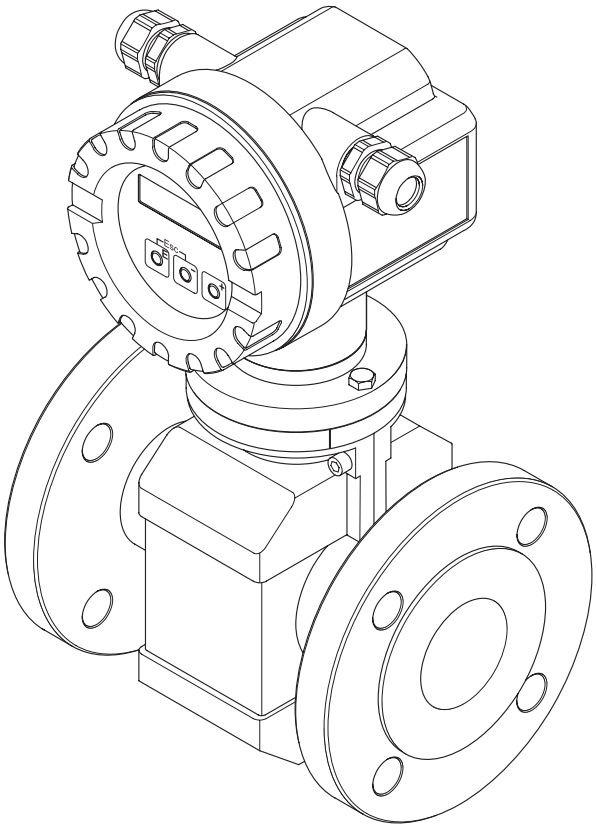
BA 082D/06/en/04.03
No. 50104788

Valid as of software version:
V 1.00.00 (amplifier)

PROline promag 10

Electromagnetic Flow Measuring System

Operating Instructions



Endress+Hauser
The Power of Know How

Brief operating instructions

These brief operating instructions explain how to commission your measuring device quickly and easily:

Safety instructions	Page 5

▼

Installation	Page 10

▼

Wiring	Page 35

▼

Switching on the measuring device	Page 60

▼

Display and operating elements	Page 48

▼

Commissioning	see Page 61 ff.
You can commission your measuring device quickly and easily using the brief operating instructions. It allows you to configure important basic functions using the local display, for example display language, measured variables, engineering units, signal type etc. If necessary, the following adjustments or configurations must be carried out separately: – Empty pipe/full pipe adjustment for Empty Pipe Detection	

▼

Customer-specific configuration	Page 49 ff.
Complex measurement tasks require the configuration of additional functions which you can individually select, set and adapt to your process conditions using the function matrix. All functions are described in detail, as is the function matrix itself on Page 92.	

▼
▼

Trouble-shooting	Page 66 ff.
Always start trouble-shooting with the checklist on Page 66 if faults occur after commissioning or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures. **Returning devices** If you return a measuring device to Endress+Hauser for repair or calibration, you must complete the “Declaration of Contamination” form and enclose it with the device. A copy of this form can be found at the end of this Operating Manual.	

Table of Contents

1 Safety instructions

1.1 Designated use

The measuring device described in these Operating Instructions is to be used only for measuring the flow rate of conductive fluid in closed pipes. The majority of fluids can be measured as of a minimum conductivity of 50 μS/cm e.g.:
- Acids, alkalis
- Drinking water, wastewater, sewage sludge
- Milk, beer, wine, mineral water, etc.

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

1.2 Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorised to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain.
- The device must be operated by persons authorised and trained by the facility's owner-operator. Strict compliance with the instructions in these Operating Instructions 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 isolated.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:
- The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of EN 61326.
- In the case of the Promag H sensor, the process connection seals must be replaced periodically depending on the application.
- The manufacturer reserves the right to modify technical data without prior notice. Your E+H distributor will supply you with current information and updates to these Operating Instructions.

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 fully completed "Declaration of Contamination" form with the device. 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 fluid residues. Pay special attention to the grooves for seals and crevices which could contain fluid residues. This is particularly important if the fluid is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
A *copy* of the "Declaration of Contamination" can be found at the end of these Operating Instructions.

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 (caustic 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. 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." They can, however, be a source of danger if used incorrectly or for use other than the designated use.
Consequently, always pay particular attention to the safety instructions indicated in these Operating Instructions by the following symbols:

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 10” flowmeter system consists of the following components:
- Promag 10 transmitter
- Promag W, Promag P or Promag H sensors

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

2.1.1 Nameplate of the transmitter

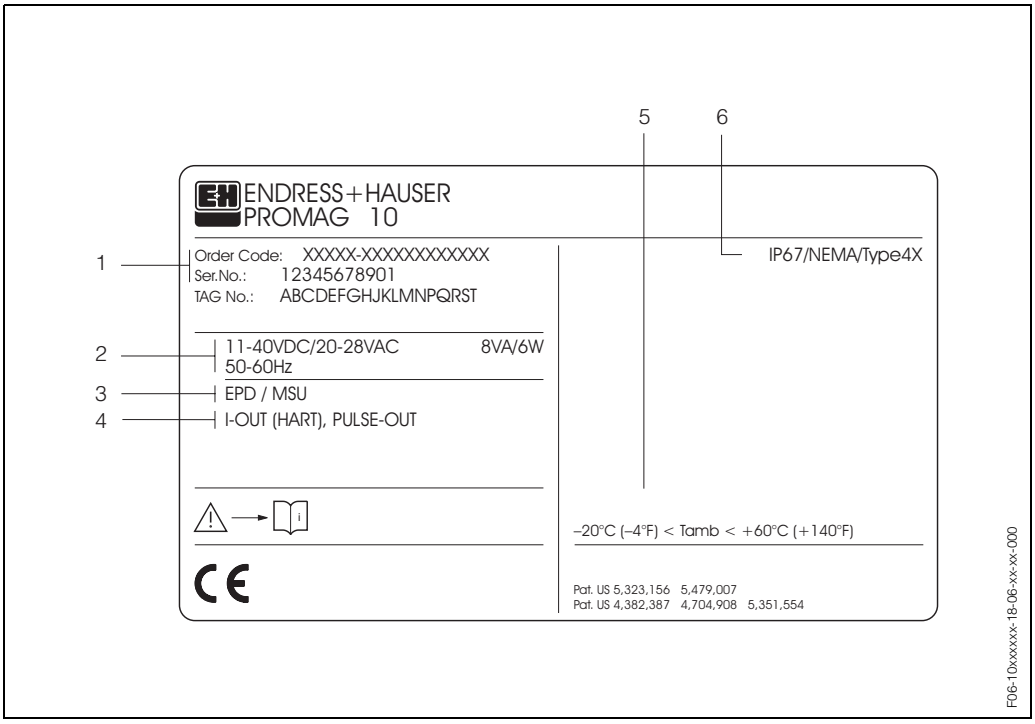


Fig. 1: Nameplate specifications for the “Promag 10” transmitter (example)

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: 11...40 V DC / 20...28 V AC
Power consumption: 6W/8VA
3 Additional information:
– EPD/MSU: with Empty Pipe Detection
4 Available outputs:
I-OUT (HART): with current output (HART)
PULSE-OUT: with pulse/status output
5 Permitted ambient temperature range
6 Degree of protection

2.1.2 Nameplate of the sensor

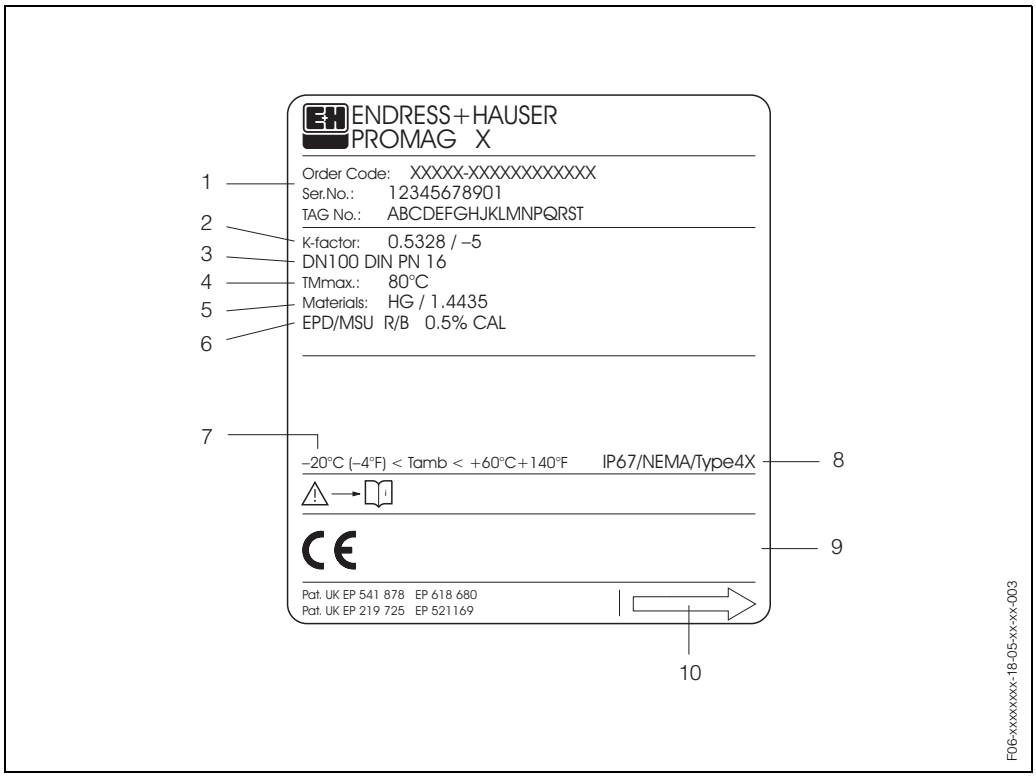


Fig. 2: Nameplate specifications for the "Promag" sensor (example)

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: DIN PN 16 bar
4 TMmax +80 °C (max. fluid temperature)
5 Materials:
– Lining: hard rubber
– Measuring electrodes: stainless steel 1.4435/316L
6 Additional information (examples):
– EPD/MSU: with Empty Pipe Detection electrode
– R/B: with reference electrode
– EME/AWE: with exchangeable measuring electrodes
– 0.5% CAL: with 0.5% calibration
7 Permitted ambient temperature range
8 Degree of protection
9 Reserved for additional information on device version (approvals, certificates)
10 Flow direction

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.”
The measuring system described in these Operating Instructions thus complies 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 ® and TEFLON ®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

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

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

FieldTool ™, FieldCheck ™, Applicator ™
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, Switzerland

3 Installation

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

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

3.1.2 Transport

Please note the following when unpacking or transporting to the measuring point:
- The devices must be transported in the container supplied.
- Do not remove the protective covers or caps on the process connections before installation. This applies especially to sensors with a Teflon lining!

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 at the connection housing of the remote version when transporting.

Transporting flanged devices (DN ≤ 300):
Use webbing slings slung round the two process connections (Fig. 3). 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, when transporting, make sure that the device does not unexpectedly turn around its axis or slip.

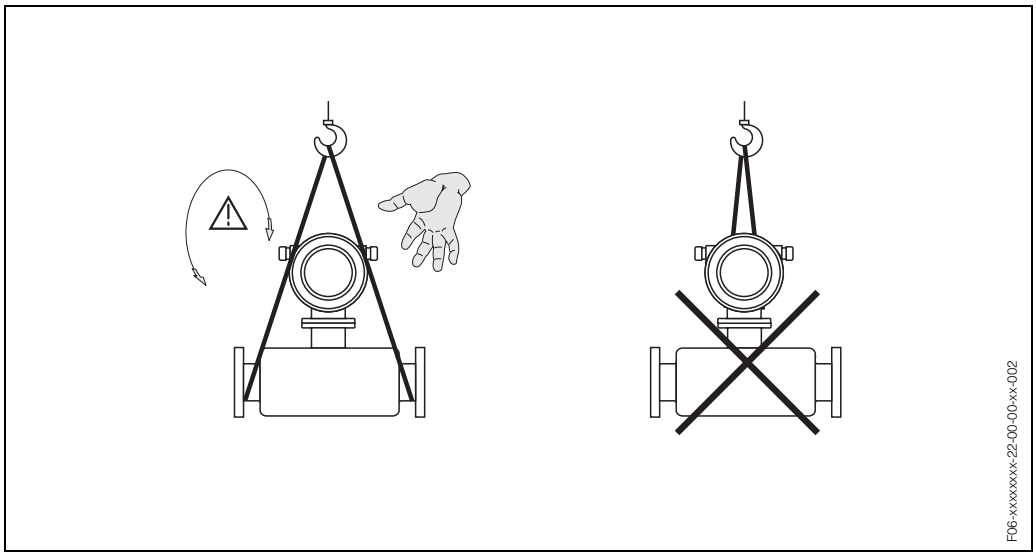


Fig. 3: Transporting sensors with DN ≤ 300

Transporting flanged devices (DN ≥ 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.

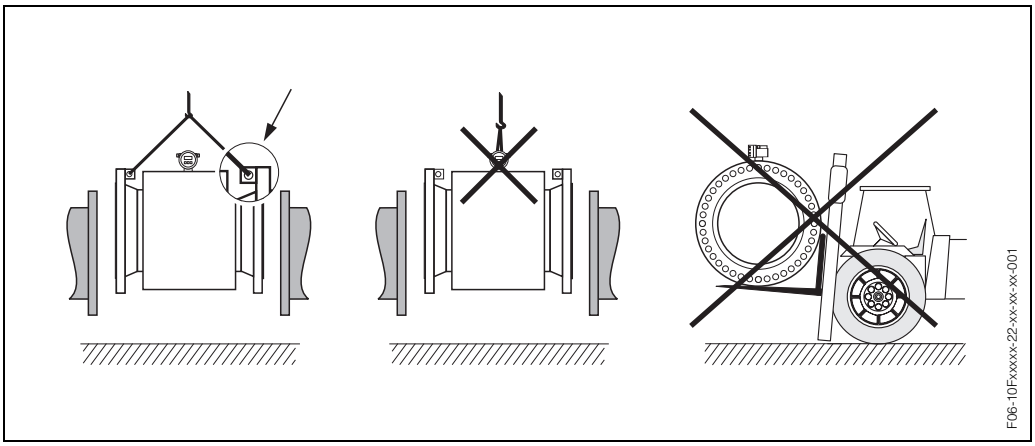


Fig. 4: Transporting sensors with DN ≥ 350

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 permissible storage temperature is –10...+50 °C (preferably +20 °C).
- Do not remove the protective covers or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with Teflon linings.
- 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.

3.2 Installation conditions

3.2.1 Dimensions

Dimensions and the fitting lengths of the sensor and the transmitter are found in the Technical Information of Promag 10 (see Page 88), which can be downloaded as PDF-files at www.endress.com.

3.2.2 Installation location

Correct measuring is possible only if the pipe is full. *Avoid* the following installation locations:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream a free pipe outlet in a vertical pipeline.

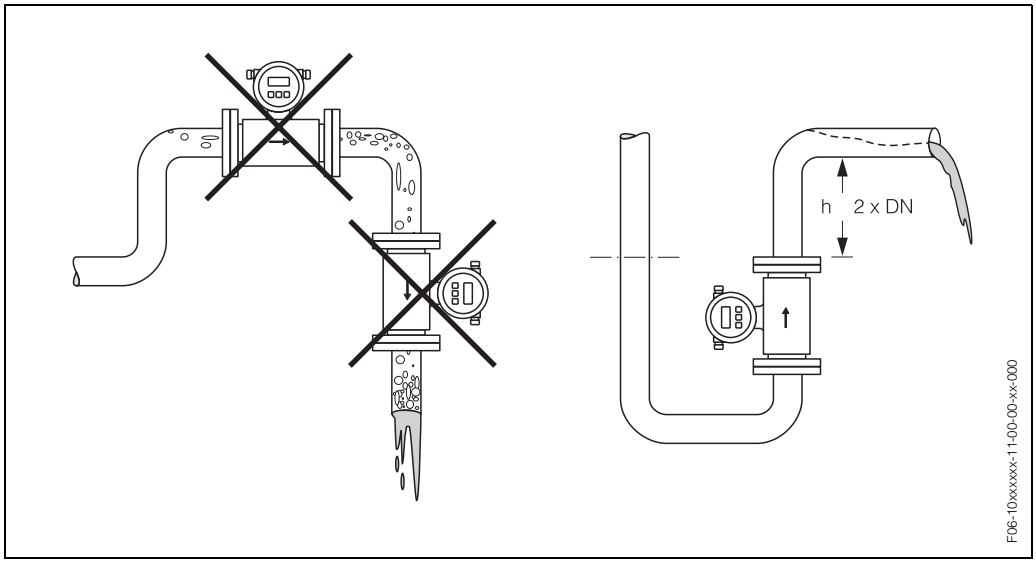


Fig. 5: Installation location

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 82.
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 80.

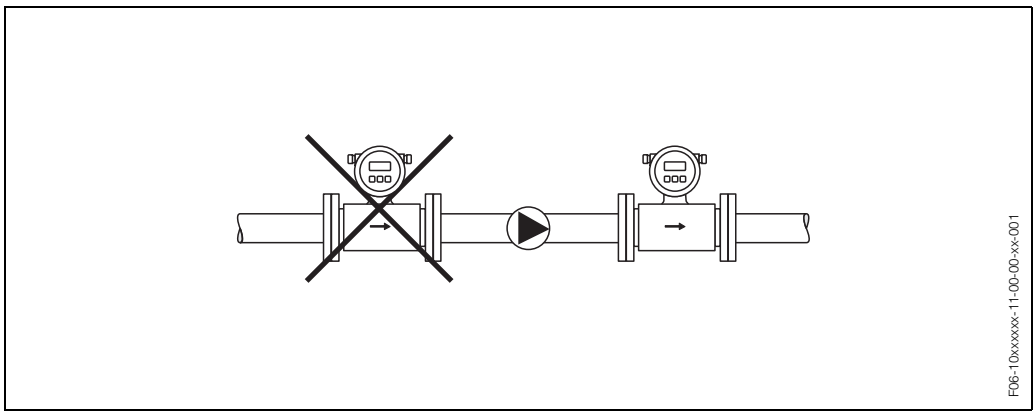


Fig. 6: Installation of pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function (see Page 107) 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.

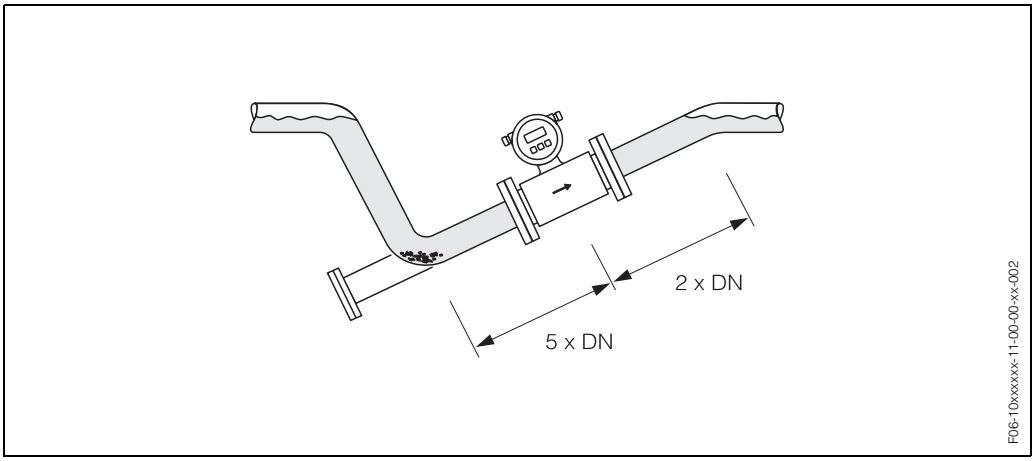


Fig. 7: Installation in partially filled pipes

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 82.

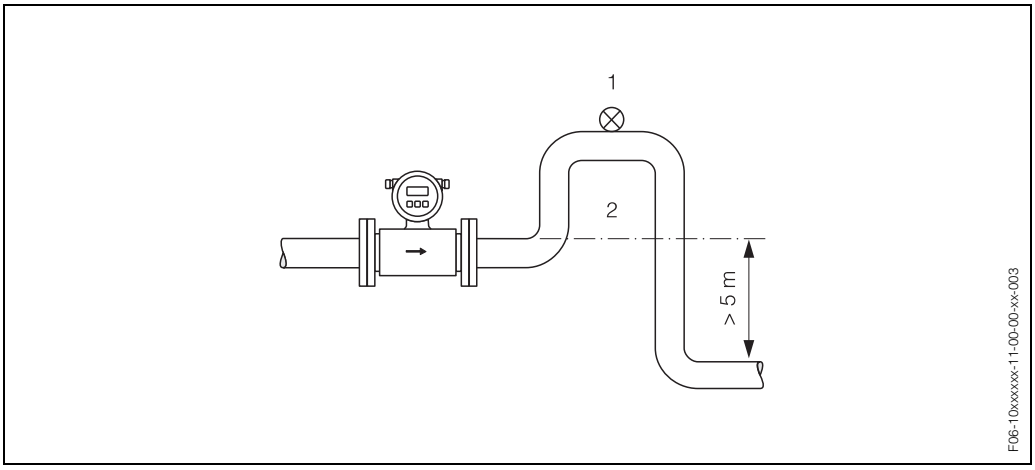


Fig. 8: Measures for installation in a down pipe (1 = vent valve; 2 = siphon)

3.2.3 Orientation

An optimum orientation helps avoid gas and air accumulations and deposits in the measuring tube. Promag, nevertheless, also offers the additional function of Empty Pipe Detection (EPD) for detecting partially filled measuring tubes or if outgassing fluids or fluctuating operating pressures are present (see Page 107)

Vertical orientation

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

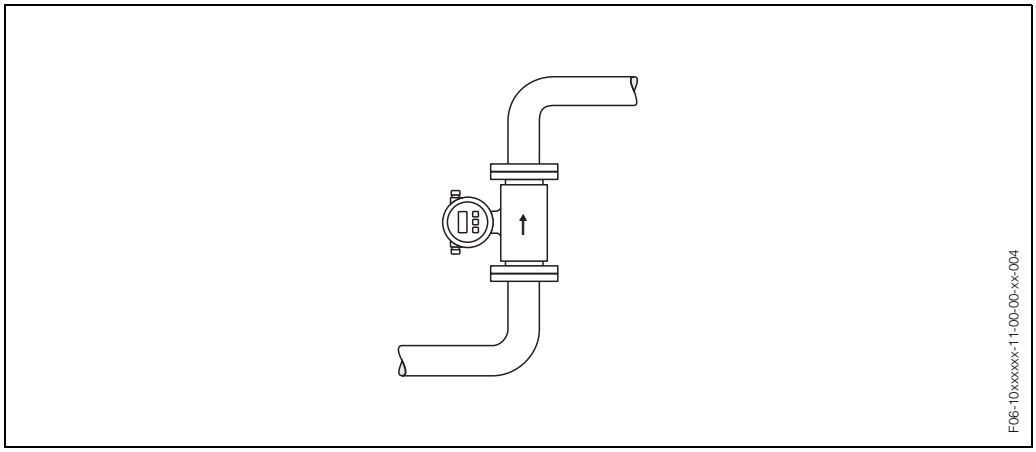


Fig. 9: Vertical orientation

Horizontal orientation

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

Caution!
Empty Pipe Detection functions correctly only when the measuring device is installed horizontally and the transmitter housing is facing upward (Fig. 10). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.

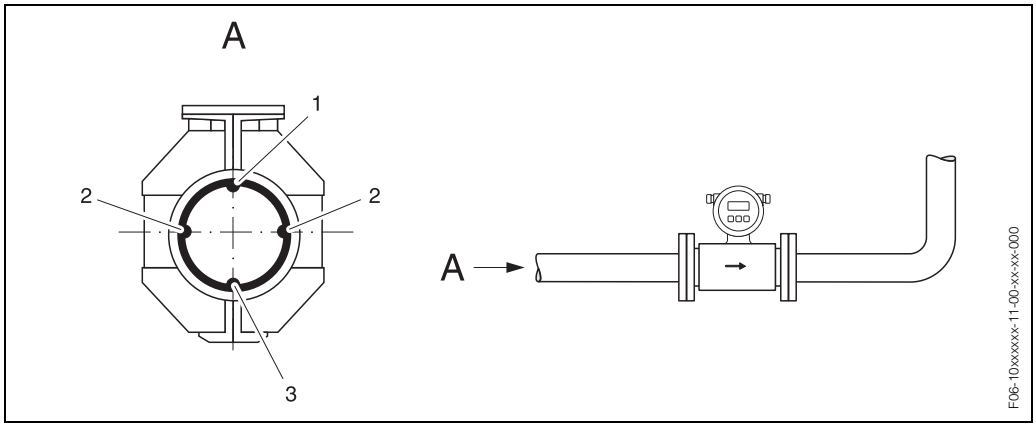


Fig. 10: Horizontal orientation

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 inlet and outlet runs is necessary in order to ensure measuring accuracy.

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

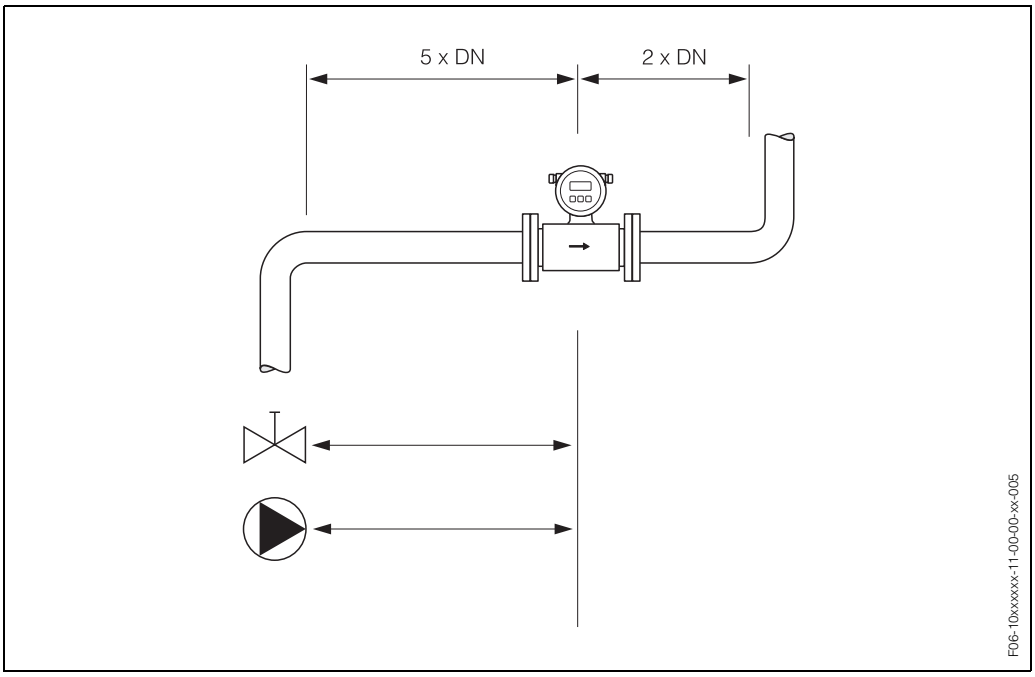


Fig. 11: Inlet and outlet run

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 shockcan be found on → Page 80.

