visual inspection)?	-
Process environment/process conditions	Notes
Are the inlet and outlet runs respected?	Inlet run: $\geq 5 \times \text{DN}$ Outlet run: $\geq 2 \times \text{DN}$
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 → Page 160

## 4 Wiring



### Warning!

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



### Note!

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

### 4.1 PROFIBUS cable specifications

#### 4.1.1 PROFIBUS DP cable specification

##### Cable type

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

Cable type A	
Characteristic impedance	135 to 165 $\Omega$ 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 x 2, 2 x 2 or 1 x 4 wire
Loop-resistance	110 $\Omega$ /km
Signal damping	Max. 9 dB over the entire length of the cable section
Shielding	Copper braided shielding or braided shielding and foil shielding

##### Bus structure

Note the following points:

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

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

- A maximum of 32 users are permitted per segment.
- Each segment is terminated at either end with a terminating resistor.
- The bus length or the number of users can be increased by introducing a repeater.
- The first and last segment can comprise max. 31 devices.  
The segments between the repeaters can comprise max. 30 stations.
- The maximum distance between two bus users can be calculated as follows:  $(NO\_REP + 1) \times$  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 data transmission. → Page 78

## Further information

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

## 4.1.2 PROFIBUS PA cable specification

### Cable type

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

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

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

	Type A	Type B
Cable structure	Twisted pair, shielded	One or more twisted pairs, fully shielded
Wire cross-section	0.8 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))	1 900 m (6200 ft)	1 200 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:

<b>Type A</b>	1900 m	6200 ft
<b>Type B</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):

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

### Number of field devices

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

### Bus termination

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

Note the following points:

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

### Further information

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

### 4.1.3 Shielding and grounding

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

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

To ensure the optimum electromagnetic compatibility of systems, it is important that the system components and above all the cables, which connect the components, are shielded and that no portion of the system is unshielded. Ideally, the cable shields are connected to the normally metal housings of the connected field devices. Since these are generally connected to the protective ground, the shield of the bus cable is grounded many times. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.

This approach, which provides the best electromagnetic compatibility and personal safety, can be used without restriction in systems with good potential matching.

In the case of systems without potential matching, a power supply frequency (50 Hz) equalizing current can flow between two grounding points which, in unfavorable cases, e.g. when it exceeds the permissible shield current, may destroy the cable.

To suppress the low frequency equalizing currents on systems without potential matching, it is therefore recommended to connect the cable shield directly to the building ground (or protective ground) at one end only and to use capacitive coupling to connect all other grounding points.



Caution!

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

## 4.2 Connecting the remote version



Warning!

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.

### 4.2.1 Connecting Promag W/P/H



Warning!

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

Procedure (Fig. 31, Fig. 32):

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



Caution!

- Make sure the connecting cables are secured. → Page 24
- Risk of damaging the coil driver. Only connect or disconnect the coil cable once the power supply has been switched off.

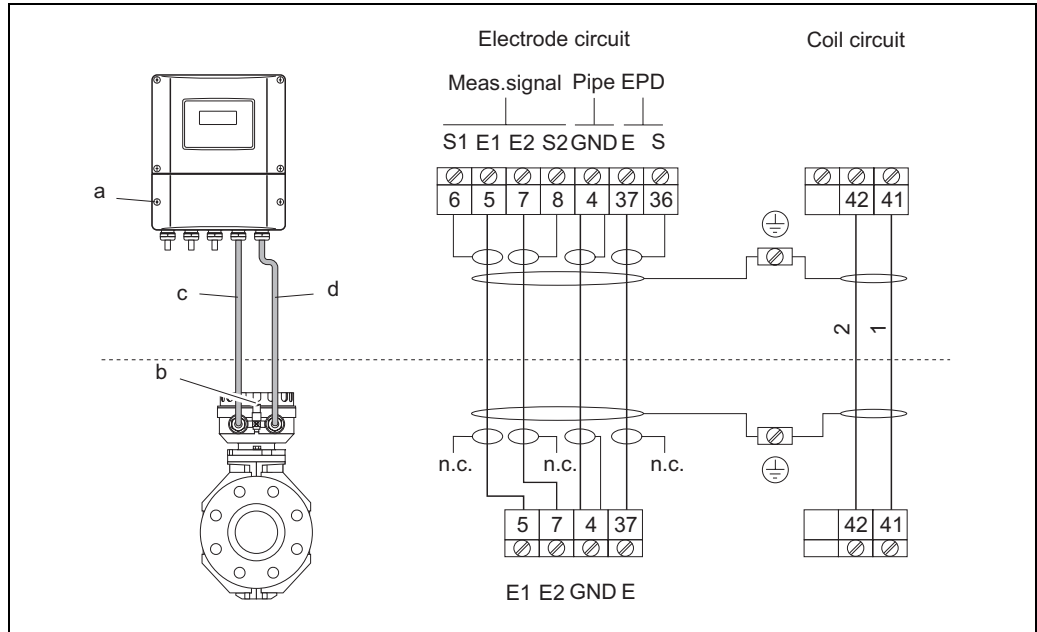
4. Terminate the signal cable and the coil current cable:  
Promag W, P → Refer to the information on Page 49  
Promag H → Refer to the information on Page 50
5. Establish the connections between sensor and transmitter in accordance with the wiring diagram:  
→ Fig. 31, Fig. 32  
→ wiring diagram inside the cover



Caution!

Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighboring cable shields inside the sensor connection housing.

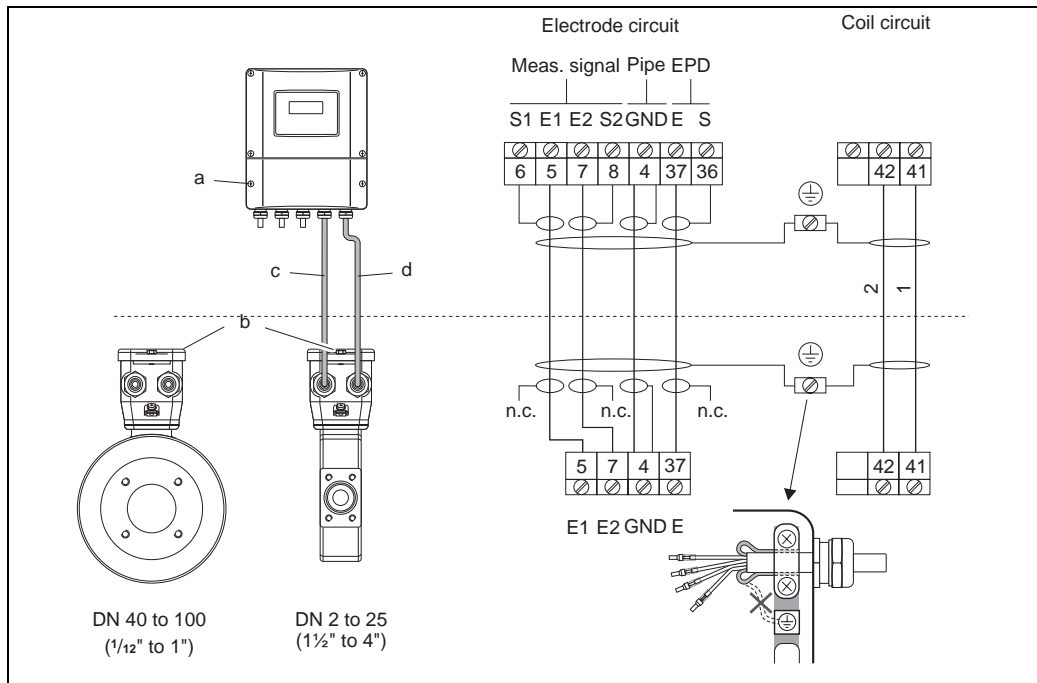
6. Transmitter: Secure the cover (a) on the connection compartment.
7. Sensor: Secure the cover (b) on the connection housing.



a0004323-en

Fig. 31: Connecting the remote version of Promag W/P

- a Connection compartment of wall-mount housing
  - b Connection compartment cover of sensor
  - c Signal cable
  - d Coil current cable
  - n.c. Not connected, insulated cable shields
- Terminal no.: 6/5 = brown; 7/8 = white; 4 = green; 37 = yellow



a0004321-en

Fig. 32: Connecting the remote version of Promag H

- a Connection compartment of wall-mount housing
  - b Connection compartment cover of sensor
  - c Signal cable
  - d Coil current cable
  - n.c. Not connected, insulated cable shields
- Terminal no.: 6/5 = brown; 7/8 = white; 4 = green; 37 = yellow



**Cable termination on the remote version  
Promag W / Promag P**

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!**

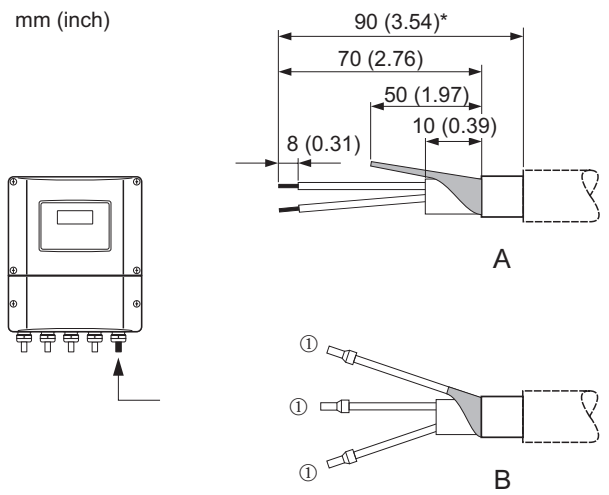
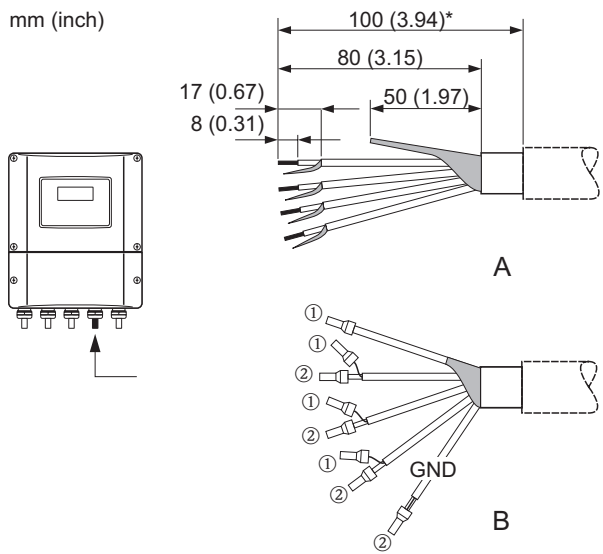
When fitting the connectors, pay attention to the following points:

- *Signal cable* → Make sure that the wire end ferrules do not touch the wire shield 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 cable at the level of the core reinforcement; you only need two cores for the connection.

**TRANSMITTER**

Signal cable

Coil current cable



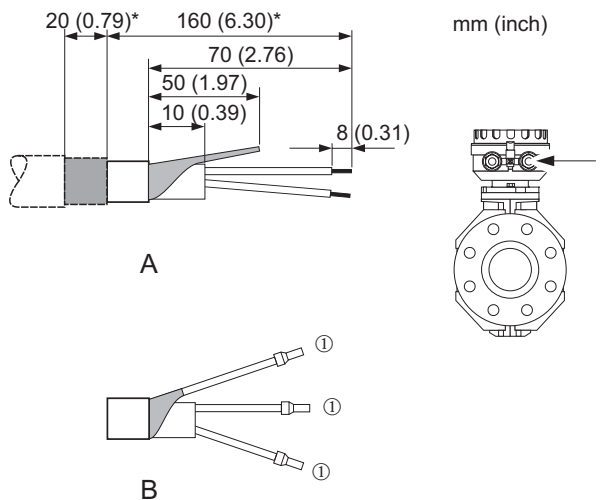
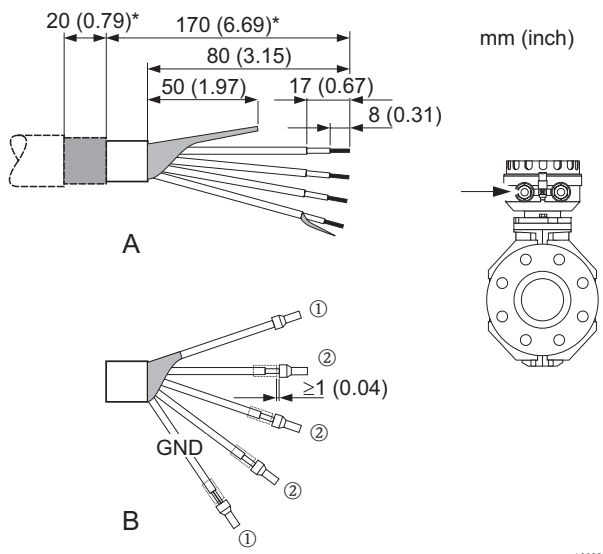
a0002687-ae

a0002688-ae

**SENSOR**

Signal cable

Coil current cable



A0002646-ae

A0002650-ae

- ① = Red cable sleeve, Ø 1.0 mm (0.04")
- ② = White cable sleeve, Ø 0.5 mm (0.02")
- \* = Stripping for armored cables only

**Cable termination on the 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 cable end sleeves (Detail B).

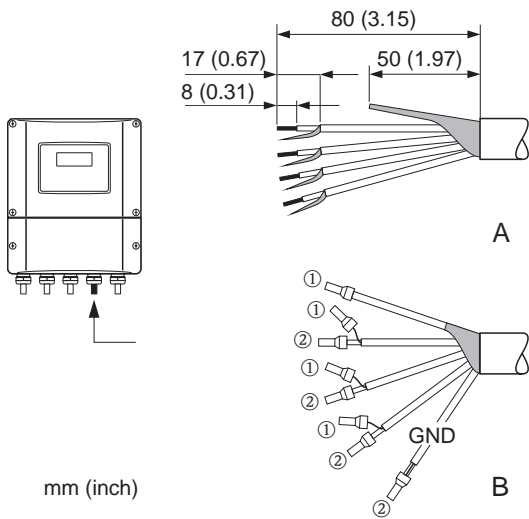
**Caution!**

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

- *Signal cable* → Make sure that the cable end ferrules do not touch the wire shield 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 cable at the level of the core reinforcement; you only need two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

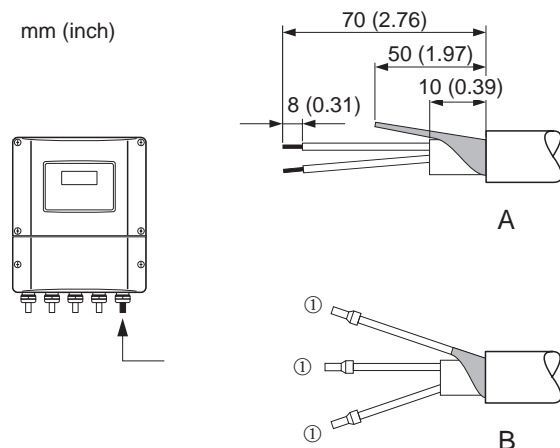
**TRANSMITTER**

Signal cable



A0002686-ae

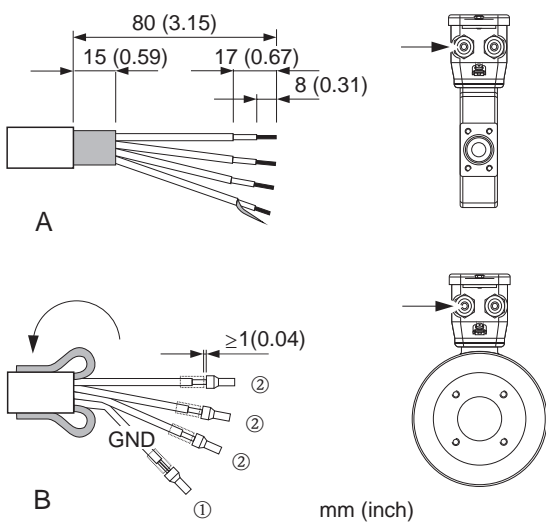
Coil current cable



A0002684-ae

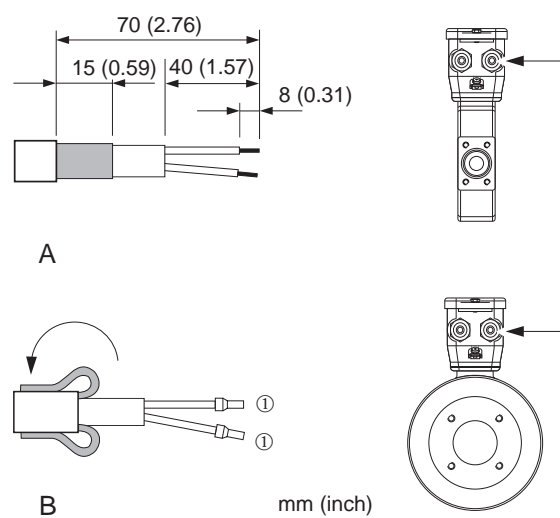
**SENSOR**

Signal cable



A0002647-ae

Coil current cable



A0002648-ae

- ① = Red cable sleeve, Ø 1.0 mm (0.04")
- ② = White cable sleeve, Ø 0.5 mm (0.02")

## 4.2.2 Cable specifications

### Coil cable

- 2 x 0.75 mm<sup>2</sup> (18 AWG) PVC cable with common, braided copper shield (Ø ~ 7 mm / 0.28")
- Conductor resistance: ≤37 Ω/km (≤0.011 Ω/ft)
- Capacitance: core/core, shield grounded: ≤120 pF/m (≤37 pF/ft)
- Operating temperature:
  - Cable not permanently routed: -20 to +80 °C (-4 to +176 °F)
  - Cable permanently routed: -40 to +80 °C (-40 to +176 °F)
- Cable cross-section: max. 2.5 mm<sup>2</sup> (14 AWG)

### Signal cable

- 3 x 0.38 mm<sup>2</sup> (20 AWG) PVC cable with common, braided copper shield (Ø ~ 7 mm / 0.28") and individually shielded cores
- With Empty Pipe Detection (EPD): 4 x 0.38 mm<sup>2</sup> (20 AWG) PVC cable with common, braided copper shield (Ø ~ 7 mm / 0.28") and individually shielded cores
- Conductor resistance: ≤50 Ω/km (≤0.015 Ω/ft)
- Capacitance: core/shield: ≤420 pF/m (≤128 pF/ft)
- Operating temperature:
  - Cable not permanently routed: -20 to +80 °C (-4 to +176 °F)
  - Cable permanently routed: -40 to +80 °C (-40 to +176 °F)
- Cable cross-section: max. 2.5 mm<sup>2</sup> (14 AWG)

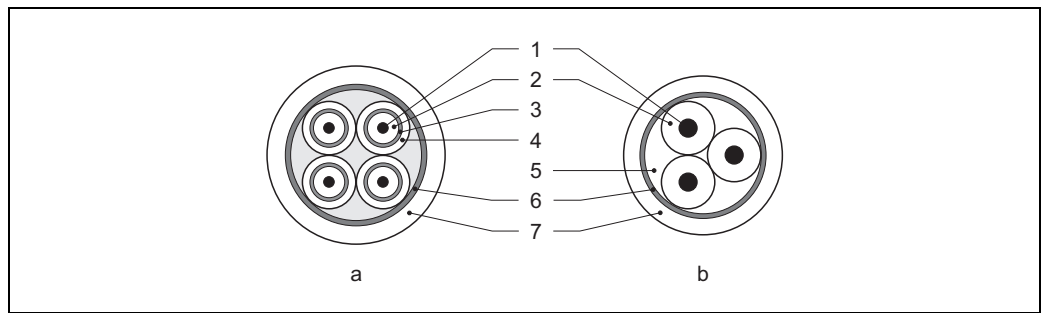


Fig. 33: Cable cross-section

a = Signal cable b = Coil current cable

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

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

## 4.3 Connecting the measuring unit

### 4.3.1 Terminal assignment



Note!

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

#### PROFIBUS DP



Caution!

Only certain combinations of submodules (see Table) on the I/O board are permissible. The individual slots are also marked and assigned to the following terminals in the connection compartment of the transmitter:

- "INPUT / OUTPUT 3" slot = terminals 22/23
- "INPUT / OUTPUT 4" slot = terminals 20/21

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

#### PROFIBUS PA

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

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

### 4.3.2 Transmitter connection



#### Warning!

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

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



#### Caution!

- Risk of damage to the fieldbus cable!  
Observe the information about shielding and grounding the fieldbus cable. → Page 46
  - We recommend that the fieldbus cable not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.
4. Screw the cover of the connection compartment (a) back onto the transmitter housing.

### 4.3.3 PROFIBUS DP connection diagram

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

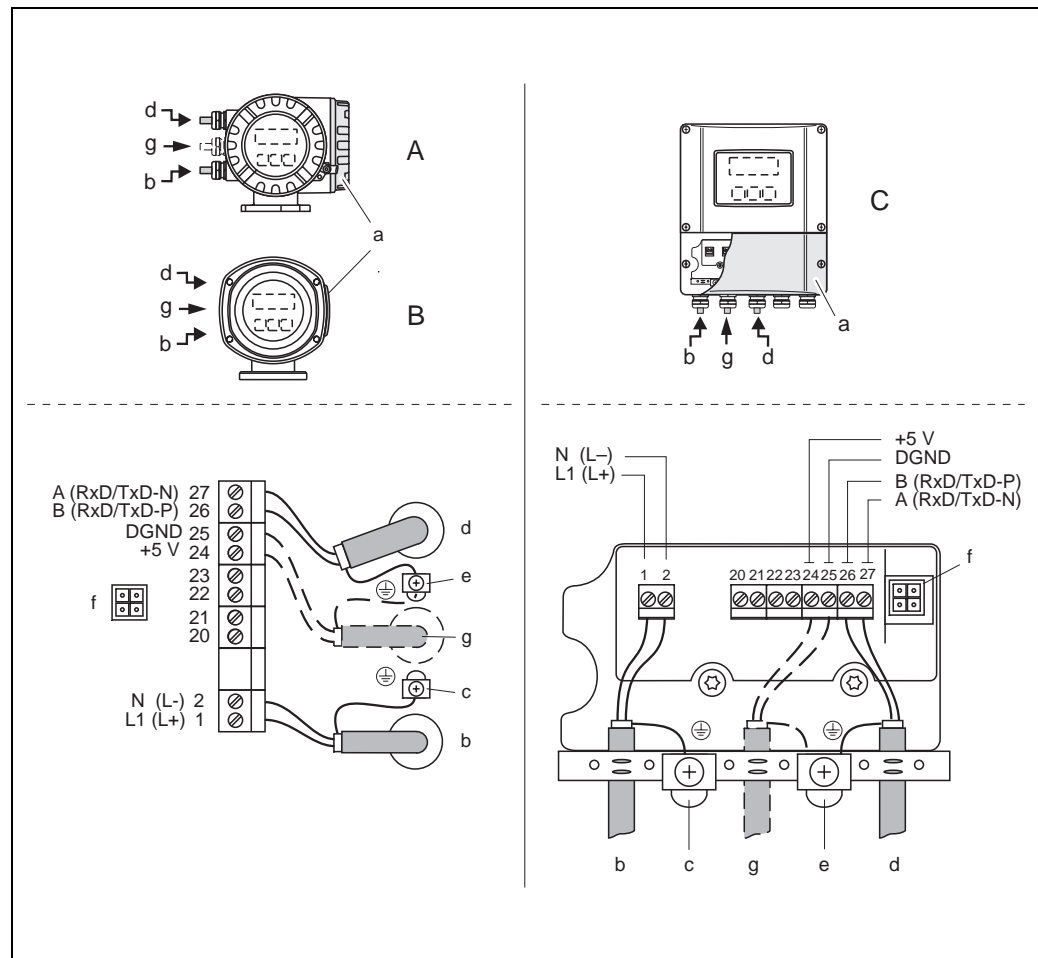


Fig. 34: Connecting the transmitter, cable cross-section: max. 2.5 mm<sup>2</sup> (14 AWG)

- 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 conductor  
 d Fieldbus cable  
 Terminal No. 26: B (Rx/D/TxD-P)  
 Terminal No. 27: A (Rx/D/TxD-N)  
 e Ground terminal for fieldbus cable shield  
 Observe the following:  
 – the shielding and grounding of the fieldbus cable → Page 46  
 – that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible
- f Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)  
 g Cable for external termination:  
 Terminal No. 24: +5 V  
 Terminal No. 25: DGND

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

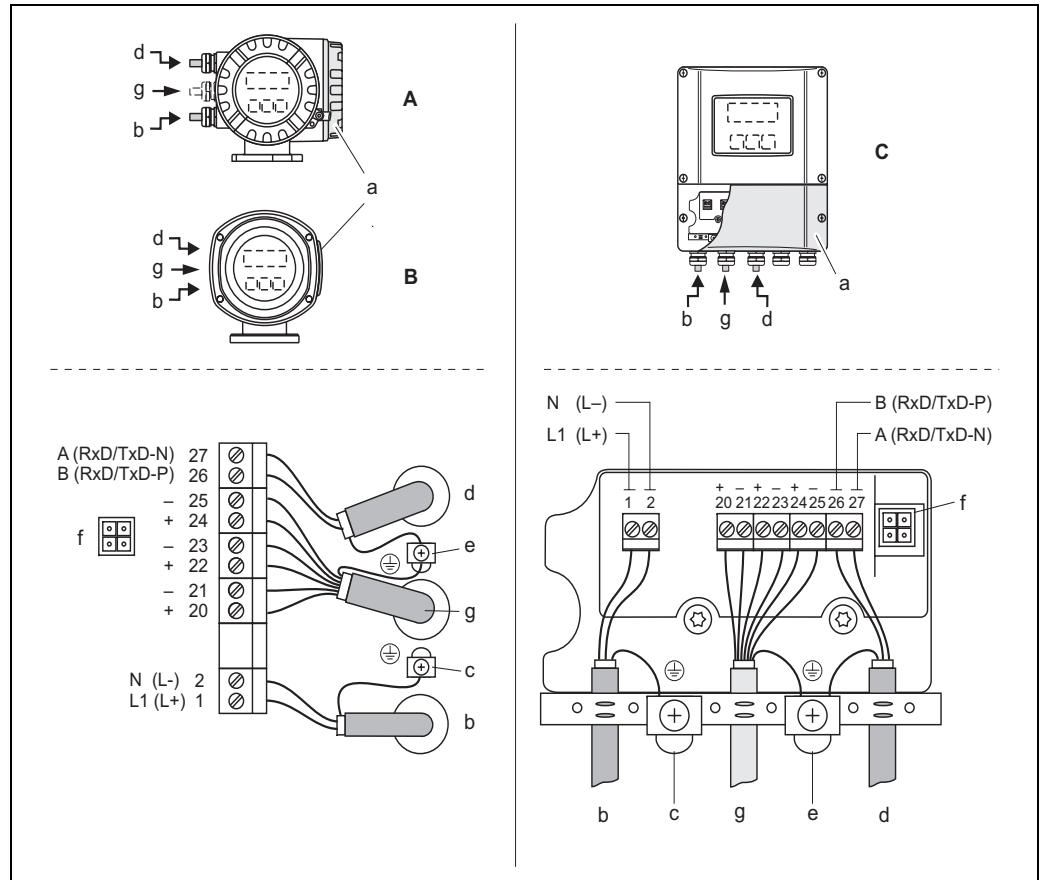


Fig. 35: Connecting the transmitter, cable cross-section: max. 2.5 mm<sup>2</sup> (14 AWG)

- 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 conductor
- d Fieldbus cable  
Terminal No. 26: B (RxD/TxD-P)  
Terminal No. 27: A (RxD/TxD-N)
- e Ground terminal for signal cable shield/fieldbus cable shield  
Observe the following:
  - the shielding and grounding of the fieldbus cable → Page 46
  - that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible
- f Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)
- g Signal cable: see Terminal assignment → Page 52

### 4.3.4 PROFIBUS PA connection diagram

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

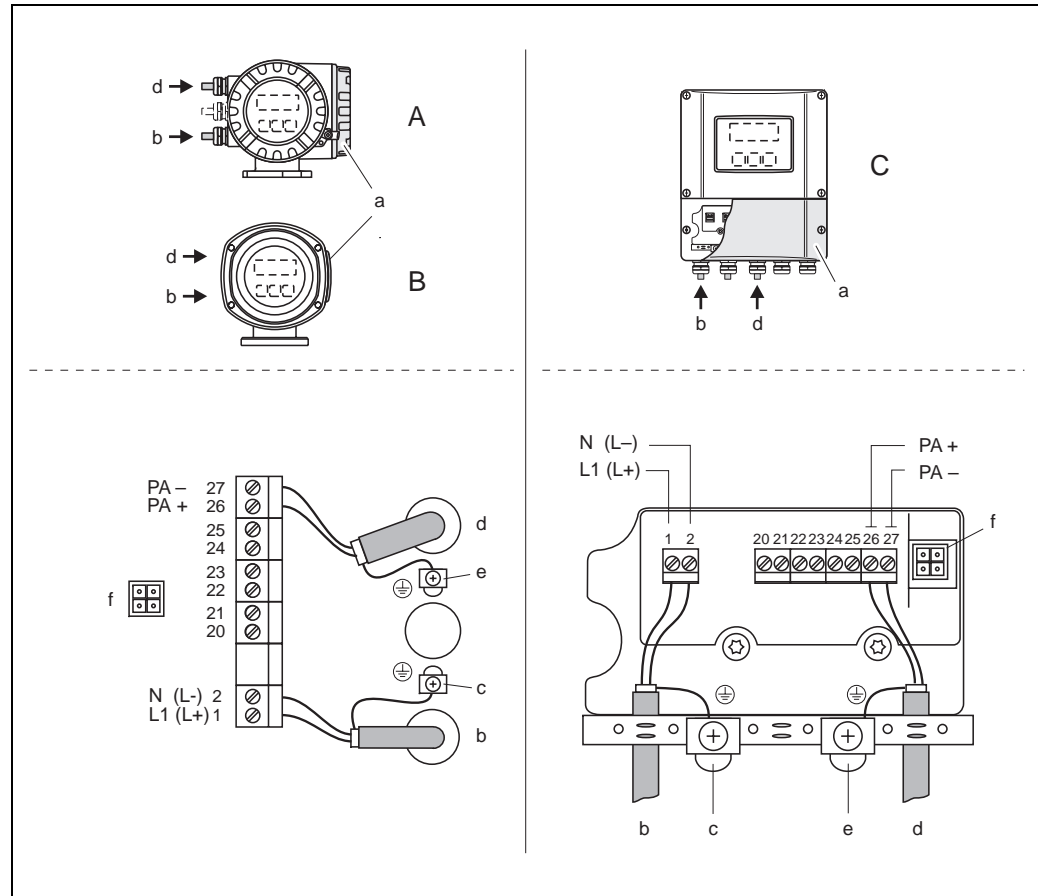


Fig. 36: Connecting the transmitter, cable cross-section: max. 2.5 mm<sup>2</sup> (14 AWG)

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 conductor

d Fieldbus cable:

Terminal No. 26: PA + (with reverse polarity protection)

Terminal No. 27: PA - (with reverse polarity protection)

e Ground terminal for fieldbus cable shield

Observe the following:

– the shielding and grounding of the fieldbus cable → Page 46

– that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible

f Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)



## Fieldbus connector



Note!

