



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

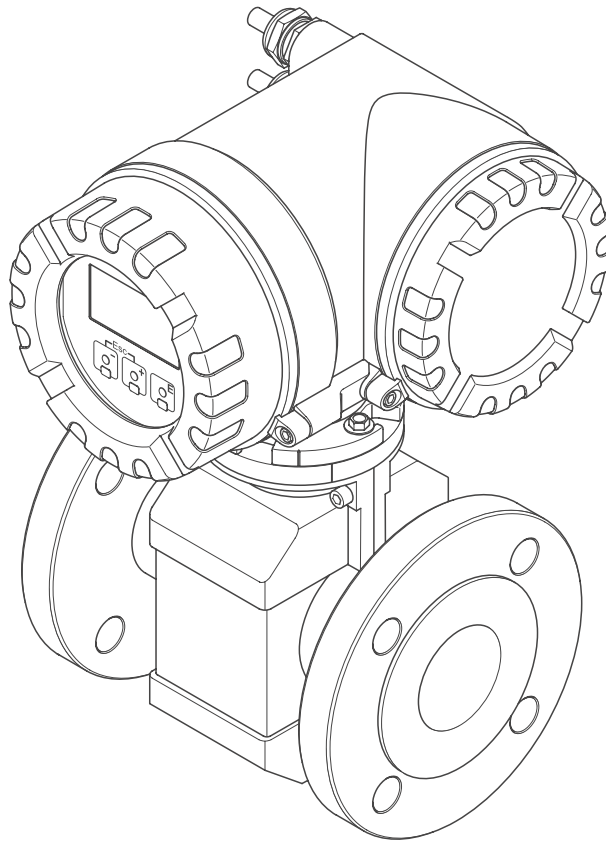


Solutions

Operating Instructions

Proline Promag 53

Electromagnetic Flow Measuring System



BA047D/06/en/03.05
50097083

Valid as of version:
V 2.00.XX (Device software)

Endress+Hauser

People for Process Automation

Brief operating instructions

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

Safety instructions	Page 7
▼	
Installation	Page 13
▼	
Wiring	Page 47
▼	
Display and operating elements	Page 61
▼	
Commissioning with “QUICK SETUP”	Page 83 ff.
You can commission the measuring device quickly and easily, using the special “Quick Setup” menu. It enables to configure important basic functions using the local display, for example display language, measured variables, units engineering, type of signal, etc. The following adjustments can be made separately as necessary: – Empty-pipe/full-pipe adjustment for empty pipe detection (EPD) – Configuration of relay contacts (NC or NO contact) – Configuration of current outputs (active/passive), etc.	
▼	
Application-specific QUICK SETUPS	Page 84 ff.
In “Quick Setup” mode you have the option of launching other, application-specific Quick Setups, for instance the menu for measuring pulsating flow.	
▼	
Customer-specific configuration	Page 65 ff.
Complex measuring operations necessitate additional functions that you can configure as necessary with the aid of the function matrix, and customize to suit the process parameters. 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 Instruction.	
▼	
Data storage	Page 92 ff.
The configuration of the transmitter can be stored on the integrated T-DAT data storage device.  Note! For time-saving commissioning, the settings stored in the T-DAT can be transmitted: – For equivalent measuring points (equivalent configuration) – In the event of device/board replacement.	
▼	
More detailed configuration	Page 97 ff.
The inputs and outputs can be modified on convertible boards by configuring the current inputs and outputs and relay contacts. The F-CHIP module gives the user the added option of using software packages for diagnosis, concentration measurement and viscosity.	



Note!

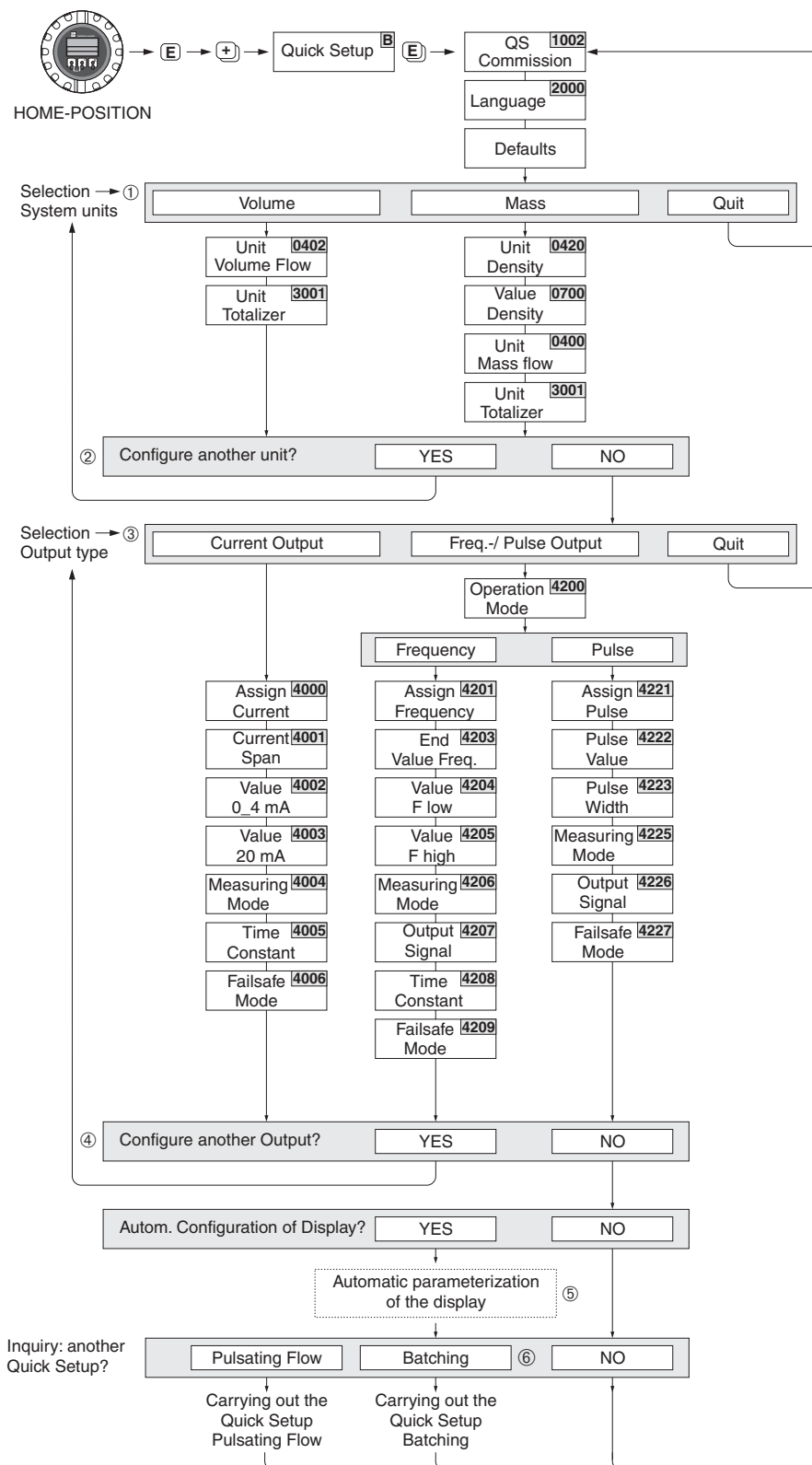
Always start trouble-shooting with the checklist on Page 105, if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

“QUICK SETUP” for commissioning



Note!

More detailed information on running Quick Setup menus, especially for devices without a local display, can be found on Page 85 ff.



F06-53xxxxxx-19-xx-xx-en-000

Fig. 1: QUICK SETUP “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 Quick Setups explained below is run.
- ① Only units not yet configured in the current Setup are offered for selection in each cycle.
The unit for mass, volume and corrected 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 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 parameterized.
“NO” is the only option displayed when no further outputs are available.
 - ⑤ The “automatic parameterization of the display” option contains the following basic settings/factory settings:
YES: Main line = Mass flow; Additional line = Totalizer 1;
Information line = Operating/system conditions
NO: The existing (selected) settings remain.
 - ⑥ The QUICK SETUP BATCHING is only available when the optional software package BATCHING is installed.

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1 Safety instructions

1.1 Designated use

The measuring device described in this Operating Manual is to be used only for measuring the flow rate of conductive fluids in closed pipes. A minimum conductivity of 20 $\mu\text{S}/\text{cm}$ is required for measuring demineralized water. Most fluids 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 will be happy to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, unless the power supply is galvanically insulated.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

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 ( Europe,  USA,  Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- 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 Return

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 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 Notes on 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 “Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures”. They can, however, be a source of danger if used incorrectly or for other than the designated use.

Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:



Warning!

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



Caution!

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



Note!

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

2 Identification

2.1 Device designation

The “Promag 53” flow measuring system consists of the following components:

- Promag 53 transmitter
- Promag W, Promag P or Promag H sensor

In the *compact version*, transmitter and sensor form a single mechanical unit; in the *remote version* they are installed separately.

2.1.1 Nameplate of the transmitter

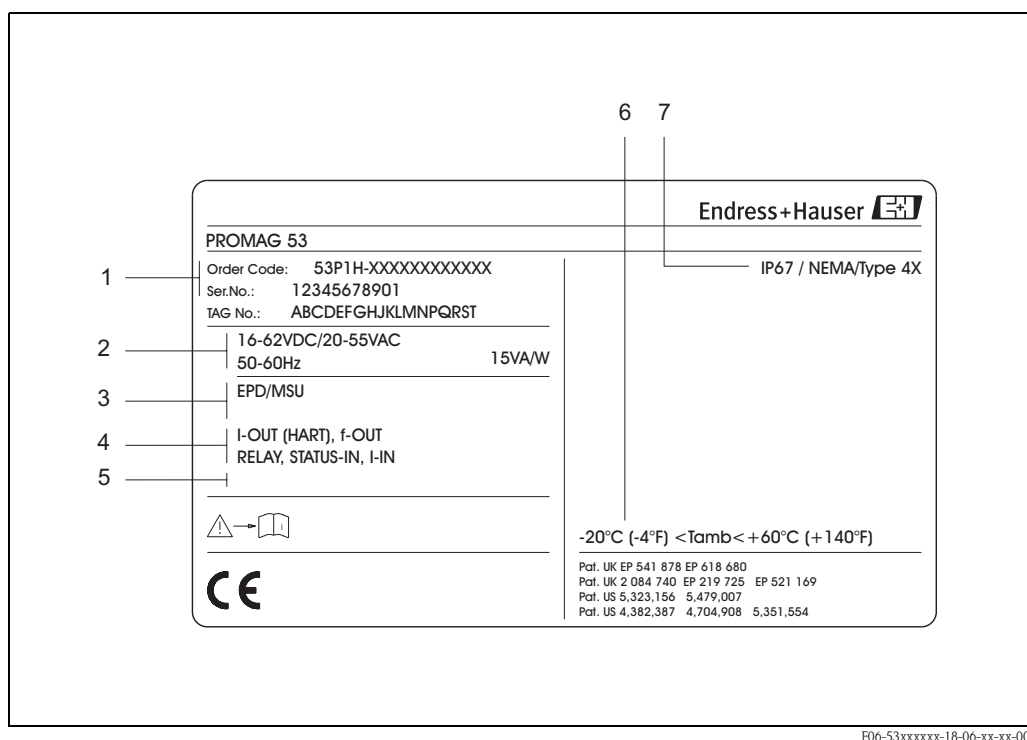
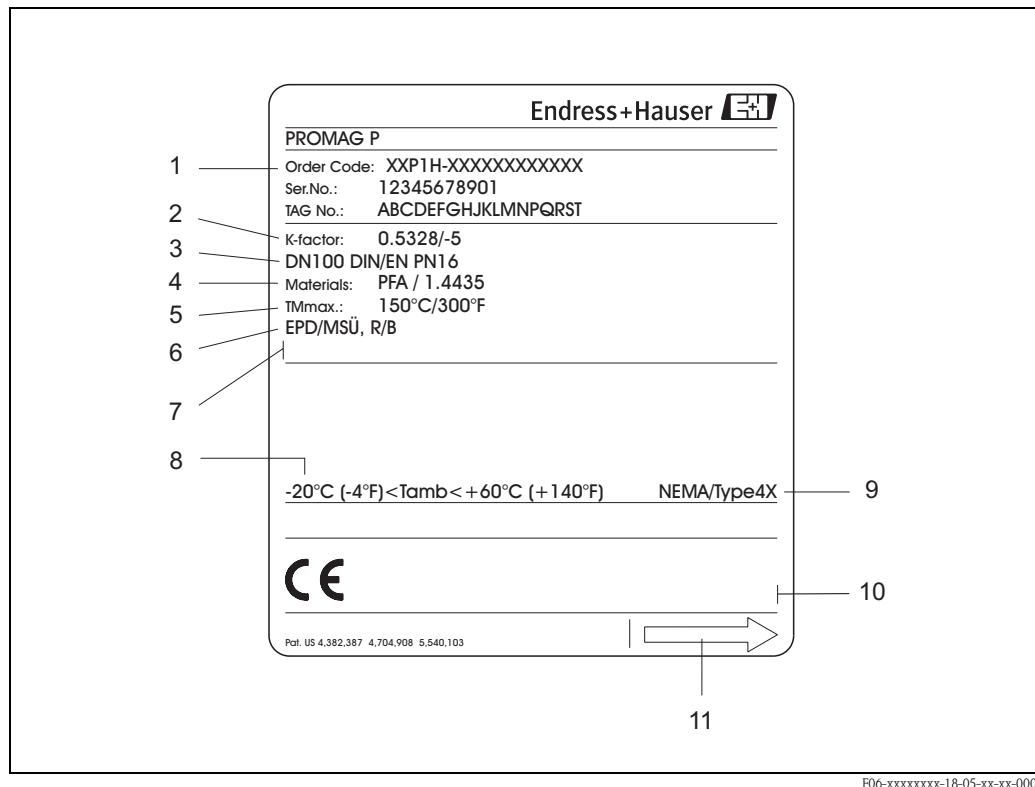


Fig. 2: Nameplate specifications for the “Promag 53” transmitter (example)

- 1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
- 2 Power supply / frequency: 16...62 V DC / 20...55 V AC / 50...60 Hz
Power consumption: 15 VA / W
- 3 Additional functions and software:
 - EPD/MSU: with Empty Pipe Detection
 - ECC: with Electrode Cleaning Circuitry
- 4 Outputs / inputs:
 - I-OUT (HART): with current output (HART)
 - f-OUT: with pulse/frequency output
 - RELAY: with relay output
 - STATUS-IN: with status input (auxiliary input)
 - I-IN: with current input
- 5 Reserved for information on special products
- 6 Ambient temperature range
- 7 Degree of protection

2.1.2 Nameplate of the sensor



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

- 1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
- 2 Calibration factor: 0.5328; zero point: -5
- 3 Nominal diameter: DN 100
Pressure rating: EN (DIN) PN 16 bar
- 4 $T_{Mmax} +150\text{ }^{\circ}\text{C}$ (max. fluid temperature)
- 5 Materials:
– Lining: PFA
– Measuring electrodes: stainless steel 1.4435
- 6 Additional information (examples):
– EPD/MSU: with Empty Pipe Detection electrode
– R/B: with reference electrode
- 7 Reserved for information on special products
- 8 Ambient temperature range
- 9 Degree of protection
- 10 Reserved for additional information on device version (approvals, certificates)
- 11 Flow direction

2.1.3 Nameplate, connections

See operating manual
Betriebsanleitung beachten
Observer manuel d'instruction

A: active
P: passive
NO: normally open contact
NC: normally closed contact

1 Ser.No.: 12345678912

4 Supply / Versorgung / Tension d'alimentation

5 I-OUT (HART)

f-OUT

STATUS-OUT

STATUS-IN

6 ex-works Device SW: XX.XX.XX

7 Communication: XXXXXXXXXX

8 Revision: XX.XX.XX

9 Date: DD.MMM.YYYY

10

20(+)/21(-)
22(+)/23(-)
24(+)/25(-)
26(+)/27(-)

319475-00XX

Fig. 4: Nameplate specifications for Proline transmitter (example)

- 1 Serial number
- 2 Possible configuration of current output
- 3 Possible configuration of relay contacts
- 4 Terminal assignment, cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal No. 1: L1 for AC, L+ for DC
Terminal No. 2: N for AC, L- for DC
- 5 Signals present at inputs and outputs, possible configuration and terminal assignment (20...27), see also "Electrical values of inputs/outputs"
- 6 Version of device software currently installed
- 7 Installed communication type, e.g.: HART, PROFIBUS PA, etc.
- 8 Information on current communication software (Device Revision and Device Description), e.g.: Dev. 01 / DD 01 for HART
- 9 Date of installation
- 10 Current updates to data specified in points 6 to 9

2.2 CE mark, declaration of conformity

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They 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 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of EN 61326/A1. 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.

2.3 Registered trademarks

KALREZ[®], VITON[®]

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

TRI-CLAMP[®]

is a registered trademark of Ladish & Co., Inc., Kenosha, USA

HART[®]

is a registered trademark of HART Communication Foundation, Austin, USA

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

are registered trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

- 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 ($DN \leq 300$):

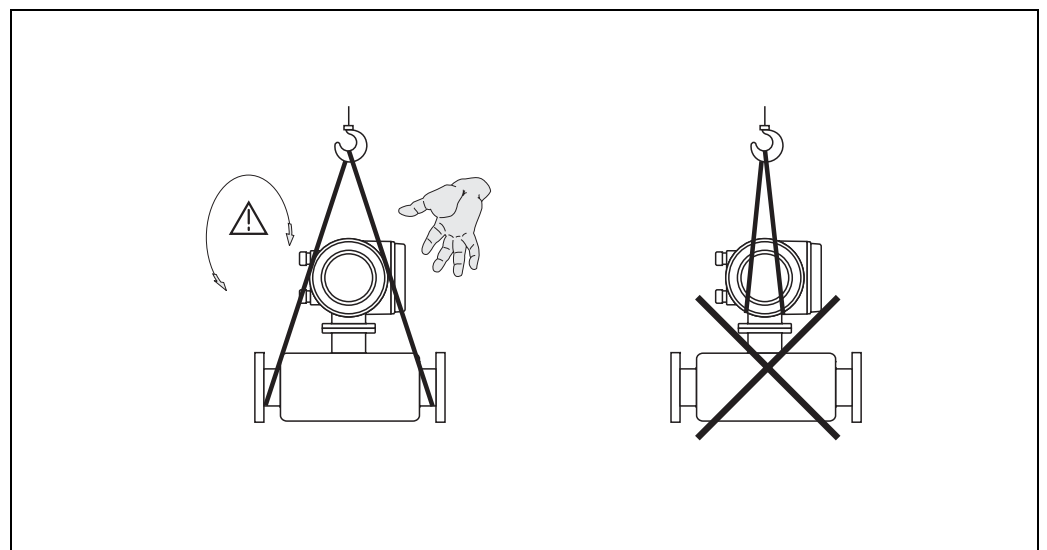
Use webbing slings slung round the two process connections (Fig. 5). Do not use chains, as they could damage the housing.



Warning!

Risk of injury if the measuring device slips. The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung.

At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.



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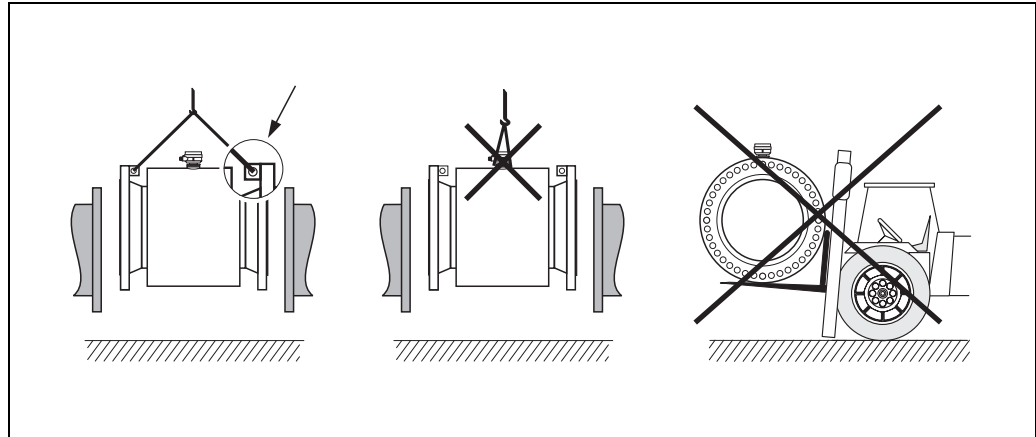
Fig. 5: Transporting transmitters with $DN \leq 300$

Transporting flanged devices ($DN \geq 350$):

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.



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Fig. 6: Transporting sensors with $DN \geq 350$

3.1.3 Storage

Note the following points:

- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.
- 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 you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

3.2 Installation conditions

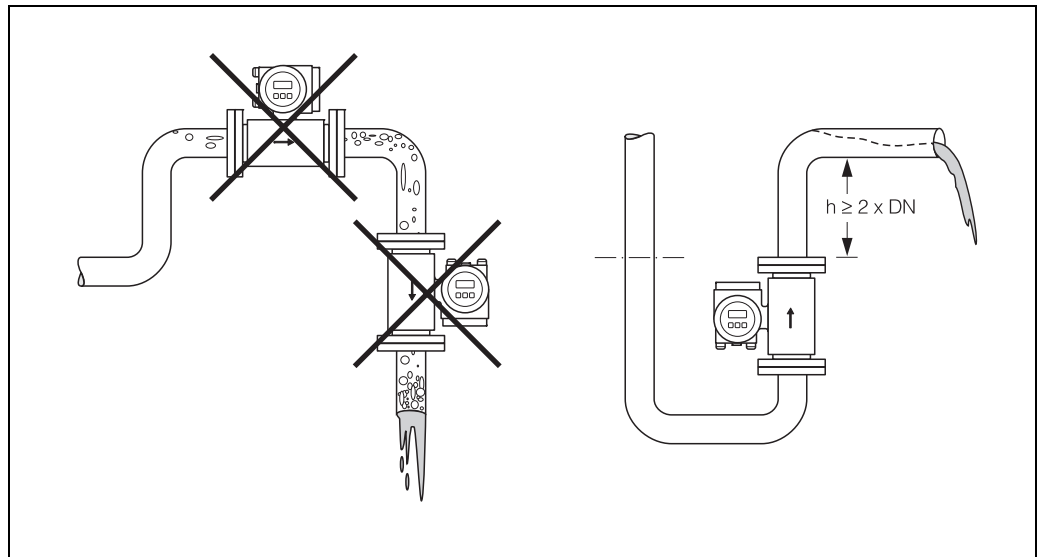
3.2.1 Dimensions

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

3.2.2 Mounting location

Correct measuring is possible only if the pipe is full. **Avoid** the following locations:

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



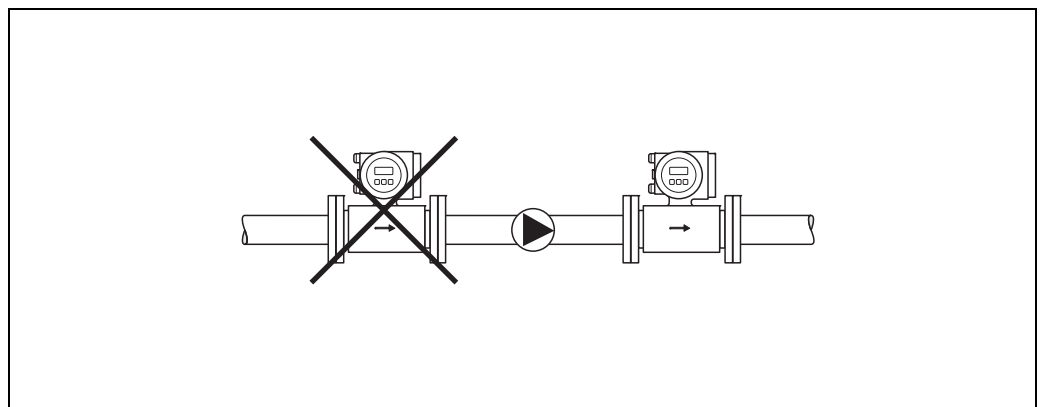
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Fig. 7: Location

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 the lining's resistance to partial vacuum can be found on → Page 132.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on → Page 129.



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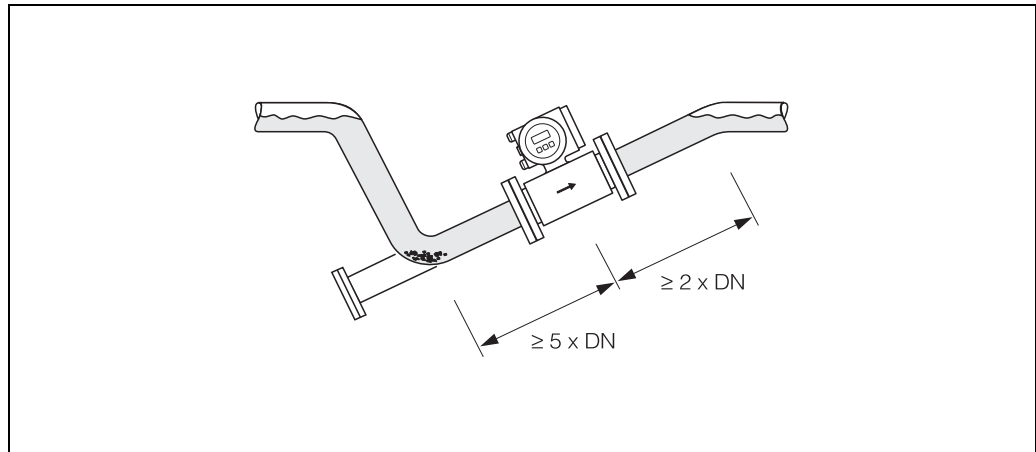
Fig. 8: Installation of pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function (see Page 93) offers additional protection by detecting empty or partially filled pipes.

**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.

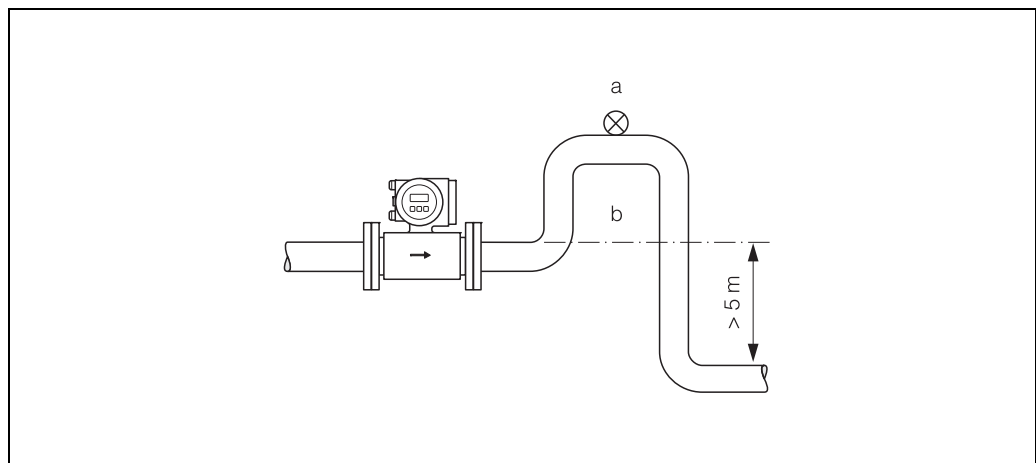


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Fig. 9: Installation in partially filled pipe

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. These measures also prevent the system losing prime, which could cause air inclusions. Information on the lining's resistance to partial vacuum can be found on Page 132.



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Fig. 10: Measures for installation in a down pipe (a = vent valve; b = siphon)

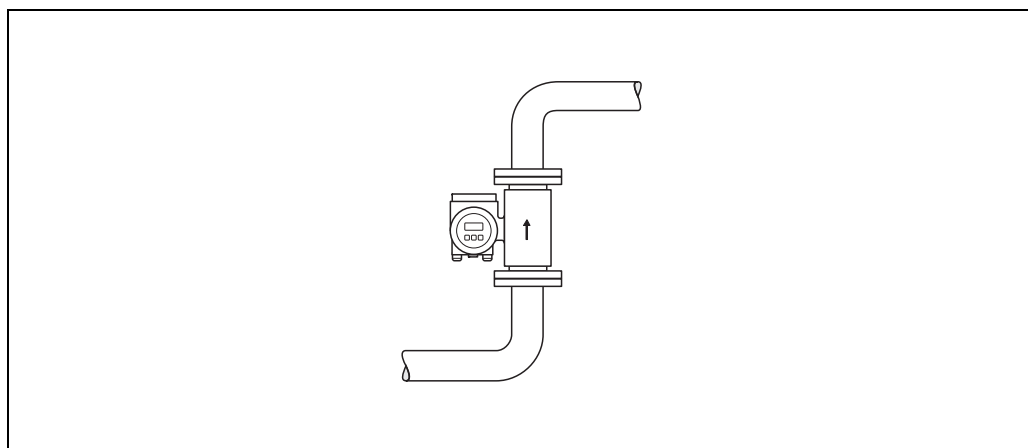
3.2.3 Orientation

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

- Electrode Cleaning Circuit (ECC) for applications with 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 (see Page 93)
- Exchangeable Measuring Electrodes for abrasive fluids (see Page 120)

Vertical orientation

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



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Fig. 11: Vertical orientation

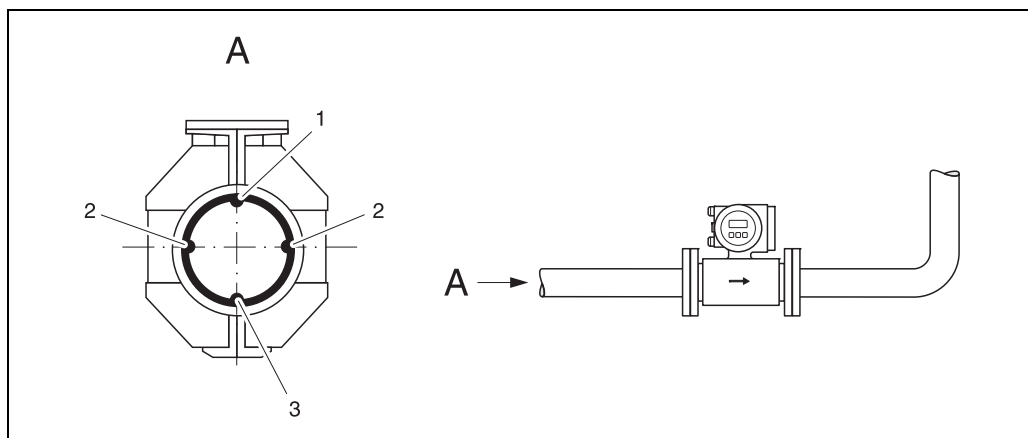
Horizontal orientation

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



Caution!

Empty Pipe Detection functions correctly with the measuring device installed horizontally only when the transmitter housing is facing upward (Fig. 12). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.