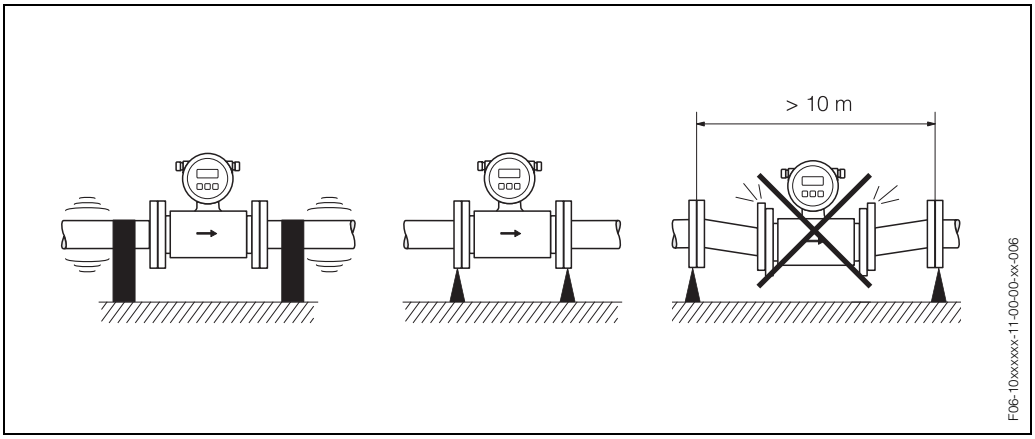


Fig. 12: Measures to prevent vibration of the measuring device

3.2.5 Foundations, supports

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

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

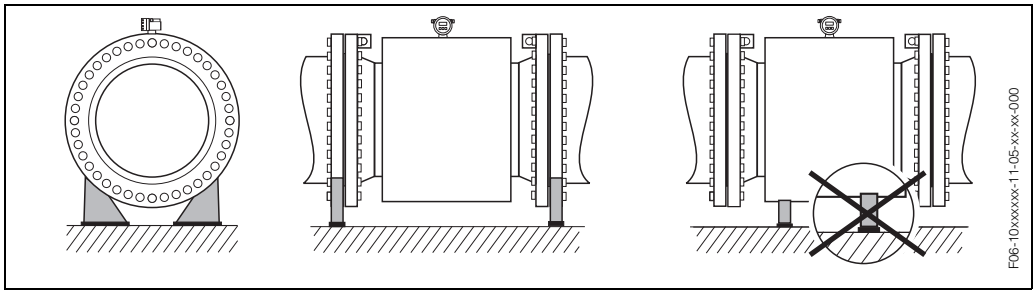


Fig. 13: Correct support for large nominal diameters (DN ≥ 350)

3.2.6 Adapters

Suitable adapters to (E) 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.

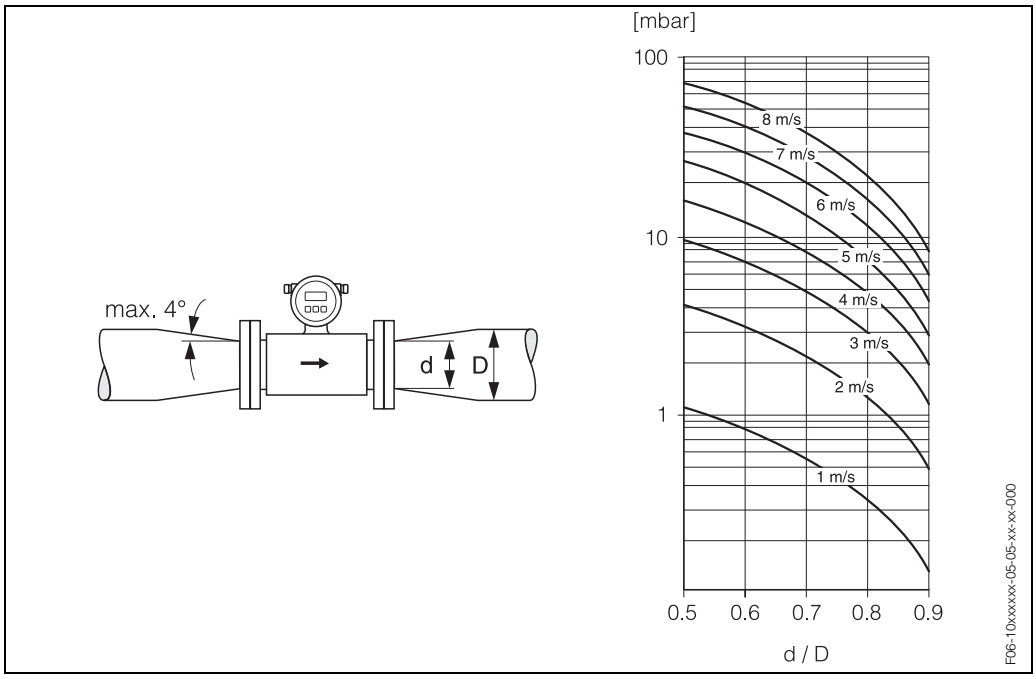


Fig. 14: Pressure loss due to adapters

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 flow velocity is between 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	Factory settings		
		Min./max. full scale value	Full scale value Current output	Pulse value	Low flow cut off
[mm]	[inch]	(v ~ 0.3 or 10 m/s)	(v ~ 2.5 m/s)	(~ 2 pulse/s)	(v ~ 0.04 m/s)
25	1"	9...300 dm³/min	75 dm³/min	0.50 dm³	1 dm³/min
32	1 1/4"	15...500 dm³/min	125 dm³/min	1.00 dm³	2 dm³/min
40	1 1/2"	25...700 dm³/min	200 dm³/min	1.50 dm³	3 dm³/min
50	2"	35...1100 dm³/min	300 dm³/min	2.50 dm³	5 dm³/min
65	2 1/2"	60...2000 dm³/min	500 dm³/min	5.00 dm³	8 dm³/min
80	3"	90...3000 dm³/min	750 dm³/min	5.00 dm³	12 dm³/min
100	4"	145...4700 dm³/min	1200 dm³/min	10.00 dm³	20 dm³/min
125	5"	220...7500 dm³/min	1850 dm³/min	15.00 dm³	30 dm³/min
150	6"	20...600 m³/h	150 m³/h	0.025 m³	2.5 m³/h
200	8"	35...1100 m³/h	300 m³/h	0.05 m³	5.0 m³/h
250	10"	55...1700 m³/h	500 m³/h	0.05 m³	7.5 m³/h
300	12"	80...2400 m³/h	750 m³/h	0.10 m³	10 m³/h
350	14"	110...3300 m³/h	1000 m³/h	0.10 m³	15 m³/h
400	16"	140...4200 m³/h	1200 m³/h	0.15 m³	20 m³/h
450	18"	180...5400 m³/h	1500 m³/h	0.25 m³	25 m³/h
500	20"	220...6600 m³/h	2000 m³/h	0.25 m³	30 m³/h
600	24"	310...9600 m³/h	2500 m³/h	0.30 m³	40 m³/h

Flow rate characteristic values - Promag W (US units)

Nominal diameter		Recommended flow rate	Factory settings		
		Min./max. full scale value	Full scale value Current output	Pulse value	Low flow cut off
[mm]	[inch]	(v ~ 0.3 or 10 m/s)	(v ~ 2.5 m/s)	(~ 2 pulse/s)	(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

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 Current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (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

Flow rate characteristic values - Promag P (US 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 Current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (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

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 Current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (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	Factory settings		
[mm]	[inch]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value Current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cut off (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 Lmax depends on the fluid conductivity (Fig. 15). For all fluids a minimum conductivity of 50 μS/cm is required.
- When the Empty Pipe Detection function is switched on, the maximum connecting cable length is 10 m.

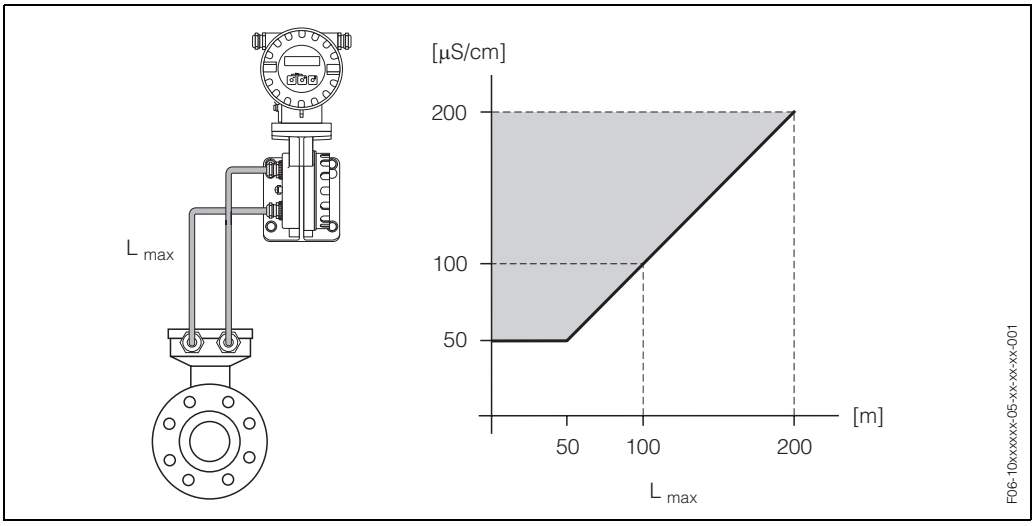


Fig. 15: Permissible cable length for the remote version

Grey shaded area = Permissible range
Lmax = Length of connecting cable in [m]
Fluid conductivity in [μS/cm]

3.3 Installation instructions

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 24 ff.
- The mounting of additional ground disks is described on Page 23.

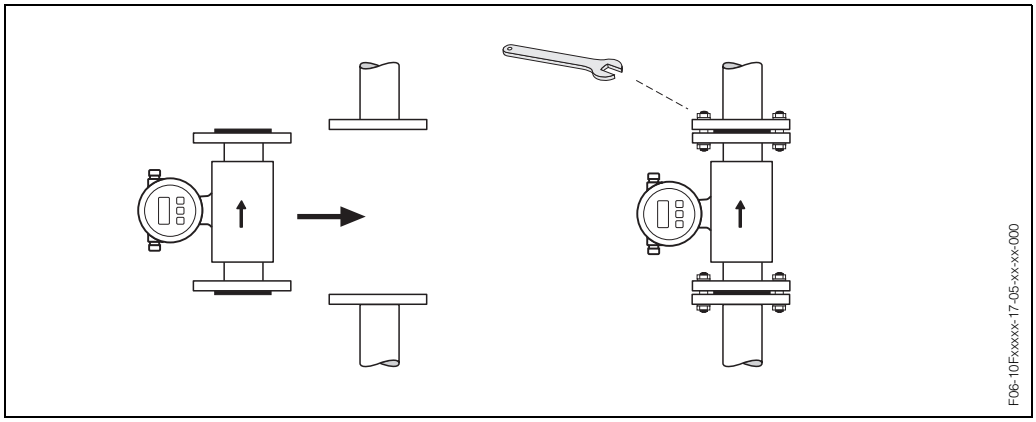


Fig. 16: Installing the Promag W sensor

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 according to DIN 2690.
- Make sure that the seals do not protrude into the piping cross-section.

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

Ground cable (DN 25...600)

If necessary, special ground cables for potential equalisation can be ordered as accessories for potential equalisation (see Page 64). Detailed mounting instructions → Page 44 ff.

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

Depending on the application, e.g. with lined or ungrounded pipes (see Page 43 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 E+H (see Page 64).

Caution!
- In this case, when using ground disks (including seals) the total fitting length increases! Dimensions are found in the Technical Information on Promag 10 (separate documents), see Page 91
- Hard rubber lining → Additional seals must be mounted between the sensor and ground disk as well as between the ground disk and the pipe flange.
- Polyurethane lining → Additional seals must be mounted between the ground disk and the pipe flange.

1. Place the ground disk and additional seal(s) between the instrument and the pipe flange (see Fig. 17).
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. 17 until the handle strikes the bolts. This will centre the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 24 ff.).
5. Connect the ground disk to ground → Page 45.

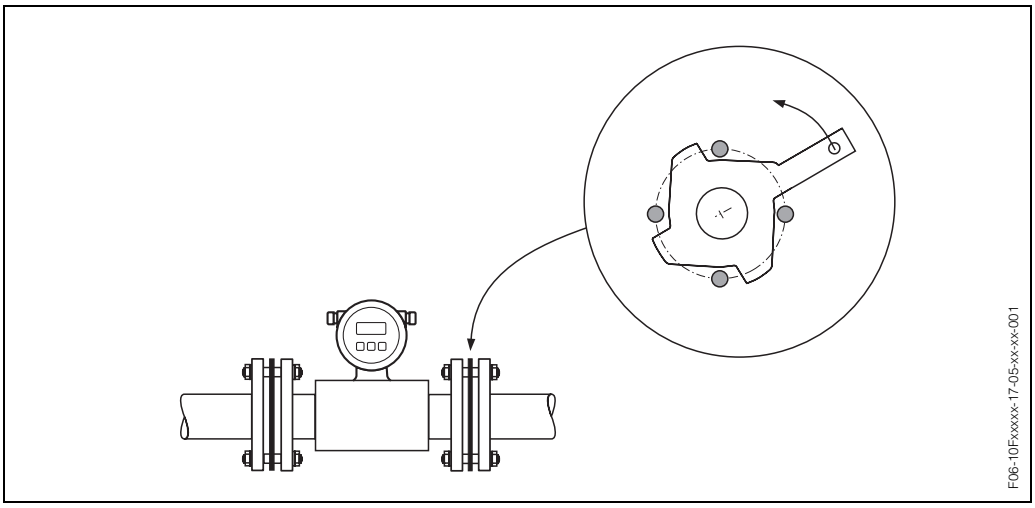


Fig. 17: Assembly ground disks (Promag W, DN 25…300)

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	DIN pressure rating	Screws	Max. torque [Nm]	
[mm]	[bar]		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	4 x M 16	65	55
80	PN 16	8 x M 16	40	34
100	PN 16	8 x M 16	43	36
125	PN 16	8 x M 16	56	48
150	PN 16	8 x M 20	74	63
200	PN 10	8 x M 20	106	91
250	PN 10	12 x M 20	82	71
300	PN 10	12 x M 20	94	81
350	PN 10	16 x M 20	112	118
400	PN 10	16 x M 24	151	167
450	PN 10	20 x M 24	153	133
500	PN 10	20 x M 24	155	171
600	PN 10	20 x M 27	206	219

Promag W nominal diameter		ANSI pressure rating	Screws	Max. torque [Nm]	
[mm]	[inch]	[lbs]		Hard rubber	Polyurethane
25	1"	Class 150	4 x 1/2"	–	7
40	1 1/2"	Class 150	4 x 1/2"	–	10
50	2"	Class 150	4 x 5/8"	–	22
80	3"	Class 150	4 x 5/8"	60	43
100	4"	Class 150	8 x 5/8"	42	31
150	6"	Class 150	8 x 3/4"	79	59
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	JIS pressure rating	Screws	Max. torque [Nm]	
[mm]			Hard rubber	Polyurethane
25	20K	4 x M 16	–	19
32	20K	4 x M 16	–	22
40	20K	4 x M 16	–	24
50	20K	8 x M 16	–	17
65	10K	4 x M 16	55	45
80	10K	8 x M 16	29	23
100	10K	8 x M 16	35	29
125	10K	8 x M 20	60	51
150	10K	8 x M 20	75	63
200	10K	12 x M 20	61	52
250	10K	12 x M 22	100	87
300	10K	16 x M 22	74	63

3.3.2 Installing the Promag P sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the Teflon (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 onPage 28 ff.
- The mounting of additional ground disks is described on Page 27.

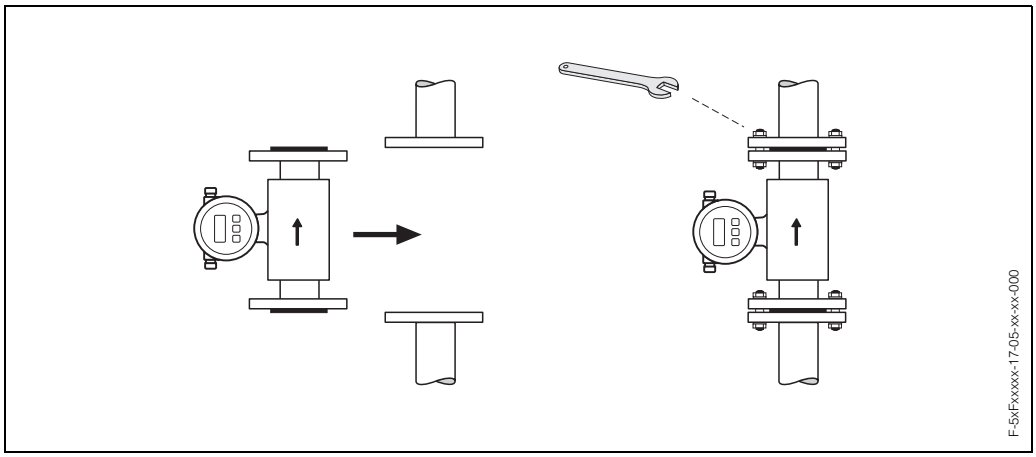


Fig. 18: Installing the Promag P sensor

Seals

Comply with the following instructions when installing seals:
- Generally, **no** seals are required since the measuring tube is lined with PTFE.
- In case you use seals with DIN flanges, use only seals according to DIN 2690.
- Make sure that the seals do not protrude into the piping cross-section.

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

Ground cable

If necessary, special ground cables can be ordered as accessories for potential equalisation (see Page 64). Detailed mounting instructions → Page 44 ff.

Mounting ground disks

Ground disks must also be mounted between the sensor and the pipe flange for potential equalisation under certain application conditions, e.g. in the case of lined or ungrounded piping (see Page 43 ff.). Ground disks can be ordered as separate accessories from E+H (see Page 64).

Caution!
- The length increases when ground disks (incl. seals) are used! Dimensions are found in the Technical Information on Promag 10 (separate documents) → Page 91
- Additional seals must be mounted between the ground disk and the pipe flange.

1. Place the ground disk and additional seal(s) between the instrument and the pipe flange (see Fig. 17).
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. 17 until the handle strikes the bolts. This will centre the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 24 ff.).
5. Connect the ground disk to ground → Page 45.

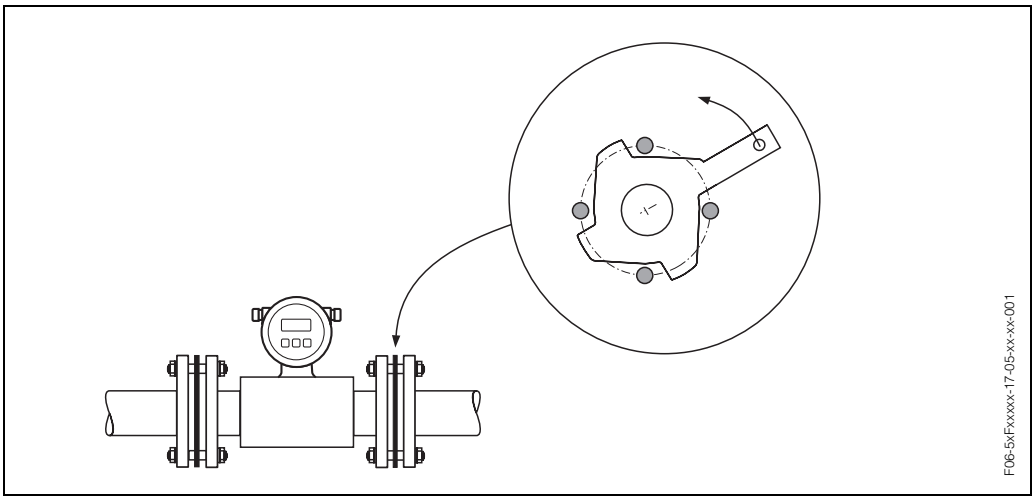


Fig. 19: Assembly with ground disks (Promag P, DN 25…300)

Screw tightening torques (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]	DIN pressure rating [bar]	Screws	Max. torque [Nm] PTFE
25	PN 40	4 x M 12	26
32	PN 40	4 x M 16	41
40	PN 40	4 x M 16	52
50	PN 40	4 x M 16	65
65	PN 16	4 x M 16	87
80	PN 16	8 x M 16	53
100	PN 16	8 x M 16	57
125	PN 16	8 x M 16	75
150	PN 16	8 x M 20	99
200	PN 10	8 x M 20	141
250	PN 10	12 x M 20	110
300	PN 10	12 x M 20	125

Promag P nominal diameter		ANSI pressure rating	Screws	Max. torque [Nm]
[mm]	[inch]	[lbs]		PTFE
25	1"	Class 150	4 x 1/2"	11
40	1 1/2"	Class 150	4 x 1/2"	24
50	2"	Class 150	4 x 5/8"	47
80	3"	Class 150	4 x 5/8"	79
100	4"	Class 150	8 x 5/8"	56
150	6"	Class 150	8 x 3/4"	106
200	8"	Class 150	8 x 3/4"	143
250	10"	Class 150	12 x 7/8"	135
300	12"	Class 150	12 x 7/8"	178

Promag P nominal diameter [mm]	**JIS pressure rating**	**Screws**	**Max. torque [Nm]** PTFE
25	20K	4 x M 16	32
32	20K	4 x M 16	38
40	20K	4 x M 16	41
50	20K	8 x M 16	27
65	10K	4 x M 16	74
80	10K	8 x M 16	38
100	10K	8 x M 16	47
125	10K	8 x M 20	80
150	10K	8 x M 20	99
200	10K	12 x M 20	82
250	10K	12 x M 22	133
300	10K	16 x M 22	99

3.3.3 Installing the Promag H sensor

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

Caution!
- If you intend using your own process connections, information on the dimensions is provided in the Technical Information on Promag 10 (separate documents) → Page 91
- The sensor might require support or additional attachments, depending on the application and the length of the piping run. A wall mounting kit can be ordered separately from E+H as an accessory (see Page 64).

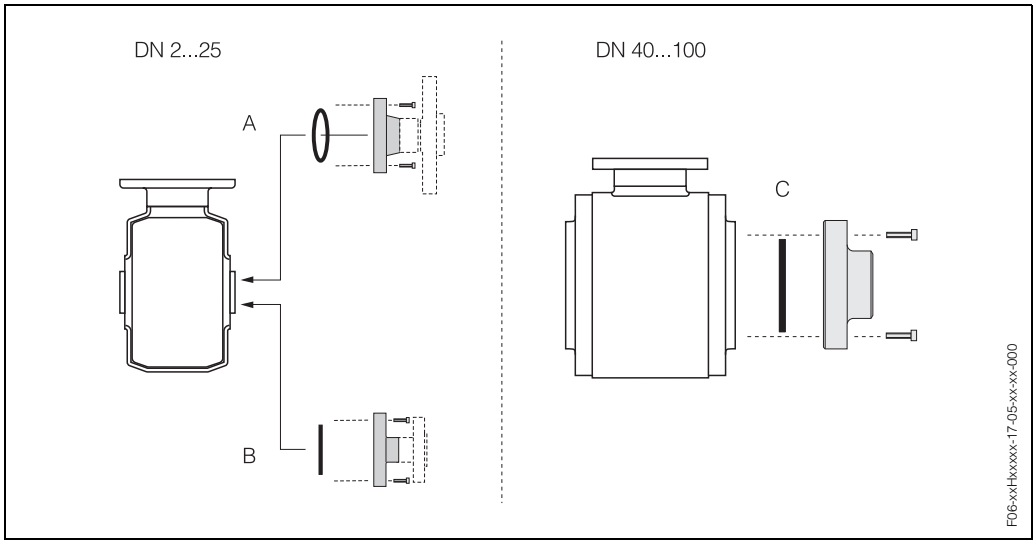


Fig. 20: Promag H process connections (DN 2...25, DN 40...100)

A: DN 2...25 / process connections with O-ring:
Flanges (DIN 2501, ANSI B16.5, JIS B2238),
External thread (ISO 228/ DIN 2999)

B: DN 2...25 / process connections with aseptic moulded seal:
Weld nipples, Tri-Clamp L14 AM7, threaded joint (DIN 11851, DIN 11864-1, SMS 1145 (only DN 25)), flange DIN 11864-2

C: DN 40...100 / process connections with aseptic moulded seal:
Weld nipples, Tri-Clamp L14 AM7, threaded joint (DIN 11851, DIN 11864-1, SMS 1145), flange DIN 11864-2

Seals

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

Caution!
- With metallic process connections, you must fully tighten screws. The process connection forms a metallic connection with the sensor which ensures a defined compression of the seal.
- Depending on the application, the seals must be replaced periodically, especially 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 64.

Welding the sensor into the piping (weld sockets)

Caution!
Risk of irreparable damage to the 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 E+H as an accessory (see Page 64).
2. Remove the threaded fasteners from the process-connection flange. Remove the sensor complete with seal from the pipe.
3. Weld the process connection into the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

Note!
- If thin-walled foodstuffs are not welded correctly, the heat could damage the installled 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 internal diameters of the measuring tube and process connection into account. Information on the dimensions are provided in the Technical Information on Promag 10 (separate documents) → Page 91.

3.3.4 Rotating the transmitter housing

1. Loosen the two securing screws.
2. Turn the bayonet lock 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 (280° clockwise, 20° counter-clockwise).
5. Lower the housing into position and re-engage the bayonet lock.
6. Retighten the two securing screws.

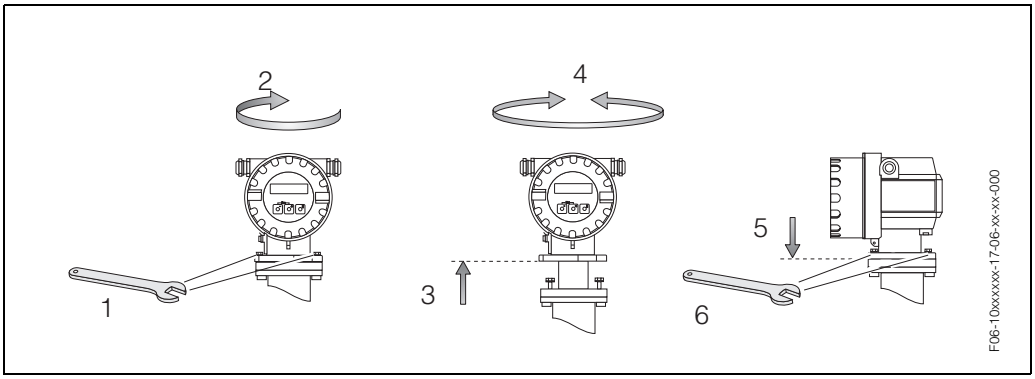


Fig. 21: Rotating the transmitter housing

3.3.5 Turning the local display

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the display module from the transmitter retainer rails.
3. Turn the display to the desired position (max. 4 x 45° in each direction) and reset it onto the retaining rails.
4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.

