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APPENDIX D-5 FLOW TRANSMITTER AND CONTROL

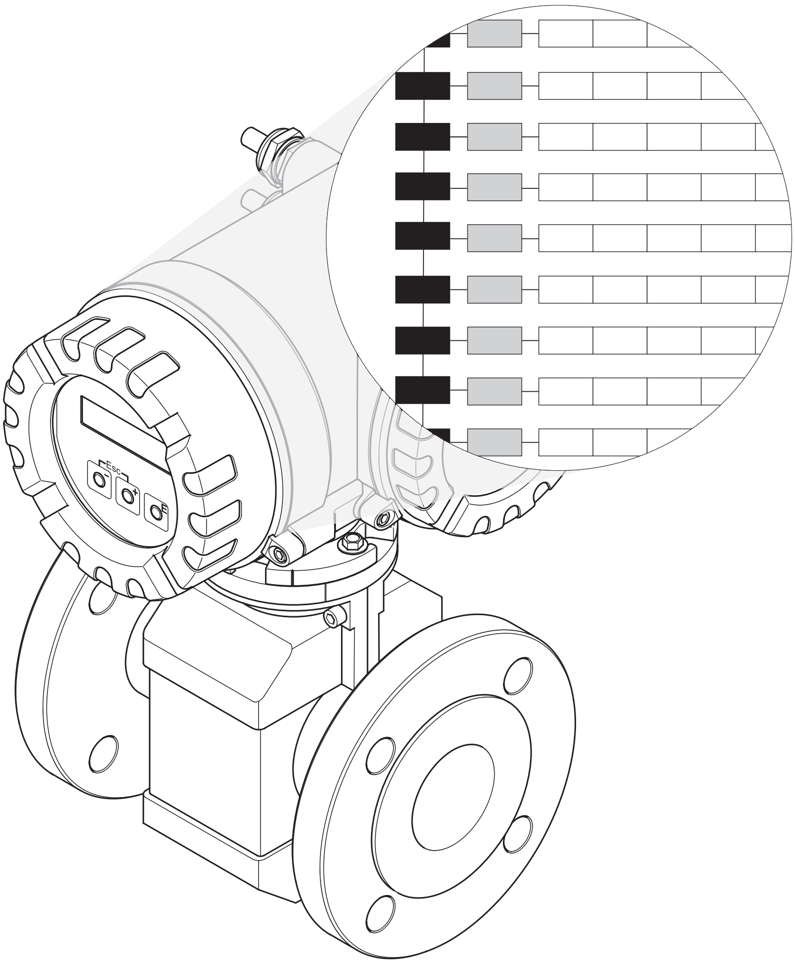
- Endress+Hauser Promag 30 Series
- Endress+Hauser Promag 50 Series

Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Description of Device Functions

Proline Promag 50

Electromagnetic Flow Measuring System



BA049D/06/en/11.09
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Valid as of version:
V 2.03.XX (Device software)

Endress+Hauser
People for Process Automation

Contents

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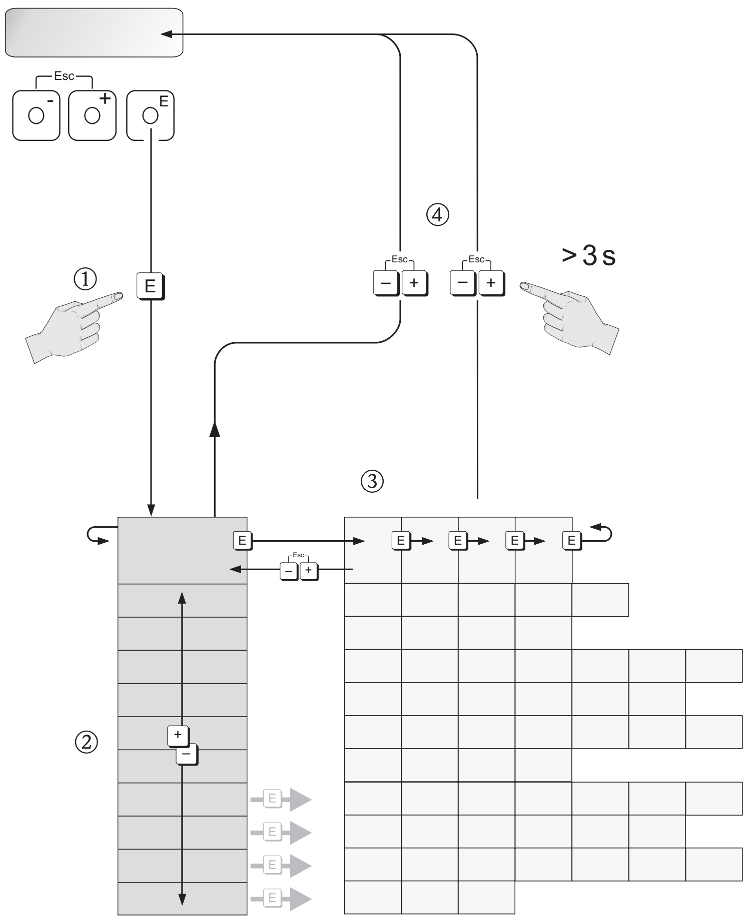
1 Function matrix Promag 50

1.1 The function matrix: layout and use

The function matrix is a two-level construct: the groups form one level and the groups' functions the other.
The groups are the highest-level grouping of the operating options for the measuring device.
A number of functions is assigned to each group.
You select a group in order to access the individual functions for operating and parameterizing the measuring device.
An overview of all the groups available is provided in the table of contents on Page 3 and in the graphical representation of the function matrix on Page 6.
An overview of all the functions available is provided on Page 6, complete with page references to the detailed function descriptions.
The descriptions of the individual functions start on Page 7.