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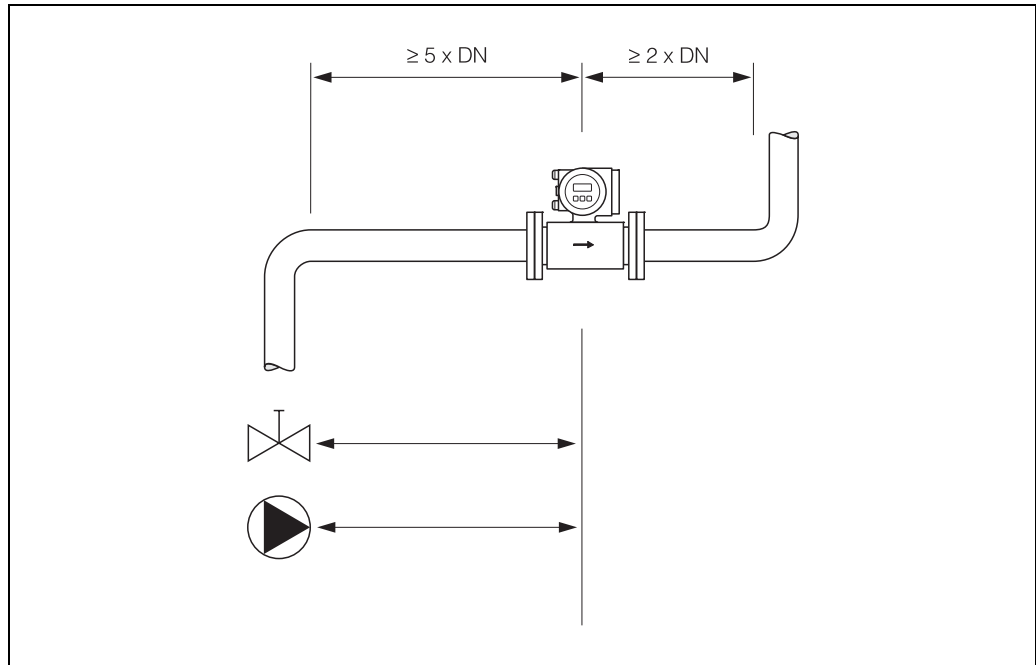
Fig. 12: Horizontal orientation

- 1 EPD electrode for the detection of empty pipes (not with Promag H, DN 2...4)
- 2 Measurement electrodes for the signal acquisition
- 3 Reference electrode for the potential equalisation (not with 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 $\geq 2 \times \text{DN}$



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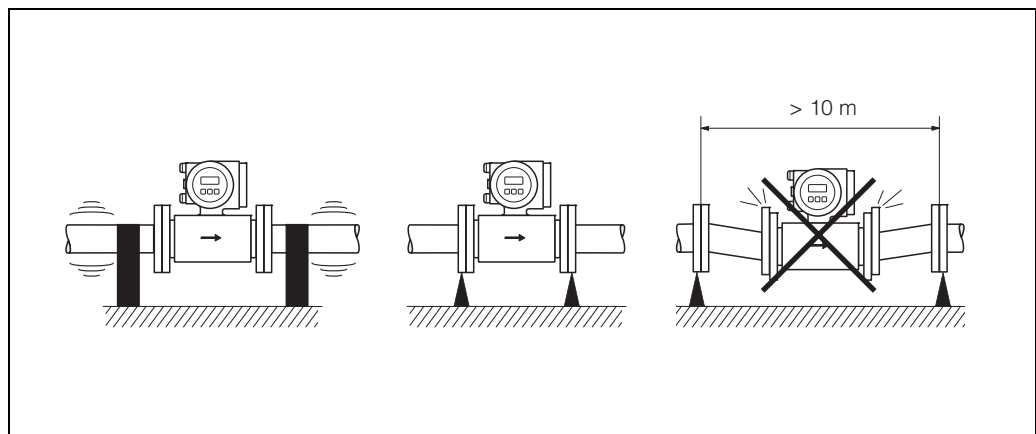
Fig. 13: Inlet and outlet runs

3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.

**Caution!**

It is advisable to install sensor and transmitter separately if vibration is excessively severe. Information on resistance to vibration and shock can be found on → Page 129.



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Fig. 14: Measures to prevent vibration of the measuring device

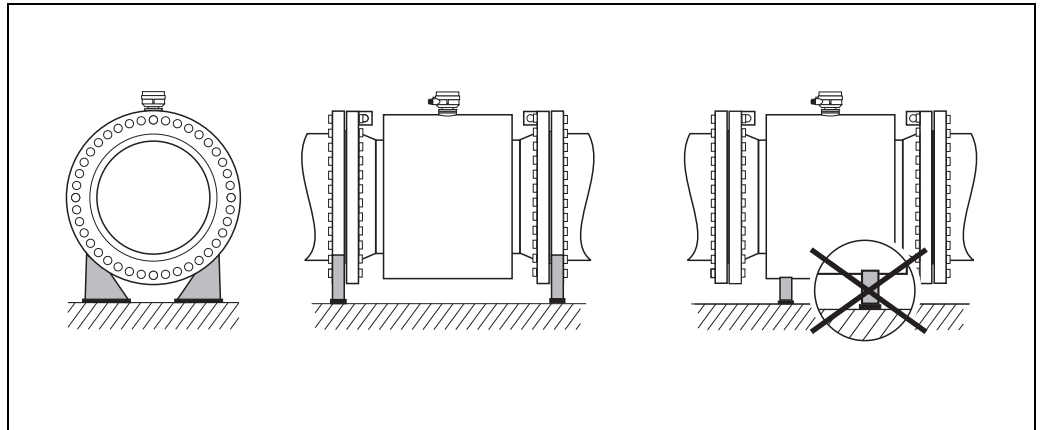
3.2.5 Foundations, supports

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



F06-5xFxxxxx-11-05-xx-xx-000

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

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.

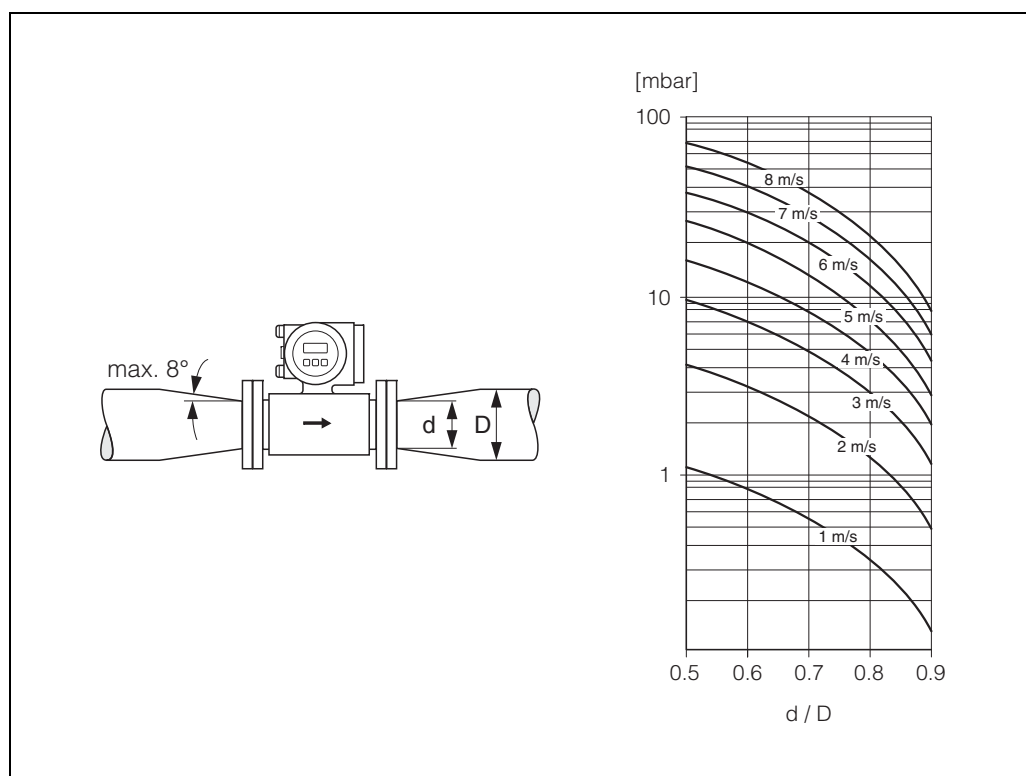
The nomogram shown here can be used to calculate the pressure loss caused by cross-section reduction:



Note!

The nomogram applies to fluids 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.



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Fig. 16: Pressure loss due to adapters

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 velocity of flow is 2...3 m/s. The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:

- $v < 2$ m/s: for abrasive fluids such as potter's clay, lime milk, ore slurry, etc.
- $v > 2$ m/s: for fluids producing build-up such as wastewater sludge, etc.



Note!

Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (see Section 3.2.6).

Promag W**Flow rate characteristic values - Promag W (SI units)**

Nominal diameter		Recommended flow rate min./max. full scale value (v ~ 0.3 or 10 m/s)	Factory settings		
[mm]	[inch]		Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
25	1"	9...300 dm ³ /min	75 dm ³ /min	0.50 dm ³	1 dm ³ /min
32	1 1/4"	15...500 dm ³ /min	125 dm ³ /min	1.00 dm ³	2 dm ³ /min
40	1 1/2"	25...700 dm ³ /min	200 dm ³ /min	1.50 dm ³	3 dm ³ /min
50	2"	35...1100 dm ³ /min	300 dm ³ /min	2.50 dm ³	5 dm ³ /min
65	2 1/2"	60...2000 dm ³ /min	500 dm ³ /min	5.00 dm ³	8 dm ³ /min
80	3"	90...3000 dm ³ /min	750 dm ³ /min	5.00 dm ³	12 dm ³ /min
100	4"	145...4700 dm ³ /min	1200 dm ³ /min	10.00 dm ³	20 dm ³ /min
125	5"	220...7500 dm ³ /min	1850 dm ³ /min	15.00 dm ³	30 dm ³ /min
150	6"	20...600 m ³ /h	150 m ³ /h	0.025 m ³	2.5 m ³ /h
200	8"	35...1100 m ³ /h	300 m ³ /h	0.05 m ³	5.0 m ³ /h
250	10"	55...1700 m ³ /h	500 m ³ /h	0.05 m ³	7.5 m ³ /h
300	12"	80...2400 m ³ /h	750 m ³ /h	0.10 m ³	10 m ³ /h
350	14"	110...3300 m ³ /h	1000 m ³ /h	0.10 m ³	15 m ³ /h
400	16"	140...4200 m ³ /h	1200 m ³ /h	0.15 m ³	20 m ³ /h
450	18"	180...5400 m ³ /h	1500 m ³ /h	0.25 m ³	25 m ³ /h
500	20"	220...6600 m ³ /h	2000 m ³ /h	0.25 m ³	30 m ³ /h
600	24"	310...9600 m ³ /h	2500 m ³ /h	0.30 m ³	40 m ³ /h
700	28"	420...13500 m ³ /h	3500 m ³ /h	0.50 m ³	50 m ³ /h
–	30"	480...15000 m ³ /h	4000 m ³ /h	0.50 m ³	60 m ³ /h
800	32"	550...18000 m ³ /h	4500 m ³ /h	0.75 m ³	75 m ³ /h
900	36"	690...22500 m ³ /h	6000 m ³ /h	0.75 m ³	100 m ³ /h
1000	40"	850...28000 m ³ /h	7000 m ³ /h	1.00 m ³	125 m ³ /h
–	42"	950...30000 m ³ /h	8000 m ³ /h	1.00 m ³	125 m ³ /h
1200	48"	1250...40000 m ³ /h	10000 m ³ /h	1.50 m ³	150 m ³ /h
–	54"	1550...50000 m ³ /h	13000 m ³ /h	1.50 m ³	200 m ³ /h
1400	–	1700...55000 m ³ /h	14000 m ³ /h	2.00 m ³	225 m ³ /h
–	60"	1950...60000 m ³ /h	16000 m ³ /h	2.00 m ³	250 m ³ /h
1600	–	2200...70000 m ³ /h	18000 m ³ /h	2.50 m ³	300 m ³ /h
–	66"	2500...80000 m ³ /h	20500 m ³ /h	2.50 m ³	325 m ³ /h
1800	72"	2800...90000 m ³ /h	23000 m ³ /h	3.00 m ³	350 m ³ /h
–	78"	3300...100000 m ³ /h	28500 m ³ /h	3.50 m ³	450 m ³ /h
2000	–	3400...110000 m ³ /h	28500 m ³ /h	3.50 m ³	450 m ³ /h

Flow rate characteristic values - Promag W (US units)					
Nominal diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1"	25	2.5...80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/4"	32	4...130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1 1/2"	40	7...190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10...300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16...500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24...800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40...1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	125	60...1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90...2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155...4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250...7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350...10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500...15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	400	600...19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800...24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000...30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400...44000 gal/min	10500 gal/min	100 gal	180 gal/min
28"	700	1900...60000 gal/min	13500 gal/min	125 gal	210 gal/min
30"	–	2150...67000 gal/min	16500 gal/min	150 gal	270 gal/min
32"	800	2450...80000 gal/min	19500 gal/min	200 gal	300 gal/min
36"	900	3100...100000 gal/min	24000 gal/min	225 gal	360 gal/min
40"	1000	3800...125000 gal/min	30000 gal/min	250 gal	480 gal/min
42"	–	4200...135000 gal/min	33000 gal/min	250 gal	600 gal/min
48"	1200	5500...175000 gal/min	42000 gal/min	400 gal	600 gal/min
54"	–	9...300 Mgal/d	75 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1400	10...340 Mgal/d	85 Mgal/d	0.0005 Mgal	1.3 Mgal/d
60"	–	12...380 Mgal/d	95 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1600	13...450 Mgal/d	110 Mgal/d	0.0008 Mgal	1.7 Mgal/d
66"	–	14...500 Mgal/d	120 Mgal/d	0.0008 Mgal	2.2 Mgal/d
72"	1800	16...570 Mgal/d	140 Mgal/d	0.0008 Mgal	2.6 Mgal/d
78"	–	18...650 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d
–	2000	20...700 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d

Promag P

Flow rate characteristic values - Promag P (SI units)						
Nominal diameter		Recommended flow rate	Factory settings			
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)	
15	1/2"	4...100 dm ³ /min	25 dm ³ /min	0.20 dm ³	0.5 dm ³ /min	
25	1"	9...300 dm ³ /min	75 dm ³ /min	0.50 dm ³	1 dm ³ /min	
32	1 1/4"	15...500 dm ³ /min	125 dm ³ /min	1.00 dm ³	2 dm ³ /min	
40	1 1/2"	25...700 dm ³ /min	200 dm ³ /min	1.50 dm ³	3 dm ³ /min	
50	2"	35...1100 dm ³ /min	300 dm ³ /min	2.50 dm ³	5 dm ³ /min	
65	2 1/2"	60...2000 dm ³ /min	500 dm ³ /min	5.00 dm ³	8 dm ³ /min	
80	3"	90...3000 dm ³ /min	750 dm ³ /min	5.00 dm ³	12 dm ³ /min	
100	4"	145...4700 dm ³ /min	1200 dm ³ /min	10.00 dm ³	20 dm ³ /min	
125	5"	220...7500 dm ³ /min	1850 dm ³ /min	15.00 dm ³	30 dm ³ /min	
150	6"	20...600 m ³ /h	150 m ³ /h	0.025 m ³	2.5 m ³ /h	
200	8"	35...1100 m ³ /h	300 m ³ /h	0.05 m ³	5.0 m ³ /h	
250	10"	55...1700 m ³ /h	500 m ³ /h	0.05 m ³	7.5 m ³ /h	
300	12"	80...2400 m ³ /h	750 m ³ /h	0.10 m ³	10 m ³ /h	
350	14"	110...3300 m ³ /h	1000 m ³ /h	0.10 m ³	15 m ³ /h	
400	16"	140...4200 m ³ /h	1200 m ³ /h	0.15 m ³	20 m ³ /h	
450	18"	180...5400 m ³ /h	1500 m ³ /h	0.25 m ³	25 m ³ /h	
500	20"	220...6600 m ³ /h	2000 m ³ /h	0.25 m ³	30 m ³ /h	
600	24"	310...9600 m ³ /h	2500 m ³ /h	0.30 m ³	40 m ³ /h	

Flow rate characteristic values - Promag P (US units)					
Nominal diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or ~ 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1/2"	15	1.0...27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	25	2.5...80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/4"	32	4...130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1 1/2"	40	7...190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10...300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16...500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24...800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40...1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	125	60...1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90...2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155...4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250...7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350...10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500...15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	400	600...19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800...24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000...30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400...44000 gal/min	10500 gal/min	100 gal	180 gal/min

Promag H

Flow rate characteristic values - Promag H (SI units)					
Nominal diameter		Recommended flow rate	Factory settings		
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
2	1/12"	0.06...1.8 dm ³ /min	0.5 dm ³ /min	0.005 dm ³	0.01 dm ³ /min
4	5/32"	0.25...7 dm ³ /min	2 dm ³ /min	0.025 dm ³	0.05 dm ³ /min
8	5/16"	1...30 dm ³ /min	8 dm ³ /min	0.10 dm ³	0.1 dm ³ /min
15	1/2"	4...100 dm ³ /min	25 dm ³ /min	0.20 dm ³	0.5 dm ³ /min
25	1"	9...300 dm ³ /min	75 dm ³ /min	0.50 dm ³	1 dm ³ /min
40	1 1/2"	25...700 dm ³ /min	200 dm ³ /min	1.50 dm ³	3 dm ³ /min
50	2"	35...1100 dm ³ /min	300 dm ³ /min	2.50 dm ³	5 dm ³ /min
65	2 1/2"	60...2000 dm ³ /min	500 dm ³ /min	5.00 dm ³	8 dm ³ /min
80	3"	90...3000 dm ³ /min	750 dm ³ /min	5.00 dm ³	12 dm ³ /min
100	4"	145...4700 dm ³ /min	1200 dm ³ /min	10.00 dm ³	20 dm ³ /min

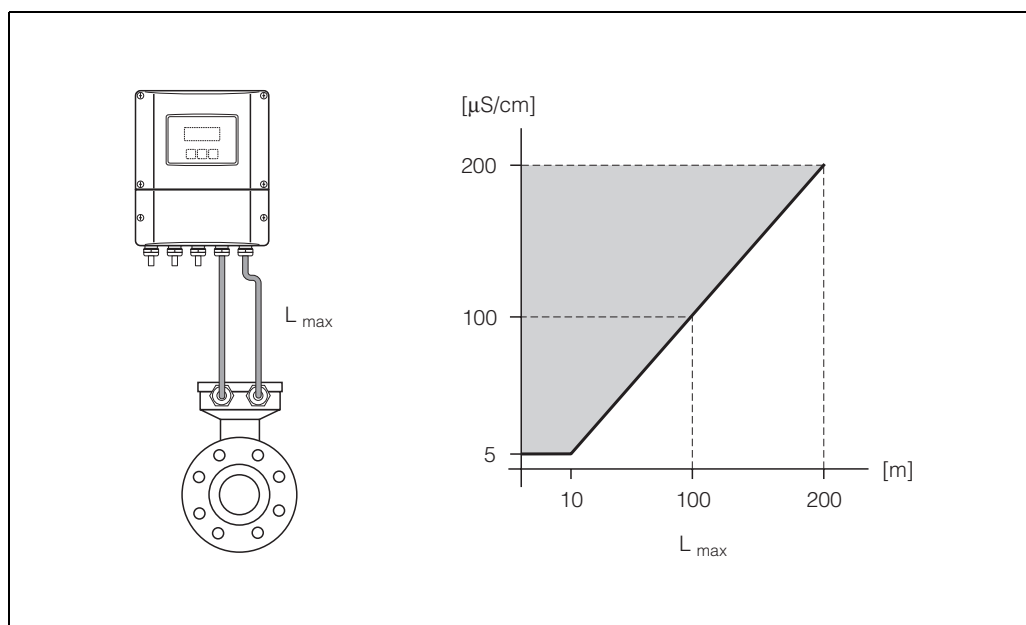
Flow rate characteristic values - Promag H (US units)

Nominal diameter		Recommended flow rate min./max. full scale value (v ~ 0.3 or 10 m/s)	Factory settings		
[inch]	[mm]		Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1/12"	2	0.015...0.5 gal/min	0.1 gal/min	0.001 gal	0.002 gal/min
5/32"	4	0.07...2 gal/min	0.5 gal/min	0.005 gal	0.008 gal/min
5/16"	8	0.25...8 gal/min	2 gal/min	0.02 gal	0.025 gal/min
1/2"	15	1.0...27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	22	2.5...65 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/2"	40	7...190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10...300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16...500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24...800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40...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 equalisation 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.



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Fig. 17: Permissible cable length for the remote version

Gray shaded area = permissible range
 L_{max} = length of connecting cable in [m]
 Medium conductivity in $\mu\text{S}/\text{cm}$

3.3 Installation instruction

3.3.1 Installing the Promag W sensor

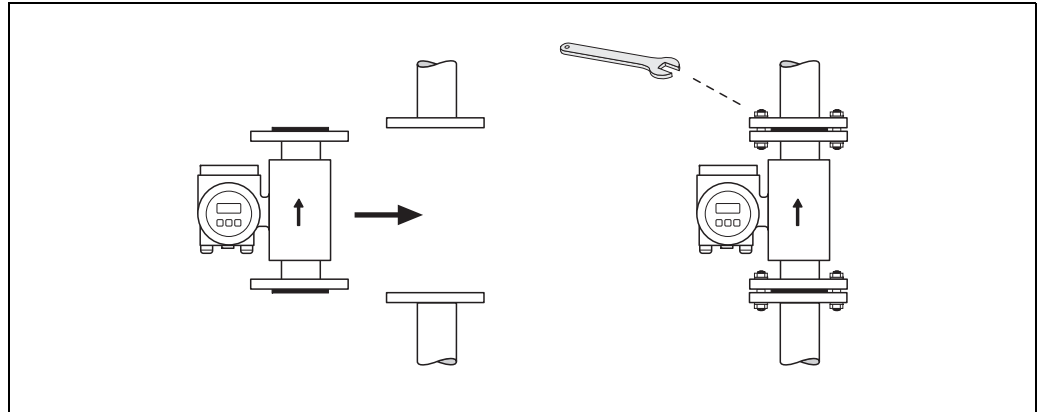


Note!

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 on Page 28 ff.
- The mounting of additional ground disks is described on Page 27.



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Fig. 18: Installing the Promag W sensor

Seals

Comply with the following instructions when installing seals:

- Hard rubber lining → additional seals are **always** necessary!
- 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 15...2000)

If necessary, the special ground cable for potential equalisation can be ordered as an accessory (see Page 101). Detailed assembly instructions → Page 57 ff.

Assembly with ground disks (DN 25...300)

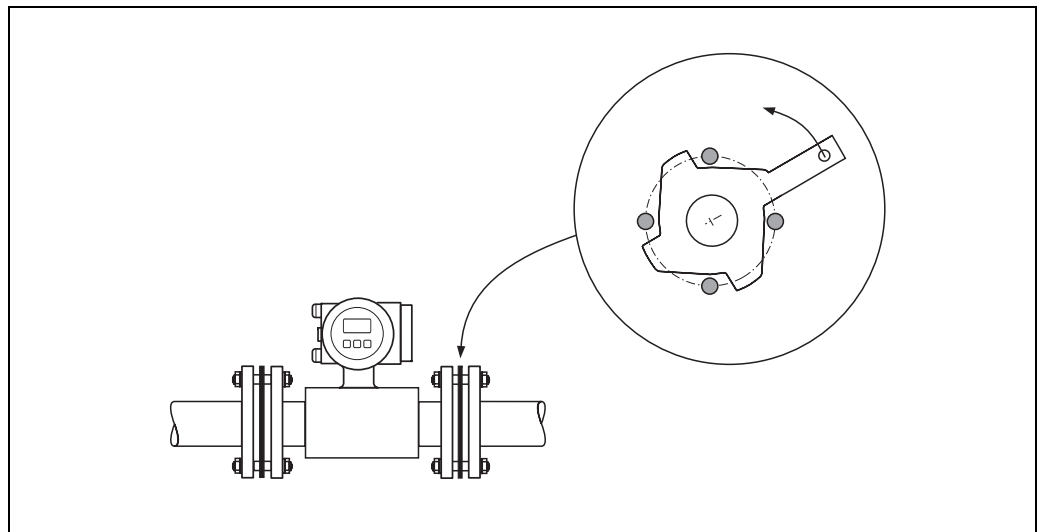
Depending on the application, e.g. with lined or ungrounded pipes (see Page 56 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for potential equalisation. Ground disks can be ordered separately as an accessory from Endress+Hauser (see Page 101).



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".
- 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 (Fig. 19).
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. 19 until the handle strikes the bolts. This will center the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 28 ff.)
5. Connect the ground disk to ground → Page 58.



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

Screw tightening torques (Promag W)

Note the following points:

- The tightening torques listed below are for lubricated threads only.
- Always tighten threaded fasteners 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]	Threaded fasteners	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
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

Promag W Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
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
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		AWWA Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]			Hard rubber	Polyurethane
700	28"	Class D	28 x 1 1/4"	247	292
750	30"	Class D	28 x 1 1/4"	287	302
800	32"	Class D	28 x 1 1/2"	394	422
900	36"	Class D	32 x 1 1/2"	419	430
1000	40"	Class D	36 x 1 1/2"	420	477
1050	42"	Class D	36 x 1 1/2"	528	518
1200	48"	Class D	44 x 1 1/2"	552	531
1350	54"	Class D	44 x 1 3/4"	730	633
1500	60"	Class D	52 x 1 3/4"	758	832
1650	66"	Class D	52 x 1 3/4"	946	955
1800	72"	Class D	60 x 1 3/4"	975	1087
2000	78"	Class D	64 x 2"	853	786

Promag W Nominal diameter		ANSI Pressure rating [lbs]	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]			Hard rubber	Polyurethane
25	1"	Class 150	4 x 1/2"	–	7
25	1"	Class 300	4 x 5/8"	–	8
40	1 1/2"	Class 150	4 x 1/2"	–	10
40	1 1/2"	Class 300	4 x 3/4"	–	15
50	2"	Class 150	4 x 5/8"	–	22
50	2"	Class 300	8 x 5/8"	–	11
80	3"	Class 150	4 x 5/8"	60	43
80	3"	Class 300	8 x 3/4"	38	26
100	4"	Class 150	8 x 5/8"	42	31
100	4"	Class 300	8 x 3/4"	58	40
150	6"	Class 150	8 x 3/4"	79	59
150	6"	Class 300	12 x 3/4"	70	51
200	8"	Class 150	8 x 3/4"	107	80
250	10"	Class 150	12 x 7/8"	101	75
300	12"	Class 150	12 x 7/8"	133	103
350	14"	Class 150	12 x 1"	135	158
400	16"	Class 150	16 x 1"	128	150
450	18"	Class 150	16 x 1 1/8"	204	234
500	20"	Class 150	20 x 1 1/8"	183	217
600	24"	Class 150	20 x 1 1/4"	268	307

Promag W Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	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 [mm]	AS 2129 Pressure rating	Threaded fasteners	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	12 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	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
80	Cl.14	4 x M 16	49
100*	Cl.14	8 x M 16	38
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
* Designed acc. to AS 2129 (not to AS 4087)			

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* the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

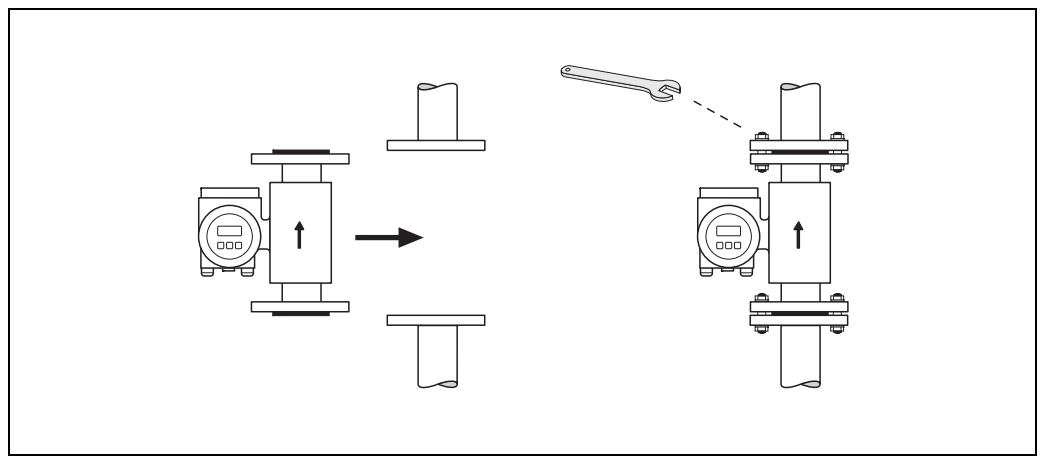


Note!

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

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

- Observe in any case the necessary screw tightening torques on Page 36 ff.
- The mounting of additional ground disks is described on Page 34.



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Fig. 20: Installing the Promag P sensor

Seals

Comply with the following instructions when installing seals:

- Measuring tube linings 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...600)

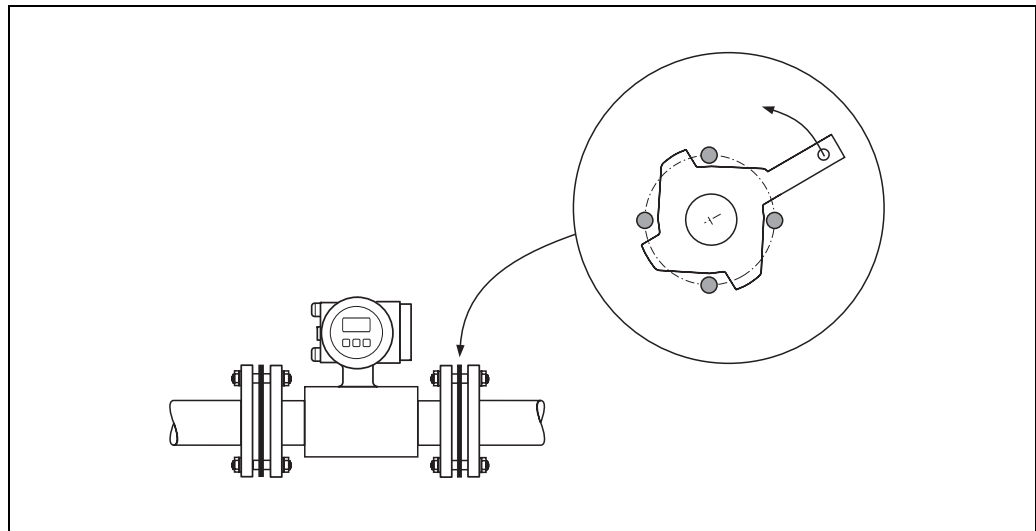
If necessary, a special ground cable for potential equalisation can be ordered as an accessory (see Page 101). Detailed assembly instructions → Page 57 ff.

Assembly with ground disks (DN 15...300)

Depending on the application, e.g. with lined or ungrounded pipes (see Page 56 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for the potential equalisation. Ground disks can be ordered separately as an accessory from Endress+Hauser (see Page 101).

**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 the additional seal between the instrument and the pipe flange (Fig. 21).
 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. 21 until the handle strikes the bolts. This will center the ground disk automatically.
 4. Now tighten the bolts to the required torque (see Page 36 ff.)
 5. Connect the ground disk to ground → Page 58.



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Fig. 21: Assembly with ground disks (Promag P, DN 15...300)

Installing the high-temperature version (with PFA lining)

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



Note!

You will find information on permissible temperature ranges on → Page 130

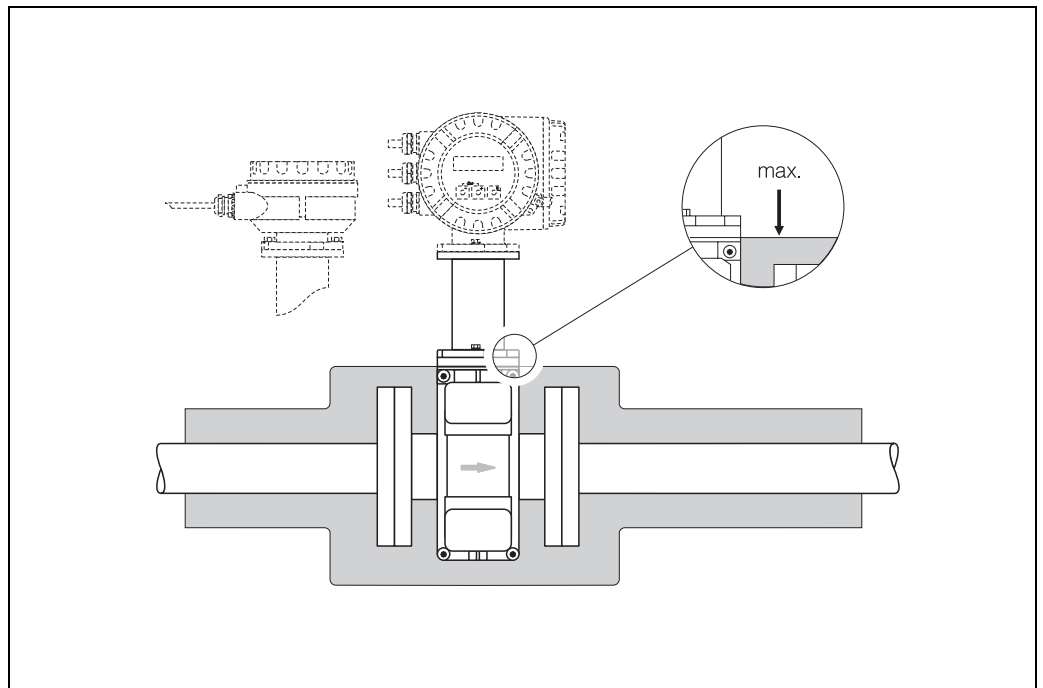
Insulation

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



Caution!

Risk of measuring electronics overheating. The housing support dissipates heat and its entire surface area must remain uncovered. Make sure that the sensor insulation does not extend past the top of the two sensor shells (Fig. 22).



