



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

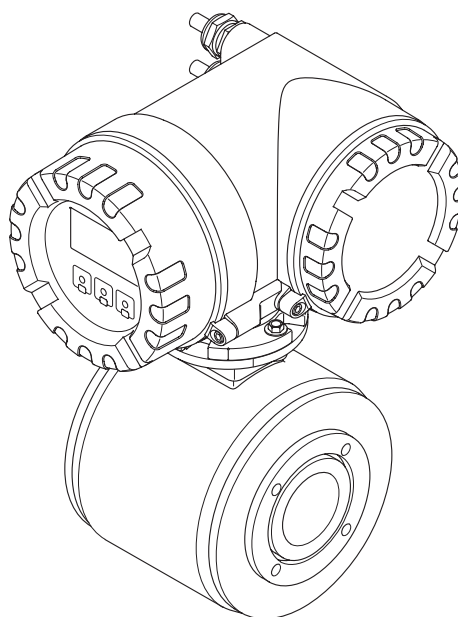
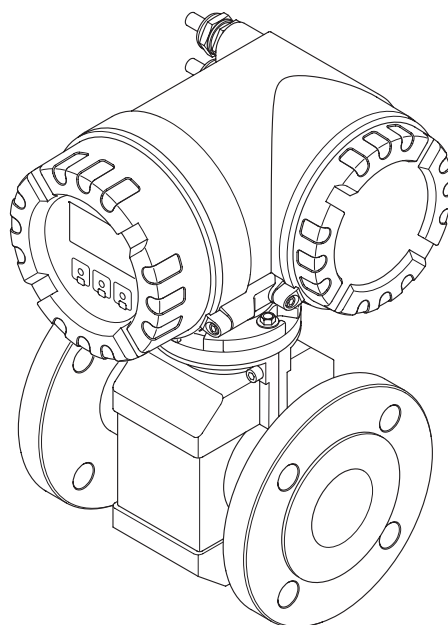


Solutions

Operating Instructions

Proline Promag 53 MODBUS RS485

Electromagnetic Flow Measuring System



BA117D/06/EN/12.09
71108004

Valid as of version
V 3.04.XX (Device software)

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1 Safety instructions

1.1 Designated use

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

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

Examples:

- Acids, alkalis,
- Drinking water, wastewater, sewage sludge,
- Milk, beer, wine, mineral water, etc.

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

1.2 Installation, commissioning and operation

Note the following points:

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

1.3 Operational safety

Note the following points:

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

- When hot fluid passes through the measuring tube, the surface temperature of the housing increases. In the case of the sensor, in particular, users should expect temperatures that can be close to the fluid temperature. If the temperature of the fluid is high, implement sufficient measures to prevent burning or scalding.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.

1.4 Return

- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.
- Please note the measures on →  115

1.5 Notes on safety conventions and icons

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



Warning!

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



Caution!

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



Note!

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

2 Identification

2.1 Device designation

The flow measuring system consists of the following components:

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

Two versions are available:

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

2.1.1 Nameplate of the transmitter

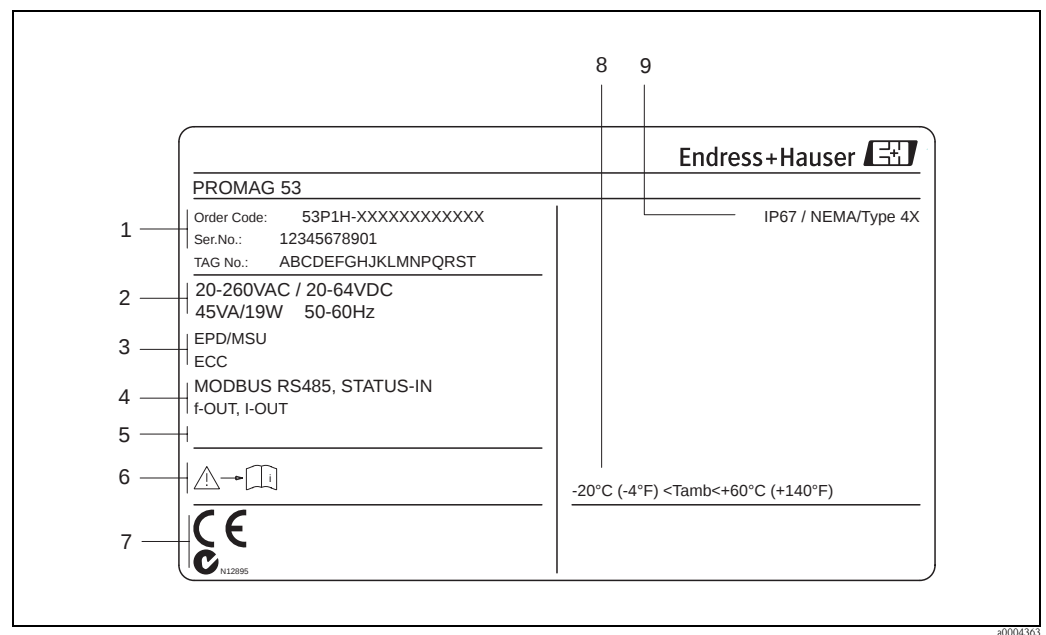


Fig. 1: Nameplate specifications for the "Promag 53" transmitter (example)

- 1 Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits
- 2 Power supply/frequency/power consumption
- 3 Additional functions and software
 - EPD: with empty pipe detection electrode
 - ECC: with electrode cleaning
- 4 Available outputs:
 - I-OUT: with current output
 - RELAY: with relay output
 - STATUS-IN: with status input (auxiliary input)
- 5 Reserved for additional information on special products
- 6 Please comply with the Operating Instructions
- 7 Reserved for additional information on device version (approvals, certificates)
- 8 Permitted ambient temperature range
- 9 Degree of protection

2.1.2 Nameplate of the sensor

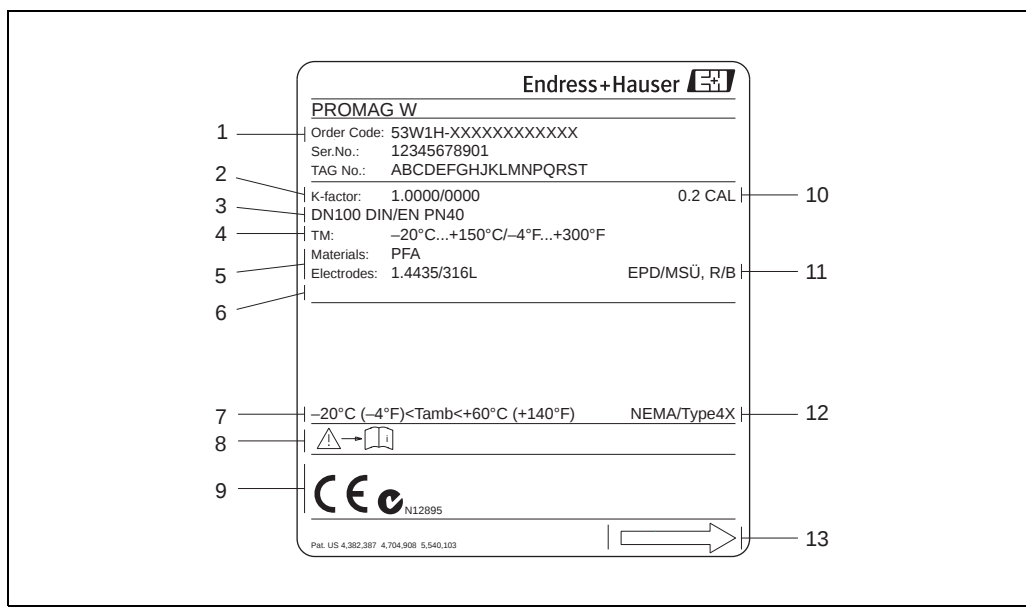


Fig. 2: Nameplate specifications for the "Promag W" sensor (example)

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

2.1.3 Nameplate for connections

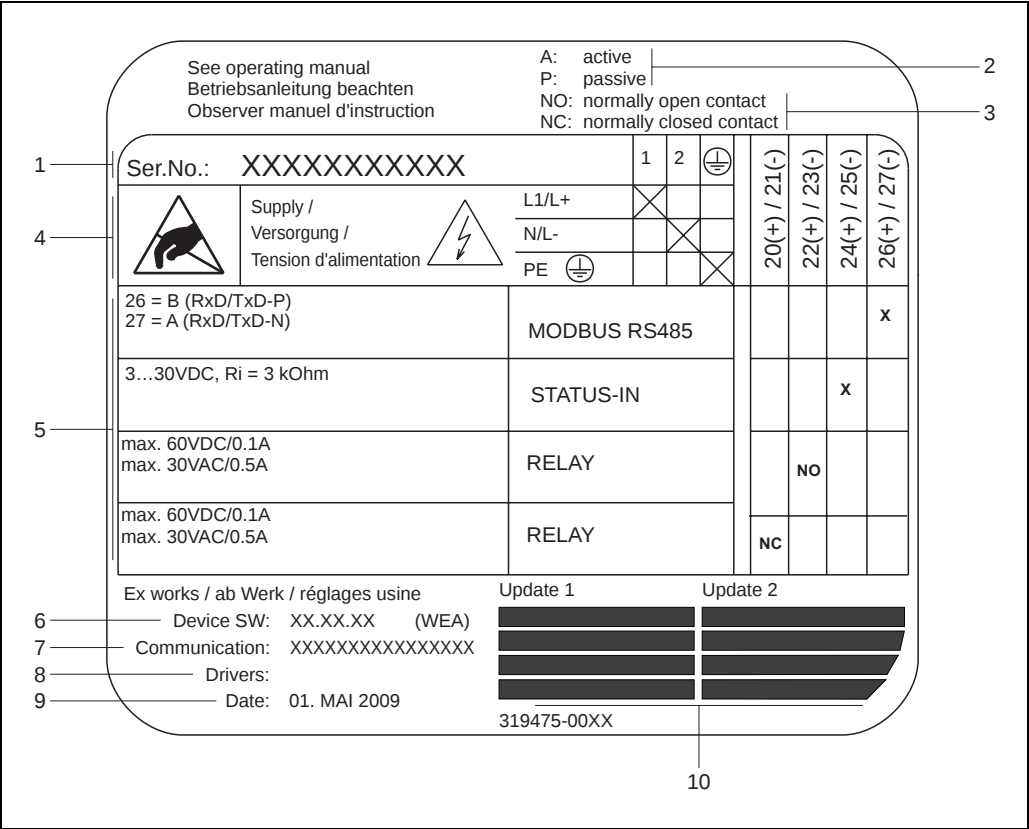


Fig. 3: Nameplate specifications for Proline transmitter connections (example)

- 1 Serial number
- 2 Possible configuration of current output
- 3 Possible configuration of relay contacts
- 4 Terminal assignment, cable for power supply:
Terminal No. 1: L1 for AC, L+ for DC
Terminal No. 2: N for AC, L- for DC
- 5 Pending signals at the inputs and outputs, possible configurations and terminal assignment → Page 47 ff.
- 6 Version of device software currently installed
- 7 Installed communication type
- 8 Information on communication driver
- 9 Date of installation
- 10 Language group
- 11 Current updates to data specified in 6 to 9

2.2 Certificates and approvals

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

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

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

The measuring device meets all the requirements of the MODBUS/TCP conformity test and holds the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the "MODBUS/TCP Conformance Test Laboratory" of the University of Michigan.

2.3 Registered trademarks

MODBUS®

Registered trademark of the MODBUS Organization

KALREZ® and VITON®

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

TRI-CLAMP®

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

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

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

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

On receipt of the goods, check the following points:

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

3.1.2 Transport

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

- Transport the devices in the containers in which they are delivered.
- Do not remove the protection plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

Special notes on flanged devices



Caution!

- The wooden covers mounted on the flanges before the device leaves the factory protect the linings on the flanges during storage and transportation. Do not remove these protection plates until *immediately before* the device is installed in the pipe.
- Do not lift flanged devices by the transmitter housing or, in the case of the remote version, by the connection housing.

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

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



Warning!

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

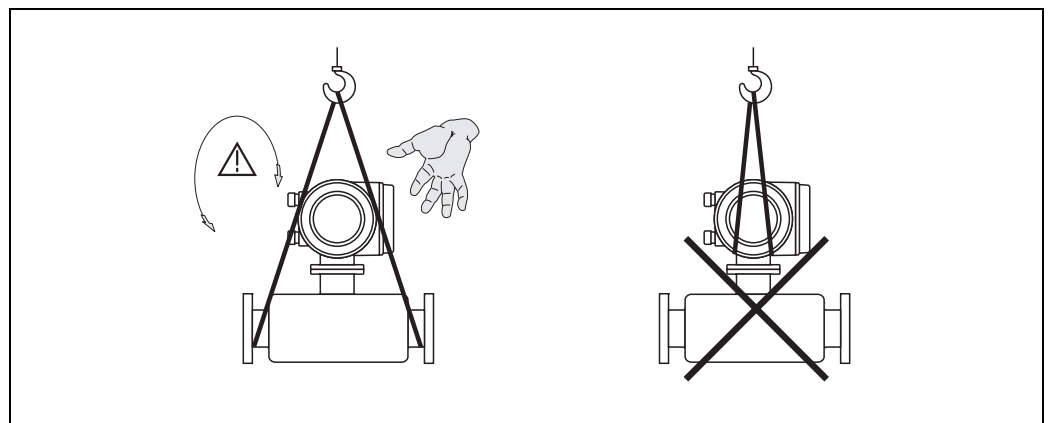


Fig. 4: Transporting sensors with $DN > \leq 300$ (12")

a0004294

Transporting flanged devices DN 300 (12")

Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

**Caution!**

Do not attempt to lift the sensor with the tines of a fork-lift truck beneath the metal casing. This would buckle the casing and damage the internal magnetic coils.

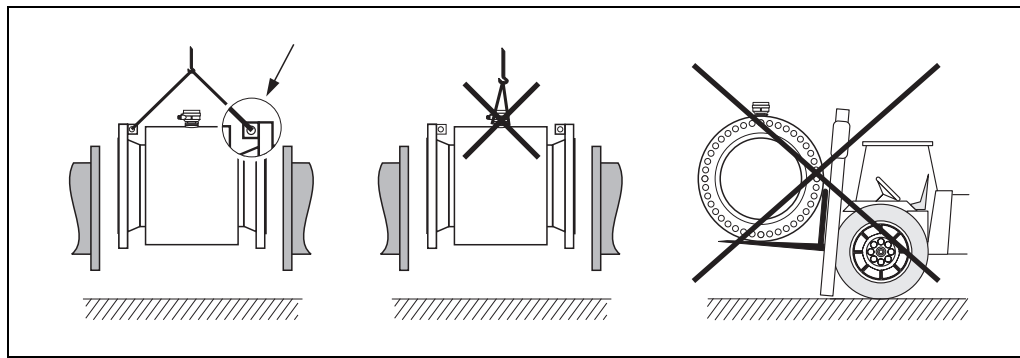


Fig. 5: Transporting sensors with DN > 300 (12")

3.1.3 Storage

Note the following points:

- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors → 120.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the lining.
- Do not remove the protection plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

3.2 Installation conditions

3.2.1 Dimensions

The dimensions and installation lengths of the sensor and transmitter can be found in the "Technical Information" for the device in question. This document can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section on → 134.

3.2.2 Mounting location

The accumulation of air or gas bubbles in the measuring tube could result in an increase in measuring errors.

Avoid the following locations:

- At the highest point of a pipeline. Risk of air accumulating.
- Directly upstream from a free pipe outlet in a vertical pipeline.

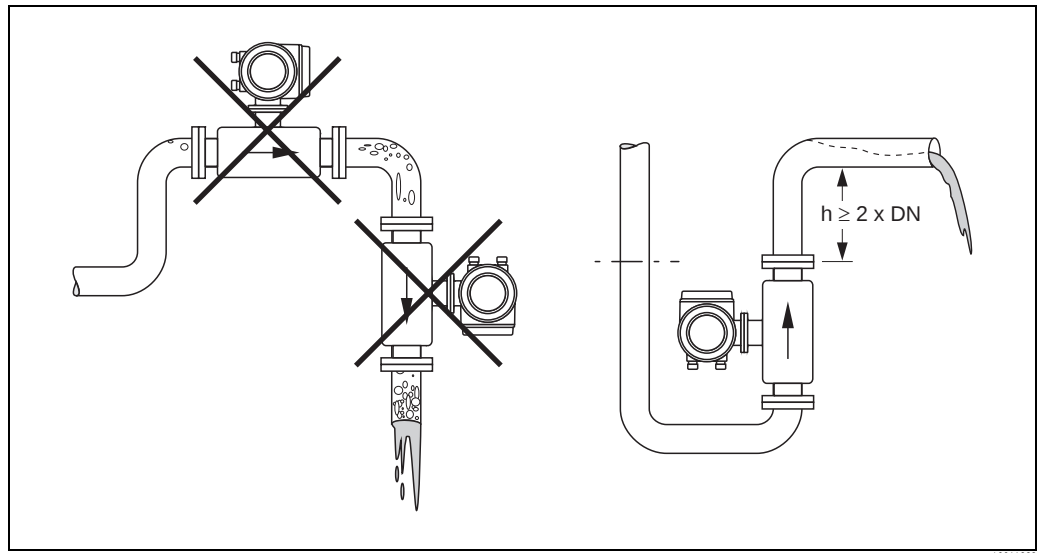


Fig. 6: Mounting location

Installing pumps

Do not install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum → 123.

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 → 120.

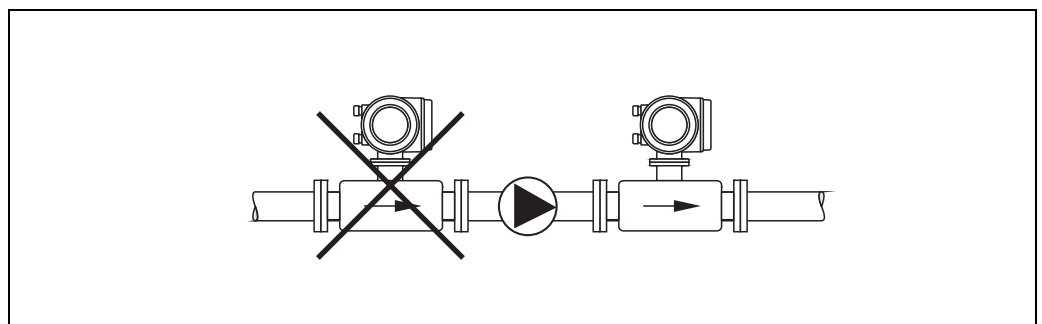


Fig. 7: Installing pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function offers additional protection by detecting empty or partially filled pipes → 91.



Caution!

Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.

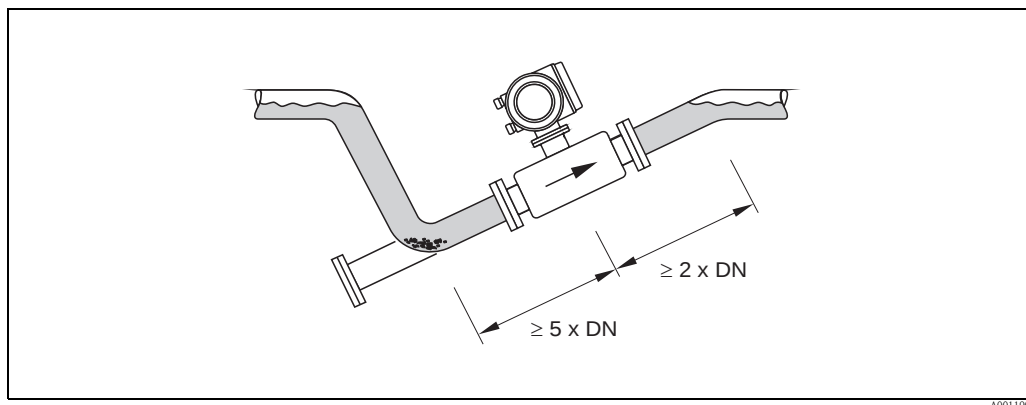


Fig. 8: Installation in partially filled pipe

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters (16,3 ft). This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. This measure also prevents the system losing prime, which could cause air inclusions.

Information on the lining's resistance to partial vacuum → 123

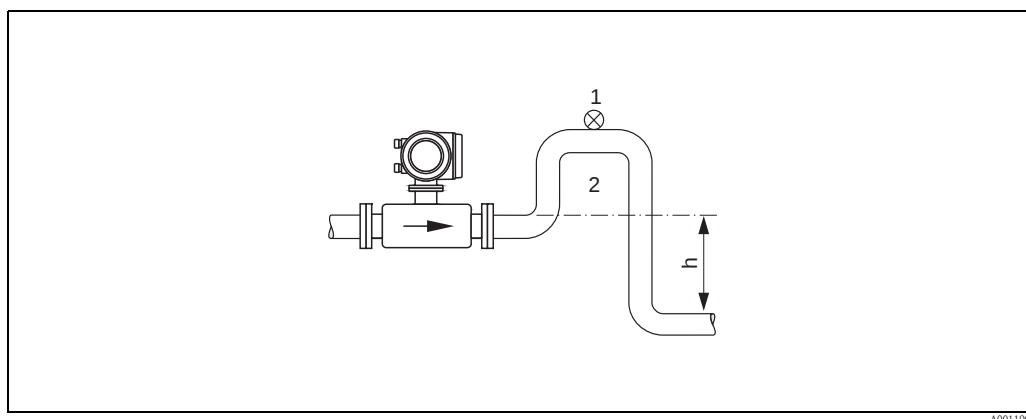


Fig. 9: Measures for installation in a down pipe

- 1 Vent valve
- 2 Siphon
- h Length of down pipe ($h \geq 5 \text{ m}$ (16,3 ft))

3.2.3 Orientation

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

- Electrode Cleaning Circuitry (ECC) to prevent electrically conductive deposits in the measuring tube, e.g. for fluids causing buildup (see "Description of Device Functions" manual).
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes or in the case of degassing fluids → 91.

Vertical orientation

A vertical orientation is ideal in the following cases:

- For self-emptying piping systems and when using empty pipe detection.
- For sludge containing sand or stones and where the solids cause sedimentation.

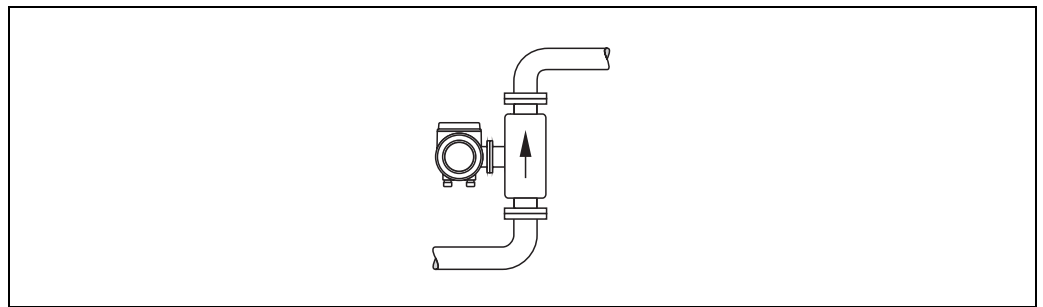


Fig. 10: Vertical orientation

Horizontal orientation

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



Caution!

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

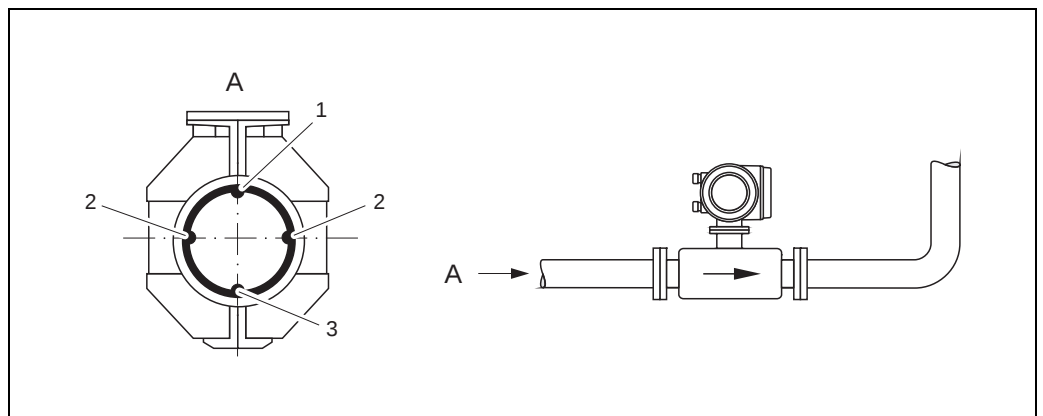


Fig. 11: Horizontal orientation

- 1 EPD electrode for empty pipe detection
(not available for "measuring electrode only" option, not in Promag H, DN 2 to 15 (1/12" to 1/2"))
- 2 Measuring electrodes for signal detection
- 3 Reference electrode for potential equalization
(not available for "measuring electrode only" option, not in Promag H)

3.2.4 Inlet and outlet runs

If possible, install the sensor in a location upstream of fittings such as valves, T-pieces, elbows, etc.

Compliance with the following requirements for the inlet and outlet runs is necessary in order to ensure measuring accuracy.

- Inlet run $\geq 5 \times \text{DN}$
- Outlet run $\geq 2 \times \text{DN}$

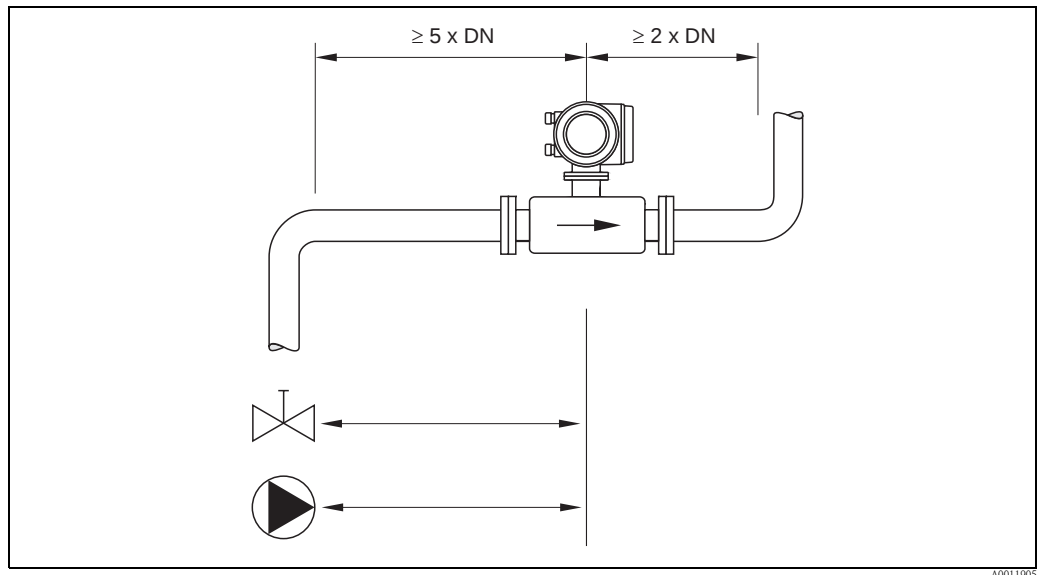


Fig. 12: Inlet and outlet runs

3.2.5 Vibrations

Secure and fix both the piping and the sensor if the vibrations are severe.



Caution!

It is advisable to install sensor and transmitter separately if vibration is excessively severe. Information on the permitted resistance to vibration and shock → 120.

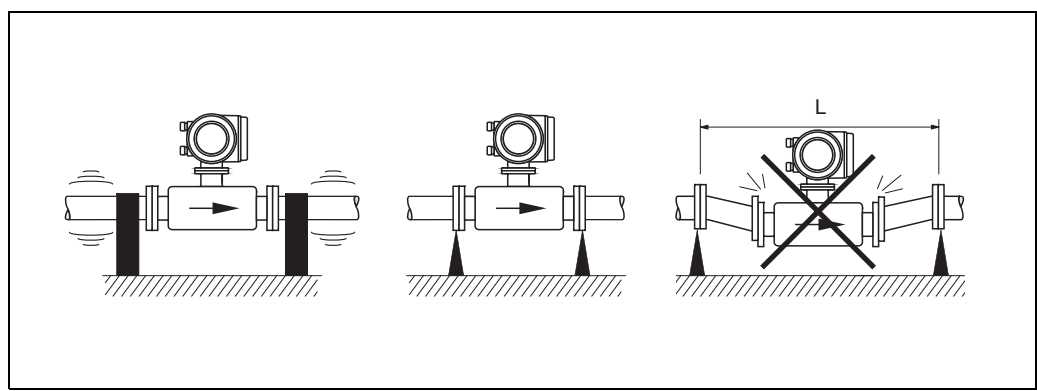


Fig. 13: Measures to prevent vibration of the measuring device ($L > 10 \text{ m}/33 \text{ ft}$)

3.2.6 Foundations, supports

If the nominal diameter is $DN \geq 350$ (14"), mount the sensor on a foundation of adequate load-bearing strength.



Caution!

Risk of damage.

Do not support the weight of the sensor on the metal casing; the casing would buckle and damage the internal magnetic coils.

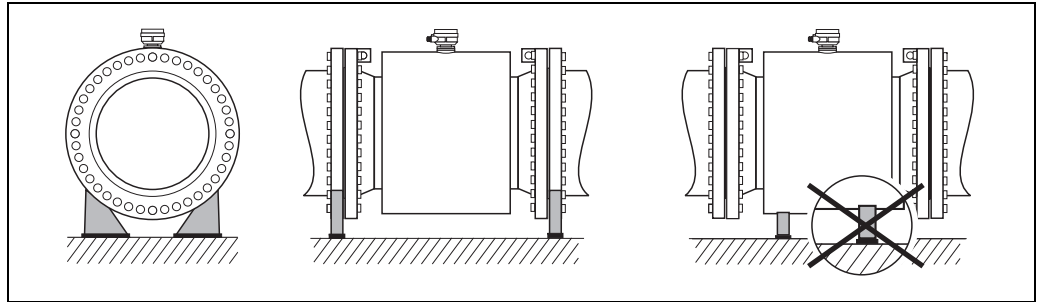


Fig. 14: Correct support for large nominal diameters ($DN \geq 350/14"$)

3.2.7 Adapters

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

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



Note!

The nomogram only applies to liquids of viscosity similar to water.

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

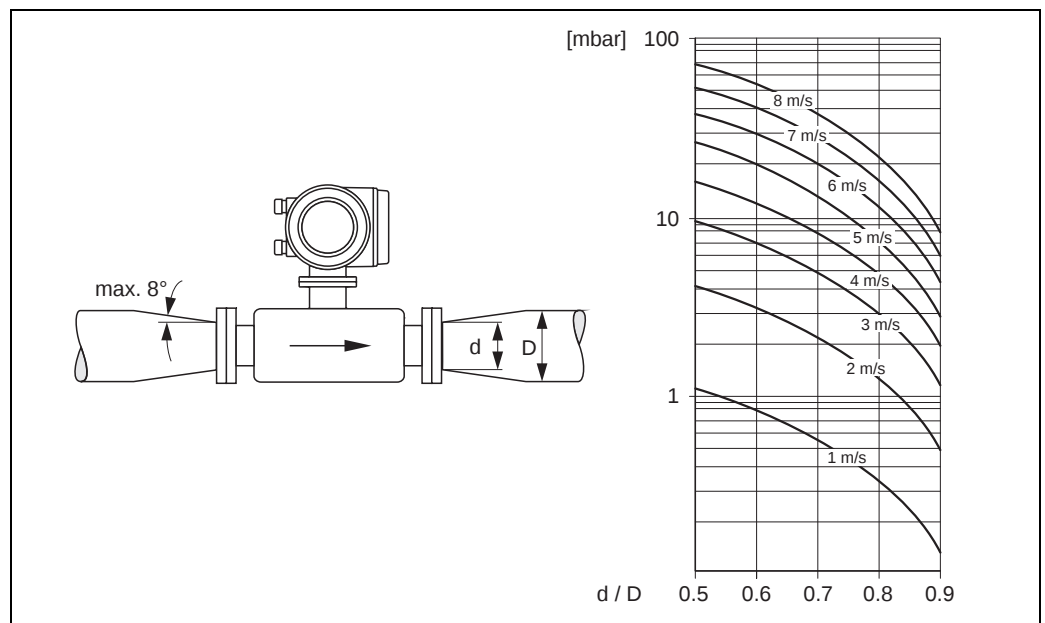


Fig. 15: Pressure loss due to adapters

3.2.8 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is between 2 and 3 m/s (6.5 to 9.8 ft/s)

The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:

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



Note!

Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (→ 17).