Example of how to parameterize a function (in this case changing the language for the UI):

1. Enter into the function matrix (E-key).
2. Select the OPERATION group.
3. Select the LANGUAGE function, change the setting from ENGLISH to DEUTSCH with +- and save with E (all text on the display now appears in German).
4. Exit the function matrix (ESC > 3 seconds).



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1.2 Illustration of the function matrix

Function groups ▶	Functions →									
MEASURING VALUES (P. 7)	VOLUME FLOW (P. 7)									
SYSTEM UNITS (P. 8)	UNIT VOL. FLOW (P. 8)	UNIT VOLUME (P. 8)	UNIT LENGTH (P. 9)	FORMAT DATE/TIME (P. 9)						
QUICK SETUP (P. 10)	QUICK SETUP COMMISSION (P. 10)									
OPERATION (P. 11)	LANGUAGE (P. 11)	ACCESS CODE (P. 12)	PRIVATE CODE (P. 12)	STATUS ACCESS (P. 12)	ACCESS CODE COUNTER (P. 12)					
USER INTERFACE (P. 13)	ASSIGN LINE 1 (P. 13)	ASSIGN LINE 2 (P. 13)	100% VALUE (P. 13)	FORMAT (P. 14)	DISPL. DAMPING (P. 14)	CONTRAST LCD (P. 14)	BACKLIGHT (P. 15)	DISPLAY TEST (P. 15)		
TOTALIZER 1/2 (P. 16)	ASSIGN TOTALIZER (P. 16)	SUM (P. 16)	OVERFLOW (P. 16)	UNIT TOTALIZER (P. 16)	TOTALIZER MODE (P. 17)	RESET TOTALIZ. (P. 17)				
HANDLING TOTALIZ. (P. 18)	RESET ALL TOTAL. (P. 18)	FAILSAFE MODE (P. 18)								
CURRENT OUTPUT (P. 19)	ASSIGN CURRENT OUTP. (P. 19)	CURRENT SPAN (P. 20)	VALUE 20 mA (P. 21)	TIME CONSTANT (P. 21)	FAILSAFE MODE (P. 21)	ACTUAL CURRENT (P. 21)	SIMUL. CURRENT (P. 22)	VALUE SIM. CURRENT (P. 22)		
PULSE/FREQ. OUTP. (P. 23)	OPERATION MODE (P. 23)	ASSIGN FREQ. (P. 23)	END VALUE FREQ. (P. 23)	VALUE-f HIGH (P. 24)	OUTPUT SIGNAL (P. 25)	TIME CONSTANT (P. 27)	FAILSAFE MODE (P. 27)	FAILSAFE VALUE (P. 27)	ACTUAL FREQ. (P. 27)	SIMUL. FREQ. (P. 28)
	VALUE SIM. FREQ. (P. 28)	ASSIGN PULSE (P. 28)	PULSE VALUE (P. 29)	PULSE WIDTH (P. 29)	OUTPUT SIGNAL (P. 30)	FAILSAFE MODE (P. 32)	SIMULATION PULSE (P. 32)	VALUE SIM. PULSE (P. 33)		
STATUS OUTPUT (P. 34)	ASSIGN STATUS (P. 34)	ON-VALUE (P. 34)	OFF-VALUE (P. 35)	TIME CONSTANT (P. 35)	ACTUAL STATUS (P. 35)	SIM. SWITCH POINT (P. 35)	VAL. SIM. SWIT. PT. (P. 36)			
STATUS INPUT (P. 40)	ASSIGN STATUS (P. 40)	ACTIVE LEVEL (P. 40)	MIN. PULSE WIDTH (P. 40)	SIM. STATUS INP. (P. 40)	VALUE SIM. STATUS (P. 41)					
COMMUNICATION (P. 42)	TAG NAME (P. 42)	TAG DESCR. (P. 42)	BUS ADDRESS (P. 42)	HART PROTOCOL (P. 42)	MANUFACT. ID (P. 42)	DEVICE ID (P. 42)	DEVICE REVISION (P. 42)			
PROCESS PARAM. (P. 43)	ASSIGN LF CUT OFF (P. 43)	ON-VALUE (P. 43)	OFF-VALUE (P. 43)	EMPTY PIPE DET. (P. 44)	EPD/OED ADJ. (P. 46)	EPD/OED RES.TIME (P. 47)	ECC (P. 47)	ECC DURATION (P. 47)	ECC RECOVERY TIME (P. 48)	ECC CLEAN. CYCL. (P. 48)
SYSTEM PARAM. (P. 49)	INSTALL. DIRECT. (P. 49)	MEASURING MODE (P. 49)	POS. ZERO RETURN (P. 50)	SYSTEM DAMPING (P. 51)	INTEGRAT. TIME (P. 51)					
SENSOR DATA (P. 52)	CALIBRATION DATE (P. 52)	K-FACTOR (P. 52)	ZERO POINT (P. 52)	NOM. DIAMETER (P. 52)	MEAS. PERIOD (P. 53)	OVERVLTG TIME (P. 53)	EPD ELECTRODE (P. 53)	POLARITY ECC (P. 53)		
SUPERVISION (P. 54)	CURR. SYS. COND. (P. 54)	PREV. SYS. COND. (P. 54)	ASSIGN SYS. ERR. (P. 54)	ERROR CATEG. (P. 54)	ASSIGN PROC. ERR. (P. 54)	ERROR CATEG. (P. 55)	ALARM DELAY (P. 55)	SYSTEM RESET (P. 55)	OPERAT. HRS. (P. 55)	
SIMULAT. SYSTEM (P. 56)	SIM. FAILS. MODE (P. 56)	SIM. MEAS. VARIAB. (P. 56)	VAL.SIM.MEAS.VAR. (P. 56)							
SENSOR VERSION (P. 57)	SERIAL NUMBER (P. 57)	SENSOR TYPE (P. 57)	HW REV. SENS. (P. 57)	SW REV. NO. S-DAT (P. 57)						
AMPLIFIER VERS. (P. 57)	DEVICE SOFTWARE (P. 57)	SW REV. AMPL. (P. 57)	LANGUAGE GROUP (P. 57)	I/O MODULE TYPE (P. 57)	SW REV. I/O MOD. (P. 57)					