The connector can only be used for PROFIBUS PA devices.

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

This connection technology, which uses prefabricated distribution modules and plug-in connectors, offers substantial advantages over conventional wiring:

- Field devices can be removed, replaced or added at any time during normal operation. Communication is not interrupted.
- Installation and maintenance are significantly easier.
- Existing cable infrastructures can be used and expanded instantly, e.g. when constructing new star distributors using 4-channel or 8-channel distribution modules.

The device can therefore be supplied with the option of a ready-mounted fieldbus connector. Fieldbus connectors for retrofitting can be ordered from Endress+Hauser as a spare part. → Page 127

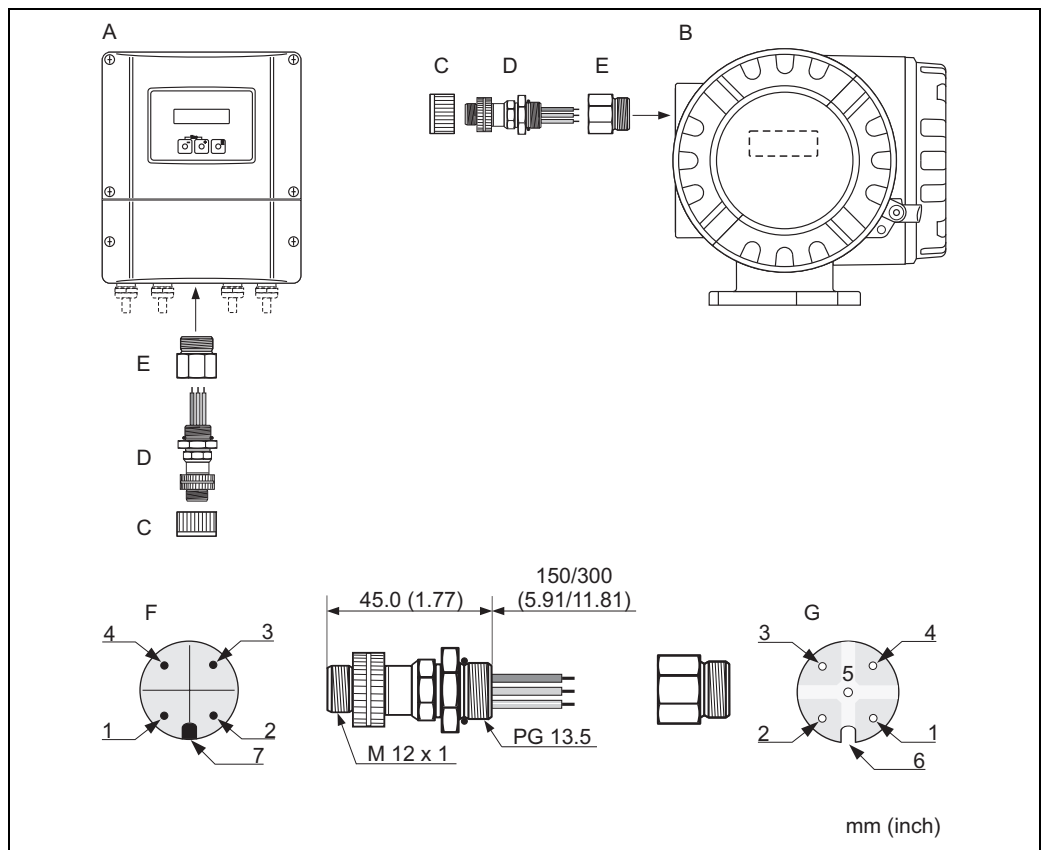


Fig. 37: Connectors for connecting to the PROFIBUS PA

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

Pin assignment/color codes:

- 1 Brown wire: PA + (terminal 26)
- 2 Not connected
- 3 Blue wire: PA - (terminal 27)
- 4 Black wire: ground (instructions for connection → Page 54 ff.)
- 5 Middle female connector not assigned
- 6 Positioning groove
- 7 Positioning key

**Technical data (fieldbus connector):**

<b>Connection cross section</b>	0.75 mm <sup>2</sup> (19 AWG )
<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

**Shielding of the supply line/T-box**

Use cable glands with good EMC properties, with surrounding contact of the cable gland (iris spring). This requires small differences in potential, and possibly potential matching.

- Do not interrupt the shielding of the PA cable.
- Always keep the connection of the shielding as short as possible.

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

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

## 4.4 Potential matching

### 4.4.1 Standard case

Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most Promag sensors have a standard installed reference electrode, which guarantees the required potential matching. This usually means that additional potential matching measures are unnecessary.

*Promag W:*

Reference electrode is standard

*Promag P:*

- Reference electrode is standard for electrode materials 1.4435, Alloy C-22 and tantalum.
- Reference electrode is optional for electrode material Pt/Rh.

*Promag H:*

- No reference electrode. The metallic process connection provides a permanent electrical connection to the fluid.
- If the process connections are made of a synthetic material, ground rings have to be used to ensure that potential is matched (→ Page 37). Ground rings can be ordered separately as accessories from Endress+Hauser. → Page 128



Note!

For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping. Also, observe company-internal grounding guidelines.

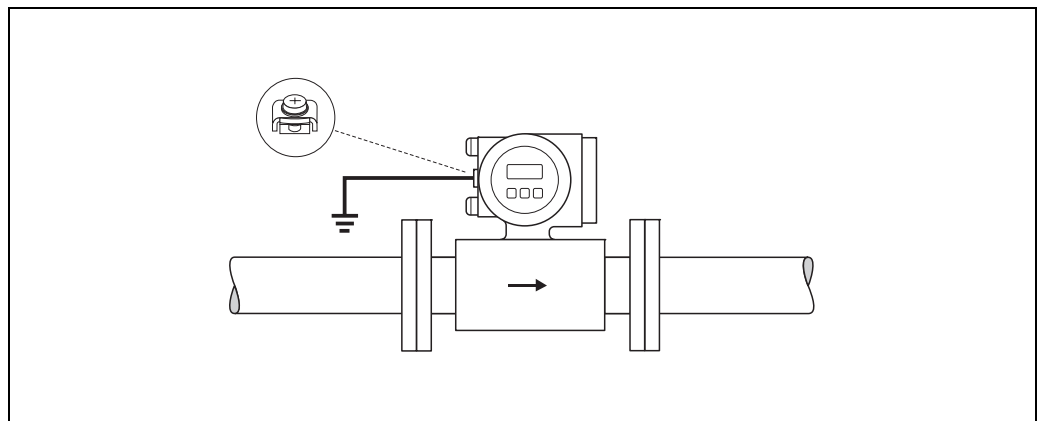


Fig. 38: Potential matching by means of the transmitter's ground terminal



Caution!

For sensors without reference electrodes or without metal process terminals, carry out potential matching as per the instructions for special cases described below. These special measures are particularly important when standard grounding practice cannot be ensured or extremely strong matching currents are expected.

## 4.4.2 Special cases

### Metal, ungrounded piping

In order to prevent outside influences on measurement, it is advisable to use ground cables to connect each sensor flange to its corresponding pipe flange and ground the flanges. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose (see Figure).

The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser → Page 128:



Caution!

Also, observe company-internal grounding guidelines.



Note!

- DN ≤ 300 (12"): The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.
- DN ≥ 350 (14"): The ground cable connects directly to the metal transport bracket.

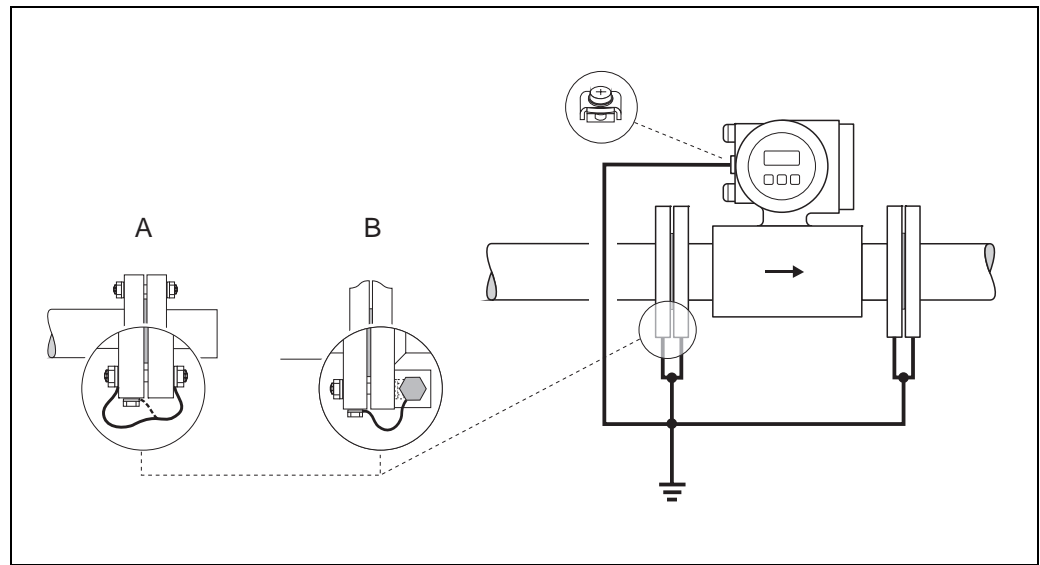


Fig. 39: Potential matching with equalizing currents in metallic, non-grounded piping systems  
(ground cable: copper wire, at least 6 mm<sup>2</sup>/10 AWG)

- A Installing ground cable at DN ≤ 300 (12")  
B Installing ground cable at DN ≥ 350 (14")

### Plastic or insulated lined pipes

Normally, potential is matched using the reference electrodes in the measuring tube. However, in exceptional cases it is possible that, due to the grounding plan of a system, large matching currents flow over the reference electrodes. This can lead to destruction of the sensor, e.g. through electrochemical decomposition of the electrodes. In such cases, e.g. for fiberglass or PVC piping, it is recommended that you use additional ground disks for potential matching. Mounting of ground disks → Page 25, Page 31



#### Caution!

- Risk of damage by electrochemical corrosion. Note the electrochemical series if the ground disks and measuring electrodes consist of different materials.
- Also, observe company-internal grounding guidelines.

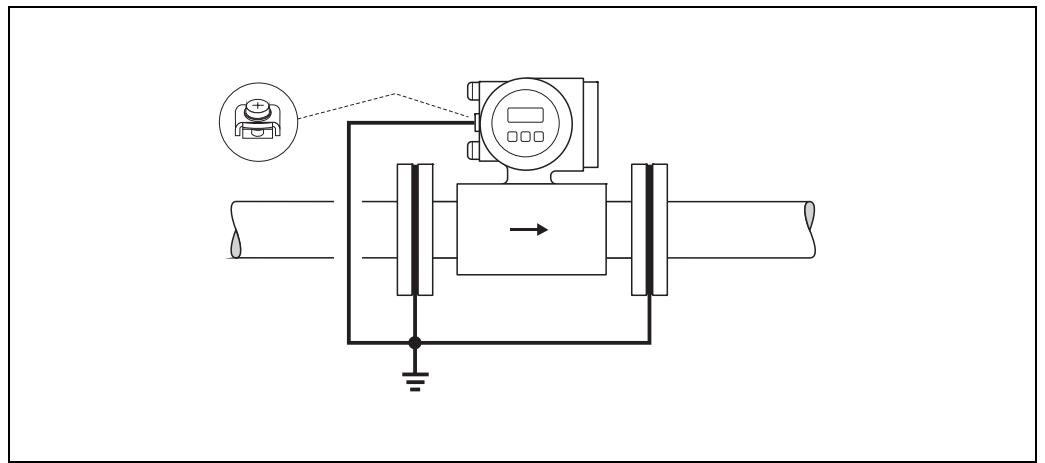


Fig. 40: Potential matching/ground disks with plastic pipes or insulated lined pipes  
(ground cable: copper wire, at least 6 mm<sup>2</sup> / 10 AWG)

### Pipes equipped with cathodic protection

In such cases, install the measuring device without potential in the piping:

- When installing the measuring device, make sure that there is an electrical connection between the two piping runs (copper wire, 6 mm<sup>2</sup> / 10 AWG).
- Make sure that the installation materials do not establish a conductive connection to the measuring device and that the installation materials withstand the tightening torques applied when the screws are tightened.
- Also comply with the regulations applicable to potential-free installation.

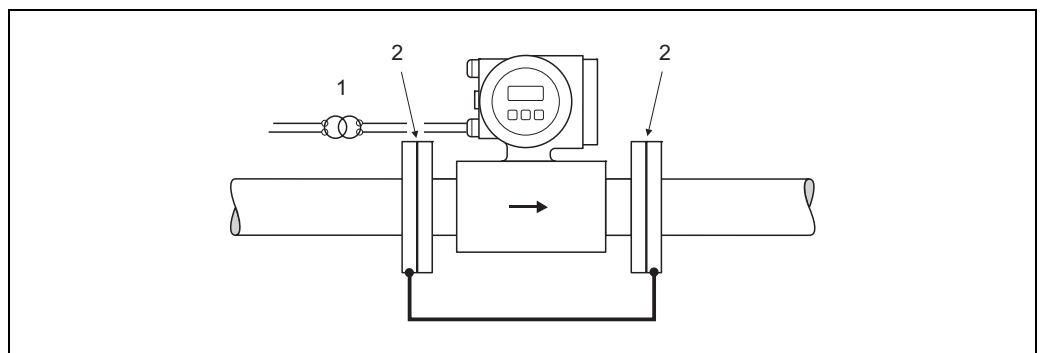


Fig. 41: Potential matching and cathodic protection (ground cable: copper wire, at least 6 mm<sup>2</sup> / 10 AWG)

- 1 Isolation transformer Power supply  
2 Electrically isolated

## 4.5 Degree of protection

The devices fulfill all the requirements for IP 67.

Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection 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 outside diameter. → Page 158
- Firmly tighten the cable entries.
- 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.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.

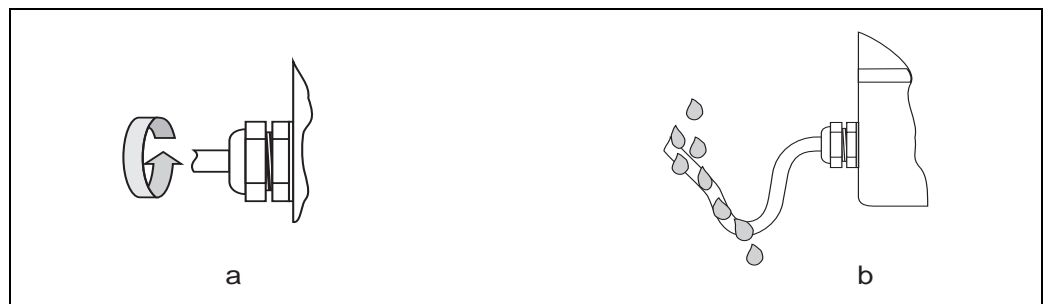


Fig. 42: Installation instructions, cable entries



### Caution!

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



### Note!

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

## 4.6 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	-
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85 to 260 V AC (45 to 65 Hz) 20 to 55 V AC (45 to 65 Hz) 16 to 62 V DC
Do the cables comply with the specifications?	PROFIBUS DP → Page 43 PROFIBUS PA → Page 44 Sensor cable → Page 51
Do the cables have adequate strain relief?	-
Cables correctly segregated by type? Without loops and crossovers?	-
Are the power supply and signal cables correctly connected?	See the wiring diagram inside the cover of the connection compartment
Are all screw terminals firmly tightened?	-
Have the measures for grounding and potential matching been correctly implemented?	→ Page 59
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ Page 62
Are all housing covers installed and firmly tightened?	-
Electrical connection of PROFIBUS DP/PA	Notes
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected to each other correctly?	-
Has each fieldbus segment been terminated at both ends with a bus terminator?	PROFIBUS DP → Seite 78
Has the max. length of the fieldbus cable been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → Page 43 PROFIBUS PA → Page 45
Has the max. length of the spurs been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → Page 44 PROFIBUS PA → Page 45
Is the fieldbus cable fully shielded and correctly grounded?	→ Page 46

## 5 Operation

### 5.1 Quick operation guide

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

1. **Local display (option)** → Page 65  
The local display enables you to read all important variables directly at the measuring point, configure device-specific parameters in the field and perform commissioning.
2. **Configuration programs** → Page 73  
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 → Page 76
  - PROFIBUS PA → Page 81

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. → Page 79

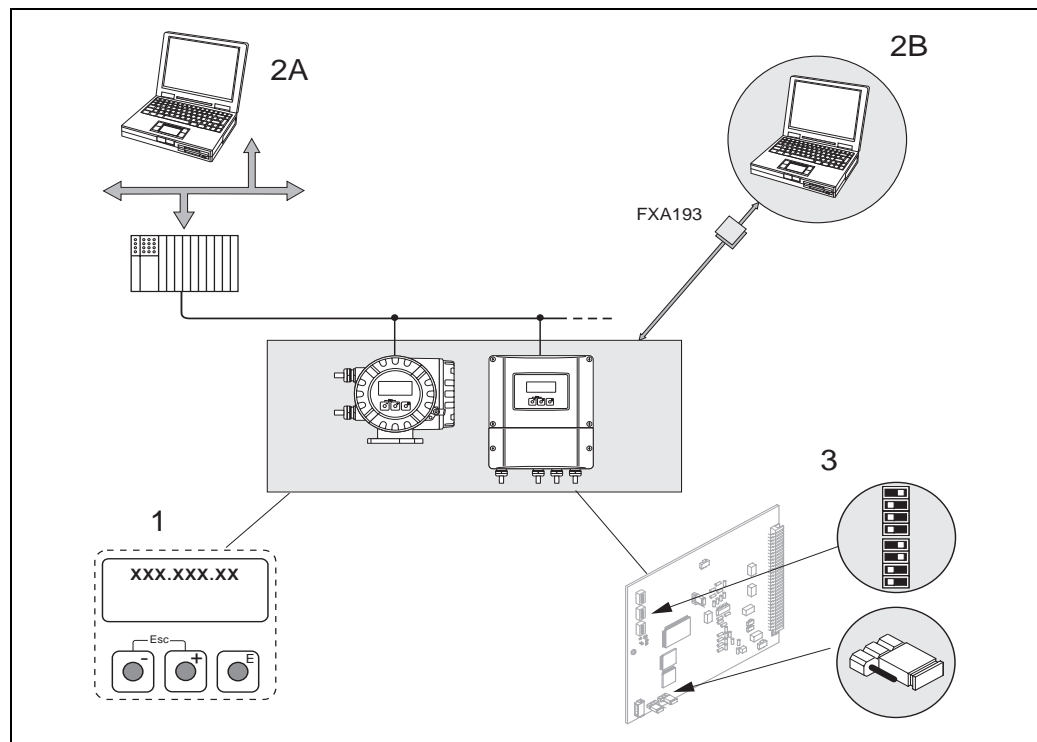


Fig. 43: Methods of operating PROFIBUS PA/DP

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



## 5.2 Local display

### 5.2.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device using the "Quick Setup" or the function matrix.

The display consists of four lines; this is where measured values and/or status variables (direction of flow, empty pipe, bar graph, etc.) are displayed. You can change the assignment of display lines to different variables to suit your needs and preferences (→ see the "Description of Device Functions" manual).

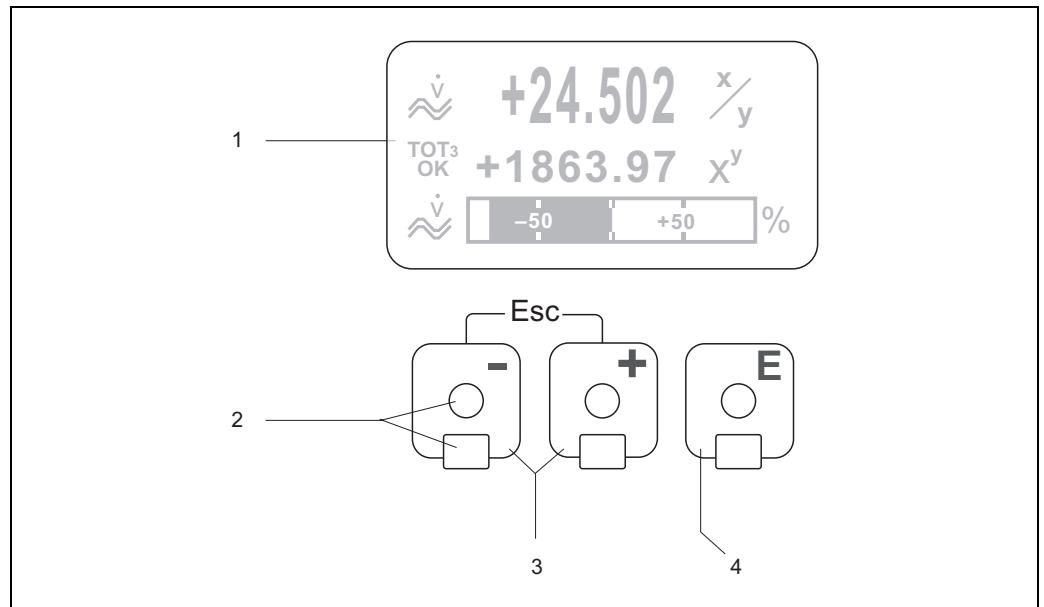


Fig. 44: Display and operating elements

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

Press the □/□ keys simultaneously to trigger the following functions:

  - Exit the function matrix step by step → HOME position
  - Press and hold down □/□ keys for longer than 3 seconds → Return directly to the HOME position
  - Cancel data entry
- 4 **⏎ key (Enter key)**
  - HOME position → Entry into the function matrix
  - Save the numerical values you input or settings you change

## 5.2.2 Display (operating mode)

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

### *Multiplex mode:*

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

### *Error messages:*

Display and presentation of system/process errors → Page 72

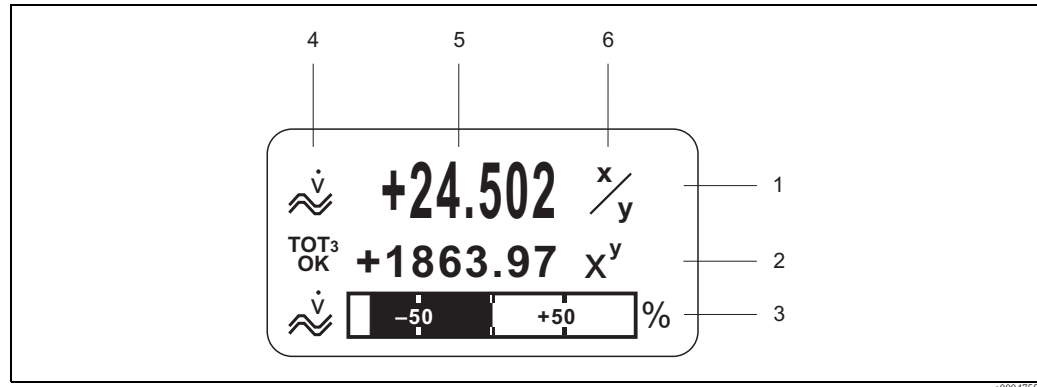


Fig. 45: Typical display for normal operating mode (HOME position)

- 1 Main display line: shows primary measured values, e.g. mass flow in [kg/h]
- 2 Additional line: shows measured variables and status variables, e.g. totalizer No. 3 in [t]
- 3 Information line: shows additional information on the measured variables and status variables, e.g. bar graph display of the full scale value achieved by the mass flow
- 4 "Info icons" field: icons representing additional information on the measured values are shown in this field.  
→ Page 67
- 5 "Measured values" field: the current measured values appear in this field
- 6 "Unit of measure" field: the units of measure and time defined for the current measured values appear in this field

## 5.2.3 Additional display functions

Depending on the order option (F-CHIP → Page 125), the local display has different display functions:

### **Device without batching software:**

From HOME position, use the  $\boxed{+}\boxed{-}$  keys to open an "Info Menu" containing the following information:

- Totalizer (including overflow)
- Actual values or states of the configured inputs/outputs
- Device TAG number (user-definable)

$\boxed{+}\boxed{-}$  → Scan of individual values within the Info Menu


















$\boxed{\text{Esc}}$  (Esc key) → Back to HOME position

### **Device with batching software:**

On measuring devices with installed batching software (F-Chip → Page 125) and a suitably configured display line, you can carry out filling processes directly using the local display. You will find a detailed description on → Page 69.

### 5.2.4 Icons

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

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
I 1 to n	Current output 1 to n	P 1 to n	Pulse output 1 to n
F 1 to n	Frequency output 1 to n	S 1 to n	Status output/relay output 1 to n
 a0001181	Measuring mode: PULSATING FLOW	 a0001182	Measuring mode: SYMMETRY (bidirectional)
 a0001183	Measuring mode: STANDARD		
 a0001188	Volume flow	 a0001195	Mass flow
 a0001201	Batching quantity upwards	 a0001202	Batching quantity downwards
 a0001203	Batching quantity	 a0001204	Batch sum
 a0001205	Batch counter (x times)	← → (scrolling display)	Cyclic communication via PROFIBUS active, for example via PLC (Class 1 master)
 a0001206	Acyclic communication via PROFIBUS active (e.g. via FieldCare)		
 a0002322	Display value (DISPLAY_VALUE module) with status GOOD = good	 a0002321	Display value (DISPLAY_VALUE module) with status UNC = uncertain
 a0002320	Display value (DISPLAY_VALUE module) with status BAD = bad		
 a0004616	Output value OUT, analog input 1 to 2 (AI module) with status GOOD = good	 a0002325	Output value OUT, totalizer 1 to 3 (TOTAL module) with status GOOD = good

Icon	Meaning	Icon	Meaning
<p>AI 1 AI 2 UNC... UNC <small>a0004617</small></p>	<p>Output value OUT, analog input 1 to 2 (AI module) with status UNC = uncertain</p>	<p>TOT 1 TOT 3 UNC... UNC <small>a0002327</small></p>	<p>Output value OUT, totalizer 1 to 3 (TOTAL module) with status UNC= unclear</p>
<p>AI 1 AI 2 BAD... BAD <small>a0004618</small></p>	<p>Output value OUT, analog input 1 to 2 (AI module) with status BAD = bad</p>	<p>TOT 1 TOT 3 BAD... BAD <small>a0002329</small></p>	<p>Output value OUT, totalizer 1 to 3 (TOTAL module) with status BAD= bad</p>

### 5.2.5 Controlling the batching processes using the local display

Filling processes can be carried out directly by means of the local display with the aid of the optional "(Batching)" software package (F-CHIP, accessories → Page 127). Therefore, the device can be fully deployed in the field as a "batch controller."