Recommended flow (SI units)

Nominal diameter [mm]	Promag W	Promag P	Promag H
	Min./max. full scale value ($v \approx 0.3$ or 10 m/s) in [dm ³ /min]		
2	–	–	0.06 to 1.8
4	–	–	0.25 to 7
8	–	–	1 to 30
15	–	4 to 100	4 to 100
25	9 to 300	9 to 300	9 to 300
32	15 to 500	15 to 500	–
40	25 to 700	25 to 700	25 to 700
50	35 to 1100	35 to 1100	35 to 1100
65	60 to 2000	60 to 2000	60 to 2000
80	90 to 3000	90 to 3000	90 to 3000
100	145 to 4700	145 to 4700	145 to 4700
125	220 to 7500	220 to 7500	–
[mm]	Min./max. full scale value ($v \approx 0.3$ or 10 m/s) in [m ³ /h]		
150	20 to 600	20 to 600	–
200	35 to 1100	35 to 1100	–
250	55 to 1700	55 to 1700	–
300	80 to 2400	80 to 2400	–
350	110 to 3300	110 to 3300	–
375	140 to 4200	–	–
400	140 to 4200	140 to 4200	–
450	180 to 5400	180 to 5400	–
500	220 to 6600	220 to 6600	–
600	310 to 9600	310 to 9600	–
700	420 to 13500	–	–
800	550 to 18000	–	–
900	690 to 22500	–	–
1000	850 to 28000	–	–
1200	1250 to 40000	–	–
1400	1700 to 55000	–	–
1600	2200 to 70000	–	–
1800	2800 to 90000	–	–
2000	3400 to 110000	–	–

Recommended flow (US units)

Nominal diameter [inch]	Promag W	Promag P	Promag H
	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [gal/min]		
1 1/12"	–	–	0.015 to 0.5
5/32"	–	–	0.07 to 2
5/16"	–	–	0.25 to 8
1/2"	–	1.0 to 27	1.0 to 27
1"	2.5 to 80	2.5 to 80	2.5 to 80
1 1/4"	4 to 130	4 to 130	–
1 1/2"	7 to 190	7 to 190	7 to 190
2"	10 to 300	10 to 300	10 to 300
2 1/2"	16 to 500	16 to 500	16 to 500
3"	24 to 800	24 to 800	24 to 800
4"	40 to 1250	40 to 1250	40 to 1250
5"	60 to 1950	60 to 1950	–
6"	90 to 2650	90 to 2650	–
8"	155 to 4850	155 to 4850	–
10"	250 to 7500	250 to 7500	–
12"	350 to 10600	350 to 10600	–
14"	500 to 15000	500 to 15000	–
15"	600 to 19000	–	–
16"	600 to 19000	600 to 19000	–
18"	800 to 24000	800 to 24000	–
20"	1000 to 30000	1000 to 30000	–
24"	1400 to 44000	1400 to 44000	–
28"	1900 to 60000	–	–
30"	2150 to 67000	–	–
32"	2450 to 80000	–	–
36"	3100 to 100000	–	–
40"	3800 to 125000	–	–
42"	4200 to 135000	–	–
48"	5500 to 175000	–	–
[inch]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [Mgal/d]		
54"	9 to 300	–	–
60"	12 to 380	–	–
66"	14 to 500	–	–
72"	16 to 570	–	–
78"	18 to 650	–	–

3.2.9 Length of connecting cable

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

- Secure the cable run or route the cable in an armored conduit. Movement of the cable can falsify the measuring signal, particularly if the fluid conductivity is low.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permissible cable length $L_{\max}$ depends on the fluid conductivity ($\rightarrow$ 16).
- The maximum connecting cable length is 10 m (32.8 ft) when empty pipe detection (EPD $\rightarrow$ 91) is switched on.

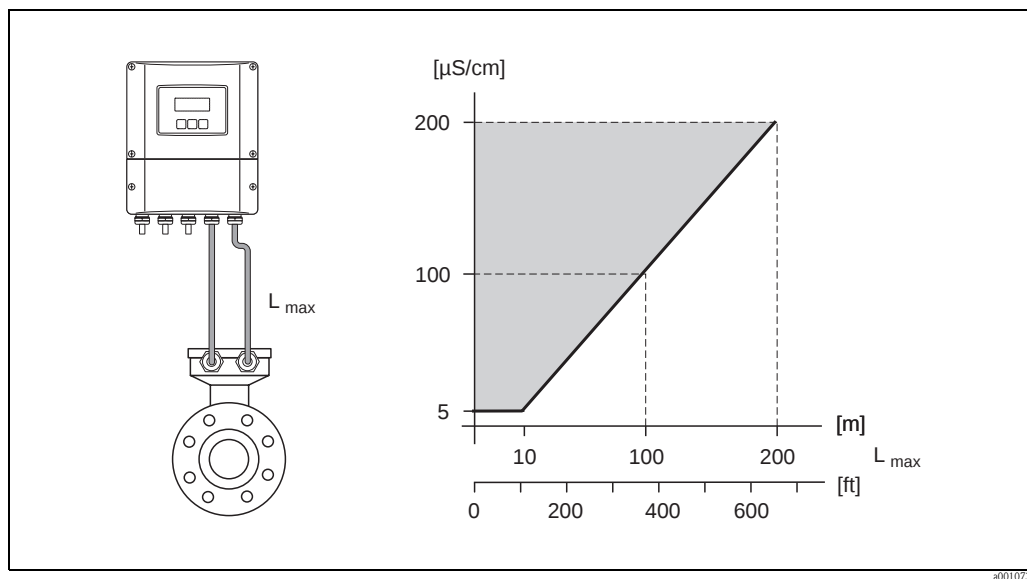


Fig. 16: Permitted lengths for connecting cable in remote version, as a function of the conductivity of the fluid

Gray shaded area = permissible range

$L_{\max}$ = length of connecting cable

3.3 Installation

3.3.1 Installing the Promag W sensor



Note!

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

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

- It is essential that you observe the necessary screw tightening torques on → 22.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

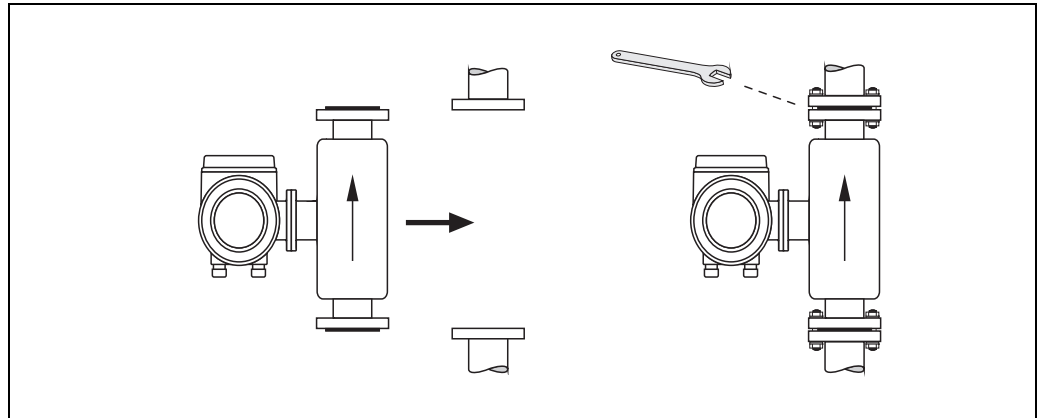


Fig. 17: Installing the Promag W sensor

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Seals

Comply with the following instructions when installing seals:

- Hard rubber lining → additional seals are **always** required.
- Polyurethane lining → seals are **not** required.
- Only use seals that comply with DIN EN 1514-1 for DIN flanges.
- Make sure that the seals do not protrude into the piping cross-section.



Caution!

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

Ground cable

- If necessary, special ground cables can be ordered as accessories for potential equalization, → 94.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 49.

Screw tightening torques (Promag W)

Note the following points:

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

Tightening torques for:

- EN (DIN) → 22
- JIS → 24
- ANSI → 24
- AWWA → 25
- AS 2129 → 25
- AS 4087 → 26

Promag W tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	PN 40	4 × M 12	-	15
32	PN 40	4 × M 16	-	24
40	PN 40	4 × M 16	-	31
50	PN 40	4 × M 16	-	40
65*	PN 16	8 × M 16	32	27
65	PN 40	8 × M 16	32	27
80	PN 16	8 × M 16	40	34
80	PN 40	8 × M 16	40	34
100	PN 16	8 × M 16	43	36
100	PN 40	8 × M 20	59	50
125	PN 16	8 × M 16	56	48
125	PN 40	8 × M 24	83	71
150	PN 16	8 × M 20	74	63
150	PN 40	8 × M 24	104	88
200	PN 10	8 × M 20	106	91
200	PN 16	12 × M 20	70	61
200	PN 25	12 × M 24	104	92
250	PN 10	12 × M 20	82	71
250	PN 16	12 × M 24	98	85
250	PN 25	12 × M 27	150	134
300	PN 10	12 × M 20	94	81
300	PN 16	12 × M 24	134	118
300	PN 25	16 × M 27	153	138
350	PN 6	12 × M 20	111	120
350	PN 10	16 × M 20	112	118
350	PN 16	16 × M 24	152	165
350	PN 25	16 × M 30	227	252
400	PN 6	16 × M 20	90	98
400	PN 10	16 × M 24	151	167
400	PN 16	16 × M 27	193	215
400	PN 25	16 × M 33	289	326
450	PN 6	16 × M 20	112	126
450	PN 10	20 × M 24	153	133
450	PN 16	20 × M 27	198	196
450	PN 25	20 × M 33	256	253
500	PN 6	20 × M 20	119	123
500	PN 10	20 × M 24	155	171

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
500	PN 16	20 × M 30	275	300
500	PN 25	20 × M 33	317	360
600	PN 6	20 × M 24	139	147
600	PN 10	20 × M 27	206	219
600 *	PN 16	20 × M 33	415	443
600	PN 25	20 × M 36	431	516
700	PN 6	24 × M 24	148	139
700	PN 10	24 × M 27	246	246
700	PN 16	24 × M 33	278	318
700	PN 25	24 × M 39	449	507
800	PN 6	24 × M 27	206	182
800	PN 10	24 × M 30	331	316
800	PN 16	24 × M 36	369	385
800	PN 25	24 × M 45	664	721
900	PN 6	24 × M 27	230	637
900	PN 10	28 × M 30	316	307
900	PN 16	28 × M 36	353	398
900	PN 25	28 × M 45	690	716
1000	PN 6	28 × M 27	218	208
1000	PN 10	28 × M 33	402	405
1000	PN 16	28 × M 39	502	518
1000	PN 25	28 × M 52	970	971
1200	PN 6	32 × M 30	319	299
1200	PN 10	32 × M 36	564	568
1200	PN 16	32 × M 45	701	753
1400	PN 6	36 × M 33	430	398
1400	PN 10	36 × M 39	654	618
1400	PN 16	36 × M 45	729	762
1600	PN 6	40 × M 33	440	417
1600	PN 10	40 × M 45	946	893
1600	PN 16	40 × M 52	1007	1100
1800	PN 6	44 × M 36	547	521
1800	PN 10	44 × M 45	961	895
1800	PN 16	44 × M 52	1108	1003
2000	PN 6	48 × M 39	629	605
2000	PN 10	48 × M 45	1047	1092
2000	PN 16	48 × M 56	1324	1261
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag W tightening torques for JIS

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

Promag W tightening torques for ANSI

Sensor Nominal diameter [inch]	ANSI Pressure rating [lbs]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
1"	Class 150	4 × ½"	–	7
1"	Class 300	4 × 5/8"	–	8
1 ½"	Class 150	4 × ½"	–	10
1 ½"	Class 300	4 × ¾"	–	15
2"	Class 150	4 × 5/8"	–	22
2"	Class 300	8 × 5/8"	–	11
3"	Class 150	4 × 5/8"	60	43
3"	Class 300	8 × ¾"	38	26
4"	Class 150	8 × 5/8"	42	31
4"	Class 300	8 × ¾"	58	40
6"	Class 150	8 × ¾"	79	59
6"	Class 300	12 × ¾"	70	51
8"	Class 150	8 × ¾"	107	80
10"	Class 150	12 × 7/8"	101	75
12"	Class 150	12 × 7/8"	133	103
14"	Class 150	12 × 1"	135	158

Sensor Nominal diameter [inch]	ANSI Pressure rating [lbs]	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
16"	Class 150	16 × 1"	128	150
18"	Class 150	16 × 1 1/8"	204	234
20"	Class 150	20 × 1 1/8"	183	217
24"	Class 150	20 × 1 1/4"	268	307

Promag W tightening torques for AWWA

Sensor Nominal diameter [inch]	AWWA Pressure rating	Screws	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
28"	Class D	28 × 1 1/4"	247	292
30"	Class D	28 × 1 1/4"	287	302
32"	Class D	28 × 1 1/2"	394	422
36"	Class D	32 × 1 1/2"	419	430
40"	Class D	36 × 1 1/2"	420	477
42"	Class D	36 × 1 1/2"	528	518
48"	Class D	44 × 1 1/2"	552	531
54"	Class D	44 × 1 3/4"	730	633
60"	Class D	52 × 1 3/4"	758	832
66"	Class D	52 × 1 3/4"	946	955
72"	Class D	60 × 1 3/4"	975	1087
78"	Class D	64 × 2"	853	786

Promag W tightening torques for AS 2129

Sensor Nominal diameter [mm]	AS 2129 Pressure rating	Screws	Max. tightening torque [Nm]
			Hard rubber
80	Table E	4 × M 16	49
100	Table E	8 × M 16	38
150	Table E	8 × M 20	64
200	Table E	8 × M 20	96
250	Table E	12 × M 20	98
300	Table E	12 × M 24	123
350	Table E	12 × M 24	203
400	Table E	12 × M 24	226
500	Table E	16 × M 24	271
600	Table E	16 × M 30	439
700	Table E	20 × M 30	355
750	Table E	20 × M 30	559
800	Table E	20 × M 30	631
900	Table E	24 × M 30	627
1000	Table E	24 × M 30	634
1200	Table E	32 × M 30	727

Promag W tightening torques for AS 4087

Sensor Nominal diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm]
			Hard rubber
80	PN 16	4 × M 16	49
100 *	PN 16	8 × M 16	38
150	PN 16	8 × M 20	52
200	PN 16	8 × M 20	77
250	PN 16	8 × M 20	147
300	PN 16	12 × M 24	103
350	PN 16	12 × M 24	203
375	PN 16	12 × M 24	137
400	PN 16	12 × M 24	226
500	PN 16	16 × M 24	271
600	PN 16	16 × M 30	393
700	PN 16	20 × M 27	330
750	PN 16	20 × M 30	529
800	PN 16	20 × M 33	631
900	PN 16	24 × M 33	627
1000	PN 16	24 × M 33	595
1200	PN 16	32 × M 33	703
* Designed acc. to AS 2129 (not to AS 4087)			

3.3.2 Installing the Promag P sensor



Caution!

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



Note!

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

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

- It is essential that you observe the necessary screw tightening torques on → 28.
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment.

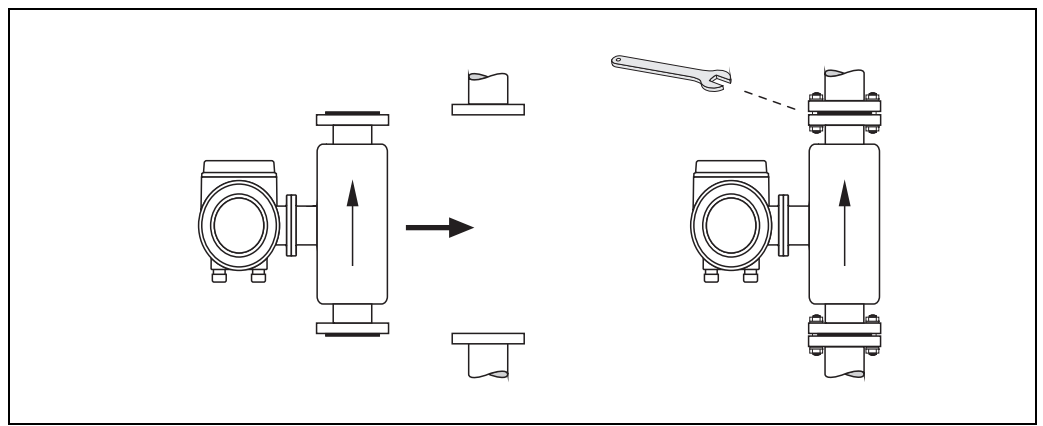


Fig. 18: Installing the Promag P sensor

Seals

Comply with the following instructions when installing seals:

- PFA or PTFE lining → seals are **not** required.
- Only use seals that comply with DIN EN 1514-1 for DIN flanges.
- Make sure that the seals do not protrude into the piping cross-section.



Caution!

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

Ground cable

- If necessary, special ground cables can be ordered as accessories for potential equalization, → 94.
- For information on potential equalization and detailed installation instructions for using ground cables, please refer to → 49.

Installing the high-temperature version (with PFA lining)

The high-temperature version has a housing support for the thermal separation of sensor and transmitter. The high-temperature version is always used for applications in which high ambient temperatures are encountered in conjunction with high fluid temperatures. The high-temperature version is obligatory if the fluid temperature exceeds +150 °C (+300 °F).



Note!

You will find information on permissible temperature ranges on → 121.

Insulation

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



Caution!

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

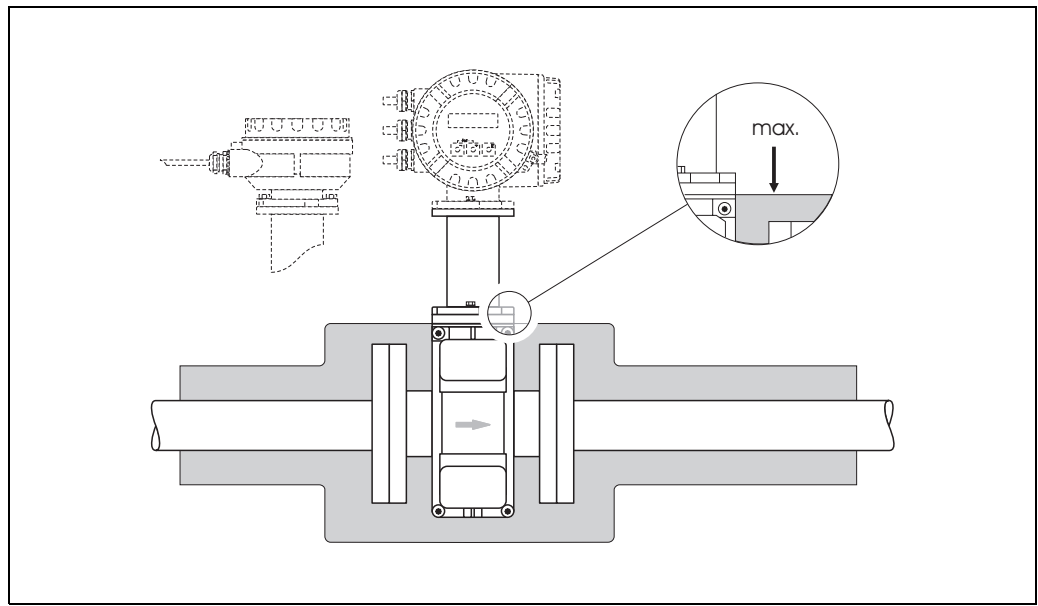


Fig. 19: Promag P sensor (high-temperature version): insulating the pipe

Screw tightening torques (Promag P)

Note the following points:

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

Tightening torques for:

- EN (DIN) → 29
- ANSI → 30
- JIS → 30
- AS 2129 → 31
- AS 4087 → 31

Promag P tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Screws	Max. tightening torque [Nm]	
			PTFE	PFA
15	PN 40	4 × M 12	11	–
25	PN 40	4 × M 12	26	20
32	PN 40	4 × M 16	41	35
40	PN 40	4 × M 16	52	47
50	PN 40	4 × M 16	65	59
65 *	PN 16	8 × M 16	43	40
65	PN 40	8 × M 16	43	40
80	PN 16	8 × M 16	53	48
80	PN 40	8 × M 16	53	48
100	PN 16	8 × M 16	57	51
100	PN 40	8 × M 20	78	70
125	PN 16	8 × M 16	75	67
125	PN 40	8 × M 24	111	99
150	PN 16	8 × M 20	99	85
150	PN 40	8 × M 24	136	120
200	PN 10	8 × M 20	141	101
200	PN 16	12 × M 20	94	67
200	PN 25	12 × M 24	138	105
250	PN 10	12 × M 20	110	–
250	PN 16	12 × M 24	131	–
250	PN 25	12 × M 27	200	–
300	PN 10	12 × M 20	125	–
300	PN 16	12 × M 24	179	–
300	PN 25	16 × M 27	204	–
350	PN 10	16 × M 20	188	–
350	PN 16	16 × M 24	254	–
350	PN 25	16 × M 30	380	–
400	PN 10	16 × M 24	260	–
400	PN 16	16 × M 27	330	–
400	PN 25	16 × M 33	488	–
450	PN 10	20 × M 24	235	–
450	PN 16	20 × M 27	300	–
450	PN 25	20 × M 33	385	–
500	PN 10	20 × M 24	265	–
500	PN 16	20 × M 30	448	–
500	PN 25	20 × M 33	533	–
600	PN 10	20 × M 27	345	–
600 *	PN 16	20 × M 33	658	–
600	PN 25	20 × M 36	731	–
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag P tightening torques for ANSI

Nominal diameter		ANSI Pressure rating [lbs]	Screws	Max. tightening torque			
[mm]	[inch]			PTFE		PFA	
				[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
15	½"	Class 150	4 × ½"	6	4	–	–
15	½"	Class 300	4 × ½"	6	4	–	–
25	1"	Class 150	4 × ½"	11	8	10	7
25	1"	Class 300	4 × 5/8"	14	10	12	9
40	1 ½"	Class 150	4 × ½"	24	18	21	15
40	1 ½"	Class 300	4 × ¾"	34	25	31	23
50	2"	Class 150	4 × 5/8"	47	35	44	32
50	2"	Class 300	8 × 5/8"	23	17	22	16
80	3"	Class 150	4 × 5/8"	79	58	67	49
80	3"	Class 300	8 × ¾"	47	35	42	31
100	4"	Class 150	8 × 5/8"	56	41	50	37
100	4"	Class 300	8 × ¾"	67	49	59	44
150	6"	Class 150	8 × ¾"	106	78	86	63
150	6"	Class 300	12 × ¾"	73	54	67	49
200	8"	Class 150	8 × ¾"	143	105	109	80
250	10"	Class 150	12 × 7/8"	135	100	–	–
300	12"	Class 150	12 × 7/8"	178	131	–	–
350	14"	Class 150	12 × 1"	260	192	–	–
400	16"	Class 150	16 × 1"	246	181	–	–
450	18"	Class 150	16 × 1 1/8"	371	274	–	–
500	20"	Class 150	20 × 1 1/8"	341	252	–	–
600	24"	Class 150	20 × 1 ¼"	477	352	–	–

Promag P tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Screws	Max. tightening torque [Nm]	
			PTFE	PFA
15	10K	4 × M 12	16	–
15	20K	4 × M 12	16	–
25	10K	4 × M 16	32	27
25	20K	4 × M 16	32	27
32	10K	4 × M 16	38	–
32	20K	4 × M 16	38	–
40	10K	4 × M 16	41	37
40	20K	4 × M 16	41	37
50	10K	4 × M 16	54	46
50	20K	8 × M 16	27	23
65	10K	4 × M 16	74	63
65	20K	8 × M 16	37	31
80	10K	8 × M 16	38	32
80	20K	8 × M 20	57	46
100	10K	8 × M 16	47	38
100	20K	8 × M 20	75	58
125	10K	8 × M 20	80	66
125	20K	8 × M 22	121	103

Nominal diameter [mm]	JIS Pressure rating	Screws	Max. tightening torque [Nm]	
			PTFE	PFA
150	10K	8 × M 20	99	81
150	20K	12 × M 22	108	72
200	10K	12 × M 20	82	54
200	20K	12 × M 22	121	88
250	10K	12 × M 22	133	–
250	20K	12 × M 24	212	–
300	10K	16 × M 22	99	–
300	20K	16 × M 24	183	–

Promag P tightening torques for AS 2129

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

Promag P tightening torques for AS 4087

Nominal diameter [mm]	AS 4087 Pressure rating	Screws	Max. tightening torque [Nm] PTFE
50	PN 16	4 × M 16	42

3.3.3 Installing the Promag H sensor

The sensor is supplied, as per your order, with or without installed process connections. Installed process connections are screwed onto the sensor using 4 or 6 hexagonal-headed bolts.



Caution!

Depending on the application and the length of the pipe, the sensor must be supported or more securely mounted if necessary. Particularly when using process connections made of plastic, it is essential that the sensor be mounted securely. A wall mounting kit for this purpose can be ordered separately as an accessory from Endress+Hauser (→ 94).

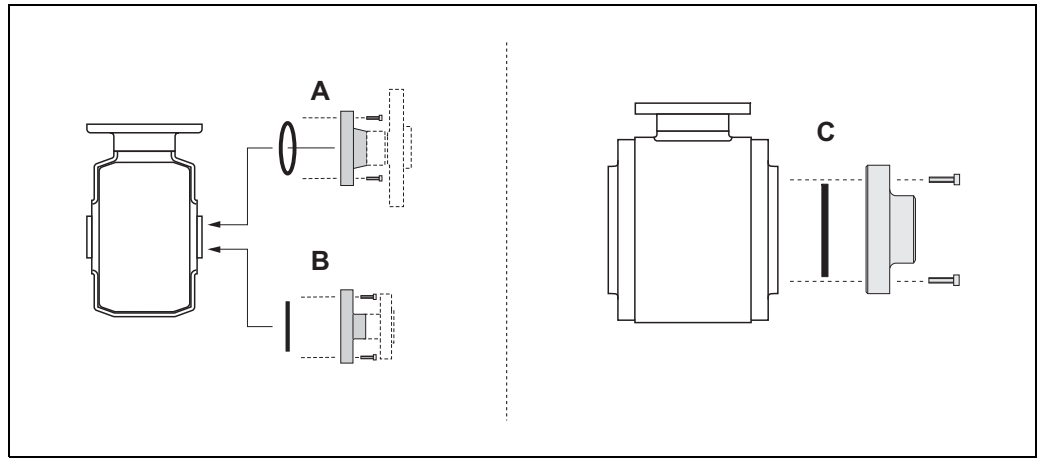


Fig. 20: Promag H process connections; DN 2 to 25 / DN 40 to 100 (1/12" to 1" / 1 1/2" to 4")

A = DN 2 to 25 (1/12" to 1") / Process connections with O-ring

Weld nipple (DIN EN ISO 1127, ODT / SMS), flange (EN (DIN), ANSI, JIS), flange made of PVDF (EN (DIN), ANSI, JIS), external thread, internal thread, hose connection, PVC adhesive fitting

B = DN 2 to 25 (1/12" to 1") / Process connections with aseptic molded seal

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

C = DN 40 to 100 (1 1/2" to 4") / Process connections with aseptic molded seal

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

Seals

When mounting the process connections, please ensure that the relevant seals are clean and properly centered.



Caution!

- In the case of metallic process connections, the screws must be fully tightened. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- In the case of process connections made of plastic, the maximum screw tightening torques for lubricated threads (7 Nm / 5.2 lbf ft) must be adhered to. In the case of plastic flanges, a seal must always be used between the connection and the counterflange.
- Depending on the application, the seals should be replaced periodically, particularly when molded seals (aseptic version) are used!

The interval between replacements depends on the frequency of the cleaning cycles and on the temperatures of the fluid and the cleaning process. Replacement seals can be ordered as an accessory at a later stage → 94.

Using and installing grounding rings (DN 2 to 25, 1/12" to 1")

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

If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the galvanic corrosion of the electrodes.



Caution!

- Depending on the option ordered, plastic rings may be installed at the process connections instead of ground rings. These plastic rings serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic rings/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from Endress+Hauser as accessories → 94. When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by galvanic corrosion! Information about the materials can be found on → 129.
- Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected.

1. Loosen the four or six hexagonal headed bolts (1) and remove the process connection from the sensor (4).
2. Remove the plastic ring (3), including the two O-ring seals (2).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (2) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again. With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft).

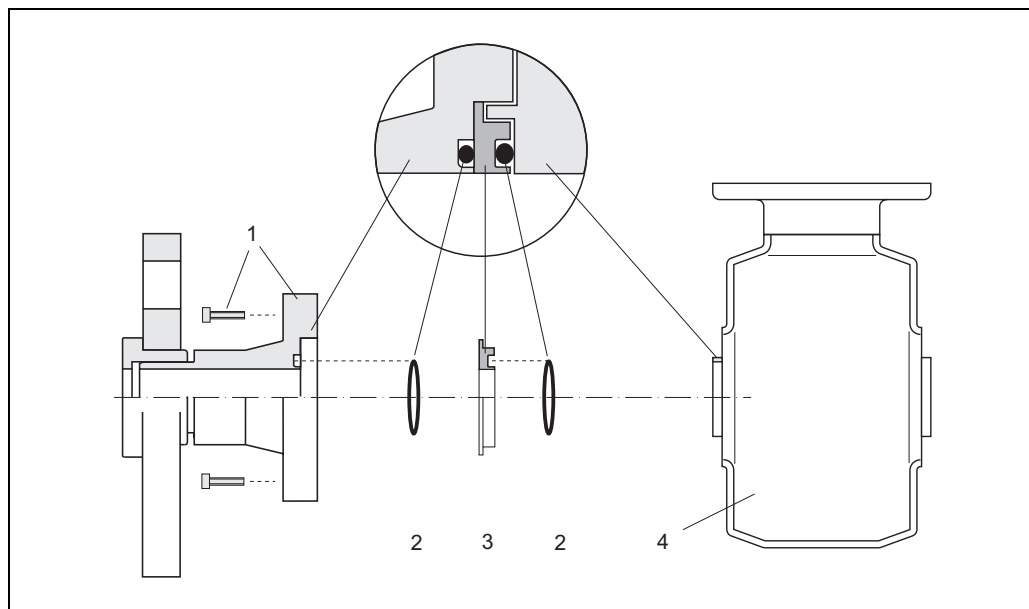


Fig. 21: Installing grounding rings in the Promag H (DN 2 to 25, 1/12" to 1")

- 1 = Hexagonal-headed bolts, process connection
 2 = O-ring seals
 3 = Grounding ring or plastic ring (spacer)
 4 = Sensor

Welding the transmitter into the pipe (weld nipple)**Caution!**

Risk of electronics being destroyed. Please ensure that the welding system is *not* grounded via the sensor or transmitter.

1. Secure the sensor using several welding points in the piping. A welding jig suitable for this purpose can be ordered separately as an accessory → 94.
2. Loosen the screws at the process connection flange, and remove the sensor incl. seal from the piping.
3. Weld the process connection into the pipe.
4. Mount the sensor back into the pipe. When doing so, make sure that the seal is clean and positioned correctly.

**Note!**

- If the welding is done properly with thin-walled food pipes, the seal will not be damaged by heat even when mounted. Nonetheless, it is recommended that you dismantle the sensor and seal.
- For dismantling purposes, it must be possible to open the piping a total of approx. 8 mm.

Cleaning using pigs

When cleaning using pigs, please note the internal diameters of the measuring tube and the process connection. All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Information" → 134.

3.3.4 Turning the transmitter housing

Turning the aluminum field housing



Warning!

The rotating mechanism in devices with Ex d/de or FM/CSA Cl. I Div. 1 approval is different to that described here. The relevant procedure is described in the Ex-specific documentation.

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

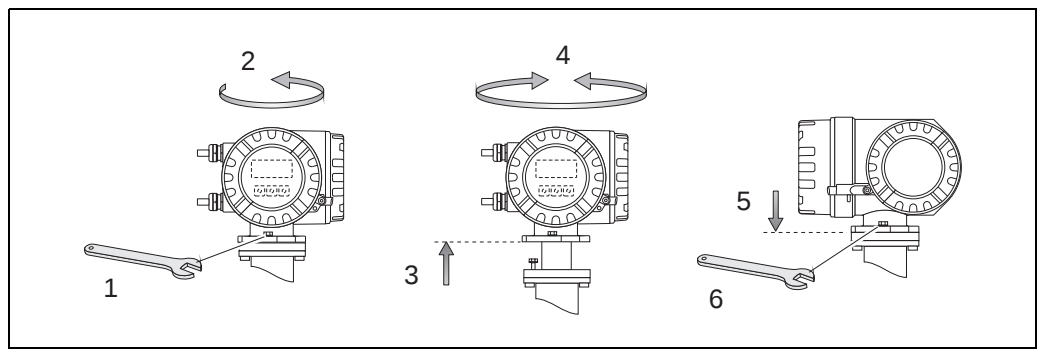


Fig. 22: Turning the transmitter housing (aluminum field housing)

Turning the stainless steel field housing

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

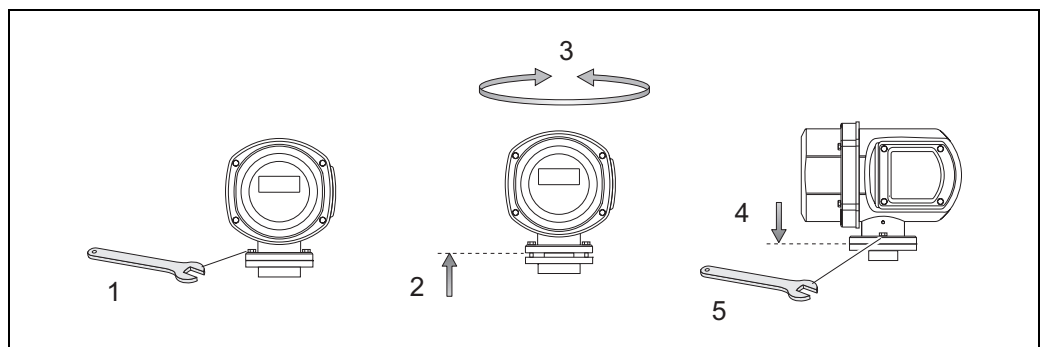


Fig. 23: Turning the transmitter housing (stainless steel field housing)

3.3.5 Turning the local display

1. Unscrew the electronics compartment cover from the transmitter housing.
2. Press the latches on the side of the display module and pull the module out of the electronics compartment cover.
3. Turn the display to the desired position (max. $4 \times 45^\circ$ in both directions) and position it back on the electronics compartment cover.
4. Screw the cover of the electronics compartment firmly onto the transmitter housing.