2 Group MEASURING VALUES

Function description MEASURING VALUES	
✎ Note! ▪ The engineering unit of the measured variable displayed here can be set in the SYSTEM UNITS group, (see Page 8). ▪ If the fluid in the pipe flows backwards, a negative sign prefixes the flow reading on the display.	
VOLUME FLOW	The volume flow currently measured appears on the display. **User interface:** 5-digit floating-point number, including unit and sign (e.g. 5.5445 dm^3/min; 1.4359 m^3/h; –731.63 gal/d; etc.)

3 Group SYSTEM UNITS

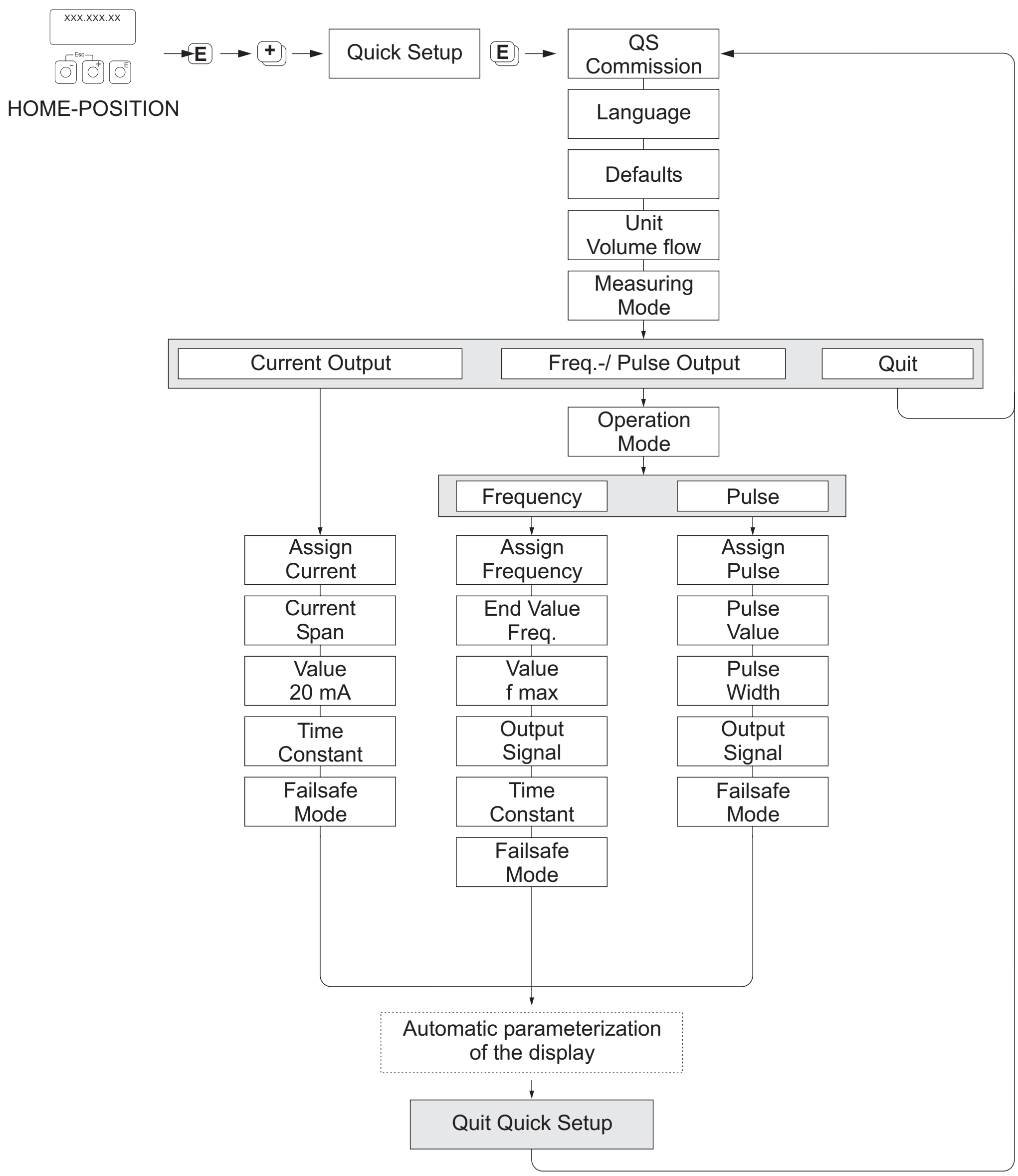
Function description SYSTEM UNITS	
Use this function group to select the unit for the measured variable.	
UNIT VOLUME FLOW	Use this function to select the unit for displaying the volume flow. The unit you select here is also valid for: ▪ Current output ▪ Frequency output ▪ Switch points (limit value for volume flow, flow direction) ▪ Low flow **Options:** Metric: Cubic centimeter → cm^3/s; cm^3/min; cm^3/h; cm^3/day Cubic decimeter → dm^3/s; dm^3/min; dm^3/h; dm^3/day Cubic meter → m^3/s; m^3/min; m^3/h; m^3/day Milliliter → ml/s; ml/min; ml/h; ml/day Liter → l/s; l/min; l/h; l/day Hectoliter → hl/s; hl/min; hl/h; hl/day Megaliter → Ml/s; Ml/min; Ml/h; Ml/day US: Cubic centimeter → cc/s; cc/min; cc/h; cc/day Acre foot → af/s; af/min; af/h; af/day Cubic foot → ft^3/s; ft^3/min; ft^3/h; ft^3/day Fluid ounce → oz f/s; oz f/min; oz f/h; oz f/day Gallon → gal/s; gal/min; gal/h; gal/day Kilo gallon → Kgal/s; Kgal/min; Kgal/h; Kgal/day Million gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (normal fluids: 31.5 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (beer: 31.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 42.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (filling tanks: 55.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Imperial: Gallon → gal/s; gal/min; gal/h; gal/day Mega gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (beer: 36.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 34.97 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).
UNIT VOLUME	Use this function to select the unit for displaying the volume. The unit you select here is also valid for: ▪ Pulse weighting (e.g. m^3/p) **Options:** Metric → cm^3; dm^3; m^3; ml; l; hl; Ml Mega US → cc; af; ft^3; oz f; gal; Kgal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals) → bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! The unit of the totalizers is independent of your choice here. The unit for each totalizer is selected separately for the totalizer in question.