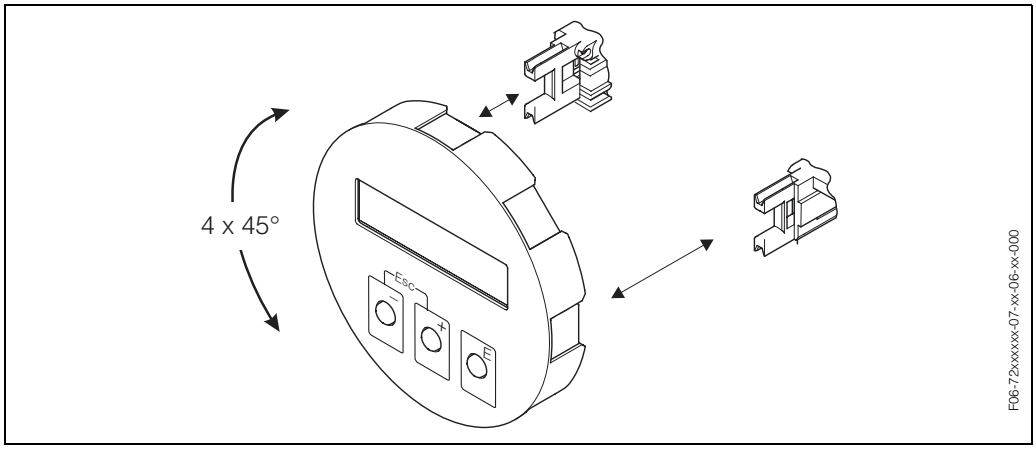


Fig. 22: Rotating the local display

3.3.6 Affixing the local display to the blind version

A local display can be temporarily affixed to devices which do not have a local display.

1. Switch off power supply.
2. Remove the cover of the electronics compartment.
3. Affix local display.
4. Switch on power supply.

3.3.7 Mounting the transmitter (remote version)

The transmitter can be mounted in the following ways:
- Wall mounting
- Pipe mounting (with separate mounting kit, accessories → Page 64)

The transmitter and the sensor must be mounted separate in the following circumstances:
- Poor accessibility
- Lack of space
- Extreme fluid/ambient temperatures (temperature ranges: → Page 81),
- Severe vibration (> 2 g/2 h per day; 10...100 Hz).

Caution!
If the device is mounted to warm piping, make certain that the housing temperature does not exceed the max. permissible value of +60 °C.

Mount the transmitter as illustrated in Fig. 23.

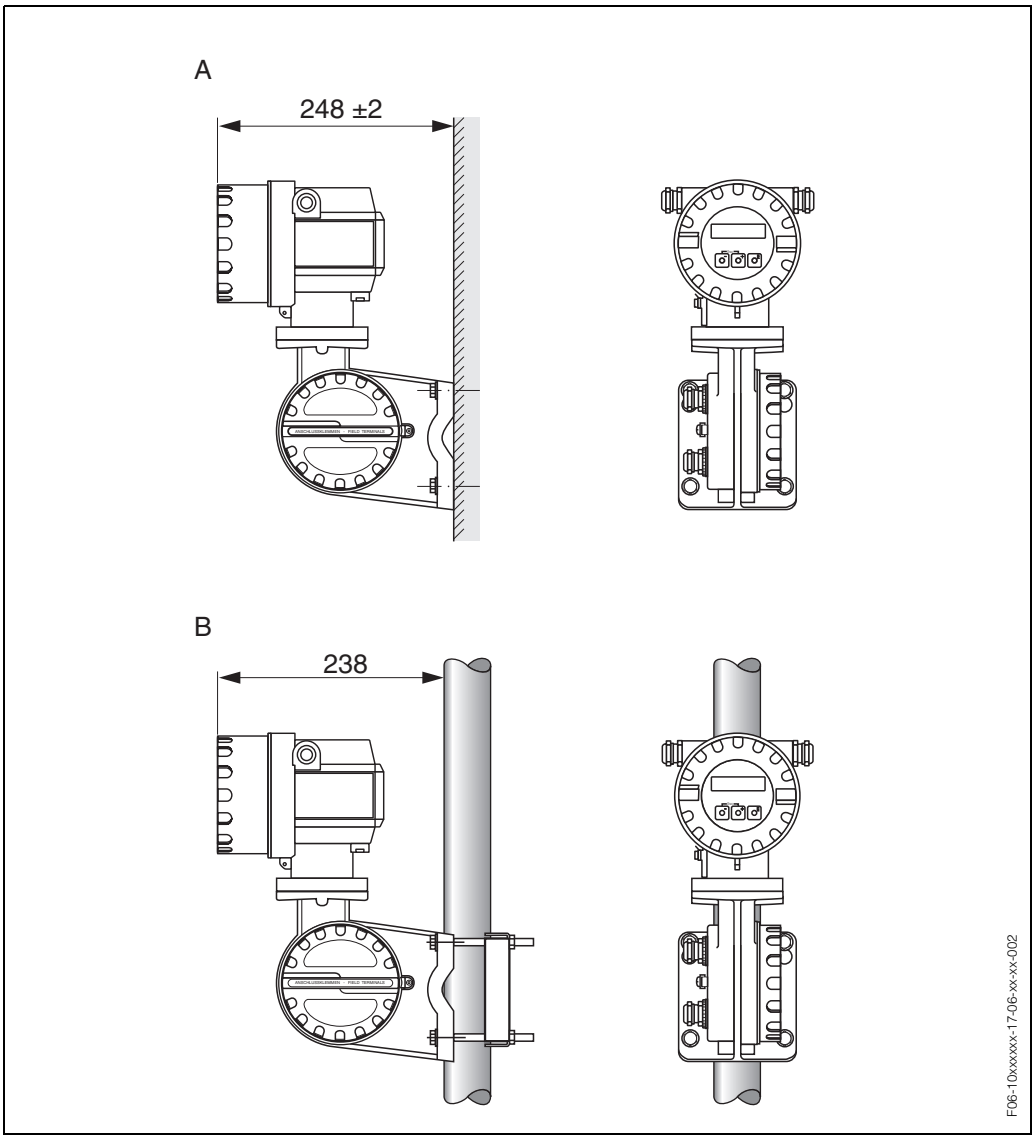


Fig. 23: Mounting the transmitter (remote version)

A = Direct wall mounting
B = Pipe mounting

3.4 Post-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, min. fluid conductivity, measuring range, etc.?	see Page 77 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 14
Were all threaded fasteners tightened to the specified torques when the sensor was installed?	see Section 3.3
For ground disks: Were the correct seals installed (type, material, installation)?	Promag W → Page 22 Promag P → Page 26
Are the measuring point number and labelling correct (visual inspection)?	–
Process environment / process conditions	Notes
Are the inlet and outlet runs respected?	Inlet run ≥ 5 x DN Outlet run ≥ 2 x DN
Is the measuring device protected against moisture and direct sunlight?	–
Is the sensor adequately protected against vibration (fixture, support)?	Acceleration up to 2 g by analogy with IEC 68-2-6 (see Page 80)

4 Wiring

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

4.1 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 earth to the ground connection on the housing before the power supply is applied.

Procedure (Fig. 24, Fig. 25):

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

Caution!
– Make sure the connecting cables are secured (see Page 21).
– Risk of damaging the coil driver. Always switch off the power supply beforeconnecting or disconnecting the coil cable.

4. Preterminate the signal cable and coil current cable:
Promag W, P → Refer to the information on Page 37
Promag H → Refer to the information on Page 38

5. Establish the connections between the sensor and transmitter in accordance with the wiring diagram:
→ Fig. 24, Fig. 25
→ Wiring diagram inside the cover.

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

6. Transmitter: secure cover (a) on the connection compartment and tighten the socket head cap screw of the securing clamp.
7. Sensor: secure cover (b) on the connection housing.

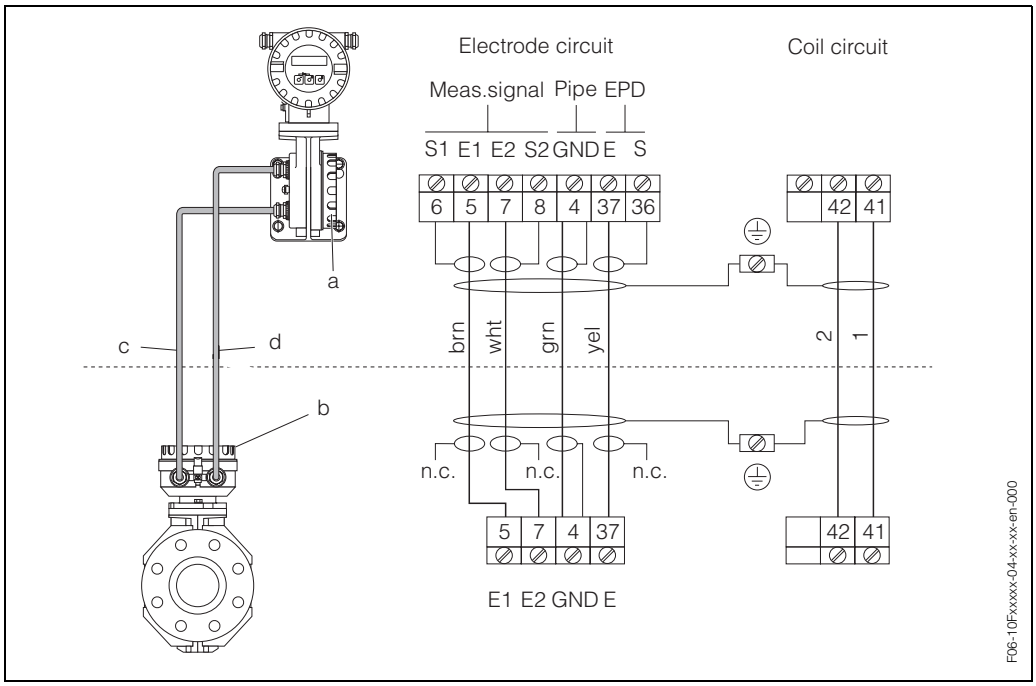


Fig. 24: Connecting the remote version Promag W/P

a = Connection compartment, transmitter, b = Connection housing cover, sensor, c = Signal cable, d = Coil current cable, n.c. = Not connected, insulated cable shields

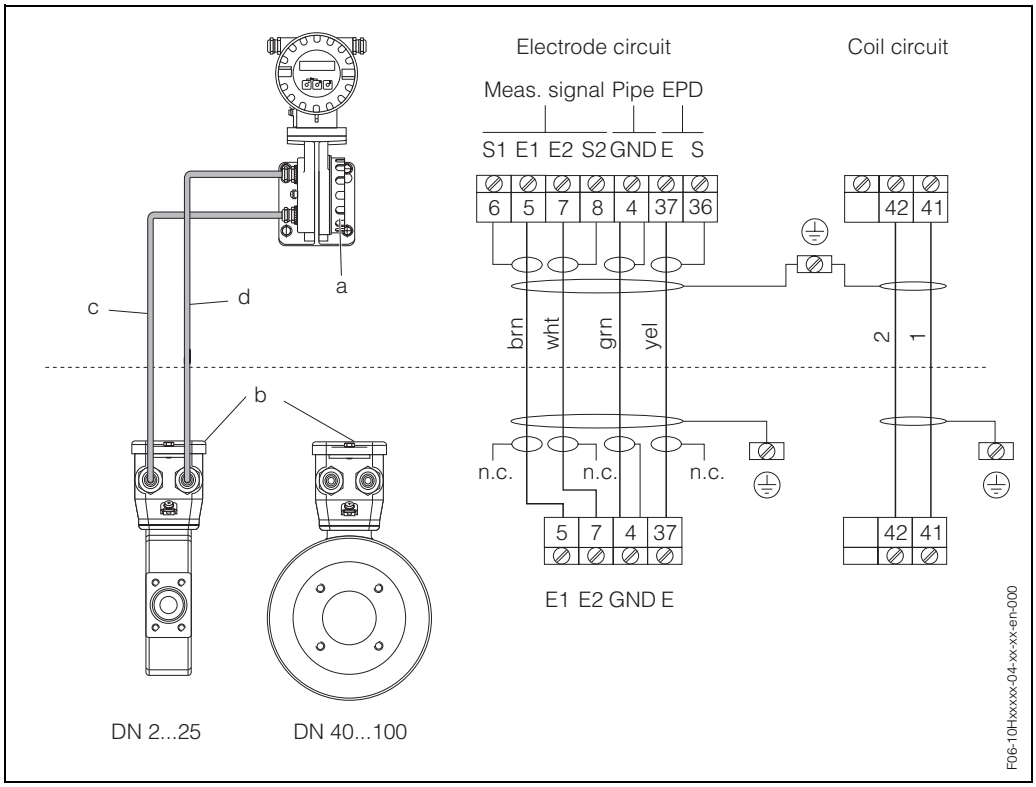


Fig. 25: Connecting the remote version Promag H

a = Connection compartment, transmitter, b = Connection housing cover, sensor, c = Signal cable, d = Coil current cable, n.c. = Not connected, insulated cable shields

Note!
The cable shieldings in the Promag H transmitter are grounded by the strain relief clamps. Pay attention to the notes for the cable termination on Page 38.

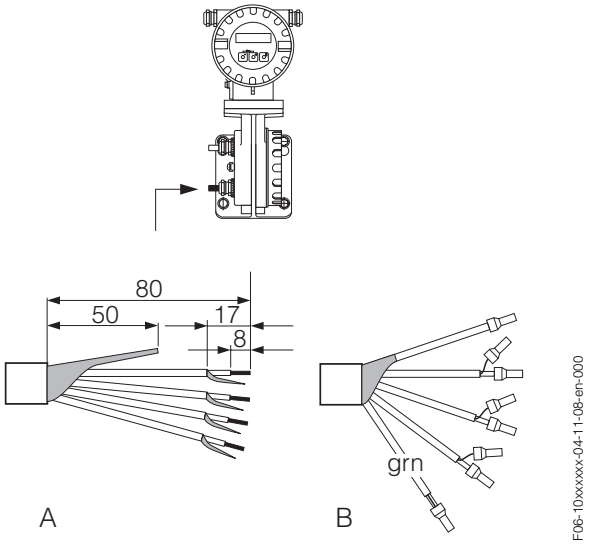
Cable termination for the remote version
Promag W / Promag P

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).

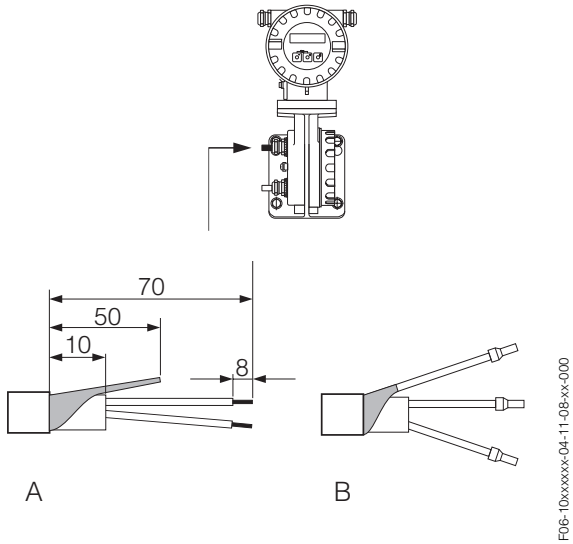
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side! Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire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

TRANSMITTER

Signal cable

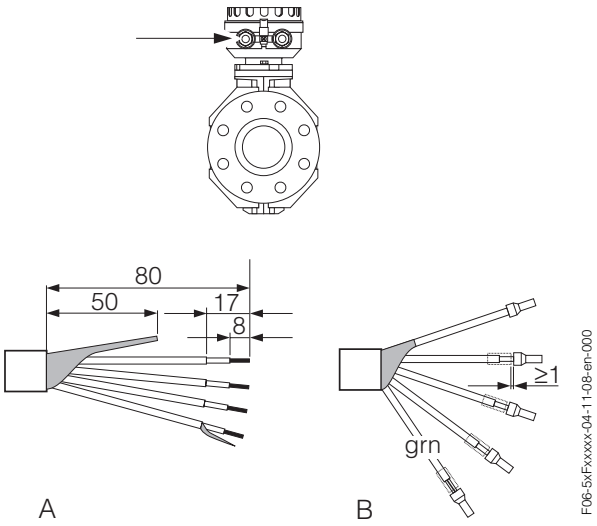


Coil current cable

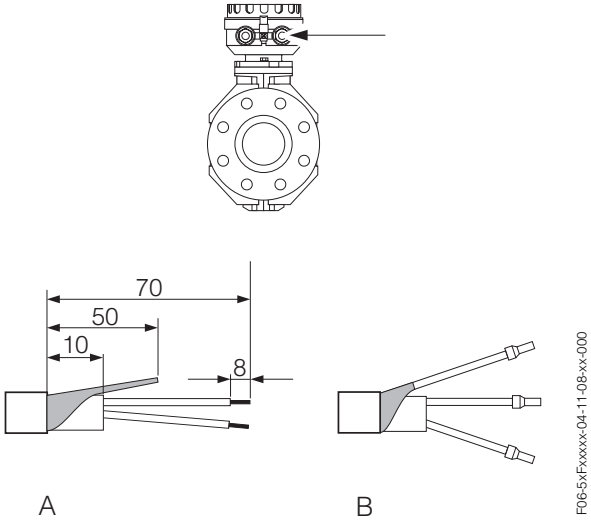


SENSOR

Signal cable



Coil current cable



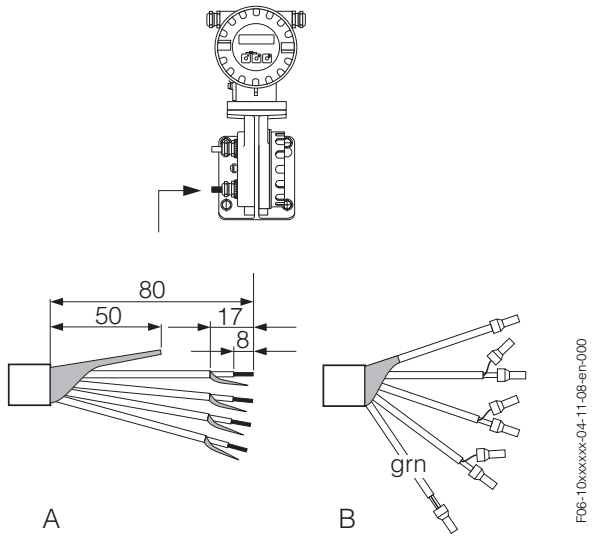
Cable termination for the remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Provide the fine-wire cores with cable end sleeves (Detail B).

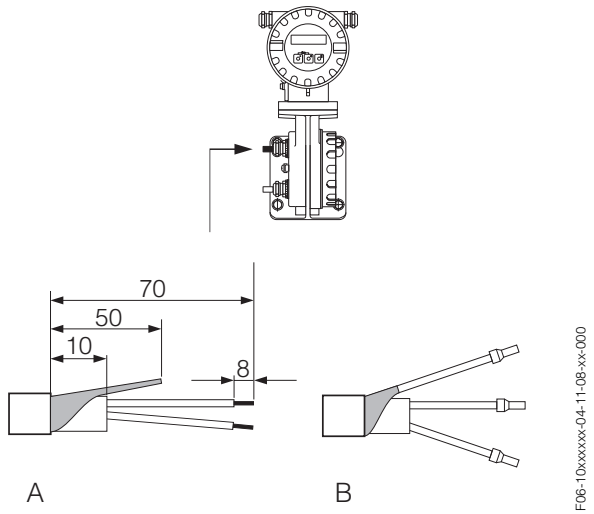
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side! Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire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

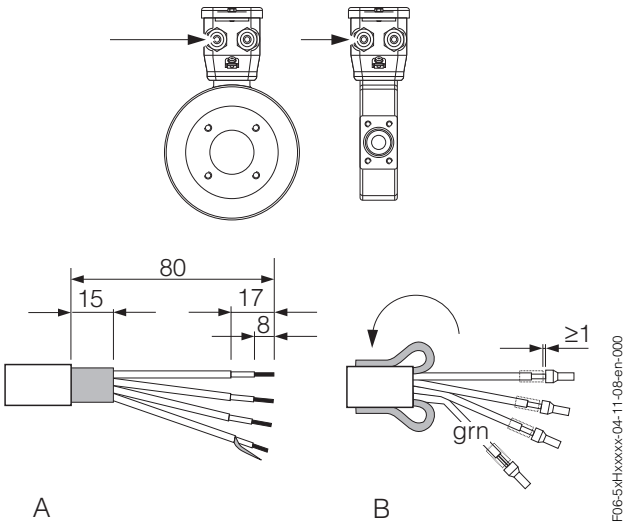


Coil current cable

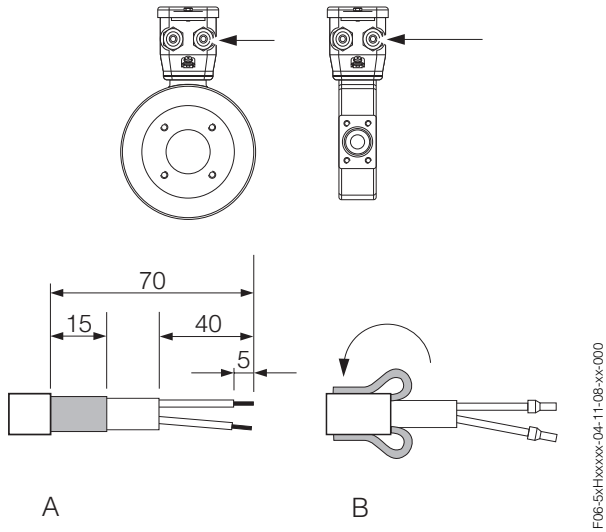


SENSOR

Signal cable



Coil current cable



4.1.2 Cable specifications

Coil cable:
- 2 x 0.75 mm^2 PVC cable with common, braided copper shield (Ø ~ 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance core/core, shield grounded: ≤ 120 pF/m
- Permanent operating temperature: –20...+80 °C
- Cable cross-section: max. 2.5 mm^2

Signal cable:
- 3 x 0.38 mm^2 PVC cable with common, braided copper shield (Ø ~ 7 mm) and individually shielded cores.
- With Empty Pipe Detection (EPD): 4 x 0.38 mm^2 PVC cable with common, braided copper shield (Ø ~ 7 mm) and individually shielded cores.
- Conductor resistance: ≤ 50 Ω/km
- Capacitance core/shield: ≤ 420 pF/m
- Operating temperature: –20...+80 °C
- Cable cross-section: max. 2.5 mm^2

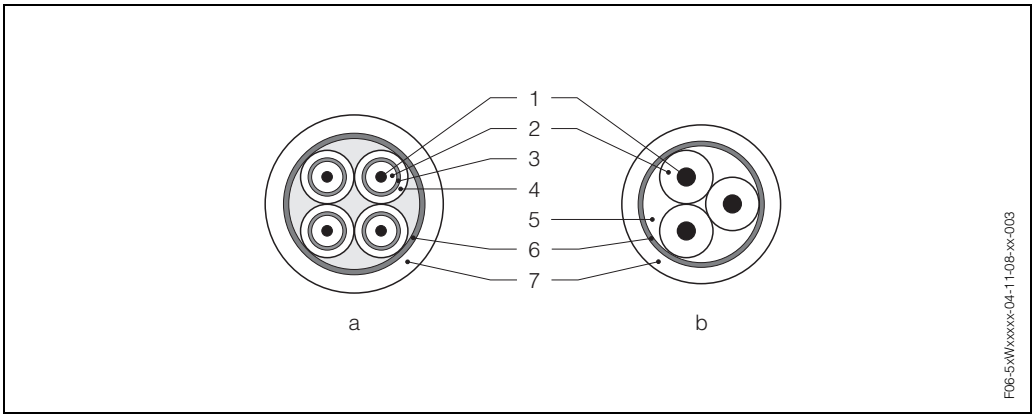


Fig. 26: Cable cross-section (a = Signal cable, b = Coil current cable)
1 = Core, 2 = Core insulation, 3 = Core shield, 4 = Core jacket, 5 = Core reinforcement, 6 = Cable shield, 7 = Outer jacket

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of EN 61326.

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

4.2 Connecting the measuring unit

4.2.1 Transmitter (aluminium)

⚠ 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 earth 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 supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.
- Promag 10 has to be connected to switched/protected circuits of the installation.

1. Unscrew the cover (c) of the electronics compartment from the transmitter housing.
2. Press the side latches and flip down the cover of the connection compartment.
3. Feed the power supply cable (a) and signal cable (b) through the appropriate cable entries.
4. Remove terminal connectors (d+e) from the transmitter housing and connect the cables for the power supply and outputs:
   – Wiring diagram → Fig. 27
   – Terminal assignment → Page 41
5. Plug the terminal connectors (d+e) into the transmitter housing.

   ✎ Note!
   The connectors are coded so you cannot mix them up.
6. Secure the ground cable to the ground terminal (g).
7. Flip up the cover of the connection compartment.
8. Screw the cover (c) of the electronics compartment firmly onto the transmitter housing.

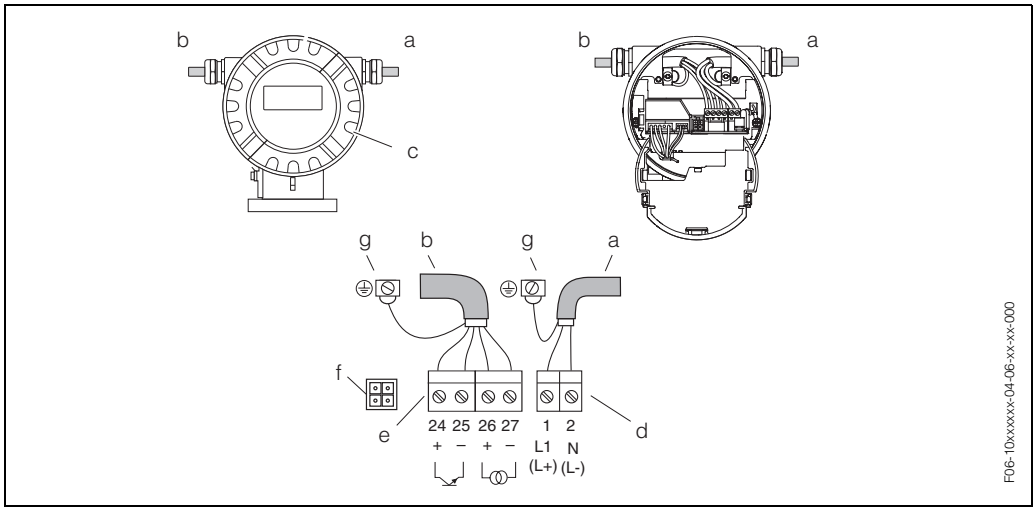


Fig. 27: Connecting the transmitter (aluminium field housing). Cable cross-section: max. 2.5 mm²

a Cable for power supply: 85...250 V AC, 11...40 V DC, 20...28 V AC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L– for DC*
*b Signal cable: terminal **Nos. 24–27** → Page 41*
c Electronics compartment cover
d Terminals for power supply
e Terminals for current/status output
f Service connector for connecting service interface FXA 193 (FieldCheck™, FieldTool™)
g Ground terminal for protective earth

4.2.2 Terminal assignment

Order variant	Terminal No. (outputs)	
	24 (+) / 25 (–)	**26 (+) / 27 (–)**
10***-**********A	Pulse output	Current output HART
Pulse output (passive) Open collector, galvanically isolated 30 V DC, 250 mA Pulse mode of operation: pulse frequency max. 100 Hz Status mode of operation: yes, can be configured *Current output (active)* Galvanically isolated, active: 4...20 mA, R_L < 700 Ω, HART: $R_L \geq 250$ Ω Ground connection, power supply → Page 40 ff.		