Procedure:

1. Configure all the required batching functions and assign the lower display info line (= BATCHING KEYS) using the "Batch" Quick Setup menu (→ Page 89) or use the function matrix (→ Page 70).  
The following "softkeys" then appear on the bottom line of the local display → Fig. 46:  
 – START = left display key (□)   
 – PRESET = middle display key (⊕)   
 – MATRIX = right display key (E)
2. Press the "PRESET (⊕)" key. Various batching process functions requiring configuration will now appear on the display:

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

3. After exiting the PRESET menu, you can now start the batching process by pressing "START (□)". New softkeys (STOP/HOLD or GO ON) now appear on the display. You can use these to interrupt, continue or stop the batching process at any time. → Fig. 46  
**STOP (□)** → Stops batching process  
**HOLD (⊕)** → Interrupts batching process (softkey changes to "GO ON")  
**GO ON (⊕)** → Continues batching process (softkey changes to "HOLD")  
 After the batch quantity is reached, the "START" or "PRESET" softkeys reappear on the display.

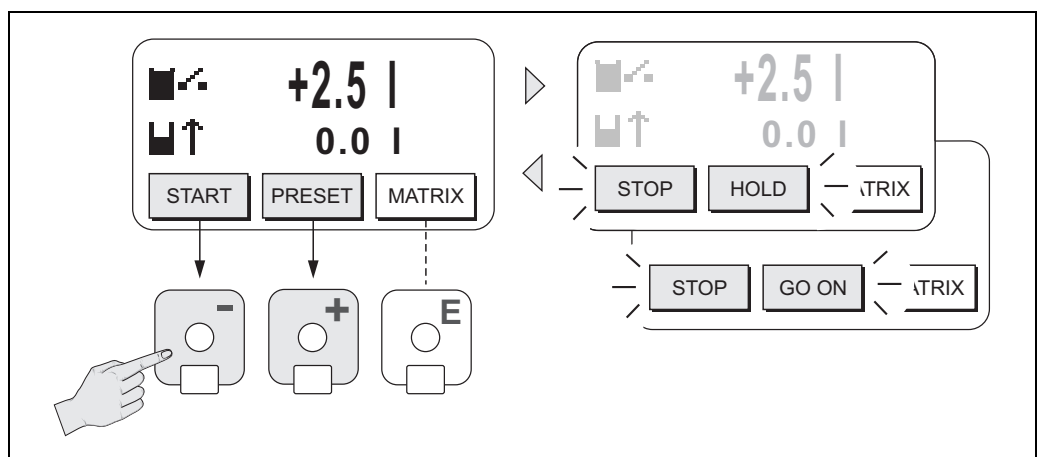


Fig. 46: Controlling batching processes using the local display (softkeys)

### 5.3 Brief Operating Manual to the function matrix



Note!

- Be certain to observe the general notes → Page 71
  - Function descriptions → see the "Description of Device Functions" manual
1. HOME position → **E** → Entry into the function matrix
  2. Select a block (e.g. OUTPUTS)
  3. Select a group (e.g. CURRENT OUTPUT 1)
  4. Select a function group (e.g. CONFIGURATION)
  5. Select a function (e.g. TIME CONSTANT)  
Change parameter/enter numerical values:
    - + -** → Select or enter enable code, parameters, numerical values
    - E** → Save your entries
  6. Exit the function matrix:
    - Press and hold down the Esc key (**Esc**) for longer than 3 seconds → HOME position
    - Repeatedly press the Esc key (**Esc**) → Return step-by-step to HOME position

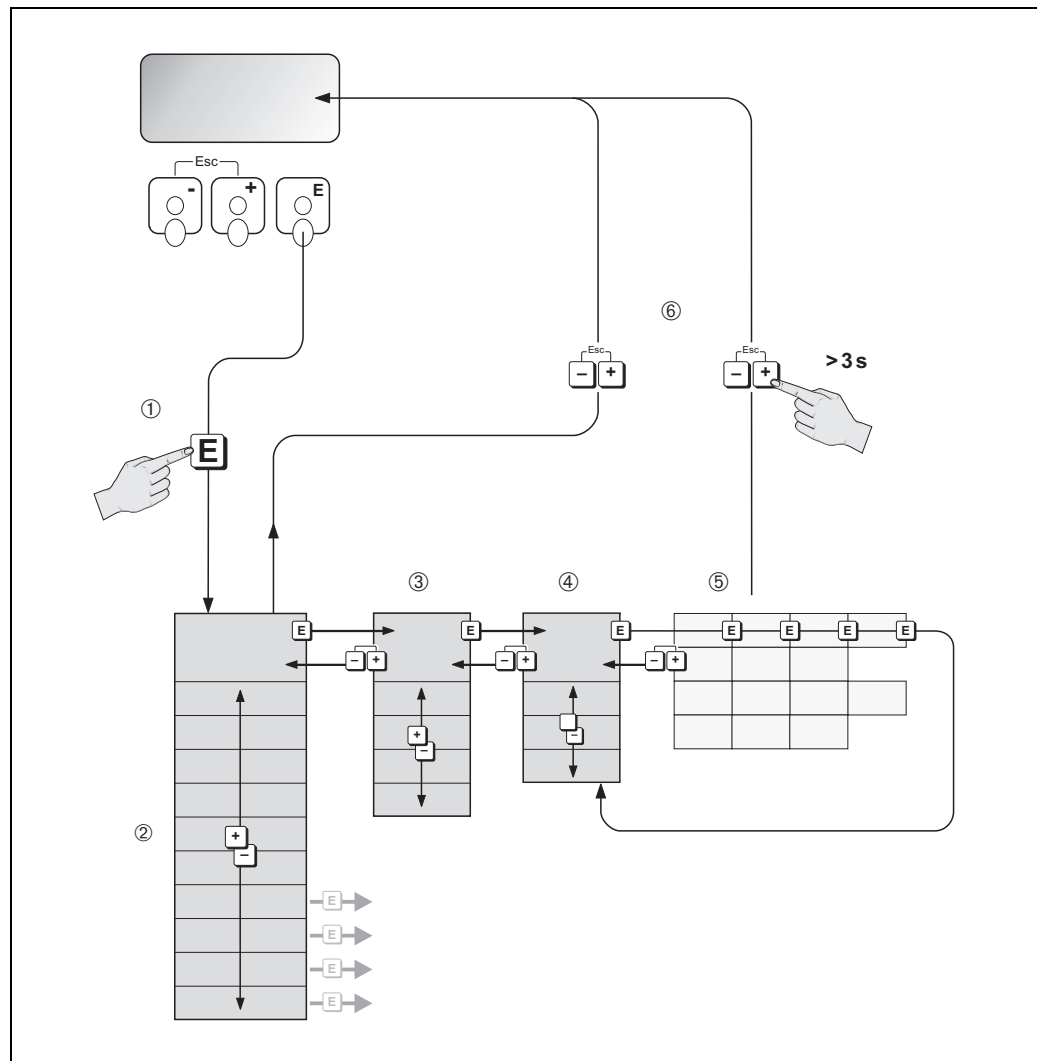


Fig. 47: Selecting functions and configuring parameters (function matrix)

### 5.3.1 General notes

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

Comply with the following instructions when configuring functions:

- You select functions as described → Page 70.  
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  $\left[ \begin{smallmatrix} + \\ - \end{smallmatrix} \right]$  to select "SURE [ YES ]" and press  $\left[ \begin{smallmatrix} E \\ \end{smallmatrix} \right]$  to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is disabled automatically if you do not press a key within 60 seconds following automatic return to the HOME position.



Caution!

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



Note!

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

### 5.3.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 53) has to be entered before settings can again be changed.

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

Comply with the following instructions when entering codes:

- If programming is disabled and the  $\left[ \begin{smallmatrix} + \\ - \end{smallmatrix} \right]$  operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the customer's code, programming is always enabled.
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.



Caution!

Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy.

There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to Endress+Hauser. Please contact your Endress+Hauser service organization if you have any questions.

### 5.3.3 Disabling the programming mode

Programming mode is again disabled if you do not press an operating element within 60 seconds following automatic return to the HOME position.

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

## 5.4 Error messages

### 5.4.1 Type of error

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

The measuring system distinguishes between two types of error:

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

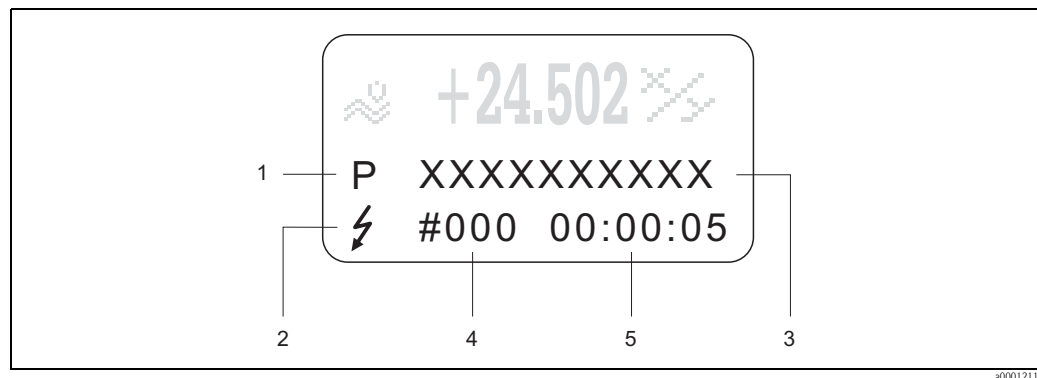


Fig. 48: Error messages on the display (example)

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

### 5.4.2 Error message type

The measuring device always assigns system and process errors which occur to two types of error messages (**fault** or **notice messages**) resulting in different weightings. → Page 132 ff.

Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

#### Notice message (!)

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

#### Fault message (⚡)

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



#### Note!

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



## 5.5 Operating options

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

### 5.5.1 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.

### 5.5.2 Operating program "ToF Tool - Fieldtool Package"

Modular software package consisting of the "ToF Tool" service program for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and evolution of pressure measuring devices as well as the "Fieldtool" service program for the configuration and diagnosis of Proline flowmeters. The Proline flowmeters are accessed via a service interface or via the service interface FXA193.

Contents of the "ToF Tool - Fieldtool Package":

- Commissioning, maintenance analysis
- Configuring flowmeters
- Service functions
- Visualization of process data
- Troubleshooting
- Reading out the verification data and updating the software of the "Fieldcheck" flow simulator


### 5.5.3 Operating program "SIMATIC PDM" (Siemens)

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

### 5.5.4 Device drivers for operating programs

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

#### PROFIBUS DP

<b>Valid for device software:</b>	3.04.XX	→ DEVICE SOFTWARE function (8100)
<b>PROFIBUS DP device data:</b>		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promag 53 ID No.:	1526hex	→ DEVICE ID function (6162)
Profile ID No.:	9741hex	
<b>GSD file information:</b>		
Promag 53 GSD file:	Extended Format (recommended):	eh3x1526.gsd
	Standard Format:	eh3_1526.gsd
	 Note! Before configuring the PROFIBUS network, read and follow the information for using the GSD file → Page 100	
Bitmaps:	EH_1526_d.bmp/.dib EH_1526_n.bmp/.dib EH_1526_s.bmp/.dib	
Profile GSD file:	PA039741.gsd	
Software release:	07.2007	
Operating program/Device driver:	Sources for obtaining device drivers/program updates:	
Promag 53 GSD file:	<ul style="list-style-type: none"> <li>■ www.endress.com (→ Download → Software → Device Drivers)</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 → Software → Device Drivers)</li> <li>■ CD-ROM (Endress+Hauser order number: 56004088)</li> </ul>	
SIMATIC PDM	<ul style="list-style-type: none"> <li>■ www.endress.com (→ Download → Software → Device Drivers)</li> <li>■ www.feldgeraete.de</li> </ul>	


Tester/simulator:	
Device:	How to acquire:
Fieldcheck	<ul style="list-style-type: none"> <li>■ Update by means of FieldCare via 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>	3.04.XX	→ DEVICE SOFTWARE function (8100)
<b>PROFIBUS PA device data:</b>		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promag 53 ID No.:	1527hex	→ DEVICE ID function (6162)
Profile ID No.:	9741hex	
<b>GSD file information:</b>		
Promag 53 GSD file:	Extended Format (recommended):	eh3x1527.gsd
	Standard Format:	eh3_1527.gsd
	 <b>Note!</b> Before configuring the PROFIBUS network, read and follow the information for using the GSD file → Page 100	
Bitmaps:	EH_1527_d.bmp/.dib EH_1527_n.bmp/.dib EH_1527_s.bmp/.dib	
Profile GSD file:	PA139741.gsd	
Software release:	07.2007	
<b>Operating program/device driver:</b>	<b>Sources for obtaining device drivers/program updates:</b>	
Promag 53 GSD file:	<ul style="list-style-type: none"> <li>■ www.endress.com (→ Download → Software → Device Drivers)</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 → Software → Device Drivers)</li> <li>■ CD-ROM (Endress+Hauser order number: 56004088)</li> </ul>	
SIMATIC PDM	<ul style="list-style-type: none"> <li>■ www.endress.com (→ Download → Software → Device Drivers)</li> <li>■ www.feldgeraete.de</li> </ul>	

<b>Tester/simulator:</b>	
<b>Device:</b>	<b>How to acquire:</b>
Fieldcheck	<ul style="list-style-type: none"> <li>■ Update by means of FieldCare via 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. → Page 147
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

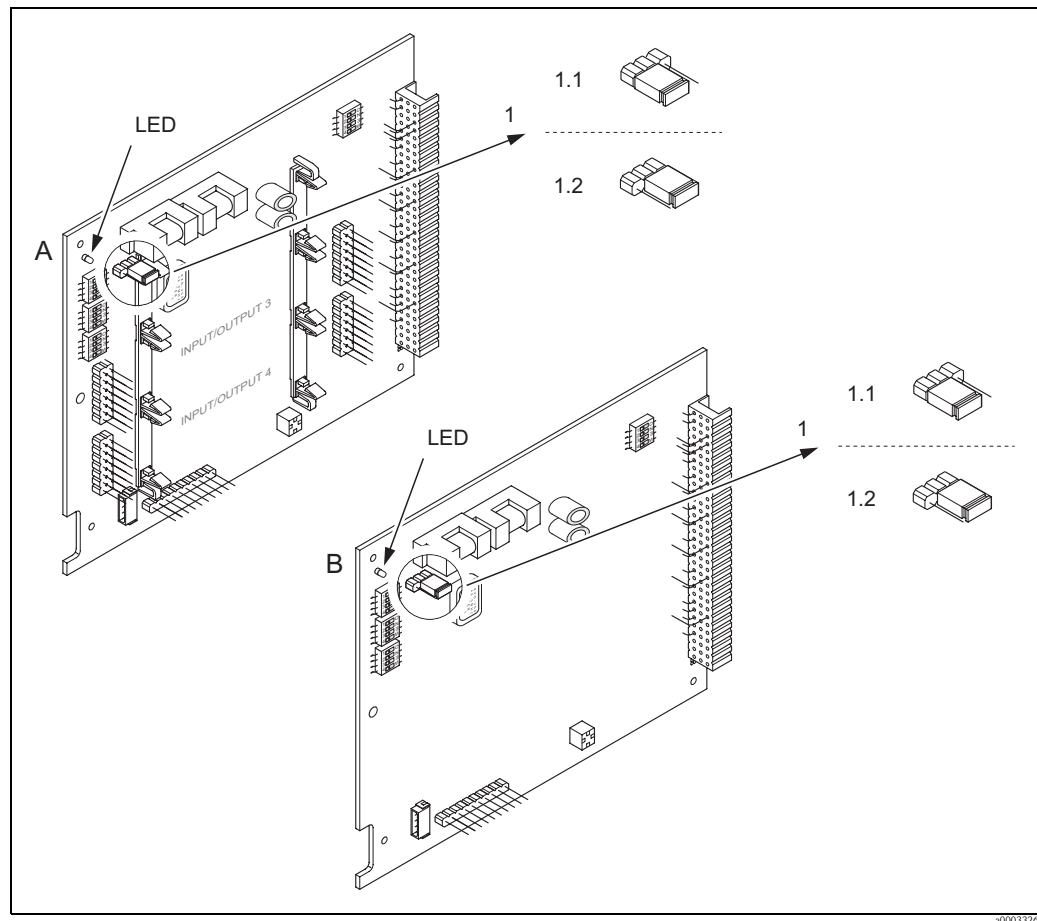


Fig. 49: Switching write protection on and off with the aid of a jumper on the I/O board

A Flexible assignment board

B Permanent assignment board

1 Jumper for switching write protection on and off

1.1 Write protection switched off (factory setting) = it is possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare).

1.2 Write protection switched on = it is **not** 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 → Page 130 ff.

## 5.6.2 Configuring the device address

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

### Addressing via local operation

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

### Addressing via miniature switches



Warning!

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

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

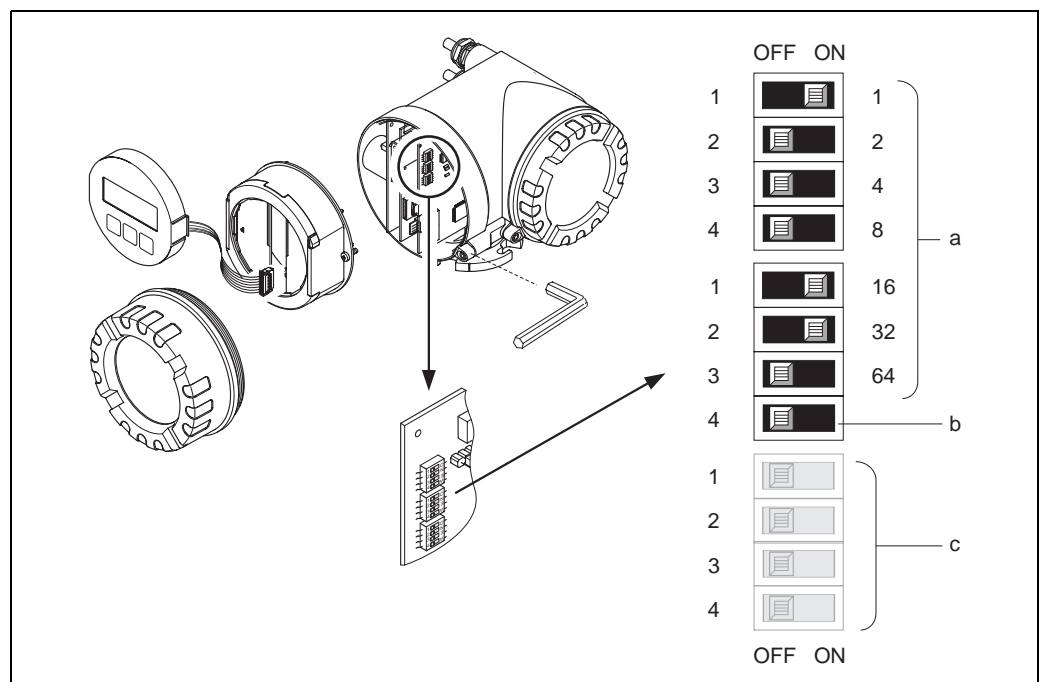


Fig. 50: Addressing with the aid of miniature switches on the I/O board

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

### 5.6.3 Configuring the terminating resistors



Note!

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



Warning!

Risk of electric shock. Exposed components carry dangerous voltages.

Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

- For baud rates up to 1.5 MBaud, the termination is set via the terminating switch SW 1 for the last transmitter on the bus: ON - ON - ON - ON.
- Device is operated with a baud rate >1.5 MBaud: due to the capacitive load of the user and the resulting line reflection, make sure that an external termination is used.  
In addition, the signal lines have to be protected (= shielded and grounded) for flexible assignment boards. → Page 55

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

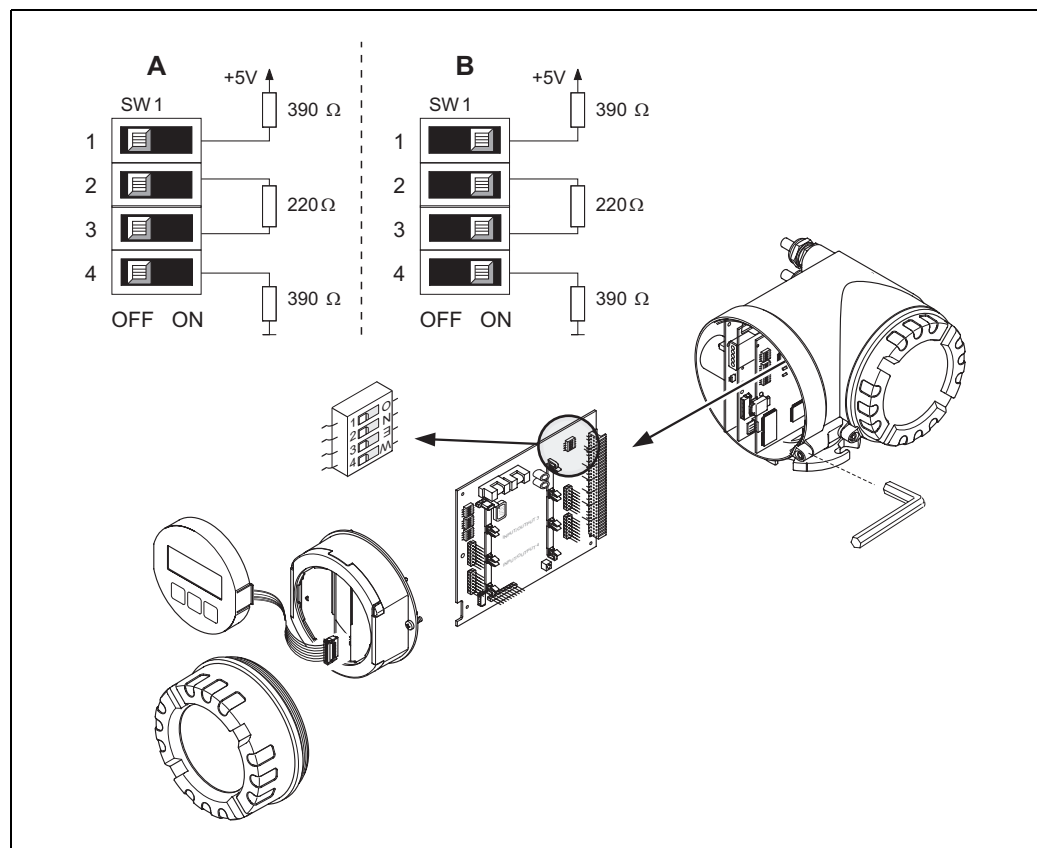


Fig. 51: Configuring the terminating resistors (for baud rates < 1.5 MBaud)

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. → Page 147 ff.
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.

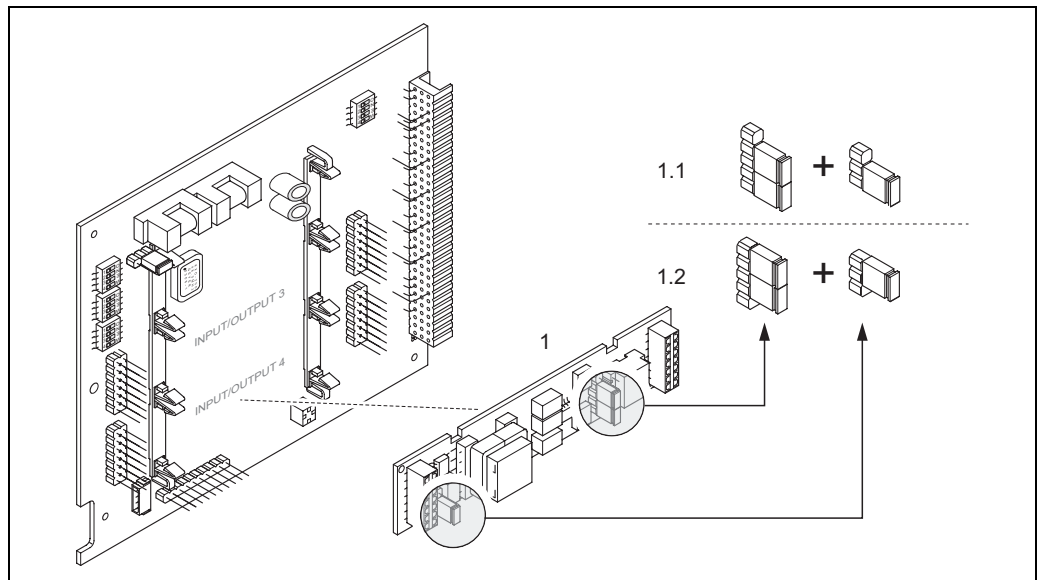


Fig. 52: Configuring the current input with the aid of jumpers (I/O board)

- 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. → Page 147
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.

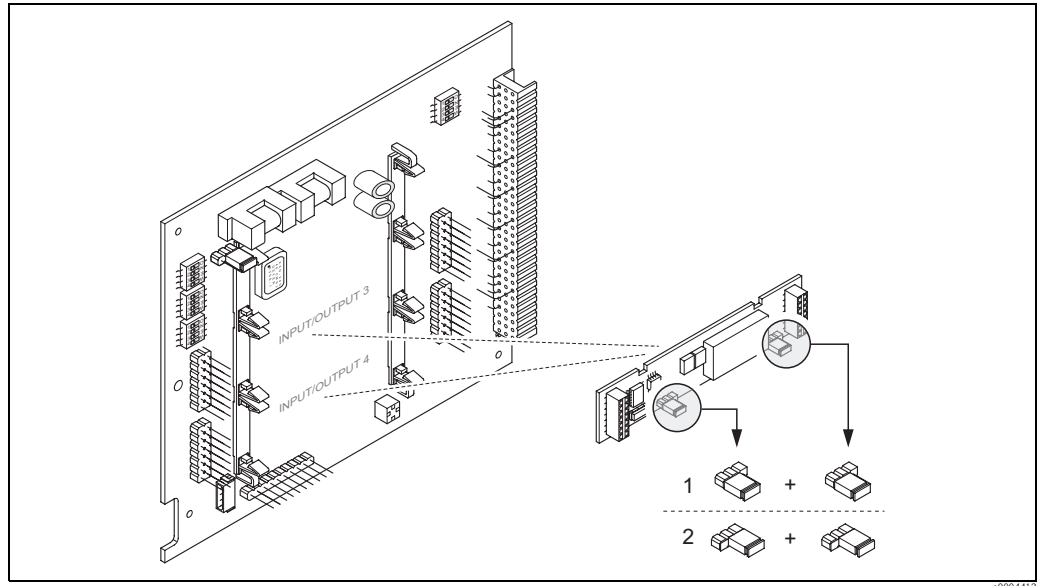


Fig. 53: Configuring relay contacts (NC/NO) on the convertible I/O board (submodule) with the help of jumpers.

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



## 5.7 Hardware PROFIBUS PA settings

### 5.7.1 Configuring the write protection

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



#### Warning!

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

1. Switch off power supply.
2. Remove the I/O board. → Page 147
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

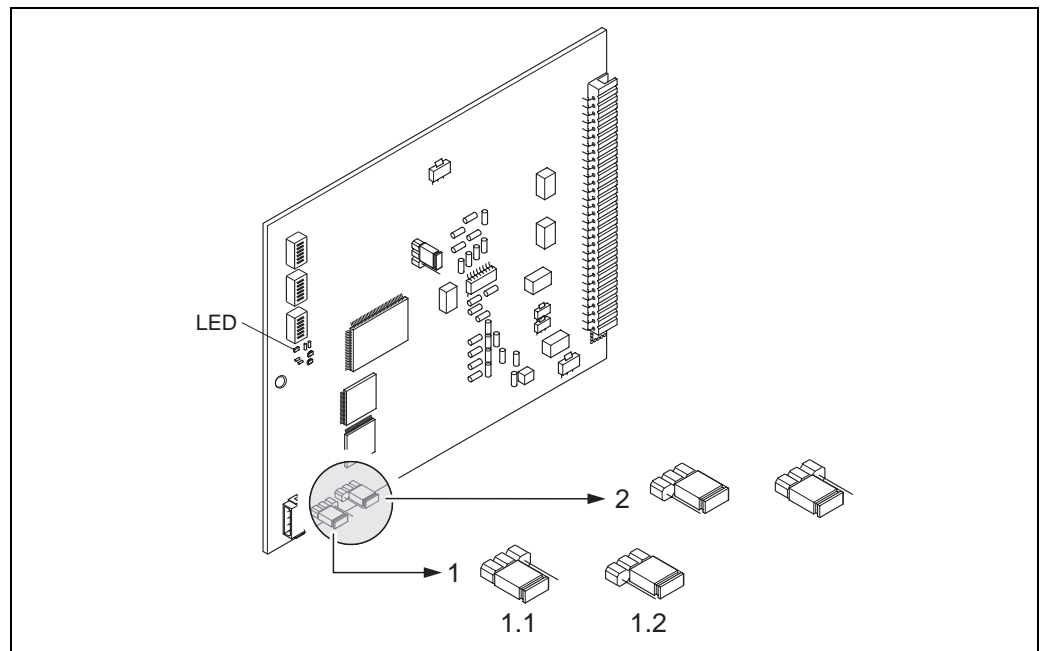


Fig. 54: Switching write protection on and off with the aid of a jumper on the I/O board

- 1 Jumper for switching write protection on and off
    - 1.1 Write protection switched off (factory setting) = it is possible to write to the device parameters via PROFIBUS (acyclic data transmission, e.g. via FieldCare).
    - 1.2 Write protection switched on = it is **not** 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 → Page 130 ff.