Function description SYSTEM UNITS	
UNIT LENGTH	Use this function to select the unit for displaying the length of the nominal diameter. The unit you select here is also valid for: ▪ Nominal diameter of sensor (see function NOMINAL DIAMETER on Page 48) **Options:** MILLIMETER INCH **Factory setting:** MILLIMETER (SI units: not for USA and Canada) INCH (US units: only for USA and Canada)
FORMAT DATE/TIME	Use this function to select the format for the date and the time. The unit you select here is also valid for: Displaying the current calibration date (function CALIBRATION DATE on Seite 52) **Options:** DD.MM.YY 24H MM/DD/YY 12H A/P DD.MM.YY 12H A/P MM/DD/YY 24H **Factory setting:** DD.MM.YY 24H (SI units) MM/DD/YY 12H A/P (US units)

4 Group QUICK SETUP

Function description QUICK SETUP	
QUICK SETUP COMMISSION	Use this function to start the Quick Setup menu for commissioning. **Options:** YES NO **Factory setting:** NO

✎ Note!
The display returns to the QUICK SETUP COMMISSION cell if you press the ESC key combination during interrogation.



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5 Group OPERATION

Function description OPERATION	
LANGUAGE	Use this function to select the language for all texts, parameters and messages shown on the local display. ✎ Note! The displayed options depend on the available language group shown in the LANGUAGE GROUP function. **Options:** Language group WEST EU / USA: ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO NEDERLANDS PORTUGUESE Language group EAST EU / SCAND: ENGLISH NORSK SVENSKA SUOMI POLISH RUSSIAN CZECH Language group ASIA: ENGLISH BAHASA INDONESIA JAPANESE (Silbenschrift) **Factory setting:** Country-dependent (see Page 58 ff.) ✎ Note! ▪ If you press the +/- keys simultaneously at startup, the language defaults to "ENGLISH". ▪ You can change the language group via the configuration program FieldCare. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