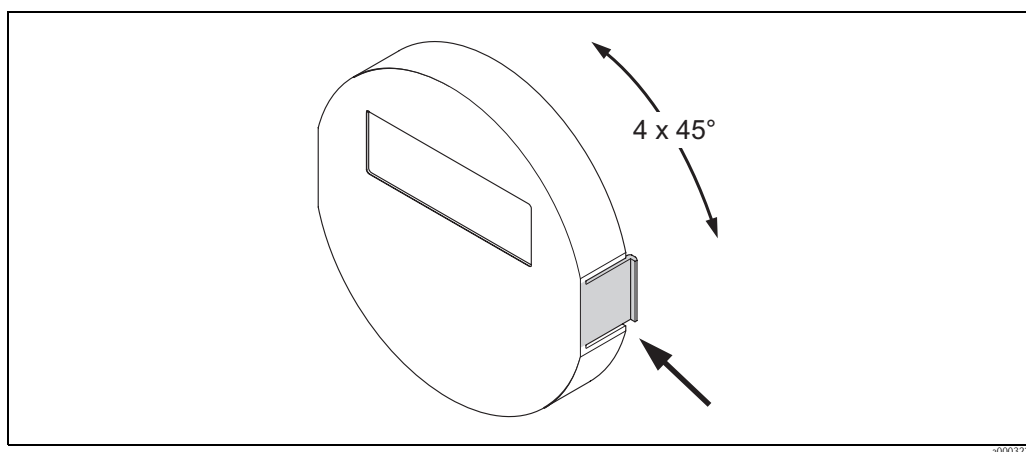


Fig. 24: Turning the local display (field housing)

3.3.6 Installing the wall-mount housing

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

- Mounted directly on the wall
- Panel mounting (with separate mounting kit, accessories) → 38
- Pipe mounting (with separate mounting kit, accessories) → 38



Caution!

- Make sure that the permitted ambient temperature range is observed (see nameplate or → 120). Install the device in a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Mounted directly on the wall

1. Drill the holes as illustrated.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
 - Securing screws (M6): max. Ø 6.5 mm (0.24")
 - Screw head: max. Ø 10.5 mm (0.4")
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

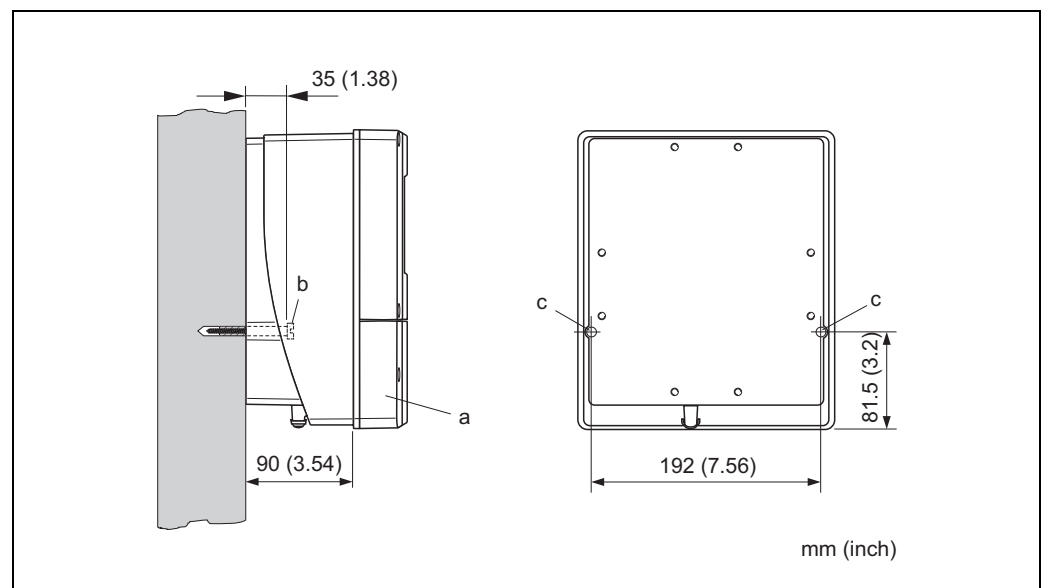


Fig. 25: Mounted directly on the wall

a0001130-ae

Panel mounting

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

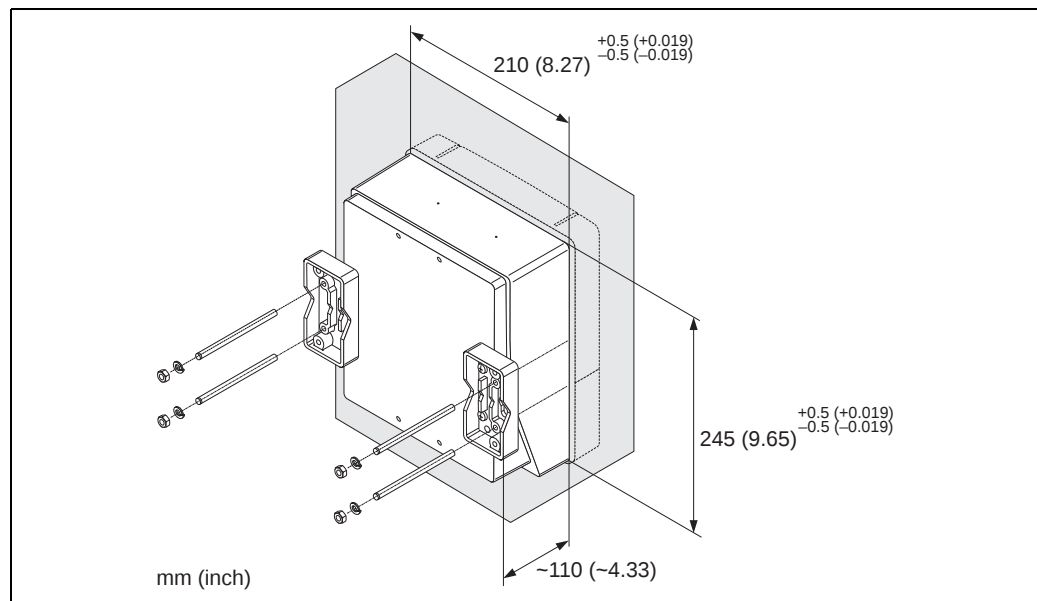


Fig. 26: Panel mounting (wall-mount housing)

Pipe mounting

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



Caution!

If the device is mounted to a warm pipe, make sure that the housing temperature does not exceed +60 °C (+140 °F), which is the maximum permissible temperature.

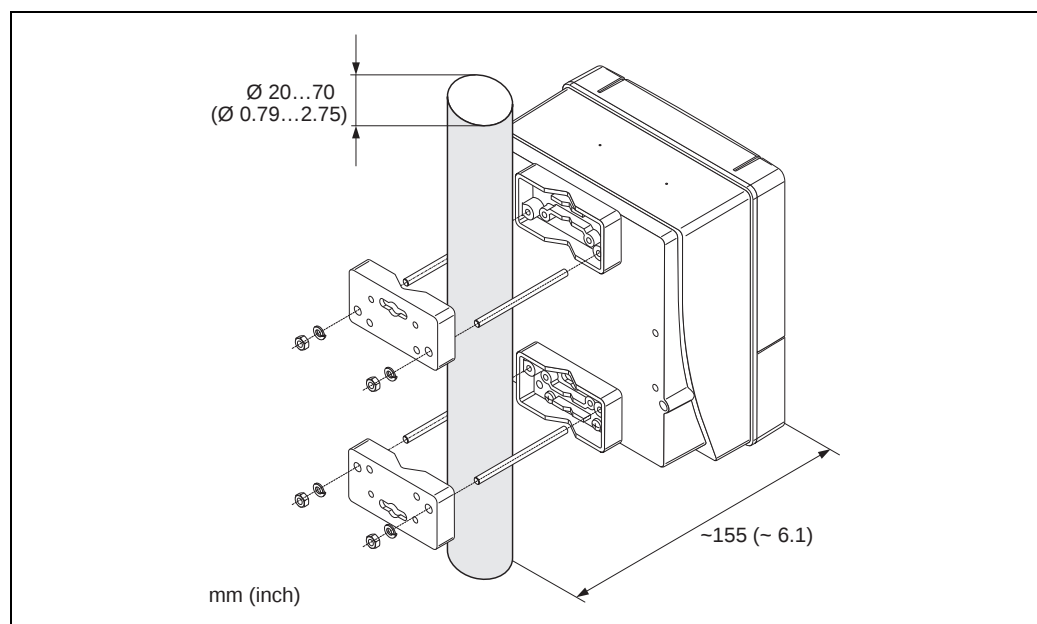


Fig. 27: Pipe mounting (wall-mount housing)

3.4 Post-installation check

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

Device condition/specifications	Notes
Is the device damaged (visual inspection)?	-
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	→ 116
Installation	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	-
Is the position of the measuring electrode plane correct?	→ 15
Is the position of the empty pipe detection electrode correct?	→ 15
Were all screws tightened to the specified tightening torques when the sensor was installed?	→ 21
Were the correct seals installed (type, material, installation)?	→ 21
Are the measuring point number and labeling correct (visual inspection)?	-
Process environment / process conditions	Notes
Are the inlet and outlet runs respected?	Inlet run $\geq 5 \times \text{DN}$ Outlet run $\geq 2 \times \text{DN}$
Is the measuring device protected against moisture and direct sunlight?	-
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g in accordance with IEC 600 68-2-6 → 120

4 Wiring



Warnung!

When connecting Ex-certified devices, please take note of the instructions and wiring diagrams in the Ex-specific supplement to these Operating Instructions. Should you have any questions, please contact your Endress+Hauser sales office for assistance.



Note!

The device does not have an internal circuit breaker. An external switch or circuit breaker must therefore be installed which can be used to disconnect the device from the main power source.

4.1 Cable specification MODBUS RS485

4.1.1 Cable type

In the EIA/TIA-485 standard, two versions (cable type A and B) are specified for the bus line and can be used for all transmission rates. However, we recommend you use cable type A. The cable specification for cable type A are provided in the following table:

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

Note the following points for the bus structure:

- All the measuring devices are connected in a bus structure (line).
- Using cable type A and with a transmission rate of 115200 Baud, the maximum line length (segment length) of the MODBUS RS485 system is 1200 m. The total length of the spurs may not exceed a maximum of 6.6 m here.
- A maximum of 32 users are permitted per segment.
- Each segment is terminated at either end with a terminating resistor.
- The bus length or the number of users can be increased by introducing a repeater.

4.1.2 Shielding and grounding

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

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

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

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

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

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



Caution!

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

4.2 Connecting the remote version

4.2.1 Connecting the sensor



Warning!

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



Caution!

- Only sensors and transmitters with the same serial number can be connected to one another. Communication problems can occur if the devices are not connected in this way.
- Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil cable.

Procedure

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



Caution!

Route the connecting cables securely (see "Connecting cable length" → 20).

4. Terminate the signal and coil current cable as indicated in the table:
 Promag W, P → Refer to the table → 44
 Promag H → Refer to the "Cable termination" table → 45
5. Establish the wiring between the sensor and the transmitter.
 The electrical wiring diagram that applies to your device can be found:
 - In the corresponding graphic:
 → 28 (Promag W, P); → 29 (Promag H)
 - In the cover of the sensor and transmitter



Note!

The cable shields of the Promag H sensor are grounded by means of the strain relief terminals (see also the "Cable termination" table → 45)



Caution!

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

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

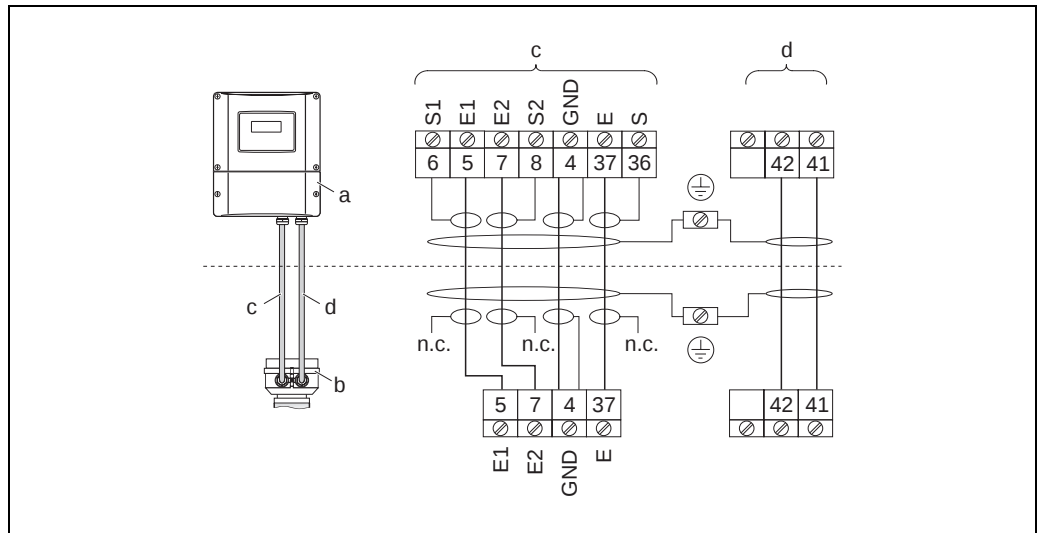
Promag W, P

Fig. 28: Connecting the remote version of Promag W, P

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

Wire colors/Terminal No.:

5/6 = brown, 7/8 = white, 4 = green, 37/36 = yellow

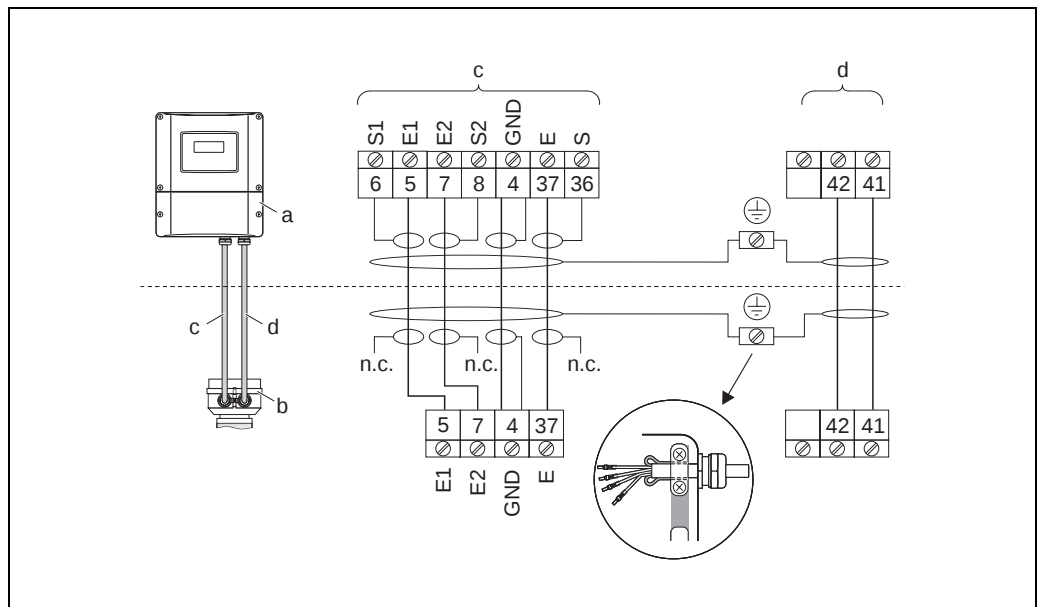
Promag H

Fig. 29: Connecting the remote version of Promag H

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

Wire colors/Terminal No.:

5/6 = brown, 7/8 = white, 4 = green, 37/36 = yellow

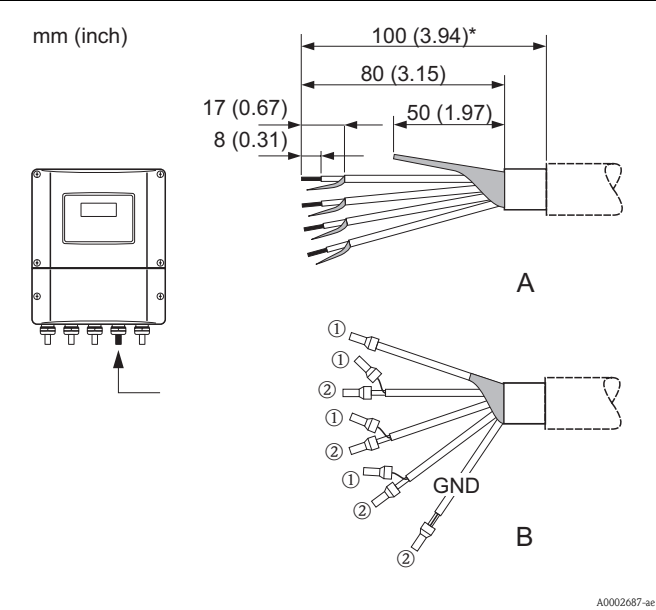
Cable termination in remote version
Promag W, Promag P

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with wire end ferrules (detail B: ① = red ferrules, Ø 1.0 mm; ② = white ferrules, Ø 0.5 mm)
* Stripping for reinforced cables only

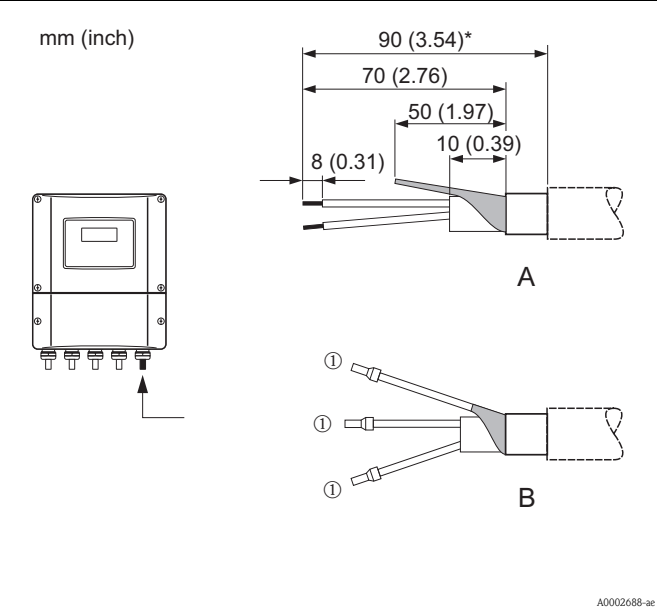
- ⚠ Caution!
- When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the wire end ferrules do not touch the wire shields on the sensor side!
Minimum distance = 1 mm (exception "GND" = green cable)
 - *Coil current cable* → Insulate one core of the three-core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

TRANSMITTER

Signal cable

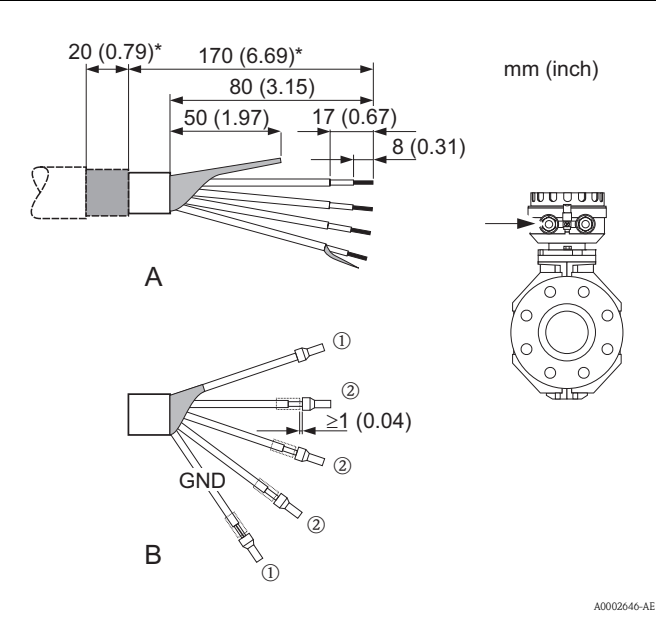


Coil current cable

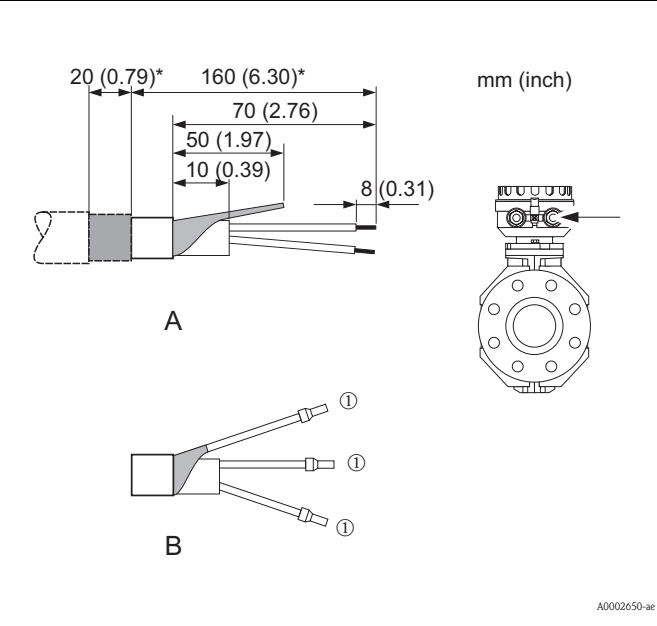


SENSOR

Signal cable



Coil current cable



Cable termination in remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with wire end ferrules (detail B: ① = ferrules red, Ø 1.0 mm; ② = ferrule white, Ø 0.5 mm)

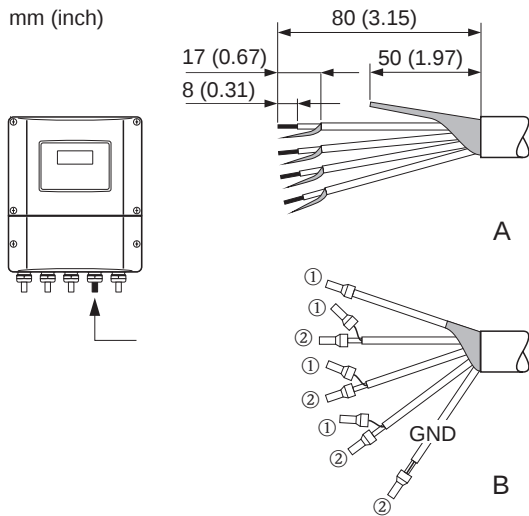
⚠ Caution!

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

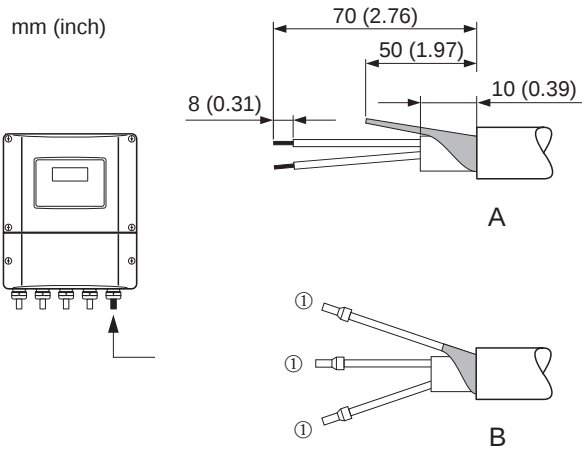
- *Signal cable* → Make sure that the wire end ferrules do not touch the wire shields on the sensor side!
Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the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

TRANSMITTER

Signal cable

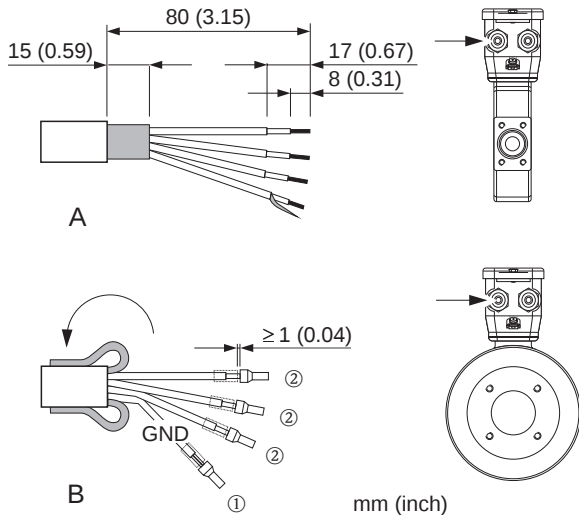


Coil current cable

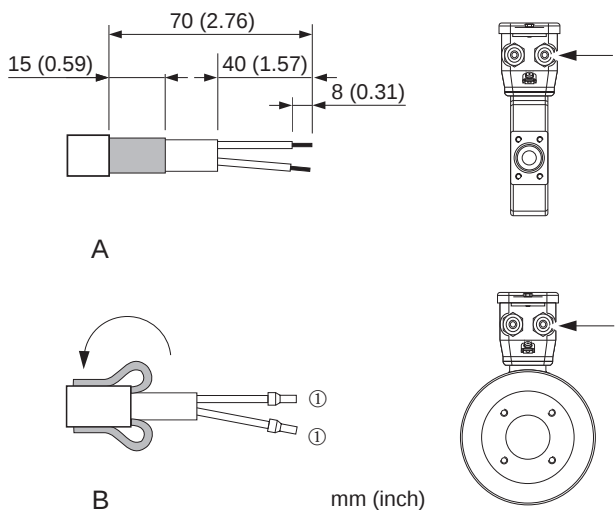


SENSOR

Signal cable



Coil current cable



4.2.2 Cable specifications

Signal cable

- $3 \times 0.38 \text{ mm}^2$ PVC cable with common, braided copper shield ($\varnothing \sim 7 \text{ mm}$) and individually shielded cores
- With Empty Pipe Detection (EPD): $4 \times 0.38 \text{ mm}^2$ PVC cable with common, braided copper shield ($\varnothing \sim 7 \text{ mm}$) and individually shielded cores
- Conductor resistance: $\leq 50 \text{ } \Omega/\text{km}$
- Capacitance: core/shield: $\leq 420 \text{ pF/m}$
- Operating temperature: -20 to $+80 \text{ }^\circ\text{C}$
- Conductor cross-section: max. 2.5 mm^2

Coil cable

- $2 \times 0.75 \text{ mm}^2$ PVC cable with common, braided copper shield ($\varnothing \sim 7 \text{ mm}$)
- Conductor resistance: $\leq 37 \text{ } \Omega/\text{km}$
- Capacitance: core/core, shield grounded: $\leq 120 \text{ pF/m}$
- Operating temperature: -20 to $+80 \text{ }^\circ\text{C}$
- Conductor cross-section: max. 2.5 mm^2
- Test current for cable insulation: $\geq 1433 \text{ V AC rms } 50/60 \text{ Hz}$ or $\geq 2026 \text{ V DC}$

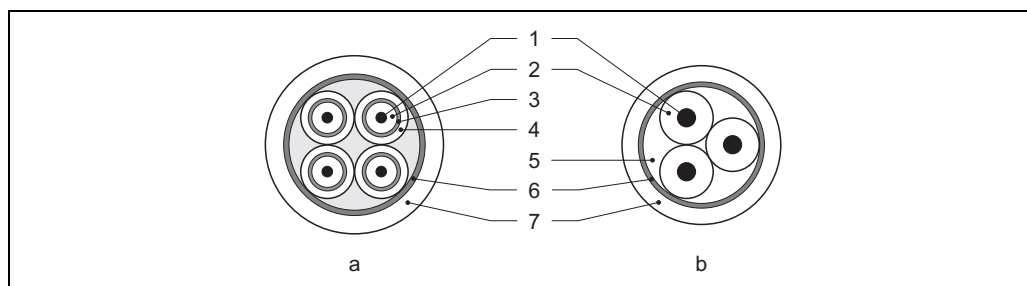


Fig. 30: Cable cross-section

- a Signal cable
b Coil current cable

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

Reinforced connecting cables

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid.

We recommend such cables for the following cases:

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

Operation in zones of severe electrical interference

The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326.



Caution!

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

4.3 Connecting the measuring unit

4.3.1 Terminal assignment



Caution!

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

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

Order version	Terminal No. (inputs / outputs)			
	20 (+) / 21 (-) Submodule on slot No. 4	22 (+) / 23 (-) Submodule on slot No. 3	24 (+) / 25 (-) Fixed on I/O board	26 = B (Rx/D/TxD-P) 27 = A (Rx/D/TxD-N) Fixed on I/O board
53***_*****Q	–	–	Status input	MODBUS RS485
53***_*****7	Relay output 2	Relay output 1	Status input	MODBUS RS485
53***_*****N	Current output	Frequency output	Status input	MODBUS RS485



Note!

The electrical values of the inputs and outputs can be found in the "Technical data" section.

4.3.2 Transmitter connection



Warning!

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

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



Caution!

- Risk of damage to the fieldbus cable!
Observe the information about shielding and grounding the fieldbus cable. → 41
 - We recommend that the fieldbus cable not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.
4. Screw the cover of the connection compartment (a) back onto the transmitter housing.

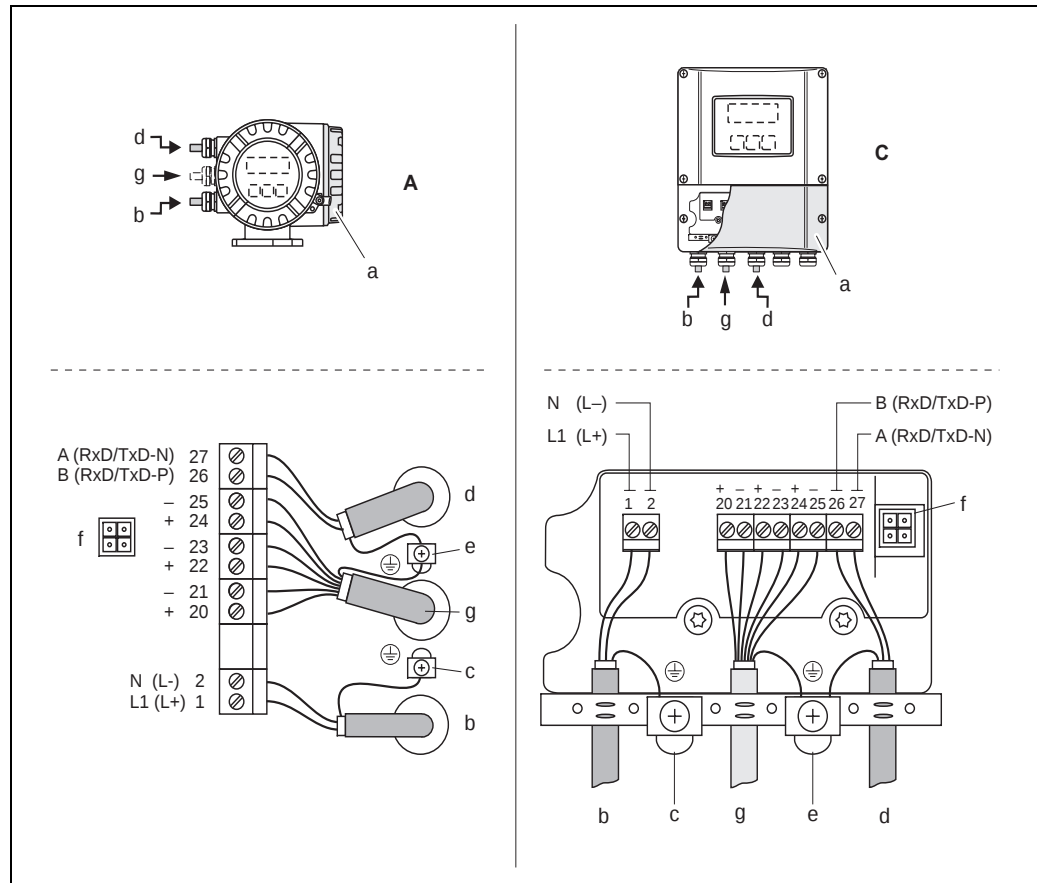


Fig. 31: Connecting the transmitter, Cable cross-section: max. 2.5 mm²

A View A (field housing)

B View B (stainless steel field housing)

C View C (wall-mount housing)

a Cover of the connection compartment

b Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC

Terminal No. 1: L1 for AC, L+ for DC

Terminal No. 2: N for AC, L- for DC

c Ground terminal for protective conductor

d Fieldbus cable

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

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

e Ground terminal for signal cable shield/fieldbus cable shield

Observe the following:

– the shielding and grounding of the fieldbus cable → 41

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

f Service adapter for connecting service interface FXA 193 (Fieldcheck, FieldCare)

g Signal cable: see Terminal assignment → 47

4.4 Potential equalization



Warning!
The measuring system must be included in potential equalization.

Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most Promag sensors have a reference electrode installed as standard, which guarantees the required potential equalization.

- The following must also be taken into account for potential equalization:
- Company-internal grounding guidelines
 - Operating conditions such as material/grounding of piping etc. (see table)

4.4.1 Potential equalization, Promag W, Promag P

Reference electrode available as standard

4.4.2 Potential equalization, Promag H

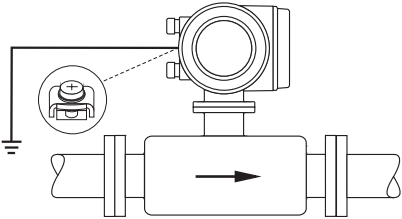
No reference electrode available!
There is always one electrical connection to the fluid via the metallic process connection.



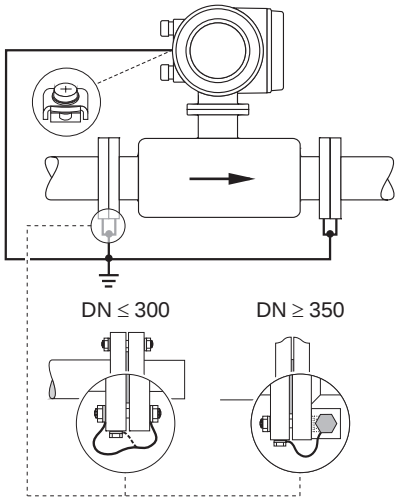
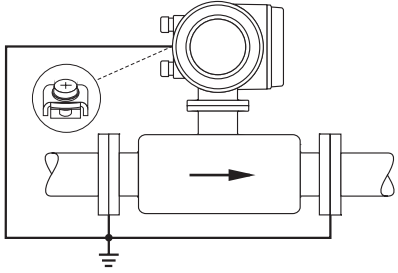
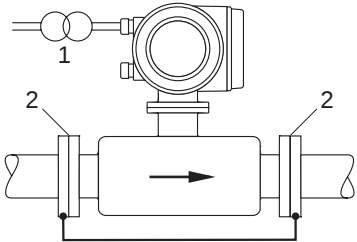
Caution!
When using process connections made of plastic, potential equalization must be guaranteed through the use of grounding rings → 33.
The necessary grounding rings may be ordered separately as an accessory from Endress+Hauser (→ 94).

4.4.3 Connection examples for potential equalization

Standard case

Operating conditions	Potential equalization
When using the measuring device in: ■ metallic, grounded piping Potential equalization is carried out via the ground terminal of the transmitter.  Note! For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping.	 AO011892 <i>Fig. 32: Via the transmitter's ground terminal</i>

Special cases

Operating conditions	Potential equalization
When using the measuring device in: ■ metallic, ungrounded piping This type of connection occurs when: ■ the usual potential equalization cannot be guaranteed ■ extremely high equalizing currents are expected A ground cable (copper wire, at least 6 mm² (0.0093 in²)) is used to connect both sensor flanges to the respective pipe flange and ground them. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. The installation of the ground cable depends on the nominal diameter: ■ DN ≤ 300 (12"): The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws. ■ DN ≥ 350 (14"): The ground cable connects directly to the metal transport bracket.  Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 A0011893 <i>Fig. 33: Via the transmitter's ground terminal and the pipe flanges</i>
When using the measuring device in: ■ Plastic pipes ■ Isolating lined pipes This type of connection occurs when: ■ the usual potential equalization cannot be guaranteed ■ extremely high equalizing currents are expected Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, min. 6 mm² (0.0093 in²)). When installing the ground disks, please comply with the enclosed Installation Instructions.	 A0011895 <i>Fig. 34: Via the transmitter's ground terminal and the optionally available ground disks</i>
When using the measuring device in: ■ pipes with cathodic protection The device is installed in the pipeline in such a way that it is potential-free. Using a ground cable (copper wire, min. 6 mm² (0.0093 in²)), only the two pipe flanges are connected. When doing so, the ground cable is mounted directly on the conductive flange coating using flange screws. Please note the following during installation: ■ The relevant regulations for potential-free installations must be observed. ■ There must not be an electrically conductive connection between the piping and the device. ■ The mounting material must be able to withstand the relevant torques.	 A0011896 <i>Fig. 35: Potential equalization and cathodic protection</i> 1 Isolation transformer power supply 2 Electrically isolated

4.5 Degree of protection

The devices fulfill all the requirements for IP 67 (NEMA 4X).

Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection (NEMA 4X) is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All housing screws and screw covers must be firmly tightened.
- The cables used for connection must be of the specified external diameter → 118.
- Tighten cable glands to prevent leakages.
- The cables must loop down before they enter the cable entries ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Close off unused cable entries using suitable insert plugs.
- Do not remove the grommet from the cable entry.

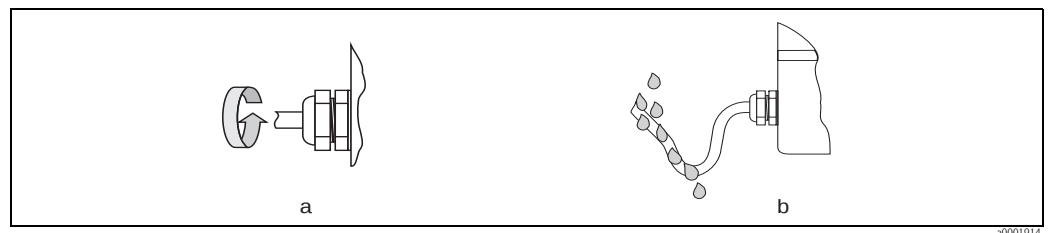


Fig. 36: Installation instructions, cable entries



Caution!

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



Note!

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

4.6 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	-
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85 to 260 V AC (45 to 65 Hz) 20 to 55 V AC (45 to 65 Hz) 16 to 62 V DC
Do the cables comply with the specifications?	→ 46
Do the cables have adequate strain relief?	-
Cables correctly segregated by type? Without loops and crossovers?	-
Are the power-supply and signal cables correctly connected?	See the wiring diagram inside the cover of the connection compartment
Are all screw terminals firmly tightened?	-
Have the measures for grounding/potential matching been correctly implemented?	→ 49
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 51
Are all housing covers installed and firmly tightened?	-
Fieldbus electrical connection	Notes
Has each fieldbus segment been terminated at both ends with a bus terminator?	→ 76
Has the max. length of the fieldbus cable been observed in accordance with the specifications?	→ 40
Has the max. length of the spurs been observed in accordance with the specifications?	→ 40
Is the fieldbus cable fully shielded and correctly grounded?	→ 41

5 Operation

5.1 Quick operation guide

You have a number of options for configuring and commissioning the device:

1. **Local display (option)** →  54
The local display enables you to read all important variables directly at the measuring point, configure bus-specific and device-specific parameters in the field and perform commissioning.
2. **Configuration programs** →  73
Operation via FieldCare.
The Proline flowmeters are accessed via the service interface or via the service interface FXA 193.
3. **Jumpers/miniature switches for hardware settings** →  74
You can make the following hardware settings using a jumper or miniature switches on the I/O board:
 - Address mode configuration (select software or hardware addressing)
 - Device bus address configuration (for hardware addressing)
 - Hardware write protection enabling/disabling



Note!

A description of the configuration of the current output (active/passive) and the relay output (NC contact/NO contact) can be found in the "Hardware settings" section. →  74

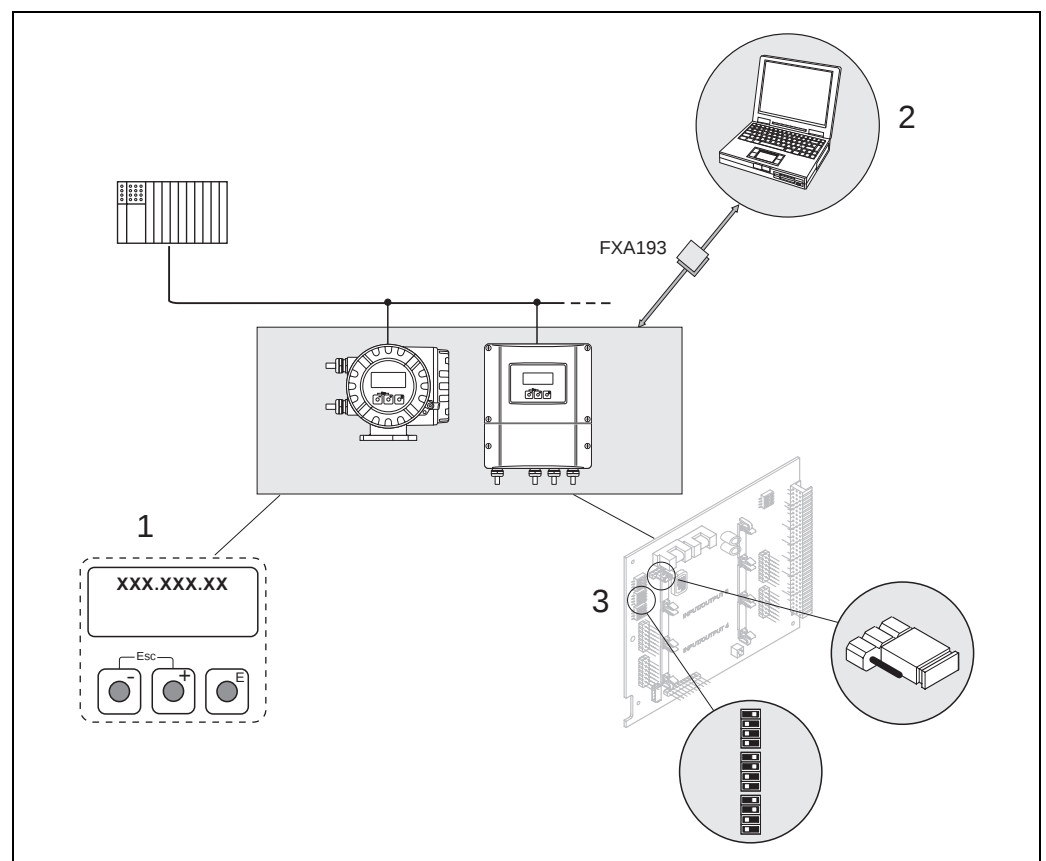


Fig. 37: Methods of operating MODBUS RS485 devices

- 1 Local display for device operation in the field (option)
- 2 Configuration/operating program for operating via the service interface FXA 193 (e.g. FieldCare)
- 3 Jumper/miniature switches for hardware settings (write protection, device address, address mode)

5.2 Local display

5.2.1 Display and operating elements

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

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

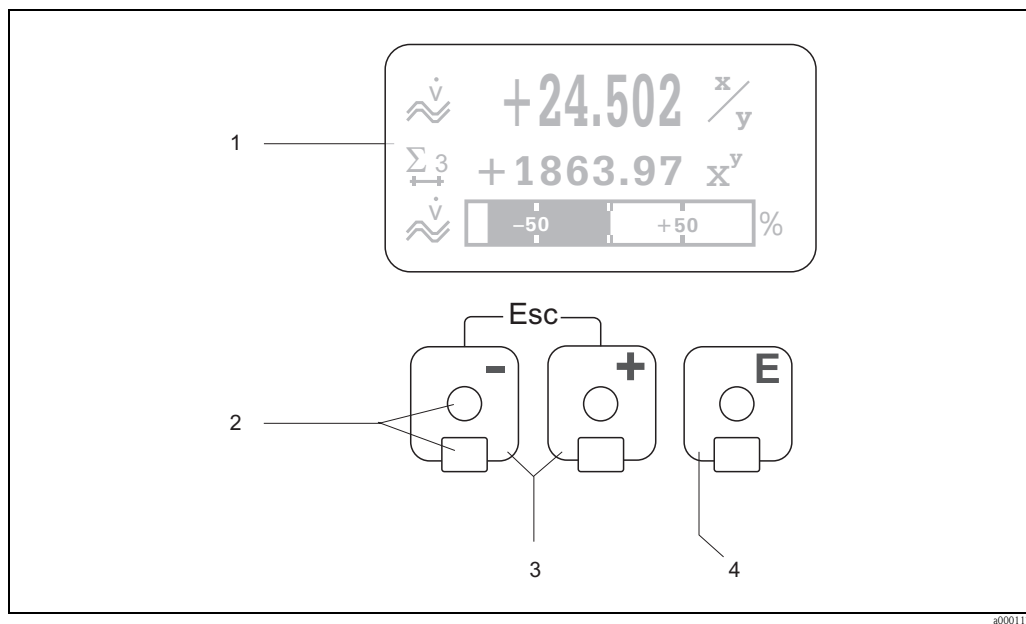


Fig. 38: Display and operating elements

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

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

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

5.2.2 Display (operating mode)

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

Multiplex mode:

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

Error messages:

Display and presentation of system/process errors → 60

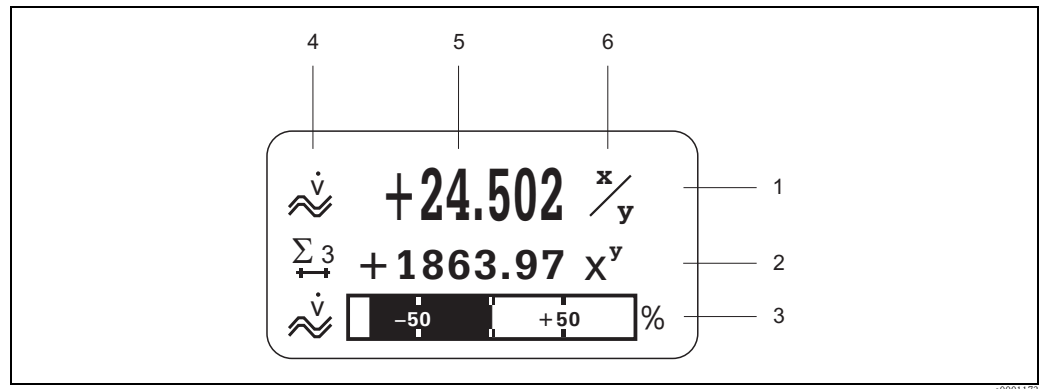


Fig. 39: Typical display for normal operating mode (HOME position)

- 1 Main line shows main measured values, e.g. flow
- 2 Supplementary line shows supplementary measured or status variables, e.g. totalizer reading.
- 3 Information line shows additional information on measured or status variables, e.g. bar graph representation of the full scale value attained by the flow rate
- 4 "Info icons" field shows additional information in the form of icons on the measured values displayed. A complete overview of all icons and their meaning can be found on → 56
- 5 "Measured values" field shows the current measured values
- 6 "Engineering unit" field shows the engineering units and time units defined for the current measured values.

5.2.3 Additional display functions

Depending on the order option (F-CHIP → 92), the local display has different display functions.

Device without batching software

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

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

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

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

Device with batching software

On measuring instruments with installed batching software (F-Chip → 92) and a suitably configured display line, you can carry out filling processes directly using the local display. You will find a detailed description on → 57.

5.2.4 Icons

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

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
I 1 to n	Current output 1 to n	P 1 to n	Pulse output 1 to n
F 1 to n	Frequency output 1 to n	S 1 to n	Status/relay output 1 to n (or status input)
Σ 1 to n	Totalizer 1 to n		
 a0001181	Measuring mode: PULSATING FLOW	 a0001182	Measuring mode: SYMMETRY (bidirectional)
 a0001183	Measuring mode: STANDARD	 a0001184	Counting mode totalizer: BALANCE (forward and reverse flow)
 a0001185	Counting mode totalizer: forward	 a0001186	Counting mode totalizer: reverse
 a0001187	Status input		
 a0001188	Volume flow	 a0001195	Mass flow
 a0001200	Fluid density		
 a0001201	Batching quantity upwards	 a0001202	Batching quantity downwards
 a0001203	Batching quantity	 a0001204	Batch sum
 a0001205	Batch counter (x times)	 a0001206	MODBUS communication active

5.2.5 Controlling the batching processes using the local display

Filling processes can be carried out directly by means of the local display with the aid of the optional "(Batching)" software package (F-CHIP, accessories → 94). Therefore, the device can be fully deployed in the field as a "batch controller".

Procedure:

1. Configure all the required batching functions and assign the lower display info line (= BATCHING KEYS) using the "Batch" Quick Setup menu (→ 85) or use the function matrix (→ 58).

The following "softkeys" then appear on the bottom line of the local display → 40:

- START = left display key (□)
- PRESET = middle display key (+)
- MATRIX = right display key (E)

2. Press the "PRESET (+)" key. Various batching process functions requiring configuration will now appear on the display:

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

3. After exiting the PRESET menu, you can now start the batching process by pressing "START (□)". New softkeys (STOP / HOLD or GO ON) now appear on the display. You can use these to interrupt, continue or stop the batching process at any time. → 40

STOP (□) → Stop batching process

HOLD (+) → Interrupts the batching process (softkey changes to "GO ON")

GO ON (+) → Continues the batching process (softkey changes to "HOLD")

After the batch quantity is reached, the "START" or "PRESET" softkeys reappear on the display.

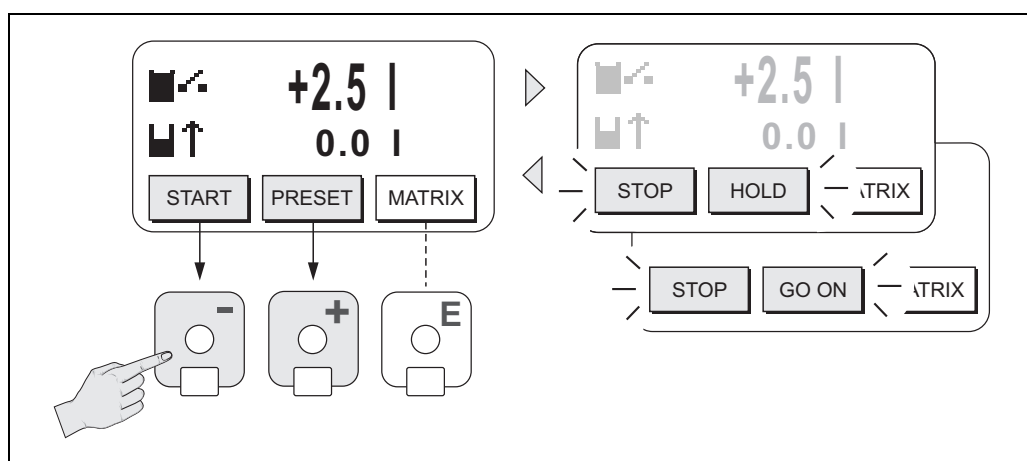


Fig. 40: Controlling batching processes using the local display (softkeys)

5.3 Brief operating instructions to the function matrix



Note!

- See the general notes → 59.
 - Function descriptions → see the "Description of Device Functions" manual
1. HOME position → **E** → Entry into the function matrix
 2. **+** / **-** → Select a block (e.g. OUTPUTS)
 3. **+** / **-** → Select a group (e.g. CURRENT OUTPUT 1)
 4. **+** / **-** → Select a function group (e.g. CONFIGURATION)
 5. Select a function (e.g. UNIT VOLUME FLOW) and change parameters/enter numerical values:
 - +** **-** → Select or enter release code, parameters, numerical values
 - E** → Save entries
 6. Exit the function matrix:
 - Press and hold down Esc key (**Esc**) for longer than 3 seconds → HOME position
 - Repeatedly press Esc key (**Esc**) → Return step by step to HOME position

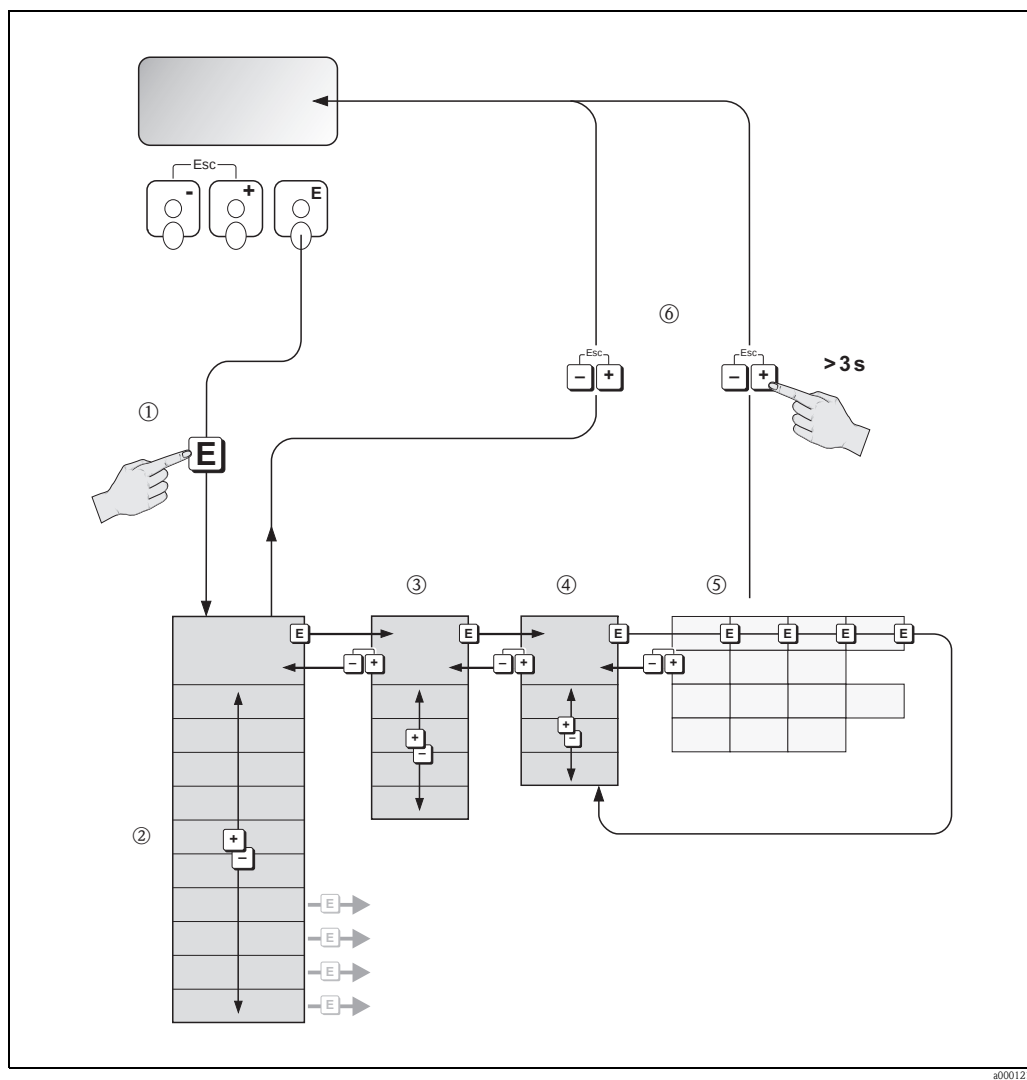


Fig. 41: Selecting functions and configuring parameters (function matrix)

5.3.1 General notes

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

Comply with the following instructions when configuring functions:

- You select functions as described →  58.
Each cell in the function matrix is identified by a numerical or letter code on the display.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press / 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.
- Programming mode is automatically disabled if you do not press a key within 60 seconds following automatic return to the HOME position.



Caution!

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



Note!

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

5.3.2 Enabling the programming mode

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

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

Comply with the following instructions when entering codes:

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



Caution!

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

5.3.3 Disabling the programming mode

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

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

5.4 Error messages

5.4.1 Type of error

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

The measuring system distinguishes between two types of error:

- **System errors:** This group comprises all device errors, e.g. communication errors, hardware errors, etc. → [97](#)
- **Process errors:** This group comprises all application errors, e.g. empty pipe, etc. → [102](#)

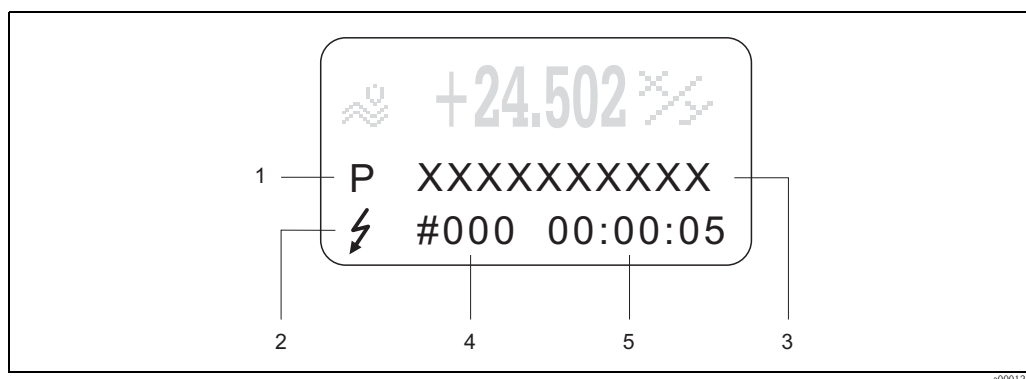


Fig. 42: Error messages on the display (example)

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

5.4.2 Error message type

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

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

Notice message (!)

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

Fault message (⚡)

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

The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix. → [105](#)



Note!

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

5.5 MODBUS RS485 communication

5.5.1 MODBUS RS485 technology

The MODBUS is an open, standardized fieldbus system which is deployed in the areas of manufacturing automation, process automation and building automation.

System architecture

The MODBUS RS485 is used to specify the functional characteristics of a serial fieldbus system with which distributed, digital automation systems are networked together. The MODBUS RS485 distinguishes between master and slave devices.

■ Master devices

Master devices determine the data traffic on the fieldbus system. They can send data without an external request.

■ Slave devices

Slave devices, like this measuring device, are peripheral devices. They do not have their own access rights to the data traffic of the fieldbus system and only send their data due to an external request from a master.

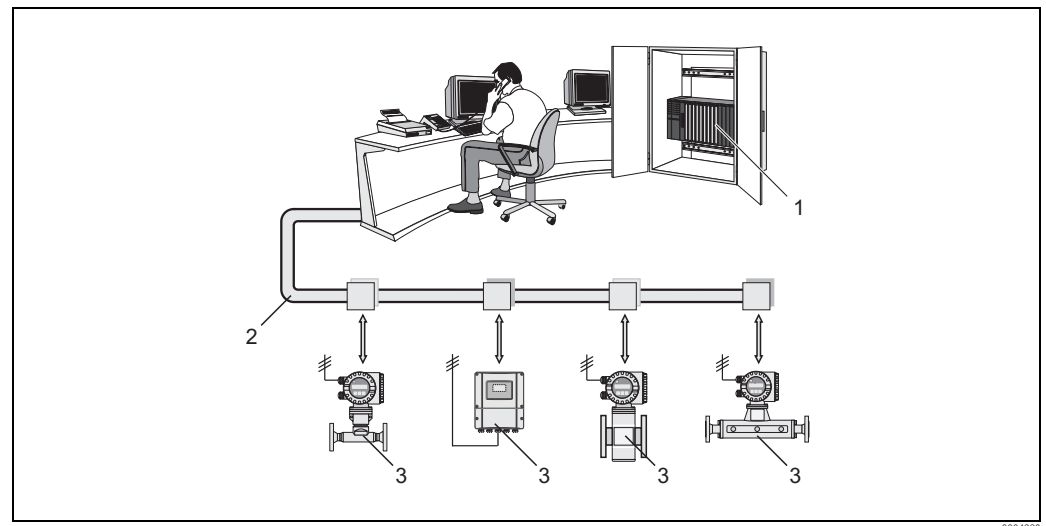


Fig. 43: MODBUS RS485 system architecture

- 1 MODBUS master (PLC, etc.)
- 2 MODBUS RS485
- 3 MODBUS slave (measuring devices, etc.)

Master/slave communication

A distinction is made between two methods of communication with regard to master/slave communication via MODBUS RS485:

■ Polling (request-response-transaction)

The master sends a request telegram to **one** slave and waits for the slave's response telegram. Here, the slave is contacted directly due to its unique bus address (1 to 247).

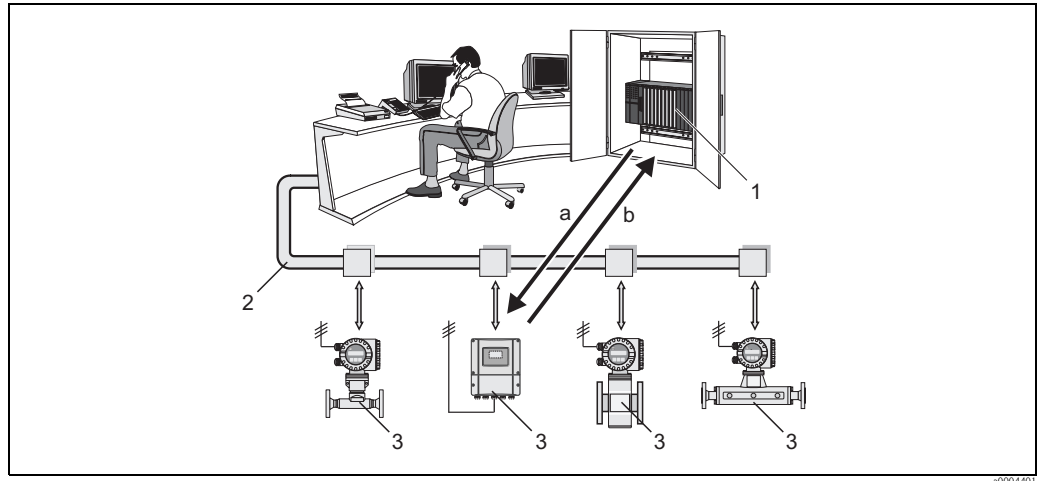


Fig. 44: MODBUS RS485 polling data traffic

- 1 MODBUS master (PLC, etc.)
- 2 MODBUS RS485
- 3 MODBUS slave (measuring devices, etc.)
- a Request telegram to this one specific MODBUS slave
- b Response telegram to the MODBUS master

■ Broadcast message

By means of the global address 0 (broadcast address), the master sends a command to all the slaves in the fieldbus system. The slaves execute the command without reporting back to the master. Broadcast messages are only permitted in conjunction with write function codes.

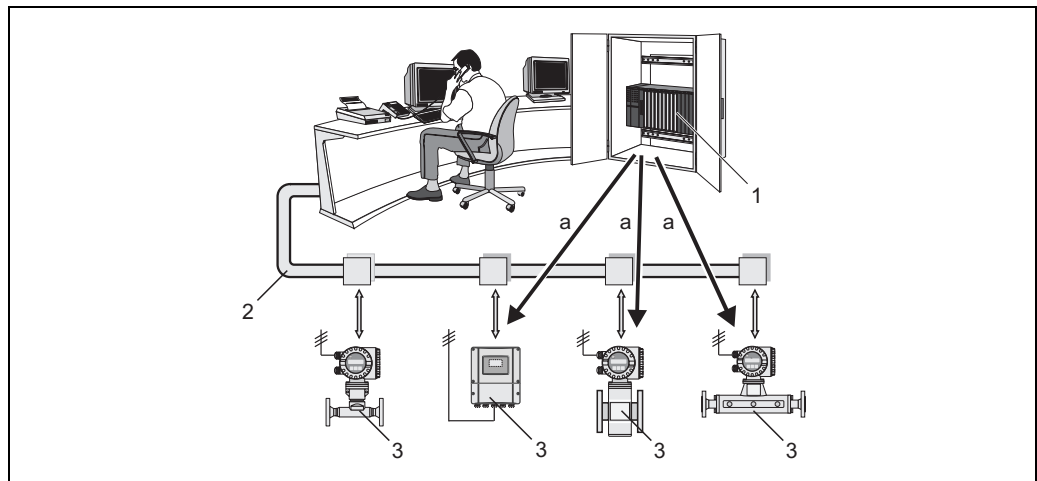


Fig. 45: MODBUS RS485 polling data traffic

- 1 MODBUS master (PLC, etc.)
- 2 MODBUS RS485
- 3 MODBUS slave (measuring devices, etc.)
- a Broadcast message command to all MODBUS slaves (request is executed without a response telegram to the master)

5.5.2 MODBUS telegram

General

The master-slave process is used for data exchange. Only the master can initiate data transmission. Following the prompt, the slave sends the master the necessary data as a response telegram or executes the command requested by the master.

Telegram structure

The data is transferred between the master and slave by means of a telegram. A request telegram from the master contains the following telegram fields:

Telegram structure:

Slave address	Function code	Data	Check sum
---------------	---------------	------	-----------

- Slave address

The slave address can be in an address range from 1 to 247.