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

Tightening torques for threaded fasteners (Promag P)

Note the following points:

- The tightening torques listed below are for lubricated threads only.
- Always tighten threaded fasteners 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]	Threaded fasteners	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	–

Promag P Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
500	PN 25	20 x M 33	533	—
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 [mm] [inch]		ANSI Pressure rating [lbs]	Threaded fasteners	Max. tightening torque [Nm]	
				PTFE	PFA
15	1/2"	Class 150	4 x 1/2"	6	—
15	1/2"	Class 300	4 x 1/2"	6	—
25	1"	Class 150	4 x 1/2"	11	10
25	1"	Class 300	4 x 5/8"	14	12
40	1 1/2"	Class 150	4 x 1/2"	24	21
40	1 1/2"	Class 300	4 x 3/4"	34	31
50	2"	Class 150	4 x 5/8"	47	44
50	2"	Class 300	8 x 5/8"	23	22
80	3"	Class 150	4 x 5/8"	79	67
80	3"	Class 300	8 x 3/4"	47	42
100	4"	Class 150	8 x 5/8"	56	50
100	4"	Class 300	8 x 3/4"	67	59
150	6"	Class 150	8 x 3/4"	106	86
150	6"	Class 300	12 x 3/4"	73	67
200	8"	Class 150	8 x 3/4"	143	109
250	10"	Class 150	12 x 7/8"	135	—
300	12"	Class 150	12 x 7/8"	178	—
350	14"	Class 150	12 x 1"	260	—
400	16"	Class 150	16 x 1"	246	—
450	18"	Class 150	16 x 1 1/8"	371	—
500	20"	Class 150	20 x 1 1/8"	341	—
600	24"	Class 150	20 x 1 1/4"	477	—

Promag P Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	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	–

Promag P Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	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	Threaded fasteners	Max. tightening torque [Nm]
			PTFE
50	Cl.14	4 x M 16	42

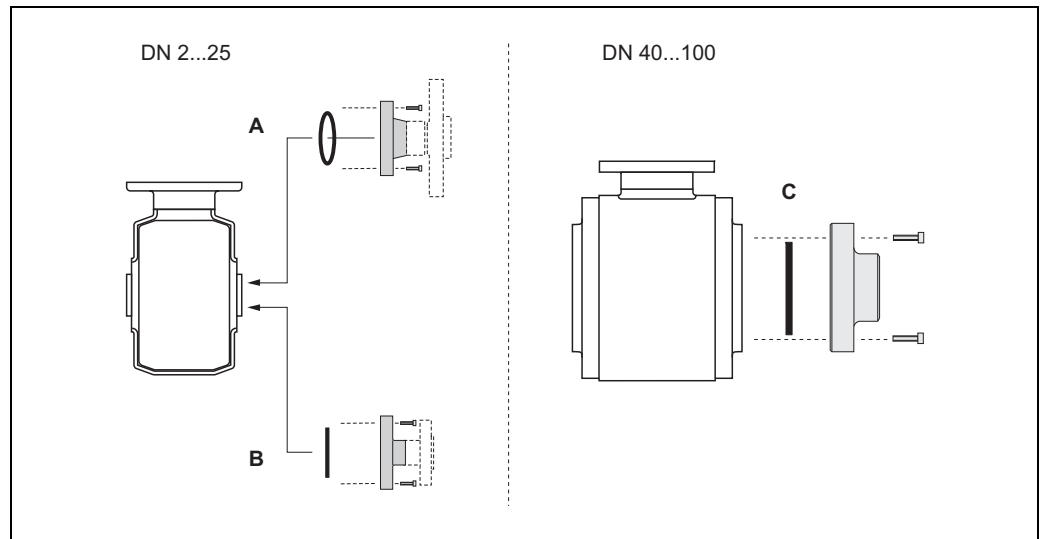
3.3.3 Installing the Promag H sensor

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



Caution!

- The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory (see Page 102).



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Fig. 23: Promag H process connections (DN 2...25, DN 40...100)

A: DN 2...25 / process connections with O-rings:

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

B: DN 2...25 / process connections with aseptic gasket seals:

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

C: DN 40...100 / process connections with aseptic gasket seals:

Weld nipples (DIN 11850, ODT / SMS), Clamp (ISO 2852, DIN 32676), L14 AM7, coupling (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flange DIN 11864-2

Seals

When installing the process connections, make sure that the seals are clean and correctly centered.



Caution!

- With metallic process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm).
With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)! The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.
Replacement seals can be ordered as accessories → Page 101.

Usage and assembly of ground rings (DN 2...25)

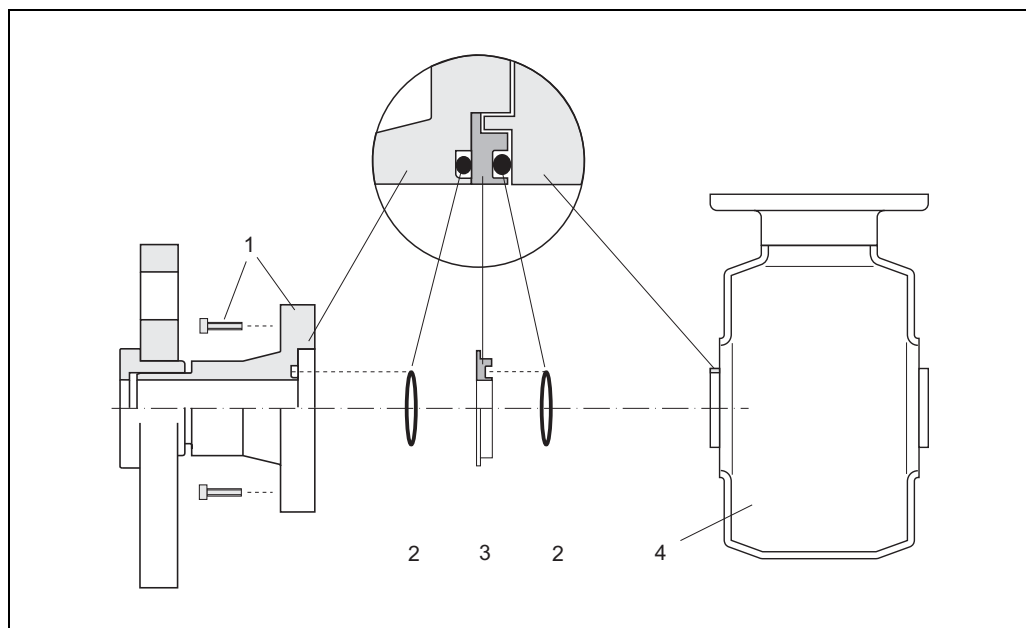
In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalised using additional ground rings.

If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the 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 equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic disks/seals must not be removed, or must always be installed.
 - Ground rings can be ordered separately from Endress+Hauser as accessories (see Page 101). When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information about the materials can be found on Page 136.
 - Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected.
1. Loosen the four hexagonal headed bolts (1) and remove the process connection from the sensor (5).
 2. Remove the plastic disk (3), including the two O-ring seals (2, 4).
 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 (4) 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).



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Fig. 24: Installing ground rings with a Promag H (DN 2...25)

1 = Hexagonal headed bolts (process connection)

2 = O-ring seals

3 = Ground ring or plastic disk (placeholder)

4 = Sensor Promag H

Welding the sensor into the piping (weld nipples)



Caution!

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

1. Tack-weld the Promag H sensor into the pipe. A suitable welding jig can be ordered separately from Endress+Hauser as an accessory (see Page 102).
2. Remove the threaded fasteners from the process-connection flange. Remove the sensor complete with seal from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.



Note!

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

Cleaning with pigs

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

3.3.4 Turning the transmitter housing

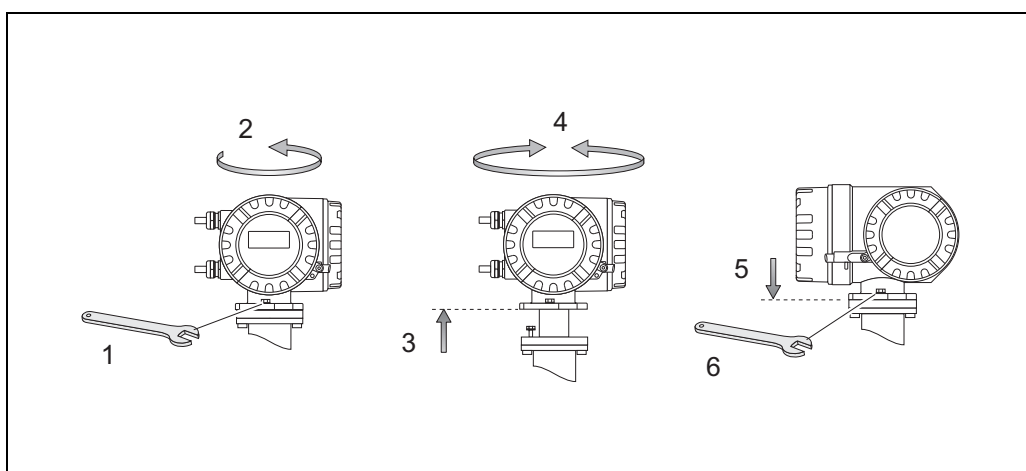
Turning the aluminum field housing



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 re-engage the bayonet catch.
6. Retighten the two securing screws.

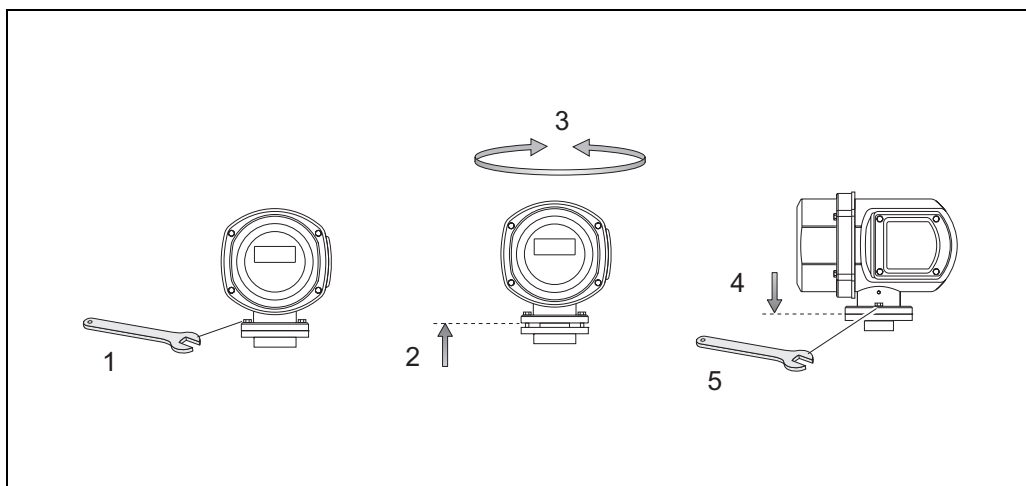


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Fig. 25: Turning the transmitter housing (aluminum field housing)

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.

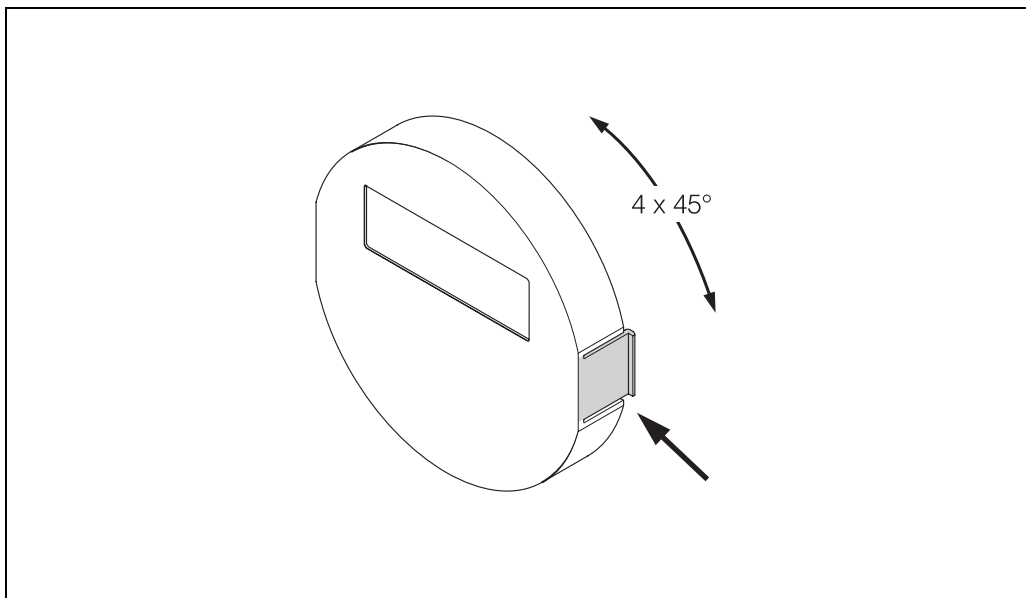


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Fig. 26: Turning the transmitter housing (stainless-steel field housing)

3.3.5 Turning the local display

1. Remove the cover of the electronics compartment.
2. Press the side latches on the display module and remove it from the electronics compartment cover plate.
3. Rotate the display to the desired position (max. 4 x 45° in each direction), and place it back into the electronics compartment cover plate.
4. Screw the cover of the electronics compartment firmly onto the transmitter housing.



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

3.3.6 Installing the wall-mount transmitter housing

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

- Mounted directly on the wall
- Installation in control panel (with separate mounting kit, accessories → Page 101)
- Pipe mounting (with separate mounting kit, accessories → Page 101)

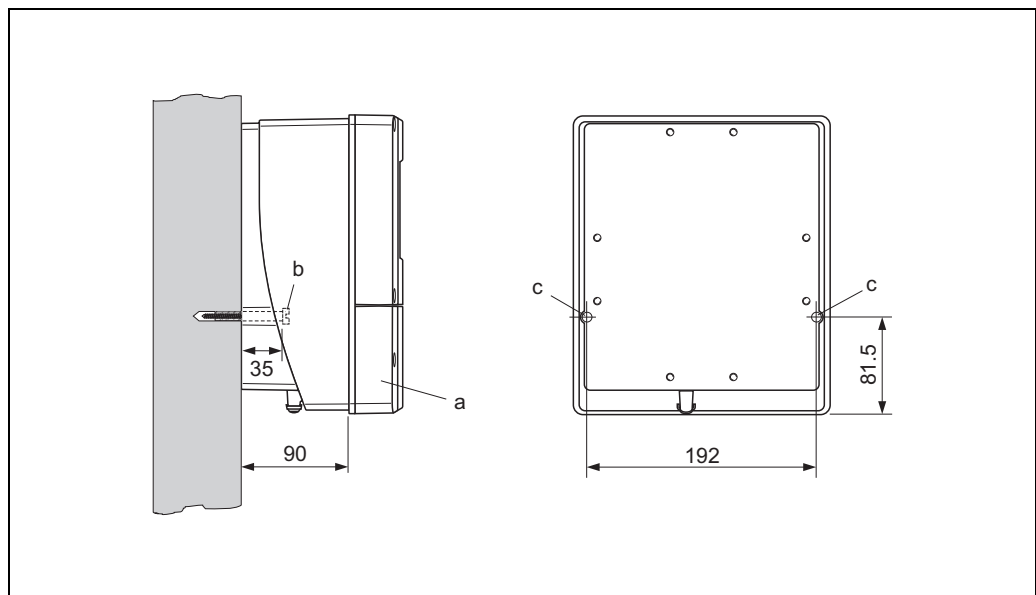


Caution!

- Make sure that ambient temperature does not exceed the permissible range ($-20...+60\text{ }^{\circ}\text{C}$), (optional $-40...+60\text{ }^{\circ}\text{C}$). Install the device at a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Direct wall mounting

1. Drill the holes as illustrated in Fig. 28.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
 - Securing screws (M6): max. $\varnothing$ 6.5 mm
 - Screw head: max. $\varnothing$ 10.5 mm
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

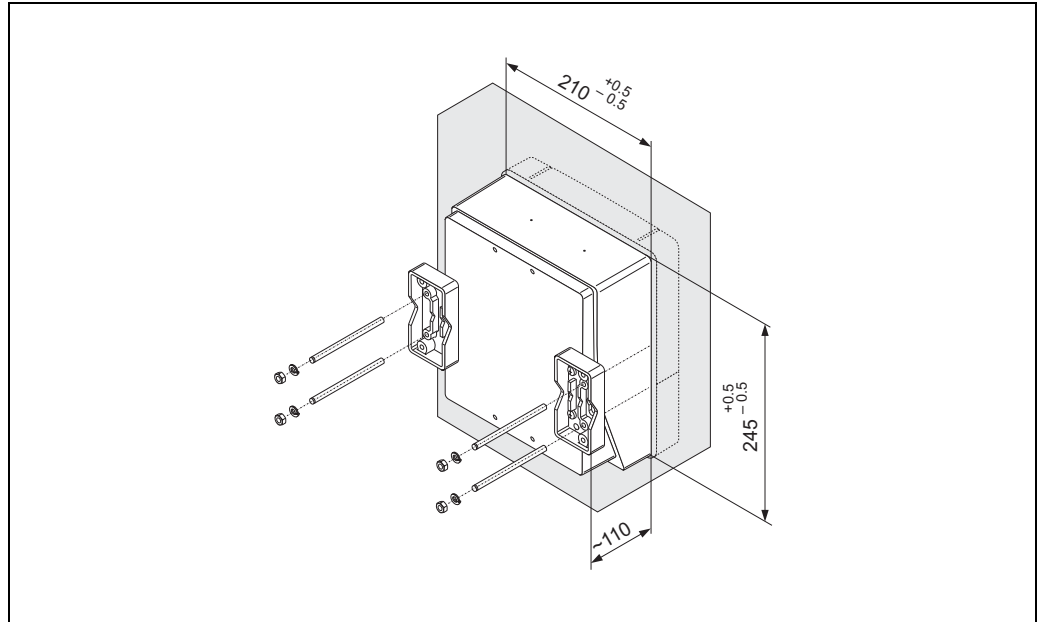


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Fig. 28: Mounted directly on the wall

Panel installation

1. Prepare the opening in the panel (Fig. 29).
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Place the threaded rods in the fasteners and screw them down until the housing is seated tightly against the panel. Afterwards, tighten the locking nuts. Additional support is not necessary.



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

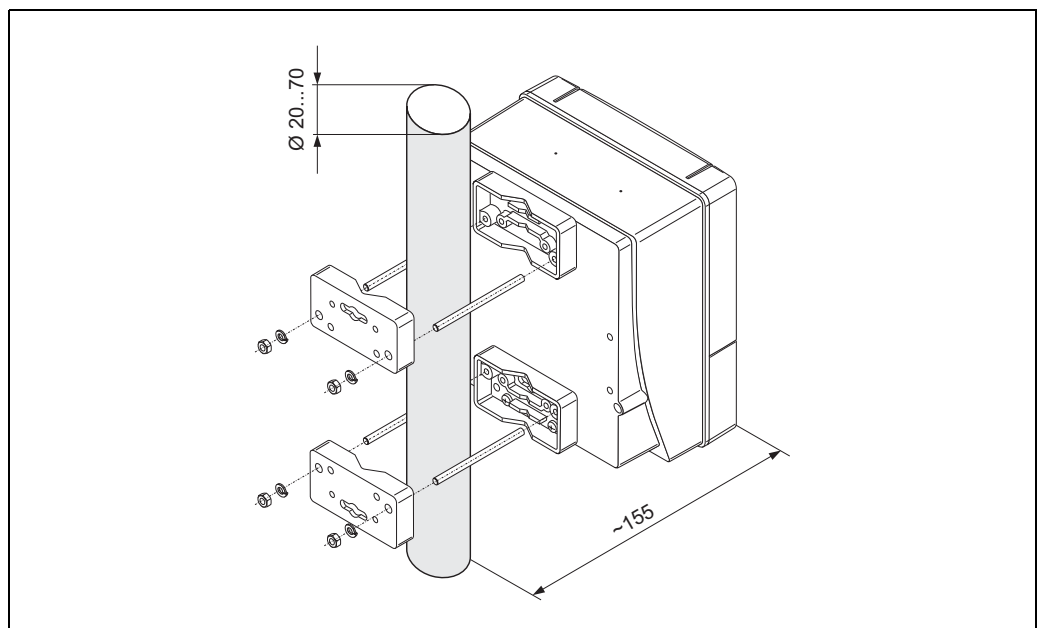
Pipe mounting

The assembly should be performed by following the instructions in Fig. 30.



Caution!

If the device is mounted to a warm pipe, make certain that the housing temperature does not exceed +60 °C, which is the maximum permissible temperature.



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

3.4 Installation check

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

Device condition and 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.?	see Page 125 ff.
Installation	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	–
Is the plane of the measuring-electrode axis correct?	Horizontal
Is the position of the Empty Pipe Detection (EPD) electrode correct?	see Page 17
Were all threaded fasteners tightened to the specified torques when the sensor was installed?	see Section 3.3
Were the correct seals installed (type, material, installation)?	Promag W → Page 26 Promag P → Page 33 Promag H → Page 39
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 (see Page 129)

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 representative if you have any questions.
- If you use remote versions, connect each sensor *only* to the transmitter having the same serial number. Measuring errors can occur if the devices are not connected in this way.

4.1 Connecting the remote version

4.1.1 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 the electronics.
- Risk of electric shock. Connect the protective conductor 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 cover (a) from the connection compartment.
2. Sensor: Remove cover (b) from the connection housing.
3. Feed signal cable (c) and coil current cable (d) through the appropriate cable entries.



Caution!

- Make sure the connecting cables are secured (see Page 25).
- Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil cable.

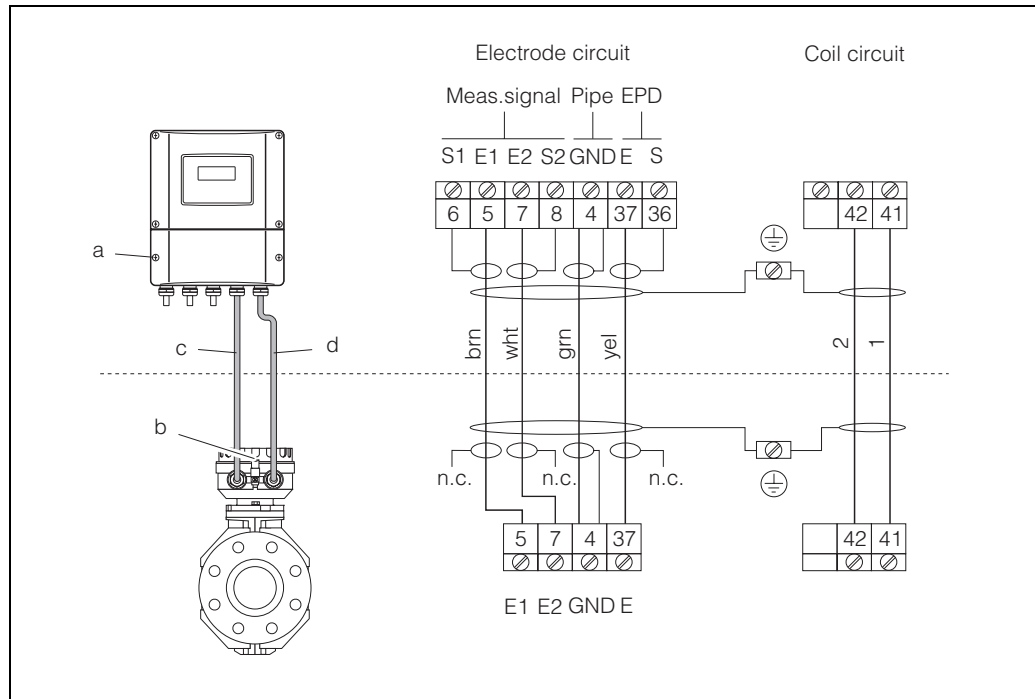
4. Preterminate signal cable and coil current cable:
 Promag W, P → Refer to the information on Page 49
 Promag H → Refer to the information on Page 50
5. Establish the connections between sensor and transmitter in accordance with the wiring diagram:
 → Fig. 31, Fig. 32
 → wiring diagram inside the cover



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.

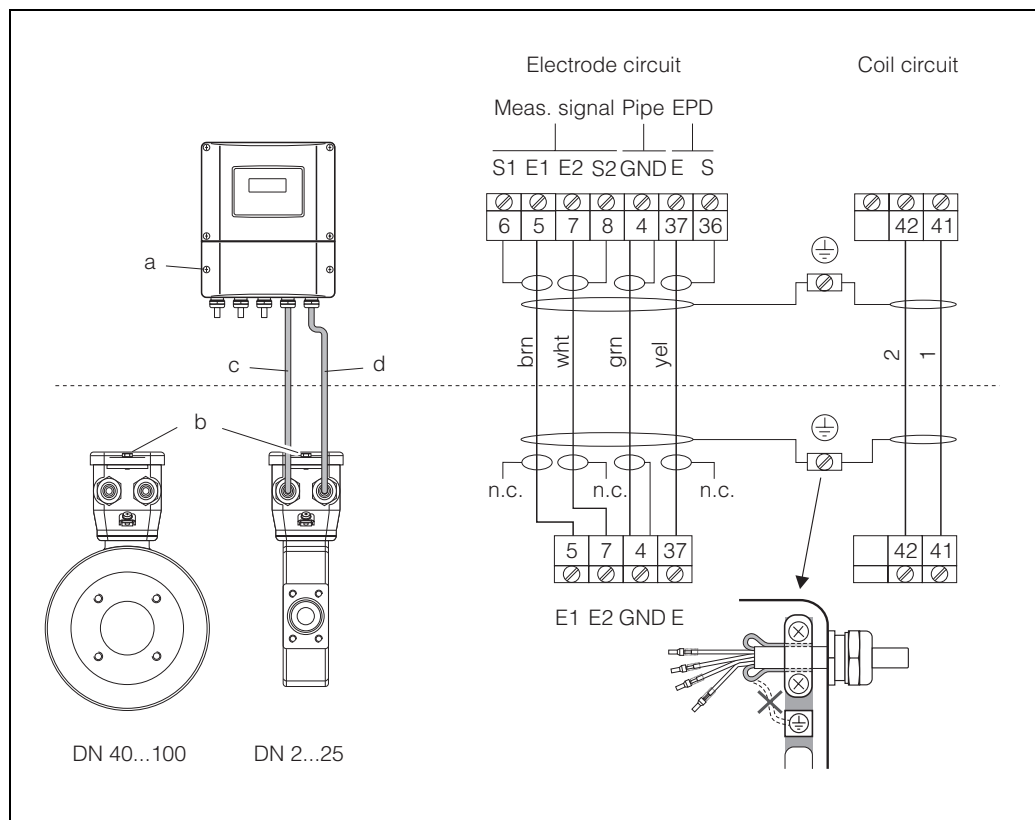
6. Transmitter: Secure cover (a) on the connection compartment.
7. Sensor: Secure cover (b) on the connection housing.



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

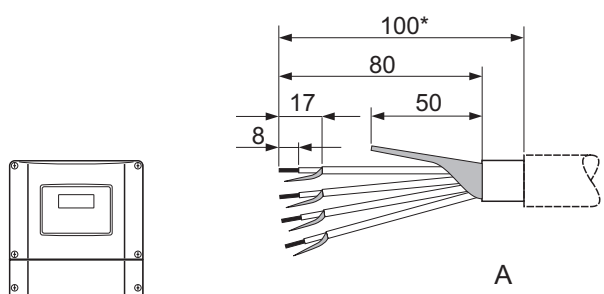
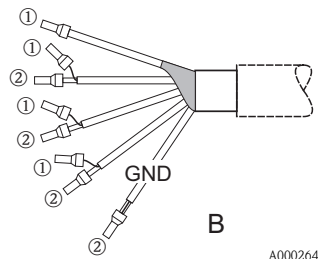
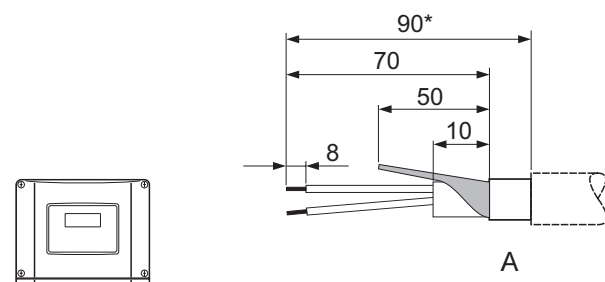
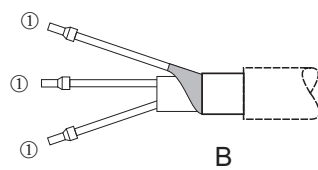
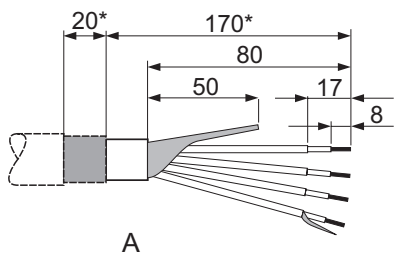
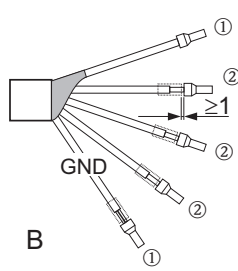
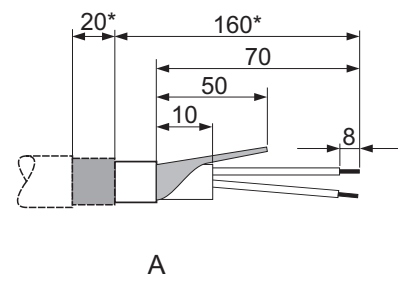
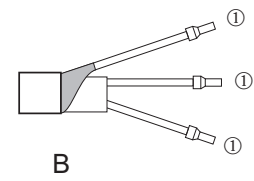
a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields



F06-5xHxxxxx-04-xx-xx-en-000

Fig. 32: Connecting the remote version of Promag H

a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields

Cable termination for 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 cable end sleeves (Detail B).	
 Caution! When fitting the connectors, pay attention to the following points: ■ <i>Signal cable</i> → Make sure that the cable end sleeves do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception “GND” = green cable). ■ <i>Coil current cable</i> → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.	
TRANSMITTER	
Signal cable	Coil current cable
  A0002643	  A0002644
SENSOR	
Signal cable	Coil current cable
  A0002646	  A0002645
① = Red cable sleeves Ø 1.0 mm ② = White cable sleeves Ø 0.5 mm * = Stripping for armoured cables only	

Cable termination for 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!