Function description OPERATION	
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the +/- keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can enable programming by entering your personal code, (**factory setting = 50**, see function PRIVATE CODE on Page 12) **User input:** max. 4-digit number: 0...9999 ✎ Note! ▪ The programming levels are disabled if you do not press a key within 60 seconds following automatic return to the HOME position. ▪ You can also disable programming in this function by entering any number (other than the defined private code). ▪ The Endress+Hauser service organization can be of assistance if you mislay your personal code.
PRIVATE CODE	Use this function to enter a personal code number for enabling programming. **User input:** 0...9999 (max. 4-digit number) **Factory setting:** 50 ✎ Note! ▪ Programming is always enabled with the code "0". ▪ Programming has to be enabled before this code can be changed. When programming is disabled this function is not available, thus preventing others from accessing your personal code.
STATUS ACCESS	Use this function to check the access status for the function matrix. **User interface:** ACCESS CUSTOMER (parameterization possible) LOCKED (parameterization disabled)
ACCESS CODE COUNTER	Displays how often the customer code, service code or the digit "0" (code-free) has been entered to gain access to the function matrix. **Display:** max. 7-digit number: 0...9999999 **Factory setting:** 0

6 Group USER INTERFACE

Function description USER INTERFACE	
ASSIGN LINE 1	Use this function to define which display value is assigned to the main line (top line of the local display) for display during normal measuring operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % TOTALIZER 1 TOTALIZER 2 **Factory setting:** VOLUME FLOW
ASSIGN LINE 2	Use this function to define which display value is assigned to the additional line (bottom line of the local display) for display during normal measuring operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % VOLUME FLOW BARGRAPH IN % TOTALIZER 1 TAG NAME OPERATING/SYSTEM CONDITION FLOW DIRECTION TOTALIZER 2 **Factory setting:** TOTALIZER 1
100% VALUE	✎ Note! This function is only available if VOLUME FLOW IN % or VOLUME FLOW BARGRAPH IN % was selected in the function ASSIGN LINE 1 or ASSIGN LINE 2. Use this function to define the flow value to be shown on the display as the 100% value. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).

Function description USER INTERFACE	
FORMAT	Use this function to define the maximum number of places after the decimal point displayed for the reading in the main line. **Options:** XXXXX. – XXXX.X – XXX.XX – XX.XXX – X.XXXX **Factory setting:** X.XXXX ✎ Note! ▪ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ▪ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In such instances an arrow appears on the display between the measuring value and the engineering unit (e.g. 1.2 → l/h), indicating that the measuring system is computing with more decimal places than can be shown on the display.
DISPLAY DAMPING	Use this function to enter a time constant defining how the display reacts to severely fluctuating flow variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** 0...100 seconds **Factory setting:** 3 s ✎ Note! Setting the time constant to zero seconds switches off damping.
CONTRAST LCD	Use this function to optimize display contrast to suit local operating conditions. **User input:** 10...100% **Factory setting:** 50%

Function description USER INTERFACE	
BACKLIGHT	Use this function to optimize the backlight to suit local operating conditions. **User input:** 0...100% ✎ Note! Entering the value "0" means that the backlight is "switched off". The display then no longer emits any light, i.e. the display texts can no longer be read in the dark. **Factory setting:** 50%
DISPLAY TEST	Use this function to test the operability of the local display and its pixels. **Options:** OFF ON **Factory setting:** OFF Test sequence: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for at least 0.75 seconds. 3. The main line and additional line show an "8" in each field for at least 0.75 seconds. 4. The main line and additional line show a "0" in each field for at least 0.75 seconds. 5. The main line and additional line show nothing (blank display) for at least 0.75 seconds. When the test completes the local display returns to its initial state and the setting changes to OFF.

7 Group TOTALIZER 1/2

Function description TOTALIZER 1/2	
ASSIGN TOTALIZER	Use this function to assign a measured variable (volume flow) to the totalizer. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! The totalizer is reset to "0" as soon as the selection is changed.
SUM	Use this function to view the total for the totalizer measured variable aggregated since measuring commenced. The value can be positive or negative. **User interface:** max. 7-digit floating-point number, including sign and unit (e.g. 896,845.7 dm^3) ✎ Note! The totalizer response to faults is defined in the FAILSAFE MODE function (see Page 18).
OVERFLOW	Use this function to view the overflow for the totalizer aggregated since measuring commenced. Total flow quantity is represented by a floating decimal point number consisting of max. 7 digits. You can use this function to view higher numerical values (>9 999 999) as overflows. The effective quantity is thus the total of OVERFLOW plus the value returned by the SUM function. Example: Reading for 2 overflows: 2 E7 kg (= 2 000 000 dm^3) The value returned by the SUM function = 896,845.7 dm^3 Effective total quantity = 2,896,845.7 dm^3 **Display shows:** Integer with exponent, including sign and unit, e.g. 2 E7 dm^3
UNIT TOTALIZER	Use this function to define the unit for the totalizer. **Options:** Metric → cm^3; dm^3; m^3; ml; l; hl; Ml Mega US → cc; af; ft^3; oz f; gal; Kgal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals); bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).

Function description TOTALIZER 1/2	
TOTALIZER MODE	Use this function to define how the flow components are to be totalised. **Options:** BALANCE Positive and negative flow components. The positive and negative flow components are balanced. In other words, net flow in the flow direction is registered. FORWARD Positive flow components only REVERSE Negative flow components only **Factory setting:** Totalizer 1 = BALANCE Totalizer 2 = FORWARD
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to "zero" (= RESET). **Options:** NO YES **Factory setting:** NO ✎ Note! If the device is equipped with a status input and if it is appropriately configured, totalizer resetting can also be triggered by a pulse.