The master talks to all the slaves simultaneously by means of the slave address 0 (broadcast message).

- Function code

The function code determines which read, write and test operations should be executed by means of the MODBUS protocol.

Function codes supported by the measuring device →  64

- Data

Depending on the function code, the following values are transmitted in this data field:

- Register start address (from which the data is transmitted)
- Number of registers
- Write/read data
- Data length
- etc.

- Check sum (CRC or LRC check)

The telegram check sum forms the end of the telegram.

The master can send another telegram to the slave as soon as it has received an answer to the previous telegram or once the time-out period set at the master has expired. This time-out period can be specified or modified by the user and depends on the slave response time.

If an error occurs during data transfer or if the slave cannot execute the command from the master, the slave returns an error telegram (exception response) to the master.

The slave response telegram consists of telegram fields which contain the requested data or which confirm that the action requested by the master has been executed. It also contains a check sum.

5.5.3 MODBUS function codes

The function code determines which read, write and test operations should be executed by means of the MODBUS protocol. The measuring device supports the following function codes:

Function code	Name in accordance with MODBUS specification	Description
03	READ HOLDING REGISTER	Reads one or more registers of the MODBUS slave. 1 to a maximum of 125 consecutive registers (1 register = 2 byte) can be read with a telegram. Application: For reading measuring device parameters with read and write access, such as reading the volume flow.
04	READ INPUT REGISTER	Reads one or more registers of the MODBUS slave. 1 to a maximum of 125 consecutive registers (1 register = 2 byte) can be read with a telegram. Application: For reading measuring device parameters with read access, such as reading the measured values (volume flow, totalizer value etc.).
06	WRITE SINGLE REGISTERS	Writes a slave register with a new value. Application: For writing just one measuring device parameter, such as writing the batch quantity or resetting the totalizer.  Note! Function code 16 is used for writing several registers by means of just one telegram.
08	DIAGNOSTICS	Checks the communication connection between the master and slave. The following "diagnostics codes" are supported: ■ Sub-function 00 = Return query data (loopback test) ■ Sub-function 02 = Return diagnostics register
16	WRITE MULTIPLE REGISTERS	Writes several slave registers with a new value. A maximum of 120 consecutive registers can be written with a telegram. Application: For writing several measuring device parameters, such as writing the batch quantity and resetting the totalizer.
23	READ/WRITE MULTIPLE REGISTERS	Simultaneous reading and writing of 1 to max. 118 registers in a telegram. Write access is executed before read access. Application: For writing and reading several measuring device parameters, such as writing the batch quantity and the compensation quantity and reading the totalizer value.



Note!

- Broadcast messages are only permitted with function codes 06, 16 and 23.
- The measuring device does not differentiate between function codes 03 and 04. These codes have the same result.

5.5.4 Maximum number of writes

If a nonvolatile device parameter is modified via the MODBUS function codes 06, 16 or 23, this change is saved in the EEPROM of the measuring device.

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

5.5.5 MODBUS register addresses

Each device parameter has its own register address. The MODBUS master uses this register address to talk to the individual device parameters and access the device data.
The register addresses of the individual device parameters can be found in the "Description of Device Functions" manual under the parameter description in question.

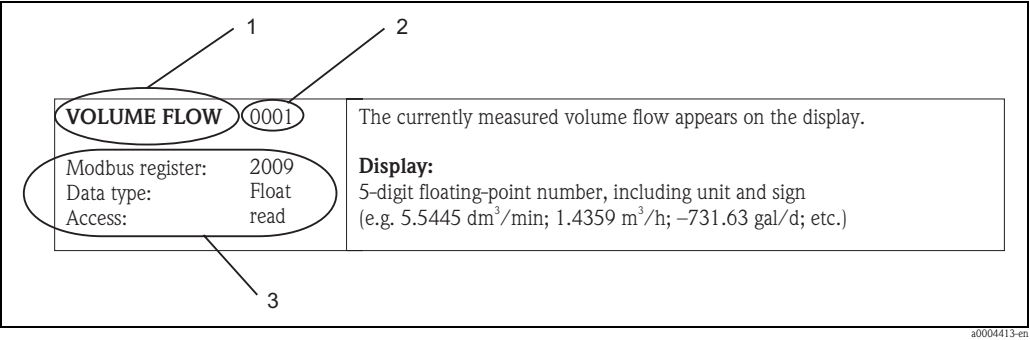


Fig. 46: Example of how a function description is illustrated in the "Description of Device Functions" manual

- 1 Name of the function
- 2 Number of the function (appears on the local display; is **not** identical to the MODBUS register address)
- 3 Information on communication via MODBUS RS485
 - MODBUS register (information in decimal numerical format)
 - Data type: Float, Integer, String
 - Possible ways of accessing the function:
 - read = read access via function codes 03, 04 or 23
 - write = write access via function codes 06, 16 or 23

MODBUS register address model

The MODBUS RS485 register addresses of the measuring device are implemented in accordance with "MODBUS Applications Protocol Specification V1.1".



Note!
In addition to the specification mentioned above, systems are also deployed which work with a register address model in accordance with the "Modicon MODBUS Protocol Reference Guide - (PI-MBUS-300 Rev. J)" specification. With this specification, the register address is extended, depending on the function code used. A "3" is put in front of the register address in the "read" access mode and a "4" in the "write" access mode.

Function code	Access type	Register in accordance with: "MODBUS Applications Protocol Specification"	Register in accordance with: "Modicon MODBUS Protocol Reference Guide"
03 04 23	Read	XXXX Example: volume flow = 2009	→ 3XXXX Example: volume flow = 32009
06 16 23	Write	XXXX Example: reset totalizer 1 = 2608	→ 4XXXX Example: reset totalizer 1 = 42608

Response times

The time it takes a measuring device to respond to a request telegram from the MODBUS master is typically 25 to 50 ms. If faster response times are needed for time-critical applications (e.g. batching applications), the "auto-scan buffer" is to be used.



Note!
It may take longer for a command to be executed in the device. The data is not updated until the command has been executed. Especially write commands are affected by this!

Data types

The following data types are supported by the measuring device:

■ **FLOAT** (floating-point numbers IEEE 754)

Data length = 4 bytes (2 registers)

Byte 3	Byte 2	Byte 1	Byte 0
SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM

S = sign

E = exponent

M = mantissa

■ **INTEGER**

Data length = 2 bytes (1 register)

Byte 1	Byte 0
Most significant byte (MSB)	Least significant byte (LSB)

■ **STRING**

Data length = depends on device parameter,

e.g. illustration of a device parameter with a data length = 18 bytes (9 registers):

Byte 17	Byte 16	...	Byte 1	Byte 0
Most significant byte (MSB)		...		Least significant byte (LSB)

Byte transmission sequence

Byte addressing, i.e. the transmission sequence of the bytes, is not specified in the MODBUS specification. For this reason, it is important to coordinate the addressing method between the master and slave during commissioning. This can be configured in the measuring device by means of the "BYTE SEQUENCE" parameter (see "Description of Device Functions" manual). Depending on the selection in the "BYTE SEQUENCE" parameter, the bytes are transmitted as follows:

Float

Selection	Sequence			
	1st	2nd	3rd	4th
1 - 0 - 3 - 2*	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM)
0 - 1 - 2 - 3	Byte 0 (MMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 2 (EMMMMMMM)	Byte 3 (SEEEEEEE)
2 - 3 - 0 - 1	Byte 2 (EMMMMMMM)	Byte 3 (SEEEEEEE)	Byte 0 (MMMMMMMM)	Byte 1 (MMMMMMMM)
3 - 2 - 1 - 0	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)

* = Factory setting

S = sign

E = exponent

M = mantissa

Integer

Selection	Sequence	
	1st	2nd
1 - 0 - 3 - 2 * 3 - 2 - 1 - 0	Byte 1 (MSB)	Byte 0 (LSB)
0 - 1 - 2 - 3 2 - 3 - 0 - 1	Byte 0 (LSB)	Byte 1 (MSB)

* = Factory setting

MSB = most significant byte

LSB = least significant byte

String

Illustration using the example of a device parameter with a data length of 18 bytes.

Selection	Sequence				
	1st	2nd	...	17th	18th
1 - 0 - 3 - 2 * 3 - 2 - 1 - 0	Byte 1	Byte 0 (LSB)	...	Byte 17 (MSB)	Byte 16
0 - 1 - 2 - 3 2 - 3 - 0 - 1	Byte 0 (LSB)	Byte 1	...	Byte 16	Byte 17 (MSB)

* = Factory setting

MSB = most significant byte

LSB = least significant byte

5.5.6 MODBUS error messages

If the MODBUS slave detects an error in the request telegram from the master, it sends a reply to the master in the form of an error message consisting of the slave address, function code, exception code and check sum. To indicate that this is an error message, the lead bit of the returned function code is used. The reason for the error is transmitted to the master by means of the exception code.

The following exception codes are supported by the measuring device:

Exception codes	Description
01	ILLEGAL_FUNCTION The function code sent by the master is not supported by the measuring device (slave).  Note! Description of the function codes supported by the measuring device →  64.
02	ILLEGAL_DATA_ADDRESS The register addressed by the master is not assigned (i.e. it does not exist) or the length of the requested data is too big.
03	ILLEGAL_DATA_VALUE ■ The master is attempting to write to a register which only allows read access. ■ The value that appears in the data field is not permitted, e.g. range limits exceeded or incorrect data format.
04	SLAVE DEVICE FAILURE The slave did not respond to the request telegram from the master or an error occurred when processing the request telegram.

5.5.7 MODBUS auto-scan buffer

Function description

The MODBUS master uses the request telegram to access the device parameters (data) of the measuring device. Depending on the function code, the master gains read or write access to a single device parameter or a group of consecutive device parameters. If the desired device parameters (registers) are not available as a group, the master has to send a request telegram to the slave for each parameter.

The measuring device has a special storage area, known as the auto-scan buffer, for grouping nonconsecutive device parameters. This can be used to flexibly group up to 16 device parameters (registers). The master can talk to this complete data block by means of just one request telegram.

Structure of the auto-scan buffer

The auto-scan buffer consists of two data records, the configuration area and the data area. In the configuration area, a list known as the scan list specifies which device parameters should be grouped. For this purpose, the corresponding register address, e.g. the register address 2009 for volume flow, is entered in the scan list. Up to 16 device parameters can be grouped.

The measuring device cyclically reads out the register addresses entered in the scan list and writes the associated device data to the data area (buffer). The request cycle runs automatically. The cycle starts again when the last entry in the scan list has been queried.

By means of MODBUS, the grouped device parameters in the data area can be read or written by the master with just one request telegram (register address 5051 to 5081).

Configuration of the scan list

During configuration, the MODBUS register addresses of the device parameters to be grouped must be entered in the scan list. The scan list can contain up to 16 entries. Float and Integer-type device parameters with read and write access are supported.

The scan list can be configured by means of:

1. The local display or a configuration program (e.g. FieldCare).
 The scan list is configured here by means of the function matrix:
 BASIC FUNCTION → MODBUS RS485 → SCAN LIST REG. 1 to SCAN LIST REG. 16

2. The MODBUS master.
Here, the scan list is configured via the register addresses 5001 to 5016.

No.	Scan list	
	MODBUS configuration Register address (data type = Integer)	Configuration via local operation / configuration program (BASIC FUNCTION → MODBUS RS485 →)
1	5001	SCAN LIST REG. 1
2	5002	SCAN LIST REG. 2
3	5003	SCAN LIST REG. 3
4	5004	SCAN LIST REG. 4
5	5005	SCAN LIST REG. 5
6	5006	SCAN LIST REG. 6
7	5007	SCAN LIST REG. 7
8	5008	SCAN LIST REG. 8
9	5009	SCAN LIST REG. 9
10	5010	SCAN LIST REG. 10
11	5011	SCAN LIST REG. 11
12	5012	SCAN LIST REG. 12
13	5013	SCAN LIST REG. 13
14	5014	SCAN LIST REG. 14
15	5015	SCAN LIST REG. 15
16	5016	SCAN LIST REG. 16

Access to data via MODBUS

The MODBUS master uses the register addresses 5051 to 5081 to access the data area of the auto-scan buffer. This data area contains the values of the device parameters defined in the scan list. For example, if the register 2009 was entered for volume flow in the scan list by means of the SCAN LIST REG. 1 function, the master can read out the current measured value of the volume flow in register 5051.

Data area				
Parameter value/Measured values		Access via MODBUS register address	Data type *	Access**
Value of scan list entry No. 1	→	5051	Integer / Float	Read/write
Value of scan list entry No. 2	→	5053	Integer / Float	Read/write
Value of scan list entry No. 3	→	5055	Integer / Float	Read/write
Value of scan list entry No. 4	→	5057	Integer / Float	Read/write
Value of scan list entry No. 5	→	5059	Integer / Float	Read/write
Value of scan list entry No. 6	→	5061	Integer / Float	Read/write
Value of scan list entry No. 7	→	5063	Integer / Float	Read/write
Value of scan list entry No. 8	→	5065	Integer / Float	Read/write
Value of scan list entry No. 9	→	5067	Integer / Float	Read/write
Value of scan list entry No. 10	→	5069	Integer / Float	Read/write
Value of scan list entry No. 11	→	5071	Integer / Float	Read/write
Value of scan list entry No. 12	→	5073	Integer / Float	Read/write
Value of scan list entry No. 13	→	5075	Integer / Float	Read/write
Value of scan list entry No. 14	→	5077	Integer / Float	Read/write
Value of scan list entry No. 15	→	5079	Integer / Float	Read/write
Value of scan list entry No. 16	→	5081	Integer / Float	Read/write
* The data type depends on the device parameter entered in the scan list				
** The data access depends on the device parameter entered in the scan list. If the device parameter entered supports read and write access, the parameter can also be accessed by means of the data area.				

Response time

The response time when accessing the data area (register addresses 5051 to 5081) is typically between 3 to 5 ms.



Note!

It may take longer for a command to be executed in the device. The data is not updated until the command has been executed. Especially write commands are affected by this!

Example

The following device parameters should be grouped via the auto-scan buffer and read out by the master with just one request telegram:

- Volume flow → Register address 2009
- Totalizer 1 → Register address 2610
- Actual system condition → Register address 6859

1. Configuration of the scan list

- With the local operation or a configuration program (via the function matrix):
 BASIC FUNCTION block → MODBUS RS485 function group → SCAN LIST REG. function
 → Entry of the address 2009 under SCAN LIST REG. 1
 → Entry of the address 2610 under SCAN LIST REG. 2
 → Entry of the address 6859 under SCAN LIST REG. 3
- Via the MODBUS master (the register addresses of the device parameters are written to the registers 5001 to 5003 via MODBUS):
 1. Write address 2009 (volume flow) to register 5001
 2. Write address 2610 (totalizer 1) to register 5002
 3. Write address 6859 (actual system condition) to register 5003

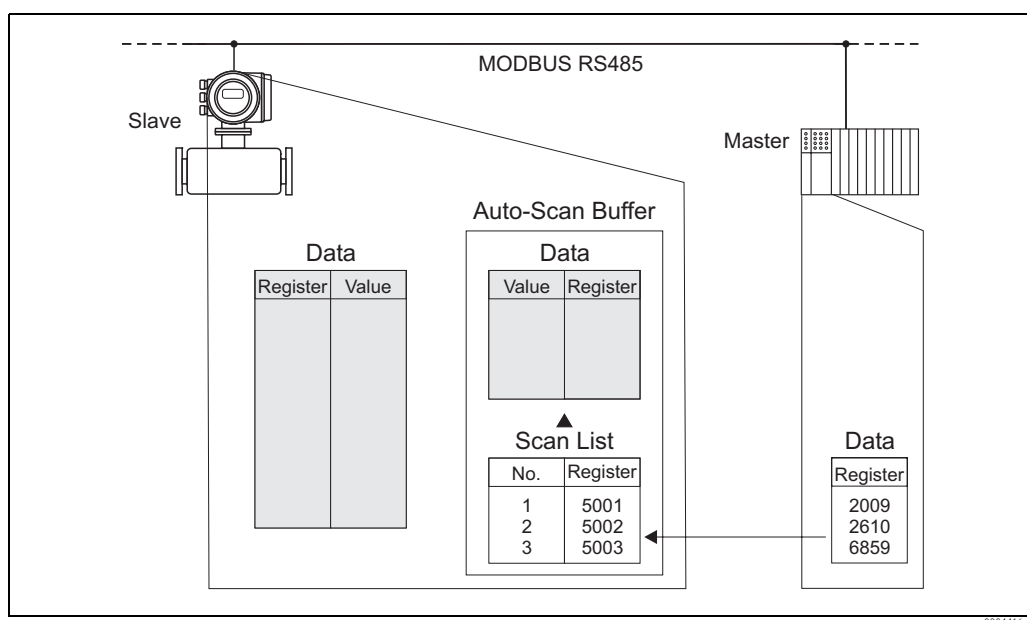


Fig. 47: Configuration of the scan list via the MODBUS master

2. Access to data via MODBUS

By specifying the register start address 5051 and the number of registers, the MODBUS master can read out the measured values with just one request telegram.

Data area			
Access via MODBUS register address	Measured values	Data type	Access
5051	Volume flow = 4567.67	Float	Read
5053	Totalizer 1 = 56345.6	Float	Read
5055	Actual system condition = 1 (system ok)	Integer	Read

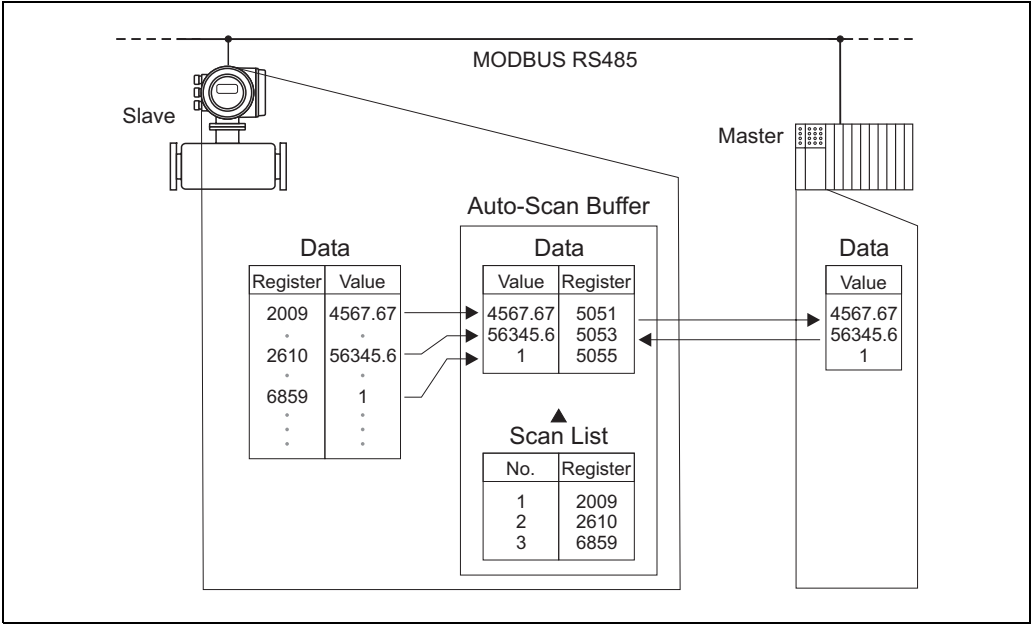


Fig. 48: With just one request telegram, the MODBUS master reads out the measured values via the auto-scan buffer of the measuring device.

5.6 Operating options

5.6.1 FieldCare

Fieldcare is Endress+Hauser's FDT-based plant Asset Management Tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA193.

5.6.2 Device drivers for operating programs

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

Operation via service protocol:

Valid for device software: 3.04.XX Software release: 07.2009		→ "DEVICE SOFTWARE" function (8100)
Operating program/Device driver:	How to acquire:	
FieldCare / DTM	■ www.endress.com → Download ■ CD-ROM (Endress+Hauser order number 56004088) ■ DVD (Endress+Hauser order number 70100690)	

Tester/simulator:

Device:	How to acquire:
Fieldcheck	Update via FieldCare using the Flow Device FXA193/291 DTM in the Fieldflash module



Note!

The Fieldcheck tester/simulator is used for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.

5.7 Hardware settings

5.7.1 Hardware write protection, switching on and off

A jumper on the I/O board provides the means of switching hardware write protection on or off. When the write protection is switched on, it is **not** possible to write to the device parameters via MODBUS RS485.



Warning!

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

1. Switch off power supply.
2. Remove the I/O board → 108
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

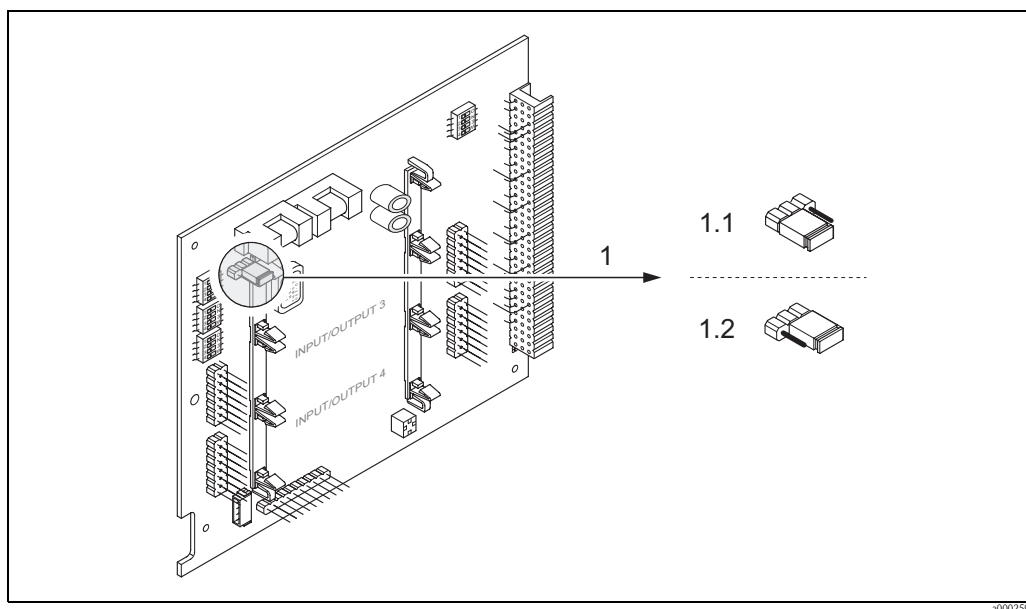


Fig. 49: Switching write protection on and off with the aid of a jumper on the I/O board

- 1 Jumper for switching write protection on and off
- 1.1 Write protection switched on = it is **not** possible to write to the device parameters via MODBUS RS485
- 1.2 Write protection switched off (factory setting) = it is possible to write to the device parameters via MODBUS RS485

5.7.2 Configuring the device address

The device address must always be configured for a MODBUS slave. The valid device addresses are in a range from 1 to 247. In a MODBUS RS485 network, each address can only be assigned once. If an address is not configured correctly, the device is not recognized by the MODBUS master. All measuring devices are delivered from the factory with the device address 247 and with the "software addressing" address mode.

Addressing via local operation

More detailed explanations for addressing the measuring device via the local display → 88

Addressing via miniature switches



Warning!

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

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

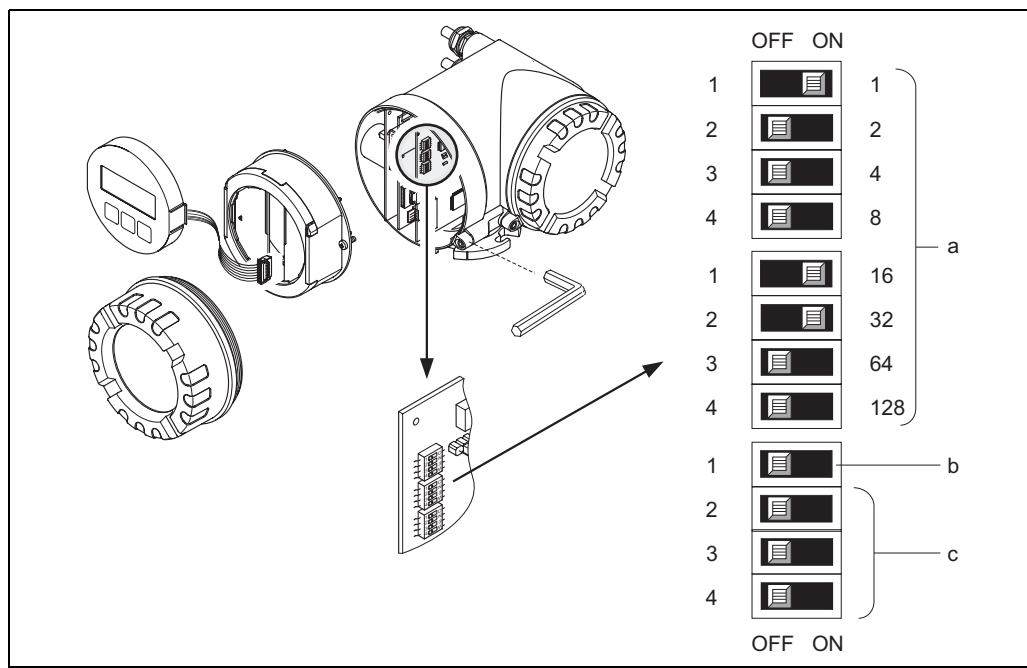


Fig. 50: Addressing with the aid of miniature switches on the I/O board

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

5.7.3 Configuring the terminating resistors

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



Warning!

Risk of electric shock. Exposed components carry dangerous voltages.

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

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

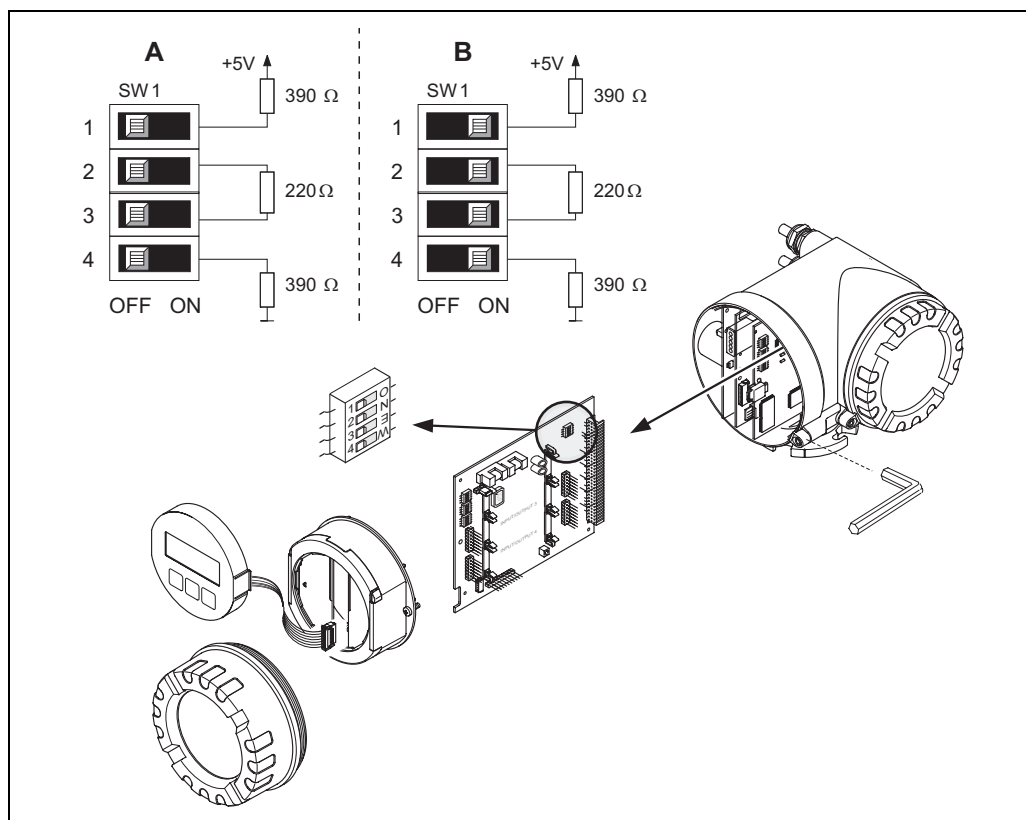


Fig. 51: Configuring the terminating resistors

A = Factory setting

B = Setting at the last transmitter



Note!

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

5.7.4 Current output configuration

The current output is configured as "active" or "passive" by means of various jumpers on the current submodule.



Warning!

Risk of electric shock. Exposed components carry dangerous voltages.

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

1. Switch off power supply.
2. Remove the I/O board. → 108
3. Position the jumpers (see Figure).



Caution!

Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagram.

Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.

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

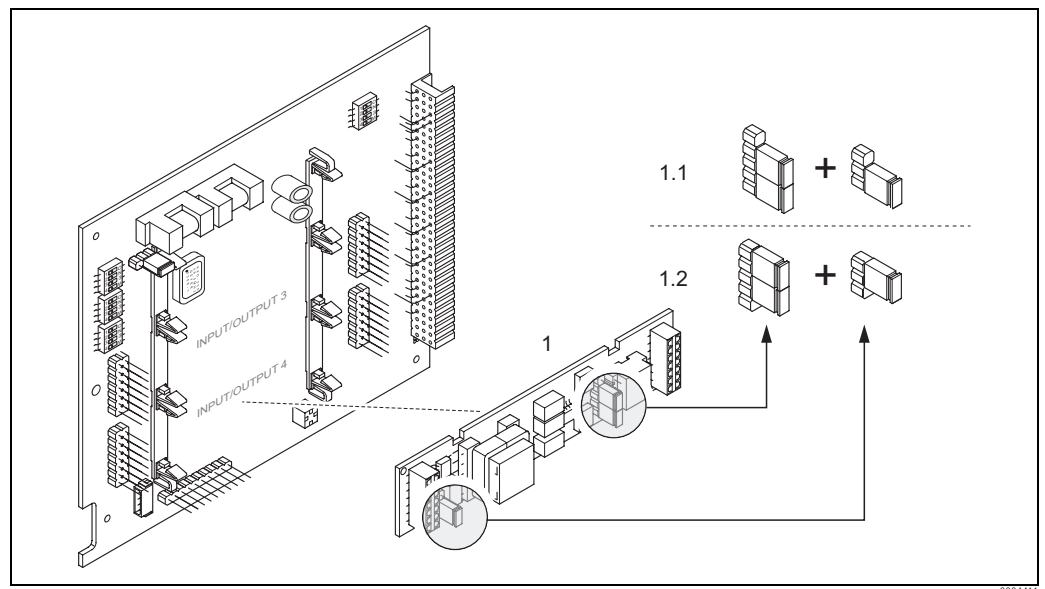


Fig. 52: Configuring the current input with the aid of jumpers (I/O board)

- 1 Current output
- 1.1 Active current output (factory setting)
- 1.2 Passive current output

5.7.5 Relay output configuration

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



Warning!

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

1. Switch off power supply.
2. Remove the I/O board. → 108
3. Position the jumpers (see Figure).



Caution!

If you change the setting you must always change the positions of **both** jumpers. Note precisely the specified positions of the jumpers.

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

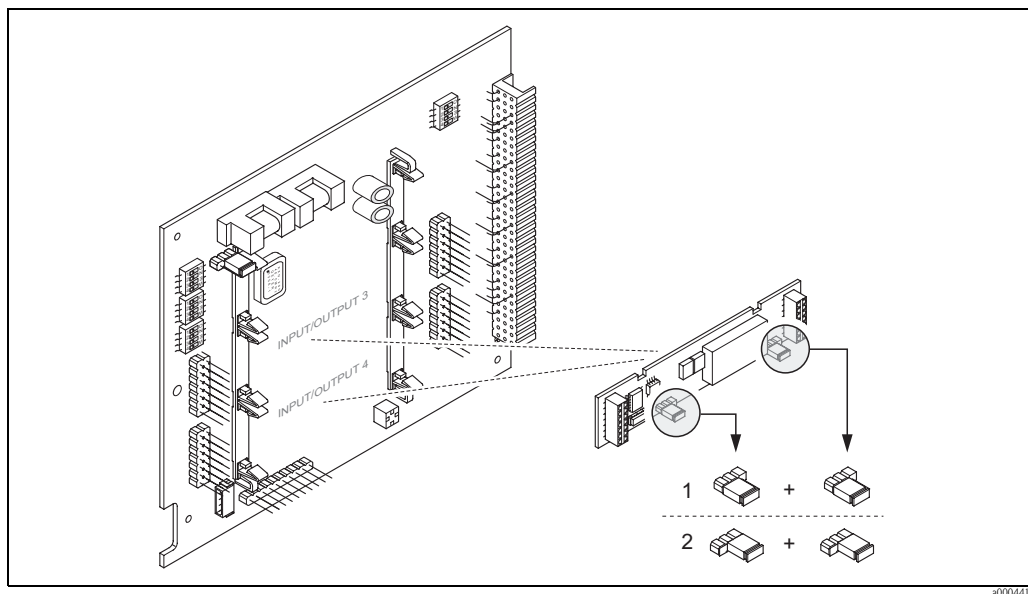


Fig. 53: Configuring relay contacts (NC / NO) on the convertible I/O board (submodule) with the help of jumpers.