✎ Note!
Wiring as per wiring diagram Fig. 27, Page 40

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.
- The CURRENT SPAN function must be set to “4–20 mA HART” (factory setting).
- 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

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

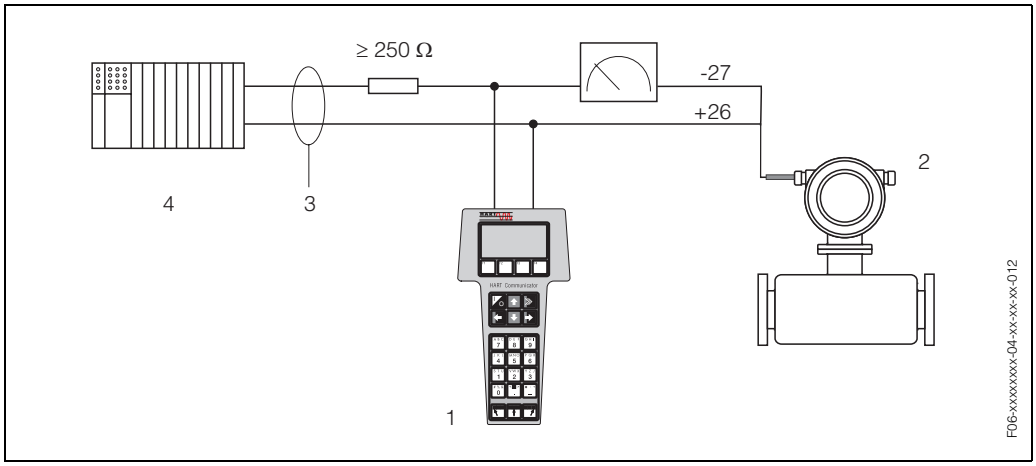


Fig. 28: Electrical connection of the HART terminal:
1 = HART communicator terminal, 2 = Power supply, 3 = Shield, 4 = Other evaluation devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with an operating software (e.g. “FieldTool™”), a HART modem (e.g. “Commubox FXA 191”) is needed.

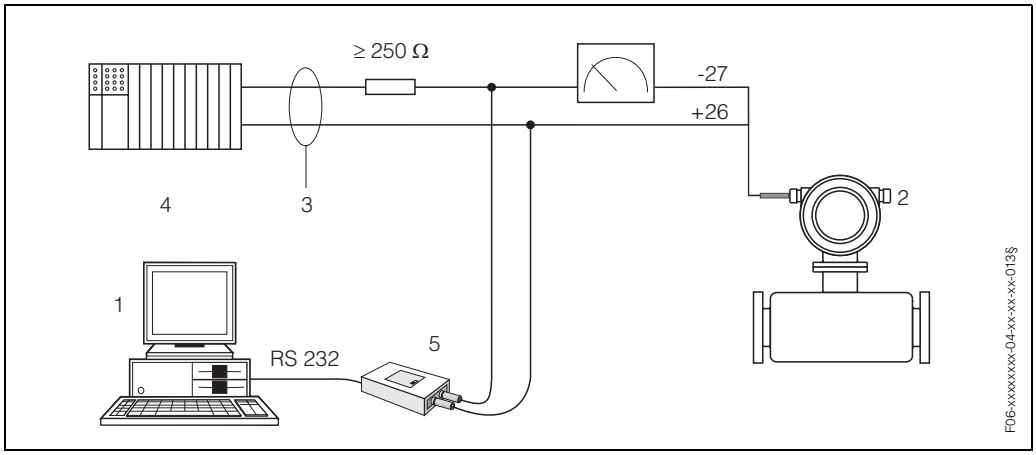


Fig. 29: Electrical connection of Commubox FXA 191:
1 = PC with operating software, 2 = Power supply, 3 = Shielding, 4 = Other switching units or PLC with passive input, 5 = HART modem, e.g. Commubox FXA 191

4.3 Potential equalisation

Warning!
The Promag 10 measuring system must be included in the 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 potential matching. This usually means that additional potential matching measures are unnecessary.

Promag W:
Reference electrode is standard

Promag P:
Reference electrode is standard

Promag H:
No reference electrode present! There is always an electrical connection to the fluid via the metallic process connection.

Caution!
For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping. Please also pay special attention to company-internal grounding concepts.

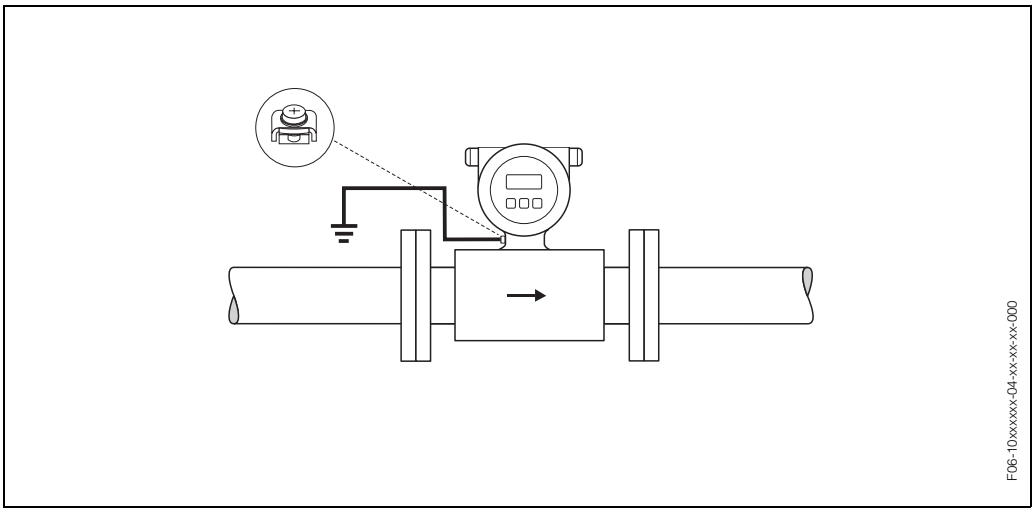


Fig. 30: Potential equalisation via the ground terminal of the transmitter

Caution!
For sensors without reference electrodes, carry out potential equalisationas 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. 31).

Caution!
Please also pay special attention to company-internal grounding concepts.

Note!
The ground cable for flange-to-flange connections can be ordered as an accessory from E+H → Page 64.
- DN ≤ 300: the ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.
- DN ≥ 350: the ground cable is in direct connection with the metal transport bracket.

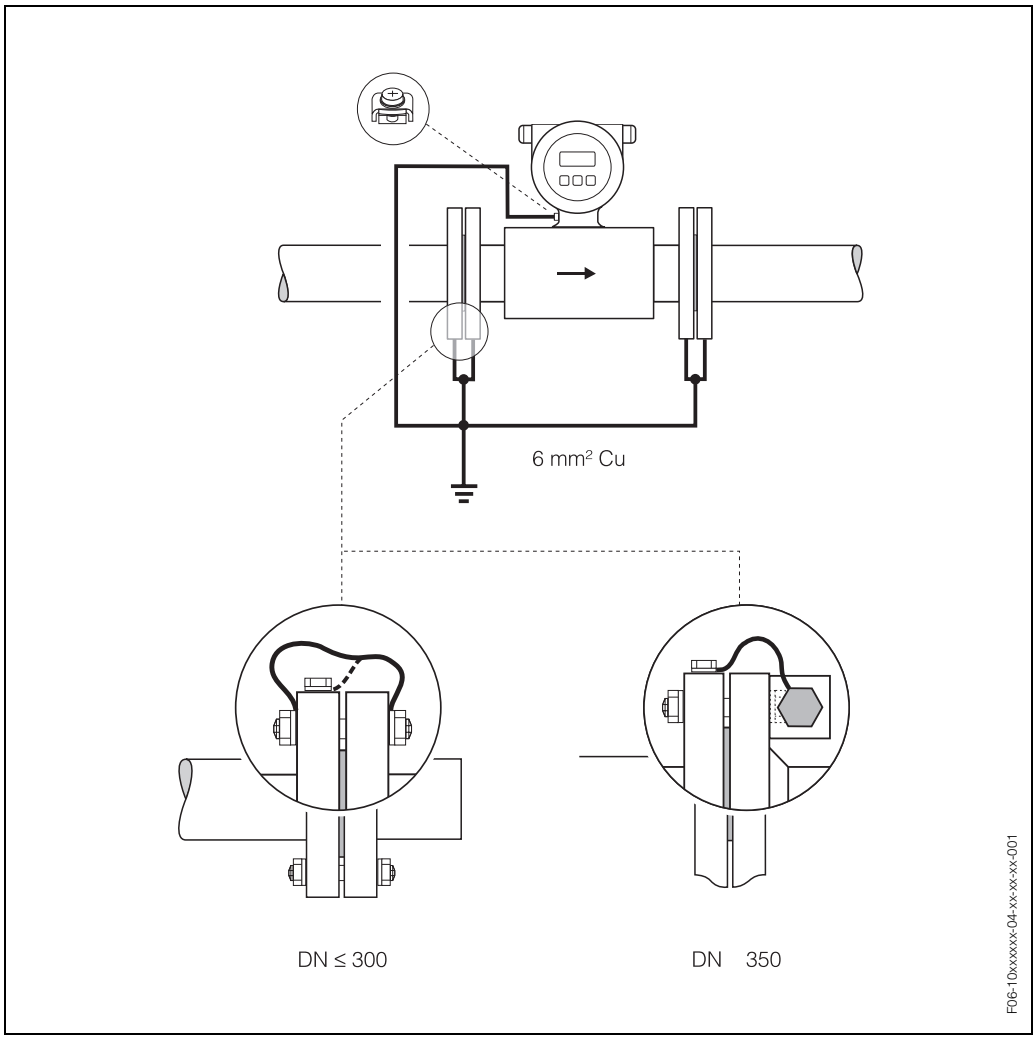


Fig. 31: Potential equalisation with equalising currents in metallic, non-grounded piping systems.

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. 26).
Mounting of ground disks → Page 23, 27

Caution!
- Risk of damage by electrochemical corrosion. Note the electrochemical insulating rating if the ground disks and measuring electrodes are made of different material.
- Please also pay special attention to company-internal grounding concepts.

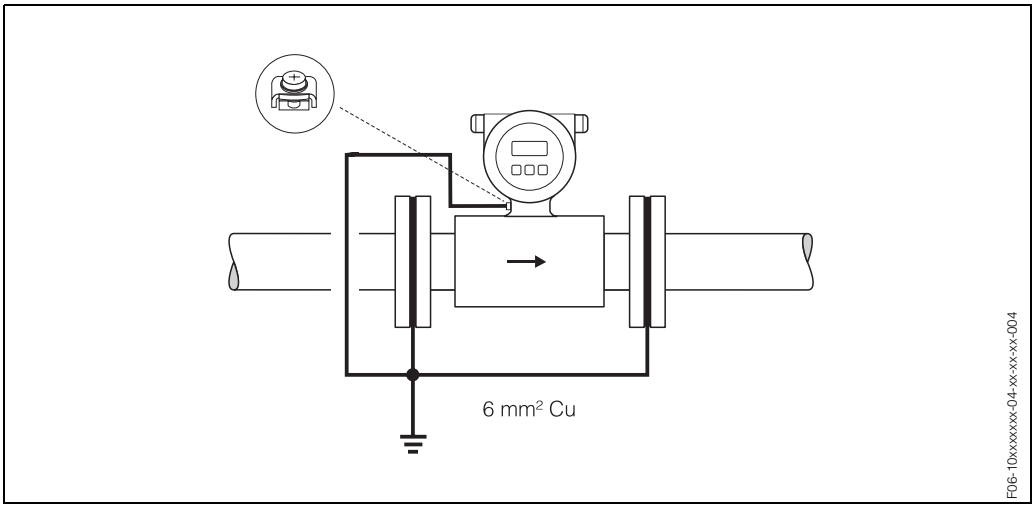


Fig. 32: Potential equalisation/ground disks for plastic or lined pipes

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 mm^2).
- 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.

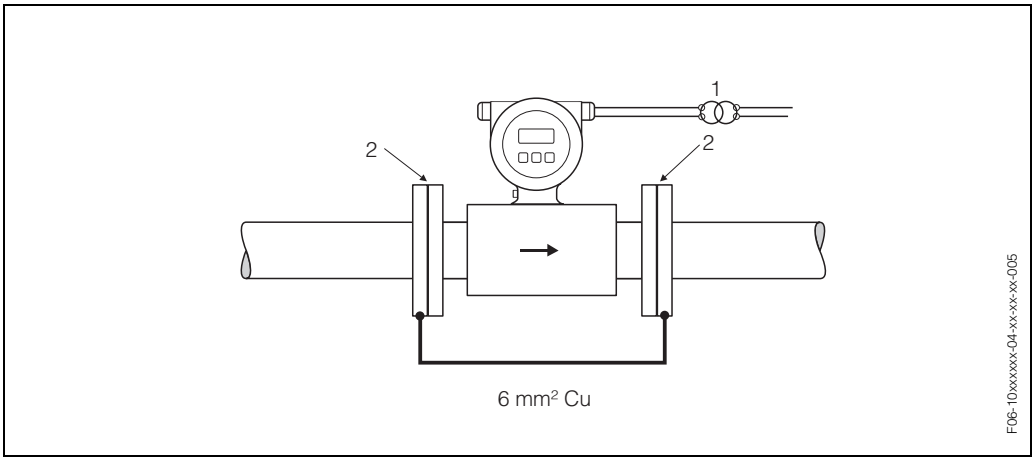


Fig. 33: Potential equalisation and cathode protection
1 = Power supply isolation transformers, 2 = Electrically insulated

4.4 Degree of protection

The devices fulfill all the requirements for IP 67 degree of protection. 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 78).
- Firmly tighten the cable entries (Fig. 34).
- The cables must loop down before they enter the cable entries (“water trap”, Fig. 34). 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 dummy plugs instead.
- Do not remove the grommet from the cable entry.

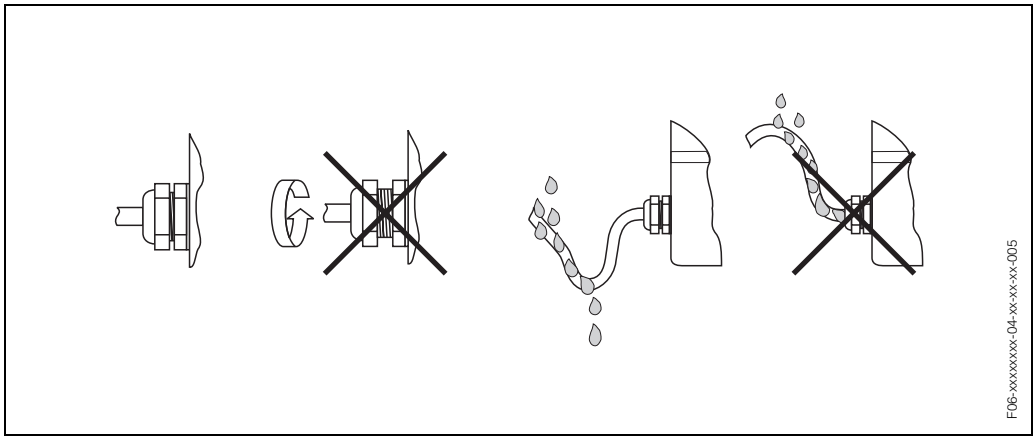


Fig. 34: Installation instructions for cable entries

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 remote from the sensor.

4.5 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85...250 V AC (50...60 Hz) 11...40 V DC 20...28 V AC (50...60 Hz)
Do the cables comply with the specifications?	see Page 78
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 in the interior of the connection compartment
Are all screw terminals firmly tightened?	–
Have the measures for grounding/potential equalisation been correctly implemented?	see Page 43 ff.
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	see Page 46
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 also configure the device.

The display area consists of two lines; this is where measured values and/or status variables (partially filled pipe) are displayed. The assignment of the display lines in operating mode is specified. The top line displays the volume flow and the bottom line displays the totalizer status.

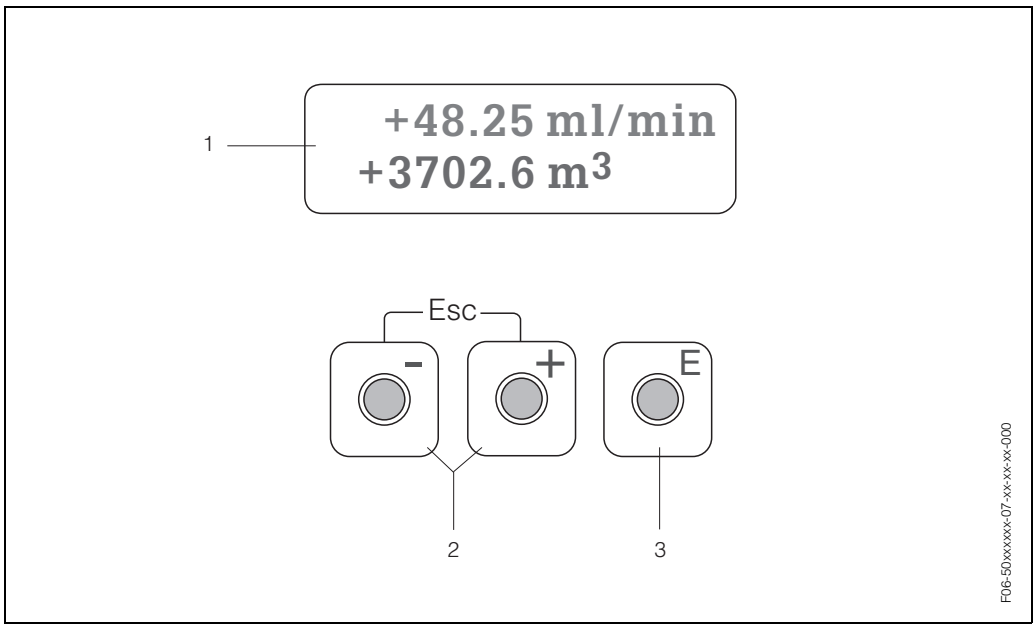


Fig. 35: Display and operating elements

Liquid crystal display (1)

The unilluminated, two-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. The display as it appears during standard measuring mode is known as the HOME position (operating mode).

Top line: shows main measured values, volume flow, e.g. in [ml/min]
Bottom line: shows the totalizer status, e.g. in [m^3],

Push buttons (2)

- *Enter numerical values, select parameters*
- *Select different function groups within the function matrix*

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

Enter push button (3)

- *HOME position → Enter the function matrix*
- *Save the numerical values you input or settings you changed*

5.2 Brief guide to the function matrix

Note!
- Please refer to the general notes on Page 50.
- Function matrix overview → Page 92
- Detailed description of all functions → Page 93 ff.

The function matrix is a two-level construct: the groups form one level and the groups' functions the other. The groups are the highest-level grouping of the control options for the measuring device. A number of functions is assigned to each group.
You select a group in order to access the individual functions for operating and configuring the measuring device.
Example of how to configure a function (in this case changing the language for the UI):

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g.USER INTERFACE)
3. Select a function (e.g. LANGUAGE)
   Change parameters / enter numerical values:
   ± → Select or enter release code, parameters, numerical values (e.g. change language from English to German)
   E → Save entries
4. Exit the function matrix:
   – Press and hold down the Esc key (−+) for more than 3 seconds → HOME position
   – Repeatedly press Esc key (−+) → Return step by step to HOME position

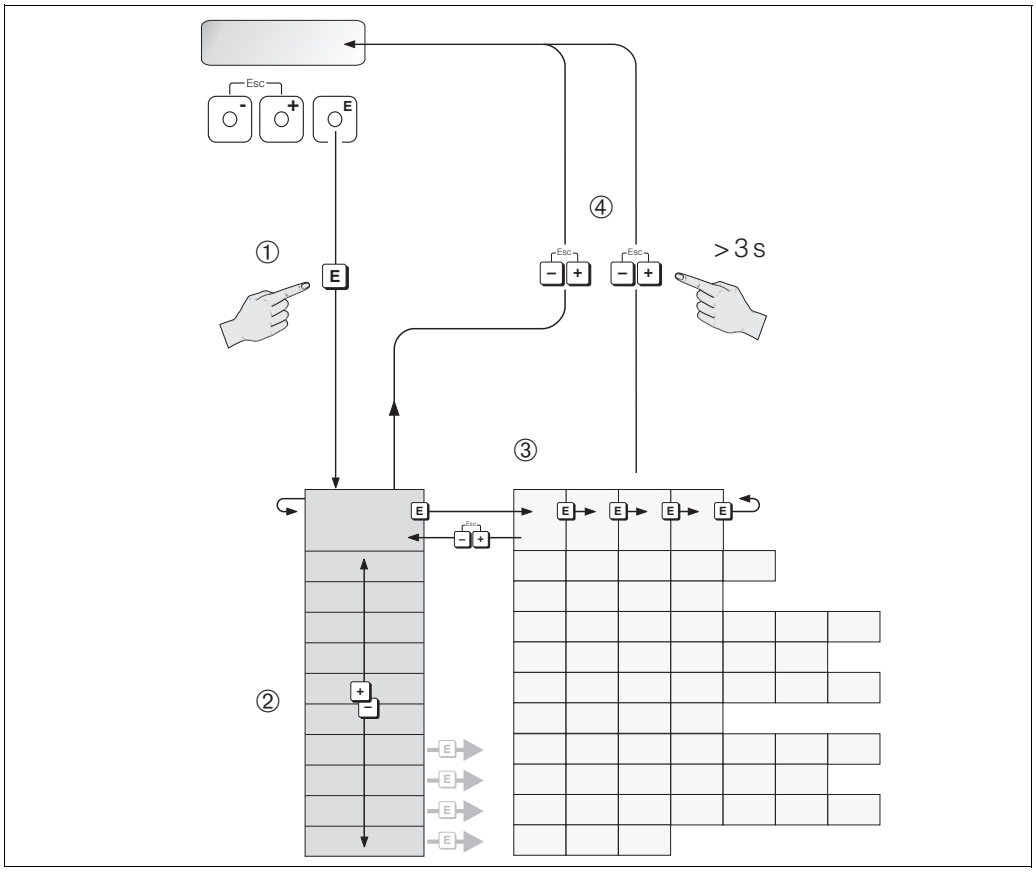


Fig. 36: Selecting and configuring functions (function matrix)

5.2.1 General notes

The brief operating instructions (see Page 61) are adequate for commissioning with the necessary standard settings. Complex measuring operations, on the other hand, necessitate additional functions that you can configure as necessary and customise to suit your process parameters. The function matrix, therefore, comprises additional functions which, for the sake of clarity, are arranged in function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on Page 49.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press ⊞ to select "SURE [YES]" and press ℡ again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

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 configured values remain safely stored in the EEPROM.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 10) has to be entered before settings can be changed.
If you use a code of your choice, you exclude the possibility of unauthorised persons accessing data (→ see ACCESS CODE function on Page 94).

Comply with the following instructions when entering codes:
- If programming is disabled and the ⊞ keys are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the private code, programming is always enabled.
- The E+H 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 device, particularly measuring accuracy. Normally, such parameters may not be changed! Please contact Endress+Hauser if you have any questions.

5.2.3 Disabling the programming mode

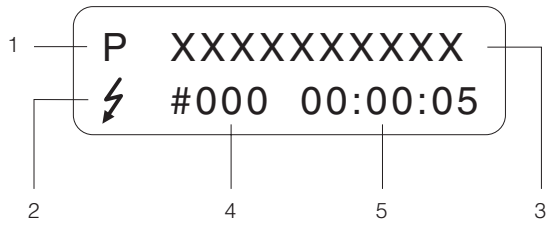
Programming is disabled if you do not press a key within 60 seconds following a return to the HOME position.
You can also disable programming in the "ACCESS CODE" function by entering any number (other than the private code).

5.3 Error messages

Type of error

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

The measuring system distinguishes between two types of error:
- *System error:* this group comprises all device errors, for example communication errors, hardware errors, etc. → see Page 67
- *Process error:* this group comprises all application errors, for example pipe partially filled, etc. → see Page 69



F06-x0xxxxxx-07-xx-xx-xx-000

Fig. 37: Error messages on the display (example)

1 Type of error: P = Process error, S = System error
2 Error message type: ϟ = Fault message, ! = Notice message
3 Error designation: e.g.EMPTY PIPE = empty or partially filled measuring tube
4 Error number: e.g. #401
5 Duration of most recent error occurrence in hours, minutes and seconds

Error message types

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

Fault message (ϟ)
- Displayed as → Lightning flash(ϟ), error type (S: system error, P: process error)
- The error in question has a direct effect on the inputs or outputs.
  The response of the inputs or outputs (failsafe mode) can be defined by means of the appropriate function in the function matrix (see Page 71).

✎ Note!
For safety reasons, error messages should be output via the status output.

5.4 Communication (HART)

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 42).

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, such as a handheld terminal or PC-based operating programs (such as FieldTool), require device description (DD) files. They are used to access all the information in a HART device. Information is exclusively transferred using so-called "commands". There are three different command classes:

Universal commands:
All HART devices support and use universal commands. The following functionalities are linked to them:
- Recognising HART devices
- Reading off 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, (among other things), such as empty/full pipe adjustment values, low flow cut off settings etc.

✎ Note!
Promag 10 has access to all three command classes. Page 54 ff. provides you with a list of 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 device description (DD) files available to the user to provide the following operating aids and programs:

HART Communicator DXR 275

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

FieldTool™ operating program

FieldTool™ is a universal service and configuration software package designed for the PROline devices. Connection is made using a HART modem, e.g. Commubox FXA 191.

The functionality of FieldTool™ includes the following:
- Configuration of device functions
- Visualisation of measured values (including data logging)
- Data backup of device parameters
- Extended device diagnosis
- Measuring point documentation

You can find more information on FieldTool™ in the following E+H document: System Information SI 031D/06/en “FieldTool™”

Further operating programs

- "AMS" operating program (Fisher Rosemount)
- "SIMATIC PDM" operating program (Siemens)

✎ Note!
The HART protocol requires the “4...20 mA (25 mA) HART”, “4...20 mA HART NAMUR”, or “4...20 mA HART US” setting in the CURRENT SPAN (current output) function.