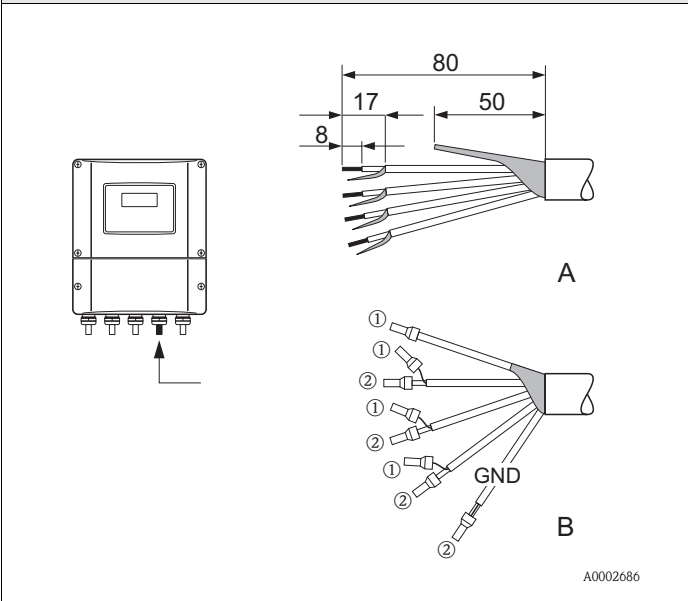
When fitting the connectors, pay attention to the following points:

- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side.
Minimum distance = 1 mm (exception “GND” = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

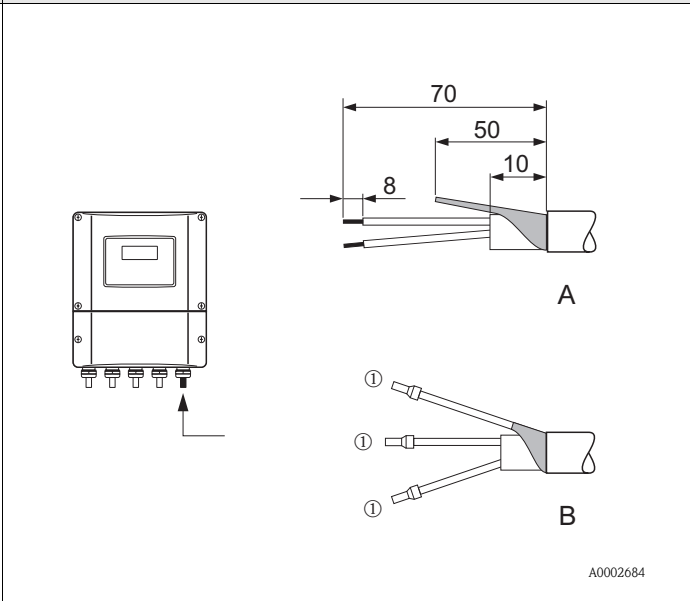
TRANSMITTER

Signal cable

Coil current cable



A0002686

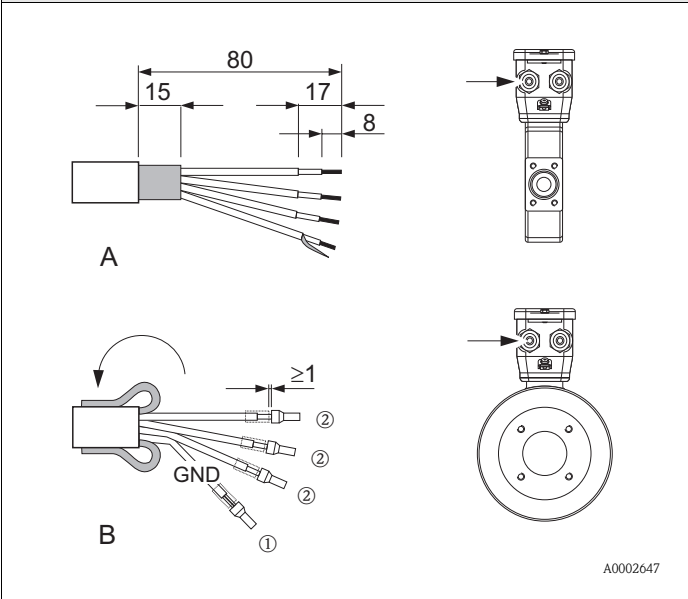


A0002684

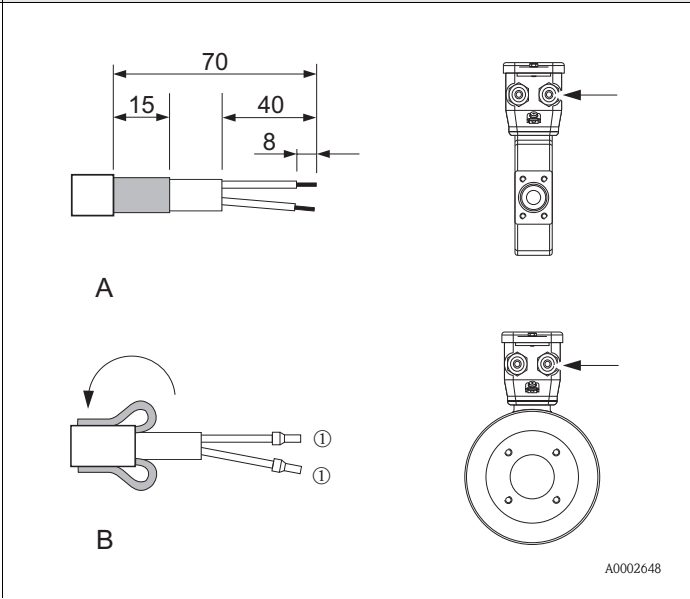
SENSOR

Signal cable

Coil current cable



A0002647



A0002648

- ① = Red cable sleeves Ø 1.0 mm
- ② = White cable sleeves Ø 0.5 mm

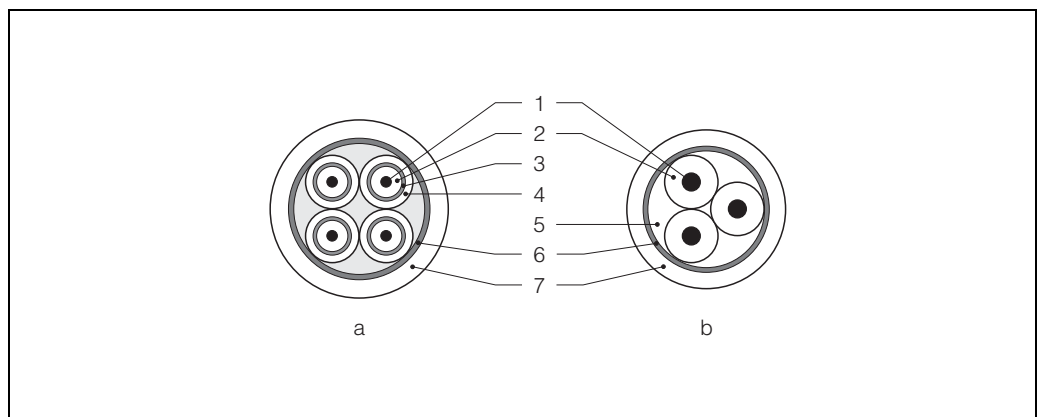
4.1.2 Cable specifications

Coil cable

- 2 x 0.75 mm² PVC cable with common, braided copper shield (Ø approx. 7 mm)
- Conductor resistance: $\leq 37 \Omega/\text{km}$
- Capacitance: core/core, shield grounded: $\leq 120 \text{ pF/m}$
- Permanent operating temperature: $-20\dots+80^\circ\text{C}$
- Cable cross-section: max. 2.5 mm²

Signal cable:

- 3 x 0.38 mm² PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 x 0.38 mm² PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores
- Conductor resistance: $\leq 50 \Omega/\text{km}$
- Capacitance: core/shield: $\leq 420 \text{ pF/m}$
- Permanent operating temperature: $-20\dots+80^\circ\text{C}$
- Cable cross-section: max. 2.5 mm²



F06-5xWxxxxx-04-11-08-xx-003

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, the EMC requirements of EN 61326/A1, 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.

4.2 Connecting the measuring unit

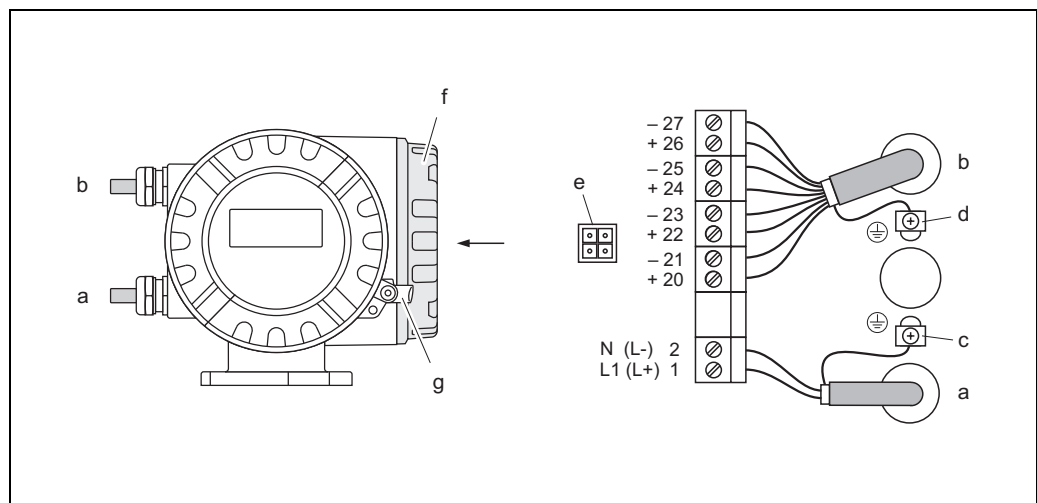
4.2.1 Transmitter



Warning!

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

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and signal cables (b) through the appropriate cable entries.
3. Connect the cables in accordance with the wiring diagram:
 - Wiring diagram (aluminium housing) → Fig. 34
 - Wiring diagram (stainless steel housing) → Fig. 35
 - Wiring diagram (wall-mount housing) → Fig. 36
 - Terminal assignment → Page 54
4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.



F06-xxxxxxxx-04-06-xx-xx-005

Fig. 34: Connecting the transmitter (aluminium field housing). Cable cross-section: max. 2.5 mm²

- a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal **No. 1**: L1 for AC, L+ for DC
Terminal **No. 2**: N for AC, L- for DC
- b Signal cable: Terminals **Nos. 20–27** → Page 54
- c Ground terminal for protective conductor
- d Ground terminal for signal cable shield
- e Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool – Fieldtool Package)
- f Cover of the connection compartment
- g Securing clamp

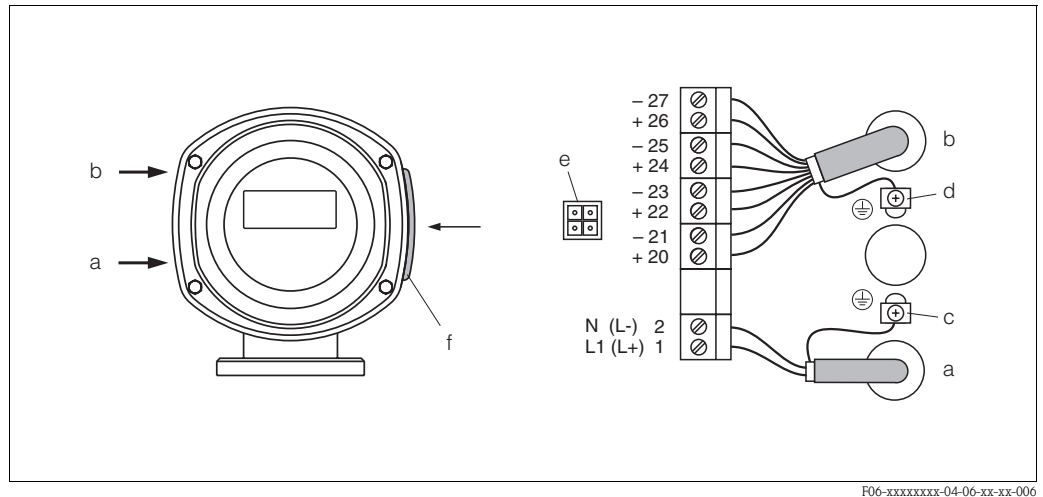


Fig. 35: Connecting the transmitter (stainless-steel field housing). Cable cross-section: max. 2.5 mm²

- a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal **No. 1**: L1 for AC, L+ for DC
Terminal **No. 2**: N for AC, L- for DC
- b Signal cable: Terminals **Nos. 20–27** → Page 54
- c Ground terminal for protective conductor
- d Ground terminal for signal cable shield
- e Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool – Fieldtool Package)
- f Cover of the connection compartment

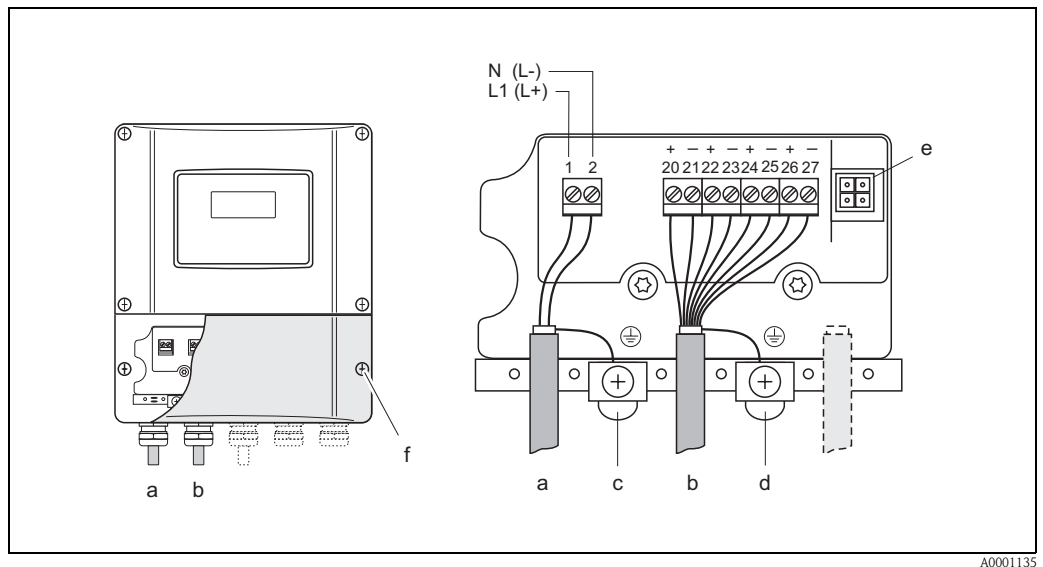


Fig. 36: Connecting the transmitter (wall-mount housing). Cable cross-section: max. 2.5 mm²

- a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal **No. 1**: L1 for AC, L+ for DC
Terminal **No. 2**: N for AC, L- for DC
- b Signal cable: Terminals **Nos. 20–27** → Page 54
- c Ground terminal for protective conductor
- d Ground terminal for signal cable shield
- e Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool – Fieldtool Package)
- f Cover of the connection compartment

4.2.2 Terminal assignment

Order variant	Terminal No. (inputs / outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (-)
<i>Fixed communication boards (fixed assignment)</i>				
53***_***** A	–	–	Frequency output	Current output HART
53***_***** B	Relay output	Relay output	Frequency output	Current output HART
53***_***** S	–	–	Frequency output Ex i	Current output Exi active, HART
53***_***** T	–	–	Frequency output Ex i	Current output Exi passive, HART
<i>Flexible communication boards</i>				
53***_***** C	Relay output	Relay output	Frequency output	Current output HART
53***_***** D	Status input	Relay output	Frequency output	Current output HART
53***_***** L	Status input	Relay output	Relay output	Current output HART
53***_***** M	Status input	Frequency output	Frequency output	Current output HART
53***_***** 2	Relay output	Current output	Frequency output	Current output HART
53***_***** 4	Current input	Relay output	Frequency output	Current output HART
53***_***** 5	Status input	Current input	Frequency output	Current output HART
<i>Status input (Auxiliary input)</i> galvanically isolated, 3...30 V DC, $R_i = 5 \text{ k}\Omega$ <i>Current input (active/passive)</i> galvanically isolated, full scale value selectable active: 0/4...20 mA, $R_i \leq 150 \Omega$, max. 24 V DC, short-circuit proof passive: 4...20 mA, max. 30 V DC, $R_i < 150 \Omega$ <i>Relay output</i> max. 60 V DC / 0.1 A; max. 30 V AC / 0.5 A; freely configurable <i>Frequency output (active/passive)</i> galvanically isolated, limit frequency 2...10000 Hz ($f_{\max} = 12500 \text{ Hz}$) active: 24 V DC, 25 mA (max. 250 mA/20 ms); passive: 30 V DC, 250 mA, Open Collector <i>Current output (active/passive)</i> galvanically isolated, active: 0/4...20 mA, $R_L < 700 \Omega$ (HART: $R_L \geq 250 \Omega$) passive: 4...20 mA, supply voltage V_s: 18...30 V DC, $R_i \geq 150 \Omega$ Ground connection, power supply → Page 52 ff.				

4.2.3 HART connection

Users have the following connection options at their disposal:

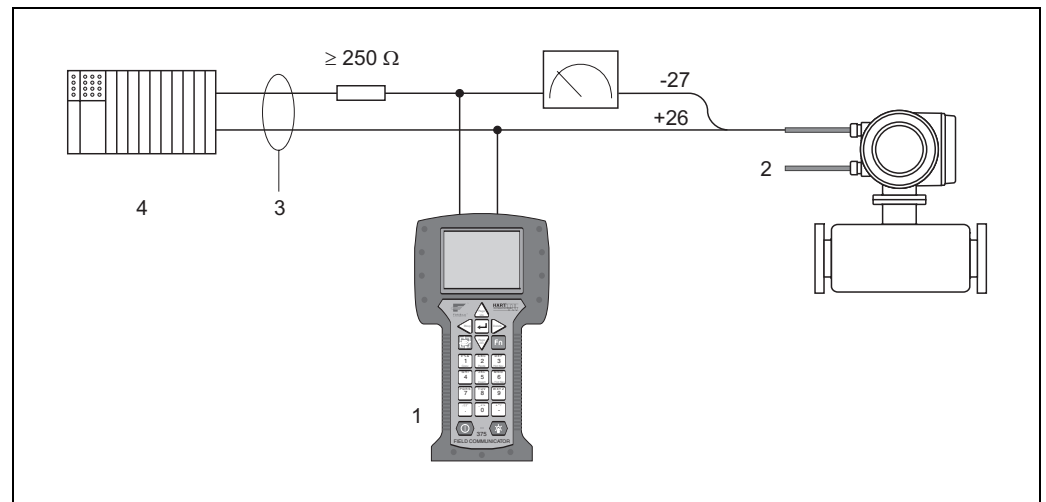
- Direct connection to transmitter by means of terminals 26(+) / 27(-)
- Connection by means of the 4...20 mA circuit



Note!

- The measuring loop's minimum load must be at least 250 Ω .
- After commissioning, make the following settings:
 - CURRENT SPAN function → “4–20 mA HART” or “4–20 mA (25 mA) HART”
 - Switching HART write protection on or off (see Page 82)
- See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: “HART, a technical summary”.

Connection of the HART handheld communicator



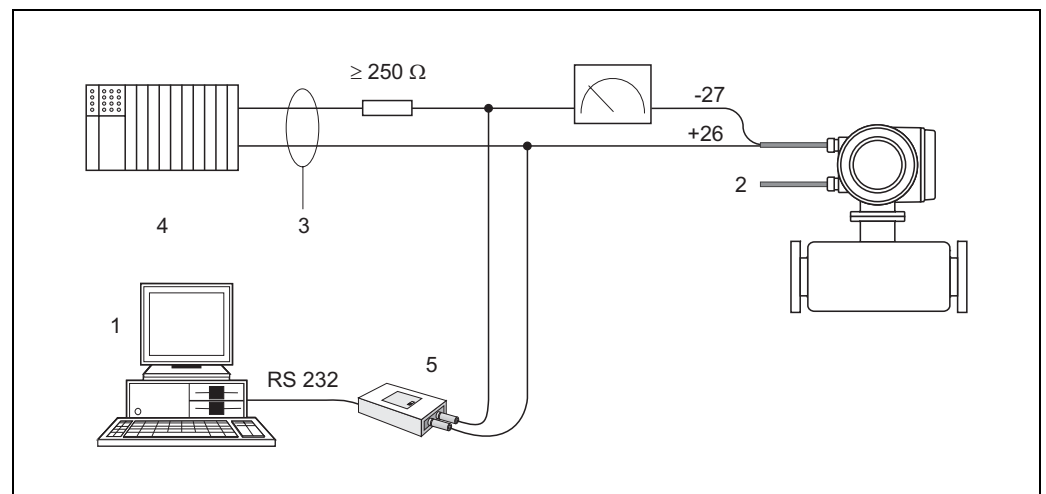
F06-xxxxxxx-04-xx-xx-xx-007

Fig. 37: Electrical connection of the HART handheld communicator:

1 = HART communicator, 2 = power supply, 3 = shield, 4 = other evaluation devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with an operating software (e.g. “ToF Tool – Fieldtool Package”), a HART modem (e.g. “Commubox FXA 191”) is needed.



F06-xxxxxxx-04-xx-xx-xx-008

Fig. 38: Electrical connection of a PC with an operating software:

1 = PC with an operating software, 2 = power supply, 3 = shield, 4 = other evaluation devices or PLC with passive input, 5 = HART modem, e.g. Commubox FXA 191

4.3 Potential equalisation

4.3.1 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 connection. 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.

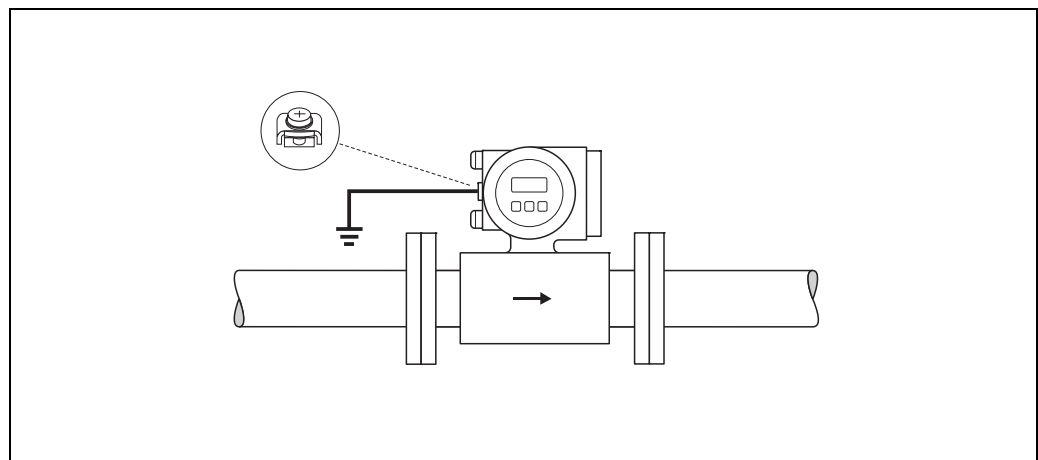
Promag H:

- 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 equalised (see Page 40). Ground rings can be ordered with the main product structure or as accessories → Page 101.



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.



F06-5xxxxxxx-04-xx-xx-xx-002

Fig. 39: Potential equalisation by means of the transmitter's ground terminal



Caution!

For sensors without reference electrodes or without metal process terminals, carry out potential equalisation 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.

4.3.2 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 (Fig. 40).



Caution!

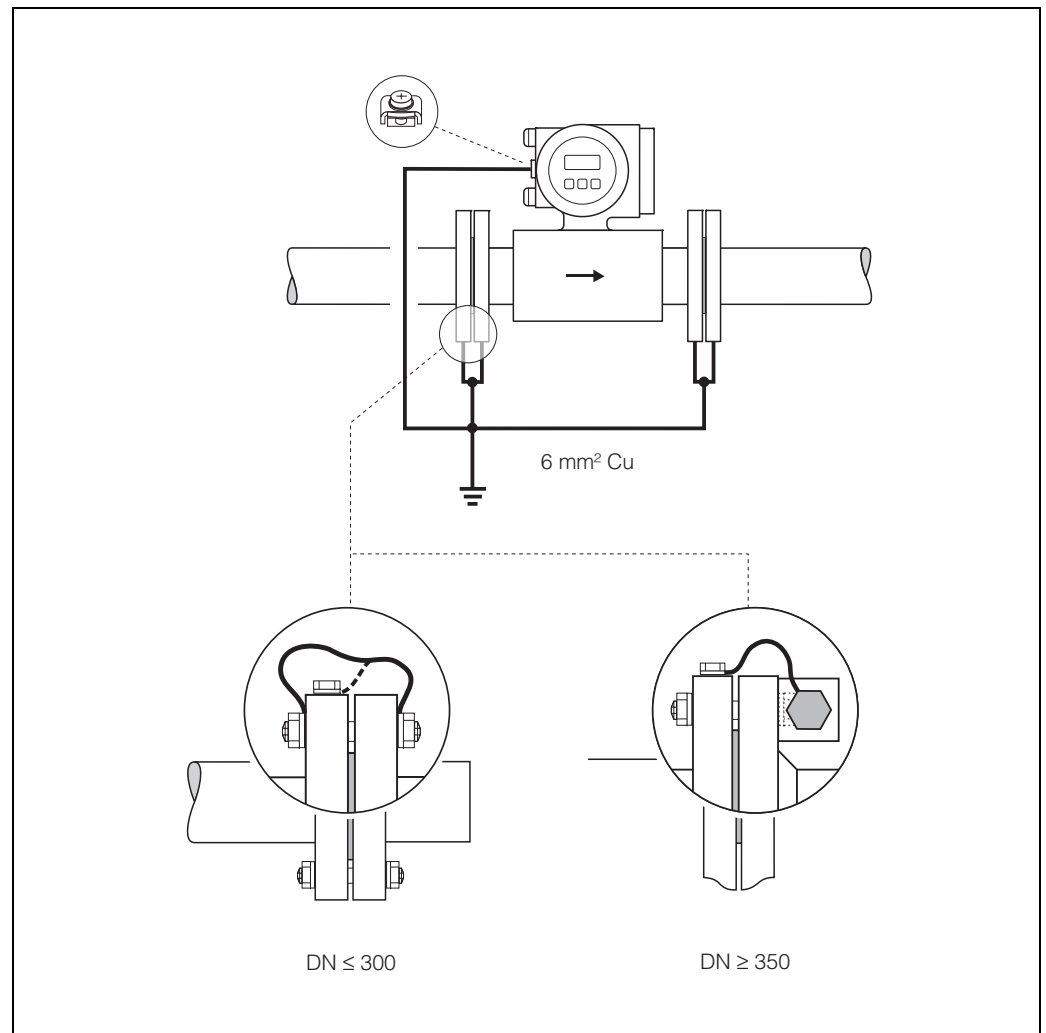
Also, observe company-internal grounding guidelines.



Note!

The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser (see Page 101):

- $DN \leq 300$: The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.
- $DN \geq 350$: The ground cable connects directly to the metal transport bracket.



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Fig. 40: Potential equalisation with equalising currents in metallic, non-grounded piping systems

Plastic pipes and isolating lined pipes

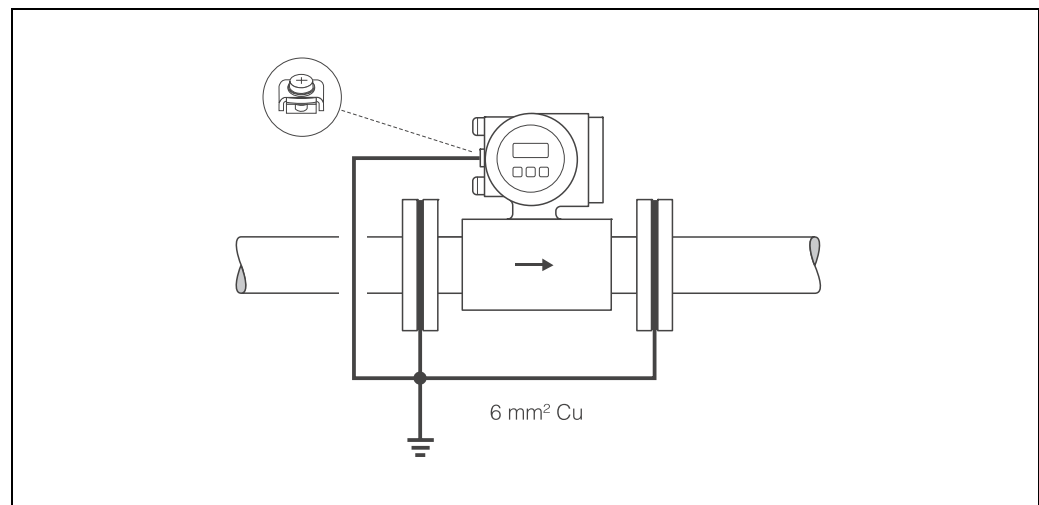
Normally, potential is matched using the reference electrodes in the measuring tube. However, in exceptional cases it is possible that, due to the grounding plan of a system, large matching currents flow over the reference electrodes. This can lead to destruction of the sensor, e.g. through electrochemical decomposition of the electrodes. In such cases, e.g. for fibre-glass or PVC piping, it is recommended that you use additional ground disks for potential matching (Fig. 41).

Mounting of ground disks → Page 27, 34



Caution!

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



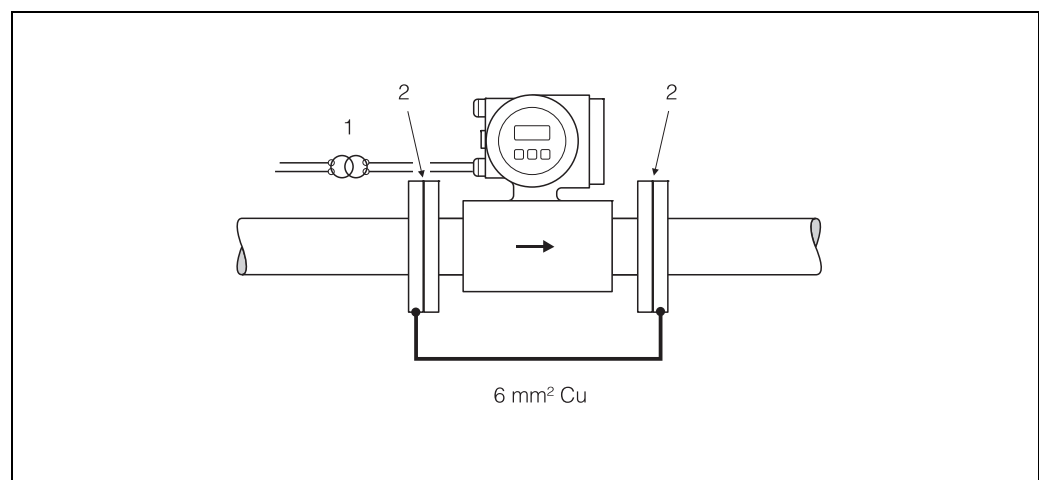
F06-5xxxxxxx-04-xx-xx-xx-004

Fig. 41: Potential equalisation/ground disks with plastic pipes or lined pipes

Lined pipes (cathodic protection)

In such cases, install the measuring instrument 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 mm²).
- 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 threaded fasteners are tightened.
- Also comply with the regulations applicable to potential-free installation.



F06-5xxxxxxx-04-xx-xx-xx-005

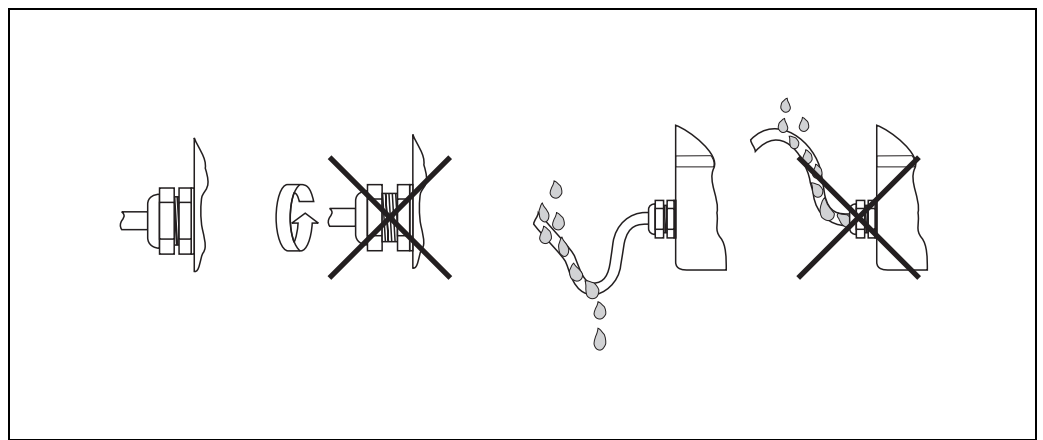
Fig. 42: Potential equalisation and cathode protection

1 = isolating transformer power supply, 2 = electrically insulated

4.4 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 threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter (see Page 127).
- Firmly tighten the cable entries (Fig. 43).
- The cables must loop down before they enter the cable entries ("water trap", Fig. 43). 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.



F06-5xxxxxxx-04-xx-xx-xx-005

Fig. 43: Installation instructions, cable entries



Caution!

Do not loosen the threaded fasteners of the Promag 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). In this case the transmitter must be installed remote from the sensor.