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

6 Commissioning

6.1 Function check

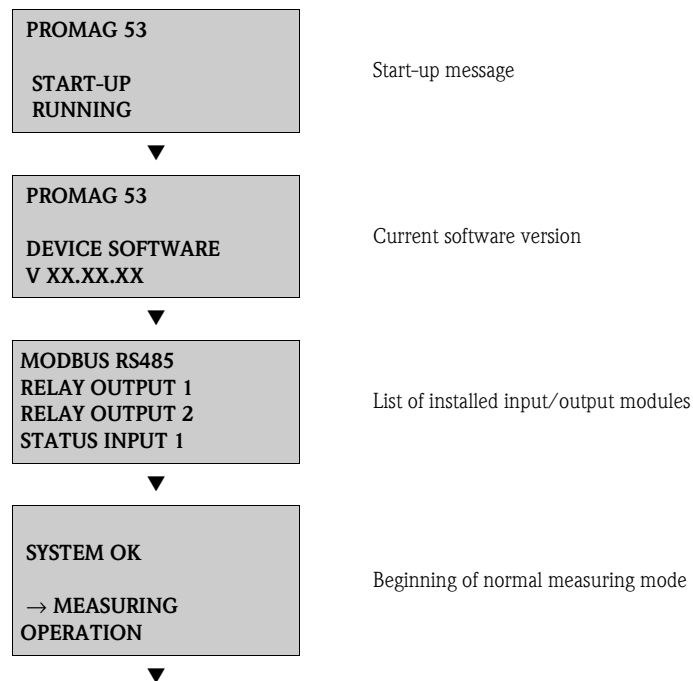
Make sure that all final checks have been completed before you start up your measuring point:

- Checklist for "Post-installation check" →  39
- Checklist for "Post-connection check" →  52

6.2 Switching on the measuring device

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

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



Normal measuring mode commences as soon as startup completes.

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



Note!

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

6.3 Quick Setup

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

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

6.3.1 Quick Setup "Commissioning"



Note!

- The display returns to the cell SETUP COMMISSIONING (1002) if you press the ESC key combination during parameter interrogation. The stored parameters remain valid.
 - The "Commissioning" Quick Setup must be carried out before one of the other Quick Setups described in these Operating Instructions is run.
- ① The DELIVERY SETTINGS option sets each selected unit to the factory setting.
The ACT.SETTING option accepts the units previously set by you.
 - ② Only units not yet configured in the current Setup are offered for selection in each cycle. The unit for mass and volume is derived from the corresponding flow unit.
 - ③ The "YES" option remains visible until all the units have been configured.
"NO" is the only option displayed when no further units are available.
 - ④ This prompt only appears if a current output and/or pulse/frequency output is available. Only the outputs not yet configured in the current Setup are offered for selection in each cycle.
 - ⑤ The "YES" option remains visible until all the outputs have been parameterized.
"NO" is the only option displayed when no further outputs are available.
 - ⑥ The "automatic parameterization of the display" option contains the following basic settings/factory settings

YES	Main line = volume flow Additional line = totalizer 1 Information line = operating/system condition
NO	The existing (selected) settings remain.
 - ⑦ The BATCHING QUICK SETUP is only available when the optional software package BATCHING is installed.
 - ⑧ The PULSATING FLOW QUICK SETUP is only available if the device has a current output or a pulse/frequency output.

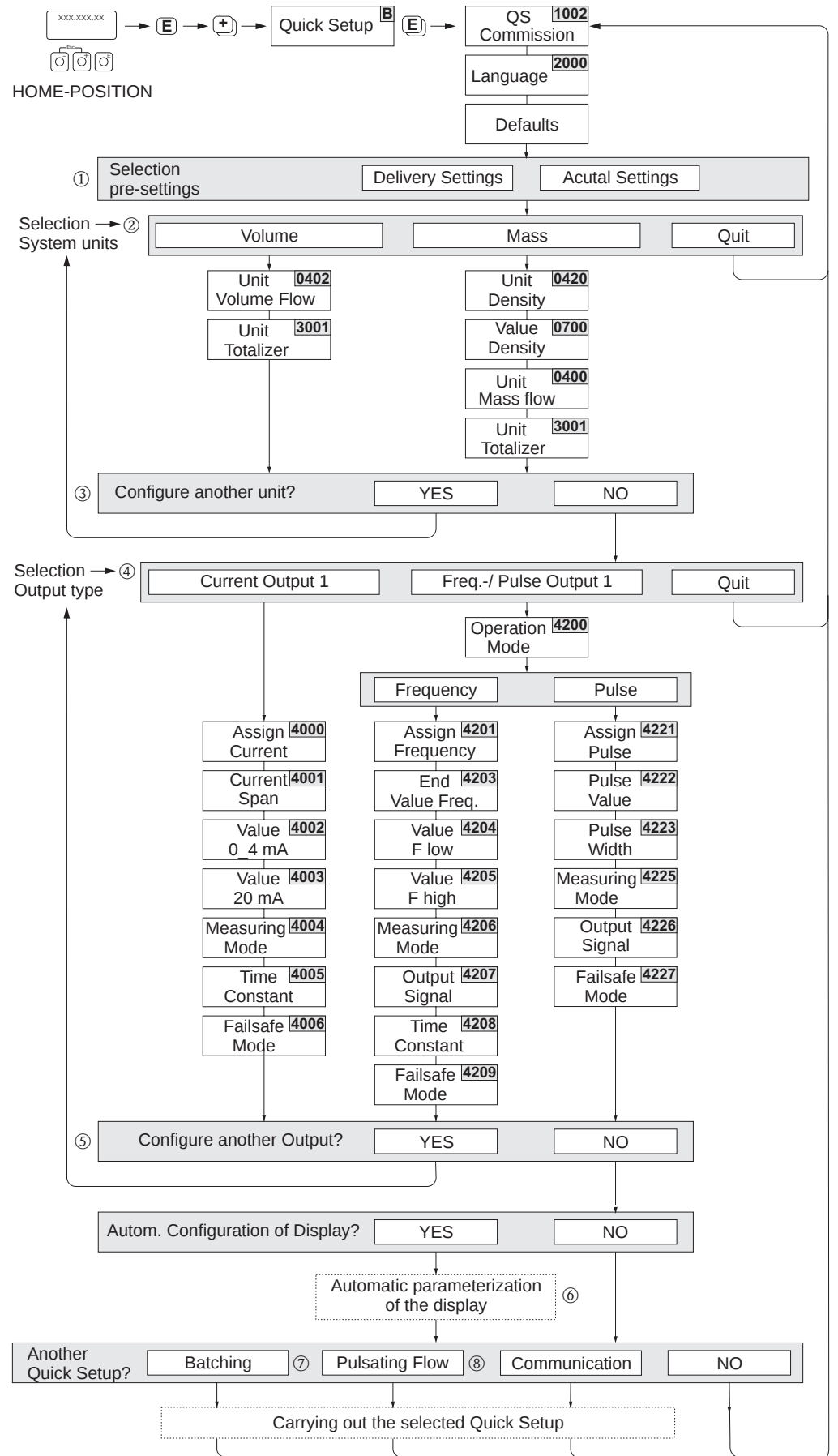


Fig. 54: Quick Setup for fast commissioning

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6.3.2 Quick Setup "Pulsating Flow"



Note!

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

Certain types of pump such as reciprocating, peristaltic and cam-type pumps, for example, create a flow characterized by severe periodic fluctuations. Negative flows can occur with pumps of these types on account of the closing volume of the valves or valve leaks.



Note!

Before carrying out the Quick Setup "Pulsating Flow" the Quick Setup "Commissioning" has to be executed. → 80

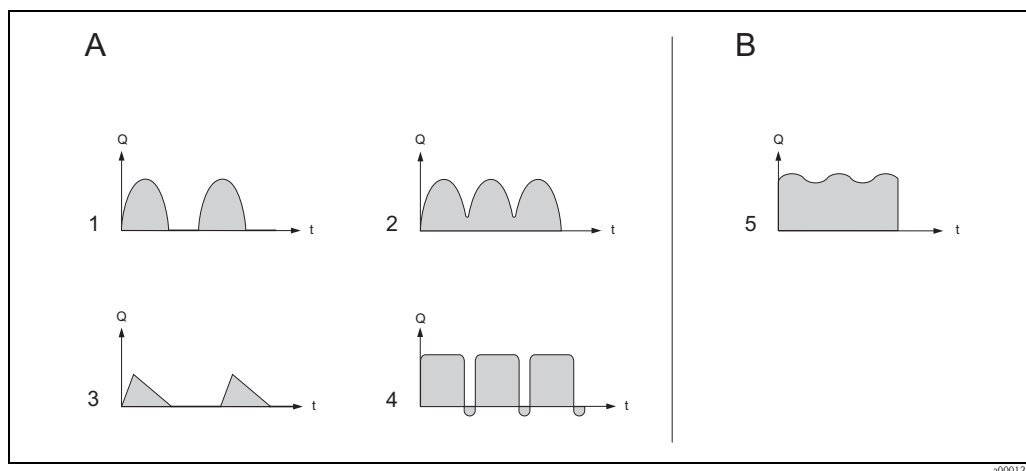


Fig. 55: Flow characteristics of various types of pump

A With severely pulsating flow

B With low pulsating flow

1 1-cylinder cam pump

2 2-cylinder cam pump

3 Magnetic pump

4 Peristaltic pump, flexible connecting hose

5 Multi-cylinder reciprocating pump

Severely pulsating flow

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



Note!

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

Slightly pulsating flow

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

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

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

Performing the "Pulsating flow" Quick Setup

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

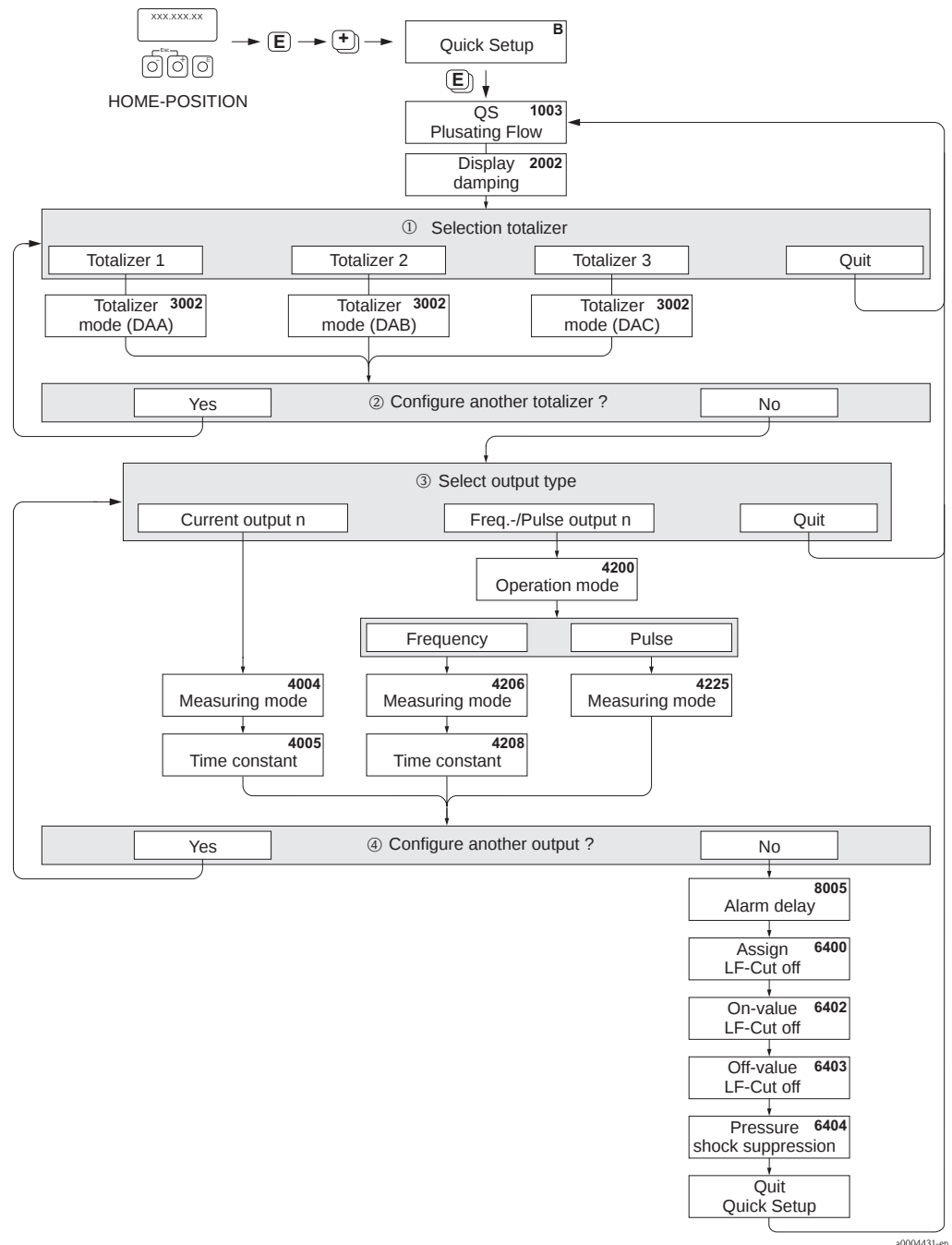


Fig. 56: Quick Setup for measuring severely pulsating flows. Recommended settings see next page.

- ① Only totalizers not yet configured in the current Setup are offered for selection in each cycle.
- ② The "YES" option remains visible until all the totalizers have been configured. "NO" is the only option displayed when no further totalizers are available.
- ③ Only the output not yet configured in the current Setup is offered for selection in the second cycle.
- ④ The "YES" option remains visible until both outputs have been parameterized. "NO" is the only option displayed when no further outputs are available.

**Note!**

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

Quick Setup "Pulsating Flow"		
HOME position → → MEASURAND → → QUICK SETUP → → QS PULSATING FLOW (1003)		
Function No.	Function name	Selection with To the next function with
1003	QS PULS. FLOW	YES After is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.



Basic configuration		
2002	DISPLAY DAMPING	3 s
3002	TOTALIZER MODE (DAA)	BALANCE (Totalizer 1)
3002	TOTALIZER MODE (DAB)	BALANCE (Totalizer 2)
3002	TOTALIZER MODE (DAC)	BALANCE (Totalizer 3)
Signal type for "CURRENT OUTPUT"		
4004	MEASURING MODE	PULS. FLOW
4005	TIME CONSTANT	3 s
Signal type for "FREQ./PULSE OUTPUT" (for FREQUENCY operating mode)		
4206	MEASURING MODE	PULS. FLOW
4208	TIME CONSTANT	0 s
Signal type for "FREQ./PULSE OUTPUT" (for PULSE operating mode)		
4225	MEASURING MODE	PULS. FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LOW FLOW CUT OFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUT OFF	Recommended setting: On-value $\approx \frac{\text{max. full scale (per DN)}^*}{1000}$ *Full scale values → 18 a0004432-en
6403	OFF-VALUE LOW FLOW CUT OFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s



Back to the HOME position:

- Press and hold down the key for longer than three seconds or
- Repeatedly press and release the key → Exit the function matrix step by step

6.3.3 Quick Setup "Batching"



Note!

This function is only available when the additional "batching" software is installed in the measuring device (order option). You can order this software from Endress+Hauser as an accessory at a later date. → 94

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

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



Caution!

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

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

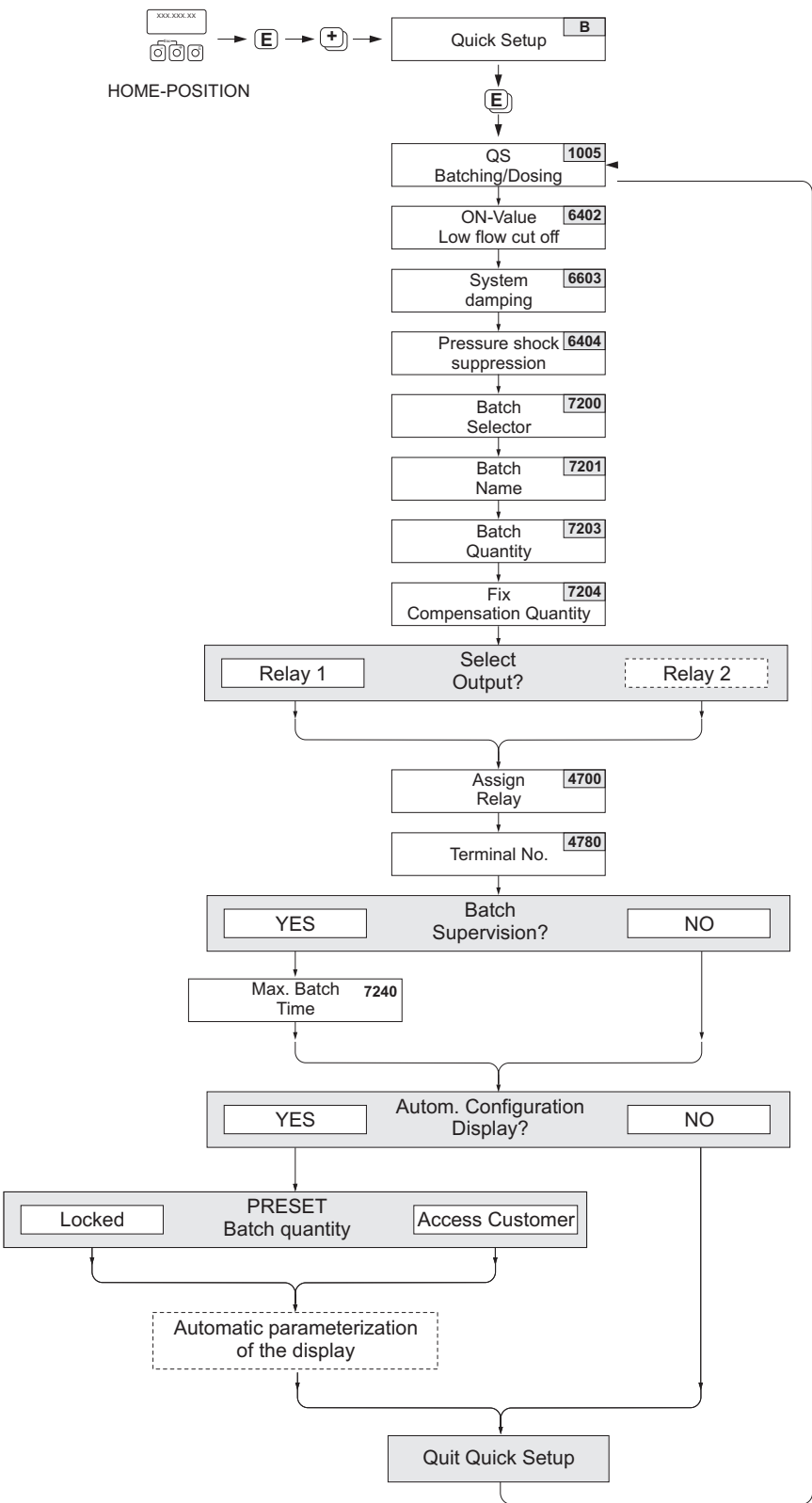


Note!

- Before carrying out the Quick Setup "Batching" the Quick Setup "Commissioning" has to be executed. → 80
- You can find detailed information on the batching functions in the separate "Description of Device Functions" manual.
- You can also directly control filling process using the local display. During Quick Setup, an appropriate dialog appears concerning the automatic display configuration. Acknowledge this by clicking "YES".

This assigns special batching functions (START, PRESET, etc.) to the bottom line of the display. These can be directly executed on-site using the three operating keys (/ /). Therefore, the measuring device can be fully deployed in the field as a "batch controller". → 57

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



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Fig. 57: Quick Setup "Batching". Recommended settings see next page.

Recommended settings

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



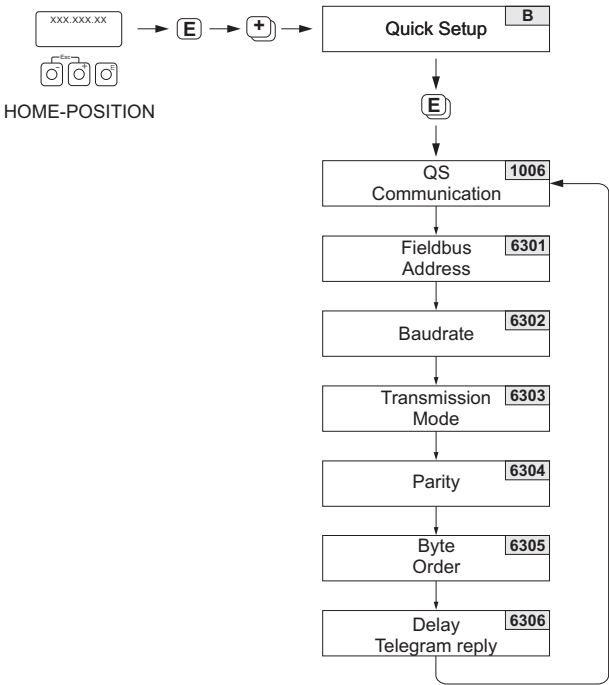
 Note! Some of the functions listed below (with a gray background) are configured automatically, i.e. by the measuring system.		
6400	ASSIGN LOW FLOW CUT OFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUT OFF	The recommended setting can be found on →  84 in Function No. 6402.
6403	OFF-VALUE LOW FLOW CUT OFF	50%
6603	SYSTEM DAMPING	9  Note! The parameter has to be optimized for highly accurate and short filling processes: to do this, put the setting to "0".
6404	PRESSURE SHOCK SUPPRESSION	0 s
7200	BATCH SELECTOR	BATCH #1
7201	BATCH NAME	BATCH #1
7202	ASSIGN BATCH VARIABLE	VOLUME
7203	BATCH QUANTITY	0
7204	FIX COMPENSATION QUANTITY	0
7208	BATCH STAGES	1
7209	INPUT FORMAT	Value input
4700	ASSIGN RELAY	BATCHING VALVE 1
4780	TERMINAL NUMBER	Output (display only)
7220	OPEN VALVE 1	0% or 0 [unit]
7240	MAXIMUM BATCH TIME	0 s (= switched off)
7241	MINIMUM BATCH QUANTITY	0
7242	MAXIMUM BATCH QUANTITY	0
2200	ASSIGN (Main line)	BATCH NAME
2220	ASSIGN (Multiplex main line)	Off
2400	ASSIGN (Additional line)	BATCH DOWNWARDS
2420	ASSIGN (Multiplex additional line)	Off
2600	ASSIGN (Information line)	BATCHING KEYS
2620	ASSIGN (Multiplex information line)	Off



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

6.3.4 Quick Setup "Communication"

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



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Fig. 58: Quick Setup communication

Quick Setup "Communication"		
HOME position → → MEASURAND → → QUICK SETUP → → QUICK SETUP COMMUNICATION		
Function No.	Function name	Setting to be selected () (to the next function with)
1006	QS-COMMUNICATION	YES → After is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
6301	FIELDBUS ADDRESS	Enter the device address (permitted address range: 1 to 247) Factory setting: 247
6302	BAUDRATE	Supported baudrates [BAUD]: 1200/2400/4800/9600/19200/38400/57600/115200 Factory setting: 19200 BAUD
6303	TRANSMISSION MODE	Select the data transfer mode: ■ ASCII → Data transmission in the form of readable ASCII characters. Error protection via LRC. ■ RTU → Data transmission in binary form. Error protection via CRC16. Factory setting: RTU

Quick Setup "Communication"		
6304	PARITY	Selection depends on the "TRANSMISSION MODE" function: NONE; EVEN; ODD ■ Available in the ASCII transfer mode → even or uneven parity bit (EVEN, ODD). ■ Available in the RTU transfer mode → no parity bit (NONE) or even or uneven parity bit (EVEN, ODD). Factory setting: EVEN
6305	BYTE ORDER	For selecting the byte transmission sequence for the Integer, Float and String data types: 0 - 1 - 2 - 3 3 - 2 - 1 - 0 2 - 3 - 0 - 1 1 - 0 - 3 - 2 Factory setting: 1 - 0 - 3 - 2  Note! The transmission sequence must suit the MODBUS master.
6306	DELAY TELEGRAM REPLY	For entering a delay time after which the measuring device replies to the request telegram of the MODBUS master. This allows communication to be adapted to slow MODBUS masters: 0 to 100 ms Factory setting: 10 ms
Back to the HOME position: → Press and hold down the  key for longer than three seconds or → Repeatedly press and release the  key = Exit the function matrix step by step		

**Note!**

The parameters described in the table can be found in the "MODBUS RS485" group of the "BASIC FUNCTION" block in the function matrix (see separate "Description of Device Functions" manual).

6.3.5 Data backup/transmission

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

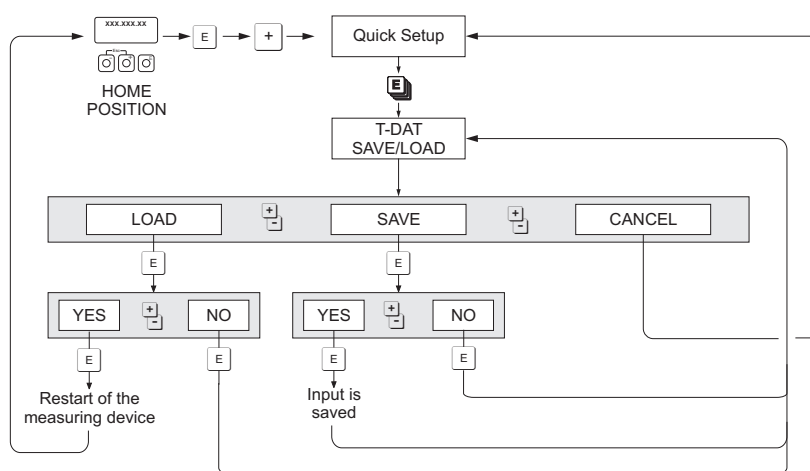
This is required in the following instances:

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



Note!

For information on installing and removing the T-DAT → 107



a0001221-en

Fig. 59: Data backup/transmission with T-DAT SAVE/LOAD function

Information on the LOAD and SAVE options available:

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



Note!

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

SAVE:

Data are transferred from the EEPROM to the T-DAT

6.4 Adjustment

6.4.1 Empty-pipe/Full-pipe adjustment

Flow cannot be measured correctly unless the measuring pipe is completely full. This status can be monitored at all times with the Empty Pipe Detection function:

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



Caution!

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

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



Note!

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

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

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



Caution!

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

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

6.5 Data memory

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

6.5.1 HistoROM/S-DAT (sensor-DAT)

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

6.5.2 HistoROM/T-DAT (transmitter-DAT)

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

Storing of specific parameter settings from the device memory (EEPROM) to the T-DAT module and vice versa has to be carried out by the user (= manual save function). Detailed information about the procedure →  90

6.5.3 F-CHIP (Function-Chip)

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

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

Accessories →  94

Plugging on to the I/O board →  107



Caution!

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

7 Maintenance

No special maintenance work is required.

7.1 Exterior cleaning

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

7.2 Seals

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

Replacement seals (accessories) →  94

8 Accessories

Various which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Detailed information about the concerned can be obtained from your Endress+Hauser service organization.

8.1 Device-specific accessories

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

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for Promag 53 transmitter	Mounting kit for wall-mounted housing (remote version). Suitable for: ■ Wall mounting ■ Pipe mounting ■ Panel mounting Mounting set for aluminum housings. Suitable for: ■ Pipe mounting	DK5WM – *
Cable for remote version	Coil and signal cables, various lengths. Reinforced cable on request.	DK5CA – * *
Ground cable for Promag W/P	A set consists of two ground cables.	DK5GC – * * *
Ground disk for Promag W/P	Ground disk for potential matching	DK5GD * * *
Mounting kit for Promag H	Mounting kit for Promag H, comprising: – 2 process connections – Screws – Seals	DKH * * – * * * *
Adapter connection for Promag A, H	Adapter connections for installing Promag 53 H instead of Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA – * * * * *
Ground rings for Promag H	If the process connections are made of PVC or PVDF, ground rings are necessary to ensure that potential is matched. A set comprises 2 ground rings.	DK5HR – * * * *
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – * * *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor.	DK5HM – * *
Welding jig for Promag H	Weld nipples as process connection: Welding jig for installation in pipes.	DK5HW – * * *

8.3 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 – *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant Asset Management Tool. It can configure all the intelligent field units in your system and helps you manage these units. By providing status information, it is also a simple but effective method of controlling the units' status.	See the product page on the Endress+Hauser website: www.endress.com
FXA193	The FXA193 service interface connects the device to the PC for configuration via FieldCare.	FXA193 – *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick. Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.	RSG40-*****

9 Troubleshooting

9.1 Troubleshooting instructions

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

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → Terminals 1, 2 2. Check device fuse → 112 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC and 16 to 62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 107
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → 107 2. Display module defective → order spare parts → 107 3. Measuring electronics defective → order spare parts → 107
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the   keys and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective → order spare parts → 107



Error messages on display	
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Type of error: S = system error, P = process error – Error message type:  = fault message, ! = notice message – EMPTY PIPE = Type of error, e.g. measuring tube is only partly filled or completely empty – 03:00:05 = Duration of error occurrence (in hours, minutes and seconds) – #401 = error number  Caution! ■ See the information on → 60. ■ 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 → 97
Error number: No. 401 - 499	Process error (application error) has occurred → 102



Other error (without error message)	
Other errors are present	Diagnosis and rectification → 104

9.2 System error messages

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



Caution!

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

→ 115

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



Note!

- The error types listed in the following correspond to the factory settings.
- See the information on → 60

MODBUS		No.	Device status message (local display)	Cause	Remedy (spare part →  107)
Register: 6859 Data type: Integer	Register: 6821 Data type: String (18 byte)				
Response to a fault message: The value "NaN" (not a number) is transmitted to the MODBUS master instead of the current measured value.			Depicted on the local display: S = System error ⚡ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)		
1	SYSTEM OK	-	There is no error present in the device		
No. # 0xx → Hardware error					
2	CRITICAL FAIL.	001	S: CRITICAL FAILURE ⚡: # 001	Serious device error.	Replace amplifier board.
3	AMP HW EEPROM	011	S: AMP HW EEPROM ⚡: # 011	Amplifier: faulty EEPROM.	Replace amplifier board.
4	AMP SW EEPROM	012	S: AMP SW EEPROM ⚡: # 012	Amplifier: Error accessing EEPROM data.	The EEPROM data blocks in which an error has occurred are displayed in the "TROUBLESHOOTING" function (No. 8047). Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the faulty parameter values.  Note! The measuring device must be restarted after fault elimination.
11	SENSOR HW DAT	031	S: SENSOR HW DAT ⚡: # 031	Sensor DAT: 1. S-DAT is defective. 2. S-DAT is not plugged into the amplifier board or is missing.	1. Check whether the S-DAT is correctly plugged into the amplifier board. 2. Replace the S-DAT if it is defective. Check that the new replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. 4. Plug the S-DAT into the amplifier board.
12	SENSOR SW DAT	032	S: SENSOR SW DAT ⚡: # 032	Sensor: Error accessing the adjustment values stored in the S-DAT.	

MODBUS		No.	Device status message (local display)	Cause	Remedy (spare part →  107)
Register: 6859 Data type: Integer	Register: 6821 Data type: String (18 byte)				
13	TRANSM. HW-DAT	041	S: TRANSM. HW-DAT #: # 041	Transmitter DAT: 1. T-DAT is defective. 2. T-DAT is not plugged into the amplifier board or is missing.	1. Check whether the T-DAT is correctly plugged into the amplifier board. 2. Replace the T-DAT if it is defective. Check that the new replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. 4. Plug the T-DAT into the amplifier board.
14	TRANSM. SW-DAT	042	S: TRANSM. SW-DAT #: # 042	Transmitter: Error accessing the adjustment values stored in the T-DAT.	
115	HW F-CHIP	061	S: HW F-CHIP #: # 061	Transmitter F-Chip: 1. F-Chip is defective. 2. F-CHIP is not plugged into the I/O board or is missing.	1. Replace the F-CHIP. 2. Plug the F-CHIP into the I/O board
No. # 1xx → Software error					
19	GAIN ERROR AMP	101	S: GAIN ERROR AMP #: # 101	Gain deviation compared to reference gain is greater than 2%.	Replace amplifier board.
114	A/C SW COMPATIB.	121	S: A / C COMPATIB. !: # 121	Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality).  Note! – The indication on the display as notice message appears only for 30 seconds (with listing in "Previous system condition" function). – This condition can occur if only one electronics board has been exchanged; the extended software functionality is not available. The previously existing software functionality is still working and the measurement possible.	Module with lower software version has either to be updated by "FieldCare" with the required software version or the module has to be replaced.
No. # 2xx → Error in DAT/no communication					
22	LOAD T-DAT	205	S: LOAD T-DAT !: # 205	Transmitter DAT: Data back-up (downloading) to T-DAT failed or Error when accessing (uploading) the values stored in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board. 2. Replace the T-DAT if it is defective. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary.
23	SAVE T-DAT	206	S: SAVE T-DAT !: # 206		

MODBUS		No.	Device status message (local display)	Cause	Remedy (spare part →  107)
Register: 6859 Data type: Integer	Register: 6821 Data type: String (18 byte)				
28	COMMUNIC. I/O	261	S: COMMUNICATION I/O f: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts.
No. # 3xx → System limits exceeded					
32	TOL.COIL CURR.	321	S: TOL. COIL CURR. f: # 321	Sensor: Coil current is out of tolerance.	 Warning! Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards! Remote version: 1. Check wiring of terminals 41/42 →  42 2. Check coil current cable connector. Compact and remote version: If the error can not be resolved, please contact your local Endress+Hauser service organization.
102 to 105	STACK CUR. OUT n	339 to 342	S: STACK CUR OUT n f: # 339 to 342	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendation in the event of fault category FAULT MESS. (f): – Configure the fault response of the output to "ACTUAL VALUE", so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
106 to 109	STACK FREQ. OUT n	343 to 346	S: STACK FREQUENCY OUTPUT n f: # 343 to 346		
110 to 113	STACK PULSE n	347 to 350	S: STACK PULSE OUT n f: # 347 to 350	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse weighting. 2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses. 3. Increase or reduce flow, as applicable. Recommendation in the event of fault category FAULT MESS. (f): – Configure the fault response of the output to "ACTUAL VALUE", so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
39 to 42	RANGE CUR. OUT n	351 to 354	S: CURRENT RANGE n !: # 351 to 354	Current output: The actual value for the flow lies outside the set limits.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
43 to 46	RANGE FREQ. OUT n	355 to 358	S: FREQ. RANGE n !: # 355 to 358	Frequency output: The actual value for the flow lies outside the set limits.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.