5.4.2 Device variables and process variables

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

ID (decimal)	Device variable
0	OFF (unassigned)
1	Volume flow
250	Totalizer

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
- Third process variable (TV) → Not assigned
- Fourth process variable (FV) → Not assigned

5.4.3 Switching HART write protection on/off

HART write protection can be switched on or off via the "WRITE PROTECTION" device function (see Page 105).

5.4.4 Universal / common practice HART commands

The following table contains all the universal and common practice commands supported by Promag 10.

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	The device identifier provides information on the device and manufacturer; it cannot be altered. 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, 69 = Promag 10 – Byte 3: number of preambles – Byte 4: universal commands rev. no. – Byte 5: rev. no. device-specific commands – Byte 6: software revision – Byte 7: hardware revision – Byte 8: additional device information – Byte 9-11: device identification
1	Read primary process variable Access type = Read	none	– Byte 0: HART unit ID of the primary process variable – Bytes 1-4: primary process variable *Factory setting:* Primary process variable = Volume flow ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240".
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = Read	none	– Byte 0-3: current current of the primary process variable in mA – Bytes 4-7: percentage of the set measuring range *Factory setting:* Primary process variable = Volume flow

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 ID of the primary process variable – Bytes 5-8: primary process variable – Byte 9: HART unit ID of the second process variable – Bytes 10-13: second process variable – Byte 14: HART unit ID of the third process variable – Bytes 15-18: third process variable – Byte 19: HART unit ID of the fourth process variable – Bytes 20-23: fourth process variable *Factory setting:* • Primary process variable = Volume flow • Second process variable = Totalizer • Third process variable = Not assigned • Fourth process variable = Not assigned ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240".
6	Set HART shortform address Access type = Write	Byte 0: desired address (0...15) *Factory setting:* 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 the unique device identifier using the TAG Access type = Read	Bytes 0-5: TAG	The device identifier provides information on the device and manufacturer; it cannot be altered. The response consists of a 12-byte device ID if the given TAG matches the one saved in the device: – Byte 0: fixed value 254 – Byte 1: manufacturer ID, 17 = E+H – Byte 2: device type ID, 69 = Promag 10 – Byte 3: number of preambles – Byte 4: universal commands rev. no. – Byte 5: rev. no. device-specific commands – Byte 6: software revision – Byte 7: hardware revision – Byte 8: additional device information – Byte 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.

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
13	Read TAG, TAG description and date Access type = Read	none	– Bytes 0-5: TAG – Byte 6-17: TAG description – Bytes 18-20: date ✎ Note! You can write the TAG, TAG description and date using command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: sensor serial number – Byte 3: HART unit ID of sensor limits and measuring range of the primary process variable – Bytes 4-7: upper sensor limit – Bytes 8-11: lower sensor limit – Byte 12-15: minimum span ✎ Note! • The data relate to the primary process variable (= volume flow). • Manufacturer-specific units are represented using the HART unit ID “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 ID for the set measuring range of the primary process variable – Bytes 3-6: end of measuring range, value for 20 mA – Bytes 7-10: start of measuring range, value for 4 mA – Bytes 11-14: attenuation constant in [s] – Byte 15: write protection ID – Byte 16: OEM dealer ID, 17 = E+H *Factory setting:* Primary process variable = Volume flow ✎ Note! Manufacturer-specific units are represented using the HART unit ID “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: Byte 0-23: current user message in the device
18	Write TAG, TAG description and date Access = Write	You can save an 8-character TAG, a 16-character TAG description and a date with this parameter: – Bytes 0-5: TAG – Byte 6-17: TAG description – Bytes 18-20: date	Displays the current information in the device: – Bytes 0-5: TAG – Byte 6-17: TAG description – 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 attenuation constants for primary process variable Access = Write	Byte 0-3: attenuation constant of the primary process variable "volume flow" in seconds = Current output damping	Displays the current attenuation constant in the device: Byte 0-3: attenuation constant in seconds
35	Write measuring range of the primary process variable Access = Write	Write the desired measuring range: – Byte 0: HART unit ID for the primary process variable – Byte 1-4: end of measuring range, value for 20 mA – Byte 5-8: start of measuring range, value for 4 mA *Factory setting:* Primary process variable = Volume flow ✎ Note! • The start of measuring range (4 mA) must correspond to zero flow. • If the HART unit ID does not suit the process variable, the device will continue with the last valid unit.	The measuring range currently set is shown as the response: – Byte 0: HART unit ID for the set measuring range of the primary process variable – Byte 1-4: end of measuring range, value for 20 mA – Bytes 5-8: start of measuring range, value for 4 mA ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240".
38	Device status reset "configuration changed" Access = Write	none	none
42	Perform device reset Access = Write	none	none
44	Write unit of the primary process variable Access = Write	Specify the unit of the primary process variable. Only units which are suitable for the process variable are accepted by the device: Byte 0: HART unit ID *Factory setting:* Primary process variable = Volume flow ✎ Note! • If the written HART unit ID does not suit the process variable, the device will continue with the last valid unit. • If you change the unit of the primary process variable, this has a direct impact on the system units.	The current unit ID of the primary process variable is displayed as a response: Byte 0: HART unit ID ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240".
48	Read extended device status Access = Read	none	The current device status is displayed in extended form as the response: Encoding: see table on Page 59

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 ID to the primary process variable – Byte 1: device variable ID to the second process variable – Byte 2: device variable ID to the third process variable – Byte 3: device variable ID to the fourth process variable *Factory setting:* • Primary process variable: ID 1 for volume flow • Second process variable: ID 250 for totalizer • Third process variable: ID 0 for OFF (not assigned) • Fourth process variable: ID 0 for OFF (not assigned)
53	Write device variable unit Access = Write	This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: device variable ID – Byte 1: HART unit ID *ID of the supported device variables:* See data on Page 53 ✎ Note! • If the written unit does not suit the device variable, the device will continue with the last valid unit. • If you change the unit of the device variable, this has a direct impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: device variable ID – Byte 1: HART unit ID ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240".
59	Specify number of preambles in message responses Access = Write	This parameter specifies the number of preambles which are inserted in the message responses: Byte 0: number of preambles (4...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 bit-encoded information (see table below).

Note!
- Detailed information on the device status messages and error messages, and how they are rectified, can be found on Page 67 ff.!
- Bits not listed are not assigned.

Byte	Bit	Error no.	Short error description (→ Page 67 ff.)
0	0	001	Serious device error.
	1	011	Faulty amplifier EEPROM.
	2	012	Error when accessing data of the amplifier EEPROM.
3	3	111	Totalizer checksum error
5	0	321	Coil current of sensor is outside tolerance.
7	3	351	Current output: the current flow is outside the set range.
8	3	359	Pulse output: the pulse output frequency is outside the set range.
10	7	401	Measuring tube partially filled or empty
11	2	461	EPD adjustment is not possible as the fluid conductivity is too low or too high.
	4	463	The EPD adjustment values for empty pipe or full pipe are identical, i.e. faulty.
12	7	501	Loading new measuring amplifier software version. No other commands possible at this point.
14	3	601	Positive zero return active.
18	3	691	Simulation of failsafe mode (outputs) active
	4	692	Simulation volume flow

6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you commission your measuring point:
- "Post-installation check" checklist → Page 34
- "Post-connection check" checklist → Page 47

6.2 Commissioning

6.2.1 Switching on the measuring device

Once the post-connection checks (see Page 47) have been successfully completed, it is time to switch on the supply voltage. The device is ready for operation!

The measuring device performs a number of internal test functions after power-up. As this procedure progresses the following sequence of messages appears on the local display:

PROMAG 10 **START-UP..**	Start-up message

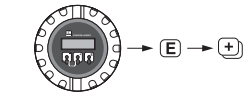
▼

Normal measuring mode commences as soon as start-up completes. The volume flow and the totalizer status appear on the display (HOME position).

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

6.2.2 Brief “commissioning” guide

These brief instructions guide you systematically through the setup procedure for all the major device functions that have to be configured for standard measuring operation.



HOME-POSITION

Configure display

Display language	→ Page 94
Display contrast	→ Page 95
Number of decimal places	→ Page 95

▼

Select engineering units

Volume flow	→ Page 93
Totalizer	→ Page 93

▼

Configure outputs

Current output		*Pulse/status output*	
Current span	→ Page 97	Operating mode	→ Page 99
Full scale value	→ Page 98	Pulse value	→ Page 99
		Pulse width	→ Page 100
		or	
		Assign status output	→ Page 101
		Switch-on point	→ Page 101

▼

More complex applications
require other functions be programmed. Notes on this can be found on the following pages:

Functions at a glance	→ Page 92
Index	→ Page 119
Operating matrix	→ Page 92

▼

For optimum measurement results

Low flow cut off	→ Page 106
Empty pipe detection	→ Page 107

6.2.3 Commissioning after installing a new electronics board

If a new electronics board has been installed, the sensor-specific data must be entered manually. After start-up, the device checks whether a serial number is available. If this is not the case, the following setup is started.

Setup "Commissioning"

Note!

- The setup can no longer be called up once a serial number has been entered and stored. If a parameter is entered incorrectly during the setup, this must be corrected in the relevant function via the function matrix.
- The appropriate information is documented on the nameplate of the sensor and in the interior of the housing cover (see Fig. 2, Page 8).

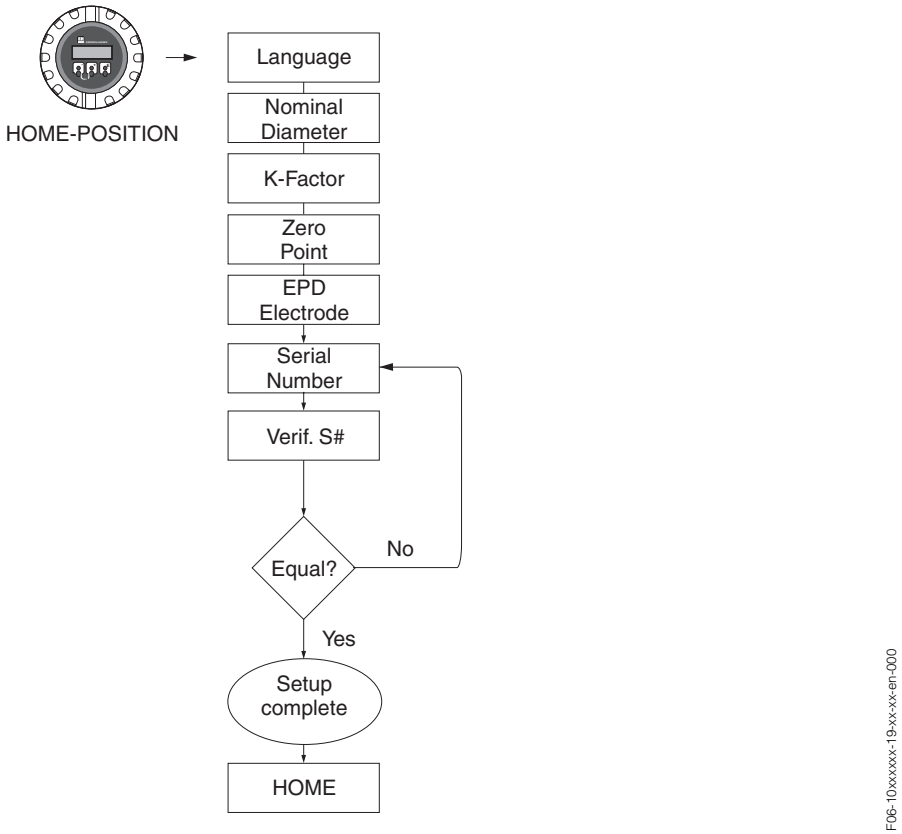


Fig. 38: Setup "Commissioning". Starts after installation of a new electronics board if no serial number is present.

7 Maintenance

The Promag 10 flowmeter system requires no special maintenance.

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.

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 (accessory) → Page 64.

8 Accessories

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

Accessory	Description	Order code
Promag 10 transmitter	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable type for remote version – Cable entry – Display / power supply / operation – Software – Outputs / inputs	10XXX – XXXXX * * * * * * * *
Cable for remote version	Coil and signal cables in various lengths.	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 remote version, aluminium housing	Mounting kit for remote version, suitable for pipe and wall mounting	DK5WM – B
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 10 H instead of a Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA – * * * * *
Sealing kit for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – * * *
Promag H wall mounting kit	Wall mounting kit for Promag H sensor	DK5HM-**
Welding jig for Promag H	Weld nipple as process connection: Welding jig for installation in pipe.	DK5HW – * * *
HART Communicator DXR 275 handheld terminal	Handheld terminal for remote configuration and for obtaining measured values via the current output HART (4...20 mA). Contact your E+H representative for more information.	DXR275 – * * * *

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 E+H representative for more information.	DKA80 – *
FieldTool ™	Configuration and service software for flowmeters in the field: – Commissioning, maintenance analysis – Measuring device configuration – Service functions – Visualisation of process data – Trouble-shooting – Controlling the "FieldCheck™" tester/simulator Contact your E+H representative for more information.	DXS10 – * * * * *
FieldCheck ™	Tester/simulator for testing flowmeters in the field. When used in conjunction with the “FieldTool™” software package, test results can be imported into a database, printed and used for official certification. Contact your E+H representative for more information.	DXC10 – * *

9 Trouble-shooting

9.1 Trouble-shooting instructions

Always start trouble-shooting with the checklist below, if faults occur after commissioning or during operation. This takes you directly (via various queries) 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 → Terminal 1, 2 2. Check the power line fuse → Page 75 85...250 V AC: 1A slow-blow 11...40 V DC and 20...55 V AC: 1.6 A slow-blow 3. Measuring electronics defective → Order spare part → Page 72
No display visible but output signals are present	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the electronics board → Page 74 2. Display module defective → Order spare part → Page 72 3. Electronics defective → Order spare part → Page 72
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ± -buttons simultaneously and switch on the measuring device again. The display text will appear in English and is displayed at maximum contrast.
Measured value indicated, but no signal output at the current or pulse output	Electronics board defective → Order spare part → Page 72

▼

Error messages on display	
Errors which occur during commissioning or operation are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Error type: **S** = System error, **P** = Process error – Error message type: ϟ = Fault message, **!** = Notice message – **EMPTY PIPE** = Error designation (e.g. partially filled measuring tube) – **03:00:05** = Duration of error occurrence (in hours / minutes /seconds) – **#401** = Error number Caution! • Please refer also to the information on Page 51 ff.! • The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → Page 67
Error number: No. 401 – 499	Process error (application error) has occurred → Page 69

▼

Other errors (without error message)	
Some other error has occurred.	Diagnosis and remedial measures → Page 70

9.2 System error messages

Serious system errors are always recognised by the device as “Fault messages” and are indicated with a lightning flash (ϟ) on the display! Fault messages have a direct effect on the inputs and outputs. Simulations and positive zero return, on the other hand, are only 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 6 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a fully completed “Declaration of Contamination” form with the device. A copy of the form can be found at the end of these Operating Instructions.

Type	Error message / No.	Cause	Remedy / spare part
S = System error ϟ = Fault message (*with* an effect on the inputs and outputs) ! = Notice message (*without* an effect on the inputs and outputs)			
No. # 0xx → Hardware error			
S ϟ	CRITICAL FAIL. **# 001**	Serious device error	Replace electronics board. Spare parts → Page 72
S ϟ	AMP HW EEPROM **# 011**	Electronics board: Faulty EEPROM	Replace electronics board. Spare parts → Page 72
S ϟ	AMP SW EEPROM **# 012**	Electronics board: Error when accessing EEPROM data.	The EEPROM data blocks in which an error has occurred are displayed in the “TROUBLESHOOTING” function. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. ✎ Note! The measuring device has to be restarted if an error has occurred in the totalizer block (see also Error No. 111 / CHECKSUM TOTAL.).
No. # 1xx → Software error			
S ϟ	CHECKSUM TOTAL. **# 111**	Totalizer checksum error	1. Restart the measuring device 2. Replace electronics board if necessary. Spare parts → Page 72

Type	Error message / No.	Cause	Remedy / spare part
No. # 3xx → System limits exceeded			
S ϟ	TOL. COIL CURR. **# 321**	Sensor: The coil current is outside the tolerance.	1. Remote version: Switch off power supply before the coil current cable is connected or detached (Terminals No. 41/42). 2. Remote version: Switch off power supply and check wiring of Terminals 41 / 42 → Page 35 ff. 3. Switch off power supply and check coil current cable connector → Page 74 4. Replace electronics board if necessary. Spare parts → Page 72
S **!**	CURRENT SPAN **# 351**	Current output: The current flow is outside the set range.	– Change full scale value entered – Increase or reduce flow
S **!**	PULSE RANGE **# 359**	Pulse output: The pulse output frequency is outside the set 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 totalizer, PLC, etc.) . *Determine pulse width:* – Method 1: enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Method 2: enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at a connected totalizer in order to be recorded. Example: The maximum input frequency of the connected totalizer is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ 3. Reduce flow
No. # 5xx → Application error			
S **!**	DOWNLOAD ACTIVE **# 501**	Electronics board: New software version being loaded, no other commands are possible at present.	Wait until process is completed and restart device.

Type	Error message / No.	Cause	Remedy / spare part
No. # 6xx → Simulation mode active			
S **!**	POS. ZERO-RET. **# 601**	Positive zero return active. Caution! This message has the highest display priority.	Switch off positive zero return
S ϟ	SIM. FAILSAFE M. **# 691**	Simulation of failsafe mode (outputs) active	Switch off simulation
S **!**	SIM. VOL. FLOW **# 692...**	Simulation of volume flow active	Switch off simulation

9.3 Process error messages

Process errors can be defined as either “Fault” or “Notice” messages and can thereby be weighted differently. This is specified via the function matrix (→ Page 92)

Type	Error message / No.	Cause	Remedy
P = Process error ϟ = Fault message (*with* an effect on the inputs and outputs) **!** = Notice message (*without* an effect on the inputs and outputs)			
P **!**	EMPTY PIPE **#401**	Measuring tube partially filled or empty	1. Check system process conditions 2. Fill measuring tube
P **!**	ADJ. N. OK **# 461**	EPD adjustment is not possible as the fluid conductivity is too low or too high.	The EPD function cannot be used for such fluids!
P **!**	EPD FULL = EMPTY **# 463**	The EPD adjustment values for empty pipe or full pipe are identical, i.e. faulty.	Repeat adjustment and follow procedure carefully → Page 107

9.4 Process errors without messages

Symptoms	Remedial measures
N.B. You may have to change or correct settings in certain functions of the function matrix in order to rectify faults.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. If remote version: – Switch off power supply and check wiring → Page 35 ff. – If necessary, reverse the connections at terminals 41 and 42 2. Change the setting in the “INST. DIRECTION, SENSOR” function accordingly
Measured value reading fluctuates even though flow is steady.	1. Check grounding and potential equalisation → Page 43 ff. 2. Check the fluid for presence of gas bubbles. 3. SYSTEM DAMPING function → Increase value
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalisation → Page 43 ff. 2. Check the fluid for presence of gas bubbles. 3. Activate the “LOW FLOW CUT OFF” function, i.e. enter or increase the value for the switch point.
Measured value reading on display even though measuring tube is empty?	1. Perform empty or full pipe adjustment and then switch on Empty Pipe Detection → Page 107 2. Remote version: check the terminal connections of the EPD cable → Page 35 ff. 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Set the “BUS ADDRESS” function to “0”. 2. Low flow cut off too high. Reduce value in the “LOW FLOW CUT OFF” function.
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your E+H service organisation.	The following options are available for tackling problems of this nature: **Request the services of an E+H service technician** If you contact our service organisation to have a service technician sent out, please be ready with the following information: – Brief description of the fault – Nameplate specifications (Page 7 ff.): order code and serial number **Return devices to E+H** The procedures on Page 6 must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a fully completed “Declaration of Contamination” form with the flowmeter. A copy of the "Dangerous Goods Sheet" can be found at the end of these Operating Instructions. **Replace transmitter electronics** Components in the electronics defective → Order spare part → Page 72

9.5 Response of outputs to errors

Note!
The response of the totalizers and current, pulse and status outputs to error can be configured by means of the central function FAILSAFE MODE (→ Page 112).

Positive zero return and error response:
You can use positive zero return to set the signals of the current, pulse and status outputs to their fallback value, for example when operation has to be interrupted while a pipe is being cleaned.
This function has priority over all other device functions; simulations are suppressed, for example.

Response of outputs and totalizers to errors

	Process/system error present	Positive zero return activated
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs! Please refer also to the information on Page 51 ff.		
Current output	*MIN.VALUE* 4–20 mA (25 mA) → 2 mA 4–20 mA NAMUR → 3.5 mA 4–20 mA US → 3.75 mA 4–20 mA (25 mA) HART → 2 mA 4–20 mA HART NAMUR → 3.5 mA 4–20 mA HART US → 3.75 mA *MAX.VALUE* 4–20 mA (25 mA) → 25mA 4–20 mA NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 4–20 mA (25 mA) HART → 25 mA 4–20 mA HART NAMUR → 22.6 mA 4–20 mA HART US → 22.6 mA *ACTUAL VALUE* Fault is ignored, i.e. standard measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Pulse output	*MINIMUM/MAXIMUM VALUE ≙ FALLBACK VALUE* Signal output → No pulses *ACTUAL VALUE* Fault is ignored, i.e. standard measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer	*MINIMUM/MAXIMUM VALUE ≙ STOP* The totalizer is paused until the fault is rectified. *ACTUAL VALUE* The fault is ignored. The totalizers continue to count in accordance with the current flow value.	Totalizer stops
Status output	In event of fault or power supply failure: Status output → not conductive	No effect on status output

9.6 Spare parts

Section 9.1 contains detailed trouble-shooting instructions. The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.
Trouble-shooting 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 E+H service organisation by providing the serial number printed on the nameplates (see Page 7).

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

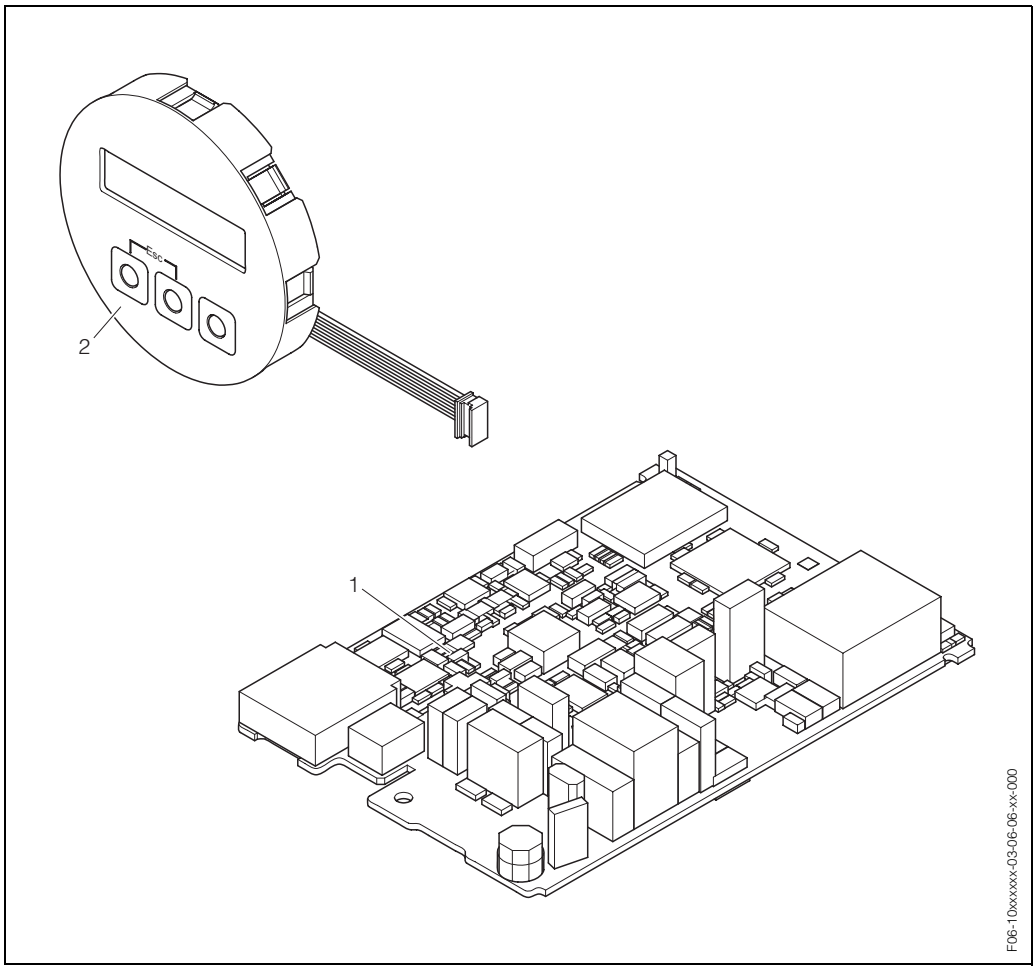


Fig. 39: Spare parts for Promag 10 transmitter

1 Electronics board (85...250 V AC or 20...28 V AC / 11...40 V DC)
2 Display module

9.7 Removing and installing electronics board

Field housing: removing and installing electronics board (Fig. 40)

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!

1. Switch off the power supply
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Remove the display (a) from the connection compartment.
4. Press the side latches (b) and flip down the cover of the connection compartment.
5. Disconnect the connector of the electrode signal cable (c) and the coil current cable (d).
6. Disconnect the connector for the power supply (e) and the outputs (f).
7. Disconnect the connector (g) for the display.
8. Loosen the threaded fasteners (h) of the connection compartment.
9. Plug ground cable (i) out of electronics board.
10. Pull entire module (plastic retainer and electronics board) out of the housing.
11. Press the side latches (j) slightly outwards and push the electronics board partly from front to rear.
12. Pull the electronics board completely out of the plastic retainer from rear.
13. Reverse the procedure to reassemble.

Caution!
Use only genuine Endress+Hauser parts.