## 5.7.2 Configuring the device address

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

### Addressing via local operation

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

### Addressing via miniature switches



#### Warning!

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

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

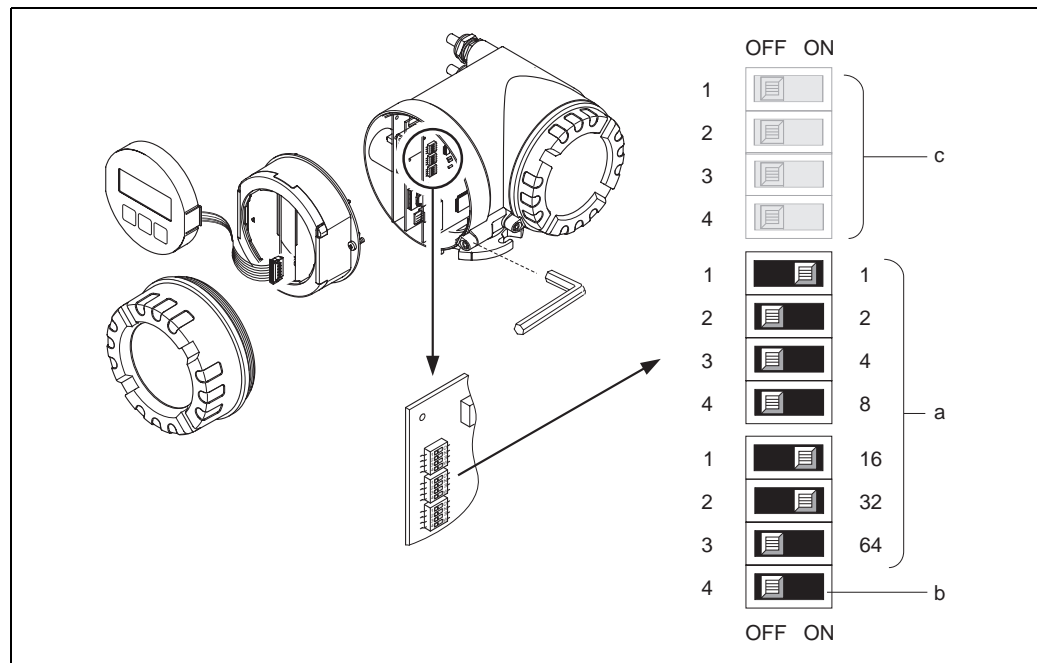


Fig. 55: Addressing with the aid of miniature switches on the I/O board

- 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

## 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" → Page 42
- Checklist for "Post-connection check" → Page 63



Note!

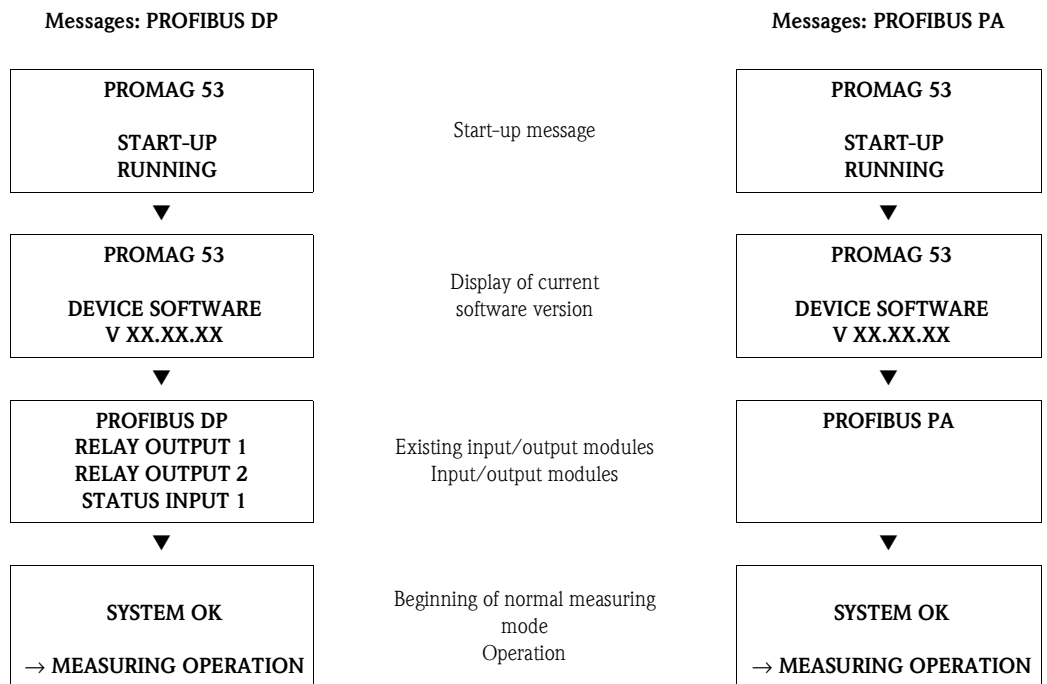
When using PROFIBUS PA, please note the following:

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

### 6.2 Switching on the measuring device

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

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



Normal measuring mode commences as soon as startup completes.

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



Note!

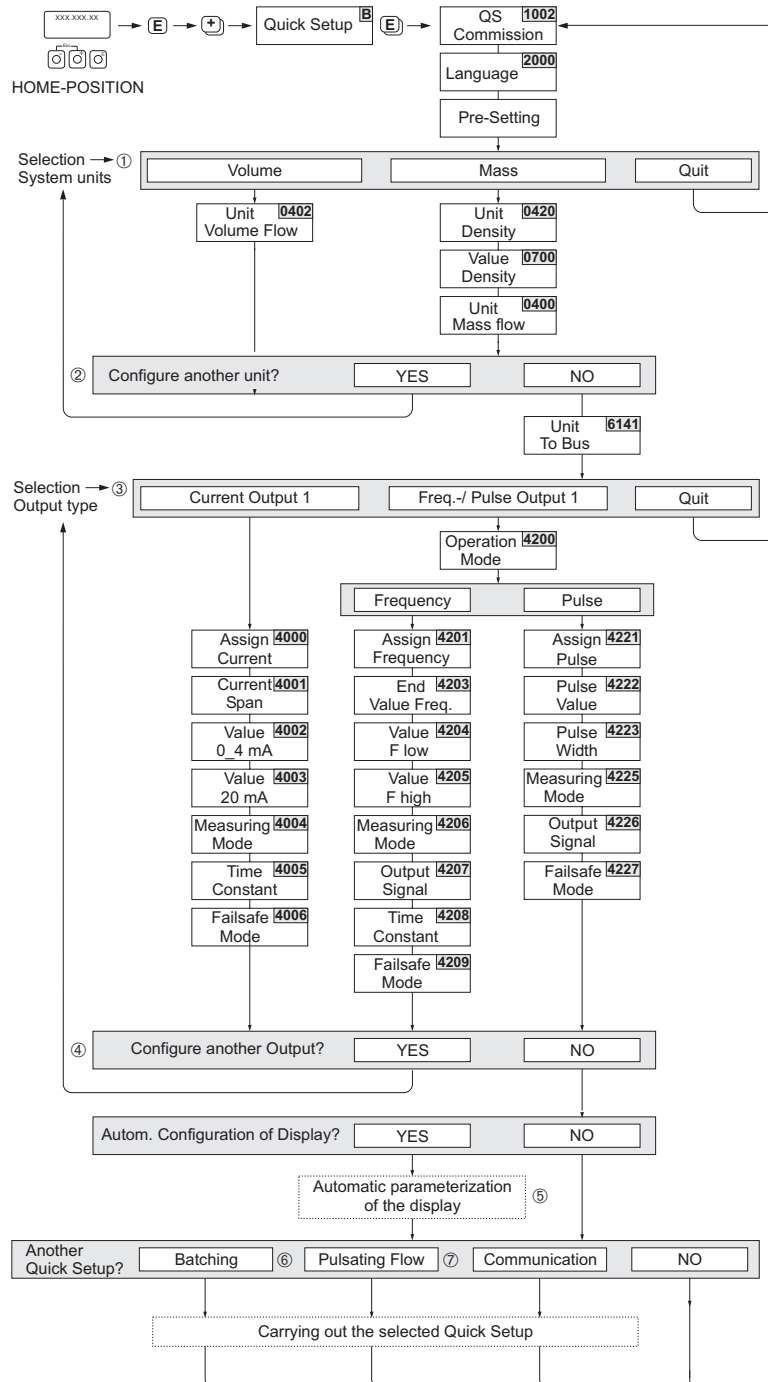
If startup fails, an error message indicating the cause is displayed.

## 6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the configuration program, e.g. FieldCare.

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

### 6.3.1 Quick Setup "Commissioning"



a0004551-en

Fig. 56: Quick Setup for fast commissioning

**Note!**

- The display returns to the cell SETUP COMMISSIONING (1002) if you press the ESC key combination during parameter interrogation. The stored parameters remain valid.
  - The "Commissioning" Quick Setup must be carried out before one of the other Quick Setups described in this Operating Manual is run.
- ① Only units not yet configured in the current Setup are offered for selection in each cycle. The unit for mass and volume is derived from the corresponding flow unit.
  - ② The "YES" option remains visible until all the units have been configured. "NO" is the only option displayed when no further units are available.
  - ③ This prompt only appears if a current output and/or pulse/frequency output is available. Only the outputs not yet configured in the current Setup are offered for selection in each cycle.
  - ④ The "YES" option remains visible until all the outputs have been configured. "NO" is the only option displayed when no further outputs are available.
  - ⑤ The "automatic display configuration" option contains the following basic settings/factory settings
    - YES      Main line = volume flow  
            Additional line = totalizer 1  
            Information line = operating/system condition
    - NO        The existing (selected) settings remain.
  - ⑥ The BATCHING QUICK SETUP is only available when the optional software package BATCHING is installed.
  - ⑦ 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. → Page 84

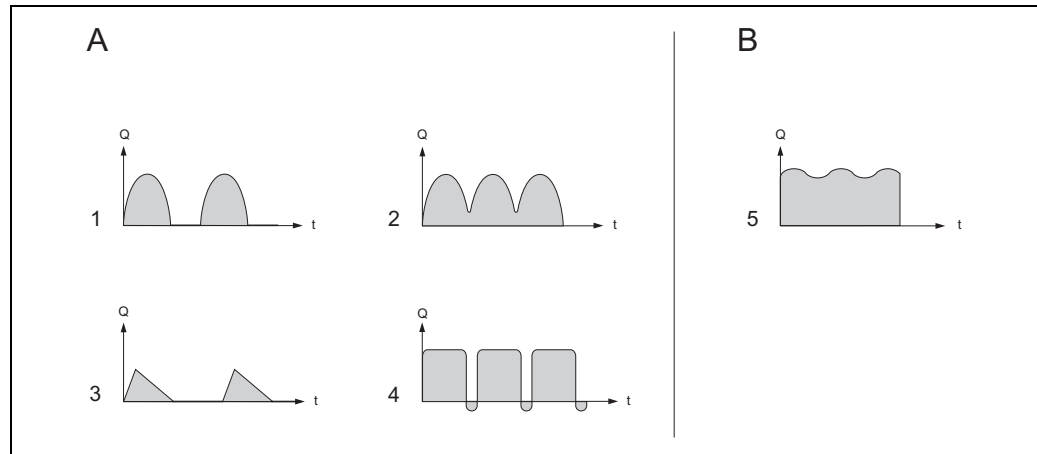


Fig. 57: Flow characteristics of various types of pump

A With severely pulsating flow  
B With low pulsating flow

- 11 -cylinder cam pump  
22 -cylinder cam pump  
3 Magnetic pump  
4 Peristaltic pump, flexible connecting hose  
5 Multi-cylinder reciprocating pump

#### Severely pulsating flow

Once several device functions have been configured in the "Pulsating flow" Quick Setup menu, flow fluctuations of this nature can be compensated over the entire flow range and pulsating liquid flows measured correctly. Below you will find detailed instructions on how to use this Quick Setup menu.



Note!

It is always advisable to work through the "Pulsating flow" Quick Setup menu if there is any uncertainty about the exact flow characteristic.

#### Slightly pulsating flow

If flow fluctuations are no more than minor, as is the case, for example with gear-type, three-cylinder or multi-cylinder pumps, it is **not** absolutely necessary to work through the Quick Setup menu.

In cases of this nature, however, it is advisable to adapt the functions listed below in the function matrix (see the "Description of Device Functions" manual) to suit local process conditions in order to ensure a stable, unvarying output signal:

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

### Performing the "Pulsating Flow" Quick Setup

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

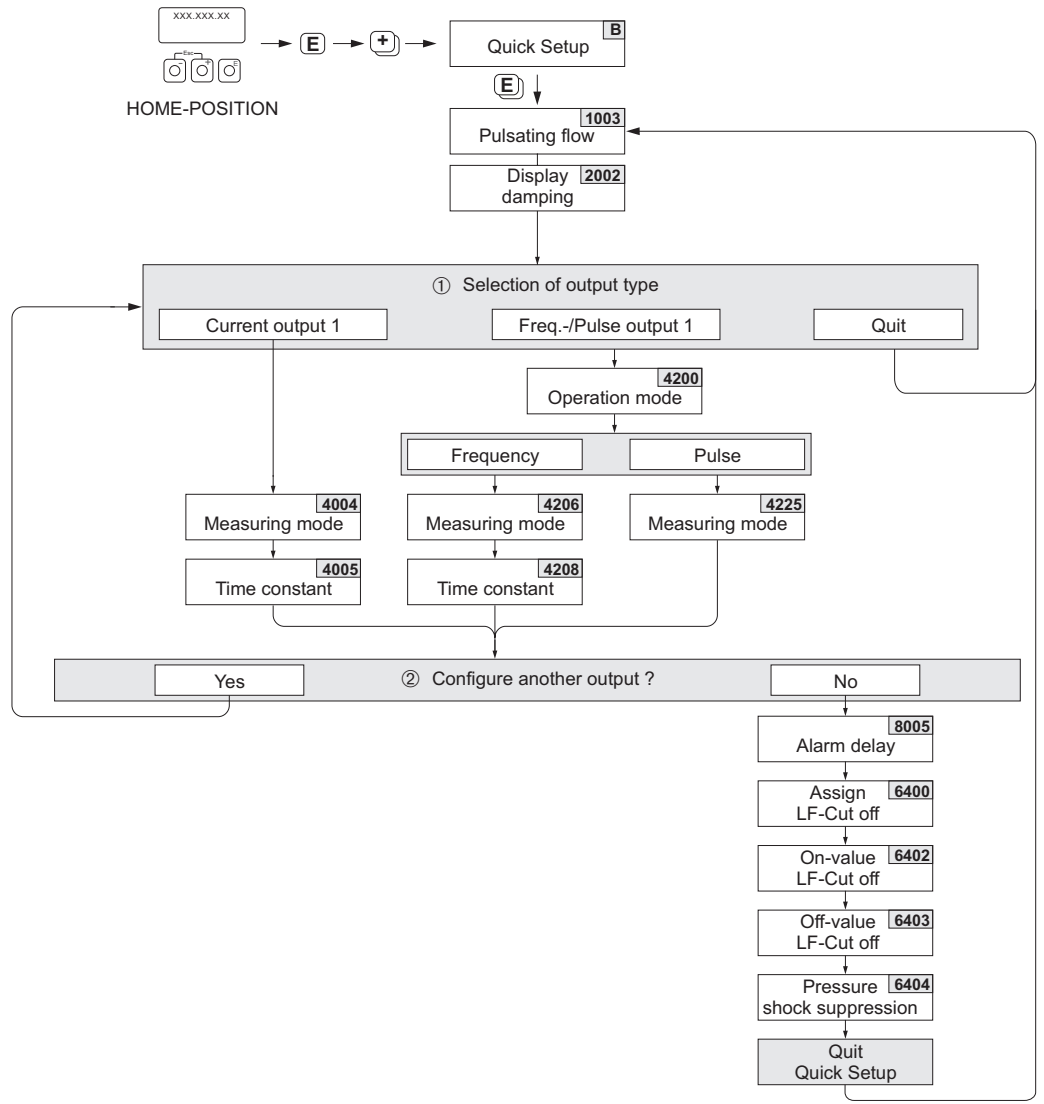








Fig. 58: Quick Setup for measuring severely pulsating flows.

- ① Only the output not yet configured in the current Setup is offered for selection in the second cycle.
- ② The "YES" option remains visible until both outputs have been configured. "NO" is the only option displayed when no further outputs are available.



**Note!**



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

Quick Setup "Pulsating Flow"		
HOME position →  → MEASURAND →  → QUICK SETUP →  → QS PULSATING FLOW (1003)		
Function No.	Function name	Selection with  To the next function with 
1003	QS PULSATING 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>a0004432-en</small> <i>*Full scale values → Page 20 ff.</i>
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s



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



### 6.3.3 Quick Setup "Batching"



Note!

This function is only available when the additional "batching" software is installed in the measuring device (order option). You can order this software from Endress+Hauser as an accessory at a later date. → Page 127

This Quick Setup menu guides you systematically through the setup procedure for all the device functions that have to be modified and configured for batching operation. These basic settings allow simple (one-step) batching processes.

Additional settings, e.g. for multistage batching procedures, must be made via the function matrix itself (see the "Description of Device Functions" manual).



Caution!

The "Batching" Quick Setup sets certain device parameters for discontinuous measurement operation.

If the measuring device is used for continuous flow measurement at a later time, we recommend at you rerun the "Commissioning" and/or "Pulsating flow" Quick Setup.

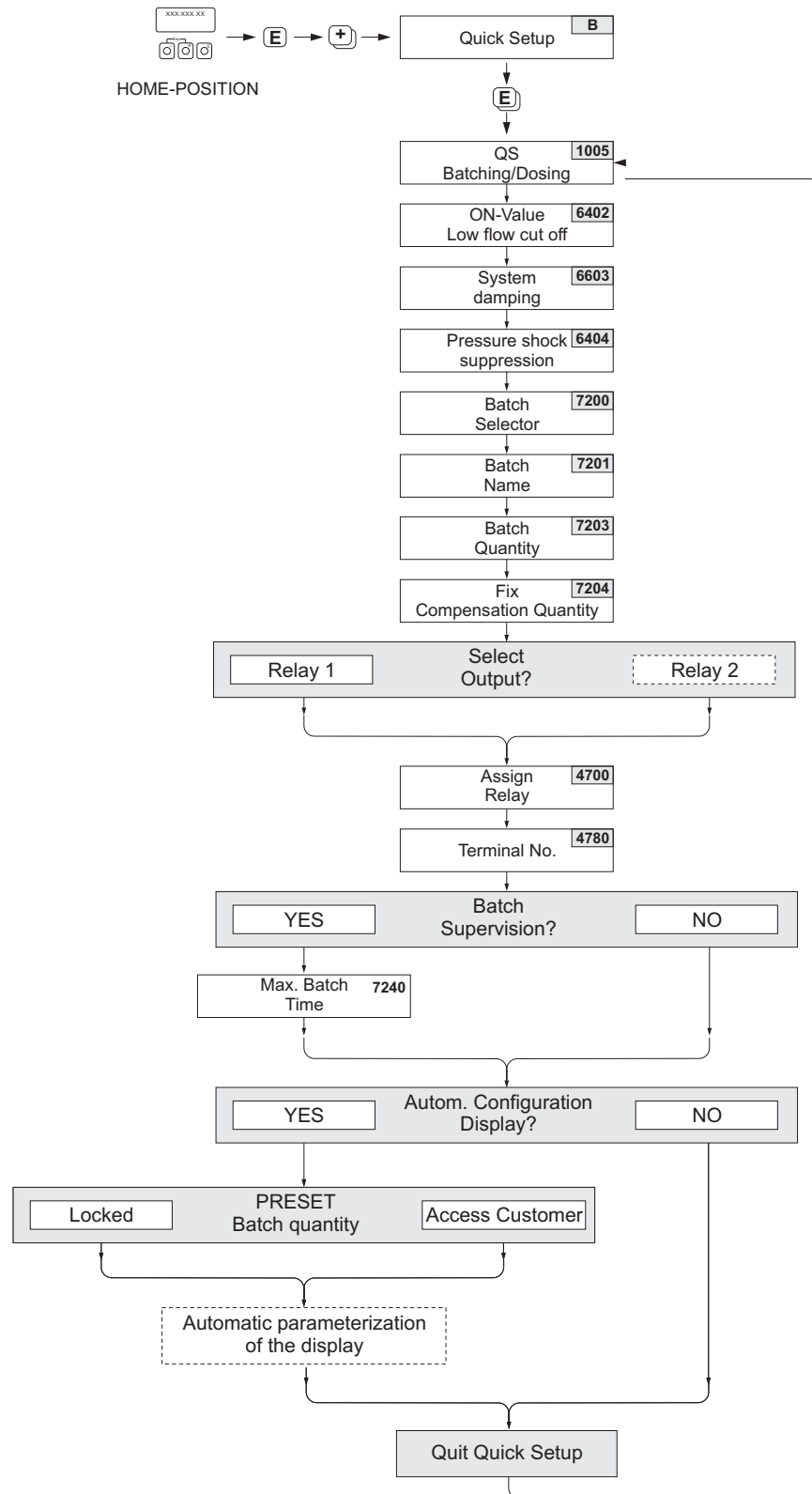


Note!

- Before carrying out the Quick Setup "Batching" the Quick Setup "Commissioning" has to be executed. → Page 84
- You can find detailed information on the batching functions in the separate "Description of Device Functions" manual.
- You can also directly control filling process using the local display. During Quick Setup, an appropriate dialog appears concerning the automatic display configuration. Acknowledge this by clicking "YES".

This assigns special batching functions (START, PRESET, etc.) to the bottom line of the display. These can be directly executed on site using the three operating keys (  $\square_{+}$  /  $\square_{-}$  /  $\square_{E}$  ). Therefore, the measuring device can be fully deployed in the field as a "batch controller". → Page 69

- You can also directly control the filling process using the fieldbus.



a0004433-en

Fig. 59: Quick Setup "Batching"

**Recommended settings**

Quick Setup "Batching"		
HOME position →  → MEASURAND →  → QUICK SETUP →  → QUICK SETUP BATCHING (1005)		
Function No.	Function name	Setting to be selected (  ) (to the next function with  )
1005	QUICK SETUP BATCHING/DOSING	YES After  is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.



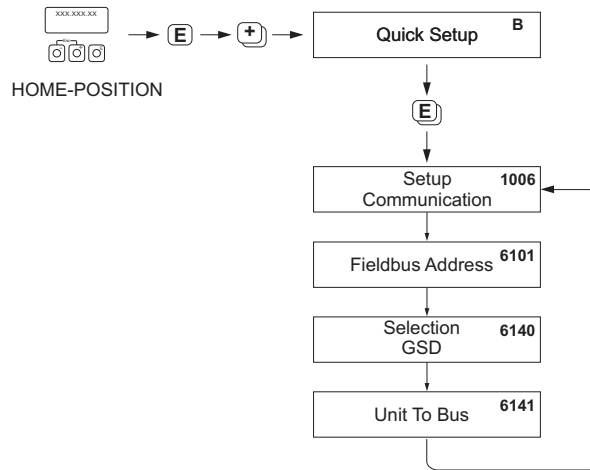
Note! Some of the functions listed below (with a gray background) are configured automatically, i.e. by the measuring system.		
6400	ASSIGN LOW FLOW CUTOFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUTOFF	The recommended setting is contained on Page 88 in Function No. 6402.
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6603	SYSTEM DAMPING	9  Note! The parameter has to be optimized for highly accurate and short filling processes: to do this, put the setting to "0".
6404	PRESSURE SHOCK SUPPRESSION	0 s
7200	BATCH SELECTOR	BATCH #1
7201	BATCH NAME	BATCH #1
7202	ASSIGN BATCH VARIABLE	VOLUME
7203	BATCH QUANTITY	0
7204	FIX COMPENSATION QUANTITY	0
7208	BATCH STAGES	1
7209	INPUT FORMAT	Value input
4700	ASSIGN RELAY	BATCHING VALVE 1
4780	TERMINAL NUMBER	Output (display only)
7220	OPEN VALVE 1	0% or 0 [unit]
7240	MAXIMUM BATCH TIME	0 s (= switched off)
7241	MINIMUM BATCH QUANTITY	0
7242	MAXIMUM BATCH QUANTITY	0
2200	ASSIGN (Main line)	BATCH NAME
2220	ASSIGN (Multiplex main line)	Off
2400	ASSIGN (Additional line)	BATCH DOWNWARDS
2420	ASSIGN (Multiplex additional line)	Off
2600	ASSIGN (Information line)	BATCHING KEYS
2620	ASSIGN (Multiplex information line)	Off



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


### 6.3.4 Quick Setup "Communication"



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



a0002600-en


Fig. 60: Quick Setup "Communication"


Quick Setup "Communication"		
HOME position → <b>E</b> → MEASURAND (A) → <b>+</b> → QUICK SETUP (B) → <b>E</b> → QUICK SETUP COMMUNICATION (1006)		
Function No.	Function name	Setting to be selected ( <b>+/-</b> ) (to the next function with <b>E</b> )
1006	QS-COMMUNICATION	After confirmation (YES) by pressing <b>E</b> the subsequent functions are called up in succession.
6101	FIELDBUS ADDRESS	Enter the device address (permitted address range: 1 to 126)  <b>Factory setting:</b> 126
6140	SELECTION GSD	Select the operating mode (the GSD file) which should be used for cyclic data transmission with the PROFIBUS master.  <b>Options:</b> MANUFACT. SPEC. → The measuring device is operated with complete device functionality. MANUFACT V2.0 → The measuring device is used as the replacement for the previous Promag 33 model (compatibility mode). PROFILE-GSD → The measuring device is operated in the PROFIBUS Profile mode.  <b>Factory setting:</b> MANUFACT. SPEC.   <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:→ Page 100

Quick Setup "Communication"		
6141	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 the  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>



Back to the HOME position:

→ Press and hold down the  key for longer than three seconds or

→ Repeatedly press and release the  key = Exit the function matrix step by step

### 6.3.5 Data backup/transmission

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

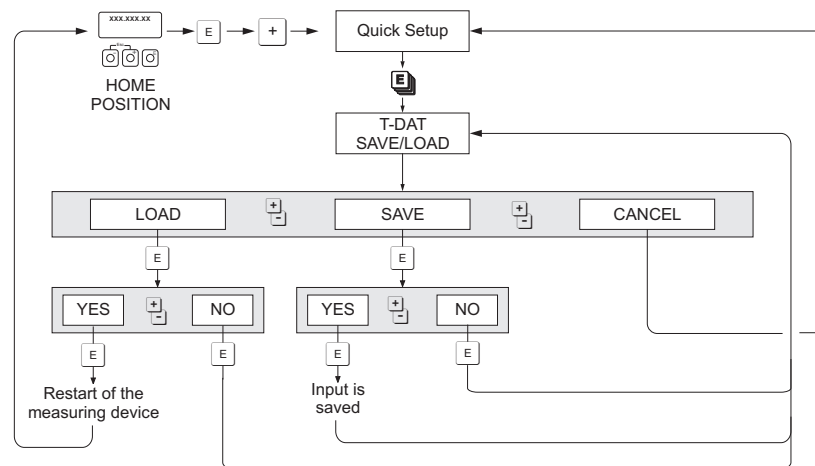
This is required in the following instances:

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



Hinweis!

For information on installing and removing the T-DAT → Seite 145 ff.



a0001221-en

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

Information on the LOAD and SAVE options available:

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



Hinweis!

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

**SAVE:**

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

## 6.4 Commissioning the PROFIBUS interface



Note!

- All functions required for commissioning are described in detail in the "Description of Device Functions" manual which is a separate part of this Operating Manual.
- A code (factory setting: 53) must be entered to change device functions, numerical values or factory settings. → Page 71

### 6.4.1 PROFIBUS DP commissioning

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

1. **Check the hardware write protection:**

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



Note!