MODBUS		No.	Device status message (local display)	Cause	Remedy (spare part → 107)
Register: 6859 Data type: Integer	Register: 6821 Data type: String (18 byte)				
47 to 50	RANGE PULSE n	359 to 362	S: PULSE RANGE !: # 359 to 362	Pulse output: Pulse output frequency is out of range.	- Increase the setting for pulse weighting. - When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC, etc.). <i>Determine the pulse width:</i> - Version 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. - Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. <i>Example:</i> The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10 \text{ Hz}} = 50 \text{ ms}$ - Reduce flow
No. # 5xx → Application error					
60	SW. UPDATE ACT	501	S: SW.-UPDATE ACT. !: # 501	New software version for the amplifier or communication (I/O module) is loaded. Currently no other functions are possible.	Wait until process is finished. The device will restart automatically.
61	UP/DOWNL. ACT	502	S: UP-/DOWNLOAD ACT. !: # 502	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until process is finished.
100	BATCH RUNNING	571	S: BATCH RUNNING !: # 571	Batching is started and active (valves are open)	No measures needed (during the batching process some other functions may not be activated).
101	BATCH HOLD	572	S: BATCH HOLD !: # 572	Batching has been interrupted (valves are closed)	Remedy optionally via: - MODBUS RS485 - Local display - Continue batching with "GO ON". - Interrupt batching with "STOP".
No. # 6xx → Simulation mode active					
64	POS.ZERO -RET.	601	S: POS. ZERO-RETURN !: # 601	Positive zero return active.  Caution! This message has the highest display priority!	Switch off positive zero return.
65 to 68	SIM. CURR. OUT n	611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	Simulation current output active.	Switch off simulation.
69 to 72	SIM FREQ.OUT n	621 to 624	S: SIM. FREQ. OUT. n !: # 621 to 624	Simulation frequency output active.	Switch off simulation.
73 to 76	SIM. PULSE n	631 to 634	S: SIM. PULSE n !: # 631 to 634	Simulation pulse output active.	Switch off simulation.
77 to 80	SIM. STAT. OUT n	641 to 644	S: SIM. STAT. OUT n !: # 641 to 644	Simulation status output active.	Switch off simulation.

MODBUS		No.	Device status message (local display)	Cause	Remedy (spare part →  107)
Register: 6859 Data type: Integer	Register: 6821 Data type: String (18 byte)				
81 to 84	SIM. REL.OUT n	651 to 654	S: SIM. RELAY n !: # 651 to 654	Simulation relay output active.	Switch off simulation.
89 to 92	SIM. STATUS IN n	671 to 674	S: SIM. STATUS IN n !: # 671 to 674	Simulation status input active.	Switch off simulation.
93	SIM. FAILSAFE	691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active.	Switch off simulation.
94	SIM. MEASURAND	692	S: SIM. MEASURAND !: # 692	Simulation of a measurand active.	Switch off simulation.
121	DEV. TEST ACT.	698	S: DEV. TEST ACT. !: # 698	The measuring device is being checked on-site using the test and simulation device.	–

9.3 Process error messages

Process errors can be defined as either "Fault" or "Notice" messages and can thereby be weighted differently. You can define messages in this way with the aid of the function matrix (→ "Description of Device Functions" manual).



Note!

- The listed error message types below correspond to the factory setting.
- See the information on → 60

MODBUS		No.	Device status message (local display)	Cause	Remedy / spare part
Register: 6859 Data type: Integer	Register: 6821 Data type: String (18 byte)				
Response to a fault message: The value "NaN" (not a number) is transmitted to the MODBUS master instead of the current measured value.			Depicted on the local display: S = System error ⚡ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)		
1	SYSTEM OK	-	<i>There is no error present in the device</i>		
52	EMPTY PIPE	401	P: EMPTY PIPE ⚡: # 401	Measuring tube partially filled or empty.	1. Check the process conditions of the plant 2. Fill the measuring tube
55	EPD ADJ N.OK	461	P: ADJ N. OK !: # 461	EPD/OED adjustment not possible because the fluid's conductivity is either too low or too high.	The EPD/OED function cannot be used with fluids of this nature.
57	EPD FULL = EMPTY	463	P: FULL = EMPTY ⚡: # 463	The EPD/OED adjustment values for empty pipe and full pipe are identical, therefore incorrect.	Repeat adjustment, making sure procedure is correct. → 91
97	> BATCH TIME	471	P: > BATCH TIME ⚡: # 471	The maximum permitted batching time was exceeded.	1. Increase flow rate. 2. Check valve (opening). 3. Adjust time setting to changed batch quantity. Note! If the errors listed above occur, these are displayed in the Home position flashing continuously. ■ General: These error messages can be reset by configuring any batching parameter. It is sufficient to confirm with the key and then the key. ■ Batching via status input: The error message can be reset by means of a pulse. Another pulse then restarts the batching. ■ Batching via operating keys (soft keys) The error message is reset by pressing the START key. Pressing the START key a second time starts the batching process. ■ Batching via the BATCHING PROCESS function (7260): The error message can be reset by pressing the STOP, START, HOLD or GO ON keys. Pressing the START key a second time starts the batching process.

MODBUS		No.	Device status message (local display)	Cause	Remedy / spare part
Register: 6859 Data type: Integer	Register: 6821 Data type: String (18 byte)				
98	>< BATCH QUANT.	472	P: >< BATCH QUANTITY !/: # 472	<i>Underbatching:</i> The minimum quantity was not reached. <i>Overbatching:</i> The maximum permitted batching quantity was exceeded.	Underbatching: 1. Increase fixed correction quantity. 2. Valve closes too quickly with active after run correction. Enter smaller after run as mean value. 3. If the batching quantity changes, the minimum batching quantity must be adjusted. Overbatching: 1. Reduce fixed correction quantity. 2. Valve closes too slowly with active after run correction. Enter larger after run as mean value. 3. If the batching quantity changes, the maximum batching quantity must be adjusted.  Note! Please observe Note in error message No. 471
99	PROGRESS NOTE	473	P: PROGRESS NOTE !/: # 473	End of filling process approaching. The running filling process has exceeded the predefined batch quantity point for the display warning message.	No measures required (if necessary prepare to replace container).
122	> MAX.FLOW RATE	474	P: > MAX. FLOW RATE !/: # 474	Maximum flow value entered is exceeded.	Reduce the flow value.  Note! Please observe Note in error message No. 471

9.4 Process errors without messages

Symptoms	Rectification
 Note! You may have to change or correct certain settings of the function matrix in order to rectify faults. The functions outlined below, such as DISPLAY DAMPING, for example, are described in detail in the "Description of Device Functions" manual.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	- Remote version: - Switch off the power supply and check the wiring →  42 - If necessary, reverse the connections at terminals 41 and 42 - Change the setting in the INSTALLATION DIRECTION SENSOR function accordingly
Measured-value reading fluctuates even though flow is steady.	- Check grounding and potential matching. →  49 - The medium is too inhomogeneous. Check the following medium characteristics: - Gas bubble percentage too high? - Solids percentage too high? - Conductivity fluctuations too high? - SYSTEM DAMPING function → increase value (→ BASIC FUNCTION/SYSTEMPARAMETER/CONFIGURATION) - TIME CONSTANT function → increase the value (→ OUTPUTS/CURRENT OUTPUT/CONFIGURATION) - DISPLAY DAMPING function → increase the value (→ USER INTERFACE/CONTROL/BASIC CONFIGURATION)
Measured-value reading or measured-value output pulsates or fluctuates, e.g. because of reciprocating pump, peristaltic pump, diaphragm pump or pump with similar delivery characteristic.	Perform the "Pulsating flow" Quick Setup (only possible if a pulse/frequency output is available). →  82 If the problem persists despite these measures, a pulsation damper will have to be installed between pump and measuring device.
There are differences between the flowmeter's internal totalizer and the external metering device.	This symptom is due primarily to backflow in the piping because the pulse output cannot subtract in the STANDARD or SYMMETRY measuring modes. The problem can be solved as follows: Allow for flow in both directions. Set the MEASURING MODE function to PULSATING FLOW for the pulse output in question.
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	- Check grounding and potential matching →  49 - Check the fluid for presence of gas bubbles. - Activate the ON-VALUE LOW FLOW CUT OFF function, i.e. enter or increase the value for the low flow cut off (→ BASIC FUNCTIONS / PROCESS PARAMETERS / CONFIGURATION).
Measured-value reading on display, even though measuring tube is empty.	- Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe Detection →  91 - Remote version: Check the terminals of the EPD cable →  42 - Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	Value for creepage too high: Reduce the corresponding value in the ON-VALUE LOW FLOW CUT OFF function.
The fault cannot be rectified or some other fault not described above has arisen. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: Request the services of an Endress+Hauser service technician If you contact our service organization to have a service technician sent out, please be ready to quote the following information: - Brief description of the fault - Nameplate specifications: order code, serial number →  7 Returning devices to Endress+Hauser The required procedures must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. →  115 Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted form at the back of these Operating Instructions. Replace transmitter electronics Components in the measuring electronics defective → order spare parts →  107

9.5 Response of outputs to errors



Note!

The failsafe mode of totalizers, current, pulse and frequency outputs can be customized by means of various functions in the function matrix. You will find detailed information on these procedures in the "Description of Device Functions" manual.

You can use positive zero return to reset the signals of the current, pulse and frequency outputs to their fallback value, or reset measured value transmission via fieldbus to "0", for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions. Simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	System/process error is present	Positive zero return is activated
 Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on →  60		
Current output	MINIMUM VALUE 0–20 mA → 0 mA 4–20 mA → 2 mA 4–20 mA NAMUR → 3.5 mA 4–20 mA US → 3.75 mA 0–20 mA (25 mA) → 0 mA 4–20 mA (25 mA) → 2 mA MAXIMUM VALUE 0–20 mA → 22 mA 4–20 mA → 22 mA 4–20 mA NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 0–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) → 25 mA HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Pulse output	FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	FALLBACK VALUE Signal output → 0 Hz FAILSAFE VALUE Output of the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"

Failsafe mode of outputs and totalizers		
	System/process error is present	Positive zero return is activated
Totalizer	STOP The totalizers are paused until the error is rectified. ACTUAL VALUE Fault is ignored, i.e. the totalizer continues to count according to the current flow value. HOLD VALUE The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Relay output	In the event of a fault or power supply failure: Relay → deenergized The "Description of Device Functions" manual contains detailed information on relay switching response for various configurations such as error message, flow direction, EPD, limits, etc.	No effect on relay output
MODBUS RS485	In the event of faults, the value "NaN" (not a number) is transmitted instead of the current measured value.	-

9.6 Spare parts

The previous sections contain a detailed troubleshooting guide. → [96](#)

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

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



Note!

You can order spare parts directly from your Endress+Hauser service organization by providing the serial number printed on the transmitter's nameplate. → [7](#)

Spare parts are shipped as sets comprising the following parts:

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

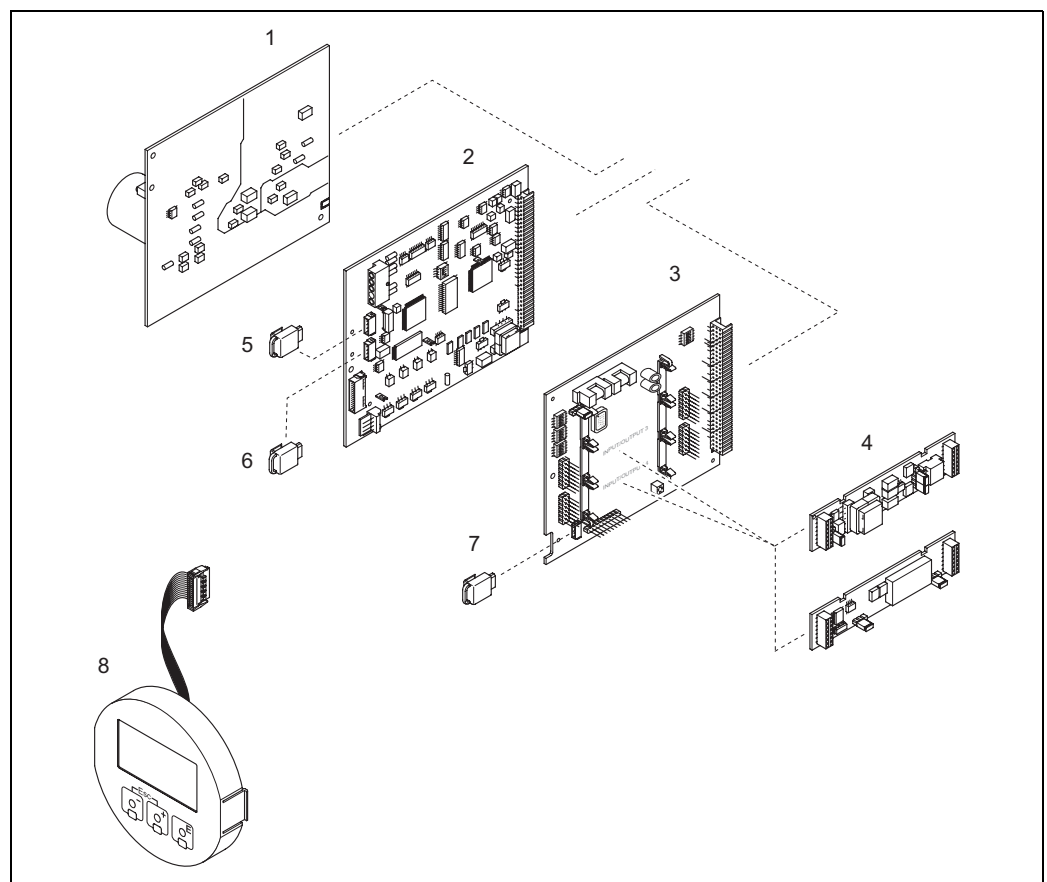


Fig. 60: Spare parts for transmitter (field and wall-mount housings)

- 1 Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
- 2 Amplifier board
- 3 I/O board (COM module), flexible assignment
- 4 Pluggable sub-modules (inputs/outputs); ordering structure → [94](#)
- 5 S-DAT (sensor data memory)
- 6 T-DAT (transmitter data memory)
- 7 F-CHIP (function chip for optional software)
- 8 Display module

9.6.1 Removing and installing printed circuit boards

Field housing



Warning!

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

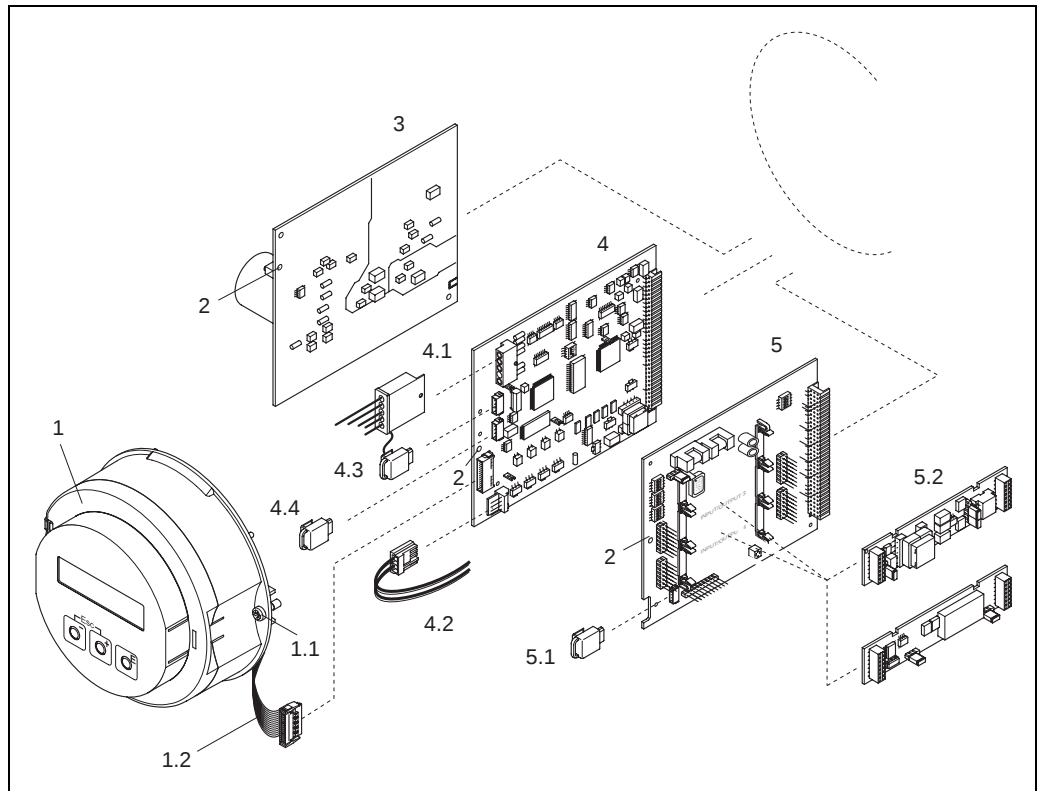


Caution!

Use only original Endress+Hauser parts.

Installing and removing printed circuit boards →  61:

1. Unscrew cover of the electronics compartment from the transmitter housing.
 2. Remove the local display (1) as follows:
 - Press in the latches (1.1) at the side and remove the display module.
 - Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
 3. Remove the screws and remove the cover (2) from the electronics compartment.
 4. Remove power unit board (4) and I/O board (6):
 - Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
 5. Removing sub-modules (6.2, only for measuring devices with convertible I/O board):
 - No tools are required for removing the submodules (inputs/outputs) from the I/O board. Installation is also a no-tools operation.
-  **Caution!**
 Only certain combinations of submodules on the I/O board are permissible. →  47
 The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:
- "INPUT / OUTPUT 3" slot = terminals 22/23
 - "INPUT / OUTPUT 4" slot = terminals 20/21
6. Remove amplifier board (5):
 - Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
 - Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it back and forward.
 - Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
 7. Installation is the reverse of the removal procedure.



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

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

Wall-mount housing



Warning!

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



Caution!

Use only original Endress+Hauser parts.

Installing and removing the circuit boards → 62:

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



Caution!

Only certain combinations of submodules on the I/O board are permissible. → 47

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

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

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

7. Installation is the reverse of the removal procedure.

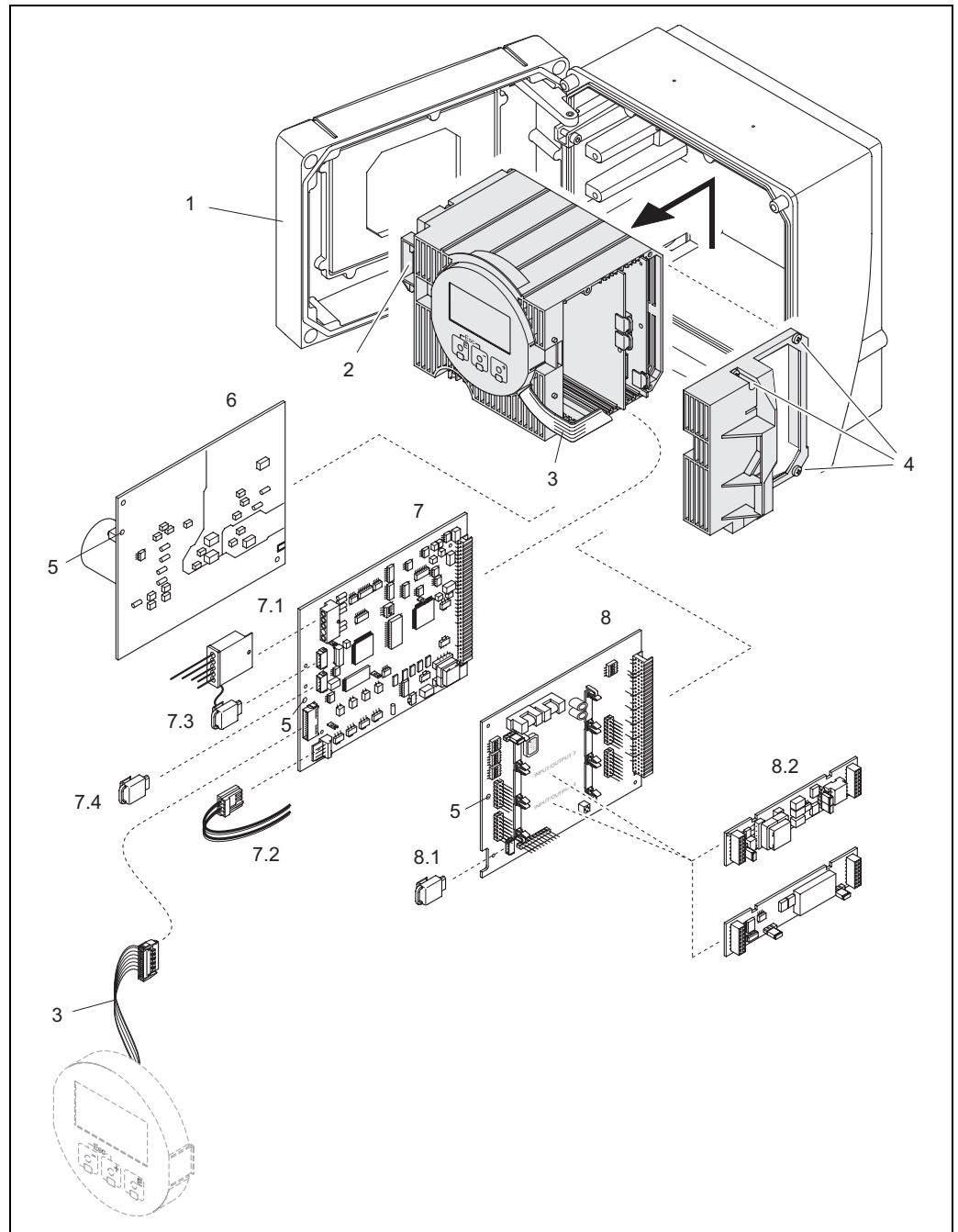


Fig. 62: Wall-mount housing: removing and installing printed circuit boards

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

9.6.2 Replacing the device fuse



Warning!

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

The main fuse is on the power supply board →  63.

The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove power unit board →  108.
3. Remove cap (1) and replace the device fuse (2).
Use only the following types of fuses:
– 85 to 260 V AC: 0.8 A slow-blow / 250 V
– 20 to 55 V AC and 16 to 62 V DC: 2 A slow-blow / 250 V
– Ex-rated devices → See the Ex documentation
4. Installation is the reverse of the removal procedure.



Caution!

Use only original Endress+Hauser parts.

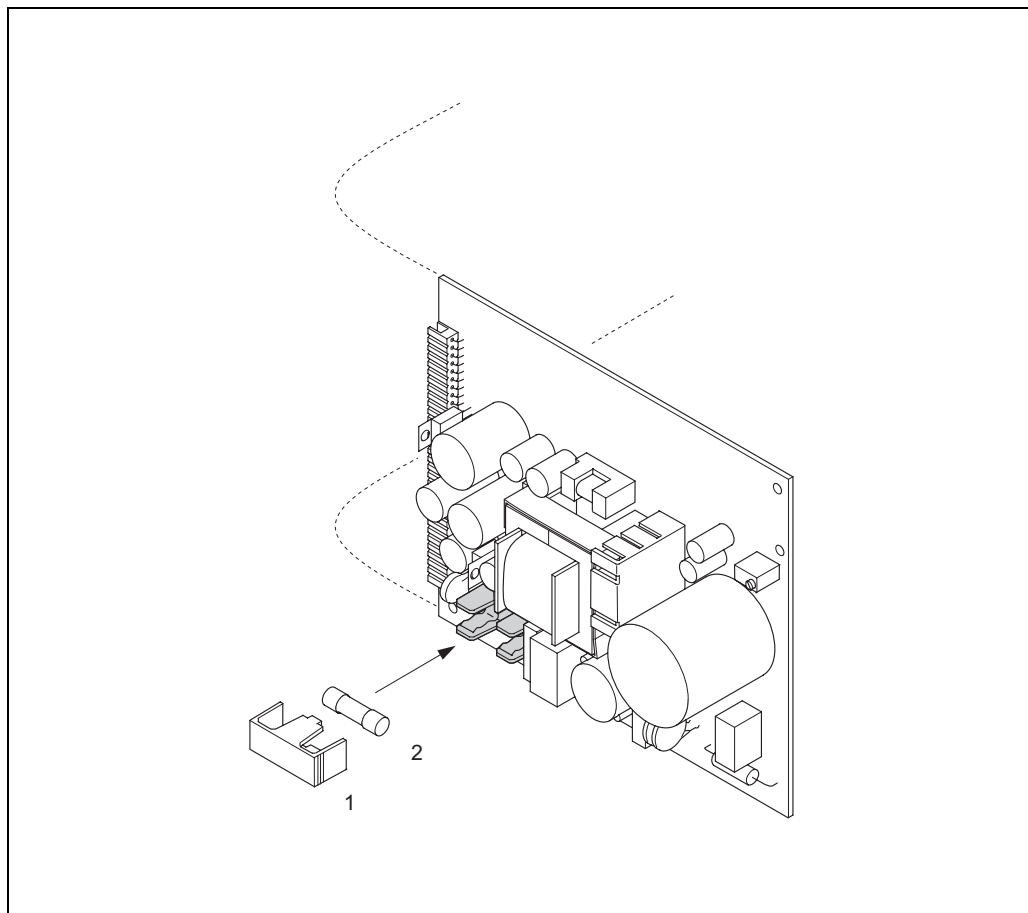


Fig. 63: Replacing the device fuse on the power supply board

- 1 Protection cap
2 Device fuse

9.6.3 Replacing the exchangeable electrode

The Promag W sensor (DN 350 to 2000; 14" to 78") can be supplied with optional exchangeable measuring electrodes. This design allows the measuring electrodes to be exchanged or cleaned under process conditions.

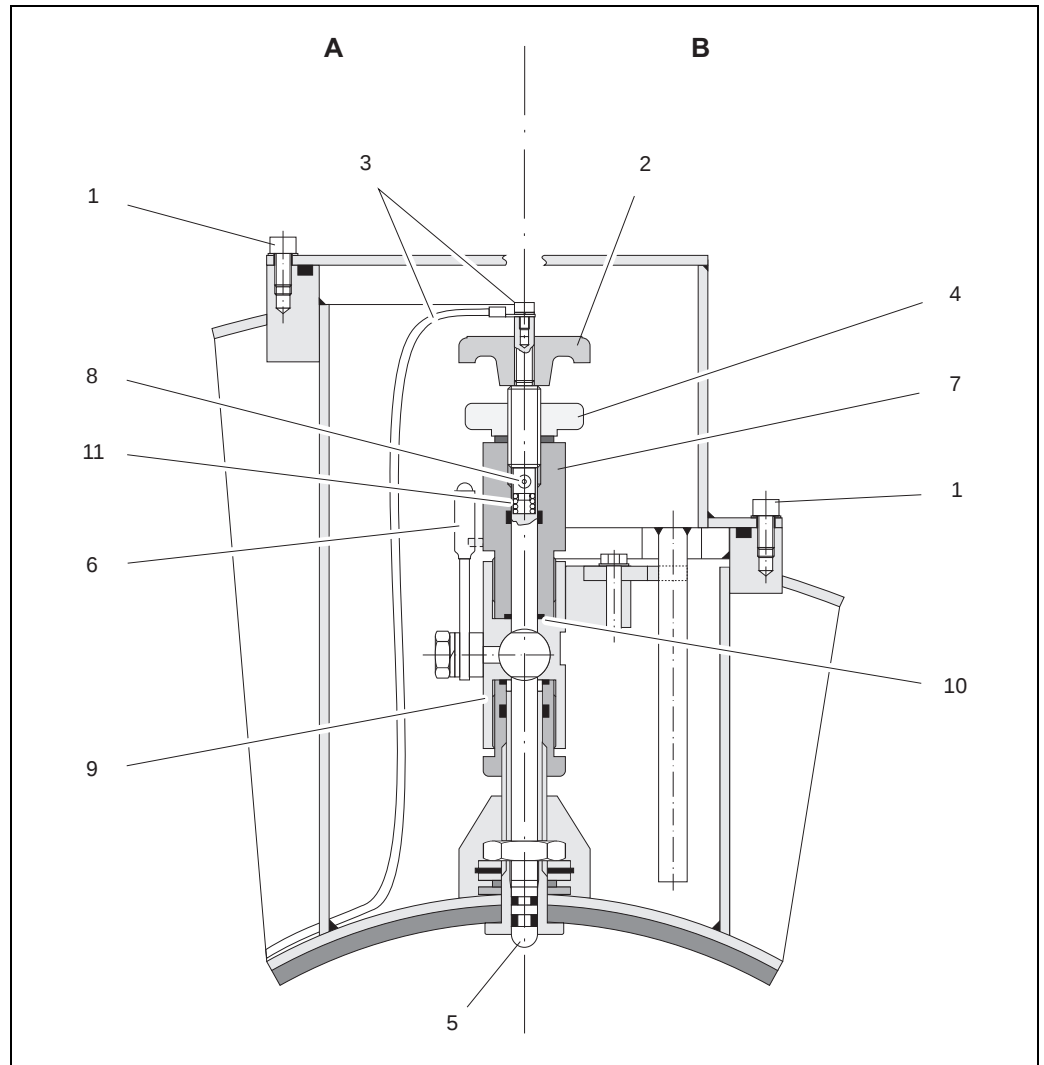


Fig. 64: Device for replacing the exchangeable measuring electrodes

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

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

- 1 Socket head cap screw
- 2 Rotary handle
- 3 Electrode cable
- 4 Knurled nut (counter nut)
- 5 Measuring electrode
- 6 Stop cock (ball valve)
- 7 Retaining cylinder
- 8 Locking bolt (rotary handle)
- 9 Ball valve housing
- 10 Seal (retaining cylinder)
- 11 Coil spring

Removing the electrode	Fitting the electrode
1 Release the socket head cap screw (1) and remove the cap.	1 Insert the new electrode (5) from underneath into the retaining cylinder (7). Ensure that the seals at the tip of the electrode are clean.
2 Unscrew the electrode cable (3) secured on the rotary handle (2).	2 Attach the rotary handle (2) to the electrode and secure with the locking bolt (8).  Caution! Ensure that the coil spring (11) is inserted to guarantee perfect electrical contact and thus correct measuring signals.
3 Release the knurled nut (4) by hand. This knurled nut serves as a counter nut.	3 Pull the electrode back until the tip is no longer protruding from the retaining cylinder (7).
4 Unscrew the electrode (5) using the rotary handle (2). It can now be pulled out of the retaining cylinder (7) up to a defined point.  Warning! Risk of injury! The electrode can bounce back to its stop under process conditions (pressure in the pipe). Exert counter pressure against it when releasing.	4 Screw the retaining cylinder (7) onto the ball valve housing (9) and secure tightly by hand. The seal (10) at the retaining cylinder must be fitted and clean.  Note! Ensure that the rubber hoses attached to the retaining cylinder (7) and stop cock (6) are the same color (red or blue).
5 Close the stop cock (6) after you have pulled out the electrode as far as it will go.  Warning! Do not open the stop cock after this to ensure that no fluid comes out.	5 Open the stop cock (6) and screw the electrode as far as it will go into the retaining cylinder using the rotary handle (2).
6 You can now unscrew the entire electrode with the retaining cylinder (7).	6 Now, screw the knurled nut (4) on the retaining cylinder. This secures the electrode in position.
7 Remove the rotary handle (2) from the electrode (5) by pushing out the locking bolt (8). Ensure that you do not lose the coil spring (11).	7 Secure the electrode cable (3) on the rotary handle (2) once more using the socket head cap screw.  Caution! Ensure that the socket head cap screw of the electrode cable is securely tightened. This guarantees perfect electrical contact and thus correct measuring signals.
8 Now replace the old electrode with the new one. You can order replacement electrodes separately from Endress+Hauser	8 Refit the cover and tighten the socket head cap screw (a).