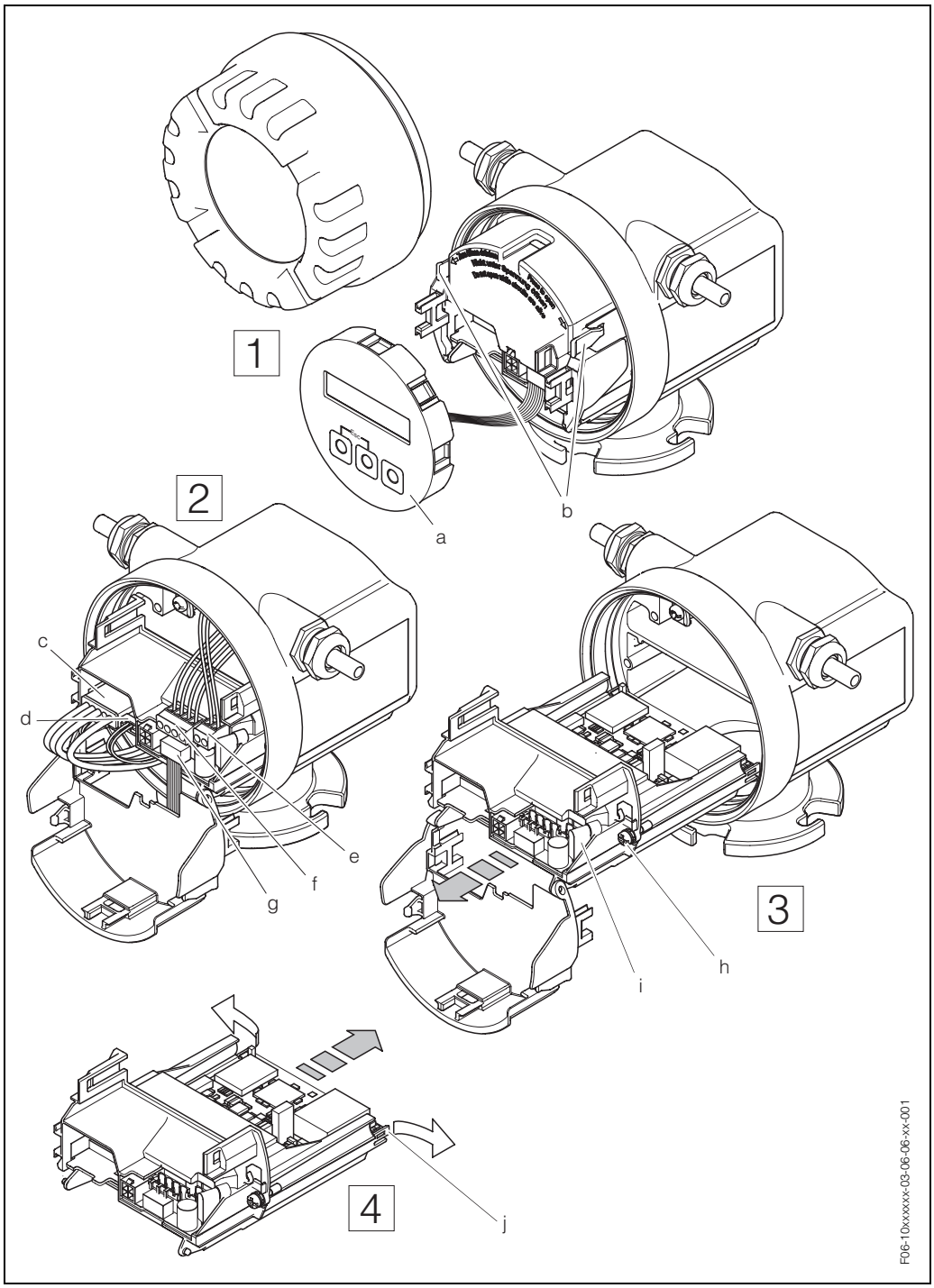


Fig. 40: Field housing: removing and installing electronics board

a Local display
b Side latches
c Connector of the electrode signal cable
d Connector of the coil current cable
e Connector for the power supply
f Connector for the current output and pulse/status output
g Connector for the local display
h Threaded fasteners of the connection compartment
i Connector of the ground cable
j Mounting link of the electronics board

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 device fuse is located on the electronics board (→ Fig. 41).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Press the side latches and flip down the cover of the connection compartment.
4. Disconnect the connector (a) for the power supply
5. Replace device fuse (b).
   Use only fuses of the following type:
   – Power supply 11...40 V DC / 20...28 V AC → 1.6 A slow-blow / 250 V TR5
   – Power supply 85...250 V DC → 1 A slow-blow / 250 V TR5
6. Installation is the reverse of the removal procedure.

Caution!
Use only genuine Endress+Hauser parts.

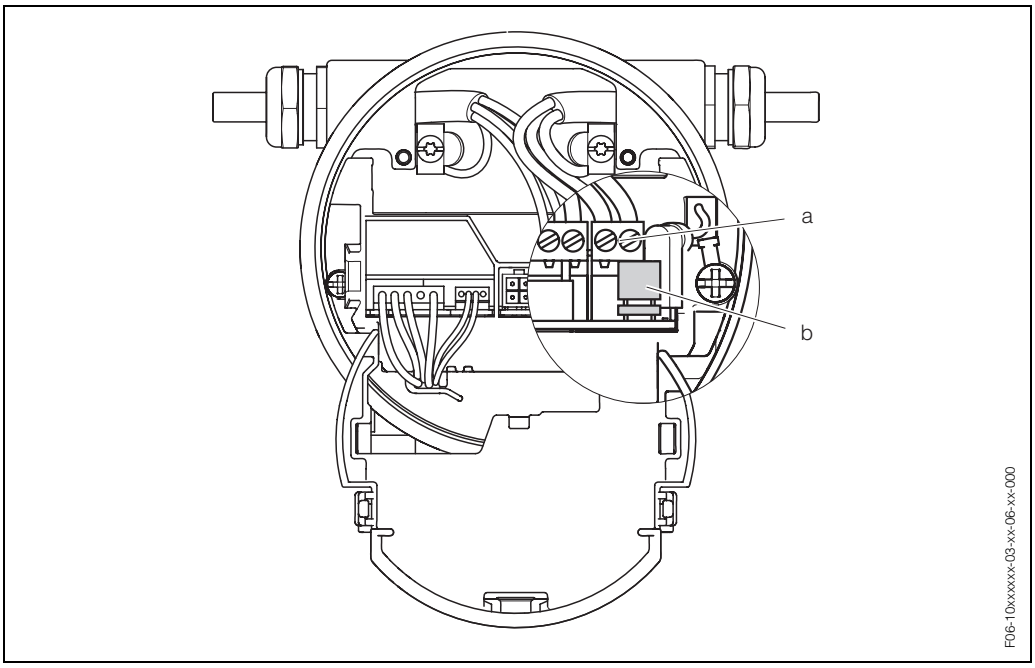


Fig. 41: Replacing the device fuse on the electronics board

a Connector for the power supply
b Device fuse

9.9 Software history

Software version / date	Software modification	Documentation Modifications / Supplements
Amplifier		
V 1.00.00 / 01.2003	Original software. Compatible with: – FieldTool ™ – Commuwin II (version 2.05.03 and higher) – HART Communicator DXR 275 (OS 4.6 and higher) with rev. 1, DD 1.	–

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

- Measuring the flow rate of fluids in closed piping systems.
- A minimum conductivity of ≥ 50 μS/cm is required for measuring
- Applications in measuring, control and regulation technology.

Note!
For liner specific applications see Section 10.1.2, "Function and system design"

10.1.2 Function and system design

Measuring principle	Electromagnetic flow measurement on the basis 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: Sensor is mounted separate from the transmitter. *Transmitter:* • Promag 10 *Sensor:* • Promag W, DN 25...600 / 1/2"...24" – Polyurethane-liner for water and waste water applications, applications with stable and constant temperature and applications with small abrasion (e.g. mining industry). – Hard rubber liner for all water applications (especially potable water applications). • Promag P, DN 25...300 / 1/4"...24" – PTFE-liner for all standard applications in the chemical and process industry. • Promag H, DN 2...100 / 1/12"...1/2" – PFA-liner for all applications in the chemical, process and food industry. Especially for applications with high temperatures and big temperature steps (e.g. CIP and SIP).

10.1.3 Input

Measured variable	Flow rate (proportional to induced voltage)
Measuring range	Typically v = 0.01...10 m/s with the specified measuring accuracy
Operable flow range	Over 1000 : 1

10.1.4 Output

Output signal	*Current output:* Active, galvanically isolated, full scale value selectable, temperature coefficient: typically 2 µA/°C, resolution: 1.5 µA • Active: 4...20 mA, R_L < 700 Ω (for HART: R_L ≥ 250 Ω) *Pulse output:* Passive, open collector, 30 V DC, 250 mA, galvanically isolated. Can be configured as: – Pulse output: Pulse value and pulse polarity can be selected, max. pulse width adjustable (5...2000 ms), pulse frequency max. 100 Hz or – Status output: For example, can be configured for error message, Empty Pipe Detection, flow recognition, limit value
Signal on alarm	• Current output → Failsafe mode can be selected • Pulse output → Failsafe mode can be selected • Status output → "Not conductive" in the event of fault or power supply failure Details → Page 71
Load	See "Output signal"
Low flow cut off	Switch-on point for low flow cut off can be selected as required
Galvanic isolation	All circuits for inputs, outputs and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connection	see Page 35 ff.
Cable entry	*Power supply and signal cables (inputs/outputs):* • Cable entry M20 x 1.5 (8...12 mm) • Thread for cable entries 1/2" NPT, G 1/2" *Connecting cable for remote version:* • Cable entry M20 x 1.5 (8...12 mm) • Thread for cable entries 1/2" NPT, G 1/2"
Cable specification	See Page 39
Supply voltage	85...250 V AC, 45...65 Hz 20...28 V AC, 45...65 Hz 11...40 V DC

Power consumption

85...250 V AC: <12 VA (incl. sensor)
20...28 V AC: <8 VA (incl. sensor)
11...40 V DC: <6 W (incl. sensor)

Switch-on current
- Max. 3.3 A (< 5 ms) at 24 V DC
- Max 5.5 A (< 5 ms) at 28 V AC
- Max. 16 A (< 5 ms) at 250 V AC

Power supply failure

Lasting min. ½ cycle frequency:
EEPROM saves measuring system data if power supply fails.

Potential equalisation

see Page 43 ff.

10.1.6 Performance characteristics

Reference operating conditions

To DIN 19200 and VDI/VDE 2641:
- Fluid temperature: +28 C ± 2 K
- Ambient temperature: +22 C ± 2 K
- Warm-up time: 30 minutes

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

Maximum measured error

Pulse output: ± 0.5% o.r. ± 2 mm/s (o.r. = of reading)

Current output: also typically ± 5 μA

Supply voltage fluctuations do not have any effect within the specified range.

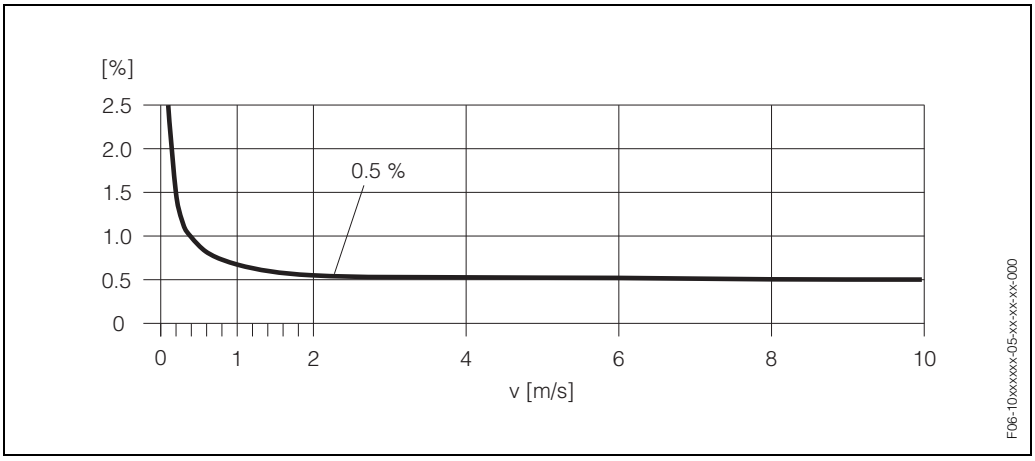


Fig. 42: Max. measured error in % of measured value (Promag 10)

Repeatability

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

10.1.7 Operating conditions

	Installation
Installation instructions	Any orientation (vertical, horizontal) Restrictions and additional installation instructions → Page 12 ff.
Inlet and outlet runs	Inlet run: typically ≥ 5 x DN Outlet run: typically ≥ 2 x DN
Length of connecting cable	For the remote version the permissible cable length L_{max} depends on the conductivity of the medium → Page 21. A minimum conductivity of 50 µS/cm is required for measuring demineralised water.
	Environment
Ambient temperature range	–20...+60 °C (sensor, transmitter) Please note the following points: • Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. • The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high (→ "Fluid temperature").
Storage temperature	–10...+50 °C (preferably at +20 °C)
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 68-2-6
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: not possible Promag H: possible (observe max. temperature)
Electromagnetic compatibility (EMC)	To EN 61326 Emission: according to limit value for industrial environments documented in EN55011.

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...600)
–20...+60 °C for polyurethane (DN 25...600)

Promag P:
–40...+130 °C for PTFE (DN 25...300), for restrictions → refer to diagrams

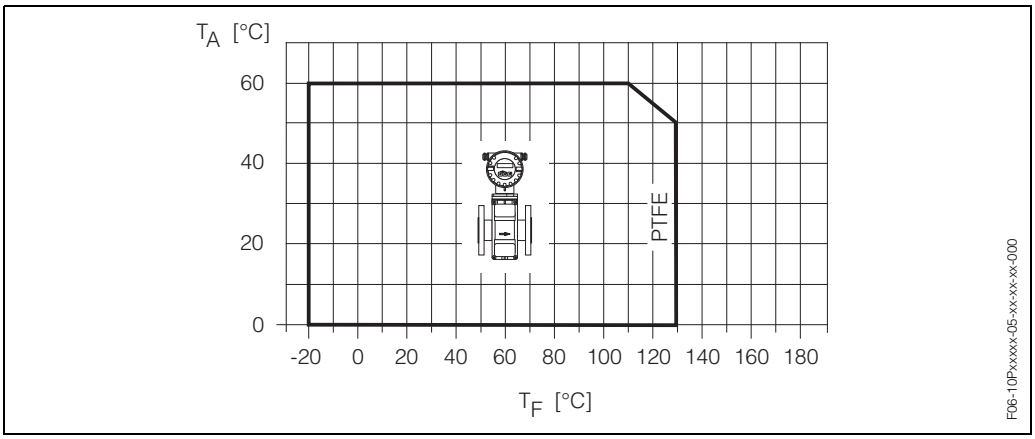


Fig. 43: Compact versions, Promag P
T_A = Ambient temperature, T_F = Medium temperature

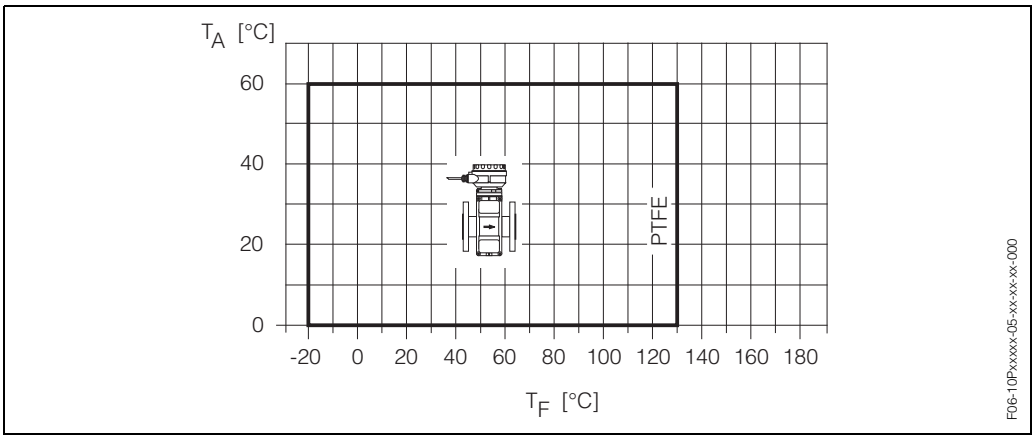


Fig. 44: Remote versions, Promag P
T_A = Ambient temperature, T_F = Medium temperature

Promag H
Sensor:
- DN 2...25: –20...+150 °C
- DN 40...100: –20...+150 °C

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

Conductivity

Minimum conductivity: ≥ 50 µS/cm
Note that in the case of the remote version, the requisite conductivity is also influenced by the length of the connecting cable → Page 21

Medium pressure range (nominal pressure)

Promag W
DIN 2501 PN 10 (DN 200...600), PN 16 (DN 65...150), PN 40 (DN 25...50)
ANSI B16.5 Class 150 (1...24")
JIS B2238 10K (DN 65...600), 20K (DN 25...50)

Promag P
DIN 2501 PN 10 (DN 200...300), PN 16 (DN 65...150), PN 40 (DN 25...150)
ANSI B16.5 Class 150 (1...12")
JIS B2238 10K (DN 65...300), 20K (DN 25...50)

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 (measuring tube lining)

Promag W nominal diameter		**Measuring tube lining**	**Pressure tightness, measuring tube lining** Limit values for absolute pressure [mbar] with different fluid temperatures						
[mm]	[inch]		25 °C	60°C	80 °C	100 °C	130 °C	150 °C	180 °C
25...600	1...24"	Polyurethane	0	0	–	–	–	–	–
65...600	1...24"	Hard rubber	0	0	0	–	–	–	–

Promag P nominal diameter		**Measuring tube lining**	**Pressure tightness, measuring tube lining** Limit values for absolute pressure [mbar] with different fluid temperatures			
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C
25	1"	PTFE	0	0	0	100
32	–	PTFE	0	0	0	100
40	1 1/2"	PTFE	0	0	0	100
50	2"	PTFE	0	0	0	100
65	–	PTFE	0	*	40	130
80	3"	PTFE	0	*	40	130
100	4"	PTFE	0	*	135	170
125	–	PTFE	135	*	240	385
150	6"	PTFE	135	*	240	385
200	8"	PTFE	200	*	290	410
250	10"	PTFE	330	*	400	530
300	12"	PTFE	400	*	500	630
* No value can be specified.						

Promag H nominal diameter		**Measuring tube lining**	**Pressure tightness, measuring tube lining** Limit values for absolute pressure [mbar] with different 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 17

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 (E) DIN EN 545 → Page 16

10.1.8 Mechanical construction

Design, dimensions → Page 91

Weight

Promag W weight data in kg

Nominal diameter		Compact version				Remote version (without cables)				
		DIN		ANSI		Sensor				Transmitter
[mm]	[inch]									
25	1"	PN 40	5.7	Class 150	5.7	PN 40	5.3	Class 150	5.3	3.1
32	1 1/4"		6.4		–		6.0		–	3.1
40	1 1/2"		7.8		7.8		7.4		7.4	3.1
50	2"		9.0		9.0		8.6		8.6	3.1
65	2 1/2"	PN 16	10.4		–	PN 16	10.0		–	3.1
80	3"		12.4		12.4		12.0		12.0	3.1
100	4"		14.4		14.4		14.0		14.0	3.1
125	5"		19.9		–		19.5		–	3.1
150	6"		23.9		23.9		23.5		23.5	3.1
200	8"	PN 10	43.4		43.4	PN 10	43		43	3.1
250	10"		63.4		73.4		63		73	3.1
300	12"		68.4		108.4		68		108	3.1
350	14"		113.4		173.4		113		173	3.1
400	16"		133.4		203.4		133		203	3.1
450	18"		173.4		253.4		173		253	3.1
500	20"		173.4		283.4		173		283	3.1
600	24"		233.4		403.4		233		403	3.1

Promag transmitter (compact version): 1.8 kg
(Weight data valid for standard pressure ratings and without packaging material)

Promag P weight data in kg

Nominal diameter		Compact version				Remote version (without cables)				
		DIN		ANSI		Sensor				Transmitter
[mm]	[inch]									
25	1"	PN 40	5.7	Class 150	5.7	PN 40	5.3	Class 150	5.3	3.1
32	1 1/4"		6.4		–		6.0		–	3.1
40	1 1/2"		7.8		7.8		7.4		7.4	3.1
50	2"		9.0		9.0		8.6		8.6	3.1
65	2 1/2"	PN 16	10.4		–	PN 16	10.0		–	3.1
80	3"		12.4		12.4		12.0		12.0	3.1
100	4"		14.4		14.4		14.0		14.0	3.1
125	5"		19.9		–		19.5		–	3.1
150	6"		23.9		23.9		23.5		23.5	3.1
200	8"	PN 10	43.4		43.4	PN 10	43		43	3.1
250	10"		63.4		73.4		63		73	3.1
300	12"		68.4		108.4		68		108	3.1

Promag transmitter (compact version): 1.8 kg
(Weight data valid for standard pressure ratings and without packaging material)

Promag H weight data in kg

Nominal diameter		Compact version	Remote version (without cables)	
[mm]	[inch]	DIN	Sensor	Transmitter
2	1/12"	3.6	2.5	3.1
4	5/32"	3.6	2.5	3.1
8	5/16"	3.6	2.5	3.1
15	1/2"	3.7	2.6	3.1
25	1"	3.9	2.8	3.1
40	1 1/2"	4.9	4.5	3.1
50	2"	7.4	7.0	3.1
65	2 1/2"	7.9	7.5	3.1
80	3"	17.4	17.0	3.1

Promag transmitter (compact version): 1.8 kg
(Weight data valid for standard pressure ratings and without packaging material)

Material

Promag W
Transmitter housing:
- Compact housing: powder-coated die-cast aluminum
- Remote version housing: powder-coated die-cast aluminium

Sensor housing:
- DN 25...300: powder-coated die-cast aluminium
- DN 350...600: coated steel (Amerlock 400)

Measuring tube:
- DN < 350: stainless steel 1.4301/304 or 1.4306/304L; flange material with Al/Zn protective coating
- DN > 300: stainless steel 1.4301/304; flange material with Amerlock 400 coating

Flanges:
- DIN: ST37 / FE 410W B (DN < 350: with Al/Zn protective coating; DN > 300 with Amerlock 400 coating)
- ANSI: A 105 (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 coating)
- JIS: S20C (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 coating)

Ground disks: 1.4435/316L or Alloy C-22
Electrodes: 1.4435/316L, Alloy C-22
Seals: seals to DIN 2690

Promag P
Transmitter housing:
- Compact housing: powder-coated die-cast aluminum
- Remote version housing: powder-coated die-cast aluminium

Sensor housing:
DN 25...300: powder-coated die-cast aluminium

Measuring tube:
Stainless steel 1.4301/304 or 1.4306/304L; flange material with Al/Zn protective coating

Flanges:
- DIN: ST37 / FE 410W B (with Al/Zn protective coating)
- ANSI: A105 (with Al/Zn protective coating)
- JIS: S20C (with Al/Zn protective coating)

Ground disks: 1.4435/316L or Alloy C-22
Electrodes: 1.4435/316L, Alloy C-22
Seal: seals to DIN 2690

Promag H
Transmitter housing:
- Compact housing: powder-coated die-cast aluminum
- Remote version housing: powder-coated die-cast aluminium

Sensor housing: 1.4301
Wall mounting kit (holding plate): 1.4301

Measuring tube: stainless steel 1.4301 or 1.4306/304L

Flanges: connections generally made of 1.4404/316L

Ground rings: 1.4435/316L, Alloy C-22

Electrodes:
- Standard: 1.4435
- Optional: Alloy C-22

Seals:
- DN 2...25: O-ring (EPDM, Viton, Kalrez) or moulded seal (EPDM, silicone, Viton)
- DN 40...100: moulded 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 10 W” (TI 093D/06/en)
- Technical Information “Promag 10 P” (TI 094D/06/en)
- Technical Information “Promag 10 H” (TI 095D/06/en)

Fitted electrodes

Promag W:
Measuring electrodes, reference electrodes and Empty Pipe Detection electrodes
Available as standard with: 1.4435/316L, Alloy C-22

Promag P:
Measuring electrodes, reference electrodes and Empty Pipe Detection electrodes
Available as standard with: 1.4435/316L, Alloy C-22

Promag H:
Measuring electrodes and Empty Pipe Detection electrodes
- Available as standard with: 1.4435/316L, Alloy C-22
- DN 2...4: without Empty Pipe Detection electrode

Process connection

Promag W:
Flange connection: DIN (dimensions to DIN 2501), ANSI, JIS

Promag P:
Flange connection: DIN (dimensions to DIN 2501), ANSI, JIS

Promag H:
- With O-ring: flange (DIN, ANSI, JIS), external thread (ISO 228/DIN299)
- With moulded seal: weld socket (DIN 11850, ODT), Tri-Clamp, threaded joint (DIN 11851, DIN 11864-1, SMS1145), flange DIN 11864-2

Surface roughness

- Measuring tube lining with PFA: ≤ 0.3 µm (Promag H)
- Electrodes:
  1.4435/316L, Alloy C-22: ≤ 0.4 µm
- Promag H process connection: ≤ 0.8 µm

(All data refer to parts in contact with medium)

10.1.9 Human interface

Display elements	• Liquid crystal display: unilluminated, two-line, 16 characters per line • Display (operating mode) preconfigured: volume flow and totalizer status • 1 totalizer
Operating elements	• Local operation via three push buttons (–/+/ E)
Remote operation	Operation via HART protocol

10.1.10 Certificates and approvals

Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Centre on request. All explosion protection data are given in a separate documentation which is available upon request.
Sanitary compatibility	Promag W: No applicable approvals or certification Promag P: No applicable approvals or certification Promag H: • 3A approval and EHEDG-tested • Seals conform to FDA (apart from Kalrez seals)
Pressure measuring device approval	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). For larger nominal diameters, certified flowmeters to Category III are optionally also available if necessary (depends on fluid and operating pressure). All devices are applicable for all fluids and instable gases on principle and have been designed and manufactured in accordance to sound engineering practice.
CE approval	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 (IEC 1326) “Emmision to class A requirements” Electromagnetic compatibility (EMC requirements) ANSI/ISA-S82.01 Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements. Pollution degree 2, Installation Category II. CAN/CSA-C22.2 No. 1010.1-92 Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category II

10.1.11 Ordering information

The E+H 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 64). Your E+H service organisation can provide detailed information on the order codes in question.