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

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → CONFIGURATION (610) → WRITE PROTECT (6102) → Display of one of the following options:

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

Deactivate the write protection if necessary. → Page 76

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) →  
FIELD BUS ADDRESS (6101)

- Hardware addressing via miniature switches → Page 77

4. **Select the system unit:**

- a. Determine the units by means of the system units group:

MEASURED VARIABLES (A) → SYSTEM UNITS (ACA) → CONFIGURATION (040) →  
UNIT MASS FLOW (0400) / UNIT MASS (0401) / UNIT  
VOLUME FLOW (0402) / ...

- b. In the function UNIT TO BUS (6141), select the option SET UNITS, so that the measured variables transmitted cyclically to the PROFIBUS master (Class 1) are transmitted with the system units set in the measuring device:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → OPERATION (614) →  
UNIT TO BUS (6141)



Note!

- The configuration of the system units for the totalizer is described separately → see step 7

- If the system unit of a measured variable is changed by means of the local operation or an operating program, this initially does not have any effect on the unit that is used to transmit the measured variable to the PROFIBUS master (Class 1). Changed system units of the measured variables are not transmitted to the PROFIBUS master (Class 1) until the SET UNITS option is activated in the function BASIC FUNCTION (G) → PROFIBUS DP (GBA) → OPERATION (614) → UNIT TO BUS (6141).


### 5. Configuration of the Analog Input function blocks 1 to 2:

The measuring device has two Analog Input function blocks (AI modules), through which the various measured variables can be cyclically transmitted to the PROFIBUS master (Class 1). The assignment of a measured variable to the Analog Input function block is shown below using the example of Analog Input function block 1 (AI module, slot 1).

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

- a. Select BASIC FUNCTION (G) → PROFIBUS DP (GBA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120).
- b. Select the option ANALOG INPUT 1.
- c. Select the function CHANNEL (6123).
- d. Select the option VOLUME FLOW.

*Possible settings:*

Measured variable	ID for "CHANNEL" function
VOLUME FLOW (factory setting AI function block 1)	273
MASS FLOW (factory setting AI function block 2)	277
<b>The following measured variables are available when the additional "batching" software is installed (order option)</b>	
BATCH UPWARDS	1346
BATCH DOWNWARDS	1347
BATCH COUNTER	1348
BATCH SUM	1349
BATCHING TIME	1354
 <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. → Page 106	

### 6. Setting the measuring mode:

In the function MEASURING MODE (6601), select the flow portions to be measured by the measuring device.

BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601) → Selection of one of the following options:

- UNIDIRECTIONAL (factory setting) = only the positive flow portions
- BIDIRECTIONAL = the positive and negative flow components

### 7. Configuration of totalizers 1 to 3:

The measuring device has three totalizers. The following example describes the configuration of the totalizer using totalizer 1 as an example.

- Using the CHANNEL function (6133), you can determine the measured variable (e.g. volume flow) to be cyclically transmitted to the PROFIBUS master (Class 1) as a totalizer value:
  - a. Select BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → SELECT TOTALIZER (6130).
  - b. Select the option TOTALIZER 1.
  - c. Go to the function CHANNEL (6133).



- d. Select one of the following options:
- VOLUME FLOW (CHANNEL = 273, factory setting): the volume flow is totalized.
  - MASS FLOW (CHANNEL = 277): the mass flow is totalized.
  - OFF (CHANNEL = 0): no totalizing, "0" is displayed as the totalizer value.

 **Note!**

If, when the PROFIBUS network configuration, the module or the function "TOTAL" was integrated in slot 2, 3 or 4, the measured variable selected in the CHANNEL function is transmitted cyclically to the PROFIBUS master (Class 1) for the respective totalizer 1 to 3.  
→ Page 106

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

 **Note!**

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

**8. Select the operating mode:**

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

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

 **Note!**

For PROFIBUS network configuration, make sure that the right device master file (GSD file) of the measuring device is used for the selected operating mode: → Page 100 ff.

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


A detailed description of the cyclic data transmission is contained on → Page 104 ff.

## 6.4.2 PROFIBUS PA commissioning

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

### 1. Check the hardware write protection:

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

 Note!

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

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → WRITE PROTECT (6102) → Display of one of the following options:

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

Deactivate the write protection if necessary. → Page 76

### 2. Enter the tag name (optional):

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → TAG NAME (6100)

### 3. Configuring the fieldbus address:

- Software addressing using the local display:

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

- Hardware addressing via miniature switches → Page 77

### 4. Select the system unit:

- a. Determine the units by means of the system units group:

MEASURED VARIABLES (A) → SYSTEM UNITS (ACA) → CONFIGURATION (040) → UNIT MASS FLOW (0400) / UNIT MASS (0401) / UNIT VOLUME FLOW (0402) / ...

- b. In the function UNIT TO BUS (6141), select the option SET UNITS, so that the measured variables transmitted cyclically to the PROFIBUS master (Class 1) are transmitted with the system units set in the measuring device:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → UNIT TO BUS (6141)

 Note!

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

### 5. Setting the measuring mode:

In the function MEASURING MODE (6601), select the flow portions to be measured by the measuring device.


BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601) → Selection of one of the following options:

- UNIDIRECTIONAL (factory setting) = only the positive flow portions
- BIDIRECTIONAL = the positive and negative flow components

## 6. Configuration of totalizers 1 to 3:

The measuring device has three totalizers. The following example describes the configuration of the totalizer using totalizer 1 as an example.

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

 Note!

If, when the PROFIBUS network configuration, the module or the function TOTAL was integrated in slot 2, 3 or 4, the measured variable selected in the CHANNEL function is transmitted cyclically to the PROFIBUS master (Class 1) for the respective totalizer 1 to 3.  
→ Page 106

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

 Note!

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

## 7. Select the operating mode:

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

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

 Note!

For PROFIBUS network configuration, make sure that the right device master file (GSD file) of the measuring device is used for the selected operating mode:→ Page 100 ff.

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

A detailed description of the cyclic data transmission is contained on → Page 104 ff.

## 6.5 PROFIBUS DP/PA system integration

### 6.5.1 Device master file (GSD file)

For PROFIBUS network configuration, the device master file (GSD file) is needed for every bus user (PROFIBUS slave). The GSD file contains a description of the properties of a PROFIBUS device, such as supported data transmission rate and number of input and output data.

Before configuration takes place, a decision should be made as to which GSD file should be used to operate the measuring device in the PROFIBUS DP master system.

The measuring device supports the following GSD files:

- Promag 53 GSD file (manufacturer-specific GSD file, complete device functionality)
- PROFIBUS Profile GSD file:
- Promag 33 GSD file (compatibility to previous model Promag 33)

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

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

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

PROFIBUS DP → Page 104 ff.

PROFIBUS PA → Page 114 ff.

*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 GSD file*

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

*How to acquire:*

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

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

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

#### **PROFIBUS Profile GSD file:**

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

The following modules are supported with the Profile GSD file:

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

*Name of the PROFIBUS Profile GSD file*

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

*Source*

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

#### **Promag 33 GSD file:**

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

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

Further information → Page 103.

## 6.5.2 Selection of the GSD file in the measuring device

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

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

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

### Example

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

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

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

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

#### Note!

When installing the GSD file, always first use the GSD file with the extended format (EH3x1527.gsd). However, if the installation or the configuration of the device fails with this format, then use the standard GSD (EH3\_1527.gsd).

Example for the configuration software Siemens STEP 7 of the Siemens PLC family S7-300/400:

Use the GSD file with the extended format (EH3x1527.gsd). Copy the file to the subdirectory "...siemensstep7s7datagsd". The GSD files also include bitmap files. These bitmap files are used to display the measuring points in image form. The bitmap files must be saved to the directory "...siemensstep7s7datansbmp".

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

2. The measuring device is a modular PROFIBUS slave, i.e. the desired module configuration (input and output data) must be performed in the next step. This can be done directly by means of the configuration software. A detailed description of the modules supported by the measuring device as follows:  
 PROFIBUS DP → Page 104 ff.  
 PROFIBUS PA → Page 114 ff.

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

Promag 33 with Profile Version 2.0 is the precursor to Promag 53. If Promag 33 is already being operated in the system and if the measuring device has to be replaced, Promag 53 can be used as a replacement device without having to reconfigure the PROFIBUS network.

In the event of a device being replaced, Promag 53 completely supports the compatibility of the cyclic data with the previous Promag 33 model.

The measuring devices can be exchanged as follows:

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

Promag 53 is accepted as the replacement device if the MANUFACT V2.0 option is activated in the SELECTION GSD (6140) function.

The measuring device automatically detects that a Promag 33 device was configured in the automation system and makes both suitable input and output data and measured value status information available even though the devices differ in name and ID number. You do not have to adjust the configuration of the PROFIBUS network in the automation system.

Procedure after replacing the measuring devices:

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



Note!

If necessary, the following settings have to be configured via an operating program:

- Configuration of the application-specific parameters
- Configuration of the system units for the measured values and totalizers.

### 6.5.4 Maximum number of writes

If a nonvolatile device parameter is modified via the cyclic or acyclic data transmission, this change is saved in the EEPROM of the measuring device.

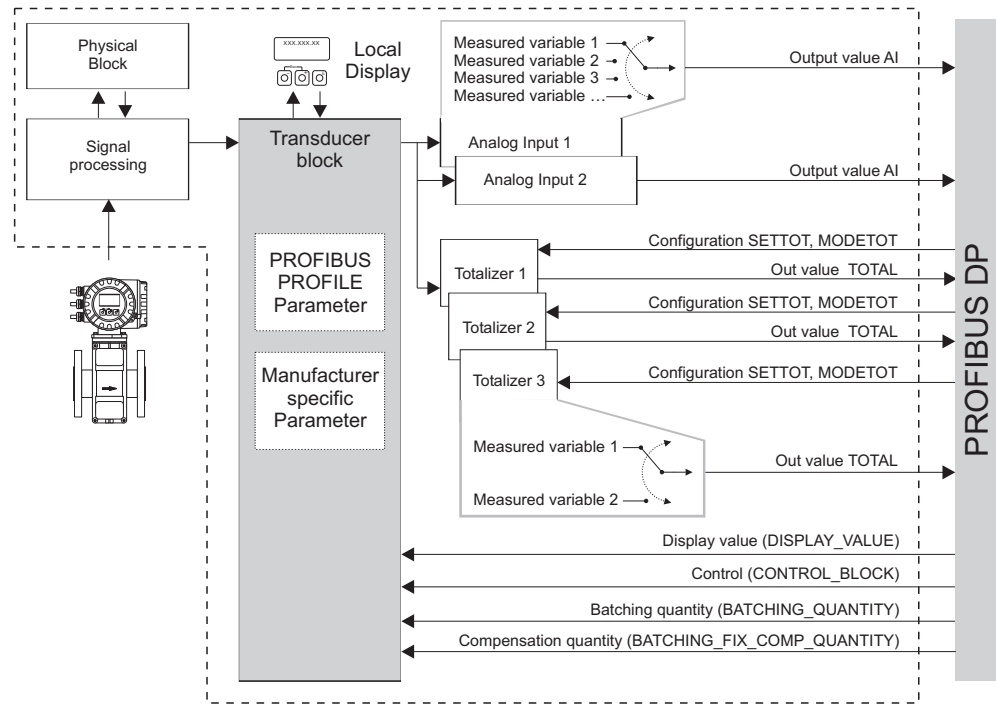
The number of writes to the EEPROM is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss and measuring device failure. For this reason, avoid constantly writing nonvolatile device parameters via the PROFIBUS!

## 6.6 PROFIBUS DP cyclic data transmission

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

### 6.6.1 Block model

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



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Fig. 62: Block model for Promag 53 PROFIBUS DP Profile 3.0

### 6.6.2 Modules for cyclic data transmission

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable - it consists of several individual modules. In the GSD file, the individual modules (input and output data) are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules (see following table). Gaps between configured modules have to be assigned the EMPTY\_MODULE module.

To optimize the data throughput rate of the PROFIBUS network, it is recommended to only configure modules that are processed in the PROFIBUS master system.



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

Slot sequence	Module	Description
1	AI	<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
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
8	BATCHING_QUANTITY	Batching quantity
9	BATCHING_FIX_COMP_QUANTITY	Fixed correction quantity



Note!

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

### 6.6.3 Description of the modules

#### AI (Analog Input) module

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

Further information on the device status → Page 132

#### Input data

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

*Assignment of the measured variables to the AI module*

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

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

*Possible settings*

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

**Note!**

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

*Factory setting*

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

**TOTAL module**

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

Further information on the device status → Page 132

*Input data*

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

*Assignment of the measured variables to the TOTAL module*

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

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

*Possible settings*

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

*Factory setting*

Module	Totalizer function block	Totalizer value/Measured variable	Unit	ID for CHANNEL function
TOTAL (slot 2)	1	VOLUME FLOW	m <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. → Page 108

*TOTAL function*

For a description of the TOTAL function, refer to TOTAL module → Page 106

*Data structure of the SETTOT\_TOTAL module combination*

Output data		Input data				
<b>SETTOT</b>		<b>TOTAL</b>				
<b>Byte 1</b>		<b>Byte 1</b>	<b>Byte 2</b>	<b>Byte 3</b>	<b>Byte 4</b>	<b>Byte 5</b>
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 → Page 107

*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 → Page 106

*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

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

#### Output data

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

#### Status

The measuring device interprets the status in accordance with PROFIBUS Profile Specification Version 3.0. The statuses OK, BAD and UNCERTAIN are indicated on the local display by a corresponding symbol. → Page 67

### 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>The following control variables are only executed if the measuring device has a relay output.</b>
	0 → 50: Relay output 1 OFF 0 → 51: Relay output 1 ON 0 → 55: Relay output 2 OFF 0 → 56: Relay output 2 ON
	<b>Control variables that are executed only if the "Batching" software plug-in is installed in the measuring device</b>
	0 → 30: Select batching specification 1 0 → 31: Select batching specification 2 0 → 32: Select batching specification 3 0 → 33: Select batching specification 4 0 → 34: Select batching specification 5 0 → 35: Select batching specification 6 0 → 40: Stop batching 0 → 41: Start batching 0 → 42: Interrupt (pause) batching 0 → 43: Continue batching 0 → 44: Reset the fault message (affects the following batching fault messages: # 471, 472, 473, 474) 0 → 46: Reset batching counter and total batching quantity to 0

**Note!**

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

*Example (change the output byte)*

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

*Output data*

Byte 1
Control

**BATCHING\_QUANTITY module**

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

**Caution!**

The batching quantity is a nonvolatile device parameter. For this reason, avoid constantly writing this device parameter via PROFIBUS! → Page 103

**Note!**

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

*Output data*

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

**Note!**

The status is not evaluated by the device.

**BATCHING\_FIX\_COMP\_QUANTITY module**

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

**Caution!**

The batching quantity is a nonvolatile device parameter. For this reason, avoid constantly writing this device parameter via PROFIBUS! → Page 103

**Note!**

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

*Output data:*

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

**Note!**

The status is not evaluated by the device.

**EMPTY\_MODULE module**

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

For a more detailed description, see → Page 105

## 6.6.4 Configuration examples with Simatic S7 HW-Konfig

### Example 1

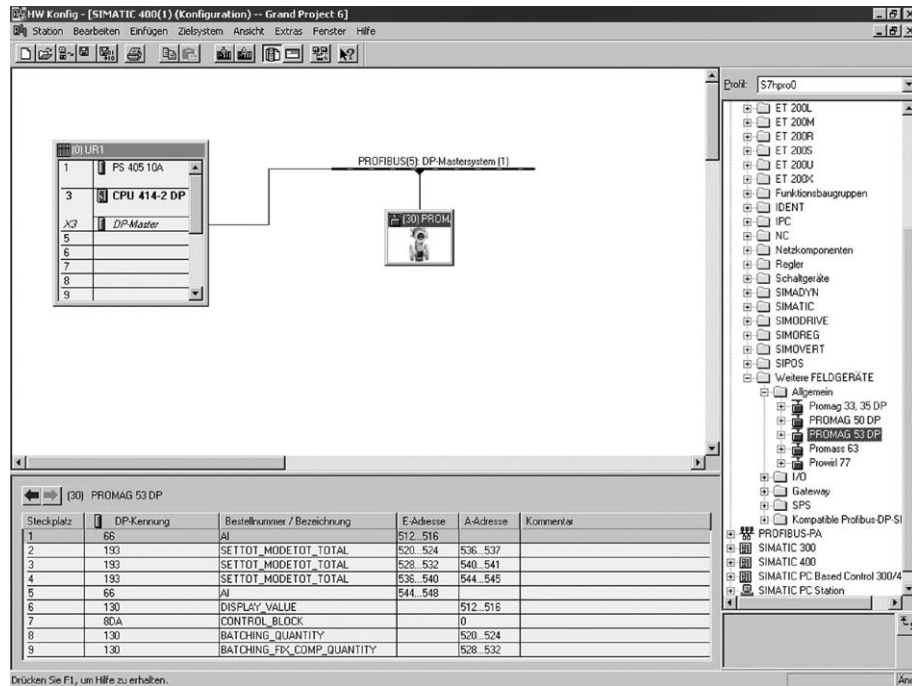


Fig. 63: Complete configuration using the Promag 53 GSD file (complete device functionality)

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

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	<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
8	BATCHING_QUANTITY	-	5	Batching quantity
9	BATCHING_FIX_COMP_QUANTITY	-	5	Fixed correction quantity



**Example 2**

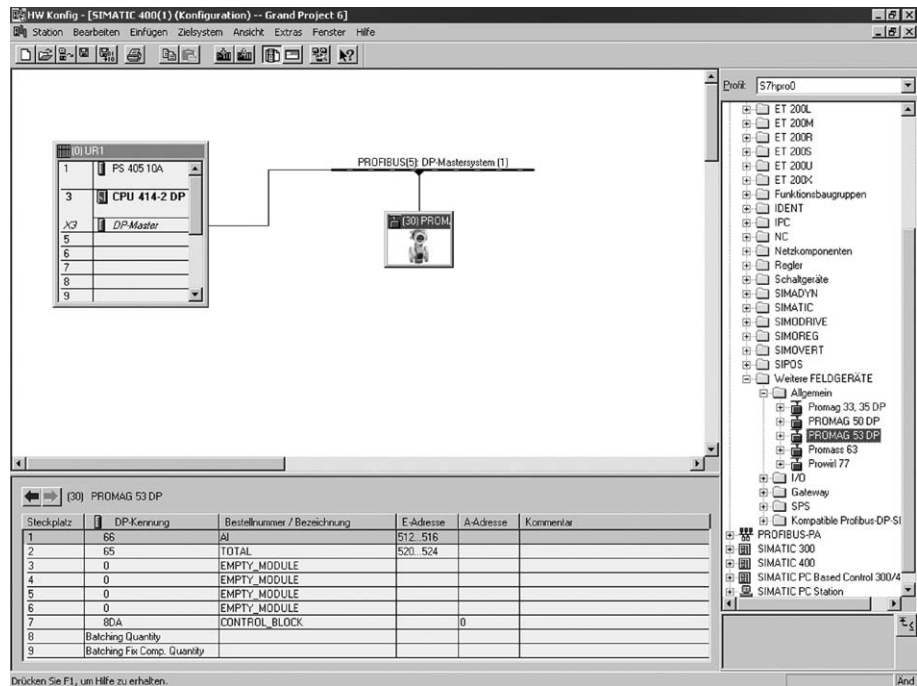


Fig. 64: In this example, modules that are not needed are replaced by the module EMPTY\_MODULE. The Promag 53 GSD file is used (manufacturer-specific GSD file, complete device functionality)

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

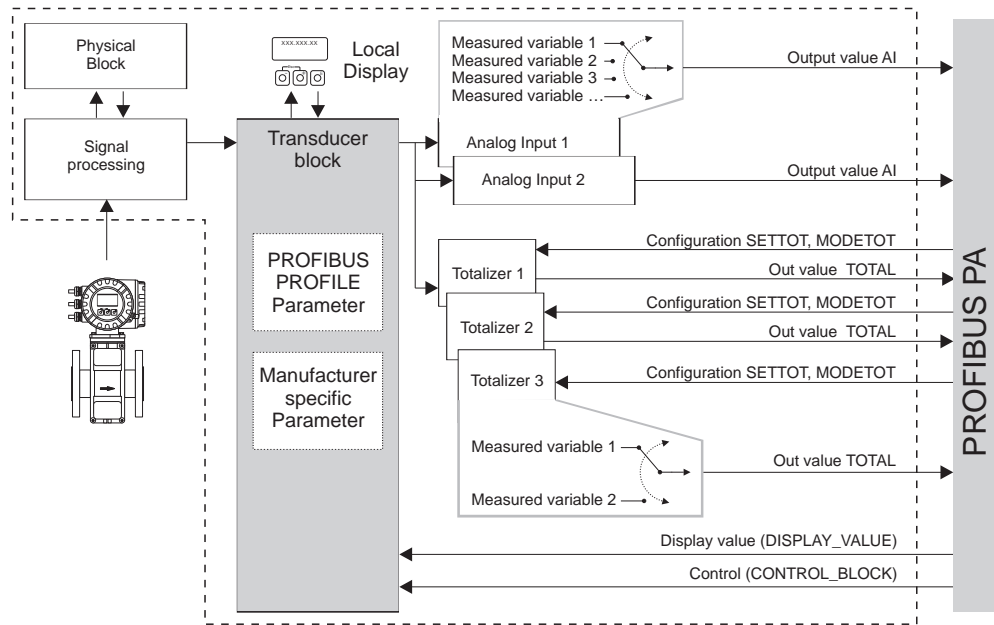
Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	<b>Analog Input function block 1</b> Output variable → volume flow (factory setting)
2	TOTAL	5	-	<b>Totalizer function block 1</b> TOTAL → output variable = volume flow (factory setting)
3	EMPTY_MODULE	-	-	Empty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

## 6.7 PROFIBUS PA cyclic data transmission

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

### 6.7.1 Block model

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



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Fig. 65: Block model for Promag 53 PROFIBUS PA Profile 3.0

### 6.7.2 Modules for cyclic data transmission

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable - it consists of several individual modules. In the GSD file, the individual modules (input and output data) are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules (see following table). Gaps between configured modules have to be assigned the EMPTY\_MODULE module.

To optimize the data throughput rate of the PROFIBUS network, it is recommended to only configure modules that are processed in the PROFIBUS master system.

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

Slot sequence	Module	Description
1	AI	<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
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 → Page 132

#### Input data

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

*Assignment of the measured variables to the AI module*

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

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

*Possible settings*

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

**Note!**

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

*Factory setting*

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

**TOTAL module**

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

Further information on the device status → Page 132

*Input data*

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

*Assignment of the measured variables to the TOTAL module*

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

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

*Possible settings*

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

*Factory setting*

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

*Example:*

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

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

**SETTOT\_TOTAL module**

The module combination SETTOT\_TOTAL (slots 2 to 4) consists of the functions SETTOT and TOTAL.

With this module combination:

- The totalizer can be controlled via the automation system (SETTOT).
- The totalizer value, is transmitted, including the status (TOTAL)

*SETTOT function*

In the SETTOT function, the totalizer can be controlled via control variables.

The following control variables are supported:

- 0 = Totalize (factory setting)
- 1 = Reset totalizer (the totalizer value is reset to 0)
- 2 = Accept totalizer preset



Note!

After the totalizer value has been reset to 0 or set to the preset value, the totalizing continues automatically. The control variable does not have to be changed to 0 again to restart totalizing. Stopping totalizing is controlled in the SETTOT\_MODETOT\_TOTAL module via the MODETOT function. → Page 108

*TOTAL function*

For a description of the TOTAL function, refer to TOTAL module → Page 106

*Data structure of the SETTOT\_TOTAL module combination*

Output data		Input data				
<b>SETTOT</b>		<b>TOTAL</b>				
<b>Byte 1</b>		<b>Byte 1</b>	<b>Byte 2</b>	<b>Byte 3</b>	<b>Byte 4</b>	<b>Byte 5</b>
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 → Page 107

*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 → Page 106

*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

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

#### Output data

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

#### Status

The measuring device interprets the status in accordance with PROFIBUS Profile Specification Version 3.0. The statuses OK, BAD and UNCERTAIN are indicated on the local display by a corresponding symbol. → Page 67

### 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



#### Note!

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

*Example (change the output byte)*

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

*Output data*

Byte 1
Control

### **EMPTY\_MODULE module**

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

For a more detailed description, see → Page 105



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

#### Example 1

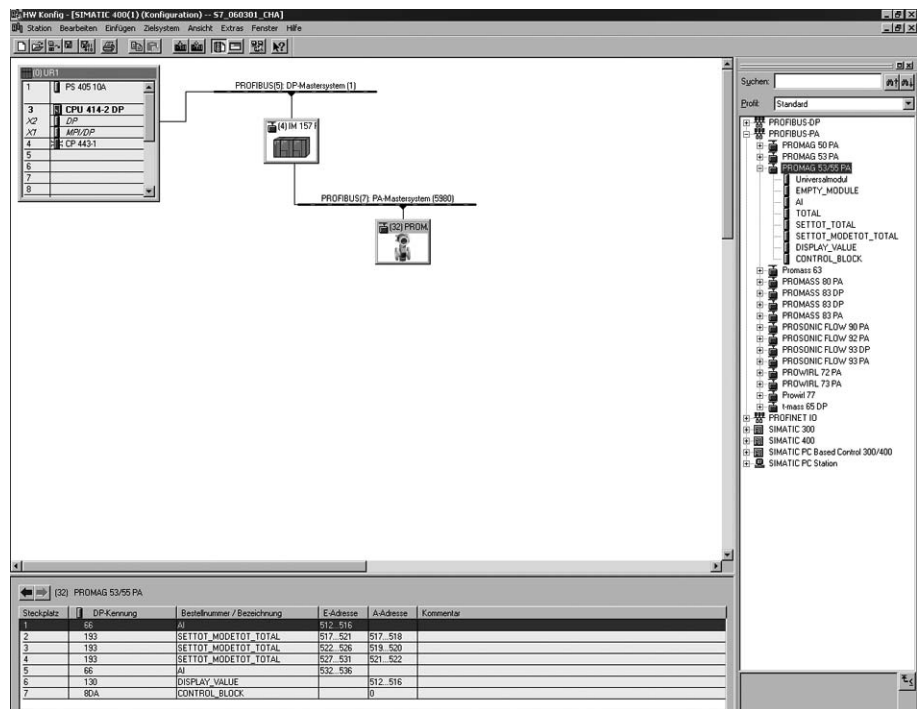
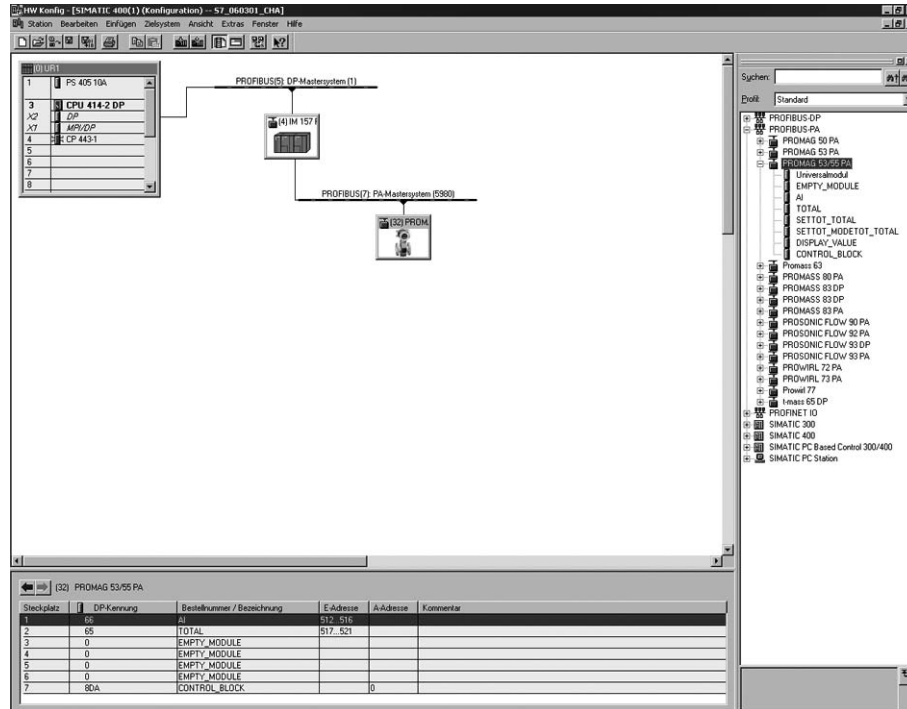


Fig. 66: Complete configuration using the Promag 53 GSD file (complete device functionality)

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

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	<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



a0004790

Fig. 67: In this example, modules that are not needed are replaced by the module `EMPTY_MODULE`. The Promag 53 GSD file is used (manufacturer-specific GSD file, complete device functionality)

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

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	-	<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 DP/PA acyclic data transmission

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

The measuring device supports the two basic types of acyclic data transmission:

- MS2AC communication with 2 available SAP's
- MS1AC communication

### 6.8.1 Master class 2 acyclic (MS2AC)

MS2AC is acyclic data transmission between a field device and a Class 2 master (z.B. FieldCare, Siemens PDM etc. → Page 73). During this process, the master opens a communication channel via an SAP (Service Access Point) to access the device.