4.5 Electrical connection check

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

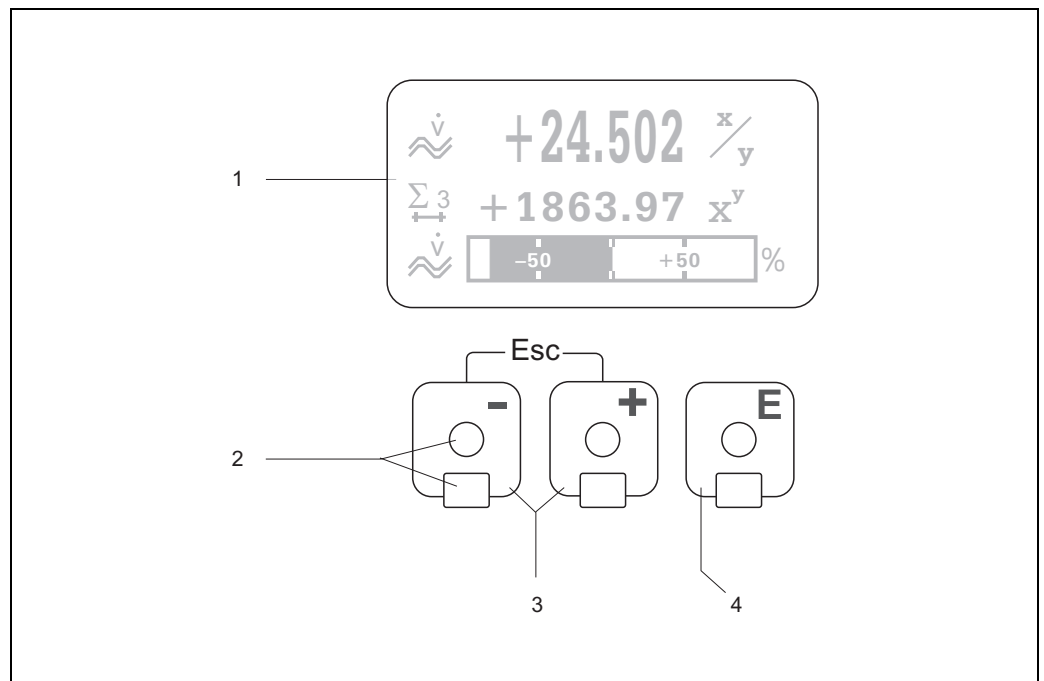
Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85...260 V AC (45...65 Hz) 20...55 V AC (45...65 Hz) 16...62 V DC
Do the cables comply with the specifications?	see Page 51, 127
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 terminal compartment
Are all screw terminals firmly tightened?	–
Have the measures for grounding/potential equalisation been correctly implemented?	see Page 56 ff.
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as “water traps”?	see Page 59
Are all housing covers installed and firmly tightened?	–

5 Operation

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



A0001172

Fig. 44: Display and operating elements

Liquid-crystal display (1)

The backlit, four-line liquid-crystal display shows measured values, dialog texts and both system and process error messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).

Optical sensors for Touch Control (2)

Plus / Minus keys (3)

- HOME position → Direct access to totalizer values and actual values of inputs/outputs
- Enter numerical values, select parameters
- Select different blocks, groups or 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

Enter key (4)

- HOME position → Entry into the function matrix
- Save the numerical values you input or settings you change

Display (operation mode)

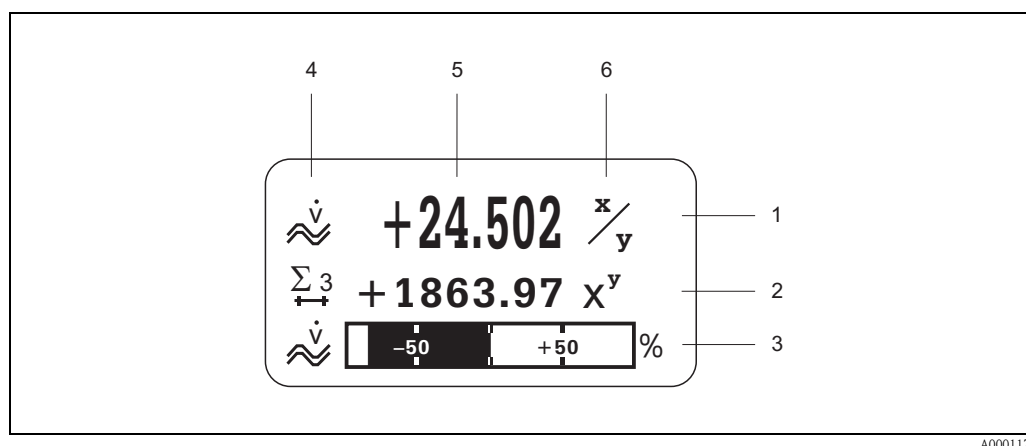
The display area consists of three lines in all; this is where measured values are displayed, and/or status variables (direction of flow, partially filled pipe, bargraph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and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

Multiplex mode:

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

Error messages:

The display modes for system and process error messages are described in detail on Page 67 ff.



A0001173

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

- 1 Main line shows primary measured values, e.g. volume flow in [l/s].
- 2 Supplementary line shows supplementary measured variables, e.g. totalizer No. 3 in [m³]
- 3 Information line shows additional information on the measured variables, e.g. bar graph of the limit value reached by the volume flow.
- 4 “Info icons” field: Icons representing additional information on the measured values are shown in this field. See Page 63 for a full list of the icons and their meanings.
- 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.

Additional display functions

Depending on the order options, the local display has different display functions:

Device without batching software:

From HOME position, use the +/- keys to open an “Info Menu” containing the following information:

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

 → Scan of individual values within the Info Menu

 (Esc key) → Back to HOME position

Device with batching software:

On measuring instruments with installed batching software (F-CHIP, see Page 101) 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 64.

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.

Symbol	Meaning	Symbol	Meaning
S	System error	P	Process error
\$	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
I 1...n	Current output 1...n, Current input	P 1...n	Pulse output 1...n
F 1...n	Frequency output 1...n	S 1...n	Status-/relay output 1...n (or status input)
Σ 1...n	Totalizer 1...n		
 a0001181	Measuring mode: PULSATING FLOW	 a0001182	Measuring mode: SYMMETRY (bidirectional)
 a0001183	Measuring mode: STANDARD	 a0001184	Counting mode totalizer: BALANCE (forward and reverse flow)
 a0001185	Counting mode totalizer: forward	 a0001186	Counting mode totalizer: reverse
 a0001187	Signal input (current or status input)		
 a0001188	Volume flow	 a0001195	Mass flow
 a0001207	Fluid temperature	 a0001200	Fluid density
 a0001201	Batching quantity upwards	 a0001202	Batching quantity downwards
 a0001203	Batching quantity	 a0001204	Total batching quantity
 a0001205	Batch counter (x times)	 a0001206	Remote configuration Active device operation via: ■ HART, e.g. ToF Tool - Fieldtool Package, DXR 375 ■ FOUNDATION Fieldbus ■ PROFIBUS, e.g. Commuwin II

Controlling the batching processes using the local display

With measuring instruments with suitable software, you can carry out batching processes directly using the local display. Therefore, the Promag 53 can be fully deployed in the field as a “batch controller”.

Procedure:

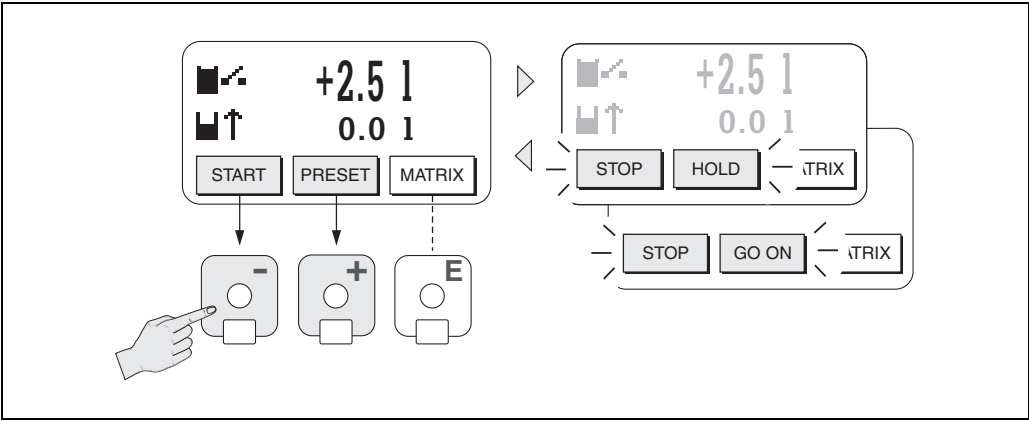
- 1. Configure all the required batching functions and assign the lower display info line (= BATCHING KEYS) using the “Batch” Quick Setup menu or use the function matrix. The following “softkeys” then appear on the bottom line of the local display (Fig. 46):
 - START = left display key (–)
 - PRESET = 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 liquid (BATCH #1...6)
7203	BATCH QUANTITY	If the “ACCESS CUSTOMER” option was selected for the “PRESET batch quantity” prompt in the “Batching” Quick Setup, the batching quantity can be altered via the local display. If the “LOCKED” option was selected, the batching quantity can only be read and cannot be altered until the private code has been entered.
7265	RESET TOTAL BATCH SUM/COUNTER	Resets the batching quantity counter or the total batching quantity to “0”.

- 3. After exiting the PRESET menu, you can now start the batching process by pressing “START (–)”. New softkeys (STOP / HOLD or GO ON) now appear on the display. You can use these to interrupt, continue or stop the batching process at any time (Fig. 46):

STOP (–) → Stop 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.



F06-x3xxxxxx-07-xx-xx-xx-005

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

5.2 Brief operating instruction to the function matrix



Note!

- See the general notes on Page 66.
- Function descriptions → see the “Description of Device Functions” manual

1. HOME position → → Enter 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

→ save your entries

6. Exit the function matrix:
 - Press and hold down Esc key () for longer than 3 seconds → HOME position
 - Repeatedly press Esc key () → return step by step to HOME position

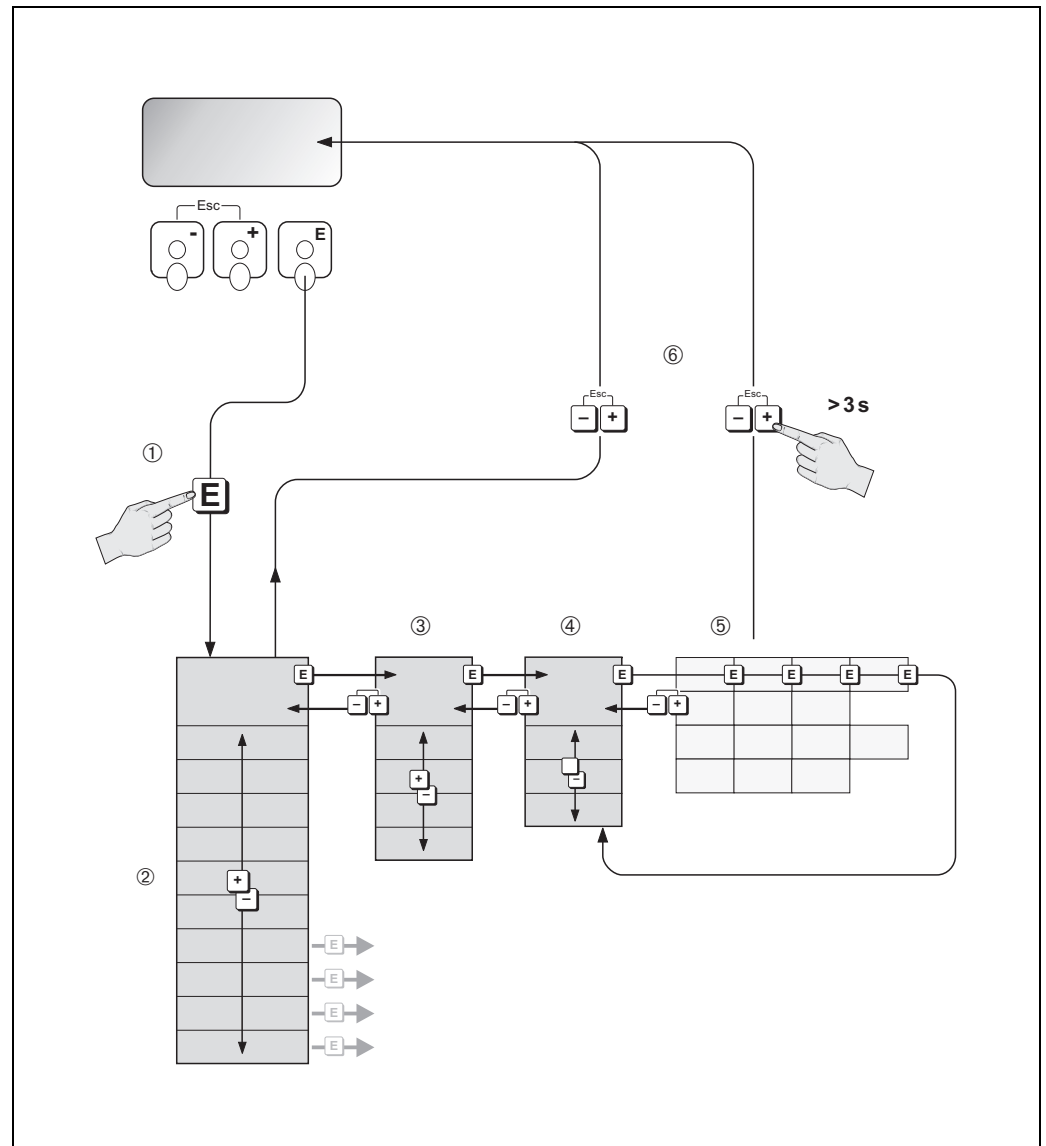


Fig. 47: Selecting functions and configuring parameters (function matrix)

A0001210

5.2.1 General notes

The Quick Setup menu (see Page 85) is adequate for commissioning in most instances. 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 on Page 65. Each cell in the function matrix is identified by a numerical or letter code on the display.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press $\boxed{+/-}$ to select “SURE [YES]” and press $\boxed{=}$ again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.



Note!

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



Caution!

All functions are described in detail, including the function matrix itself, in the “**Description of Device Functions**” manual, which is a separate part of this Operating Instruction.

5.2.2 Enabling the programming mode

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

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

Comply with the following instructions when entering codes:

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



Caution!

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

5.2.3 Disabling the programming mode

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

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

5.3 Error messages

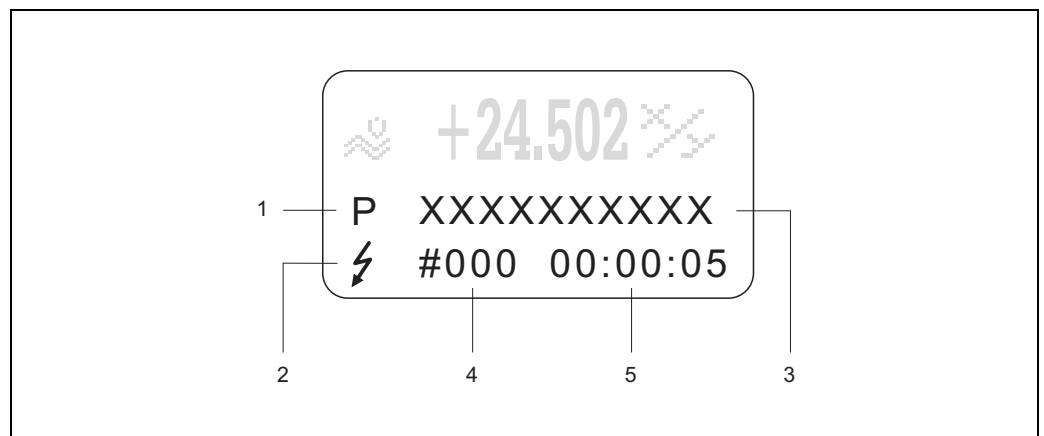
Type of error

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



The measuring system distinguishes between two types of error:

- **System errors:** This group comprises all device errors, e.g. communication errors, hardware errors, etc. → see Page 106.
- **Process errors:** This group comprises all application errors, e.g. empty pipe, etc. → see Page 110.



A0001211

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: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty
- 4 Error number: e.g. #401
- 5 Duration of most recent error occurrence (in hours, minutes and seconds)

Error message type

Users have the option of weighting certain errors differently, in other words having them classed as “**Fault messages**” or “**Notice messages**”. You can define messages in this way with the aid of the function matrix (see the “Description of Device Functions” manual).

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

Notice message (!)

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

Fault message (⚡)

- Displayed as → Lightning flash (⚡), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.

The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix (see Page 112).



Note!

For security reasons, error messages should be output via the relay outputs.

Confirming error messages

For the sake of plant and process safety, the measuring device can be configured in such a way that fault messages () always have to be rectified and acknowledged locally by pressing  . Only then do the error messages disappear from the display.

This option can be switched on or off by means of the “ACKNOWLEDGE FAULT MESSAGES” function (see the “Description of Device Functions” manual).



Note!

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

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART (see Page 55).

The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes. The HART master, e.g. a handheld terminal or PC-based operating programs (such as ToF Tool – Fieldtool Package), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using so-called “commands”. There are three different command groups:

Universal commands:

All HART device support and use universal commands. The following functionalities are linked to them:

- Identify HART devices
- Reading digital measured values (volume flow, totalizer, etc.)

Common practice commands:

Common practice commands offer functions which are supported and can be executed by most but not all field devices.

Device-specific commands:

These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty-pipe/full-pipe adjustment values, low flow cutoff settings, etc.



Note!

Promag 53 has access to all three command classes. On Page 72, you will find a list with all the supported “Universal Commands” and “Common Practice Commands”.

5.4.1 Operating options

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



Note!

- In the CURRENT RANGE function (current output 1), the HART protocol demands the setting “4...20 mA HART” or “4-20 mA (25 mA) HART”.
- HART write protection can be disabled or enabled by means of a jumper on the I/O board → Page 82.

HART handheld terminal DXR 375

Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.

The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program “ToF Tool – Fieldtool Package”

Modular software package consisting of the service program “ToF Tool” for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and evolution of pressure measuring instruments as well as the “Fieldtool” service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193 or the HART protocol.

Contents of the “ToF Tool – Fieldtool Package”:

- Commissioning, maintenance analysis
- Configuring flowmeters
- Service functions
- Visualisation of process data
- Trouble-shooting
- Controlling the “Fieldcheck” tester/simulator

Fieldcare

Fieldcare is Endress+Hauser's FDT-based plant Asset Management Tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193.

Operating program “SIMATIC PDM” (Siemens)

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

Operating program “AMS” (Emerson Process Management)

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

5.4.2 Current device description files

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

HART protocol:

Valid for software:	2.00.XX	→ Function "Device software"
Device data HART		
Manufacturer ID:	11 _{hex} (ENDRESS+HAUSER)	→ Function "Manufacturer ID"
Device ID:	42 _{hex}	→ Function "Device ID"
HART version data:	Device Revision 6/ DD Revision 1	
Software release:	03.2005	
Operating program:	Sources for obtaining device descriptions:	
Handheld terminal DXR 375	■ Use update function of handheld terminal	
ToF Tool - Fieldtool Package	■ www.tof-fieldtool.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)	
Fieldcare / DTM	■ www.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)	
AMS	■ www.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)	
SIMATIC PDM	■ www.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)	

Operation via the service protocol

Valid for device software:	2.00.XX	→ Function "Device software"
Software release:	03.2005	
Operating program:	Sources for obtaining device descriptions:	
ToF Tool - Fieldtool Package	■ www.tof-fieldtool.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)	

Tester/simulator:	Sources for obtaining device descriptions:
Fieldcheck	■ Update by means of ToF Tool - Fieldtool Package via Fieldflash module

5.4.3 Device and process variables

Device variables:

The following device variables are available using the HART protocol:

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

Process variables:

At the factory, the process variables are assigned to the following device variables:

- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → Mass flow
- Fourth process variable (FV) → not assigned



Note!

You can set or change the assignment of device variables to process variables using Command 51 (see Page 76).

5.4.4 Universal / Common practice HART commands

The following table contains all the universal and common practice commands supported by Promag 53.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Universal Commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 66 = Promag 53 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable <i>Factory setting:</i> Primary process variable = Volume flow  Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ Manufacturer-specific units are represented using the HART unit code “240”.
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: actual current of the primary process variable in mA – Bytes 4-7: Percentage of the set measuring range <i>Factory setting:</i> Primary process variable = Volume flow  Note! You can set the assignment of device variables to process variables using Command 51.

Command No. HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
3 Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable <i>Factory setting:</i> ■ Primary process variable = Volume flow ■ Second process variable = Totalizer 1 ■ Third process variable = Mass flow ■ Fourth process variable = OFF (not assigned)  Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ Manufacturer-specific units are represented using the HART unit code "240".
6 Set HART shortform address Access type = write	Byte 0: desired address (0...15) <i>Factory setting:</i> 0  Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address
11 Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 66 = Promag 53 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
12 Read user message Access type = read	none	Bytes 0-24: User message  Note! You can write the user message using Command 17.
13 Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date  Note! You can write the TAG, descriptor and date using Command 18.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span  Note! ■ The data relate to the primary process variable (= volume flow). ■ Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: End of measuring range, value for 20 mA – Bytes 7-10: Start of measuring range, value for 4 mA – Bytes 11-14: Attenuation constant in [s] – Byte 15: Write protection ID – Byte 16: OEM dealer ID, 17 = E+H <i>Factory setting:</i> Primary process variable = Volume flow  Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ Manufacturer-specific units are represented using the HART unit code "240".
16	Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Common Practice Commands			
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable in seconds <i>Factory setting:</i> Primary process variable = Volume flow	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA <i>Factory setting:</i> Primary process variable = Volume flow  Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA  Note! Manufacturer-specific units are represented using the HART unit code “240”.
38	Device status reset (Configuration changed) Access = write	none	none
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0-3: Output current in mA <i>Factory setting:</i> Primary process variable = Volume flow  Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0-3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code <i>Factory setting:</i> Primary process variable = Volume flow  Note! ■ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ■ If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code  Note! Manufacturer-specific units are represented using the HART unit code “240”.
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table on Page 77

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

5.4.5 Device status / Error messages

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



Note!

You can find a detailed explanation of the device status and error messages and their elimination on Page 106 ff.

Byte-Bit	Error No.	Short error description (→ Page 106 ff.)
0-0	001	Serious device error
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
0-3	not assigned	–
0-4	not assigned	–
0-5	not assigned	–
0-6	not assigned	–
0-7	not assigned	–
1-0	not assigned	–
1-1	031	S-DAT: defective or missing
1-2	032	S-DAT: Error accessing saved values
1-3	041	T-DAT: defective or missing
1-4	042	T-DAT: Error accessing saved values
1-5	051	I/O board and the amplifier board are not compatible.
1-6	not assigned	–
1-7	not assigned	–
2-0	not assigned	–
2-1	not assigned	–
2-2	not assigned	–
2-3	not assigned	–
2-4	not assigned	–
2-5	not assigned	–
2-6	not assigned	–
2-7	not assigned	–
3-0	not assigned	–
3-1	not assigned	–
3-2	not assigned	–
3-3	111	Totalizer checksum error
3-4	121	I/O board and the amplifier board are not compatible.

Byte-Bit	Error No.	Short error description (→ Page 106 ff.)
3-5	not assigned	–
3-6	205	T-DAT: Data download unsuccessful
3-7	206	T-DAT: Data upload unsuccessful
4-0	not assigned	–
4-1	not assigned	–
4-2	not assigned	–
4-3	251	Internal communication fault on the measuring amplifier
4-4	261	No data reception between amplifier and I/O board
4-5	not assigned	–
4-6	not assigned	–
4-7	not assigned	–
5-0	321	Coil current of the sensor is outside the tolerance.
5-1	not assigned	–
5-2	not assigned	–
5-3	not assigned	–
5-4	not assigned	–
5-5	not assigned	–
5-6	not assigned	–
5-7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-0	340	
6-1	341	
6-2	342	
6-3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-4	344	
6-5	345	
6-6	346	
6-7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7-0	348	
7-1	349	
7-2	350	
7-3	351	Current output: flow is out of range.
7-4	352	
7-5	353	
7-6	354	

Byte-Bit	Error No.	Short error description (→ Page 106 ff.)
7-7	355	Frequency output: flow is out of range.
8-0	356	
8-1	357	
8-2	358	
8-3	359	Pulse output: the pulse output frequency is out of range.
8-4	360	
8-5	361	
8-6	362	
8-7	not assigned	—
9-0	not assigned	—
9-1	not assigned	—
9-2	not assigned	—
9-3	not assigned	—
9-4	not assigned	—
9-5	not assigned	—
9-6	not assigned	—
9-7	not assigned	—
10-0	not assigned	—
10-1	not assigned	—
10-2	not assigned	—
10-3	not assigned	—
10-4	not assigned	—
10-5	not assigned	—
10-6	not assigned	—
10-7	401	Measuring tube partially filled or empty
11-0	not assigned	—
11-1	not assigned	—
11-2	461	EPD adjustment not possible because the fluid's conductivity is either too low or too high.
11-3	not assigned	—
11-4	463	The EPD adjustment values for empty pipe and full pipe are identical, therefore incorrect.
11-5	not assigned	—
11-6	471	Max. permitted batching time has been exceeded.
11-7	472	Underbatching: the minimum quantity was not reached. Overbatching: the maximum permitted batching quantity was exceeded.

Byte-Bit	Error No.	Short error description (→ Page 106 ff.)
12-0	473	The predefined batch quantity point was exceeded. End of filling process approaching.
12-1	481	Actual relaxation time has exceeded the limit value.
12-2	482	Electrical potential of electrode 1 has exceeded the limit value.
12-3	483	Electrical potential of electrode 2 has exceeded the limit value.
12-4	not assigned	–
12-5	not assigned	–
12-6	not assigned	–
12-7	501	New amplifier software version is loaded. Currently no other commands are possible.
13-0	not assigned	–
13-1	not assigned	–
13-2	571	Batching process in progress (valves are open)
13-3	572	Batching process has been stopped (valves are closed)
13-4	not assigned	–
13-5	not assigned	–
13-6	not assigned	–
13-7	not assigned	–
14-0	not assigned	–
14-1	not assigned	–
14-2	not assigned	–
14-3	601	Positive zero return active
14-4	not assigned	–
14-5	not assigned	–
14-6	not assigned	–
14-7	611	Simulation current output active
15-0	612	
15-1	613	
15-2	614	
15-3	621	Simulation frequency output active
15-4	622	
15-5	623	
15-6	624	

Byte-Bit	Error No.	Short error description (→ Page 106 ff.)
15-7	631	Simulation pulse output active
16-0	632	
16-1	633	
16-2	634	
16-3	641	Simulation status output active
16-4	642	
16-5	643	
16-6	644	
16-7	651	Simulation relay output active
17-0	652	
17-1	653	
17-2	654	
17-3	661	Simulation current input active
17-4	not assigned	–
17-5	not assigned	–
17-6	not assigned	–
17-7	671	Simulation status input active
18-0	672	Simulation status input active
18-1	673	Simulation status input active
18-2	674	Simulation status input active
18-3	691	Simulation of response to error (outputs) active
18-4	692	Simulation of volume flow active
18-5	not assigned	–
18-6	not assigned	–
18-7	not assigned	–
24-0	363	Current input: The actual value for the current lies outside the set limits.

5.4.6 Switching HART write protection on and off

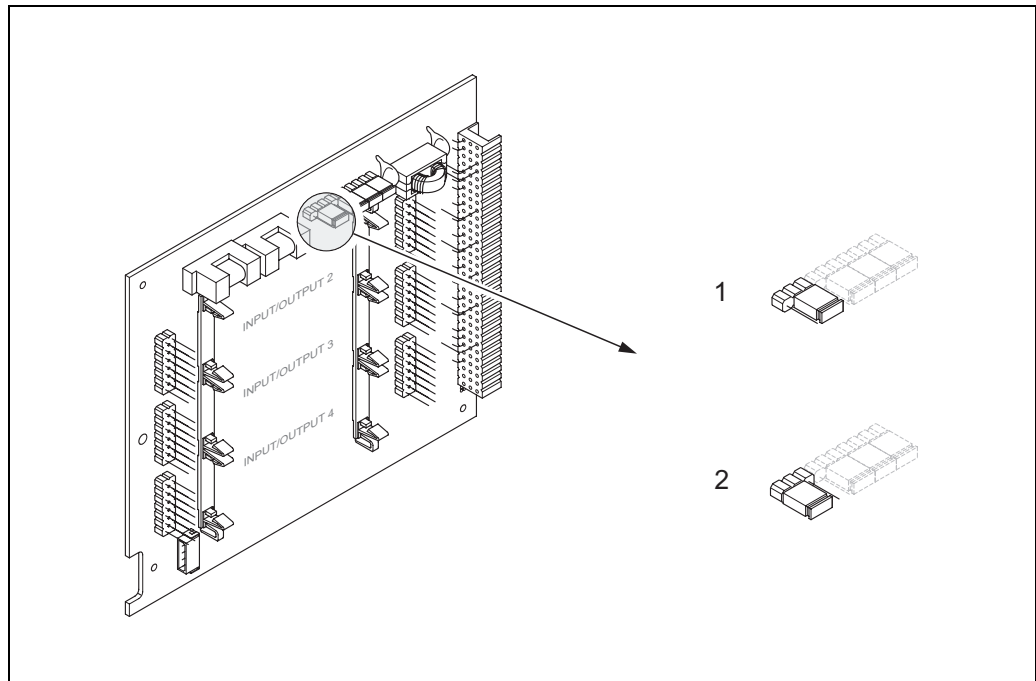
A jumper on the I/O board provides the means of activating or deactivating HART write protection.



Warning!

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

1. Switch off power supply.
2. Remove the I/O board → Page 115, 117
3. Switch HART write protection on or off, as applicable, by means of the jumper (Fig. 49).
4. Installation of the I/O board is the reverse of the removal procedure.



A0001212

Fig. 49: Switching HART write protection on and off

- 1 HART write protection OFF (default), that is: HART protocol unlocked.
- 2 HART write protection ON, that is: HART protocol locked.

6 Commissioning

6.1 Function check

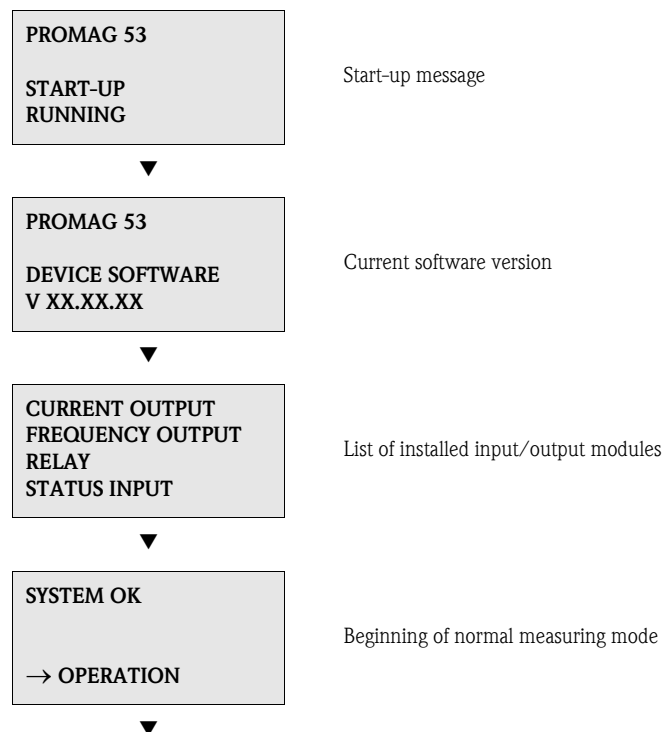
Make sure that all final checks have been completed before you start up your measuring point:

- Checklist for “Installation check” → Page 46
- Checklist for “Electrical connection check” → Page 60

6.1.1 Switching on the measuring device

Once the connection checks (see Page 60) have been successfully completed, it is time to switch on the power supply. The device is now operational.

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



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



Note!

If start-up fails, an error message indicating the cause is displayed.

6.2 Application-specific commissioning

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the configuration program, e.g. ToF Tool - Fieldtool Package. If the measuring device is equipped with a local display, all the important device parameters for standard operation can be configured quickly and easily by means of the “Commissioning” Quick Setup menu.

- Quick Setup “Commissioning”, → Page 4 ff.
- Quick Setup “Pulsating flow”, → Page 86 ff.
- Quick Setup “Batching”, → Page 89 ff.