10.1.13 Documentation

- System Information Promag 10 (SI 042D/06/en)
- Technical Information Promag 10 W (TI 093D/06/en)
- Technical Information Promag 10 P (TI 094D/06/en)
- Technical Information Promag 10 H (TI 095D/06/en)

10.2 Measuring tube specifications

Promag W nominal diameter		Pressure rating			Measuring tube internal diameter	
DIN [mm]	ANSI [inch]	DIN [bar]	ANSI [lbs]	JIS	Hard rubber	Polyurethane
25	1"	PN 40	Cl 150	20K		24
32	–	PN 40	–	20K		32
40	1 1/2"	PN 40	Cl 150	20K		38
50	2"	PN 40	Cl 150	20K		50
65	–	PN 16	–	10K	66	66
80	3"	PN 16	Cl 150	10K	76	79
100	4"	PN 16	Cl 150	10K	102	102
125	–	PN 16	–	10K	127	127
150	6"	PN 16	Cl 150	10K	156	156
200	8"	PN 10	Cl 150	10K	204	204
250	10"	PN 10	Cl 150	10K	258	258
300	12"	PN 10	Cl 150	10K	309	309
350	14"	PN 10	Cl 150	–	342	342
400	16"	PN 10	Cl 150	–	392	392
450	18"	PN 10	Cl 150	–	437	437
500	20"	PN 10	Cl 150	–	492	492
600	24"	PN 10	Cl 150	–	594	594

Promag P nominal diameter		Pressure rating			Internal diameter Measuring tube
DIN [mm]	ANSI [inch]	DIN [bar]	ANSI [lbs]	JIS	with PTFE [mm]
25	1"	PN 40	Cl 150	20K	26
32	–	PN 40	–	20K	35
40	1 1/2"	PN 40	Cl 150	20K	41
50	2"	PN 40	Cl 150	10K	52
65	–	PN 16	–	10K	67
80	3"	PN 16	Cl 150	10K	80
100	4"	PN 16	Cl 150	10K	104
125	–	PN 16	–	10K	129
150	6"	PN 16	Cl 150	10K	156
200	8"	PN 10	Cl 150	10K	202
250	10"	PN 10	Cl 150	10K	256
300	12"	PN 10	Cl 150	10K	306

Promag H nominal diameter		Pressure ratings *	Measuring tube internal diameter**
DIN [mm]	ANSI [inch]	DIN [bar]	PFA
2	1/12"	PN 16 / PN 40	2.25
4	5/32"	PN 16 / PN 40	4.5
8	5/16"	PN 16 / PN 40	9.0
15	1/2"	PN 16 / PN 40	16.0
–	1"	PN 16 / PN 40	22.6
25	–	PN 16 / PN 40	26.0
40	1 1/2"	PN 16 / PN 40	35.3
50	2"	PN 16 / PN 40	48.1
65	2 1/2"	PN 16 / PN 40	59.9
80	3"	PN 16 / PN 40	72.6
100	4"	PN 16 / PN 40	97.5

* The pressure rating depends on the process connection and the seals used (see Page 82)
** Internal diameter of process connections see Technical Information on Promag 10 (separate document) → Page 91

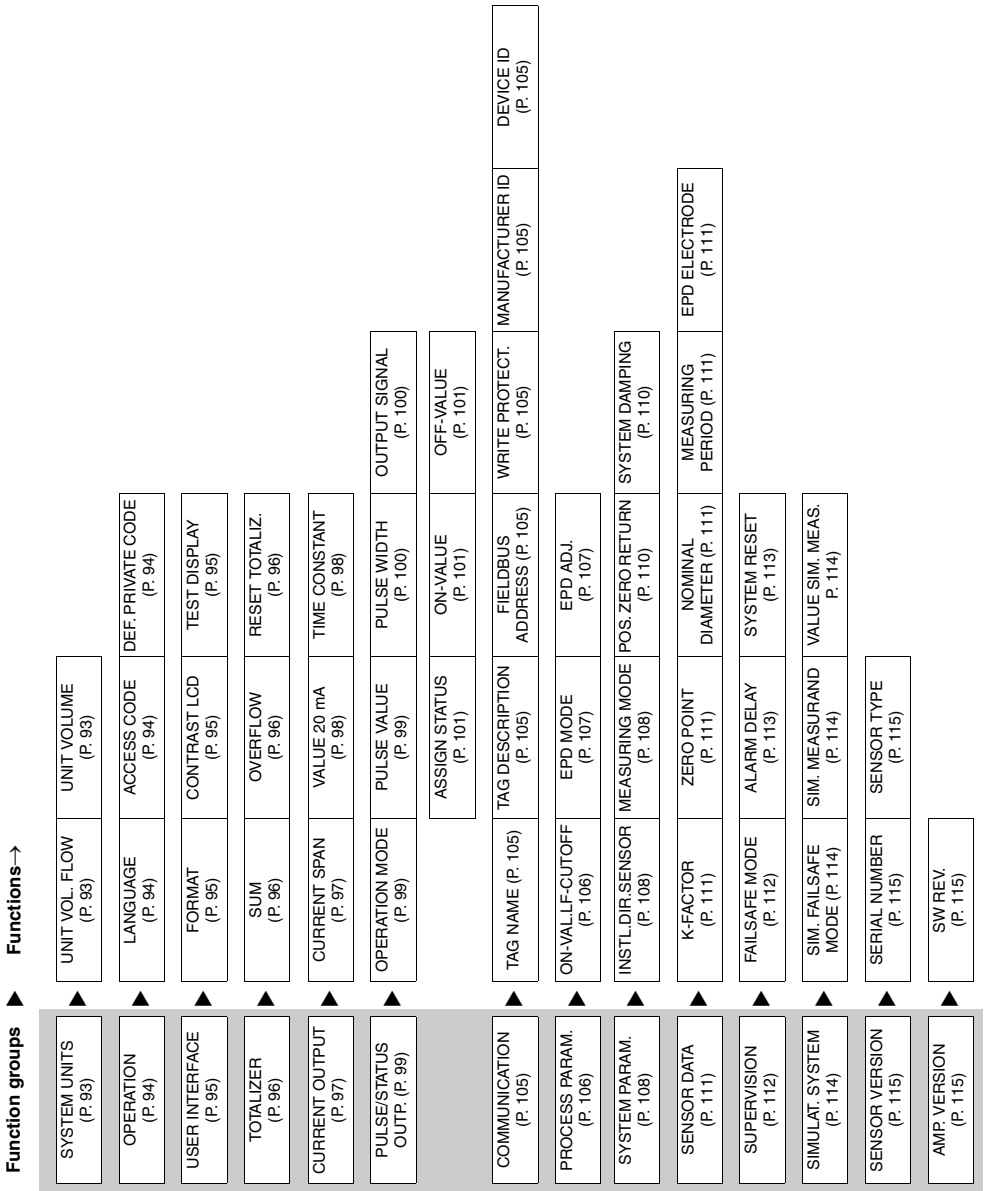
10.3 Dimensions

Information on the dimensions can be found in the following documents:
- Technical Information Promag 10 W (TI 093D/06/en)
- Technical Information Promag 10 P (TI 094D/06/en)
- Technical Information Promag 10 H (TI 095D/06/en)

You can also download these documents as PDF files from Endress+Hauser's Internet site → www.endress.com

11 Description of Device Functions

11.1 Illustration of the Promag 10 function matrix



11.2 Group SYSTEM UNITS

Function description SYSTEM UNITS	
Use this function group to select the unit for the measured variable.	
UNIT VOLUME FLOW	Use this function to select the unit for displaying the volume flow. The unit you select here is also valid for: • Volume flow display • Current output • Switch points (limit value for volume flow, flow direction) • Low flow cut off **Options:** Metric: Cubic centimetre → cm^3/s; cm^3/min; cm^3/h; cm^3/day Cubic decimetre → dm^3/s; dm^3/min; dm^3/h; dm^3/day Cubic metre → m^3/s; m^3/min; m^3/h; m^3/day Millilitre → ml/s; ml/min; ml/h; ml/day Litre → l/s; l/min; l/h; l/day Hectolitre → hl/s; hl/min; hl/h; hl/day Megalitre → Ml/s; Ml/min; Ml/h; Ml/day US: Cubic centimeter → cc/s; cc/min; cc/h; cc/day Acre foot → af/s; af/min; af/h; af/day Cubic foot → ft^3/s; ft^3/min; ft^3/h; ft^3/day Fluid ounce → oz f/s; oz f/min; oz f/h; oz f/day Gallon → gal/s; gal/min; gal/h; gal/day Million gallons → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (normal fluids: 31.5 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (beer: 31.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 42.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (filling tanks: 55.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Imperial Gallon → gal/s; gal/min; gal/h; gal/day Mega gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (beer: 36.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 34.97 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day **Factory setting:** Depends on nominal diameter and country (dm^3/min...m^3/h or US-gal/min), corresponding to the full scale value unit (see Page 116 ff.) factory setting.
UNIT VOLUME	Use this function to select the unit for displaying the volume. The unit you select here is also valid for: • Totalizer status display • Totalizer unit • Pulse value (e.g. m^3/p) **Options:** Metric → cm^3; dm^3; m^3; ml; l; hl; Ml US → cc; af; ft^3; oz f; gal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals) → bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting:** Depends on nominal diameter and country (dm^3...m^3 or US-gal), corresponding to the totalizer unit (see Page 116 ff.) factory setting.

11.3 Group OPERATION

Function description OPERATION	
LANGUAGE	Use this function to select the language for all texts, parameters and messages shown on the local display. **Options:** ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO **Factory setting:** Depends on country, see factory setting Page 116 ff. ✎ Note! If you press the ⊡+⊡ keys simultaneously at startup, the language defaults to "ENGLISH".
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the ⊡+⊡ keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can enable programming by entering your private code (**factory setting = 10**, see DEF. PRIVATE CODE function on Page 94) **User input:** Max. 4-digit number: 0...9999 ✎ Note! • The programming levels are disabled if you do not press a key within 60 seconds following automatic return to the HOME position. • You can also disable programming in this function by entering any number (other than the defined private code). • The Endress+Hauser service organisation can be of assistance if you mislay your personal code.
DEF. PRIVATE CODE	Use this function to enter a personal code for enabling programming. **User input:** 0...9999 (max. 4-digit number) **Factory setting:** 10 ✎ Note! • Programming is always enabled with the code “0”. • Programming has to be enabled before this code can be changed. When programming is disabled this function is not available, thus preventing others from accessing your personal code. • The function is not available unless the personal code was entered in the function ACCESS CODE.

11.4 Group USER INTERFACE

Function description USER INTERFACE	
FORMAT	Use this function to define the maximum number of places after the decimal point displayed for the reading in the main line. **Options:** XXXXX. - XXXX.X - XXX.XX - XX.XXX -X.XXXX **Factory setting:** X.XXXX ✎ Note! • Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. • The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In these instances an arrow appears on the display between the measured value and the engineering unit (e.g. 1.2 → l/h), indicating that the measuring system is computing with more decimal places than can be shown on the display.
CONTRAST LCD	Use this function to optimise display contrast to suit local operating conditions. **User input:** 10...100% **Factory setting:** 50%
TEST DISPLAY	Use this function to test the operability of the local display and its pixels. **Options:** OFF ON **Factory setting:** OFF Test sequence: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for minimum 0.75 seconds. 3. The main line and additional line show an "8" in each field for minimum 0.75 seconds. 4. The main line and additional line show a "0" in each field for minimum 0.75 seconds. 5. The main line and additional line show nothing (blank display) for minimum 0.75 seconds. When the test completes the local display returns to its initial state and the setting changes to OFF.

11.5 Group TOTALIZER

Function description TOTALIZER	
SUM	The total for the totalizer's measured variable aggregated since measuring commenced appears on the display. This value can be positive or negative, depending on: • Flow direction and/or • Setting in the MEASURING MODE function (Page 108) **Display:** Max. 7-digit floating-point number, including sign and unit (e.g. 15467.04 m^3) ✎ Note! • The totalizer's response to faults is defined in the central “FAILSAFE MODE” function (see Page 112). • The unit of the totalizer is defined in the UNIT VOLUME function (Page 93).
OVERFLOW	The total for the totalizer's overflow aggregated since measuring commenced appears on the display. Total flow quantity is represented by a floating-point number consisting of max. 7 digits. You can use this function to view higher numerical values (>9,999,999) as overflows. The effective quantity is thus the total of the OVERFLOW function plus the value displayed in the SUM function. Example: Reading for 2 overflows: 2 E7 dm^3 (= 20,000,000 dm^3) The value displayed in the function “SUM” = 196,845.7 dm^3 Effective total quantity = 20,196,845.7 dm^3 **Display:** Integer with exponent, including sign and unit, e.g. 2 E7 dm^3
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to "zero" (= RESET). **Options:** NO YES **Factory setting:** NO

11.6 Group CURRENT OUTPUT

Function description CURRENT OUTPUT

✎ Note!
The functions of the Group CURRENT OUTPUT are not available unless the value 0 was entered in the FIELDBUS ADDRESS function (Group COMMUNICATION, → Page 105)

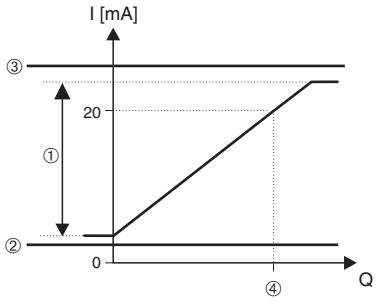
CURRENT SPAN

Use this function to define the current span. You can configure the current output either in accordance with the NAMUR recommendation (max. 20.5 mA) or for a maximum drive of 25 mA.

Options:
OFF
4-20 mA (25 mA)
4-20 mA (25 mA) HART
4-20 mA NAMUR
4-20 mA HART NAMUR
4-20 mA US
4-20 mA HART US

Factory setting:
4-20 mA (25 mA) HART

Current span, work range and signal on alarm level



A	①	②	③
OFF	4 mA	-	-
4-20 mA (25 mA)	4 - 24 mA	2	25
4-20 mA (25 mA) HART	4 - 24 mA	2	25
4-20 mA NAMUR	3,8 - 20,5 mA	3,5	22,6
4-20 mA HART NAMUR	3,8 - 20,5 mA	3,5	22,6
4-20 mA US	3,9 - 20,8 mA	3,75	22,6
4-20 mA HART US	3,9 - 20,8 mA	3,75	22,6

F06-10xxxxxx-05-xx-xx-xx-003

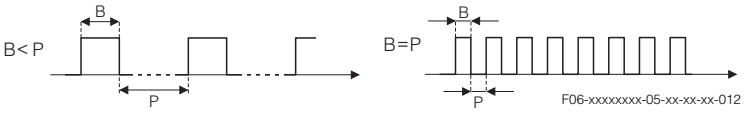
A = Current span (option)
① = Work range
② = Lower signal on alarm level
③ = Upper signal on alarm level
④ = Scaled full scale value
Q = Flow

✎ Note!
- If the measured value exceeds the measuring range (as defined in the function VALUE 20 mA, Page 98) a notice message is generated (#351, current span)
- The current output's response to faults is defined in the central FAILSAFE MODE function (Page 112).

Function description CURRENT OUTPUT	
VALUE 20 mA	Use this function to assign the 20 mA current a full scale value. Positive and negative values are permitted. The required measuring range is defined by defining the VALUE 20 mA. In the SYMMETRY measuring mode (see Page 108), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input:** 5-digit floating-point number, with sign **Factory setting:** Depends on nominal diameter and country, [value] / [dm^3...m^3 or US-gal...US-Mgal] Corresponds to the factory setting for the full scale value (see Page 116 ff.). ✎ Note! • The appropriate unit is taken from the SYSTEM UNITS group (see Page 93). • The value for 4 mA always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.
TIME CONSTANT	Use this function to enter a time constant defining how the current output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** Fixed-point number 0.01...100.00 s **Factory setting:** 1.00 s

11.7 Group PULSE/STATUS OUTPUT

Function description PULSE/STATUS OUTPUT	
OPERATION MODE	Use this function to configure the output as a pulse output or status output. The functions available in this function group vary, depending on which option you select here. **Options:** OFF PULSE STATUS **Factory setting:** PULSE
PULSE VALUE	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to define the flow at which a pulse is triggered. These pulses can be totalled by an external totalizer, and the total flow quantity since measuring started can be registered in this way. In the SYMMETRY measuring mode (Page 108), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the positive flow direction. **User input:** 5-digit floating-point number [unit] **Factory setting:** Depends on nominal diameter and country, [value] [dm^3...m^3 or US-gal] / pulse; Corresponds to the factory setting for the pulse value (see Page 116 ff.). ✎ Note! The appropriate unit is taken from the SYSTEM UNITS group (see Page 93).

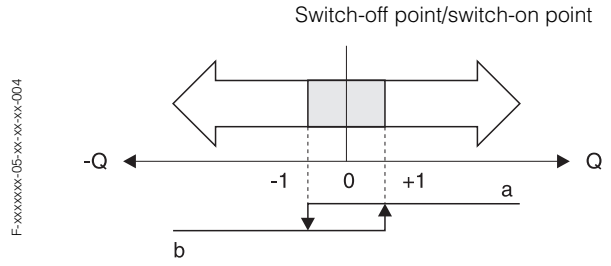
Function description PULSE/STATUS OUTPUT	
PULSE WIDTH	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to enter the maximum pulse width of the output pulses. **User input:** 5...2000 ms **Factory setting:** 100 ms Pulse output is **always** with the pulse width (B) entered in this function. The pauses (P) between the individual pulses are automatically configured. However, they must at least correspond to the pulse width (B = P).  B = Pulse width entered (the illustration applies to positive pulses) P= Intervals between the individual pulses ✎ Note! • When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC, etc.). • The pulse output's response to faults is defined in the central FAILSAFE MODE function (Page 112). ☝ Caution! Buffering (pulse memory) takes place if the number of pulses is too large to output the pulses with the selected pulse width (see PULSE VALUE function on Page 99). The system error message RANGE PULSE is displayed if more pulses are in the pulse memory than can be output in 4 seconds.
OUTPUT SIGNAL	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to configure the output in such a way that it matches an external counter, for example. Depending on the application, you can select the direction of the pulses here. **Options:** PASSIVE/POSITIVE PASSIVE/NEGATIVE **Factory setting:** PASSIVE/POSITIVE

Function description PULSE/STATUS OUTPUT	
ASSIGN STATUS	✎ Note! This function is not available unless the STATUS setting was selected in the OPERATION MODE function (Page 99). **Options:** ON (operation) FAULT MESSAGE NOTICE MESSAGE FAULT & NOTICE MESSAGE EPD (Empty Pipe Detection, only if active) FLOW DIRECTION VOLUME FLOW LIMIT VALUE **Factory setting:** FAULT MESSAGE ✎ Note! • The behaviour of the status output is a normally closed behaviour, in other words the output is closed (transistor conductive) when normal, error-free measuring is in progress. • It is very important to read and comply with the information on the switching characteristics of the status output (see Page 103).
ON-VALUE	✎ Note! This function is not available unless LIMIT VALUE or FLOW DIRECTION was selected in the ASSIGN STATUS function. Use this function to assign a value to the switch-on point (status output pulls up). The value can be equal to, greater than or less than the switch-off point. Positive and negative values are permitted. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] ✎ Note! • The appropriate unit is taken from the SYSTEM UNITS group (see Page 93). • Only the switch-on point is available for flow direction output (no switch-off point). If you enter a value not equal to the zero flow (e.g. 5), the difference between the zero flow and the value entered corresponds to half the switchover hysteresis.
OFF-VALUE	✎ Note! This function is not available unless LIMIT VALUE was selected in the ASSIGN STATUS function. Use this function to assign a value to the switch-off point (status output drops out). The value can be equal to, greater than or less than the switch-on point. Positive and negative values are permitted. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] ✎ Note! • The appropriate unit is taken from the SYSTEM UNITS group (see Page 93). • If SYMMETRY is selected in the MEASURING MODE function (Page 108) and values with different signs are entered for the switch-on and switch-off points, the notice message “INPUT RANGE EXCEEDED” appears.

11.7.1 Information on the response of the status output

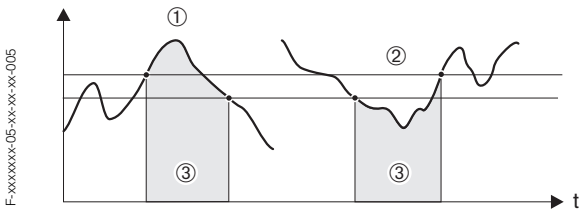
General
If you have configured the status output for “LIMIT VALUE” or “FLOW DIRECTION”, you can configure the requisite switch points in the ON-VALUE and OFF-VALUE functions. When the measured variable in question reaches these predefined values, the status output switches as shown in the illustrations below.

Status output configured for flow direction
The value you entered in the function SWITCH-ON POINT defines the switch point for the positive and negative directions of flow. If, for example, the switch point entered is = 1 m^3/h, the status output switches off at –1 m^3/h (not conductive) and switches on again at +1 m^3/h (conductive). Set the switch point to 0 if your process calls for direct switchover (no switching hysteresis). If low flow cut off is used, it is advisable to set hysteresis to a value greater than or equal to the low flow cut off rate.



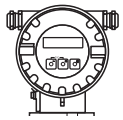
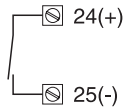
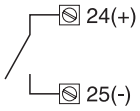
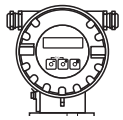
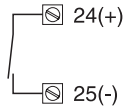
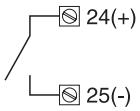
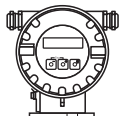
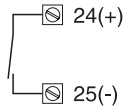
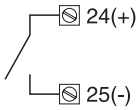
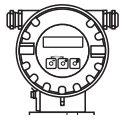
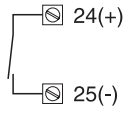
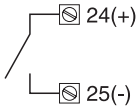
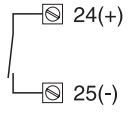
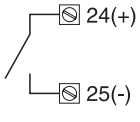
a = Status output conductive
b = Status output not conductive

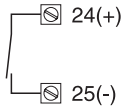
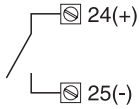
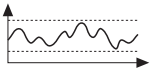
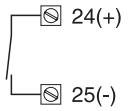
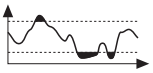
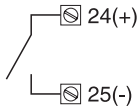
Status output configured for limit value
The status output switches as soon as the measured variable undershoots or overshoots a defined switch point.
Application: monitoring flow or process-related boundary conditions.



① = ON ≤ SWITCH-OFF POINT (maximum safety)
② = ON > SWITCH-OFF POINT (minimum safety)
③ = Status output switched off (not conductive)

11.7.2 Switching behaviour of the status output

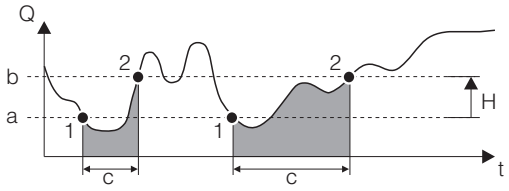
Function	State		Open collector behaviour (transistor)
ON (operation)	System in measuring mode		con-ductive 
	System not in measuring mode (power supply failed)		not con-ductive 
Fault message	System OK		con-ductive 
	(System or process error) Fault → Response to error, outputs /inputs and totalizers		not con-ductive 
Notice message	System OK		con-ductive 
	(System or process error) Notice → Continuation of measuring		not con-ductive 
Fault message or notice message	System OK		con-ductive 
	(System or process error) Fault → Response to error or Notice → Continuation of measuring		not con-ductive 
Empty pipe detection (EPD)	Measuring tube full		con-ductive 
	Measuring tube partially filled / empty measuring tube		not con-ductive 

Function	State		Open collector behaviour (transistor)
Flow direction	Forward		con-ductive 
	Reverse		not con-ductive 
Limit value - volume flow	Limit value not overshot or undershot		con-ductive 
	Limit value overshot or undershot		not con-ductive 

11.8 Group COMMUNICATION

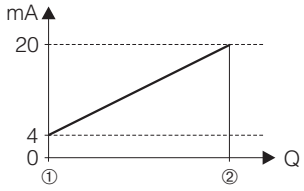
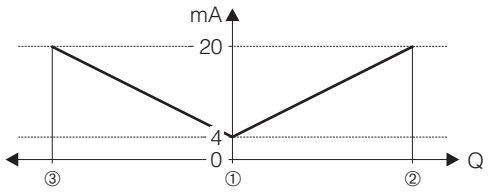
Function description COMMUNICATION	
✎ Note! The Group COMMUNICATION is not available unless the option HART was selected in the CURRENT SPAN function (→ Page 97)	
TAG NAME	Use this function to enter a tag name for the measuring device. You can edit and read this tag name at the local display or via the HART protocol. **User input:** Max. 8-character text, permitted characters are: A-Z, 0-9, +,-, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _" (no text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag description at the local display or via the HART protocol. **User input:** Max. 16-character text, permitted characters are: A-Z, 0-9, +,-, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _" (no text)
FIELDBUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. **User input:** 0...15 **Factory setting:** 0 ✎ Note! Addresses 1...15: a constant 4 mA current is applied.
WRITE PROTECTION	Use this function to activate HART write protection. **Options:** OFF = Function can be edited/read out via HART protocol ON = HART protocol write protected (can only be read out) **Factory setting:** OFF
MANUFACTURER ID	Use this function to view the manufacturer ID in decimal numerical format. **Display:** 17 (≙ 11 hex) for Endress+Hauser
DEVICE ID	Use this function to view the device ID in hexadecimal numerical format. **Display:** 69 (≙ 45 hex) for Promag 10

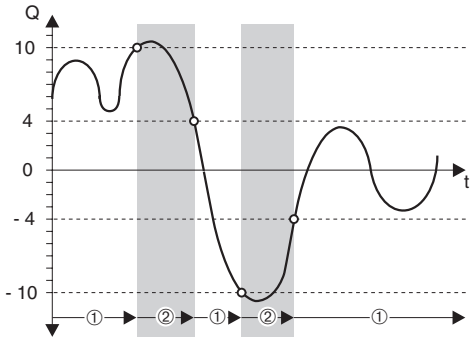
11.9 Group PROCESS PARAMETER

Function description PROCESS PARAMETER	
ON-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-on point for low flow cut off. Low flow cut off is active if the value entered is not equal to 0. The sign of the flow value is highlighted on the display to indicate that low flow cut off is active. **User input:** 5-digit floating-point number, [unit] **Factory setting:** Depends on nominal diameter and country, [value] / [dm^3...m^3 or US-gal] Corresponds to the factory setting for the low flow cut off (see Page 116 ff.). ✎ Note! The appropriate unit is taken from the SYSTEM UNITS group (see Page 93). The switch-off point is specified as a positive hysteresis from the switch-on point with 50%. Example:  Q = Flow [volume/time] t = Time a = ON-VALUE LOW FLOW CUT OFF = 200 dm^3/h b = Low flow cut off switch-off point = 50% c = Low flow cut off active 1 = Low flow cut off is switched on at 200 dm^3/h 2 = Low flow cut off is switched off at 300 dm^3/h

Function description PROCESS PARAMETER	
EPD MODE	Use this function to activate Empty Pipe Detection (EPD). **Options:** OFF ON (Empty Pipe Detection) **Factory setting:** OFF ✎ Note! • The ON option is not available unless the sensor is equipped with an EPD electrode. • The default setting for the EPD function when the device is delivered is OFF. The function must be activated as required. • The device is calibrated at the factory with water (500 µS/cm). If the conductivity of certain fluids deviates from this reference, empty pipe/full pipe adjustment (see EPD ADJUSTMENT function on Page 107) must be performed on site. • The adjustment coefficients must be valid before switching on the function. If they are not available the EPD cannot be switched on. • The following alarm messages might appear on the display in the event of switched on EPD and additional incorrect adjustment: – ADJUSTMENT FULL = EMPTY: the adjustment values for empty pipe and full pipe are identical. – ADJUSTMENT NOT OK: adjustment is not possible as the fluid conductivity values are outside the permitted range. In such instances, empty pipe adjustment/full pipe adjustment **must** be carried out **again**. **Notes on Empty Pipe Detection (EPD)** • Flow cannot be measured correctly unless the measuring pipe is completely full. This status can be monitored at all times by means of the EPD. • An empty or partially filled pipe is a process error. A default factory setting defines that a notice message is issued and that this process error has no effect on the outputs. • The EPD process error can be output via the configurable status output. **Response to partially filled pipe** If the EPD is switched on and responds to a partially filled or empty pipe, the notice message “EMPTY PIPE” appears on the display and zero flow is indicated. If the pipe is partially empty and the EPD is **not** switched on, the response can vary in identically configured systems: • Flow reading fluctuates • Zero flow • Excessively high flow values
EPD ADJUSTMENT	Use this function to activate adjustment for an empty or full measuring tube. **Options:** OFF EPD FULL PIPE ADJUST EPD EMPTY PIPE ADJ. **Factory setting:** OFF **Procedure for EPD empty pipe / full pipe adjustment** 1. Empty the piping. 2. Start empty pipe adjustment: select “EMPTY PIPE ADJUST” and press E to confirm. 3. Fill piping with fluid. 4. Start full pipe adjustment with fluid: Select “FULL PIPE ADJUST” and press E to confirm. 5. When the adjustment procedure is complete, switch on the detection system: Select “EPD” (flashing) and press E to confirm.