All parameters to be exchanged with a device via PROFIBUS must be made known to a Class 2 master. This assignment to each individual parameter takes place either in a device description (DD), a DTM (Device Type Manager), or inside a software component in the master via slot and index addressing.

When using MS2AC communication, note the following:


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

### 6.8.2 Master class 1 acyclic (MS1AC)

In MS1AC, a cyclic master, that is already reading the cyclic data from the device or writing to the device opens the communication channel via the SAP 0x33 (special Service Access Point for MS1AC) and can then read or write a parameter acyclically like a Class 2 master via the slot and the index (if supported).

When using MS1AC communication, note the following:

- Currently, few PROFIBUS masters on the market support this data transmission.
- MS1AC is not supported by all PROFIBUS devices.
- In the user program, note that constant writing of parameters (for example, at every cycle of the program) can drastically reduce the service life of a device. Acyclically written parameters are written to voltage-resistant memory modules (EEPROM, Flash etc.). These memory modules are designed for a limited number of write operations. In normal operation without MS1AC (during parameter configuration), the number of write operations does not even come close to this number. If programming is incorrect, this maximum number can be reached quickly, drastically reducing a device's service life.

 Note!

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

## 6.9 Adjustment

### 6.9.1 Empty-pipe/Full-pipe adjustment

Flow cannot be measured correctly unless the measuring pipe is completely full.

This status can be monitored at all times with the Empty Pipe Detection function:

- EPD = Empty Pipe Detection (with the help of an EPD electrode)
- OED = Open Electrode Detection (Empty Pipe Detection with the help of the measuring electrodes, if the sensor is not equipped with an EPD electrode or the orientation is not suitable for using EPD).



Caution!

A **detailed** description and other helpful hints for the empty-pipe/full-pipe adjustment procedure are contained in the separate "Description of Device Functions" manual:

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



Note!

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

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

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



Caution!

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

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

## 6.10 Data storage device (HistoROM), F-CHIP

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

### 6.10.1 HistoROM/S-DAT (Sensor DAT)

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

### 6.10.2 HistoROM/T-DAT (Transmitter DAT)

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

Storing of specific parameter settings from the device memory (EEPROM) to the T-DAT module and vice versa has to be carried out by the user (= manual save function). Detailed information about the procedure → Page 94

### 6.10.3 F-CHIP (Function Chip)

The F-Chip is a microprocessor chip that contains additional software packages that extend the functionality and application possibilities of the transmitter.

In the case of a later upgrade, the F-CHIP can be ordered as an accessory and can simply be plugged on to the I/O board. After start up, the software is immediately made available to the transmitter.

Accessories → Page 127

Plugging on to the I/O board → Page 145



Caution!

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

## **7 Maintenance**

No special maintenance work is required.

### **7.1 Exterior cleaning**

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

### **7.2 Seals**

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

Replacement seals (accessories)→ Page 128

## 8 Accessories

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

### 8.1 Device-specific accessories

Accessory	Description	Order code
Promag 53 transmitter	Transmitter for replacement or for stock. Use the order code to define the following specifications: <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>	53XXX - XXXXX * * * * * * * *
Conversion kit for inputs/outputs (PROFIBUS DP only)	Conversion kit with appropriate slot modules for converting the present input/output configuration to a new version.	DKUI - * *
Software packages for Promag 53 (PROFIBUS DP only)	Software add-ons on F-CHIP, can be ordered individually: <ul style="list-style-type: none"> <li>- Electrode Cleaning Circuitry (ECC)</li> <li>- Batching</li> </ul>	DK5SO - *

## 8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for Promag 53 transmitter	Mounting kit for wall-mounted housing (remote version). Suitable for: <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 - *
Cable for remote version	Coil and signal cables, various lengths. Reinforced cable on request.	DK5CA - * * *
Ground cable for Promag W/P	A set consists of two ground cables.	DK5GC - * * *
Ground disk for Promag W/P	Ground disk for potential matching	DK5GD * * *
Mounting kit for Promag H	Mounting kit for Promag H, comprising: <ul style="list-style-type: none"> <li>- 2 process connections</li> <li>- Screws</li> <li>- Seals</li> </ul>	DKH * * - * * * *
Adapter connection for Promag A, H	Adapter connections for installing Promag 53 H instead of Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA - * * * * * *
Ground rings for Promag H	If the process connections are made of PVC or PVDF, ground rings are necessary to ensure that potential is matched. A set comprises 2 ground rings.	DK5HR - * * * *
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS - * * *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor.	DK5HM - * *
Welding jig for Promag H	Weld nipples as process connection: Welding jig for installation in pipes.	DK5HW - * * *




### 8.3 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 - *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant Asset Management Tool. It can configure all the intelligent field units in your system and helps you manage these units. By providing status information, it is also a simple but effective method of controlling the units' status.	See the product page on the Endress+Hauser website: <a href="http://www.endress.com">www.endress.com</a>
FXA193	The FXA193 service interface connects the device to the PC for configuration via FieldCare.	FXA193 - *



## 9 Troubleshooting

### 9.1 Troubleshooting instructions

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

Check the display	
No display visible and no output signals present.	<ol style="list-style-type: none"> <li>1. Check the supply voltage → Terminals 1, 2</li> <li>2. Check device fuse → Page 151 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC and 16 to 62 V DC: 2 A slow-blow / 250 V</li> <li>3. Measuring electronics defective → order spare parts → Page 145</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 → Page 145 ff.</li> <li>2. Display module defective → order spare parts → Page 145</li> <li>3. Measuring electronics defective → order spare parts → Page 145</li> </ol>
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the  keys and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective → order spare parts → Page 145



Error messages on display
<p>Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example):</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 TUBE</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 refer to the information on → Page 72</li> <li>■ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.</li> </ul>
System error (device error) has occurred→ Page 132
Process error (application error) has occurred→ Page 141



Faulty connection to control system	
No connection can be made between the control system and the device. Check the following points:	
Supply voltage Transmitter	Check the Supply voltage → Terminals 1/2
Device fuse	Check device fuse → Page 151 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC and 16 to 62 V DC: 2 A slow-blow / 250 V
Fieldbus connection	<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>



<b>Faulty connection to control system (continued)</b>	
Fieldbus connector (only for PROFIBUS PA)	<ul style="list-style-type: none"> <li>■ Check pin assignment/wiring</li> <li>■ Check connection between connector/fieldbus port. Is the coupling ring tightened correctly?</li> </ul>
Fieldbus voltage (only for PROFIBUS PA)	Check that a min. bus voltage of 9 V DC is present at terminals 26/27. Permissible range: 9 to 32 V DC
Network structure	Check permissible fieldbus length and number of spurs.
Basic current (only for PROFIBUS PA)	Is there a basic current of min. 11 mA?
Bus address	Check bus address: make sure there are no double assignments
Bus termination	Has the PROFIBUS network been terminated correctly? Each bus segment must always be terminated with a bus terminator at both ends (start and finish). Otherwise there may be interference in communication.
Power consumption, permitted feed current (only for PROFIBUS PA)	Check the current consumption of the bus segment: The current consumption of the bus segment in question (= total of basic currents of all bus users) must not exceed the max. permissible feed current of the bus power supply.



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



<b>Other error (without error message)</b>	
Other errors are present	Diagnosis and rectification → Page 143

## 9.2 System error messages

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



Caution!

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

→ Page 153

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



Note!

- The error types listed in the following correspond to the factory settings.
- See the information on → Page 72

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

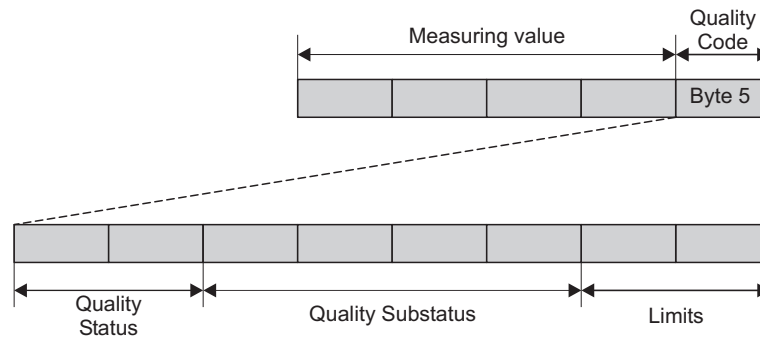
#### Display in the operating program (acyclic data transmission)

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.



a0002707-en

Fig. 68: Structure of the quality byte

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

- For the selection FAILSAFE\_TYPE → FSAFE VALUE :

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

- For the selection FAILSAFE\_TYPE → LAST GOOD VALUE (factory setting):

If a valid output value was available before the failure:

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

If no valid output value was available before the failure:


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

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

### 9.2.2 List of system error messages

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → Seite 145 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 the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)							
<b>No. # 0xx → Hardware error</b>							
001	S: CRITICAL FAILURE †: # 001	0x0F	BAD	Device Failure	Constant	ROM/RAM failure	<i>Cause:</i> ROM/RAM error. Error when accessing the program memory (ROM) or random access memory (RAM) of the processor.  <i>Remedy:</i> Replace the amplifier board.
011	S: AMP HW EEPROM †: # 011	0x0F	BAD	Device Failure	Constant	Amplifier EEPROM failure	<i>Cause:</i> Amplifier with faulty EEPROM  <i>Remedy:</i> 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 → Seite 145 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
012	S: AMP SW EEPROM #: # 012	0x0F	BAD	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>1. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the faulty parameter values.</li> <li>2. 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	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>1. S-DAT is not correctly plugged into the amplifier board (or is missing).</li> <li>2. S-DAT is defective.</li> </ol> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>1. Check whether the S-DAT is correctly plugged into the amplifier board.</li> <li>2. Replace the S-DAT if it is defective. Check whether the new replacement DAT is compatible with the existing electronics. Check the: - Spare part set number - Hardware revision code</li> <li>3. Replace measuring electronics boards if necessary.</li> <li>4. Plug the S-DAT into the amplifier board.</li> </ol>	
032	S: SENSOR SW DAT #: # 032	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	S-DAT data inconsistent	<ol style="list-style-type: none"> <li>3. Replace measuring electronics boards if necessary.</li> <li>4. Plug the S-DAT into the amplifier board.</li> </ol>	
041	S: TRANSM. HW-DAT #: # 041	0x0F	BAD	Device Failure	Constant	T-DAT failure	<p><i>Cause:</i></p> <ol style="list-style-type: none"> <li>1. T-DAT is not correctly plugged into the amplifier board (or is missing).</li> <li>2. T-DAT is defective.</li> </ol> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>1. Check whether the T-DAT is correctly plugged into the amplifier board.</li> <li>2. Replace the T-DAT if it is defective. Check whether the new replacement DAT is compatible with the existing electronics. Check the: - Spare part set number - Hardware revision code</li> <li>3. Replace measuring electronics boards if necessary.</li> <li>4. Plug the T-DAT into the amplifier board.</li> </ol>	
042	S: TRANSM. SW-DAT #: # 042	0x0F	BAD	Device Failure	Constant	T-DAT data inconsistent	<ol style="list-style-type: none"> <li>2. Replace the T-DAT if it is defective. Check whether the new replacement DAT is compatible with the existing electronics. Check the: - Spare part set number - Hardware revision code</li> <li>3. Replace measuring electronics boards if necessary.</li> <li>4. 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 → Seite 145 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
061	S: HW F-CHIP f: # 061	0x0F	BAD	Device Failure	Constant	F-CHIP defect/not plugged	<p><i>Cause:</i> Transmitter F-Chip:</p> <ul style="list-style-type: none"> <li>- F-Chip is defective</li> <li>- F-Chip is not plugged into the I/O board or is missing.</li> </ul> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> <li>1. Replace the F-CHIP.</li> <li>2. Plug the F-CHIP into the I/O board.</li> </ol>	
<b>No. # 1xx → Software error</b>								
101	S: GAIN ERROR AMP f: # 101	0x0F	BAD	Device Failure	Constant	Gain Error Amplifier	<p><i>Cause:</i> Gain deviation compared to reference gain is greater than 2%.</p> <p><i>Remedy:</i> Replace the amplifier board.</p>	
121	S: A/C COMPATIB. !: # 121	0x0F	BAD	Device Failure	Constant	Amplifier and I/O board only partially compatible	<p><i>Cause:</i> 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> Module with lower software version has either to be updated by "FieldCare" with the required software version or the module has to be replaced.</p>	
<b>No. # 2xx → Error in DAT/no communication</b>								


No.	Device status message (local display)	PROFIBUS measured value status				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → Seite 145 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
205	S: LOAD T-DAT !: # 205	0x0F	BAD	Device Failure	Constant	Save to T-DAT failed	<p><i>Cause:</i> 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>1. Check whether the T-DAT is correctly plugged into the amplifier board.</li> <li>2. Replace the T-DAT if it is defective. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: <ul style="list-style-type: none"> <li>– Spare part set number</li> <li>– Hardware revision code</li> </ul> </li> <li>3. Replace measuring electronics boards if necessary</li> </ol>	
206	S: SAVE T-DAT !: # 206	0x0F	BAD	Device Failure	Constant	Restore from T-DAT failed	<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</p>	
261	S: COMMUNICAT. I/O !: # 261	0x18 0x19 0x1A	BAD	No Communication	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</p>	
<b>No. # 3xx → System limits exceeded</b>								
321	S: TOL. COIL CURR. !: # 321	0x0F	BAD	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></p> <ol style="list-style-type: none"> <li>1. Remote version: Switch off the power supply before connecting or disconnecting the cable of the coil (terminals 41/42). → Page 47 ff.</li> <li>2. Remote version: Switch off power supply and check wiring of terminals 41/42. → Page 47 ff.</li> <li>3. Switch off the power supply and check the connectors of the coil cable.</li> <li>4. Replace measuring electronics boards if necessary.</li> </ol>	



No.	Device status message (local display)	PROFIBUS measured value status				Limits	Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → Seite 145 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus				
339 to 342	S: STACK CUR OUT n f: # 339 to 342	0x0F	BAD	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. Change the upper or lower limit setting, as applicable.</li> <li>2. Increase or reduce flow, as applicable.</li> </ol>	
343 to 346	S: STACK FREQ. OUT n f: # 343 to 346	0x0F	BAD	Device Failure	Constant	Temp. Buf. not cleared	<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>	
347 to 350	S: STACK PULSE OUT n !: # 347 to 350	0x0F	BAD	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 RANGE n !: # 351 to 354	0x54 0x55 0x56	UNCERTAIN	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	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				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → Seite 145 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
359 to 362	S: PULSE RANGE !: # 359 to 362	0x54 0x55 0x56	UNCERTAIN	Engineering Unit Range Violation	O.K. Low High	Flow is Out of Range	<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	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 process is finished. The device will restart automatically.</p>
502	S: UP-/DOWNLO. ACT. !: # 502	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	Upload/download of device data active	<p><i>Cause:</i> Up- or downloading the device data via configuration program. Currently no other functions are possible.</p> <p><i>Remedy:</i> Wait until process is finished.</p>
571	P: RUN BATCHING !: # 571	0x80	GOOD	O.K.	O.K.	Batch running	<p><i>Cause:</i> Batching is started and active (valves are open)</p> <p><i>Remedy:</i> No measures needed (during the batching process some other functions may not be activated).</p>

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No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → Seite 145 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
572	P: HOLD BATCHING !: # 572	0x80	GOOD	O.K.	O.K.	Batch hold	<p><i>Cause:</i> Batching has been interrupted (valves are closed)</p> <p><i>Remedy:</i> Using either:</p> <ul style="list-style-type: none"> <li>■ PROFIBUS DP/PA</li> <li>■ Local display: <ul style="list-style-type: none"> <li>– Continue batching with "GO ON".</li> <li>– Interrupt batching with "STOP".</li> </ul> </li> </ul>
<b>No. # 6xx → Simulation mode active</b>							
601	S: POS. ZERO-RETURN !: # 601	0x53	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> <b>Note!</b> This message has the highest display priority!</p> <p><i>Remedy:</i> Switch off positive zero return.</p> <p><i>Access:</i> BASIC FUNCTION → 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>

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (Spare parts → Seite 145 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
691	S: SIM. FAILSAFE !: # 691	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	Simulation failsafe active	<i>Cause:</i> Simulation of failsafe mode (outputs) is active. <i>Remedy:</i> Switch off simulation. <i>Access:</i> SUPERVISION → SYSTEM → OPERATION → SIM. FAILSAFE MODE (→ OFF)
692	S: SIM. MEASURAND !: # 692	0x60 0x61 0x62	UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Simulation measured value active	<i>Cause:</i> Simulation of the measured value is active. <i>Remedy:</i> Switch off simulation. <i>Access:</i> SUPERVISION → SYSTEM → OPERATION → SIM. MEASURAND (→ OFF)
698	S: DEV. TEST ACT. !: # 698	0x60 0x61 0x62	UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Device test via Fieldcheck active	<i>Cause:</i> The measuring device is being checked on site via the test and simulation device.

## 9.3 Process error messages



Note!

Also note the versions on → Page 72 and Page 144.

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


For more information, refer to → Page 132

### 9.3.2 List of process error messages

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
P = Process error † = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)							
401	P: EMPTY PIPE †: # 401	0x03	BAD	Non specific (uncertain status)	Constant	Empty Pipe detected	<i>Cause:</i> Measuring tube partially filled or empty.  <i>Remedy:</i> 1. Check the process conditions of the plant. 2. Fill the measuring tube.
461	P: ADJ N. OK !: # 461	0x40 0x41 0x42	UNCERT AIN	Non specific (uncertain status)	O.K. Low High	EPD adjustment not possible	<i>Cause:</i> EPD/OED adjustment not possible because the fluid's conductivity is either too low or too high.  <i>Remedy:</i> The EPD/OED function cannot be used with fluids of this nature.
463	P: FULL = EMPTY †: # 463	0x40 0x41 0x42	UNCERT AIN	Non specific (uncertain status)	O.K. Low High	EPD adjustment wrong	<i>Cause:</i> The EPD/OED adjustment values for empty pipe and full pipe are identical, therefore incorrect.  <i>Remedy:</i> Repeat adjustment, making sure procedure is correct. → Page 124
471	P: > BATCH TIME †: # 471	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Batch Time	<i>Cause:</i> The maximum permitted batching time was exceeded.  <i>Remedy:</i> 1. Increase flow rate. 2. Check valve (opening). 3. Adjust time setting to changed batch quantity.

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		
472	P: >< BATCH QUANTITY !:# 472	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Batch Quantity	<p><i>Cause:</i> EPD calibration not possible as the fluid conductivity is either too low or too high.</p> <ul style="list-style-type: none"> <li>- Underbatching: The minimum quantity was not reached.</li> <li>- Overbatching: The maximum permitted batching quantity was exceeded.</li> </ul> <p><i>Remedy:</i> Underbatching:</p> <ol style="list-style-type: none"> <li>1. Increase fixed correction quantity.</li> <li>2. If the batching quantity changes, the minimum batching quantity must be adjusted.</li> </ol> <p>Overbatching:</p> <ol style="list-style-type: none"> <li>1. Reduce fixed correction quantity.</li> <li>2. If the batching quantity changes, the maximum batching quantity must be adjusted.</li> </ol>
473	P: PROGRESS NOTE !:# 473	0x80	GOOD	O.K.	O.K.	Progress Note	<p><i>Cause:</i> End of filling process approaching. The running filling process has exceeded the predefined batch quantity point for the display warning message.</p> <p><i>Remedy:</i> No measures required (if necessary prepare to replace container).</p>
474	P: MAX. FLOW RATE !:# 474	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Flow Rate	<p><i>Cause:</i> Maximum flow value entered is exceeded.</p> <p><i>Remedy:</i> Reduce the flow value.</p>

## 9.4 Process errors without messages

Symptoms	Rectification
 <b>Note!</b> You may have to change or correct certain settings of the function matrix in order to rectify faults. The functions outlined below, such as DISPLAY DAMPING, for example, are described in detail in the "Description of Device Functions" manual.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	<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 → Page 47 ff.</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. → Page 59 ff.</li> <li>Check the fluid for presence of gas bubbles.</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). → Page 86 If the problem persists despite these measures, a pulsation damper will have to be installed between pump and measuring device.
There are differences between the flowmeter's internal totalizer and the external metering device.	This symptom is due primarily to backflow in the piping because the pulse output cannot subtract in the STANDARD or SYMMETRY measuring modes. The problem can be solved as follows: Allow for flow in both directions. Set the MEASURING MODE function to PULSATING FLOW for the pulse output in question.
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	<ol style="list-style-type: none"> <li>Check grounding and potential matching → Page 59 ff.</li> <li>Check the fluid for presence of gas bubbles.</li> <li>Activate the ON-VALUE LOW FLOW CUT OFF function, i.e. enter or increase the value for the low flow cut off (→ BASIC FUNCTIONS / PROCESS PARAMETERS / CONFIGURATION).</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 → Page 124</li> <li>Remote version: Check the terminals of the EPD cable → Page 47</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 occurred. 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, serial number → Page 9 ff.</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. → Page 153                Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted form at the back of this Operating Manual.             </li> <li> <b>Replace transmitter electronics</b>                Components in the measuring electronics defective → order spare parts → Page 145             </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 → Page 72		
Current output	<b>MIN. CURRENT</b> The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). <b>MAX. CURRENT</b> The current output will be set to the higher value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). <b>HOLD VALUE</b> Last valid value (preceding occurrence of the fault) is output. <b>ACTUAL VALUE</b> Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Pulse output	<b>FALLBACK VALUE</b> Signal output → no pulses <b>HOLD VALUE</b> Last valid value (preceding occurrence of the fault) is output. <b>ACTUAL VALUE</b> Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	<b>FALLBACK VALUE</b> Signal output → 0 Hz <b>FAILSAFE LEVEL</b> Output of the frequency specified in the FAILSAFE VALUE function. <b>HOLD VALUE</b> Last valid value (preceding occurrence of the fault) is output. <b>ACTUAL VALUE</b> 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	→ Page 132	-



## 9.6 Spare parts

The previous sections contain a detailed troubleshooting guide. → Page 130 ff.

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

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



Note!

You can order spare parts directly from your Endress+Hauser service organization by providing the serial number printed on the transmitter's nameplate. → Page 9

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

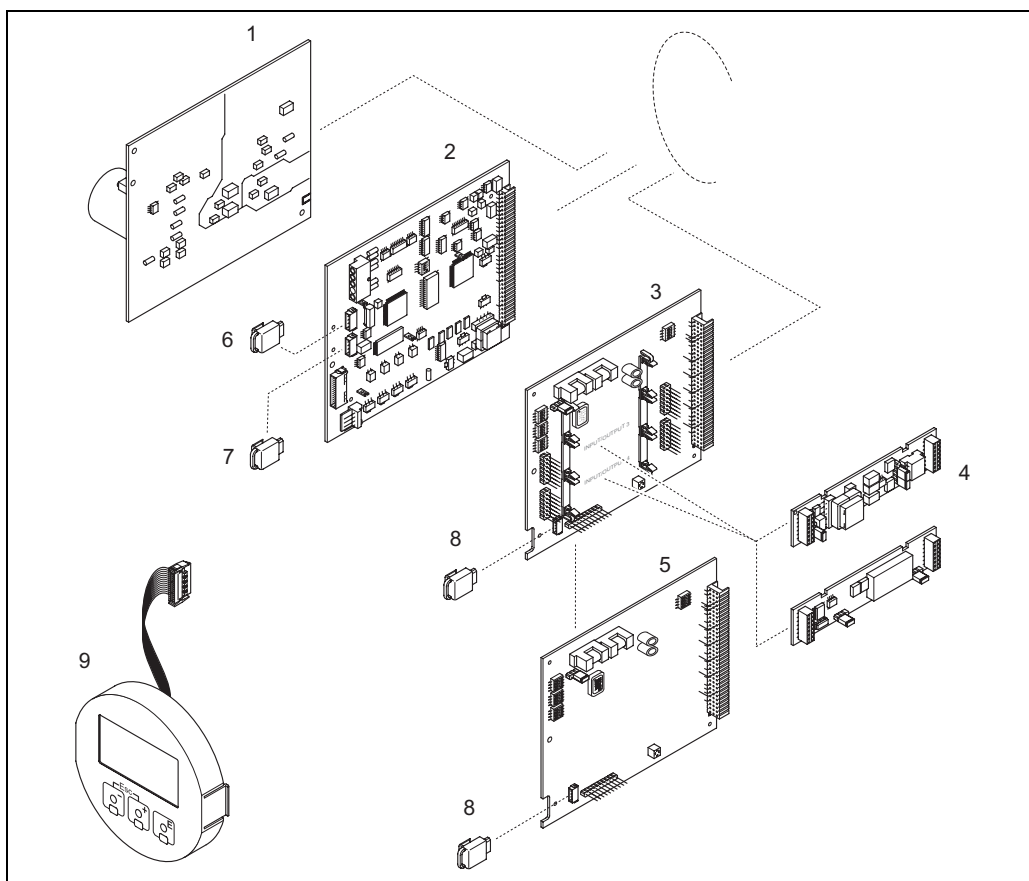


Fig. 69: Spare parts for PROFIBUS DP transmitters (field and wall-mount housing)

- 1 Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
- 2 Amplifier board
- 3 I/O board (COM module), flexible
- 4 Pluggable input/output submodules; ordering structure → Page 127
- 5 I/O board (COM module), permanent assignment
- 6 S-DAT (sensor data storage device)
- 7 T-DAT (transmitter data storage device)
- 8 F-CHIP (function chip for optional software)
- 9 Display module

## 9.6.2 PROFIBUS PA

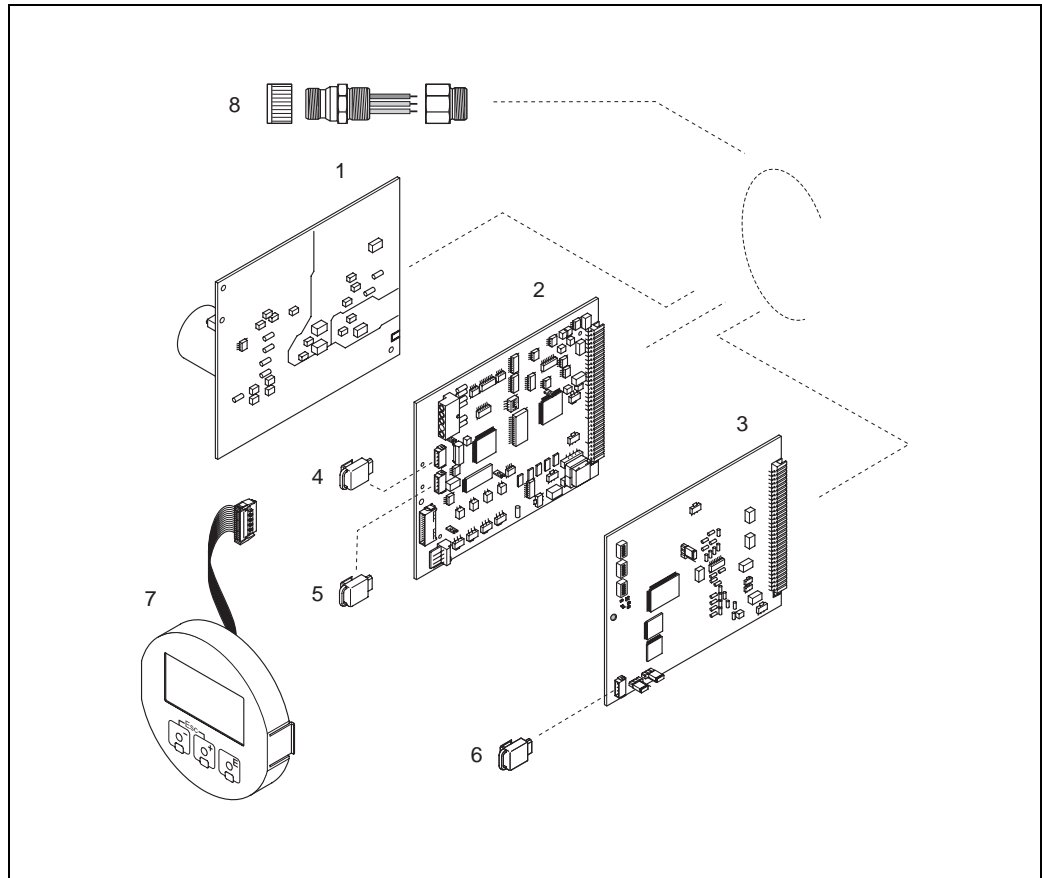


Fig. 70: Spare parts for PROFIBUS PA transmitters (field and wall-mount housing)

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

### 9.6.3 Removing and installing printed circuit boards

#### Field housing



##### Warning!

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



##### Caution!

Use only original Endress+Hauser parts.