6.2.1 “Commissioning” Quick Setup menu

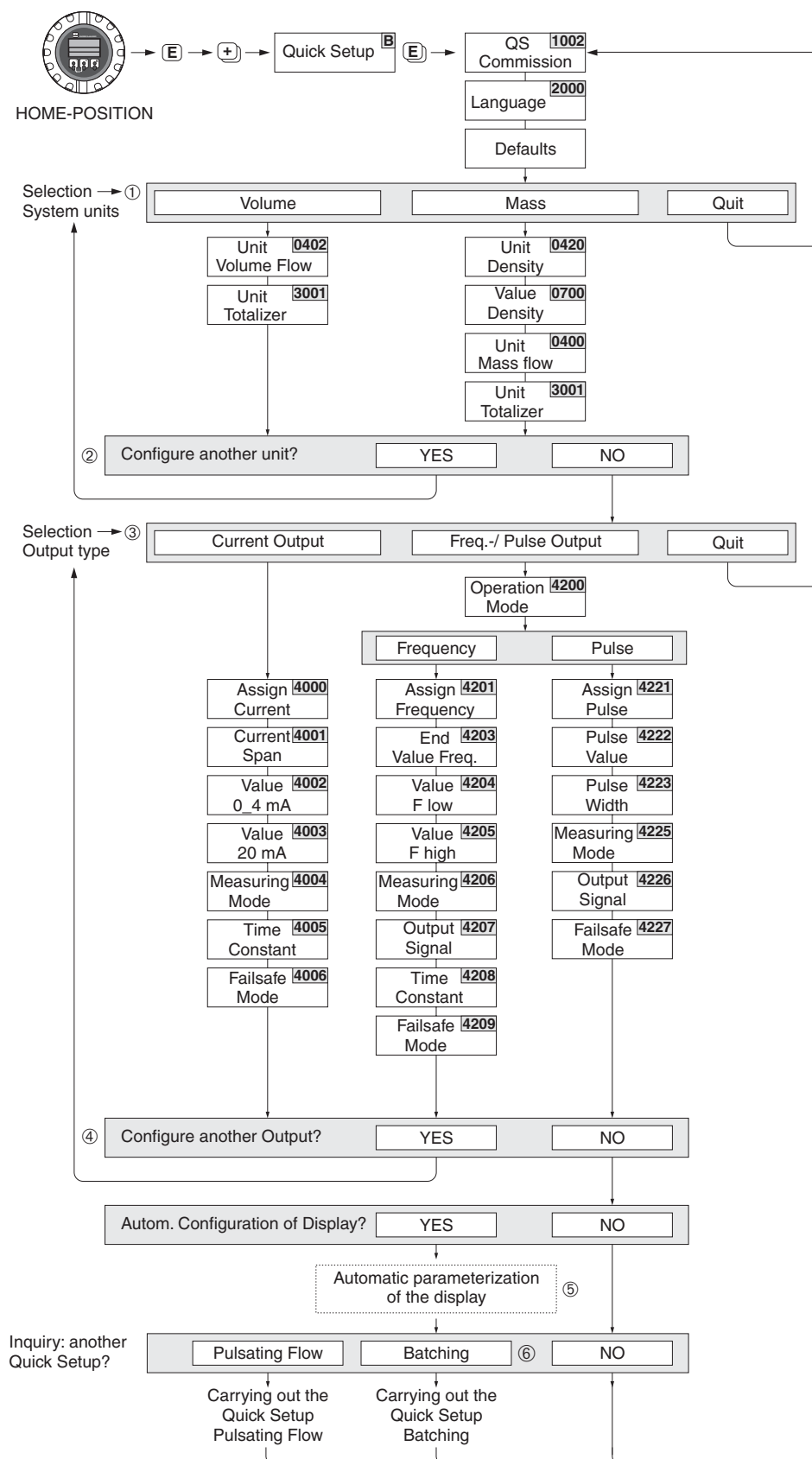


Note!

- The display returns to the cell SETUP COMMISSIONING (1002) if you press the ESC key combination during parameter interrogation. The stored parameters remain valid.
 - The “Commissioning” Quick Setup must be carried out before one of the Quick Setups explained below is run.
- ① Only units not yet configured in the current Setup are offered for selection in each cycle.
The unit for mass, volume and corrected 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 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 parameterized.
“NO” is the only option displayed when no further outputs are available.
 - ⑤ The “automatic parameterization of the display” option contains the following basic settings/factory settings:
YES: Main line = Mass flow; Additional line = Totalizer 1;
Information line = Operating/system conditions
NO: The existing (selected) settings remain.
 - ⑥ The QUICK SETUP BATCHING is only available when the optional software package BATCHING is installed.

6.2.2 “Commissioning” Quick Setup menu

This Quick Setup menu guides you systematically through the setup procedure for all the major device functions that have to be configured for standard measuring operation.



F06-53xxxxxx-19-xx-xx-en-000

Fig. 50: Setup menu for straightforward configuration of the major device functions

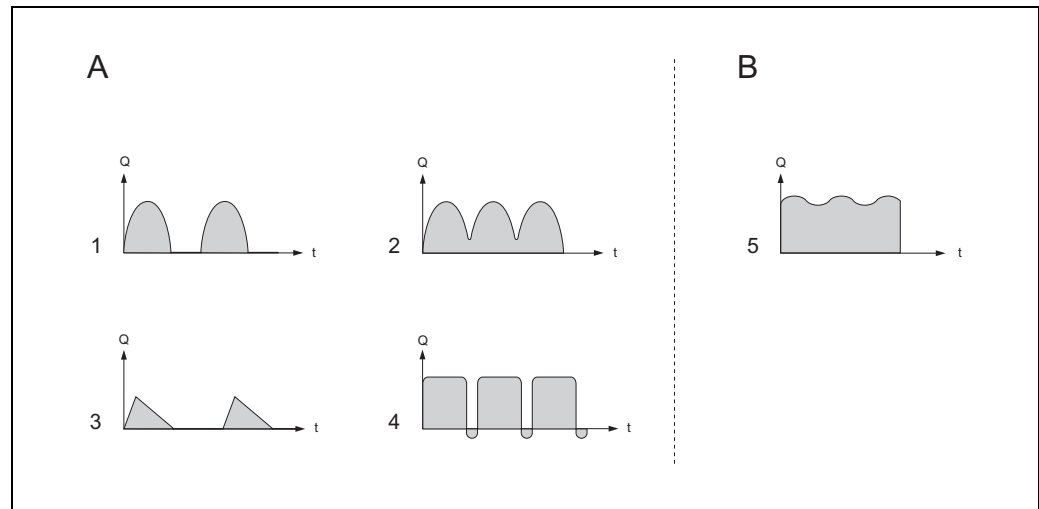
6.2.3 “Pulsating Flow” Quick Setup menu

Certain types of pump such as reciprocating, peristaltic and cam-type pumps, for example, create a flow characterised by severe periodic fluctuations (Fig. 51). 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” (see Page 86) has to be executed.



A0001213

Fig. 51: Flow characteristics of various types of pump

A = With severely pulsating flow

B = With slightly pulsating flow

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

Severely pulsating flow

Once several device functions have been configured in the “Pulsating Flow” Quick Setup menu, flow fluctuations can be compensated over the entire flow range and pulsating fluid flows measured correctly.

You will find detailed instructions on how to use this Quick Setup menu on Page 87.



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

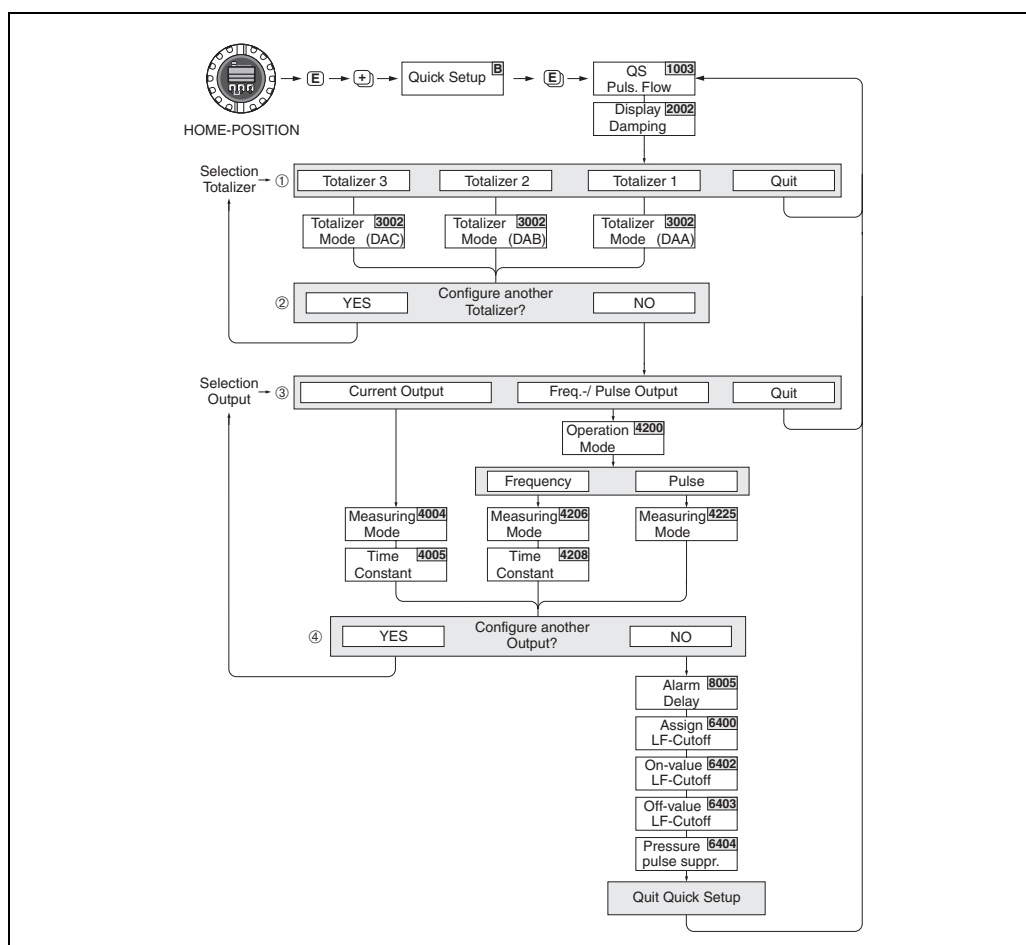
If flow fluctuations are no more than minor, as is the case, for example with gear-type, three-cylinder or multi-cylinder pumps, it is **not** absolutely necessary to work through the “Pulsating Flow” menu.

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

- Measuring system damping: 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 configured for measuring pulsating flows. Note that this has no effect on the original signal values such as measuring range, current range or limit value!



F06-53xxxxxx-19-xx-xx-en-001

Fig. 52: Quick Setup for measuring severely pulsating flows
Recommended settings → see next page

“Pulsating flow” Quick Setup menu		
HOME position →  → MEASURED VARIABLE (A) MEASURED VARIABLE →  → QUICK SETUP (B) QUICK SETUP →  → QS PULSATING FLOW (1003)		
Function No.	Function name	Setting to select () (Go to next function: press )
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
3002	TOTALIZER MODE (DAA)	BALANCE (Totalizer 1)
3002	TOTALIZER MODE (DAB)	BALANCE (Totalizer 2)
3002	TOTALIZER MODE (DAC)	BALANCE (Totalizer 3)
Signal type for “CURRENT OUTPUT 1...n”		
4004	MEASURING MODE	PULSATING FLOW
4005	TIME CONSTANT	3 s
Signal type for “PULSE/FREQ. OUTPUT 1...n” (for FREQUENCY operating mode)		
4206	MEASURING MODE	PULSATING FLOW
4208	TIME CONSTANT	0 s
Signal type for “PULSE/FREQ. OUTPUT 1...n” (for PULSE operating mode)		
4225	MEASURING MODE	PULSATING FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LOW FLOW CUTOFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUT OFF	Recommended setting: $\text{On-value} \approx \frac{\text{max. full scale (per DN)} *}{1000}$ *) Full scale values → Page 21 ff.
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s



Back to the HOME position → Press and hold down Esc key () for longer than three seconds. → Repeatedly press and release Esc key () → exit the function matrix step by step

6.2.4 “Batching” Quick Setup

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

Additional settings, e.g. for the calculation of after runs or for multi-stage batching procedures, must be made via the function matrix itself (see the “Description of Device Functions” manual).



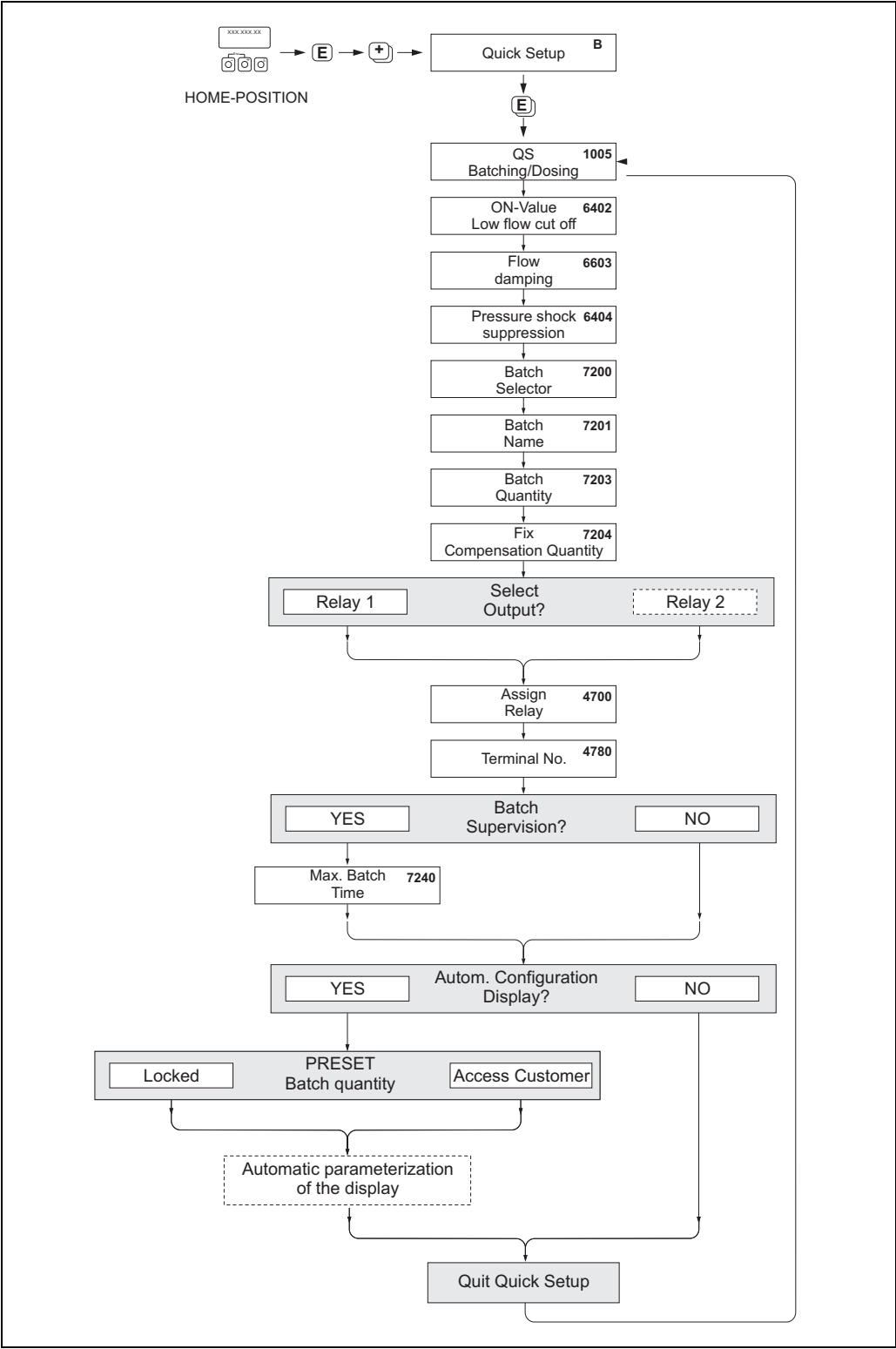
Note!

- The “Commissioning” Quick Setup (see Page 85) must be run prior to running the “Batching” Quick Setup.
- 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 (see Page 101).
- 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. Exit this by clicking “YES”. This assigns special batching functions (START, PRESET, MATRIX) to the bottom line of the display. These can be directly executed on-site using the three operating keys (-/+/E). Therefore, Promag 53 can be fully deployed in the field as a “batch controller” → Page 64.



Caution!

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



A0002611-EN

Fig. 53: "Batching" Quick Setup for configuration of batching functions

“Batching” Quick Setup menu

HOME position →  → MEASURED VARIABLE (A)
 MEASURED VARIABLE →  → QUICK SETUP (B)
 QUICK SETUP →  → QUICK SETUP BATCHING / DOSING (1005)

Function No.	Function name	Setting to select () (Go to next function: press )
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.

**Warning!**

Some of the functions listed below (with a grey background) are configured automatically, i.e. by the measuring system.

6400	ASSIGN LOW FLOW CUTOFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUTOFF	Recommended settings can be found on Page 88 in Function No. 6402.
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6603	FLOW DAMPING	9
6404	PRESSURE SHOCK SUPPRESSION	0 seconds
7200	BATCH SELECTOR	BATCH #1
7201	BATCH NAME	BATCH #1
7202	ASSIGN BATCH VARIABLE	VOLUME FLOW
7203	BATCH QUANTITY	0 [unit]
7204	FIX COMPENSATION QUANTITY	0 [unit]
7208	BATCH STAGES	1
7209	INPUT FORMAT	Value input
4700	ASSIGN RELAY	BATCH VALVE 1
4780	TERMINAL NUMBER	Output (display only)
7220	OPEN VALVE 1	0% or 0 [unit]
7240	MAXIMUM BATCH TIME	0 seconds (= switched off)
7241	MINIMUM BATCH TIME	0 seconds (= switched off)
7242	MAXIMUM BATCH QUANTITY	0 seconds (= switched off)
2200	ASSIGN (main line)	BATCH NAME
2220	ASSIGN (multiplex main line)	OFF
2400	ASSIGN (addition line)	BATCH DOWNWARDS
2420	ASSIGN (multiplex addition line)	OFF
2600	ASSIGN (information line)	BATCHING KEYS
2620	ASSIGN (multiplex information line)	OFF



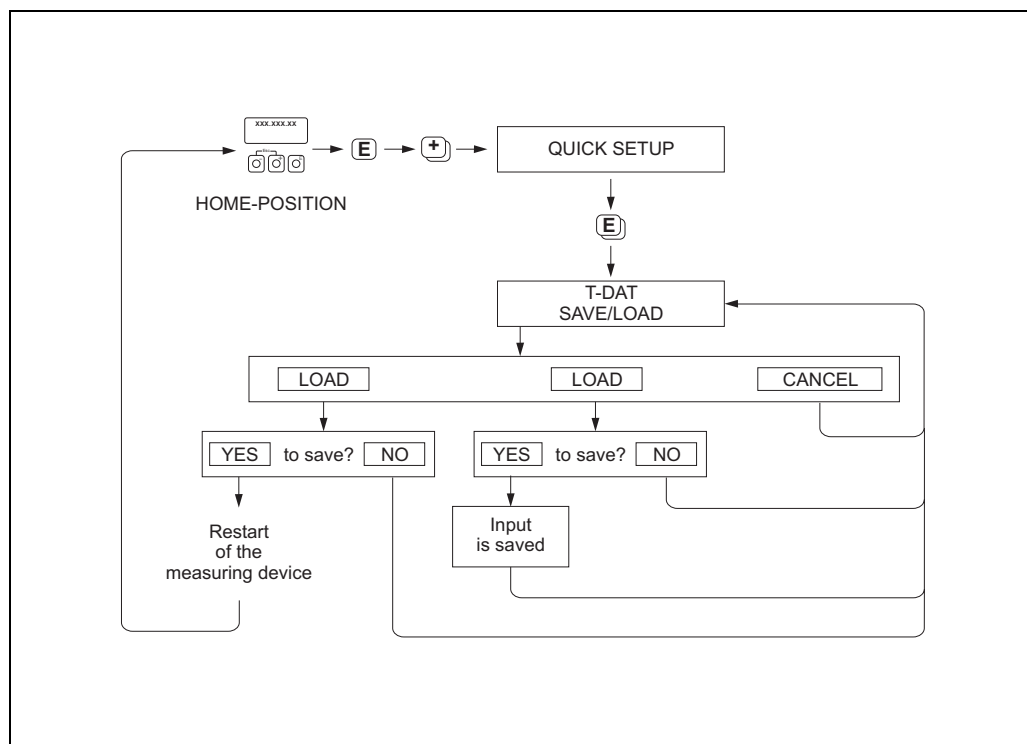
Back to the HOME position

→ Press and hold down Esc key () for longer than three seconds.

→ Repeatedly press and release Esc key () → exit the function matrix step by step

6.2.5 Data back-up with "T-DAT SAVE/LOAD"

The "T-DAT SAVE/LOAD" function can be used to store all the settings and parameters of the device to the T-Dat data storage device.



A0001221-EN

Fig. 54: Data back-up with "T-DAT SAVE/LOAD" function

Options

LOAD

Data on the T-DAT data storage device are copied to the device memory (EEPROM). This overwrites any settings and parameters of the device.

SAVE

Settings and parameters are copied from the device memory (EEPROM) to the T-DAT.

CANCEL

Cancels the option selection and returns you to the higher selection level.

Application examples

- After commissioning, the current measuring point parameters can be saved to the T-DAT as a backup.
- If the transmitter is replaced for some reason, the data from the T-DAT can be loaded into the new transmitter -(EEPROM).



Note!

- If the target device has an older software version, the message "TRANSM. SW-DAT" is displayed during start-up. Then only the "SAVE" function is available.
- **LOAD**
 - This function is only possible if the target device has the same software version as, or a more recent software version than, the source device.
- **SAVE**
 - This function is always available.

6.2.6 Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is completely full. This status can be permanently monitored using the Empty Pipe Detection:

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



Caution!

A **detailed** description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found in the separate “Description of Device Functions” Manual:

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



Note!

- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory with water (approx. 500 µS/cm).
If the fluid 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 appropriate function in the function matrix:
HOME → → → BASIC FUNCTIONS → → → PROCESSPARAMETER → → → 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:

– FULL = EMPTY

The adjustment values for empty pipe and full pipe are identical. In cases of this nature you **must** repeat empty-pipe or full-pipe adjustment!

– ADJUSTMENT NOT OK

Adjustment is not possible because the fluid’s conductivity is out of range.

6.2.7 Current output: active/passive

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

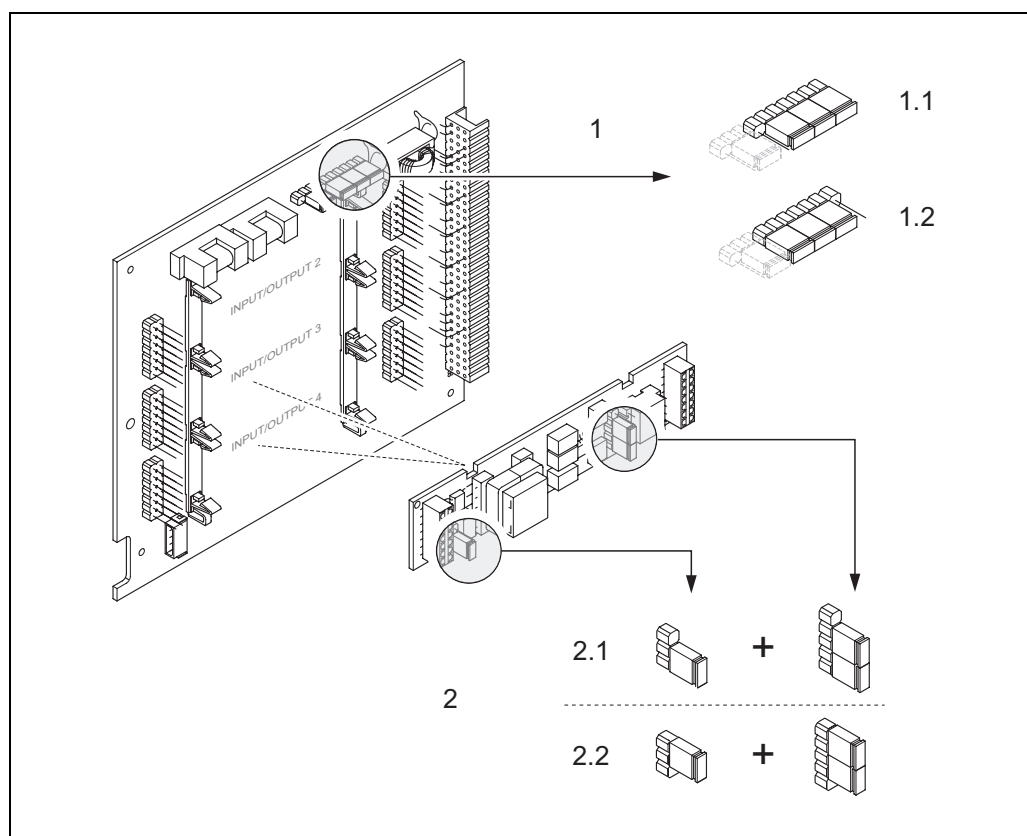
1. Switch off power supply.
2. Remove the I/O board → Page 115, 117
3. Set the jumpers in accordance with Fig. 55.



Caution!

- Risk of destroying the measuring device. Set the jumpers exactly as shown in Fig. 55. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.
- Note that the position of the current submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → Page 54.

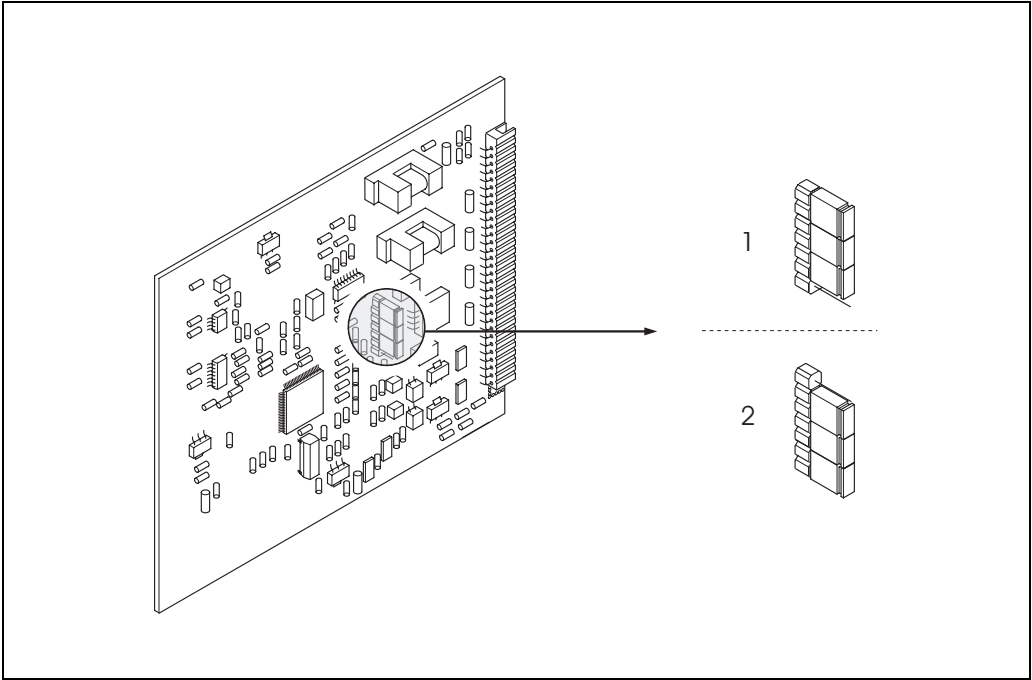
4. Installation of the I/O board is the reverse of the removal procedure.



A0001214

Fig. 55: Configuring the current output for the flexible module board

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



A0001044

Fig. 56: Configuring the current output for the fixed module board

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

6.2.8 Current input: active/passive

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



Warning!

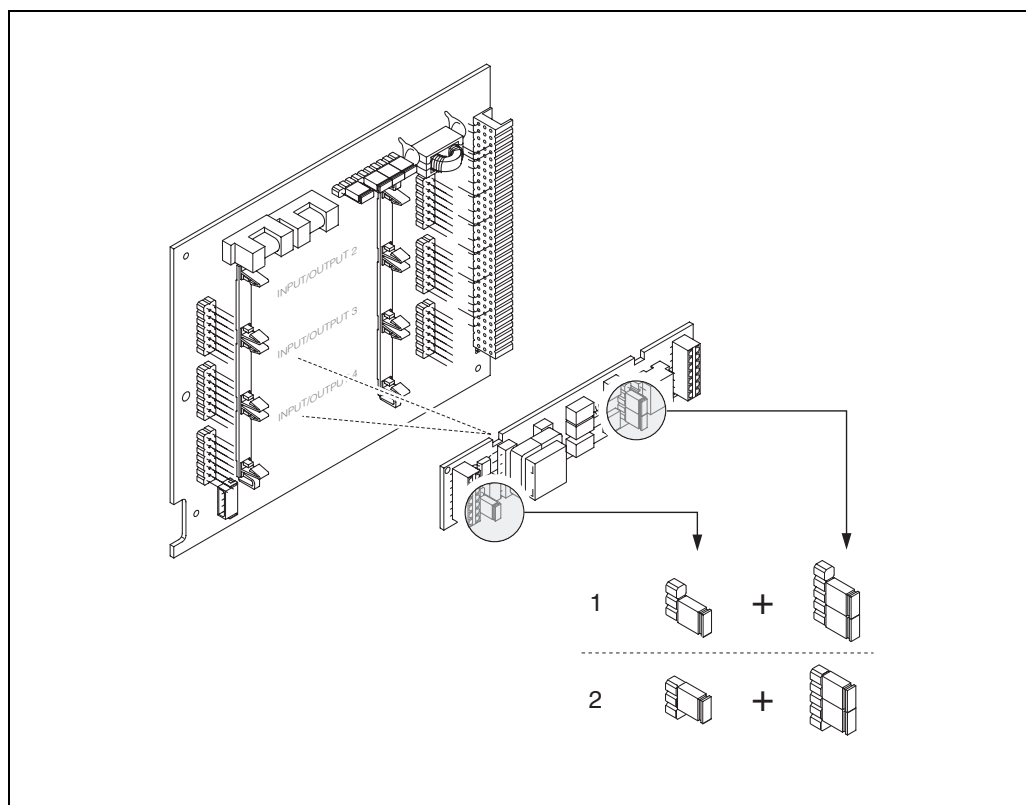
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → Page 115, 117
3. Set the jumpers in accordance with Fig. 57.



Caution!

- Risk of destroying the measuring device. Set the jumpers exactly as shown in Fig. 57. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.
 - Note that the position of the current input submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → Page 54.
4. Installation of the I/O board is the reverse of the removal procedure.



F06-x3xxxxxx-16-xx-06-xx-004

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

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

6.2.9 Relay contacts: Normally closed/normally open

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



Warning!

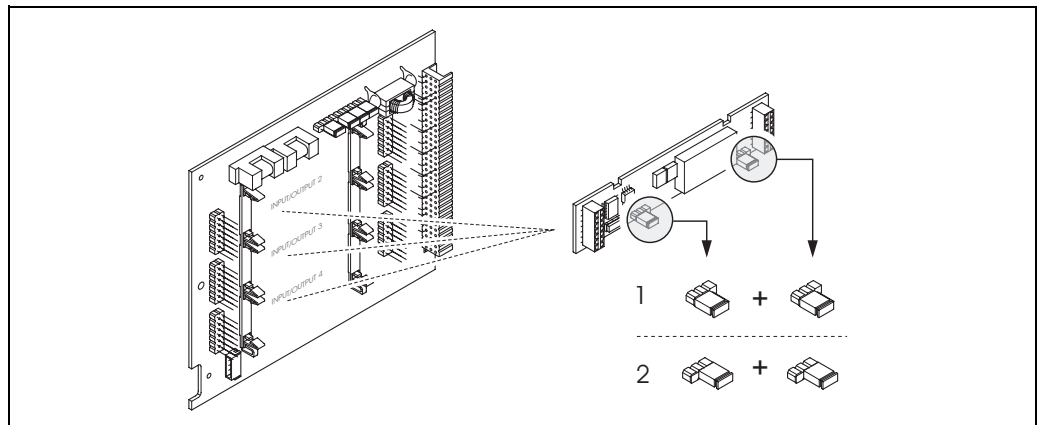
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.
2. Remove the I/O board → Page 115, 117
3. Set the jumpers in accordance with Fig. 58 and Fig. 59.



Caution!

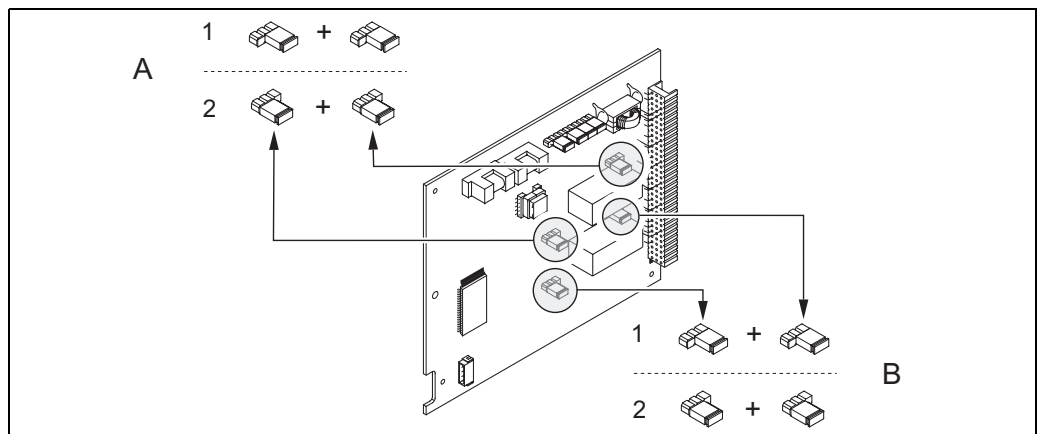
- If you change the setting you must always change the positions of **both** jumpers. Set the jumpers exactly as shown in Fig. 58 and Fig. 59.
 - Note that the position of the relay submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → Page 54.
4. Installation of the I/O board is the reverse of the removal procedure.