8 Group HANDLING TOTALIZER

Function description HANDLING TOTALIZER	
RESET ALL TOTALIZERS	Use this function to reset the totals (including all overflows) of the totalizers (1...2) to "zero". **Options:** NO YES **Factory setting:** NO ✎ Note! If the device has a status input and if it is appropriately configured, a reset for the totalizer (1...2) can also be triggered by a pulse (see the ASSIGN STATUS INPUT function on Page 31).
FAILSAFE MODE	Use this function to define the totalizer response in case of fault. **Options:** STOP The totalizer is paused until the fault is rectified. ACTUAL VALUE The totalizer continues to count on the basis of the current flow measuring value. The fault is ignored. HOLD VALUE The totalizer continues to count the flow that is based on the last valid flow measuring value (before the fault occurred). **Factory setting:** STOP

9 Group CURRENT OUTPUT

Function description CURRENT OUTPUT	
ASSIGN CURRENT OUTPUT	Use this function to assign a measured variable to the current output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! If you select OFF, the only function shown in this group is the function (ASSIGN CURRENT OUTPUT).

Function description CURRENT OUTPUT

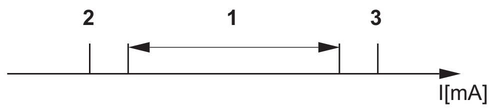
CURRENT SPAN

Use this function to define the current span. The selection specifies the operational range and the lower and upper signal on alarm. For the current output the option HART can be defined additionally.

Options:
0–20 mA
4–20 mA
4–20 mA HART
4–20 mA NAMUR
4–20 mA HART NAMUR
4–20 mA US
4–20 mA HART US
0–20 mA (25 mA)
4–20 mA (25 mA)
4–20 mA (25 mA) HART

Factory setting:
4–20 mA HART NAMUR

Current span, operational range and signal on alarm level



a	1	2	3
0-20 mA	0 - 20.5 mA	0	22
4-20 mA	4 - 20.5 mA	2	22
4-20 mA HART	4 - 20.5 mA	2	22
4-20 mA NAMUR	3.8 - 20.5 mA	3.5	22.6
4-20 mA HART NAMUR	3.8 - 20.5 mA	3.5	22.6
4-20 mA US	3.9 - 20.8 mA	3.75	22.6
4-20 mA HART US	3.9 - 20.8 mA	3.75	22.6
0-20 mA (25 mA)	0 - 24 mA	0	25
4-20 mA (25 mA)	4 - 24 mA	2	25
4-20 mA (25 mA) HART	4 - 24 mA	2	25

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a = Current span
1 = Operational range (measuring information)
2 = Lower signal on alarm level
3 = Upper signal on alarm level

✎ Note!

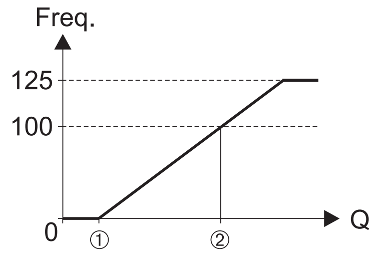
- When switching the hardware from an active (factory setting) to a passive output signal select a current span of 4–20 mA.
- If the measured value exceeds the measuring range a notice message is generated (#351...354, current span).
- In case of a fault the behaviour of the current output is according to the selected option in the function FAILSAFE MODE (see Page 21). Change the error category in the function ASSIGN SYSTEM ERROR (see Page 54) to generate a fault message instead of a notice message.

Function description CURRENT OUTPUT	
VALUE 20 mA	Use this function to assign the 20 mA current a full scale value. Positive and negative values are permissible. The required measuring range is defined by defining the VALUE 20 mA. In the SYMMETRY measuring mode, (see Page 45), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input:** 5-digit floating-point number, with sign **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! ■ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ■ The value for 0 or 4 mA always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.
TIME CONSTANT	Use this function to enter a time constant defining how the current output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** fixed-point number 0.01...100.00 s **Factory setting:** 3.00 s
FAILSAFE MODE	For safety reasons it is advisable to ensure that the current output assumes a predefined state in the event of a fault. The setting you select here affects only the current output. The failsafe mode of other outputs and the totalizers is defined in the corresponding function groups. **Options:** MIN. CURRENT The current output adopts the value of the lower signal on alarm level (as defined in the function CURRENT SPAN). MAX. CURRENT The current output adopts the value of the upper signal on alarm level (as defined in the function CURRENT SPAN). HOLD VALUE (**not recommended**) Measuring value output is based on the last measuring value saved before the error occurred . ACTUAL VALUE Measured value output is based on the current flow measurement. The fault is ignored . **Factory setting:** MIN. CURRENT
ACTUAL CURRENT	Use this function to view the computed actual value of the output current. **User interface:** 0.00...25.00 mA

Function description CURRENT OUTPUT	
SIMULATION CURRENT	Use this function to activate simulation of the current output. **Options:** OFF ON **Factory setting:** OFF ✎ Note! ▪ The "SIMULATION CURRENT OUTPUT" notice message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. ☝ Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION CURRENT	✎ Note! This function is not available unless the function SIMULATION CURRENT is active (= ON). Use this function to define a selectable value (e.g. 12 mA) to be output at the current output. This value is used to test downstream devices and the measuring device itself. **User input:** Floating-point number: 0.00...25.00 mA **Factory setting:** 0.00 mA ☝ Caution! The setting is not saved if the power supply fails.