9.7 Return



Caution!

Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.

Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

The following steps must be taken before returning a flow measuring device to Endress+Hauser, e.g. for repair or calibration:

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



Note!

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

9.8 Disposal

Observe the regulations applicable in your country!

9.9 Software history

Date	Software version	Changes to software	Operating Instructions
07.2009	3.04.XX	Introduction of Calf history	71108004/12.09
10.2005	3.01.XX	-	71005396/10.05

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

→ 5

10.1.2 Function and system design

Measuring principle	Electromagnetic flow measurement on the basis of Faraday's Law.
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Measuring system	→ 7
------------------	-----

10.1.3 Input variables

Measured variable	Flow rate (proportional to induced voltage)
-------------------	---

Measuring range	Typically $v = 0.01$ to 10 m/s (0.03 to 33 ft/s) with the specified measuring accuracy
-----------------	---

Operable flow range	Over $1000 : 1$
---------------------	-----------------

Input signal	<i>Status input (auxiliary input):</i> $U = 3$ to 30 V DC, $R_i = 3$ k Ω , galvanically isolated. Switch level: ± 3 to ± 30 VDC, independent of polarity
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10.1.4 Output variables

Output signal	<i>Current output</i> Active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s), Full scale value selectable, temperature coefficient: typically 0.005% o.r./ $^{\circ}\text{C}$ (0.003% o.f.s/ $^{\circ}\text{F}$), resolution: 0.5 μA ■ Active: $0/4$ to 20 mA, $R_L < 700$ Ω ■ Passive: 4 to 20 mA; supply voltage V_S 18 to 30 V DC; $R_i \geq 150$ Ω <i>Pulse / frequency output:</i> Active/passive selectable, galvanically isolated ■ Active: 24 V DC, 25 mA (max. 250 mA during 20 ms), $R_L > 100$ Ω ■ Passive: open collector, 30 V DC, 250 mA ■ Frequency output: full scale frequency 2 to 10000 Hz ($f_{\text{max}} = 12500$ Hz), on/off ratio $1:1$, pulse width max. 2 s ■ Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.05 to 2000 ms)
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MODBUS RS485:

- MODBUS device type: slave
- Address range: 1 to 247
- Functions codes supported: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Physical interface: RS485 in accordance with standard EIA/TIA-485
- Baudrate supported: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Transmission mode: RTU or ASCII
- Parity:
 - RTU mode = NONE, EVEN, UNEVEN
 - ASCII mode = EVEN, UNEVEN
- Response time:
 - Direct data access = typically 25 to 50 ms
 - Auto-scan buffer (data area) = typically 3 to 5 ms

Signal on alarm	<i>Current output:</i> Failsafe mode selectable (e.g. in accordance with NAMUR recommendation NE 43) <i>Pulse / frequency output:</i> Failsafe mode selectable <i>Relay output:</i> De-energized by fault or power supply failure <i>MODBUS RS485:</i> If an error occurs, the value NaN (not a number) is output for the measured values.
Load	see "Output signal"
Switching output	<i>Relay output:</i> Normally closed (NC or break) or normally open (NO or make) contacts available (default: relay 1 = NO, relay 2 = NC), max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.
Low flow cut off	Switch points for low flow cut off are selectable.
Galvanic isolation	All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connections	→  40
Supply voltage	85 to 260 V AC, 45 to 65 Hz 20 to 55 V AC, 45 to 65 Hz 16 to 62 V DC
Cable entries	Power supply and signal cable (inputs/outputs): ■ Cable gland M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 inch) ■ Cable gland sensor for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 inch) ■ Cable entries for thread ½" NPT, G ½" Connecting cable for remote version: ■ Cable gland M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 inch) ■ Cable gland sensor for armored cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63 inch) ■ Cable entries for thread ½" NPT, G ½"
Cable specifications (remote version)	→  46
Power consumption	AC: <15 VA (including sensor) DC: <15 W (including sensor) Switch-on current: ■ max. 13.5 A (< 50 ms) at 24 V DC ■ max. 3 A (< 5 ms) at 260 V AC
Power supply failure	Lasting min. 1 power cycle ■ EEPROM or T-DAT saves measuring system data if power supply fails ■ S-DAT: exchangeable data memory which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point, etc.)
Potential matching	→  49

10.1.6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:

- Fluid temperature: $+28\text{ °C} \pm 2\text{ K}$
- Ambient temperature: $+22\text{ °C} \pm 2\text{ K}$
- Warm-up time: 30 minutes

Installation:

- Inlet run $> 10 \times \text{DN}$
- Outlet run $> 5 \times \text{DN}$
- Sensor and transmitter grounded.
- Sensor centered relative to the pipe.

Maximum measured error

Standard: $\pm 0.2\%$ o.r. $\pm 2\text{ mm/s}$ (o.r. = of reading)



Note!

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

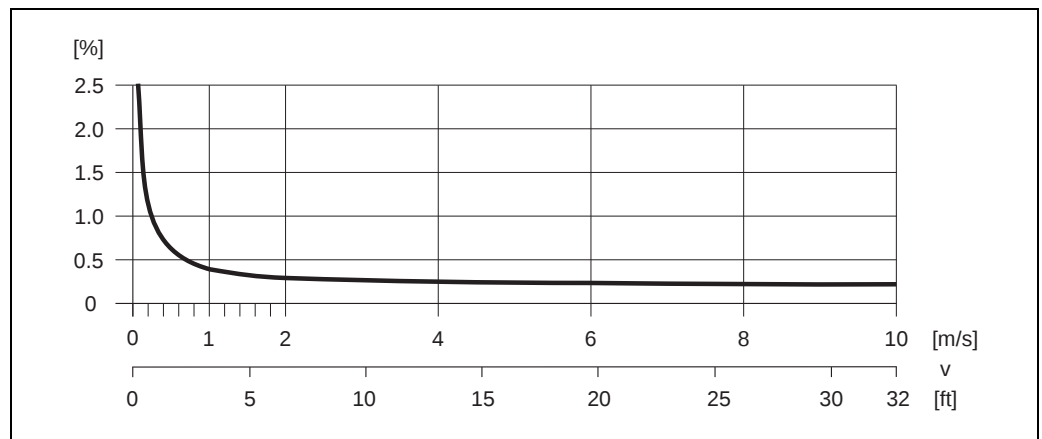


Fig. 65: Max. measured error in % of reading

Repeatability

Standard: max. $\pm 0.1\%$ o.r. $\pm 0.5\text{ mm/s}$ (o.r. = of reading)

10.1.7 Operating conditions: Installation

Installation instructions

→ 13

Inlet and outlet runs

Inlet run: typically $\geq 5 \times \text{DN}$

Outlet run: typically $\geq 2 \times \text{DN}$

Length of connecting cable

- The permissible cable length L_{max} for the remote version depends on the conductivity of the medium → 20.
- A minimum conductivity of $20\text{ }\mu\text{S/cm}$ is required to measure demineralized water.

10.1.8 Operating conditions: Environment

Ambient temperature range	Transmitter: ■ Standard: -20 to +60 °C (-4 to +140 °F) ■ Optional: -40 to +60 °C (-40 to +140 °F)  Note! At ambient temperatures below -20 °C (-4 °F), the readability of the display may be impaired. Sensor: ■ Flange material carbon steel: -10 to +60 °C (+14 to +140 °F) ■ Flange material stainless steel: -40 to +60 °C (-40 to +140 °F)  Caution! Do not exceed the min. and max. temperatures for the lining of the measuring tube (→ "Medium temperature range"). Note the following points: ■ Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. ■ If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ "Medium temperature range").
Storage temperature	The storage temperature corresponds to the operating temperature range of the transmitter and sensor.  Caution! ■ The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures. ■ Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the lining.
Degree of protection	■ Standard: IP 67 (NEMA 4X) for transmitter and sensor ■ Optional: IP 68 (NEMA 6P) for remote version of Promag W and Promag P sensors
Shock and vibration resistance	Acceleration up to 2 g in accordance with IEC 600 68-2-6 (High-temperature version: no data available)
CIP cleaning	 Caution! The maximum fluid temperature permitted for the measuring device must not be exceeded. CIP cleaning possible: Promag P, Promag H CIP cleaning not possible: Promag W
SIP cleaning	 Caution! The maximum fluid temperature permitted for the measuring device must not be exceeded. SIP cleaning possible: Promag P (with PFA lining), Promag H SIP cleaning not possible: Promag W
Electromagnetic compatibility (EMC)	■ As per IEC/EN 61326 and NAMUR Recommendation NE 21 ■ Emission: to limit value for industry EN 55011

10.1.9 Operating conditions: Process

Medium temperature range

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

Promag W

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 65 to 2000 / 2½ to 80")
- -20 to +50 °C (-4 to +122 °F) for polyurethane (DN 25 to 1200 / 1 to 48")

Promag P

Standard

- -40 to +130 °C (-40 to +266 °F) for PTFE (DN 15 to 600 / ½" to 24"),
restrictions → see diagrams below
- -20 to +130 °C (-4 to +266 °F) for PFA/HE (DN 25 to 200 / 1" to 8"),
restrictions → see diagrams below
- -20 to +150 °C (-4 to +302 °F) for PFA (DN 25 to 200 / 1" to 8"),
restrictions → see diagrams below

Optional

High-temperature version (HT): -20 to +180 °C (-4 to +356 °F) for PFA (DN 25 to 200 / 1" to 8")

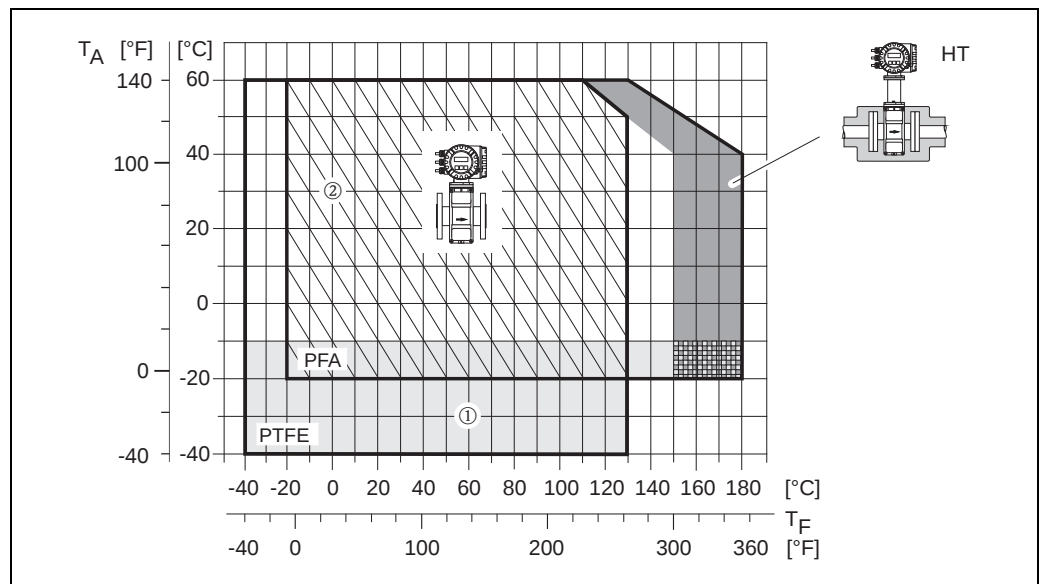


Fig. 66: Promag P compact version (with PFA or PTFE lining)

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

① = Light gray area → temperature range from -10 to -40 °C (-14 to -40 °F) applies only to stainless steel flanges

② = Diagonally hatched area → foam lining (HE) + degree of protection IP68 = fluid temperature max. 130°C / 266 °F

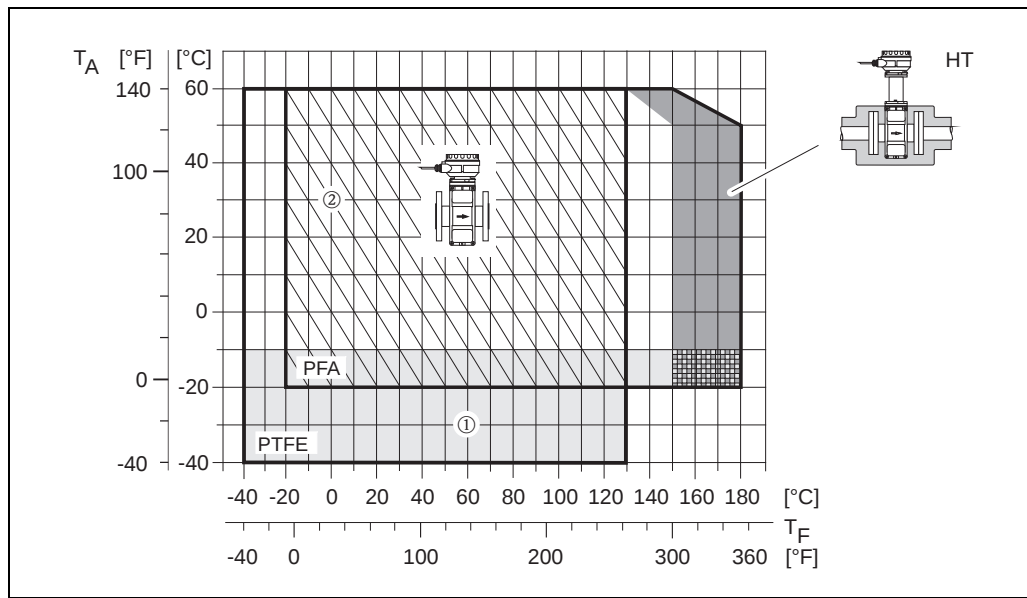


Fig. 67: Remote versions (with PFA or PTFE lining)

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

① = Light gray area → temperature range from -10 to -40 °C (-14 to -40 °F) applies only to stainless steel flanges

② = Diagonally hatched area → foam lining (HE) + degree of protection IP68 = fluid temperature max. 130 °C / 266 °F

Promag H

Sensor:

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

Seals:

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

Conductivity of the fluid



The minimum conductivity is ≥ 5 $\mu\text{S}/\text{cm}$ (for demineralized water ≥ 20 $\mu\text{S}/\text{cm}$)

Note!

In the remote version, the required minimum conductivity is also influenced by the length of the connecting cable → 20.

Limiting medium pressure range (nominal pressure)

Promag W

- EN 1092-1 (DIN 2501)
 - PN 6 (DN 350 to 2000)
 - PN 10 (DN 200 to 2000)
 - PN 16 (DN 65 to 2000)
 - PN 25 (DN 200 to 1000)
 - PN 40 (DN 25 to 150)
- ANSI B 16.5
 - Class 150 (1" to 24")
 - Class 300 (1" to 6")
- AWWA
 - Class D (28" to 78")
- JIS B2220
 - 10 K (DN 50 to 300)
 - 20 K (DN 25 to 300)

- AS 2129
 - Table E (DN 80, 100, 150 to 1200)
- AS 4087
 - PN 16 (DN 80, 100, 150 to 1200)

Promag P

- EN 1092-1 (DIN 2501)
 - PN 10 (DN 200 to 600)
 - PN 16 (DN 65 to 600)
 - PN 25 (DN 200 to 600)
 - PN 40 (DN 15 to 150)
- ANSI B 16.5
 - Class 150 (½" to 24")
 - Class 300 (½" to 6")
- JIS B2220
 - 10 K (DN 50 to 300)
 - 20 K (DN 15 to 300)
- AS 2129
 - Table E (DN 25, 50)
- AS 4087
 - PN 16 (DN 50)

Promag H

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

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

Pressure tightness (measuring tube lining)

Promag W

Promag W nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum: limit values for absolute pressure [mbar] ([psi]) at various fluid temperatures						
[mm]	[inch]		25 °C 77 °F	50 °C 122 °F	80 °C 176 °F	100 °C 212 °F	130 °C 266 °F	150 °C 302 °F	180 °C 356 °F
25 to 1200	1 to 48"	Polyurethane	0	0	–	–	–	–	–
65 to 2000	3 to 78"	Hard rubber	0	0	0	–	–	–	–

Promag P

Measuring tube lining: PFA

Promag P nominal diameter		Resistance of measuring tube lining to partial vacuum: limit values for absolute pressure [mbar] ([psi]) at various fluid temperatures					
[mm]	[inch]	25 °C	80° C	100 °C	130 °C	150 °C	180 °C
		77 °F	176° F	212 °F	266 °F	302 °F	356 °F
25	1"	0	0	0	0	0	0
32	-	0	0	0	0	0	0
40	1 ½"	0	0	0	0	0	0
50	2"	0	0	0	0	0	0
65	-	0	*	0	0	0	0
80	3"	0	*	0	0	0	0
100	4"	0	*	0	0	0	0
125	-	0	*	0	0	0	0
150	6"	0	*	0	0	0	0
200	8"	0	*	0	0	0	0

* No value can be quoted.

Promag P
Measuring tube lining: PTFE

Promag P nominal diameter		Resistance of measuring tube lining to partial vacuum: limit values for absolute pressure [mbar] ([psi]) at various fluid temperatures								
[mm]	[inch]	25 °C		80 °C	100 °C		130 °C		150 °C	180 °C
		77 °F		176 °F	212 °F		266 °F		302 °F	356 °F
		[mbar]	[psi]		[mbar]	[psi]	[mbar]	[psi]		
15	½"	0	0	0	0	0	100	1,45	–	–
25	1"	0	0	0	0	0	100	1,45	–	–
32	–	0	0	0	0	0	100	1,45	–	–
40	1 ½"	0	0	0	0	0	100	1,45	–	–
50	2"	0	0	0	0	0	100	1,45	–	–
65	–	0	0	*	40	0,58	130	1,89	–	–
80	3"	0	0	*	40	0,58	130	1,89	–	–
100	4"	0	0	*	135	1,96	170	2,47	–	–
125	–	135	1,96	*	240	3,48	385	5,58	–	–
150	6"	135	1,96	*	240	3,48	385	5,58	–	–
200	8"	200	2,90	*	290	4,21	410	5,95	–	–
250	10"	330	4,79	*	400	5,80	530	7,69	–	–
300	12"	400	5,80	*	500	7,25	630	9,14	–	–
350	14"	470	6,82	*	600	8,70	730	10,59	–	–
400	16"	540	7,83	*	670	9,72	800	11,60	–	–
450	18"	Partial vacuum is impermissible								
500	20"									
600	24"									
* No value can be quoted.										

Promag H (measuring tube lining: PFA)

Promag H nominal diameter		Pressure tightness, measuring tube lining: limit values for absolute pressure [mbar] ([psi]) at various fluid temperature					
[mm]	[inch]	25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
		77 °F	176 °F	212 °F	266 °F	302 °F	356 °F
2 to 100	1/12 to 4"	0	0	0	0	0	0

Limiting flow

Further information can be found in the "Nominal diameter and flow rate" → 18 section

Pressure loss

- No pressure loss if the sensor is installed in piping with the same nominal diameter (for Promag H only from DN8).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → 17.

10.1.10 Mechanical construction

Design / dimensions

The dimensions and face-to-face length of the sensor and transmitter can be found in the separate "Technical Information" documentation for each device which can be downloaded in PDF format from www.endress.com. A list of available "Technical Information" documentation can be found in the "Documentation" →  134 section.

Weight (SI units)

Promag W



Note!

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

Nominal diameter	Weights in [kg] for the Promag W								
	Compact version				Remote version (without cable)				
	Sensor		Transmitter						
[mm]	EN (DIN) / AS*		JIS		EN (DIN) / AS*		JIS		
25	PN 40	7.3	10K	7.3	PN 40	5.3	10K	5.3	6.0
32		8.0		7.3		6.0		5.3	6.0
40		9.4		8.3		7.4		6.3	6.0
50		10.6		9.3		8.6		7.3	6.0
65	PN 16	12.0	10K	11.1	PN 16	10.0	10K	9.1	6.0
80		14.0		12.5		12.0		10.5	6.0
100		16.0		14.7		14.0		12.7	6.0
125		21.5		21.0		19.5		19.0	6.0
150	PN 10	25.5	10K	24.5	PN 10	23.5	10K	22.5	6.0
200		45		41.9		43		39.9	6.0
250		65		69.4		63		67.4	6.0
300		70		72.3		68		70.3	6.0
350	PN 10	115	10K	PN 10	113	10K	10K	10K	6.0
375		134			133				6.0
400		135			133				6.0
450		175			173				6.0
500		175			173				6.0
600		235			233				6.0
700		355			353				6.0
800		435			433				6.0
900		575			573				6.0
1000		700			698				6.0
1200	PN 6	850	10K	PN 6	848	10K	10K	10K	6.0
1400		1300			1298				6.0
1600		1700			1698				6.0
1800		2200			2198				6.0
2000	2800	2798	6.0						
Promag transmitter (compact version): 3.4 kg									
*Only DN 80, 100, 150 to 400, 500 and 600 are available for flanges as per AS									

Promag P



Note!

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

Nominal diameter	Weights in [kg] for the Promag P								
	Compact version				Remote version (without cable)				
	[mm]	EN (DIN) / AS*		JIS		Sensor		Transmitter	
15	PN 40	6.5	10K	6.5	PN 40	4.5	10K	4.5	6.0
25		7.3		7.3		5.3		5.3	6.0
32		8.0		7.3		6.0		5.3	6.0
40		9.4		8.3		7.4		6.3	6.0
50		10.6		9.3		8.6		7.3	6.0
65	PN 16	12.0	10K	11.1	PN 16	10.0	10K	9.1	6.0
80		14.0		12.5		12.0		10.5	6.0
100		14.4		14.7		14.0		12.7	6.0
125		16.0		21.0		19.5		19.0	6.0
150		21.5		24.5		23.5		22.5	6.0
200	PN 10	45	10K	41.9	PN 10	43	10K	39.9	6.0
250		65		69.4		63		67.4	6.0
300		70		72.3		68		70.3	6.0
350		115				113			6.0
400		135				133			6.0
450	PN 10	175	10K		PN 10	173	10K		6.0
500		175				173			6.0
600		235				233			6.0
Promag transmitter (compact version): 3.4 kg High-temperature version: +1.5 kg * Only DN 25 and 50 are available for flanges as per AS									

Promag H



Note!

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

Nominal diameter	Weights in [kg] for the Promag H			
	Compact version		Remote version (without cable)	
			Sensor	Transmitter
DIN				
[mm]				
2	5.2		2.0	6.0
4	5.2		2.0	6.0
8	5.3		2.0	6.0
15	5.4		1.9	6.0
25	5.5		2.8	6.0
40	6.5		4.5	6.0
50	9.0		7.0	6.0
65	9.5		7.5	6.0
80	19.0		17.0	6.0
100	18.5		16.5	6.0

Promag transmitter (compact version): 3.4 kg

Weight (US units)

Promag W

Note!

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

Nominal diameter	Weights in [lbs] for the Promag W				
	Compact version		Remote version (without cable)		
			Sensor	Transmitter	
[inch]	ANSI / AWWA		ANSI / AWWA		
1"	Class 150	16	Class 150	12	13
1 ½"		21		16	13
2"		23		19	13
3"		31		26	13
4"		35		31	13
6"		56		52	13
8"		99		95	13
10"		143		161	13
12"		243		238	13
14"		386		381	13
16"		452		448	13
18"		562		558	13
20"		628		624	13
24"		893		889	13
28"	Class D	882	Class D	878	13
30"		1014		1010	13
32"		1213		1208	13
36"		1764		1760	13
40"		1985		1980	13
42"		2426		2421	13
48"		3087		3083	13
54"		4851		4847	13
60"		5954		5949	13
66"		8159		8154	13
72"		9041		9036	13
78"		10143		10139	13
Promag transmitter (compact version): 7.5 lbs					

Promag P

Note!

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

Nominal diameter	Weights in [lbs] for the Promag P				
	Compact version		Remote version (without cable)		
			Sensor	Transmitter	
[inch]	ANSI / AWWA		ANSI / AWWA		
½"	Class 150	14	Class 150	10	13
1 "		16		12	13
1 ½"		21		16	13
2"		23		19	13
3"		31		26	13
4"		35		31	13
6"		56		52	13
8"		99		95	13
10"		165		161	13
12"		243		238	13
14"		386		381	13
16"		452		448	13
18"		562		558	13
20"		628		624	13
24"		893		889	13
Promag transmitter (compact version): 7.5 lbs High-temperature version: + 3.3 lbs					

Promag H

Note!

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

Nominal diameter [inch]	Weights in [lbs] for the Promag H		
	Compact version	Remote version (without cable)	
		Sensor	Transmitter
1/12"	11.5	4.4	13.5
5/32"	11.5	4.4	13.5
5/16"	11.7	4.4	13.5
½"	11.9	4.2	13.5
1"	12.1	6.2	13.5
1 ½"	14.3	9.9	13.2
2"	19.8	15.5	13.2
3"	41.9	37.5	13.2
4"	40.8	36.5	13.2
Promag transmitter (compact version): 7.5 lbs			

Material

Promag W

- Transmitter housing:
 - Housing for compact version: powder-coated die-cast aluminum
 - Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
 - DN 25 to 300: powder-coated die-cast aluminum
 - DN 350 to 2000: with protective coating
- Measuring tube
 - DN ≤ 300: stainless steel 1.4301 or 1.4306/304L
for flanges made of carbon steel with Al/Zn protective coating
 - DN ≥ 350: stainless steel 1.4301 or 1.4306/304
for flanges made of carbon steel with protective coating
- Electrodes: 1.4435, Alloy C-22, tantalum
- Flanges
 - EN 1092-1 (DIN2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B
(DN ≤ 300: with Al/Zn protective coating; DN ≥ 350 with protective coating)
 - ANSI: A105; F316L
(DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective coating)
 - AWWA: 1.0425
 - JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L
(DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective coating)
 - AS 2129
 - (DN 150, 200, 250, 300, 600) A105 or RSt37-2 (S235JRG2)
 - (DN 80, 100, 350, 400, 500) A105 or St44-2 (S275JR)
 - AS 4087: A105 or St44-2 (S275JR)
- Seals: as per DIN EN 1514-1
- Ground disks: 1.4435/316L, Alloy C-22, titanium, tantalum

Promag P

- Transmitter housing:
 - Compact housing: powder-coated die-cast aluminum
 - Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
 - DN 15 to 300: powder-coated die-cast aluminum
 - DN 350 to 2000: with protective coating
- Measuring tube
 - DN ≤ 300: stainless steel 1.4301 or 1.4306/304L
for flanges made of carbon steel with protective coating
 - DN ≥ 350: stainless steel 1.4301 or 1.4306/304
for flanges made of carbon steel with protective coating
- Electrodes: 1.4435; Alloy C-22; titanium; tantalum; platinum
- Flanges
 - EN 1092-1 (DIN2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B
(DN ≤ 300: with Al/Zn protective coating; DN ≥ 350 with protective coating)
 - ANSI: A105; F316L
(DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective coating)
 - AWWA: 1.0425
 - JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L
(DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective coating)
 - AS 2129
 - (DN 25) A105 or RSt37-2 (S235JRG2)
 - (DN 40) A105 or St44-2 (S275JR)
 - AS 4087: A105 or St44-2 (S275JR)

- Seals: as per DIN EN 1514-1
- Ground disks: 1.4435/316L, Alloy C-22, titanium, tantalum

Promag H

Transmitter housing:

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

Flanges:

- Connection generally made of stainless steel 1.4404/316L
- Flanges (EN (DIN), ANSI, JIS) also in PVDF
- Adhesive fitting made of PVC

Electrodes:

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

Seals:

- DN 2 to 25: O-ring (EPDM, Viton, Kalrez) or molded seal (EPDM, silicone, Viton)
- DN 40 to 100: molded seal (EPDM, silicone)

Grounding rings:

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

Material load diagrams

The material load diagrams (pressure-temperature diagrams) for the process connections can be found in the separate "Technical Information" documentation, which you can download in PDF format from www.endress.com.

A list of available "Technical Information" documentation can be found in the "Documentation" →  134 section.

Fitted electrodes

Promag W

Available as standard:

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

Optionally available:

- Exchangeable measuring electrodes for DN 350 to 2000 (14" to 78")

Promag P

Available as standard:

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

Optionally available:

- Platinum measuring electrodes only

Promag H

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection, not for DN 2 to 15 (1/12" to 1/2")

Process connection	<i>Promag W and Promag P</i> Flange connections: ■ EN 1092-1 (DIN 2501) – DN ≤ 300 = form A – DN ≥ 350 = form B – DN 65 PN 16 and DN 600 PN 16 exclusively according to EN 1092-1 ■ ANSI ■ AWWA (Promag W only) ■ JIS ■ AS <i>Promag H</i> With O-ring: ■ Weld nipple DIN (EN), ISO 1127, ODT/SMS ■ Flange EN (DIN), ANSI, JIS ■ Flange made of PVDF EN (DIN), ANSI, JIS ■ External thread ■ Internal thread ■ Hose connection ■ PVC adhesive fitting With molded seal: ■ Weld nipple DIN 11850, ODT/SMS ■ Clamp ISO 2852, DIN 32676, L14 AM7 ■ Coupling DIN 11851, DIN 11864-1, ISO 2853, SMS 1145 ■ Flange DIN 11864-2
Surface roughness	All data relate to parts in contact with fluid. ■ Liner → PFA: ≤ 0.4 µm (15 µin) ■ Electrodes: 0.3 to 0.5 µm (12 to 20 µin) ■ Process connection made of stainless-steel (Promag H): ≤ 0.8 µm (31 µin)

10.1.11 Human interface

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

Operating elements	■ Local operation with three optical keys ([-]/[+]/[E]) ■ Application-specific Quick Setup menus for straightforward commissioning
--------------------	---

Language groups	Language groups available for operation in different countries: ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish, Czech ■ South and east Asia (SEA): English, Japanese, Indonesian ■ China (CN): English, Chinese
-----------------	--



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

10.1.12 Certificates and approvals

CE mark	The measuring system complies with the legal requirements of the EU directives. Endress+Hauser confirms that the device has been tested successfully by affixing the CE mark to it.
---------	---

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

Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, TIIS, IECEx, NEPSI etc.) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.
-------------	---

Sanitary compatibility	<i>Promag W and Promag P</i> No applicable approvals or certification <i>Promag H</i> ■ 3A-approval and EHEDG-tested ■ Seals: FDA-compliant (except for Kalrez seals)
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Drinking water approval	<i>Promag W</i> ■ WRAS BS 6920 ■ ACS ■ NSF 61 ■ KTW/W270 <i>Promag P</i> ■ ACS
-------------------------	---

Pressure device approval	Measuring devices with a nominal diameter smaller than or equal to DN 25 correspond to Article 3(3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. For larger nominal diameters, optional approvals according to Cat. II/III are available when required (depends on fluid and process pressure).
MODBUS RS485	The measuring device meets all the requirements of the MODBUS/TCP conformity and integration test and holds the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the "MODBUS/TCP Conformance Test Laboratory" of the University of Michigan.
Other standards and guidelines	■ EN 60529: Degrees of protection by housing (IP code) ■ EN 61010-1 Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures ■ IEC/EN 61326 "Emission in accordance with requirements for class A". Electromagnetic compatibility (EMC requirements). ■ ANSI/ISA-S82.01 Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements. Pollution degree 2, Installation Category II. ■ CAN/CSA-C22.2 (No. 1010.1-92) Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category I. ■ NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment. ■ NAMUR NE 43 Standardization of the signal level for the breakdown information of digital transmitters with analog output signal. ■ NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics.

10.1.13 Ordering information

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

10.1.14 Accessories

Various accessories are available for the transmitter and the sensor. These can be ordered separately from Endress+Hauser →  94.



Note!

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

10.1.15 Documentation

- Flow Measurement (FA005D/06)
- Promag 53W Technical Information (TI046D/06)
- Promag 53P Technical Information (TI047D/06)
- Promag 53H Technical Information (TI048D/06)
- Description of Device Functions Promag 53 MODBUS RS485 (BA118D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA

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V

Vibration resistance

Vibrations

Measures to prevent vibrations.

Shock and vibration resistance

W

Wall-mount housing, installing

Weight

(SI units)

(US units)

Weld nipple, Promag H

Writes (max.)

120

16

16

120

37

125

127

34

64

138

Endress+Hauser

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

RA No.

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

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

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

Type of instrument / sensor

Geräte-/Sensortyp

Serial number

Seriennummer

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

Process data / Prozessdaten

Temperature / *Temperatur* _____ [°F] _____ [°C]

Conductivity / *Leitfähigkeit* _____ [µS/cm]

Pressure / *Druck* _____ [psi] _____ [Pa]

Viscosity / *Viskosität* _____ [cp] _____ [mm²/s]

Medium and warnings

Warnhinweise zum Medium



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

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

* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

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

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

Description of failure / Fehlerbeschreibung

Company data / Angaben zum Absender

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

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

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

(place, date / *Ort, Datum*)

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

Signature / *Unterschrift*

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