11.10 Group SYSTEM PARAMETER

Function description SYSTEM PARAMETER	
INSTALLATION DIRECTION SENSOR	Use this function to reverse the sign of the flow quantity, if necessary. **Options:** NORMAL (flow as indicated by the arrow) INVERSE (flow opposite to direction indicated by the arrow) **Factory setting:** NORMAL ✎ Note! Ascertain the actual direction of fluid flow with reference to the direction indicated by the arrow on the sensor (nameplate).
MEASURING MODE	Use this function to select the measuring mode for all outputs and for the internal totalizer. **Options:** STANDARD SYMMETRY **Factory setting:** STANDARD The responses of the individual outputs and the internal totalizer in each of the measuring modes are described in detail on the following pages: **Current output** STANDARD Only the flow components for the selected flow direction are totalled, (positive or negative full scale value ② = flow direction). Flow components in the opposite direction are not taken into account (suppression). Example for current output:  F-xxxxxxx-05-xx-xx-xx-003 SYMMETRY The output signals of the current output are independent of the direction of flow (absolute amount of the measured variable). The "VALUE 20mA" ③ (e.g. backflow) corresponds to the mirrored VALUE 20mA ② (e.g. flow). Positive and negative flow components are taken into account. Example for current output:  F-xxxxxxx-05-xx-xx-xx-007 ✎ Note! The direction of flow can be output via the configurable status output. (Continued on next page)

Function description SYSTEM PARAMETER	
MEASURING MODE (Contd)	**Pulse output** STANDARD Only the flow components for positive flow direction are totalled. Components in the opposite direction are not taken into account. SYMMETRY Positive and negative flow components are taken into account. **Status output** ✎ Note! The information is only applicable if LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. STANDARD The status output signal switches at the defined switch points. SYMMETRY The status output signal switches at the defined switch points, irrespective of the sign. In other words, if you define a switch point with a positive sign, the status output signal switches as soon as the value is reached in the negative direction (negative sign), (see illustration). Example for the SYMMETRY measuring mode: Switch-on point: Q = 4 Switch-off point: Q = 10 ① = Status output switched on (conductive) ② = Status output switched off (not conductive)  F-xxxxxx-05-xx-xx-xx-005 **Totalizer** STANDARD Only positive flow components are totalled. Negative components are not taken into account. SYMMETRY The positive and negative flow components are balanced. In other words, net flow in the flow direction is registered.

Function description SYSTEM PARAMETER	
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a piping system is being cleaned, for example. This setting acts on all function and outputs of the measuring device. **Options:** OFF ON → Signal output is set to the "ZERO FLOW" value. **Factory setting:** OFF
SYSTEM DAMPING	Use this function to set the filter depth of the digital filter. This reduces the sensitivity of the measuring signal to interference peaks (e.g. high solids content, gas bubbles in the fluid, etc.). The system reaction time increases with the filter setting. **User input:** 0 ... 4 **Factory setting:** 3 ✎ Note! The system damping acts on all functions and outputs of the measuring device.

11.11 Group SENSOR DATA

Function description SENSOR DATA	
All sensor data (calibration factors, zero point and nominal diameter etc.) are set at the factory. Caution! Under normal circumstances you should not change the following parameter settings, because changes affect numerous functions of the entire measuring facility in general and the accuracy of the measuring system in particular. For this reason, the functions described below are provided with an additional prompt (with the code 10) once you enter your private code. Contact the E+H service organisation if you have any questions about these functions.	
K-FACTOR	Use this function to display the current calibration factor (positive and negative flow direction) for the sensor. The calibration factor is determined and set at the factory. **User input:** 5-digit fixed-point number: 0.5000 ...2.0000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
ZERO POINT	This function shows the current zero-point correction value for the sensor. Zero-point correction is determined and set at the factory. **User input:** Max. 4-digit number: -1000...+1000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
NOMINAL DIAMETER	This function shows the nominal diameter for the sensor. The nominal diameter depends on the size of the sensor and is set at the factory. **Options:** 2...600 MM 1/12...24" **Factory setting:** Depends on the size of the sensor Note! This value is also provided on the sensor nameplate.
MEASURING PERIOD	Use this function to set the time for a full measuring period. The duration of the measuring period is calculated from the rise time of the magnetic field, the brief recovery time, the (automatically tracked) integration time and the Empty Pipe Detection time. **User input:** 40...1000 ms **Factory setting:** Depends on nominal diameter
EPD ELECTRODE	Use this function to check whether the sensor is equipped with an EPD electrode. **Display:** YES NO **Factory setting:** YES → Electrode fitted as standard

11.12 Group SUPERVISION

Function description SUPERVISION	
FAILSAFE MODE	The dictates of safety render it advisable to ensure that the device signal processing assumes a predefined state in the event of a fault. The setting you select here is valid for: • Current output • Pulse output • Totalizer ✎ Note! This has no effect on the display. **Options:** MINIMUM VALUE MAXIMUM VALUE ACTUAL VALUE **Factory setting:** MINIMUM VALUE The response of the individual outputs and the totalizer is listed below. **Current output:** MINIMUM VALUE The current output is set to the lower value of the signal on alarm level. (The values in question can be found in the CURRENT SPAN function on Page 97). MAXIMUM VALUE The current output is set to the upper value of the signal on alarm level. (The values in question can be found in the CURRENT SPAN function on Page 97). ACTUAL VALUE Measured value output is based on the current flow measurement; the fault is ignored. **Pulse output:** MINIMUM or MAXIMUM VALUE Output is zero pulse ACTUAL VALUE Measured value output is based on the current flow measurement (fault is ignored). **Totalizer:** MINIMUM or MAXIMUM VALUE The totalizer is paused until the fault is rectified. ACTUAL VALUE The totalizer continues to count on the basis of the current flow value. The fault is ignored.

Function description SUPERVISION	
ALARM DELAY	Use this function to define a time span in which the criteria for an error have to be satisfied without interruption before an error or notice message is generated. Depending on the setting and the type of error, this suppression acts on: • Display • Current output • Pulse/status output **User input:** 0...100 s (in steps of one second) **Factory setting:** 0 s Caution! If this function is activated error and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-order controller (process controller, etc.). It is therefore imperative to check in advance in order to make sure whether a delay of this nature could affect the safety requirements of the process. If error and notice messages cannot be suppressed, a value of 0 seconds must be entered here.
SYSTEM RESET	Use this function to perform a reset of the measuring system. **Options:** NO RESTART SYSTEM (Restart without disconnecting main power) RESET DELIVERY (Restart without disconnecting main power, the saved settings of the delivery status (factory settings) are applied). **Factory setting:** NO

11.13 Group SIMULATION SYSTEM

Function description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all outputs and the totalizer to their defined failsafe modes, in order to check whether they respond correctly. During this time, the words "SIMULATION FAILSAFE MODE" appear on the display. **Options:** ON OFF **Factory setting:** OFF
SIMULATION MEASURAND	Use this function to set all outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the words “SIMULATION MEASURAND” appear on the display. **Options:** OFF VOLUME FLOW **Factory setting:** OFF Caution! • The measuring device cannot be used for measuring while this simulation is in progress. • The setting is not saved if the power supply fails.
VALUE SIMULATION MEASURAND	Note! This function is not available unless the SIMULATION MEASURAND function is active (= VOLUME FLOW). Use this function to specify a selectable value (e.g. 12 m^3/s). This value is used to test downstream devices and the flowmeter itself. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] Caution! The setting is not saved if the power supply fails. Note! The appropriate unit is taken from the SYSTEM UNITS group (see Page 93)

11.14 Group SENSOR VERSION

Function description SENSOR VERSION	
SERIAL NUMBER	Use this function to view the serial number of the sensor.
SENSOR TYPE	Use this function to view the sensor type.

11.15 Group AMPLIFIER VERSION

Function description AMPLIFIER VERSION	
SOFTWARE REVISION NUMBER AMPLIFIER	Use this function to view the software revision number of the electronics board.

11.16 Factory settings

11.16.1 SI units (not for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Nominal diameter		Low flow cut off		Full scale value Current output		Pulse value		Totalizer
[mm]	[inch]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/ second at v = 2.5 m/s)		
2	1/12"	0.01	dm³/min	0.5	dm³/min	0.005	dm³	dm³
4	5/32"	0.05	dm³/min	2	dm³/min	0.025	dm³	dm³
8	5/16"	0.1	dm³/min	8	dm³/min	0.10	dm³	dm³
15	1/2"	0.5	dm³/min	25	dm³/min	0.20	dm³	dm³
25	1"	1	dm³/min	75	dm³/min	0.50	dm³	dm³
32	1 1/4"	2	dm³/min	125	dm³/min	1.00	dm³	dm³
40	1 1/2"	3	dm³/min	200	dm³/min	1.50	dm³	dm³
50	2"	5	dm³/min	300	dm³/min	2.50	dm³	dm³
65	2 1/2"	8	dm³/min	500	dm³/min	5.00	dm³	dm³
80	3"	12	dm³/min	750	dm³/min	5.00	dm³	dm³
100	4"	20	dm³/min	1200	dm³/min	10.00	dm³	dm³
125	5"	30	dm³/min	1850	dm³/min	15.00	dm³	dm³
150	6"	2.5	m³/h	150	m³/h	0.025	m³	m³
200	8"	5.0	m³/h	300	m³/h	0.05	m³	m³
250	10"	7.5	m³/h	500	m³/h	0.05	m³	m³
300	12"	10	m³/h	750	m³/h	0.10	m³	m³
350	14"	15	m³/h	1000	m³/h	0.10	m³	m³
400	16"	20	m³/h	1200	m³/h	0.15	m³	m³
450	18"	25	m³/h	1500	m³/h	0.25	m³	m³
500	20"	30	m³/h	2000	m³/h	0.25	m³	m³
600	24"	40	m³/h	2500	m³/h	0.30	m³	m³

Language

Country	Language
Belgium	English
Denmark	English
Germany	Deutsch
England	English
Finland	English
France	Francais
Holland	English
Hong Kong	English
International Instruments	English
Italy	Italiano
Japan	English
Malaysia	English
Norway	English
Austria	Deutsch
Sweden	English
Switzerland	Deutsch
Singapore	English
Spain	Espanol
South Africa	English
Thailand	English

11.16.2 US units (only for USA and Canada)

Low flow cut off, full scale value, pulse value, totalizer

Nominal diameter		Low flow cut off		Full scale value Current output		Pulse value		Totalizer
[inch]	[mm]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/ second at v = 2.5 m/s)		
1/12"	2	0.002	gal/min	0.1	gal/min	0.001	gal	gal
5/32"	4	0.008	gal/min	0.5	gal/min	0.005	gal	gal
5/16"	8	0.025	gal/min	2	gal/min	0.02	gal	gal
1/2"	15	0.10	gal/min	6	gal/min	0.05	gal	gal
1"	25	0.25	gal/min	18	gal/min	0.20	gal	gal
1 1/4"	32	0.50	gal/min	30	gal/min	0.20	gal	gal
1 1/2"	40	0.75	gal/min	50	gal/min	0.50	gal	gal
2"	50	1.25	gal/min	75	gal/min	0.50	gal	gal
2 1/2"	65	2.0	gal/min	130	gal/min	1	gal	gal
3"	80	2.5	gal/min	200	gal/min	2	gal	gal
4"	100	4.0	gal/min	300	gal/min	2	gal	gal
5"	125	7.0	gal/min	450	gal/min	5	gal	gal
6"	150	12	gal/min	600	gal/min	5	gal	gal
8"	200	15	gal/min	1200	gal/min	10	gal	gal
10"	250	30	gal/min	1500	gal/min	15	gal	gal
12"	300	45	gal/min	2400	gal/min	25	gal	gal
14"	350	60	gal/min	3600	gal/min	30	gal	gal
16"	400	60	gal/min	4800	gal/min	50	gal	gal
18"	450	90	gal/min	6000	gal/min	50	gal	gal
20"	500	120	gal/min	7500	gal/min	75	gal	gal
24"	600	180	gal/min	10500	gal/min	100	gal	gal

11.16.3 Language

	Unit
Language	English

Index

T

U

V

W

Z

Declaration of contamination

Dear customer,
Because of legal determinations and for the safety of our employes and operating equipment we need this "Declaration of contamination" with your signature before your order can be handled. Please put the completely filled in declaration to the instrument and to the shipping documents in any case. Add also safety sheets and/or specific handling instructions if necessary.

type of instrument / sensor: _____ serial number: _____

medium / concentration: _____ temperature: _____ pressure: _____

cleaned with: _____ conductivity: _____ viscosity: _____

Warning hints for medium used:

☐ radioactive ☐ explosive ☐ caustic ☐ poisonous ☐ harmful of health ☐ biological hazardous ☐ inflammable ☐ safe

Please mark the appropriate warning hints.

Reason for return:

_____

_____

Company data:

company: _____ contact person: _____

_____ _____

_____ department: _____

address: _____ phone number: _____

_____ Fax/E-Mail: _____

_____ your order no.: _____

I hereby certify that the returned equipment has been cleaned and decontaminated acc. to good industrial practices and is in compliance with all regulations. This equipment poses no health or safety risks due to contamination.

_____ _____

(Date) (company stamp and legally binding signature)

More information about services and repairs:
www.services.endress.com

Endress+Hauser
The Power of Know How

Europe

Austria – Wien
❑ Endress+Hauser Ges.m.b.H.
Tel. (01) 88 05 60, Fax (01) 88 05 63 35

Belarus – Minsk
Belorgsintez
Tel. (017) 2 50 84 73, Fax (017) 2 50 85 83

Belgium / Luxembourg – Bruxelles
❑ Endress+Hauser S.A. / N.V.
Tel. (02) 2 48 06 00, Fax (02) 2 48 05 53

Bulgaria – Sofia
Intertech-Automation Ltd.
Tel. (02) 9 62 71 52, Fax (02) 9 62 14 71

Croatia – Zagreb
❑ Endress+Hauser GmbH+Co.
Tel. (01) 6 63 77 85, Fax (01) 6 63 78 23

Cyprus – Nicosia
I+G Electrical Services Co. Ltd.
Tel. (02) 48 47 88, Fax (02) 48 46 90

Czech Republic – Praha
❑ Endress+Hauser Czech s.r.o.
Tel. (02) 66 78 42 31, Fax (026) 66 78 41 79

Denmark – Søborg
❑ Endress+Hauser A/S
Tel. (70) 13 11 32, Fax (70) 13 21 33

Estonia – Tartu
Elvi-Aqua
Tel. (7) 30 27 32, Fax (7) 30 27 31

Finland – Helsinki
❑ Metso Endress+Hauser Oy
Tel. (204) 8 31 60, Fax (204) 8 31 61

France – Huningue
❑ Endress+Hauser S.A.
Tel. (389) 69 67 68, Fax (389) 69 48 02

Germany – Weil am Rhein
❑ Endress+Hauser Messtechnik GmbH+Co. KG
Tel. (07621) 9 75 01, Fax (07621) 97 55 55

Greece – Athens
I & G Building Services Automation S.A.
Tel. (01) 9 24 15 00, Fax (01) 9 22 17 14

Hungary – Budapest
❑ Endress+Hauser Magyarország
Tel. (01) 4 12 04 21, Fax (01) 4 12 04 24

Iceland – Reykjavik
Sindra-Stál hf
Tel. 5 75 00 00, Fax 5 75 00 10

Ireland – Clane / County Kildare
❑ Flomeaco Endress+Hauser Ltd.
Tel. (045) 86 86 15, Fax (045) 86 81 82

Italy – Cernusco s/N, Milano
❑ Endress+Hauser S.p.A.
Tel. (02) 92 19 21, Fax (02) 92 19 23 62

Latvia – Riga
Elekoms Ltd.
Tel. (07) 33 64 44, Fax (07) 33 64 48

Lithuania – Kaunas
UAB Agava Ltd.
Tel. (03) 7 20 24 10, Fax (03) 7 20 74 14

Netherlands – Naarden
❑ Endress+Hauser B.V.
Tel. (035) 6 95 86 11, Fax (035) 6 95 88 25

Norway – Lierskogen
❑ Endress+Hauser A/S
Tel. 32 85 98 50, Fax 32 85 98 51

Poland – Wroclaw
❑ Endress+Hauser Polska Sp. z o.o.
Tel. (071) 7 80 37 00, Fax (071) 7 80 37 60

Portugal – Cacem
❑ Endress+Hauser Lda.
Tel. (21) 4 26 72 90, Fax (21) 4 26 72 99

Romania – Bucharest
Romconseng S.R.L.
Tel. (01) 4 10 16 34, Fax (01) 4 11 25 01

Russia – Moscow
❑ Endress+Hauser GmbH+Co
Tel. (095) 1 58 75 64, Fax (095) 7 84 63 91

Slovak Republic – Bratislava
Transcom Technik s.r.o.
Tel. (2) 44 88 86 90, Fax (2) 44 88 71 12

Slovenia – Ljubljana
❑ Endress+Hauser (Slovenija) D.O.O.
Tel. (01) 5 19 22 17, Fax (01) 5 19 22 98

Spain – Sant Just Desvern
❑ Endress+Hauser S.A.
Tel. (93) 4 80 33 66, Fax (93) 4 73 38 39

Sweden – Sollentuna
❑ Endress+Hauser AB
Tel. (08) 55 51 16 00, Fax (08) 55 51 16 55

Switzerland – Reinach/BL 1
❑ Endress+Hauser Metso AG
Tel. (061) 7 15 75 75, Fax (061) 7 11 16 50

Turkey – Levent/Istanbul
Intek Endüstriyel Ölcü ve Kontrol Sistemleri
Tel. (0212) 2 75 13 55, Fax (0212) 2 66 27 75

Ukraine – Kiev
Photonika GmbH
Tel. (44) 2 68 81 02, Fax (44) 2 69 07 05

Great Britain – Manchester
❑ Endress+Hauser Ltd.
Tel. (0161) 2 86 50 00, Fax (0161) 9 98 18 41

Yugoslavia Republic – Beograd
Meris d.o.o.
Tel. (11) 4 44 29 66, Fax (11) 3 08 57 78

Africa

Algeria – Annaba
Symes Systemes et Mesures
Tel. (38) 88 30 03, Fax (38) 88 30 02

Egypt – Heliopolis/Cairo
Anasia Egypt For Trading (S.A.E.)
Tel. (02) 2 68 41 59, Fax (02) 2 68 41 69

Morocco – Casablanca
Oussama S.A.
Tel. (02) 22 24 13 38, Fax (02) 2 40 26 57

Rep. South Africa – Sandton
❑ Endress+Hauser (Pty.) Ltd.
Tel. (011) 2 62 80 00, Fax (011) 2 62 80 62

Tunisia – Tunis
CMR Controle, Maintenance et Regulation
Tel. (01) 79 30 77, Fax (01) 78 85 95

America

Argentina – Buenos Aires
❑ Endress+Hauser Argentina S.A.
Tel. (11) 45 22 79 70, Fax (11) 45 22 79 09

Brazil – Sao Paulo
❑ Samson Endress+Hauser Ltda.
Tel. (011) 50 31 34 55, Fax (011) 50 31 30 67

Canada – Burlington, Ontario
❑ Endress+Hauser (Canada) Ltd.
Tel. (905) 6 81 92 92, Fax (905) 6 81 94 44

Chile – Santiago de Chile
❑ Endress+Hauser (Chile) Ltd.
Tel. (02) 3 21 30 09, Fax (02) 3 21 30 25

Colombia – Bogota D.C.
Colsein Ltda.
Tel. (01) 2 36 76 59, Fax (01) 6 10 78 68

Costa Rica – San Jose
Euro-Tec (Costa Rica) S.A.
Tel. 2 20 28 08, Fax 2 96 15 42

Ecuador – Quito
Insetec Cia. Ltda.
Tel. (02) 2 26 91 48, Fax (02) 2 46 18 33

El Salvador – San Salvador
Automatizacion y Control Industrial de El Salvador, S.A. de C.V.
Tel. 2 84 31 51, Fax 2 74 92 48

Guatemala – Ciudad de Guatemala
Automatizacion y Control Industrial, S.A.
Tel. (03) 34 59 85, Fax (03) 32 74 31

Honduras – San Pedro Sula, Cortes
Automatizacion y Control Industrial de Honduras, S.A. de C.V.
Tel. 5 57 91 36, Fax 5 57 91 39

Mexico – México, D.F
❑ Endress+Hauser (México), S.A. de C.V.
Tel. (5) 5 55 68 24 07, Fax (5) 5 55 68 74 59

Nicaragua – Managua
Automatización y Control Industrial de Nicaragua, S.A.
Tel. 2 22 61 90, Fax 2 28 70 24

Peru – Lima
Process Control S.A.
Tel. (2) 61 05 15, Fax (2) 61 29 78

USA – Greenwood, Indiana
❑ Endress+Hauser Inc.
Tel. (317) 5 35 71 38, Fax (317) 5 35 84 98

USA – Norcross, Atlanta
❑ Endress+Hauser Systems & Gauging Inc.
Tel. (770) 4 47 92 02, Fax (770) 4 47 57 67

Venezuela – Caracas
Controval C.A.
Tel. (212) 9 44 09 66, Fax (212) 9 44 45 54

Asia

Azerbaijan – Baku
Modcon Systems
Tel. (12) 92 98 59, Fax (12) 92 98 59

Brunei – Negara Brunei Darussalam
American International Industries (B) Sdn. Bhd.
Tel. (3) 22 37 37, Fax (3) 22 54 58

Cambodia – Khan Daun Penh, Phom Penh
Comin Khmere Co. Ltd.
Tel. (23) 42 60 56, Fax (23) 42 66 22

China – Shanghai
❑ Endress+Hauser (Shanghai) Instrumentation Co. Ltd.
Tel. (021) 54 90 23 00, Fax (021) 54 90 23 03

China – Beijing
❑ Endress+Hauser (Beijing) Instrumentation Co. Ltd.
Tel. (010) 65 88 24 68, Fax (010) 65 88 17 25

Hong Kong – Tsimshatsui / Kowloon
❑ Endress+Hauser (H.K.) Ltd.
Tel. 8 52 25 28 31 20, Fax 8 52 28 65 41 71

India – Mumbai
❑ Endress+Hauser (India) Pvt. Ltd.
Tel. (022) 6 93 83 36, Fax (022) 6 93 83 30

Indonesia – Jakarta
PT Grama Bazita
Tel. (21) 7 95 50 83, Fax (21) 7 97 50 89

Iran – Tehran
Patsa Industry
Tel. (021) 8 72 68 69, Fax (021) 8 71 96 66

Israel – Netanya
Instrumetrics Industrial Control Ltd.
Tel. (09) 8 35 70 90, Fax (09) 8 35 06 19

Japan – Tokyo
❑ Sakura Endress Co. Ltd.
Tel. (0422) 54 06 11, Fax (0422) 55 02 75

Jordan – Amman
A.P. Parpas Engineering S.A.
Tel. (06) 5 53 92 83, Fax (06) 5 53 92 05

Kazakhstan – Almaty
BEI Electro
Tel. (72) 30 00 28, Fax (72) 50 71 30

Saudi Arabia – Jeddah
Anasia Industrial Agencies
Tel. (02) 6 53 36 61, Fax (02) 6 53 35 04

Kuwait – Safat
United Technical Services Est. For General Trading
Tel. 2 41 12 63, Fax 2 41 15 93

Lebanon – Jbeil Main Entry
Network Engineering
Tel. (3) 94 40 80, Fax (9) 54 80 38

Malaysia – Shah Alam, Selangor Darul Ehsan
❑ Endress+Hauser (M) Sdn. Bhd.
Tel. (03) 78 46 48 48, Fax (03) 78 46 88 00

Pakistan – Karachi
Speedy Automation
Tel. (021) 7 72 29 53, Fax (021) 7 73 68 84

Philippines – Pasig City, Metro Manila
❑ Endress+Hauser (Phillipines) Inc.
Tel. (2) 6 38 18 71, Fax (2) 6 38 80 42

Singapore – Singapore
❑ Endress+Hauser (S.E.A.) Pte. Ltd.
Tel. (65) 66 82 22, Fax (65) 66 68 48

Korea, South – Seoul
❑ Endress+Hauser (Korea) Co. Ltd.
Tel. (02) 6 58 72 00, Fax (02) 6 59 28 38

Sultanate of Oman – Ruwi
Mustafa & Sultan Sience & Industry Co. L.L.C.
Tel. 63 60 00, Fax 60 70 66

Taiwan – Taipei
Kingjarl Corporation
Tel. (02) 27 18 39 38, Fax (02) 27 13 41 90

Thailand – Bangkok 10210
❑ Endress+Hauser (Thailand) Ltd.
Tel. (2) 9 96 78 11-20, Fax (2) 9 96 78 10

United Arab Emirates – Dubai
Descon Trading L.L.C.
Tel. (04) 2 65 36 51, Fax (04) 2 65 32 64

Uzbekistan – Tashkent
Im Mexatronika-Tes
Tel. (71) 1 91 77 07, Fax (71) 1 91 76 94

Vietnam – Ho Chi Minh City
Tan Viet Bao Co. Ltd.
Tel. (08) 8 33 52 25, Fax (08) 8 33 52 27

Australia + New Zealand

Australia – Sydney, N.S.W.
❑ Endress+Hauser (Australia) Pty. Ltd.
Tel. (02) 88 77 70 00, Fax (02) 88 77 70 99

New Zealand – Auckland
EMC Industrial Group Ltd.
Tel. (09) 4 15 51 10, Fax (09) 4 15 51 15

All other countries

❑ Endress+Hauser GmbH+Co. KG
Instruments International
Weil am Rhein, Germany
Tel. (07621) 9 75 02, Fax (07621) 97 53 45

Endress+Hauser
The Power of Know How

❑ Members of the Endress+Hauser group 09.02

BA 082D/06/en/04.03
50104788
FM+SGML 6.0