A0001215

Fig. 58: Configuring relay contacts (NC / NO) for the flexible module board.

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



A0001216

Fig. 59: Configuring relay contacts (NC / NO) for the fixed module board.

A = relay 1, B = relay 2

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

6.3 Data storage device (HistoROM)

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

6.3.1 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.

6.3.2 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 EEPROM to the T-DAT and vice versa has to be carried out by the user (= manual save function). Detailed instructions regarding this can be found in the handbook "Description of Device Functions" (function "T-DAT SAVE/LOAD", No. 1009).

6.3.3 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 101
- Plugging on to the I/O board → Page 114



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

The Promag 53 flow measuring system requires no special maintenance.

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 periodically, particularly in the case of gasket seals (aseptic version). The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessories) → see Page 101.

8 Accessories

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

8.1 Device-specific accessories

Accessory	Description	Order code
Transmitter Promag 50	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable type for the remote version – Cable entries – Display / power supply / operation – Software – Outputs / inputs	50XXX – XXXXX * * * * *
Conversion kit for inputs/outputs	Conversion kit with appropriate plug-in point modules for converting the input/output configuration in place to date to a new version.	DKUI – * *
Software packages for Promag 53	Software add-ons on F-CHIP, can be ordered individually: – Electrode Cleaning Circuitry (ECC) – Batching	DK5SO – *

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for transmitter Promag 50/53	Mounting kit for wall-mounted housing (remote version). Suitable for: – Wall mounting – Post mounting – Installation in control panel Mounting set for aluminium housings. Suitable for pipe mounting (3/4" ... 32")	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 equalisation	DK5GD – ***
Mounting kit for Promag H	Mounting kit for Promag H, comprising: – 2 process connections – Threaded fasteners – Seals	DKH ** – ***
Adapter connection for Promag A, H	Adapter connections for installing Promag 50 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. Set of ground rings, comprising: – 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 nipple as process connection: welding jig for installation in pipe.	DK5HW – ***

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator DXR 375 hand-held terminal	Hand-held terminal for remote parameterisation and for fetching measured values via the current output HART (4...20 mA). Contact your Endress+Hauser representative for more information.	DXR375 – * * * *

8.4 Communication-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 – *
ToF Tool – Fieldtool Package	Modular software package consisting of the service program “ToF Tool” for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and the “Fieldtool” service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193. Contents of the “ToF Tool – Fieldtool Package”: – Commissioning, maintenance analysis – Configuring flowmeters – Service functions – Visualisation of process data – Trouble-shooting – Controlling the “Fieldcheck” tester/simulator Contact your Endress+Hauser representative for more information.	DXS10 – * * * * *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the “ToF Tool – Fieldtool Package” 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

9 Trouble-shooting

9.1 Trouble-shooting instructions

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

Check the display	
No display visible and no output signals present.	1. Check the power supply → terminals 1, 2 2. Check the power line fuse → Page 119 85...260 V AC: 0.8 A slow-blow / 250 V 20...55 V AC and 16...62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → Page 114
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 116, 118 2. Display module defective → order spare parts → Page 114 3. Measuring electronics defective → order spare parts → Page 114
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the   buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective → order spare parts → Page 114



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



Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → Page 111

9.2 System error messages

Serious system errors are **always** recognised by the instrument as “Fault message”, and are shown as a lightning flash (⚡) 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. The procedures on Page 8 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed “Declaration of contamination” form. You will find a preprinted blank of this form at the back of this manual.



Note!

The listed error message types below correspond to the factory setting.
Also observe the information on Page 67 and 112.

No.	Error message / Type	Cause	Remedy / spare part
S = System error ⚡ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE ⚡: # 001	Serious device error	Replace the amplifier board. Spare parts → Page 114
011	S: AMP HW EEPROM ⚡: # 011	Amplifier: Defective EEPROM	Replace the amplifier board. Spare parts → Page 114
012	S: AMP SW EEPROM ⚡: # 012	Amplifier: Error accessing EEPROM data	The EEPROM data blocks in which an error has occurred are displayed in the “TROUBLESHOOTING” function (No. 8047). Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values.  Note! The measuring device must be restarted after fault elimination.
031	S: SENSOR HW DAT ⚡: # 031	Sensor DAT: 1. S-DAT is defective. 2. S-DAT is not plugged into the amplifier board or is missing.	1. Replace the S-DAT. Spare parts → Page 114 Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the S-DAT into the amplifier board → Page 116, 118
032	S: SENSOR SW DAT ⚡: # 032	Sensor: Error accessing the calibration values stored in the S-DAT.	1. Check whether the S-DAT is correctly plugged into the amplifier board → Page 116, 118 2. Replace the S-DAT if it is defective. Spare parts → Page 114 Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → Page 114

No.	Error message / Type	Cause	Remedy / spare part
041	S: TRANSM. HW-DAT !/: # 041	Transmitter DAT: 1. T-DAT is defective. 2. T-DAT is not plugged into the amplifier board or is missing.	1. Replace the T-DAT. Spare parts → Page 114 Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the T-DAT into the amplifier board → Page 116, 118
042	S: TRANSM. SW-DAT !/: # 042	Transmitter DAT: Error accessing the calibration values stored in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → Page 116, 118 2. Replace the T-DAT if it is defective. Spare parts → Page 114 Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → Page 114
061	S: HW F-CHIP !/: # 061	Transmitter F-CHIP: 1. F-CHIP is defective. 2. F-CHIP is not plugged into the I/O board or is missing.	1. Replace the F-CHIP. Accessories → Page 101 2. Plug the F-CHIP into the I/O board → Page 116, 118
No. # 1xx → Software error			
101	S: GAIN ERROR AMP !/: # 101	Gain deviation compared to reference gain is greater than 2%.	Replace amplifier board. Spare parts → Page 114
111	S: CHECKSUM TOTAL !/: # 111	Totalizer checksum error	1. Restart the measuring device 2. Replace the amplifier board if necessary. Spare parts → Page 114
121	S: A / C COMPATIB. !/: # 121	Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality).  Note! – The indication on the display as notice message appears only for 30 seconds (with listing in “Previous system condition” function). – This condition can occur if only one electronics board has been exchanged; the extended software functionality is not available. The previously existing software functionality is still working and the measurement possible.	Module with lower software version has either to be actualized by FieldTool with the required software version or the module has to be replaced. Spare parts → Page 114
No. # 2xx → Error in DAT / no communication			
205	S: LOAD T-DAT !/: # 205	Data backup (downloading) to T-DAT failed, or error when accessing (uploading) the calibration values stored in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → Page 116, 118 2. Replace the T-DAT if it is defective. Spare parts → Page 114 Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → Page 114
206	S: SAVE T-DAT !/: # 206		
261	S: COMMUNICATION I/O !/: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts

No.	Error message / Type	Cause	Remedy / spare part
No. # 3xx → System limits exceeded			
321	S: TOL. COIL CURR. !: # 321	Sensor: Coil current is out of tolerance.	1. Remote version: Switch off the power supply before connecting or disconnecting the cable of the coil (terminals 41/42). 2. Remote version: Switch off power supply and check wiring of terminals 41/42 → Page 47 ff. 3. Switch off the power supply and check the connectors of the coil cable → Page 116, 118 4. Replace measuring electro-nics boards if necessary. Spare parts → Page 114
339 ... 342	S: STACK CURRENT OUTPUT n !: # 339...342	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (!): – Configure the fault response of the output to “ACTUAL VALUE” (see Page 112), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
343 ... 346	S: STACK FREQUENCY OUTPUT n !: # 343...346		
347 ... 350	S: STACK PULS OUTPUT n !: # 347...350	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse weighting 2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses. 3. Reduce flow Recommendations in the event of fault category = FAULT MESSAGE (!): – Configure the fault response of the output to “ACTUAL VALUE” (see Page 112), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
351 ... 354	S: CURRENT RANGE n !: # 351...354	Current output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 ... 358	S: FREQ. RANGE n !: # 355...358	Frequency output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 ... 362	S: PULSE RANGE n !: # 359...362	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). <i>Determine the pulse width:</i> – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half “reciprocal value” that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10 \text{ Hz}} = 50 \text{ ms}$ 3. Reduce flow.
363	S: RANGE CUR. IN !: # 363	Current input: Actual current value is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Check the settings of the external measuring sensor.

No.	Error message / Type	Cause	Remedy / spare part
No. # 5xx → Application error			
501	S: SW.-UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT. !: # 502	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until the procedure is finished.
571	S: BATCH RUNNING !: # 571	Batching is started and active (valves are open)	No measures needed (during the batching process some other functions may not be activated).
572	S: BATCH HOLD !: # 572	Batching has been interrupted (valves are closed)	1. Continue batching with command "GO ON". 2. Interrupt batching with "STOP" command.
No. # 6xx → Simulation mode active			
601	S: POS. ZERO-RETURN !: # 601	Positive zero return active  Caution! This message has the highest display priority!	Switch off positive zero return
611 ... 614	S: SIM. CURR. OUT. n !: # 611...614	Simulation current output active	Switch off simulation
621 ... 624	S: SIM. FREQ. OUT. n !: # 621...624	Simulation frequency output active	Switch off simulation
631 ... 634	S: SIM. PULSE n !: # 631...634	Simulation pulse output active	Switch off simulation
641 ... 644	S: SIM. STAT. OUT n !: # 641...644	Simulation status output active	Switch off simulation
651 ... 654	S: SIM. RELAY n !: # 651...654	Simulation relay output active	Switch off simulation
661	S: SIM. CURR. IN n !: # 661	Simulation current input active	Switch off simulation
671 ... 674	S: SIM. STATUS IN !: # 671...674	Simulation status input active	Switch off simulation
691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active	Switch off simulation
692	S: SIM. MEASURAND !: # 692	Simulation of volume flow active	Switch off simulation
698	S: DEV. TEST ACT. !: # 698	The measuring device is being checked on site via the test and simulation device.	—

9.3 Process error messages

Process errors can be defined as either “Fault” or “Notice” messages and can thereby be weighted differently. Determination of this is done via the function matrix (see the “Description of Device Functions” Manual).



Note!

The error types listed in the following correspond to the factory settings.

Also observe the information on Page 67 and 112

No.	Error message / Type	Cause	Remedy
P = Process error ⚡ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
No. # 4xx → Process limits exceeded			
401	P: EMPTY PIPE ⚡: # 401	Measuring tube partially filled or empty	– Check the process conditions of the plant – Fill the measuring tube
461	P: ADJ. NOT OK !: # 461	EPD/OED adjustment not possible because the fluid's conductivity is either too low or too high.	The EPD/OED function cannot be used with fluids of this nature.
463	P: FULL = EMPTY ⚡: # 463	The EPD/OED adjustment values for empty pipe and full pipe are identical, therefore incorrect.	Repeat adjustment, making sure procedure is correct → Page 93
471	P: > BATCH TIME ⚡: # 471	The maximum permitted batching time was exceeded.	1. Increase flow rate 2. Check valve (opening) 3. Adjust time setting to changed batch quantity
472	P: >< BATCH QUANTITY ⚡: # 472	– Underbatching: The minimum quantity was not reached. – Overbatching: The maximum permitted batching quantity was exceeded.	<i>Underbatching:</i> 1. Increase fixed correction quantity. 2. Valve closes too quickly with active after run correction. Enter smaller after run as mean value. 3. If the batching quantity changes, the minimum batching quantity must be adjusted. <i>Overbatching:</i> 1. Reduce fixed correction quantity. 2. Valve closes too slowly with active after run correction. Enter larger after run as mean value. 3. If the batching quantity changes, the maximum batching quantity must be adjusted.
473	P: PROGRESS NOTE !: # 473	End of filling process approaching. The running filling process has exceeded the predefined batch quantity point for the display warning message.	No measures required (if necessary prepare to replace container).
474	P: MAX. FLOW ⚡: # 474	Maximum flow value entered is overshoot.	Reduce the flow value Note! Please observe Note in error message No. 471

9.4 Process errors without message

Symptoms	Rectification
N.B.: You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault. The functions outlined below, such as DISPLAY DAMPING, 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.	- Remote version: - Switch off the power supply and check the wiring → Page 47 ff. - If necessary, reverse the connections at terminals 41 and 42 - Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly
Measured-value reading fluctuates even though flow is steady.	- Check grounding and potential equalization → Page 56 ff. - Check the fluid for presence of gas bubbles. - In the "TIME CONSTANT" function (current output) → increase the value - In the "DISPLAY DAMPING" function → increase the value
Measured-value reading or measured-value output pulsates or fluctuates, e.g. because of reciprocating pump, peristaltic pump, diaphragm pump or pump with similar delivery characteristic.	Run the "Pulsating Flow" Quick Setup → Page 87 ff. 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.	- Check grounding and potential equalization → Page 56 ff. - Check the fluid for presence of gas bubbles. - Activate the "LOW FLOW CUTOFF" function, i.e. enter or increase the value for the switching point.
Measured-value reading on display, even though measuring tube is empty.	- Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe detection → Page 93 - Remote version: Check the terminals of the EPD cable → Page 47 ff. - Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	- Select the "BUS ADDRESS" function and change the setting to "0". - Value for creepage too high. Reduce the corresponding values in the "Low flow cutoff" functions (ON-/OFF VALUE).
The fault cannot be rectified or some other fault not described above has arisen. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: Request the services of an Endress+Hauser service technician If you contact our service organization to have a service technician sent out, please be ready to quote the following information: - Brief description of the fault - Nameplate specifications (Page 9 ff.): order code, serial number Returning devices to Endress+Hauser The procedures on Page 8 must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted form at the back of this manual. Replace transmitter electronics Components in the measuring electronics defective → order spare parts → Page 114

9.5 Response of outputs to errors



Note!
The failsafe mode of totalizers, 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.

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

Failsafe mode of outputs and totalizers		
	Process/system error is current	Positive zero return is activated
 Caution! System or process errors defined as “Notice messages” have no effect whatsoever on the inputs and outputs. See the information on Page 67 ff.		
Current output	<i>MINIMUM CURRENT</i> 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). <i>MAXIMUM CURRENT</i> 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). <i>HOLD VALUE</i> Measured value display on the basis of the last saved value preceding occurrence of the fault. <i>ACTUAL VALUE</i> Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to “zero flow”
Pulse output	<i>FALLBACK VALUE</i> Signal output → no pulses <i>ACTUAL VALUE</i> Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to “zero flow”

Failsafe mode of outputs and totalizers		
	Process/system error is current	Positive zero return is activated
Frequency output	<i>FALLBACK VALUE</i> Signal output → 0 Hz <i>FAILSAFE LEVEL</i> Output of the frequency specified in the FAILSAFE VALUE function (No. 4211). <i>HOLD VALUE</i> Last valid value (preceding occurrence of the fault) is output. <i>ACTUAL VALUE</i> Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to “zero flow”
Totalizer	<i>STOP</i> The totalizers are paused until the error is rectified. <i>ACTUAL VALUE</i> The fault is ignored. The totalizers continue to count in accordance with the current flow value. <i>HOLD VALUE</i> The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
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, limits, etc.	No effect on relay output

9.6 Spare parts

Chap. 9.1 contains a detailed trouble-shooting guide. 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.

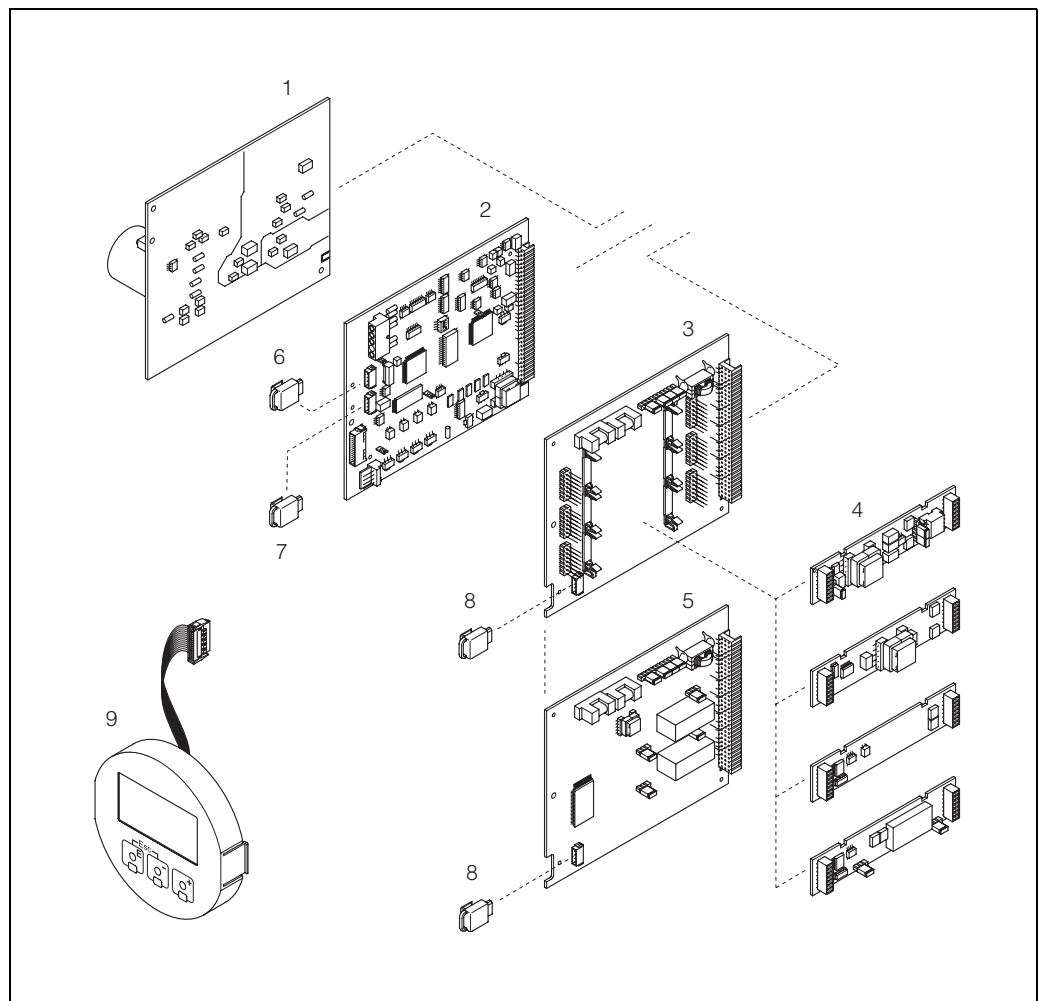


Note!

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

Spare parts are shipped as sets comprising the following parts:

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



F06-53xxxxxx-03-06-06-xx-000

Fig. 60: Spare parts for Promag 53 transmitter (field and wall-mount housing)

- 1 Power unit board (85...260 V AC, 20...55 V AC, 16...62 V DC)
- 2 Amplifier board
- 3 I/O board (flexible assignment)
- 4 Pluggable input/output submodules (ordering structure → Page 101)
- 5 I/O board (permanent assignment)
- 6 S-DAT (sensor data memory)
- 7 T-DAT (transmitter data memory)
- 8 F-CHIP (function chip for optional software)
- 9 Display module

9.7 Removing and installing printed circuit boards

Field housing: removing and installing printed circuit boards (Fig. 61)



Warning!

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

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, 7):
Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
5. Remove submodules (6.2):
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 (see Page 54). The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

“INPUT / OUTPUT 2” slot = terminals 24 / 25

“INPUT / OUTPUT 3” slot = terminals 22 / 23

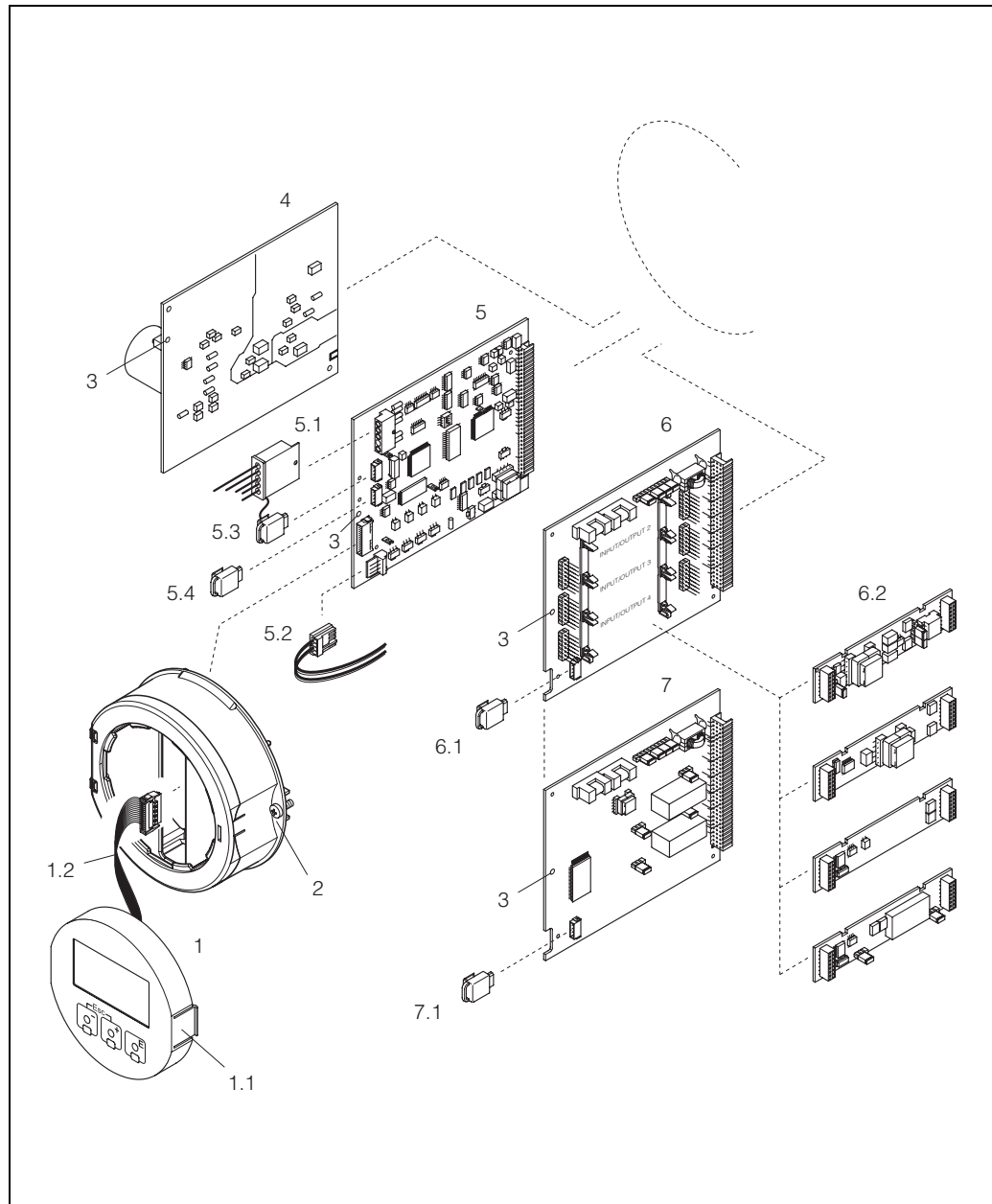
“INPUT / OUTPUT 4” slot = terminals 20 / 21

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 to and fro.
 - 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.



Caution!

Use only original Endress+Hauser parts.



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Fig. 61: 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 memory)
- 5.4 T-DAT (transmitter data memory)
- 6 I/O board (flexible assignment)
- 6.1 F-CHIP (function chip for optional software)
- 6.2 Pluggable submodules (status input and current input; current output, frequency output, relay output)
- 7 I/O board (permanent assignment)
- 7.1 F-CHIP (function chip for optional software)

Wall-mounted housing: removing and installing printed circuit boards (Fig. 62)**Warning!**

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

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-mounted 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). To do so, loosen the plug locking of the coil current cable and gently disconnect the plug from the board, i.e. without moving it to and fro.
 - Ribbon cable plug (3) of the display module
4. Remove the cover (4) from the electronics compartment by loosening the screws.
5. Remove the boards (6, 7, 8, 9):
Insert a thin pin into the hole (5) provided for the purpose and pull the board clear of its holder.
6. Remove submodules (8.2):
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 (see Page 54). The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

“INPUT / OUTPUT 2” slot = terminals 24 / 25

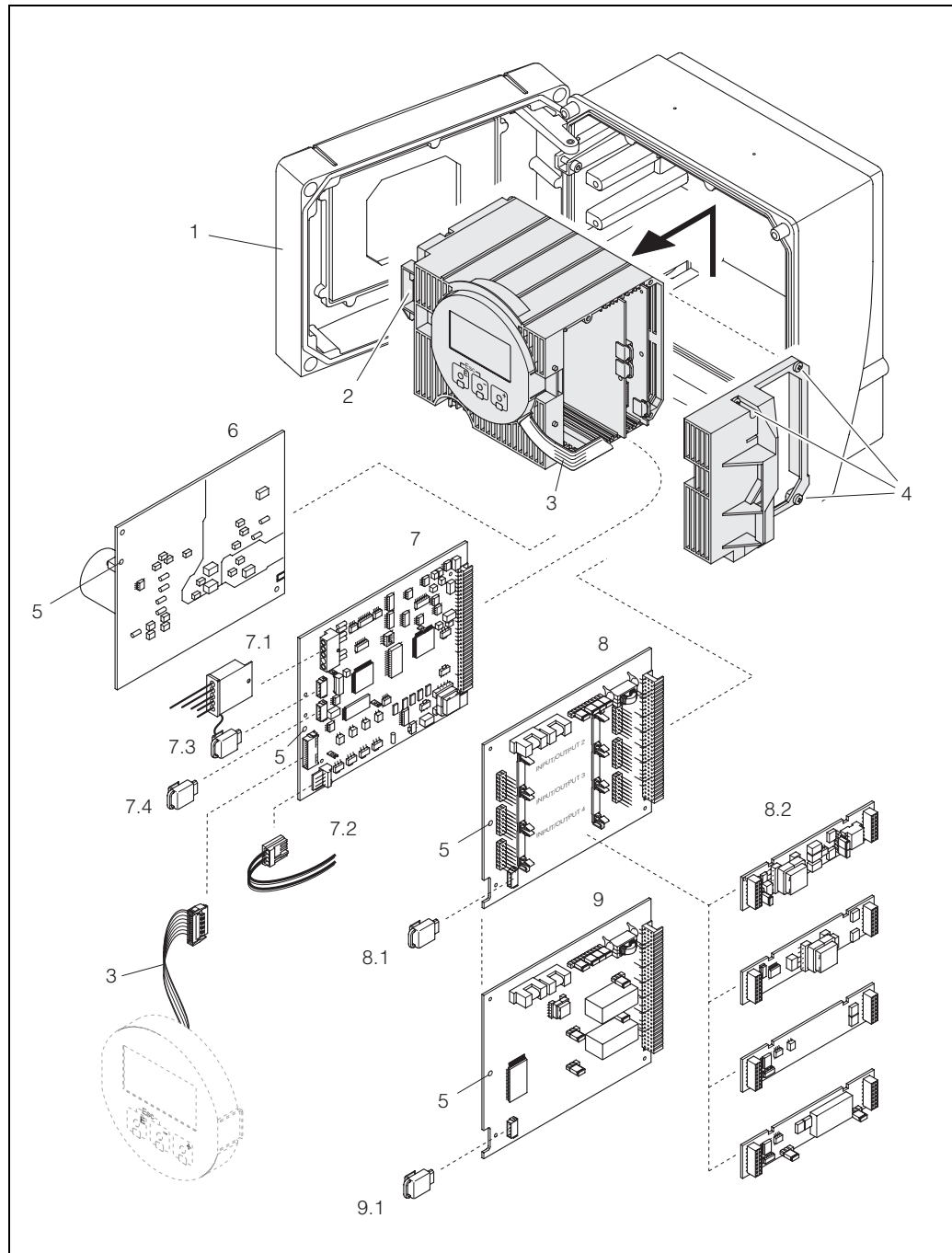
“INPUT / OUTPUT 3” slot = terminals 22 / 23

“INPUT / OUTPUT 4” slot = terminals 20 / 21

7. Installation is the reverse of the removal procedure.

**Caution!**

Use only original Endress+Hauser parts.



F06-53XXXXXX-03-03-06-XF-000

Fig. 62: Wall-mounted 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 memory)
- 7.4 T-DAT (transmitter data memory)
- 8 I/O board (flexible assignment)
- 8.1 F-CHIP (function chip for optional software)
- 8.2 Pluggable submodules (status input and current input, current output, frequency output, relay output)
- 9 I/O board (permanent assignment)
- 9.1 F-CHIP (function chip for optional software)

9.8 Replacing the device fuse



Warning!

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

The main fuse is on the power supply board (Fig. 63).

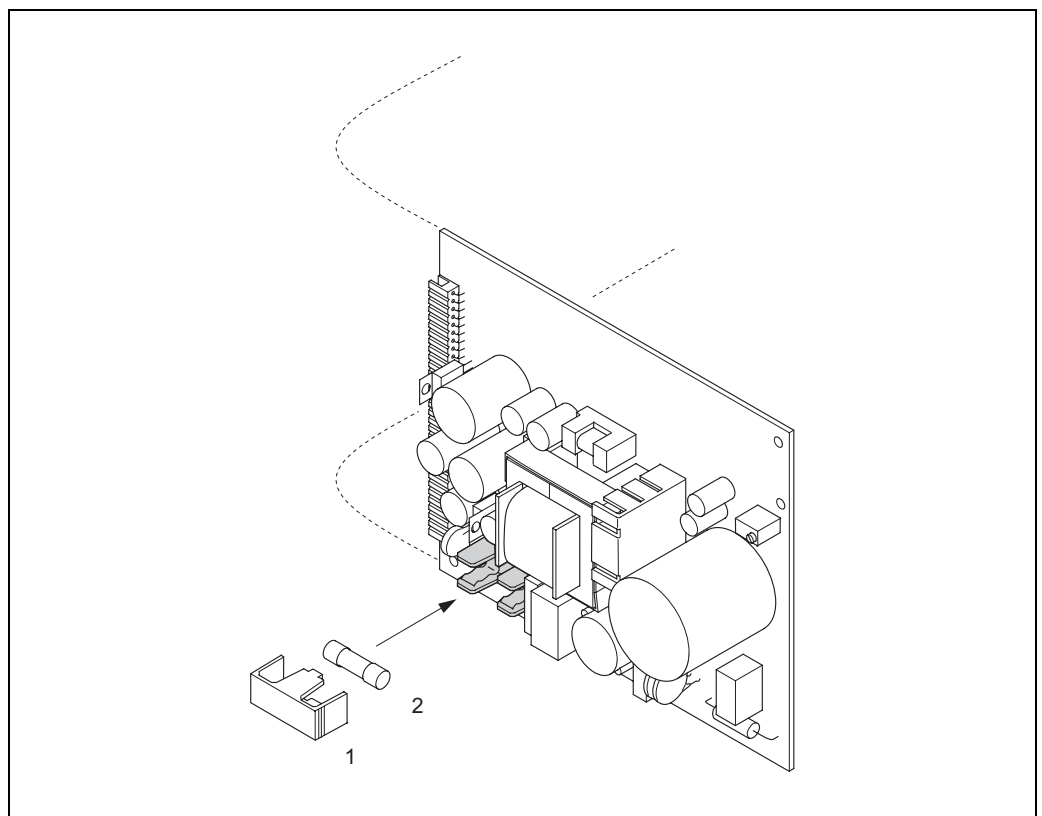
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power supply board → Page 115, 117
3. Remove cap (1) and replace the device fuse (2).
Use only fuses of the following type:
 - Power supply 20...55 V AC / 16...62 V DC → 2.0 A slow-blow / 250 V; 5.2 x 20 mm
 - Power supply 85...260 V AC → 0.8 A slow-blow / 250 V; 5.2 x 20 mm
 - Ex-rated devices → see the Ex documentation.
4. Assembly is the reverse of the disassembly procedure.