10 Group PULSE/FREQUENCY OUTPUT

Function description PULSE/FREQUENCY OUTPUT	
This group is not available unless the measuring device is equipped with a pulse/frequency output.	
OPERATION MODE	Use this function to configure the output as a pulse output or frequency output. The functions available in this function group vary, depending on which option you select here. **Options:** PULSE FREQUENCY **Factory setting:** PULSE
ASSIGN FREQUENCY	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to assign a measured variable to the frequency output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! If you select OFF, the only functions shown in this function group are the functions ASSIGN FREQUENCY and OPERATION MODE.
END VALUE FREQ.	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to define a full scale frequency for the frequency output. You define the associated measured value of the measuring range in the function VALUE-f HIGH on Page 24. **User input:** 4-digit fixed-point number 2...1250 Hz **Factory setting:** 1000 Hz Example: ▪ VALUE-f HIGH = 1000 l/h, end frequency = 1000 Hz: i.e. at a flow of 1000 l/h, a frequency of 1000 Hz is output. ▪ VALUE-f HIGH = 3600 l/h, end frequency = 1000 Hz: i.e. at a flow of 3600 l/h, a frequency of 1000 Hz is output. ✎ Note! ▪ In the FREQUENCY operating mode the output signal is symmetrical (on/off ratio = 1:1). At low frequencies the pulse duration is limited to a maximum of 2 seconds, i.e. the on/off ratio is no longer symmetrical. ▪ The initial frequency is always 0 Hz. This value is fixed and cannot be edited.

Function description PULSE/FREQUENCY OUTPUT	
VALUE-f HIGH	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to assign a value to the end value frequency. Positive and negative values are permissible. The required measuring range is defined by defining the VALUE-f HIGH. In the SYMMETRY measuring mode, (see Page 45), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter and country, [value] / [dm^3...m^3 or US-gal...US-Mgal] corresponds to the factory setting for the final value (see Page 58 ff.) .  A0001279 ① = *Value-f min.* ② = *Value-f high* ✎ Note! ▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ▪ The value-f min. for the initial frequency always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL

✎ Note!
Function is not available unless the FREQUENCY setting was selected in the OPERATION MODE function.

For selecting the output configuration of the frequency output.

Options:
PASSIVE - POSITIVE
PASSIVE - NEGATIVE

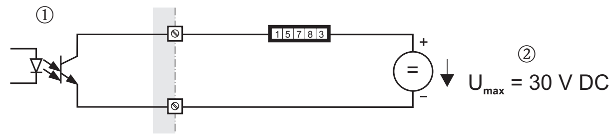
Factory setting: PASSIVE - POSITIVE

Explanation
- PASSIVE = power is supplied to the frequency output by means of an external power supply.

Configuring the output signal level (POSITIVE or NEGATIVE) determines the quiescent behaviour (at zero flow) of the frequency output.
The internal transistor is activated as follows:
- If POSITIVE is selected, the internal transistor is activated with a **positive** signal level.
- If NEGATIVE is selected, the internal transistor is activated with a **negative** signal level (0 V).

✎ Note!
With the passive output configuration, the output signal levels of the frequency output depend on the external circuit (see examples).

Example for passive output circuit (PASSIVE)
If PASSIVE is selected, the frequency output is configured as an open collector.

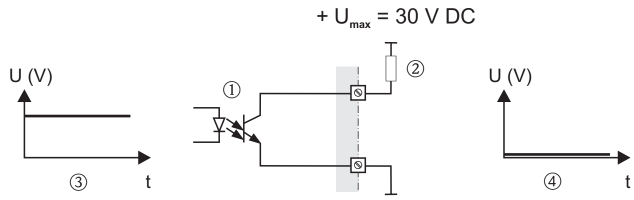


A0001225

① = *Open collector*
② = *External power supply*

✎ Note!
For continuous currents up to 25 mA (I_{max} = 250 mA / 20 ms).

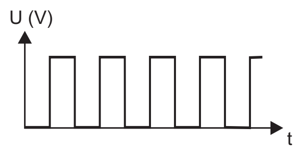
Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-up resistance.
In the quiescent state (at zero flow), the output signal level at the terminals is 0 V.



A0004687

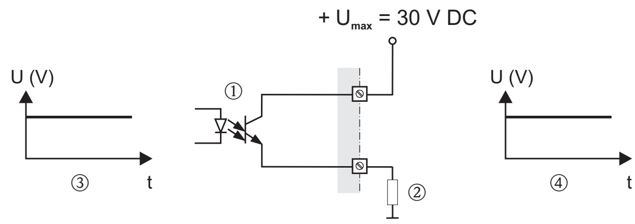
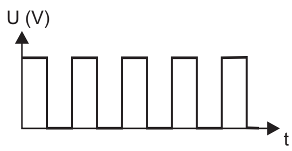
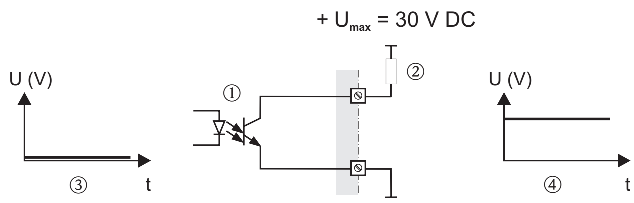
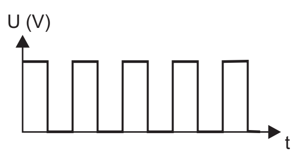
① = *Open collector*
② = *Pull-up resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from 0 V to a positive voltage level.