Installing and removing the circuit boards → Fig. 71:

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the local display (1) as follows:
  - Press in the latches (1.1) at the side and remove the display module.
  - Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
3. Remove the screws and remove the cover (2) from the electronics compartment.
4. Remove power unit board (4) and I/O board (6):  
Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
5. Removing sub-modules (6.2, only for measuring devices with convertible I/O board):  
No tools are required for removing the submodules (inputs/outputs) from the I/O board.  
Installation is also a no-tools operation.



##### Caution!

Only certain combinations of submodules on the I/O board are permissible. → Page 52

The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

- "INPUT / OUTPUT 3" slot = terminals 22/23
- "INPUT / OUTPUT 4" slot = terminals 20/21

6. Remove amplifier board (5):
  - Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
  - Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it back and forward.
  - Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

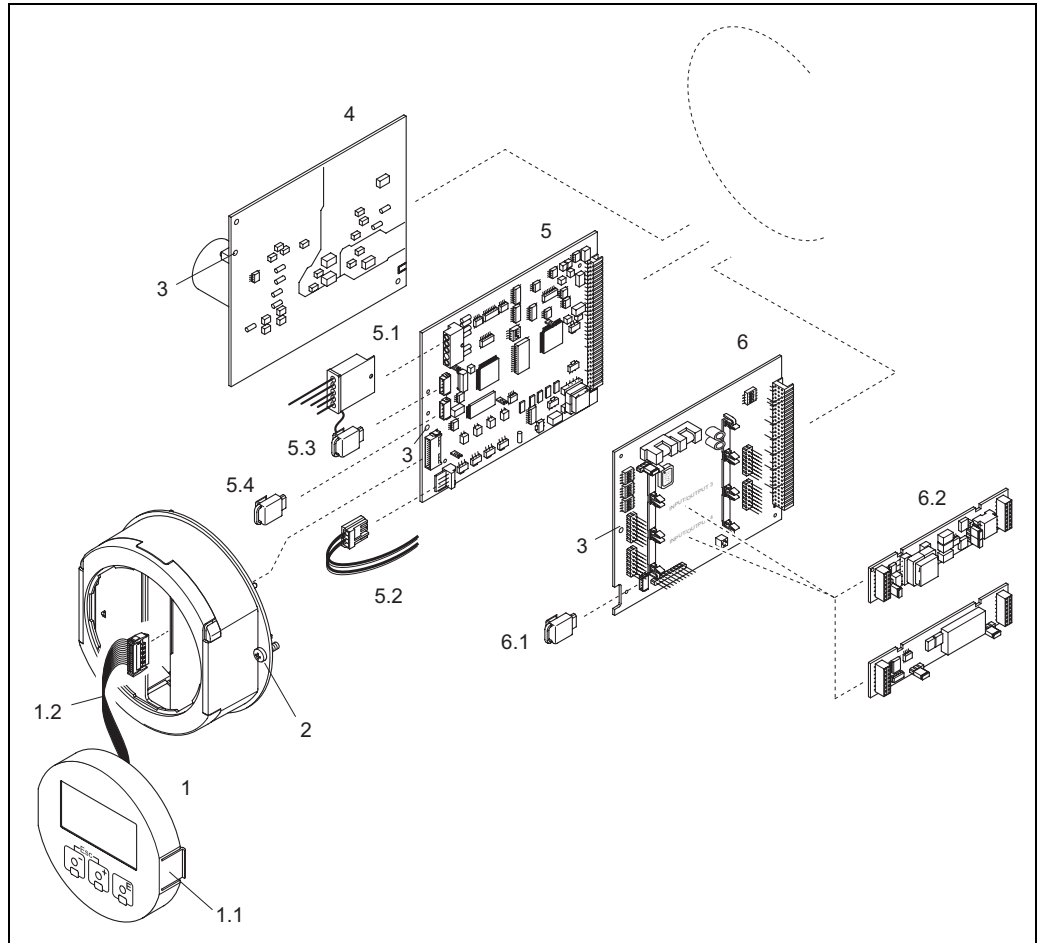


Fig. 71: Field housing: removing and installing printed circuit boards

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

**Wall-mounted housing****Warning!**

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

**Caution!**

Use only original Endress+Hauser parts.

Installing and removing the circuit boards → Fig. 72: Wall-mount housing

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

**Caution!**

Only certain combinations of submodules on the I/O board are permissible. → Page 52

The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

"INPUT / OUTPUT 3" slot = terminals 22/23

"INPUT / OUTPUT 4" slot = terminals 20/21

7. Installation is the reverse of the removal procedure.

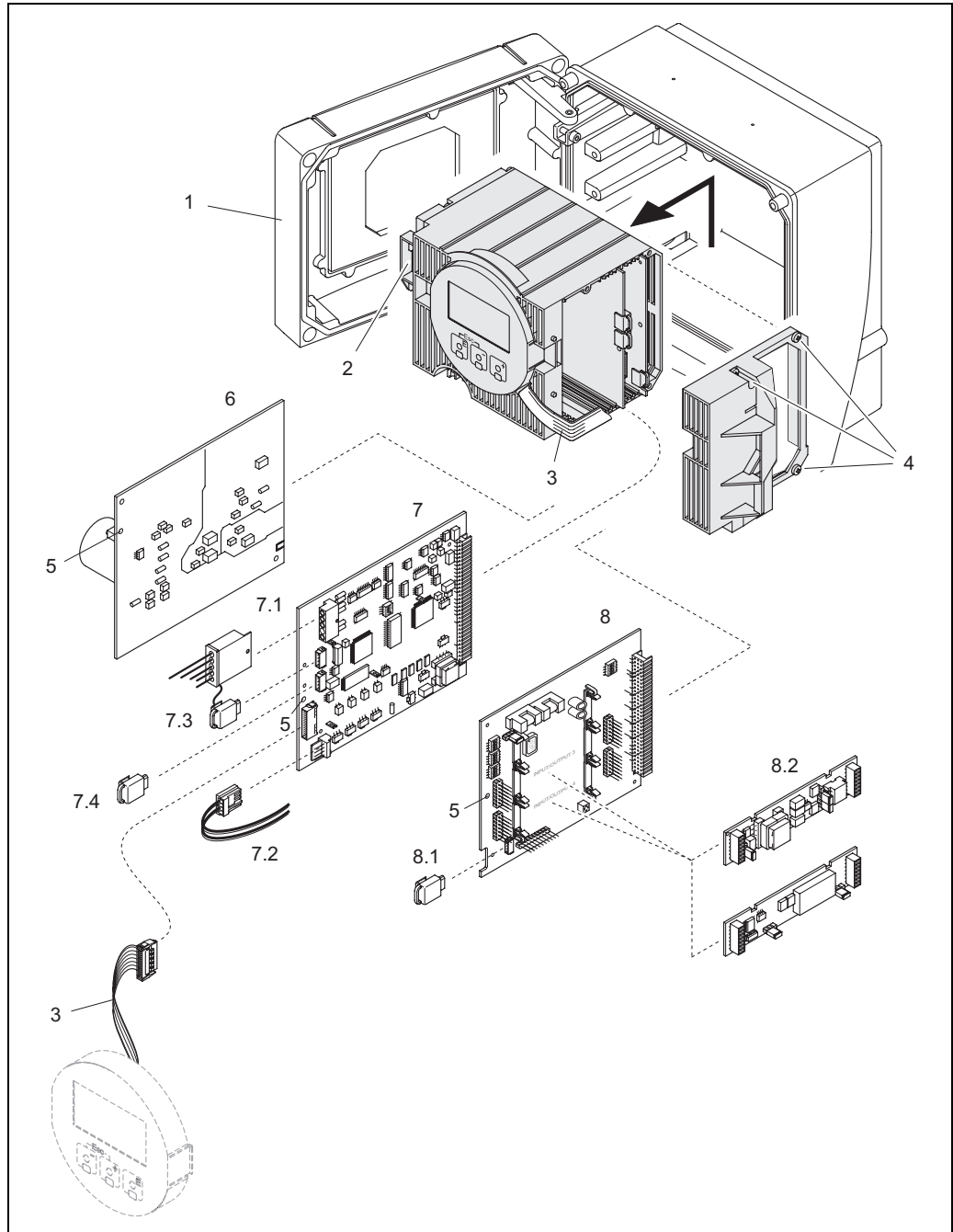


Fig. 72: Wall-mount housing: removing and installing printed circuit boards

- 1 Housing cover
- 2 Electronics module
- 3 Ribbon cable (display module)
- 4 Screws of electronics compartment cover
- 5 Aperture for installing/removing boards
- 6 Power unit board
- 7 Amplifier board
- 7.1 Electrode signal cable (sensor)
- 7.2 Coil current cable (sensor)
- 7.3 S-DAT (sensor data storage device)
- 7.4 T-DAT (transmitter data storage device)
- 8 I/O board (flexible assignment)
- 8.1 F-CHIP (function chip for optional software)
- 8.2 Pluggable sub-modules (current, pulse/frequency and relay output)

### 9.6.4 Replacing the device fuse



Warning!

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

The main fuse is on the power unit board. → Fig. 73

The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power unit board. → Page 147 ff.
3. Remove the protection cap (1) and replace the device fuse (2).  
Use only fuses of the following type:
  - 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 x 20 mm
  - Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 x 20 mm
  - Ex-rated devices → see the Ex documentation
4. Installation is the reverse of the removal procedure.



Caution!

Use only original Endress+Hauser parts.

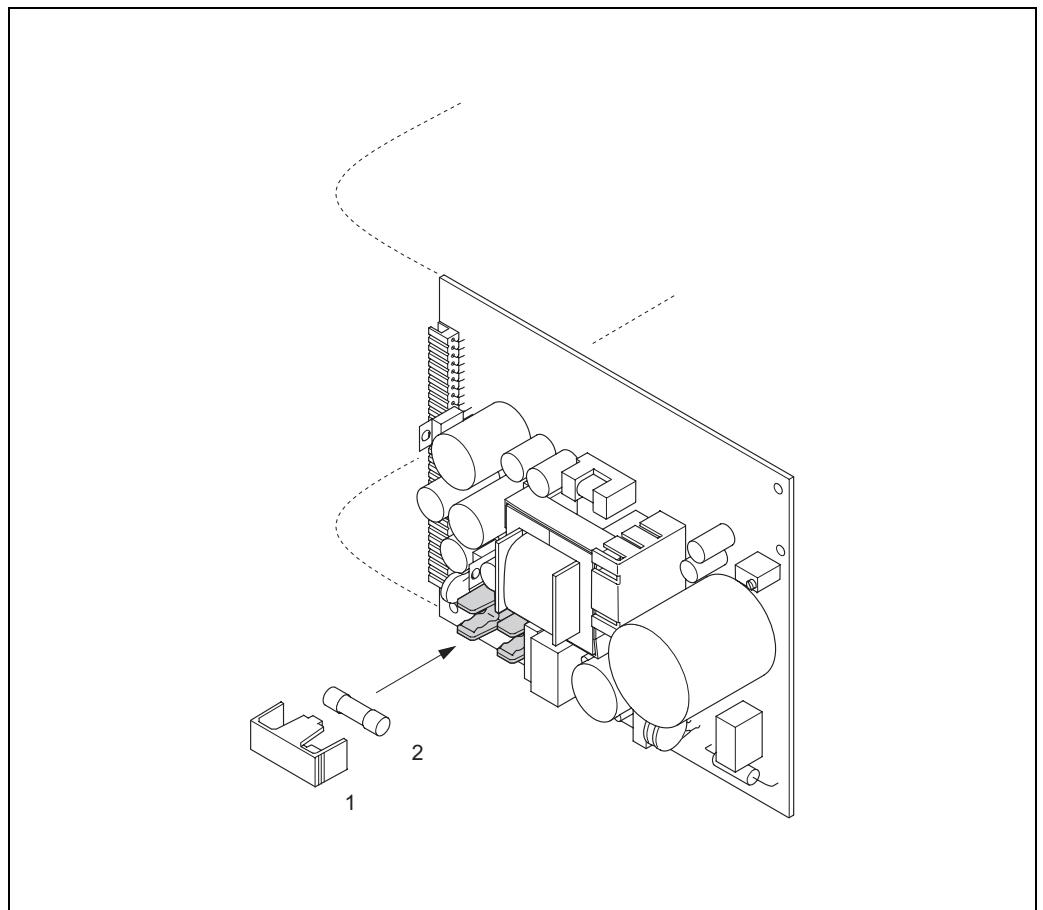


Fig. 73: Replacing the device fuse on the power unit board

- 1 Protective cap
- 2 Device fuse

### 9.6.5 Replacing exchangeable measuring electrodes

The Promag W sensor (DN 350 to 2000; 14" to 78") is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions. → Page 153

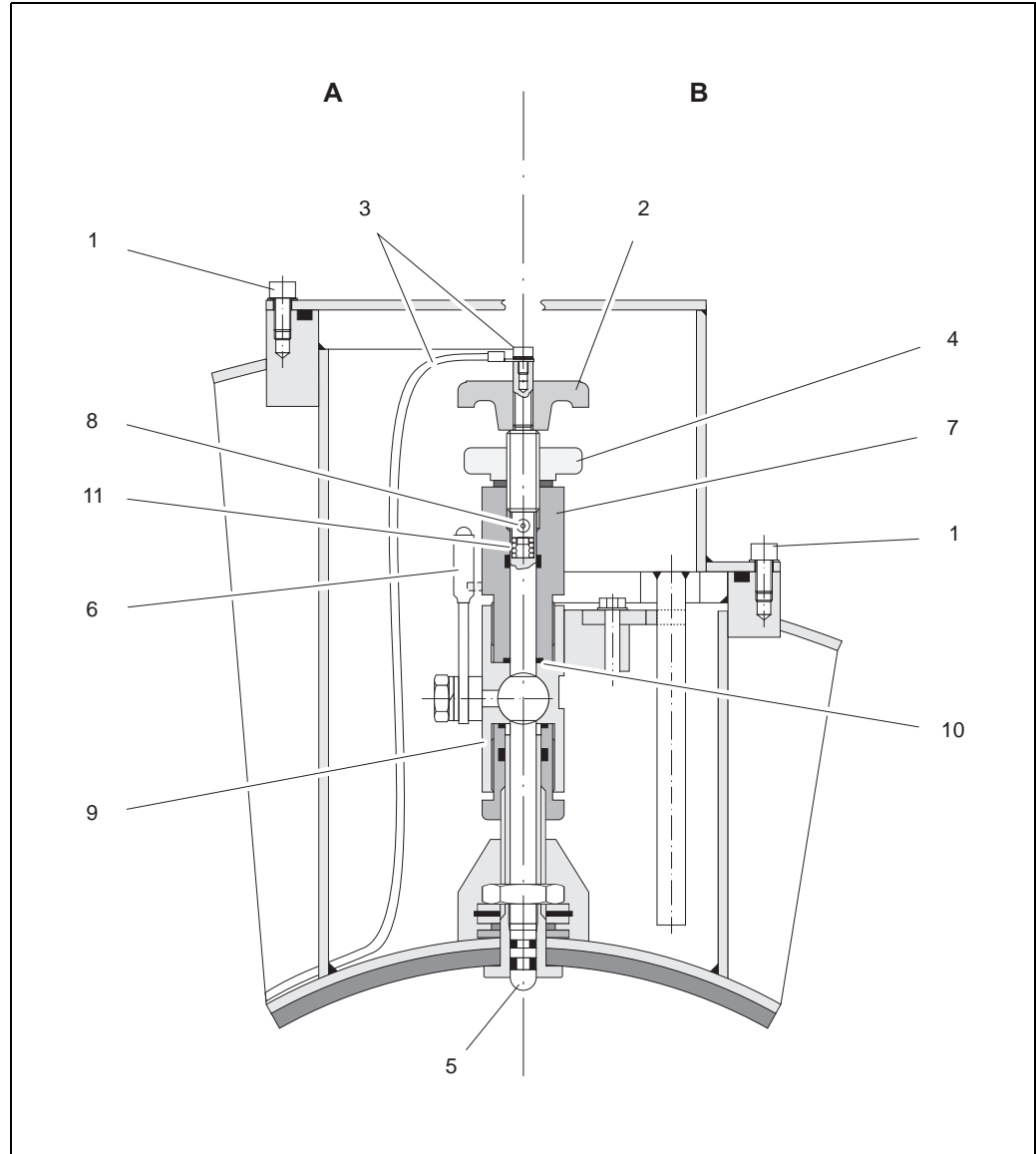







Fig. 74: Apparatus for replacing exchangeable measuring electrodes

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

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

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



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


## 9.7 Returns

→ Seite 8

## 9.8 Disposal

Observe the regulations applicable in your country!

## 9.9 SoftwareHistory

Date	Software version	Changes to software	Operating Manual
08.2007	PROFIBUS PA 3.04.XX	Introduction of a new PROFIBUS PA I/O board	BA053D/06/de/08.07 71060107
07.2007	PROFIBUS DP 3.04.XX	Software adjustment	
10.2006	PROFIBUS DP 3.04.00	Software adjustment	
12.2005			
10.2005	PROFIBUS DP 3.01.XX	Introduction of a new PROFIBUS DP I/O-board: – Support of additional output signals (current, frequency etc.)  Software expansion: – Batching	BA053D/06/de/10.05 50099246
03.2005	PROFIBUS PA 2.03.XX	Software expansion: – New, improved functions  New functions: – DEVICE SOFTWARE → Display of the device software (NAMUR recommendation 53) – US unit Kgal	BA053D/06/de/10.03 50099246
10.2003	Amplifier: 1.06.XX Communication module: 2.03.XX	Software expansion: – Language groups – New error messages – SIL 2 – The totalizer values are also updated without integration into the cyclic data transmission – Support of compatibility with previous PROFIBUS model Promag 33 with Profile Version 2.0  New functions: – Operation hours counter – Intensity of background illumination adjustable – Counter for access code – Upload/download via ToF Tool - Fieldtool Package  Compatible with service protocol: – ToF-Tool FieldTool Package (the latest SW version can be downloaded under: <a href="http://www.tof-fieldtool.endress.com">www.tof-fieldtool.endress.com</a> )	
12.2002	Communication module: 2.02.XX	Software adjustment	
09.2002	Amplifier: 1.04.XX Communication module: 2.01.XX	Software expansion: – Data length of advanced diagnosis adjusted in the cyclic data transmission   Note! As of this software version, a new device master file (GSD) must be used when replacing the device!	

Date	Software version	Changes to software	Operating Manual
03.2002	Amplifier: 1.03.XX Communication module: 2.00.01	Software expansion: – Communication software can be updated via service protocol	BA053D/06/de/10.03 50099246
07.2001	Com. module: 1.01.00	Software adjustment	
06.2001	Amplifier: 1.02.00	Software adjustment	
04.2001	Com. module: 1.00.00	Original software	BA053D/06/de/04.01 50099246
09.2000	Amplifier: 1.01.01	Software adjustment	
08.2000	Amplifier: 1.01.00	Software enhancement (functional adaptations)	
04.2000	Amplifier: 1.00.00	Original software	

## 10 Technical data

### 10.1 Technical data at a glance

#### 10.1.1 Applications

The measuring device described in this Operating Manual 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 metered, provided they have a minimum conductivity of 5  $\mu\text{S}/\text{cm}$ , for example:

- acids, alkalis, pastes, mashes, pulps,
- drinking water, wastewater, sewage sludge,
- milk, beer, wine, mineral water, yogurt, molasses, etc.

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

Liner specific applications:

- Promag W (DN 25 to 2000; 1" to 78"):
  - Polyurethane lining for applications with cold water and for slightly abrasive fluids,
  - Hard rubber lining for all applications with water (especially for drinking water).
- Promag P (DN 15 to 600; ½ to 24"):
  - PTFE lining for standard applications in chemical and process industries,
  - PFA lining for all applications in chemical and process industries; especially for high process temperatures and applications with temperature shocks.
- Promag H (DN 2 to 100; 1/12" to 4"):
  - PFA lining for all applications in chemical, process and food industries; especially for high process temperatures, for applications with temperature shocks and for applications with CIP or SIP cleaning processes.

#### 10.1.2 Function and system design

Measuring principle	Electromagnetic flow measurement on the basis of Faraday's Law.
Measuring system	<p>The flow measuring system consists of the following components:</p> <ul style="list-style-type: none"> <li>■ Promag 53 transmitter</li> <li>■ Promag W, Promag P or Promag H sensor</li> </ul> <p>Two versions are available:</p> <ul style="list-style-type: none"> <li>■ Compact version: transmitter and sensor form a single mechanical unit.</li> <li>■ Remote version: transmitter and sensor are installed separately.</li> </ul>

#### 10.1.3 Input variables

Measured variable	Flow rate (proportional to induced voltage)
Measuring range	Typically $v = 0.01$ to $10$ m/s (0.03 to 0.33 ft/s) with the specified measuring accuracy
Operable flow range	Over 1000 : 1
Input signal	<p><i>Status input (auxiliary input):</i></p> <p><math>U = 3</math> to <math>30</math> V DC, <math>R_i = 3</math> k<math>\Omega</math>, galvanically isolated. Switch level: <math>\pm 3</math> to <math>\pm 30</math> VDC, independent of polarity</p>

### 10.1.4 Output variables

Output signal	<p><i>Current output</i></p> <p>Active/passive selectable, galvanically isolated, time constant selectable (0.05 to 100 s), Full scale value adjustable, temperature coefficient: typically 0.005% o.r./°C, resolution: 0.5 µA</p> <ul style="list-style-type: none"> <li>■ Active: 0/4 to 20 mA, <math>R_L</math> max. 700 Ω</li> <li>■ Passive: 4 to 20 mA; supply voltage <math>V_S</math> 18 to 30 V DC; <math>R_i \geq 150 \Omega</math></li> </ul> <p><i>Pulse/frequency output:</i></p> <p>Active/passive selectable, galvanically isolated</p> <ul style="list-style-type: none"> <li>■ Active: 24 V DC, 25 mA (max. 250 mA during 20 ms), <math>R_L &gt; 100 \Omega</math></li> <li>■ Passive: open collector, 30 V DC, 250 mA</li> <li>■ Frequency output: full scale frequency 2 to 10000 Hz (<math>f_{max} = 12500</math> Hz), on/off ratio 1:1, pulse width max. 2 s</li> <li>■ Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.05 to 2000 ms)</li> </ul> <p><i>PROFIBUS DP interface:</i></p> <ul style="list-style-type: none"> <li>■ PROFIBUS DP in accordance with IEC 61158, galvanically isolated</li> <li>■ Profile Version 3.0</li> <li>■ Data transmission rate: 9.6 kBaud to 12 MBaud</li> <li>■ Automatic identification of data transmission rate</li> <li>■ Signal coding: NRZ code</li> <li>■ Bus address can be configured via miniature switches or via the local display (optional)</li> </ul> <p><i>PROFIBUS PA interface:</i></p> <ul style="list-style-type: none"> <li>■ PROFIBUS PA in accordance with IEC 61158 (MBP), galvanically isolated</li> <li>■ Profile Version 3.0</li> <li>■ Data transmission rate: 31.25 kBaud</li> <li>■ Current consumption: 11 mA</li> <li>■ Permitted supply voltage: 9 to 32 V</li> <li>■ Bus connection with integrated reverse polarity protection</li> <li>■ Error current FDE (Fault Disconnection Electronic): 0 mA</li> <li>■ Signal coding: Manchester II</li> <li>■ Bus address can be configured via miniature switches or via the local display (optional)</li> </ul>
Signal on alarm	<p><i>Current output:</i></p> <p>Failsafe mode selectable (e.g. in accordance with NAMUR recommendation NE 43)</p> <p><i>Pulse/frequency output:</i></p> <p>Failsafe mode selectable</p> <p><i>Relay output:</i></p> <p>De-energized by fault or power supply failure</p> <p><i>PROFIBUS DP/PA</i></p> <p>Status and alarm messages in accordance with PROFIBUS Profile Version 3.0</p>
Load	See "Output signal"
Switching output	<p><i>Relay output:</i></p> <p>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.</p>
Low flow cut off	Switch points for low flow are selectable.

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

### 10.1.5 Power supply

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Electrical connections                → Page 43 ff.

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

---

Cable entries                          Power supply and signal cables (inputs/outputs):

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

Connecting cable for remote version:

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

---

Cable specifications  
(remote version)                        → Page 51

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

Switch-on current:

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

---

Power supply failure                   Lasting min. 1 power cycle

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

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Potential matching                    → Page 59 ff.

### 10.1.6 Accuracy

Reference operating conditions

In accordance with DIN EN 29104 and VDI/VDE 2641:

- Fluid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up time: 30 minutes

Installation:

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

Maximum measured error

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

Current output:  
additional typically ± 5 µA



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

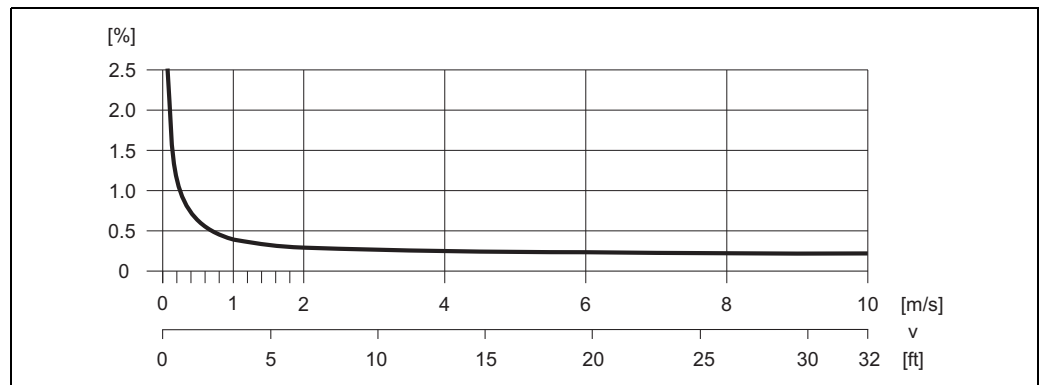


Fig. 75: Max. measured error in % of reading

Repeatability

max. ± 0.1% of measured value ± 0.5 mm/s

### 10.1.7 Operating conditions: Installation

Installation instructions

→ Page 15 ff.



Inlet and outlet runs

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

Length of connecting cable

For the remote version, the permissible cable length  $L_{max}$  depends on the conductivity of the medium. → Page 24  
A minimum conductivity of 20 µS/cm is required for measuring demineralized water.