Caution!

Use only original Endress+Hauser parts.



A0001148

Fig. 63: Replacing the device fuse on the power supply board

- 1 Protective cap
2 Device fuse

9.9 Replacing exchangeable measuring electrodes

The Promag W sensor (DN 350...2000) is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions (see Page 121).

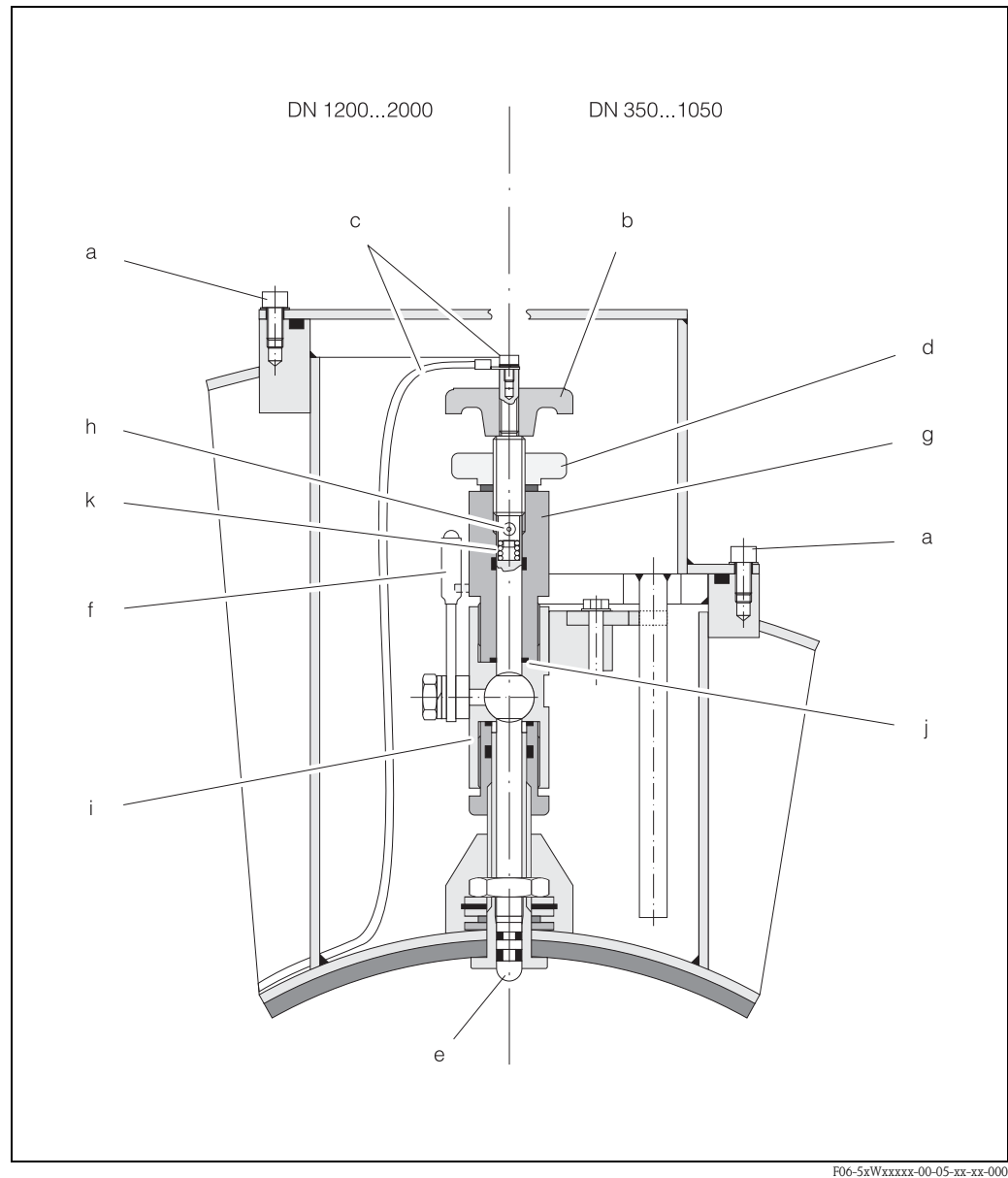


Fig. 64: Apparatus for replacing exchangeable measuring electrodes (Replacing → Page 121)

- a Allen screw
- b Handle
- c Electrode cable
- d Knurled nut (locknut)
- e Measuring electrode
- f Stop cock
- g Retaining cylinder
- h Locking pin (for handle)
- i Ball valve housing
- j Seal (retaining cylinder)
- k Coil spring

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

9.10 Software history

Date	Software version	Changes to documentation	Operating Instructions
03.2005	2.00.XX	Software expansion: – Language group (contains the language Chinese and English) New functionalities: – DEVICE SOFTWARE → Device software displayed (NAMUR-recommendation 53) – Unit US Kgal	50097083/03.05
11.2004	Amplifier: 1.06.01 Communication module: 1.04.00	Software update relevant only for production	50097083/10.03
10.2003	Amplifier: 1.06.00 Communication module: 1.03.00	Software expansion: – Language groups – Flow direction pulse output selectable New functionalities: – Second Totalizer – Adjustable backlight (display) – Operation hours counter – Simulation function for pulse output – Access code for counter – Reset function (fault history) – Up-/download with FieldTool	50097083/10.03
08.2003	Communication module: 1.02.01	Software expansion: – New / revised functionalities Special documentation: – Current span NAMUR NE 43 – Failsafe mode function – Trouble-shooting function – System and process error messages – Response of status output	50097083/08.03
08.2002	Amplifier: 1.04.00	Software expansion: – New / revised functionalities Special documentation: – Current span NAMUR NE 43 – Quick Setup “Batching” – EPD (new mode) – Failsafe mode function – Acknowledge fault function – Trouble-shooting function – Function “T-DAT SAVE/LOAD” – System and process error messages – Response of relay and status output	50097083/08.02
06.2001	Amplifier: 1.02.00 Communication module: 1.02.00	Software expansion: – New functionalities New functionalities: – Device functions in general – “Batching” software function – “OED” software function – “Advanced Diagnostics” software function – “Pulse width” software function	50097083/06.01

Date	Software version	Changes to documentation	Operating Instructions
09.2000	Amplifier: 1.01.01 Communication module: 1.01.00	Software expansion: – Functional adaptations)	none
08.2000	Amplifier: 1.01.00	Software expansion: – Functional adaptations)	none
04.2000	Amplifier: 1.00.00 Communication module: 1.00.00	Original software. Compatible with: – FieldTool – Commuwin II (version 2.05.03 and higher) – HART Communicator DXR 375 (from OS 4.6) with Rev. 1, DD 1.	–

**Note!**

Usually, an upload or download between the different software versions is only possible with a special service software.

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

Application

- Measuring the flow rate of fluids in closed piping systems.
- A minimum conductivity of $\geq 5 \mu\text{S}/\text{cm}$ is required for measuring; the minimum conductivity required in the case of demineralised water is $\geq 20 \mu\text{S}/\text{cm}$.
- Applications in measuring, control and regulation technology for monitoring processes, filling and batching operations.

Liner specific applications:

- Promag W (DN 25...2000):
 - 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...600):
 - 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...100):
 - 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

The measuring system consists of a transmitter and a sensor.

Two versions are available:

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

Transmitter:

- Promag 53

Sensor:

- Promag W (DN 25...2000)
- Promag P (DN 15...600)
- Promag H (DN 2...100)

10.1.3 Input

Measured variable

Flow rate (proportional to induced voltage)

Measuring range

Typically $v = 0.01 \dots 10 \text{ m/s}$ with the specified measuring accuracy

Operable flow range

Over 1000 : 1

Input signals	Status input (auxiliary input): $U = 3 \dots 30 \text{ V DC}$, $R_i = 5 \text{ k}\Omega$, galvanically isolated Configurable for: totalizer(s) reset, measured value suppression, error-message reset Current input (active, passive): galvanically isolated, full scale value selectable, resolution: $3 \text{ }\mu\text{A}$, temperature coefficient: typically $0.005\% \text{ o.f.s./}^\circ\text{C}$ active: $4 \dots 20 \text{ mA}$, $R_i \leq 150 \text{ }\Omega$, max. 24 V DC, short-circuit proof; passive: $0/4 \dots 20 \text{ mA}$, $R_i < 150 \text{ }\Omega$, max. 30 V DC
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10.1.4 Output

Output signal	Current output: active/passive selectable, galvanically isolated, time constant selectable ($0.01 \dots 100 \text{ s}$), full scale value selectable, temperature coefficient: typically $0.005\% \text{ o.f.s./}^\circ\text{C}$; resolution: $0.5 \text{ }\mu\text{A}$ ■ active: $0/4 \dots 20 \text{ mA}$, $R_L < 700 \text{ }\Omega$ (for HART: $R_L \geq 250 \text{ }\Omega$) ■ passive: $4 \dots 20 \text{ mA}$, supply voltage V_s: $18 \dots 30 \text{ V DC}$, $R_i \geq 150 \text{ }\Omega$ Pulse / frequency output: active/passive selectable, galvanically isolated ■ active: 24 V DC, 25 mA (max. $250 \text{ mA}/20 \text{ ms}$), $R_L > 100 \text{ }\Omega$ ■ passive: open collector, 30 V DC, 250 mA ■ Frequency output: full scale frequency $2 \dots 10000 \text{ Hz}$ ($f_{\text{max}} = 12500 \text{ Hz}$), on/off ratio 1:1, pulse width max. 10 s ■ Pulse output: pulse value and pulse polarity selectable, pulse width configurable ($0.05 \dots 2000 \text{ ms}$)
Signal on alarm	■ Current output → failsafe mode selectable (e.g. to NAMUR recommendation NE 43) ■ Pulse/frequency output → failsafe mode selectable ■ Relay output → “de-energised” by fault or power supply failure Details → Page 112
Load	see “output signal”
Switching output	Relay output (relay 1, relay 2): Normally closed (NC or break) or normally open (NO or make) contacts available (default: relay 1 = NO, relay 2 = NC), max. $30 \text{ V} / 0.5 \text{ A AC}$; $60 \text{ V} / 0.1 \text{ A DC}$, galvanically isolated. Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values, batching contacts.
Low flow cutoff	Switch points for low flow cutoff are selectable
Galvanic isolation	All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connections	see Page 47 ff.
Cable entry	Power-supply and signal cables (inputs/outputs): ■ Cable entry M20 x 1.5 (8...12 mm) ■ Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm) ■ Threads for cable entries, PG 13.5 (5...15 mm), 1/2" NPT, G 1/2" Connecting cable for remote version: ■ Cable entry M20 x 1.5 (8...12 mm) ■ Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm) ■ Threads for cable entries, PG 13.5 (5...15 mm), 1/2" NPT, G 1/2"
Cable specifications	see Page 51
Supply voltage	85...260 V AC, 45...65 Hz 20...55 V AC, 45...65 Hz 16...62 V DC
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 chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point, etc.)
Potential equalisation	see Page 56 ff.

10.1.6 Performance characteristics

Reference operating conditions	To 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.
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Maximum measured error	Pulse output: ± 0.2% o.r. ± 2 mm/s (o.r. = of reading) Current output: plus typically ± 5 µA Supply-voltage fluctuations have no effect within the specified range.
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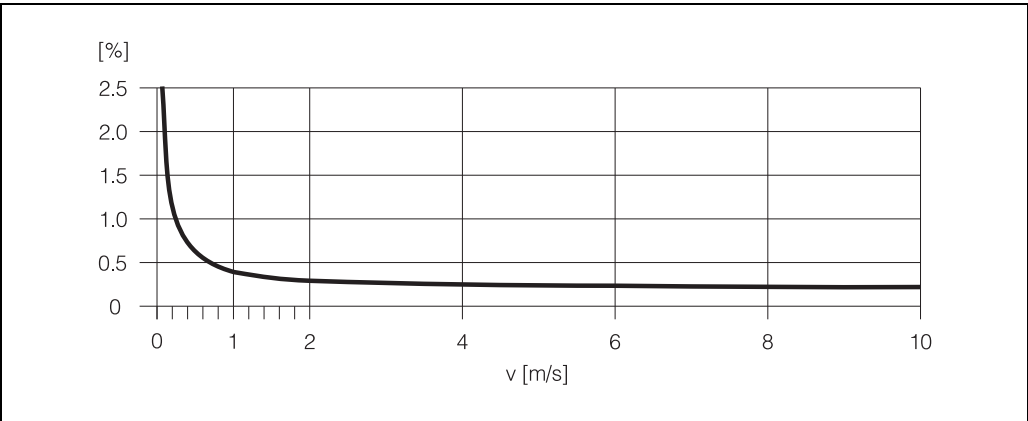


Fig. 65: Max. measured error in % of reading

F06-53xxxxxx-05-xx-xx-xx-001

Repeatability	max. ± 0.1% o.r. ± 0.5 mm/s (o.r. = of reading)
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10.1.7 Operating conditions

Installation

Installation instructions	Any orientation (vertical, horizontal) Restrictions and additional installation instructions → Page 15 ff.
Inlet and outlet runs	Inlet run: typically $\geq 5 \times \text{DN}$ Outlet run: typically $\geq 2 \times \text{DN}$
Length of connecting cable	■ For the remote version the permissible cable length L_{max} depends on the conductivity of the medium (see Page 25). ■ A minimum conductivity of $20 \mu\text{S}/\text{cm}$ is required for measuring demineralized water.

Environment

Ambient temperature	Transmitter: ■ Standard: $-20 \dots +60 \text{ }^{\circ}\text{C}$ ■ Optional: $-40 \dots +60 \text{ }^{\circ}\text{C}$  Note! At ambient temperatures below $-20 \text{ }^{\circ}\text{C}$ the readability of the display may be impaired. Sensor: ■ Flange material carbon steel: $-10 \dots +60 \text{ }^{\circ}\text{C}$ ■ Flange material stainless steel: $-40 \dots +60 \text{ }^{\circ}\text{C}$  Caution! It is not allowed to use the device beyond the min. and max. lining specified temperature values (→ “Medium temperature range”). Note the following points: ■ Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. ■ If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ “Medium temperature range”).
Storage temperature	The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.
Degree of protection	■ Standard: IP 67 (NEMA 4X) for transmitter and sensor ■ Optional: IP 68 (NEMA 6P) for remote version of Promag W and P sensor
Shock and vibration resistance	Acceleration up to 2 g by analogy with IEC 60068-2-6 (high-temperature version: no data available)
CIP cleaning	Promag W: not possible Promag P: possible (note max. temperature) Promag H: possible (note max. temperature)
SIP cleaning	Promag W: not possible Promag P: possible with PFA (note max. temperature) Promag H: possible (note max. temperature)
Electromagnetic compatibility (EMC)	To EN 61326/A1 and NAMUR recommendation NE 21.

Process

Medium temperature range The permissible fluid temperature depends on the lining of the measuring tube:

Promag W
0...+80 °C for hard rubber (DN 65...2000)
-20...+50 °C for polyurethane (DN 25...1000)

Promag P
-40...+130 °C for PTFE (DN 15...600), for restrictions → refer to diagrams
-20...+180 °C for PFA (DN 25...200), for restrictions → refer to diagrams

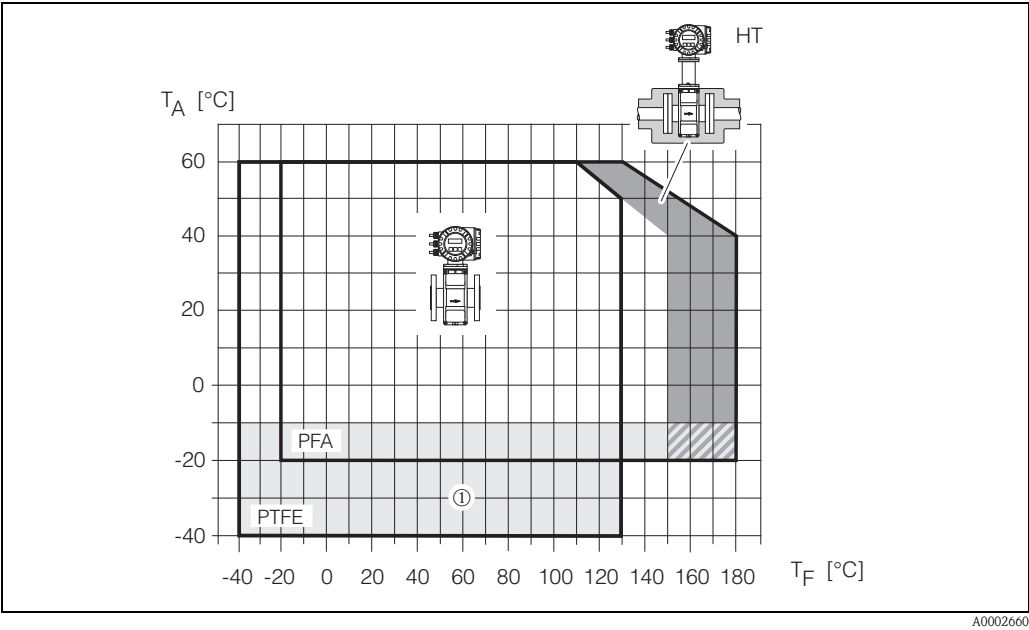


Fig. 66: Compact version Promag P (with PFA or PTFE lining)
 T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation
① = Temperature range from -10 °C to -40 °C is valid for stainless steel flanges only

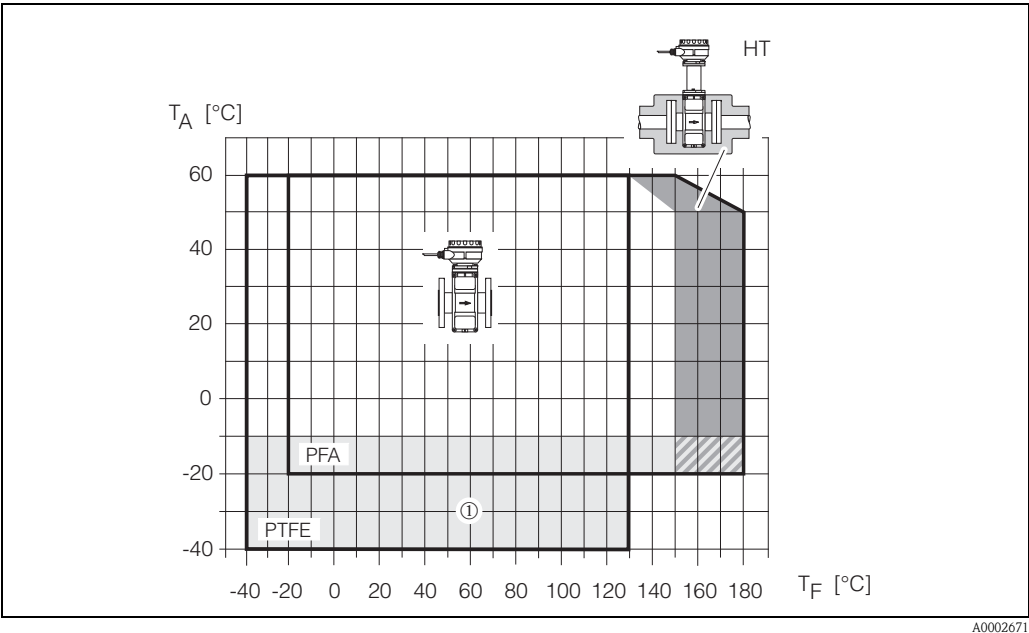


Fig. 67: Remote version Promag P (with PFA or PTFE lining)
 T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation
① = Temperature range from -10 °C to -40 °C is valid for stainless steel flanges only

Promag H

Sensor:

- DN 2...25: -20...+150 °C
- DN 40...100: -20...+150 °C

Seal:

- EPDM: -20...+130 °C
- Silicone: -20...+150 °C
- Viton: -20...+150 °C
- Kalrez: -20...+150 °C

Conductivity

Minimum conductivity:

- $\geq 5 \mu\text{S}/\text{cm}$ for fluids generally
- $\geq 20 \mu\text{S}/\text{cm}$ for demineralised water

Note that in the case of the remote version, the requisite conductivity is also influenced by the length of the connecting cable → Page 25.

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

- EN 1092-1 (DIN 2501): PN 6 (DN 1200...2000), PN 10 (DN 200...2000), PN 16 (DN 65...2000), PN 25 (DN 200...1000), PN 40 (DN 25...150)
- ANSI B16.5: Class 150 (1...24"), Class 300 (1...6")
- AWWA: Class D (28...78")
- JIS B2238: 10K (DN 50...300), 20K (DN 25...300)

Promag P

- EN 1092-1 (DIN 2501): PN 10 (DN 200...600), PN 16 (DN 65...600), PN 25 (DN 200...600), PN 40 (DN 15...150)
- ANSI B16.5: Class 150 (1/2...24"), Class 300 (1/2...6")
- JIS B2238: 10K (DN 50...300), 20K (DN 15...300)

Promag H

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

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

Pressure tightness
(liner)

Promag W Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures						
[mm]	[inch]		25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
25...1000	1...40"	Polyurethane	0	0	–	–	–	–	–
65...2000	3...78"	Hard rubber	0	0	0	–	–	–	–

Promag P Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures					
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
15	1/2"	PTFE	0	0	0	100	–	–
25	1"	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	1 1/2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
50	2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
65	–	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
80	3"	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
100	4"	PTFE / PFA	0 / 0	*	135 / 0	170 / 0	– / 0	– / 0
125	–	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
150	6"	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
200	8"	PTFE / PFA	200 / 0	*	290 / 0	410 / 0	– / 0	– / 0
250	10"	PTFE	330	*	400	530	–	–
300	12"	PTFE	400	*	500	630	–	–
350	14"	PTFE	470	*	600	730	–	–
400	16"	PTFE	540	*	670	800	–	–
450	18"	PTFE	Partial vacuum is impermissible					
500	20"	PTFE						
600	24"	PTFE						
* No value can be quoted.								

Promag H Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures						
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C	
2...100	1/12...4"	PFA	0	0	0	0	0	0	

Limiting flow

see Page 21

Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter (Promag H: only DN 8 and larger).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → Page 20

10.1.8 Mechanical construction

Design / dimensions

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

Weight

Weight data of Promag W in kg

Nominal diameter		Compact version				Remote versin (without cable)				
		EN (DIN) / AS*		JIS	ANSI / AWWA	Sensor		ANSI / AWWA		Wall housing
[mm]	[inch]					EN (DIN) / AS*	JIS			
25	1"	PN 40	7.3	7.3	7.3	PN 40	5.3	10K	5.3	6.0
32	1 1/4"		8.0	7.3	–		5.3		–	6.0
40	1 1/2"		9.4	8.3	9.4		6.3		7.4	6.0
50	2"		10.6	9.3	10.6		7.3		8.6	6.0
65	2 1/2"	PN 16	12.0	11.1	–	PN 16	10.0	10K	–	6.0
80	3"		14.0	12.5	14.0		12.0		12.0	6.0
100	4"		16.0	14.7	16.0		14.0		14.0	6.0
125	5"		21.5	21.0	–		19.5		–	6.0
150	6"	PN 10	25.5	24.5	25.5	PN 10	23.5	10K	23.5	6.0
200	8"		45	41.9	45		43		43	6.0
250	10"		65	69.4	75		63		73	6.0
300	12"		70	72.3	110		68		108	6.0
350	14"	PN 10	115	Class 150	175	PN 10	113	10K	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"	PN 10	235	Class 150	405	PN 10	233	10K	403	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	Class D	800	PN 6	573	10K	798	6.0
1000	40"		700		900		698		898	6.0
–	42"		–		1100		–		1098	6.0
1200	48"		850		1400		848		1398	6.0
–	54"	PN 6	–	Class D	2200	PN 6	–	10K	2198	6.0
1400	–		1300		–		1298		–	6.0
–	60"		–		2700		–		2698	6.0
1600	–		1700		–		1698		–	6.0
–	66"	PN 6	–	Class D	3700	PN 6	–	10K	3698	6.0
1800	72"		2200		4100		2198		4098	6.0
–	78"		–		4600		–		4598	6.0
2000	–		2800		–		2798		–	6.0

Transmitter Promag (compact version): 3.4 kg

(Weight data valid for standard pressure ratings and without packaging material)

* Flanges according AS are only available for DN 80, 100, 150...400, 500 and 600

Weight data of Promag P in kg										
Nominal diameter		Compact version				Remote version (without cable)				
[mm]	[inch]	EN (DIN) /AS*	JIS	ANSI	EN (DIN) /AS*	Sensor	JIS	ANSI	Wall housing	
15	1/2"	PN 40	6.5	6.5	PN 40	4.5	4.5	4.5	6.0	
25	1"		7.3	7.3		5.3	5.3	5.3	6.0	
32	1 1/4"		8.0	7.3		6.0	5.3	–	6.0	
40	1 1/2"		9.4	8.3		7.4	6.3	7.4	6.0	
50	2"		10.6	9.3		8.6	7.3	8.6	6.0	
65	2 1/2"	PN 16	12.0	11.1	PN 16	10.0	9.1	–	6.0	
80	3"		14.0	12.5		12.0	10.5	12.0	6.0	
100	4"		16.0	14.7		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		23.5	22.5	23.5	6.0	
200	8"	PN 10	45	41.9	PN 10	43	39.9	43	6.0	
250	10"		65	69.4		63	67.4	73	6.0	
300	12"		70	72.3		68	70.3	108	6.0	
350	14"		115			113		173	6.0	
400	16"		135			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 Promag (compact version): 3.4 kg High-temperature version: +1.5 kg (Weight data valid for standard pressure ratings and without packaging material) * Flanges according AS are only available for DN 25 and 50										

Weight data of Promag H in kg				
Nominal diameter		Compact version	Remote version (without cable)	
		DIN	Sensor	Wall housing
[mm]	[inch]			
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	1/2"	5.4	2.6	6.0
25	1"	5.5	2.8	6.0
40	1 1/2"	6.5	4.5	6.0
50	2"	9.0	7.0	6.0
65	2 1/2"	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)				

Materials

Promag W

Transmitter housing:

- Compact housing: powder coated die-cast aluminium
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing:

- DN 25...300: powder-coated die-cast aluminium
- DN 350...2000: painted steel (Amerlock 400)

Measuring tube:

- DN < 350: stainless steel 1.4301 or 1.4306/304L; non-stainless flange material with Al/Zn protective coating
- DN > 300: 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: with Al/Zn protective coating; DN > 300 with Amerlock 400 paint)
- ANSI: A105, F316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AWWA: 1.0425
- JIS: RSt37-2 (S235JRG2) / H II / 1.0425 / 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AS 2129: (DN 150, 200, 250, 300, 600) A105 or RSt37-2 (S235JRG2) (DN 80, 100, 350, 400, 500) A105 or St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)

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

Electrodes: 1.4435 or Alloy C-22, tantalum

Seals: Seals to DIN EN 1514-1

Promag P

Transmitter housing:

- Compact housing: powder coated die-cast aluminium or stainless steel field housing
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing:

- DN 15...300: powder-coated die-cast aluminium
- DN 350...600: painted steel (Amerlock 400)

Measuring tube:

- DN < 350: stainless steel 1.4301 or 1.4306/304L; non-stainless flange material with Al/Zn protective coating
- DN > 300: 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: with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- ANSI: A105, F316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- JIS: RSt37-2 (S235JRG2) / H II / 1.0425 / 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AS 2129: (DN 25) A105 or RSt37-2 (S235JRG2) (DN 50) A105 oder St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)

Ground disks: 1.4435/316L or Alloy C-22
 Electrodes: 1.4435, platinum/rhodium 80/20 or Alloy C-22, tantalum
 Seals: Seals to DIN EN 1514-1

Promag H

Transmitter housing:

- Compact housing: powder coated die-cast aluminium or stainless-steel field housing 1.4301/316L
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing: 1.4301

Wall mounting (holder panel): 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 fitting made of PVC

Ground rings: 1.4435/316L, Option: 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...25: O-ring (EPDM, Viton, Kalrez) or gasket seal (EPDM, silicone, Viton)
- DN 40...100: gasket seal (EPDM, silicone)

Material load diagram

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the following documents:

- Technical Information "Promag 50/53 W" (TI 046D/06/en)
- Technical Information "Promag 50/53 P" (TI 047D/06/en)
- Technical Information "Promag 50/53 H" (TI 048D/06/en)

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...2000)

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 electrodes and EPD electrodes

- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20
- DN 2...4: without EPD electrode

Process connections	Promag W: Flange connection: EN 1092-1 (DIN 2501); DN 65 PN 16 and DN 600 PN 16 exclusively to EN 1092-1, ANSI, AWWA, JIS, AS
	Promag P: Flange connection: EN 1092-1 (DIN 2501); DN 65 PN 16 and DN 600 PN 16 exclusively to EN 1092-1, ANSI, JIS, AS
	Promag H: ■ 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 fittings ■ With gasket seal: weld nipples (DIN 11850, ODT / SMS), clamps (ISO 2852, DIN 32676, L14 AM7), threaded fasteners (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flanges (DIN 11864-2)

Surface roughness	■ PFA liner: $\leq 0.4 \mu\text{m}$ ■ Electrodes: – 1.4435, Alloy C-22: $0.3\ldots 0.5 \mu\text{m}$ – Tantalum, platinum/rhodium: $0.3\ldots 0.5 \mu\text{m}$ ■ Process connection Promag H: $\leq 0.8 \mu\text{m}$ (all data relate to parts in contact with medium)
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10.1.9 Human interface

Display elements	■ Liquid-crystal display: illuminated, four lines with 16 characters per line ■ Custom configurations for presenting different measured values and status variables ■ 3 totalizers ■ At ambient temperatures below -20°C the readability of the display may be impaired
Operating elements	■ Local operation with three optical keys (–, +, E) ■ Application-specific Quick Setup menus for straightforward commissioning
Language group	Language groups available for operation in different countries: ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech ■ South and east Asia (SEA): English, Japanese, Indonesian ■ China (CIN): English, Chinese You can change the language group via the operating program “ToF Tool – Fieldtool Package.”
Remote operation	Operation via HART protocol

10.1.10 Certificates and approvals

Ex Approvals	Information on the currently available Ex-rated versions (ATEX, FM, CSA, etc.) is available on request from your Endress+Hauser sales outlet. All information relevant to explosion protection is available in separate Ex documents that you can order as necessary.
Sanitary compatibility	Promag W: No applicable approvals or certification Promag P: No applicable approvals or certification Promag H: ■ 3A authorization and EHEDG-tested ■ Seals in conformity with FDA (except Kalrez seals)
Pressure Equipment Directive	Measuring devices with a nominal diameter smaller than or equal to DN 25 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. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.
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.
Other standards and guidelines	EN 60529 Degrees of protection by housing (IP code) EN 61010 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures EN 61326/A1 (IEC 6326) Electromagnetic compatibility (EMC requirements) NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment. NAMUR NE 43 Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal. NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics.

10.1.11 Ordering information

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

10.1.12 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor (see Page 101). The Endress+Hauser service organisation can provide detailed information on request.

10.1.13 Supplementary documentation

- System Information Promag (SI 028D/06/en)
- Technical Information Promag 50/53W (TI 046D/06/en)
- Technical Information Promag 50/53P (TI 047D/06/en)
- Technical Information Promag 50/53H (TI 048D/06/en)
- Description of Device Functions Promag 53 (BA 048D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

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Declaration of Contamination

Erklärung zur Kontamination

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or – even better – 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", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor

Geräte-/Sensortyp _____

Serial number

Seriennummer _____

Process data/Prozessdaten

Temperature / Temperatur _____ [°C] Pressure / Druck _____ [Pa]

Conductivity / Leitfähigkeit _____ [S] Viscosity / Viskosität _____ [mm²/s]

Medium and warnings

Warnhinweise zum Medium



	Medium /concentration Medium /Konzentration	Identification CAS No.	flammable entzündlich	toxic giftig	corrosive ätzend	harmful/ irritant gesundheitsschädlich/ 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 security sheet and, if necessary, special handling instructions.

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

Reason for return / Grund zur Rücksendung

Company data / Angaben zum Absender

Company / Firma _____	Contact person / Ansprechpartner _____
_____	Department / Abteilung _____
Address / Adresse _____	Phone number/ Telefon _____
_____	Fax / E-Mail _____
_____	Your order No. / Ihre Auftragsnr. _____

We hereby certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free from any residues in dangerous quantities.

Hiermit bestätigen wir, dass die zurückgesandten Teile sorgfältig gereinigt wurden, und nach unserem Wissen frei von Rückständen in gefährbringender Menge sind.

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