### 10.1.8 Operating conditions: Environment

Ambient temperature	<p>Transmitter:</p> <ul style="list-style-type: none"> <li>■ Standard: -20 to +60 °C (-4 to 140 °F)</li> <li>■ Optional: -40 to +60 °C (-40 to 140 °F)</li> </ul> <p> Note! At ambient temperatures below -20 °C the readability of the display may be impaired.</p> <p>Sensor:</p> <ul style="list-style-type: none"> <li>■ Non-stainless flange material: -10 to +60 °C (+14 to 140 °F)</li> <li>■ Stainless steel flange material: -40 to +60 °C (-40 to 140 °F)</li> </ul> <p> Caution! The min. and max. lining specified temperature values must not be exceeded (→ "Medium temperature range").</p> <p>Note the following points:</p> <ul style="list-style-type: none"> <li>■ Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions.</li> <li>■ If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ "Medium temperature range").</li> </ul>
Storage temperature	The storage temperature corresponds to the ambient temperature range of the transmitters and sensors.
Degree of protection	<ul style="list-style-type: none"> <li>■ Standard: IP 67 (NEMA 4X) for transmitter and sensor</li> <li>■ Optional: IP 68 (NEMA 6P) for remote version of Promag W and P sensor</li> </ul>
Shock and vibration resistance	Acceleration up to 2 g in accordance with IEC 600 68-2-6 (high-temperature version: no data available)
CIP cleaning	<p>Promag W: not possible</p> <p>Promag P: possible (note max. temperature)</p> <p>Promag H: possible (note max. temperature)</p>
SIP cleaning	<p>Promag W: not possible</p> <p>Promag P: possible with PFA (note max. temperature)</p> <p>Promag H: possible (note max. temperature)</p>
Electromagnetic compatibility (EMC)	As per IEC/EN 61326 and NAMUR recommendation NE 21

### 10.1.9 Operating conditions: Process

Medium temperature range	<p><i>Promag W</i></p> <p>The permissible temperature depends on the lining of the measuring tube:</p> <ul style="list-style-type: none"> <li>■ 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 65 to 2000 , 2½" to 78")</li> <li>■ -20 to +50 °C (-4 to +122 °F) for polyurethane (DN 25 to 1000; 1" to 40")</li> </ul> <p><i>Promag P</i></p> <p>The permissible temperature depends on the lining of the measuring tube:</p> <ul style="list-style-type: none"> <li>■ -40 to +130 °C (-40 to +266 °F) for PTFE (DN 15 to 600; ½" to 24"), restrictions → see diagrams</li> <li>■ -20 to +180 °C (-40 to +356 °F) for PFA (DN 25 to 200; 1" to 8"), restrictions → see diagrams</li> </ul>
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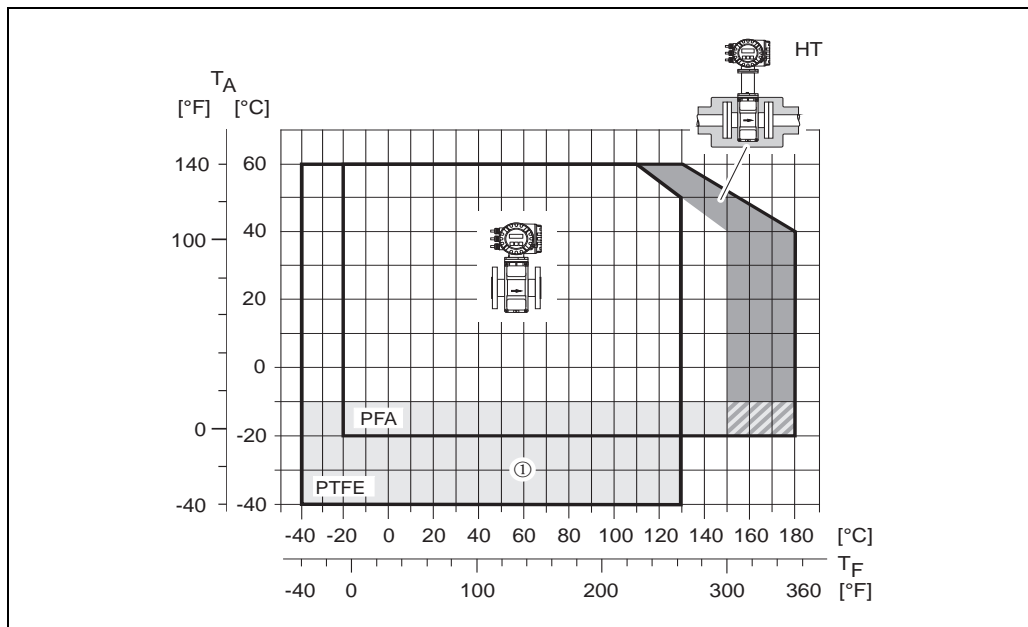


Fig. 76: Compact versions Promag P (with PFA or PTFE lining)

TA = Ambient temperature, TF = Fluid temperature, HT = High-temperature version with insulation  
 ① = Temperature range from -10 to -40 °C (+14 to -40 °F) only applies to stainless steel flanges

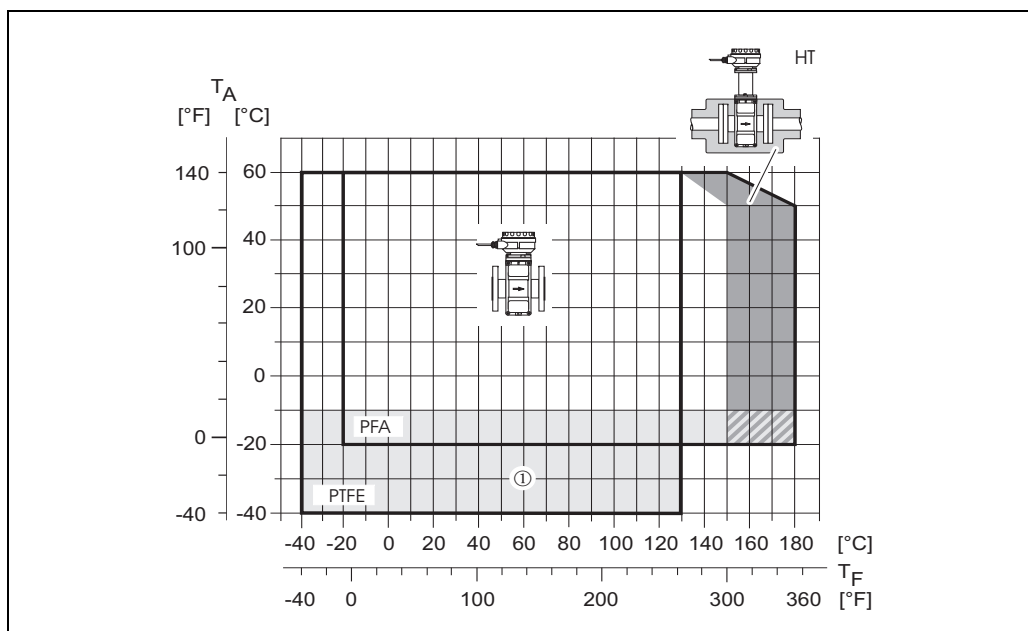


Fig. 77: Remote versions Promag P (with PFA or PTFE lining)

TA = Ambient temperature, TF = Fluid temperature, HT = High-temperature version with insulation  
 ① = Temperature range from -10 to -40 °C (+14 to -40 °F) only applies to stainless steel flanges

Promag H

Sensor:

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

The permitted fluid temperature is dependent on the material of the seal:

- EPDM: -20 to +130 °C (-4 to +266 °F)
- Silicone: -20 to +150 °C (-4 to +302 °F)
- Viton: -20 to +150 °C (-4 to +302 °F)
- Kalrez: -20 to +150 °C (-4 to +302 °F)

Conductivity

- Minimum conductivity
- $\geq 5 \mu\text{S/cm}$  for liquids generally
  - $\geq 20 \mu\text{S/cm}$  for demineralized water



Note!  
Note that, in the case of the remote version, the requisite minimum conductivity is also influenced by the length of the connecting cable. → Page 24

Fluid pressure range (nominal pressure)

*Promag W*

- EN 1092-1 (DIN 2501):
  - PN 6 (DN 1200 to 2000; 48" to 78")
  - PN 10 (DN 200 to 2000; 8" to 78")
  - PN 16 (DN 65 to 2000; 2½" to 78")
  - PN 25 (DN 200 to 1000; 8" to 40")
  - PN 40 (DN 25 to 150; 1" to 6")
- ANSI B 16.5:
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- AWWA: Class D (28 to 78")
- JIS B2220:
  - 10 K (DN 50 to 300; 2" to 12")
  - 20 K (DN 25 to 300; 1" to 12")
- AS 2129: Table E (DN 80, 100, 150 to 400, 500, 600; 3", 4", 6" to 16", 20", 24")
- AS 4087: Cl. 14 (DN 80, 100, 150 to 400, 500, 600; 3", 4", 6" to 16", 20", 24")

*Promag P*

- 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")
- ANSI B 16.5:
  - Class 150 (½ to 24")
  - Class 300 (½ to 6")
- JIS B2220:
  - 10 K (DN 50 to 300; 2" to 12")
  - 20 K (DN 15 to 300; ½" to 12")
- AS 2129: Table E (DN 25, 50; 1", 2")
- AS 4087: Cl. 14 (DN 50; 2")

*Promag H*

The permissible nominal pressure depends on the process connection and the seal:

- 40 bar (580 psi): flange, weld nipple (with O-ring seal)
- 16 bar (232 psi): all other process connections

Resistance to partial vacuum

Resistance to partial vacuum (measuring tube lining) (SI-Units)

*Promag W*

Nominal diameter	Measuring tube lining	Resistance of measuring tube lining to partial vacuum (SI-Units)						
		Limit values for abs. pressure [mbar] at various fluid temperatures:						
[mm]	Material	25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
25 to 1000	Polyurethan	0	0	-	-	-	-	-
65 to 2000	Hartgummi	0	0	0	-	-	-	-

*Promag P*

Nominal diameter [mm]	Measuring tube lining Material	Resistance of measuring tube lining to partial vacuum (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*

Nominal diameter [mm]	Measuring tube lining Material	Resistance of measuring tube lining to partial vacuum (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 100	PFA	0	0	0	0	0	0

Resistance to partial vacuum  
(measuring tube lining) (*US-Units*)

*Promag W*

Nominal diameter [inch]	Measuring tube lining Material	Resistance of measuring tube lining to partial vacuum (US-Units)						
		Limit values for abs. pressure [psia] at various fluid temperatures:						
		77 °F	122 °F	176 °F	212 °F	266 °F	302 °F	356 °F
1 to 40"	Polyurethan	0	0	-	-	-	-	-
3 to 78"	Hartgummi	0	0	0	-	-	-	-

*Promag P*

Nominal diameter [inch]	Measuring tube lining Material	Resistance of measuring tube lining to partial vacuum (US-Units)					
		Limit values for abs. pressure [psia] 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
1½"	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
3"	PTFE / PFA	0 / 0	*	0.6 / 0	1.9 / 0	- / 0	- / 0
4"	PTFE / PFA	0 / 0	*	2 / 0	2.5 / 0	- / 0	- / 0
6"	PTFE / PFA	2 / 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*

Nominal diameter [inch]	Measuring tube lining Material	Resistance of measuring tube lining to partial vacuum (US-Units)					
		Limit values for abs. pressure [psia] at various fluid temperatures:					
		77 °F	176 °F	212 °F	266 °F	302 °F	356 °F
1/12 to 4"	PFA	0	0	0	0	0	0

Limiting flow

More detailed information in the "Nominal diameter and flow rate" section → Page 20

Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter (Promag H: only DN 8 (5/16") and larger).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → Page 19

### 10.1.10 Mechanical construction

Design / dimensions

The dimensions and lengths of the sensor and transmitter are contained in the separate documentation "Technical information" for the respective measuring device, which you can download in PDF format at [www.endress.com](http://www.endress.com). A list of the available "Technical information" documents is contained in the "Supplementary documentation" section → Page 173.

Weight (SI-Units)

Promag W

Indication of weight in kg															
Nominal diameter		Compact version					Remote version (without cable)								
[mm]	[inch]	EN (DIN) / AS*		JIS		ANSI / AWWA	EN (DIN) / AS*		Sensor		ANSI / AWWA	Wall-mount housing			
25	1"	PN 40	7.3	10K	7.3	Class 150	7.3	PN 40	5.3	10K	5.3	Class 150	6.0		
32	1¼"		8.0		7.3		–		6.0		5.3		–	6.0	
40	1½"		9.4		8.3		9.4		7.4		6.3		7.4	6.0	
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0	
65	2½"	PN 16	12.0	10K	Class 150	PN 16	10.0	10K	9.1	Class 150	–	Class 150	6.0		
80	3"		14.0				11.1		–		12.0		10.5	–	6.0
100	4"		16.0				12.5		14.0		14.0		12.7	12.0	6.0
125	5"		21.5				14.7		16.0		14.0		19.0	14.0	6.0
150	6"	PN 10	25.5	10K	Class 150	PN 10	19.5	10K	22.5	Class 150	–	Class 150	6.0		
200	8"		45				21.0		–		23.5		19.0	23.5	6.0
250	10"		65				24.5		45		43		39.9	43	6.0
300	12"		70				41.9		75		63		67.4	73	6.0
350	14"	PN 10	115	10K	Class 150	PN 10	110	10K	70.3	Class 150	108	Class 150	6.0		
400	16"		135				175		113		173		173	6.0	
450	18"		175				205		133		253		283	6.0	
500	20"		175				255		173		403		403	6.0	
600	24"	PN 10	235	10K	Class 150	PN 10	405	10K	233	Class 150	398	Class 150	6.0		
700	28"		355				400		353		398		6.0		
–	30"		–				460		–		458		6.0		
800	32"		435				550		433		548		6.0		
900	36"	PN 6	575	10K	Class 150	PN 6	800	10K	573	Class 150	798	Class 150	6.0		
1000	40"		700				900		698		898		6.0		
–	42"		–				1100		–		1098		6.0		
1200	48"		850				1400		848		1398		6.0		
–	54"	–	2200	–	2198	6.0									
1400	–	PN 6	1300	10K	Class 150	PN 6	–	10K	1298	Class 150	–	Class 150	6.0		
–	60"		–				2700		–		2698		6.0		
1600	–		1700				–		1698		–		6.0		
–	66"		–				3700		–		3698		6.0		
1800	72"	PN 6	2200	10K	Class 150	PN 6	4100	10K	2198	Class 150	4098	Class 150	6.0		
–	78"		–				4600		–		4598		6.0		
2000	–		2800				–		2798		–		6.0		
–	–		–				–		–		–		6.0		

Transmitter Promag (compact version): 3.4 kg  
 (Weight data valid for standard pressure ratings and without packaging material)  
 \* For flanges according to AS, only DN 80, 100, 150 to 400, 500 and 600 are available.

Promag P

Indication of weight in kg														
Nominal diameter		Compact version					Remote version (without cable)							
		[mm]	[inch]	EN (DIN) / AS*	JIS	ANSI / AWWA	EN (DIN) / AS*	Sensor		ANSI / AWWA	Wall-mount housing			
15	½"	PN 40	6.5	10K	6.5	Class 150	6.5	PN 40	4.5	10K	4.5	Class 150	4.5	6.0
25	1"		7.3		7.3		7.3		5.3		5.3		5.3	6.0
32	1¼"		8.0		7.3		-		6.0		5.3		-	6.0
40	1½"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2½"	PN 16	12.0	10K	11.1	Class 150	-	PN 16	10.0	10K	9.1	Class 150	-	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		16.0		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		21.5		21.0		-		19.5		19.0		-	6.0
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45	10K	41.9	Class 150	45	PN 10	43	10K	39.9	Class 150	43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115		-		175		113		-		173	6.0
400	16"		135		-		205		133		-		203	6.0
450	18"	175	-	255	173	-	253	6.0						
500	20"	175	-	285	173	-	283	6.0						
600	24"	235	-	405	233	-	403	6.0						

Transmitter (compact version): 3.4 kg  
 High-temperature version: + 1.5 kg  
 (Weight data valid for standard pressure ratings and without packaging material)  
 \*For flanges according to AS, only DN 25 and 50 are available

Promag H

Indication of weight in kg				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Messaufnehmer	Messumformer
2	1/12"	5.2	2.5	6.0
4	5/32"	5.2	2.5	6.0
8	5/16"	5.3	2.5	6.0
15	½"	5.4	2.6	6.0
25	1"	5.5	2.8	6.0
40	1½"	6.5	4.5	6.0
50	2"	9.0	7.0	6.0
65	2½"	9.5	7.5	6.0
80	3"	19.0	17.0	6.0
100	4"	18.5	16.5	6.0

Transmitter Promag (compact version): 3.4 kg  
 (Weight data valid for standard pressure ratings and without packaging material)

Weight (US-Units)

Promag W

Indication of weight in Pounds (lbs)															
Nominal diameter		Compact version					Remote version (without cable)								
		[mm]	[inch]	EN (DIN) / AS*	JIS	ANSI / AWWA	EN (DIN) / AS*	Sensor		ANSI / AWWA	Wall-mount housing				
								JIS							
25	1"	PN 40	16	10K	16	16	PN 40	12	10K	12	12	13			
32	1¼"		18					16		13			12	13	
40	1½"		21					18		21			14	16	13
50	2"		23					21		23			16	19	13
65	2½"	PN 16	27	10K	24	-	PN 16	22	10K	20	-	13			
80	3"		31					28		31			23	26	13
100	4"		35					32		35			28	31	13
125	5"		47					46		-			42	43	13
150	6"	56	54	56	50	52	13								
200	8"	PN 10	99	10K	92	Class 150	PN 10	95	10K	88	Class 150	13			
250	10"		143					153		139			149	161	
300	12"		154					159		150			155	238	13
350	14"		254							249				381	13
400	16"	298		452		448	13								
450	18"	386		562		558	13								
500	20"	386		628		624	13								
600	24"	518		893		889	13								
700	28"	783		882		878	13								
-	30"	-		1014		1010	13								
800	32"	959		1213		1208	13								
900	36"	1268		1764		1760	13								
1000	40"	1544		1985		1980	13								
-	42"	-		2426		2421	13								
1200	48"	1874		3087		3083	13								
-	54"	-		4851		4847	13								
1400	-	2867		-		-	13								
-	60"	-		5954		5949	13								
1600	-	3749		-		-	13								
-	66"	-		8159		8154	13								
1800	72"	4851		9041		9036	13								
-	78"	-		10143		10139	13								
2000	-	16.1		-		-	13								
Transmitter Promag (compact version): 7 lbs (Weight data valid for standard pressure ratings and without packaging material) * For flanges according to AS, only DN 3", 4", 6" to 16", 20" and 24" are available.															

*Weight P*

Indication of weight in Pounds (lbs)										
Nominal diameter		Compact version					Remote version (without cable)			
		[mm]	[inch]	EN (DIN) / AS*	JIS	ANSI / AWWA	Sensor			Wall-mount housing
						EN (DIN) / AS*	JIS	ANSI / AWWA		
15	½"	PN 40	14	14	14	PN 40	4.5	10	10	13
25	1"		16	16	16		5.3	12	12	13
32	1¼"		18	16	-		6	12	-	13
40	1½"		21	18	21		7.4	14	16	13
50	2"		23	21	23		8.6	16	19	13
65	2½"	PN 16	26	24	-	PN 16	10	20	-	13
80	3"		31	28	31		12	23	26	13
100	4"		35	32	35		14	28	31	13
125	5"		47	46	-		19.5	42	-	13
150	6"		56	54	56		23.5	50	52	13
200	8"	PN 10	99	92	99	PN 10	43	88	95	13
250	10"		143	153	165		63	149	161	13
300	12"		154	159	243		68	155	238	13
350	14"		254		386		113		381	13
400	16"		298		452		133		448	13
450	18"	386		562	173		558	13		
500	20"	386		628	173		624	13		
600	24"	518		893	233		889	13		

Transmitter (compact version): 7.5 lbs  
 High-temperature version: + 3.3 lbs  
 (Weight data valid for standard pressure ratings and without packaging material)  
 \*For flanges according to AS, only DN 1" and 2" are available

*Weight H*

Indication of weight in Pounds (lbs)				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Sensor	Wall-mount housing
2	1/12"	11	6	13
4	5/32"	11	6	13
8	5/16"	12	6	13
15	½"	12	6	13
25	1"	12	6	13
40	1½"	14	10	13
50	2"	20	15	13
65	2½"	21	17	13
80	3"	42	37	13
100	4"	41	36	13

Transmitter Promag (compact version): 7 lbs  
 (Weight data valid for standard pressure ratings and without packaging material)



## Materials

*Promag W*

Transmitter housing:

- Compact and remote version: Powder-coated die-cast aluminum

Sensor housing:

- DN 25 to 300 (1" to 12"): powder-coated die-cast aluminum
- DN 350 to 2000 (14" to 78"): painted steel (Amerlock 400)

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; non-stainless flange material with Amerlock 400 paint

Flange:

- EN 1092-1 (DIN 2501): 316L / 1.4571; RSt37-2 (S235JRG2) / C22 / FE 410W B (DN < 350 (14"): with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)
- ANSI: A105; F316L (DN < 350 (14") with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)
- AWWA: 1.0425
- JIS: RSt37-2 (S235JRG2) / HII / 1.0425 / 316L (DN < 350 (14") with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)
- AS 2129
  - (DN 150, 200, 250, 300, 600) (6", 8", 10", 12", 24") A105 or RSt37-2 (S235JRG2)
  - (DN 80, 100, 350, 400, 500) (3", 4", 14", 16", 20") A105 or St44-2 (S275JR) (DN < 350 (14") with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)
- AS 4087: A105 or St44-2 (S275JR) (DN < 350 (14") with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)

Ground disks: 1.4435/316L or Alloy C-22

Electrodes: 1.4435, Alloy C-22, tantalum

Seals: as per DIN EN 1514-1

*Promag P*

Transmitter housing:

- Compact and remote version: Powder-coated die-cast aluminum

Sensor housing:

- DN 15 to 300 (1" to 12"): powder-coated die-cast aluminum
- DN 350 to 600 (14" to 78"): painted steel (Amerlock 400)

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; non-stainless flange material with Amerlock 400 paint

Flange:

- EN 1092-1 (DIN 2501): 316L / 1.4571; RSt37-2 (S235JRG2) / C22 / FE 410W B (DN < 350 (14"): with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)
- ANSI: A105; F316L (DN < 350 (14") with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)
- JIS: RSt37-2 (S235JRG2) / HII / 1.0425 / 316L (DN < 350 (14") with Al/Zn protective coating; DN > 300 (12") with Amerlock 400 paint)
- AS 2129
  - DN 25, (1"): A105 or RSt37-2 (S235JRG2)
  - DN 50, (2"): A105 or St44-2 (S275JR) (with Al/Zn protective coating)
- AS 4087: A105 or St44-2 (S275JR) (with Al/Zn protective coating)

Ground disks: 1.4435/316L or Alloy C-22

Electrodes: 1.4435, platinum/rhodium 80/20 or Alloy C-22, tantalum

Seals: as per DIN EN 1514-1

*Promag H*

Transmitter housing:

- Compact housing: powder coated die-cast aluminum or stainless-steel (1.4301/316L)
- Wall-mounted housing: powder coated die-cast aluminum

Sensor housing: Stainless steel 1.4301

Wall mounting (holder panel): Stainless steel 1.4301

Measuring tube: stainless steel 1.4301 or 1.4306/304L

Flange:

- All connections 1.4404/316L
- Flanges (EN (DIN), ANSI, JIS) made of PVDF
- Adhesive coupling made of PVC

Ground rings:

- Standard: 1.4435/316L
- Optional: Tantalum, Alloy C-22

Electrodes:

- Standard: 1.4435
- Option: Alloy C-22, tantalum, platinum/rhodium 80/20 (up to DN 25 only)

Seals:

- DN 2 to 25 (1/12" to 1"): O-ring (EPDM, Viton, Kalrez) or molded seal (EPDM, silicone, Viton)
- DN 40 to 100 (1½ to 4"): molded seal (EPDM, silicone)

Material load curves

The material load curves (pressure-temperature diagrams) for the process connections are included in the separate "Technical information" documentation for the respective measuring device, which you can download in PDF format at [www.endress.com](http://www.endress.com).

A list of the available "Technical Information" documents is contained in the "Documentation" section → Page 173.

Fitted electrodes

*Promag W*

Measuring, reference and EPD electrodes:

- Standard available with: 1.4435, Alloy C-22, tantalum
- Optional: exchangeable measuring electrodes made of 1.4435 (DN 350 to 2000; 14" to 78")

*Promag P*

Measuring, reference and EPD electrodes:

- Standard available with: 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20
- Optional: measuring electrodes made of platinum/rhodium 80/20

*Promag H*

Measuring and EPD electrodes:

- DN 2 to 4 (1/12" to 5/32"): without EPD electrode
- Standard available with: 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20

Process connection	<p><i>Promag W</i></p> <p>Flange connection: EN 1092-1 (DIN 2501), DN &lt; 350 (14"): Form A, DN &gt; 300 (12"): Form B (DN 65 (2 1/12"), PN 16 and DN 600 (24"), PN 16 exclusively to EN 1092-1); ANSI; AWWA; JIS and AS</p> <p><i>Promag P</i></p> <p>Flanschanschluss: EN 1092-1 (DIN 2501), DN &lt; 350 (14"): Form A, DN &gt; 300 (12"): Form B (DN 65 (2 1/12"), PN 16 and DN 600 (24"), PN 16 exclusively to EN 1092-1); ANSI; JIS; AS</p> <p><i>Promag H</i></p> <ul style="list-style-type: none"> <li>■ With O-ring: weld nipples (DIN EN ISO 1127, ODT / SMS), flanges (EN (DIN), ANSI, JIS), PVDF flanges (EN (DIN), ANSI, JIS), external pipe thread, internal pipe thread, hose connection, PVC adhesive coupling</li> <li>■ With molded seal: weld nipples (DIN 11850, ODT / SMS), clamps (ISO 2852, DIN 32676, L14 AM7), threaded connection (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flanges DIN 11864-2</li> </ul>
Surface roughness	<ul style="list-style-type: none"> <li>■ Measuring tube lined with PFA: <math>\leq 0.4 \mu\text{m}</math> (16 <math>\mu\text{in}</math>)</li> <li>■ Electrodes: 0.3 to 0.5 <math>\mu\text{m}</math> (12 to 16 <math>\mu\text{in}</math>)</li> <li>■ Process connection Promag H: <math>\leq 0.8 \mu\text{m}</math> (31 <math>\mu\text{in}</math>)</li> </ul> <p>All specifications refer to wetted parts.</p>

### 10.1.11 Human interface

Display elements	<ul style="list-style-type: none"> <li>■ Liquid crystal display: illuminated, four lines with 16 characters per line</li> <li>■ Selectable display of different measured values and status variables</li> <li>■ 3 totalizers</li> <li>■ At ambient temperatures below <math>-20 \text{ }^\circ\text{C}</math> (<math>-15 \text{ }^\circ\text{F}</math>) the readability of the display may be impaired.</li> </ul>
Operating elements	<ul style="list-style-type: none"> <li>■ Local operation with three optical keys (<math>\ominus/\oplus/\text{E}</math>)</li> <li>■ Application-specific Quick Setup menus for straightforward commissioning</li> </ul>
Language groups	<p>Language groups available for operation in different countries:</p> <ul style="list-style-type: none"> <li>■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese</li> <li>■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech.</li> <li>■ South and east Asia (SEA): English, Japanese, Indonesian</li> <li>■ China (CN): English, Chinese</li> </ul>



Note!

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

### 10.1.12 Certificates and approvals

CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
C-Tick symbol	The measuring system complies with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA etc.) can be supplied by your E+H Sales Center on request. All information relevant to explosion protection is available in separate Ex documents that you can order as necessary.
Compatibility with foodstuffs	<p><i>Promag W</i></p> <p>No applicable approvals or certification</p> <p><i>Promag P</i></p> <p>No applicable approvals or certification</p> <p><i>Promag H</i></p> <ul style="list-style-type: none"> <li>■ 3A authorization and EHEDG-tested</li> <li>■ Seals → in conformity with FDA (except Kalrez seals)</li> </ul>
PROFIBUS DP/PA certification	<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>
Pressure device approval	Measuring devices with a nominal diameter smaller than or equal to DN 25 (1") correspond to Article 3(3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. For larger nominal diameters, optional approvals according to Cat. II/III are available when required (depends on fluid and process pressure).
Other standards and guidelines	<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 "Emission in accordance with requirements for Class A". Electromagnetic compatibility (EMC-requirements).</li> <li>■ NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.</li> <li>■ NAMUR NE 43 Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.</li> <li>■ NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics.</li> </ul>

### 10.1.13 Ordering information

The Endress+Hauser service organization can provide detailed ordering information and information on the order codes on request.

### 10.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. → Page 127



Note!

The Endress+Hauser service organization can provide detailed information on request.

### 10.1.15 Supplementary documentation

- Flow Measurement (FA005D/06/en)
- Technical information Promag 50W, 53W (TI046D/06/en)
- Technical information Promag 50P, 53P (TI047D/06/en)
- Technical information Promag 50H, 53H (TI048D/06/en)
- Description of device functions Promag 53, PROFIBUS DP/PA (BA064D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA

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## Declaration of Hazardous Material and De-Contamination Erklärung zur Kontamination und Reinigung

RA No.

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.  
Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor

Geräte-/Sensortyp \_\_\_\_\_

Serial number

Seriennummer \_\_\_\_\_

Used as SIL device in a Safety Instrumented System / Einsatz als SIL Gerät in Schutzeinrichtungen

Process data / Prozessdaten

Temperature / Temperatur \_\_\_\_\_ [°F] \_\_\_\_\_ [°C]

Pressure / Druck \_\_\_\_\_ [psi] \_\_\_\_\_ [ Pa ]

Conductivity / Leitfähigkeit \_\_\_\_\_ [µS/cm]

Viscosity / Viskosität \_\_\_\_\_ [cp] \_\_\_\_\_ [mm<sup>2</sup>/s]

Medium and warnings

Warnhinweise zum Medium



	Medium / concentration Medium / Konzentration	Identification CAS No.	flammable entzündlich	toxic giftig	corrosive ätzend	harmful/ irritant gesundheits- schädlich/ reizend	other * sonstiges*	harmless unbedenklich
Process medium Medium im Prozess								
Medium for process cleaning Medium zur Prozessreinigung								
Returned part cleaned with Medium zur Endreinigung								

\* explosive; oxidising; dangerous for the environment; biological risk; radioactive

\* explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.

Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / Fehlerbeschreibung \_\_\_\_\_

Company data / Angaben zum Absender

Company / Firma _____	Phone number of contact person / Telefon-Nr. Ansprechpartner: _____
Address / Adresse _____	Fax / E-Mail _____
_____	Your order No. / Ihre Auftragsnr. _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge. We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefährlicher Menge sind."

(place, date / Ort, Datum)

Name, dept./Abt. (please print / bitte Druckschrift)

Signature / Unterschrift

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