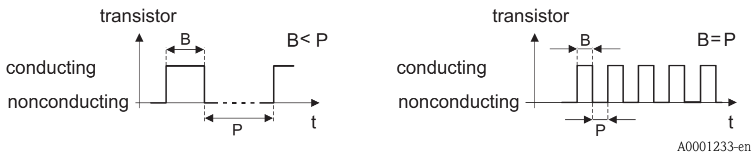
A0001975

(continued on next page)

Function description PULSE/FREQUENCY OUTPUT	
OUTPUT SIGNAL (continued)	**Example for output configuration PASSIVE-POSITIVE:** Output configuration with an external pull-down resistance. In the quiescent state (at zero flow), a positive voltage level is measured via the pull-down resistance.  A0004689 ① = *Open collector* ② = *Pull-down resistance* ③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)* ④ = *Output signal level in quiescent state (at zero flow)* In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.  A0001981 **Example for output configuration PASSIVE-NEGATIVE:** Output configuration with an external pull-up resistance. In the quiescent state (at zero flow), the output signal level at the terminals is at a positive voltage level.  A0004690 ① = *Open collector* ② = *Pull-up resistance* ③ = *Transistor activation in "NEGATIVE" quiescent state (at zero flow)* ④ = *Output signal level in quiescent state (at zero flow)* In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.  A0001981

Function description PULSE/FREQUENCY OUTPUT	
TIME CONSTANT	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to enter a time constant defining how the frequency output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** Floating-point number 0.00...100.00 s **Factory setting:** 0.00 s
FAILSAFE MODE	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. For safety reasons it is advisable to ensure that the frequency output assumes a predefined state in the event of a fault. Use this function to define this state. The setting you select here affects only the frequency output. It has no effect on other outputs and the display (e.g. totalizers). **Options:** FALLBACK VALUE Output is 0 Hz. FAILSAFE LEVEL Output is the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Measuring value output is based on the last measuring value saved before the error occurred. ACTUAL VALUE Measuring value output is based on the current flow measurement. The fault is ignored. **Factory setting:** FALLBACK VALUE
FAILSAFE VALUE	✎ Note! This function is not available unless FREQUENCY was selected in the OPERATION MODE function and FAILSAFE LEVEL was selected in the function FAILSAFE MODE. Use this function to define the frequency that the measuring device should output in the event of a fault. **User input:** max. 4-digit number: 0...1250 Hz **Factory setting:** 1250 Hz
ACTUAL FREQUENCY	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to view the computed value of the output frequency. **User interface:** 0...1250 Hz

Function description PULSE/FREQUENCY OUTPUT	
SIMULATION FREQUENCY	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to activate simulation of the frequency output. **Options:** OFF ON **Factory setting:** OFF ✎ Note! ▪ The "SIMULATION FREQUENCY OUTPUT" notice message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION FREQUENCY	✎ Note! This function is not available unless FREQUENCY was selected in the OPERATION MODE function and the function VALUE SIMULATION FREQUENCY is active (= ON). Use this function to define a selectable frequency value (e.g. 500 Hz) to be output at the frequency output. This value is used to test downstream devices and the measuring device itself. **User input:** 0...1250 Hz **Factory setting:** 0 Hz Caution! The setting is not saved if the power supply fails.
ASSIGN PULSE	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to assign a measured variable to the pulse output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! If you select OFF, the only functions shown in this function group are the functions ASSIGN PULSE and OPERATION MODE.

Function description PULSE/FREQUENCY OUTPUT	
PULSE VALUE	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to define the flow at which a pulse is triggered. These pulses can be totalled by an external totalizer and in this way the total flow since measuring commenced can be registered. **User input:** 5-digit floating-point number, [unit] **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! The appropriate unit is taken from the group SYSTEM UNITS (see Page 8).
PULSE WIDTH	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to enter the maximum pulse width of the output pulses. **User input:** 0.5...2000 ms **Factory setting:** 100 ms Pulse output is **always** with the pulse width (B) entered in this function. The intervals (P) between the individual pulses are automatically configured. However, they must at least correspond to the pulse width (B = P).  B = Pulse width entered (the illustration applies to positive pulses) P= Intervals between the individual pulses ✎ Note! When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC, etc.). ☝ Caution! If the pulse number or frequency resulting from the pulse value entered, (see function PULSE VALUE on Page 27), and from the current flowis too large to maintain the pulse width selected (interval P is smaller than the pulse width B entered), a system error message (pulse memory) is generated after buffering/balancing time.

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL

✎ Note!
Function is not available unless the PULSE setting was selected in the OPERATION MODE function.

For selecting the output configuration of the pulse output.

Options:
PASSIVE - POSITIVE
PASSIVE - NEGATIVE

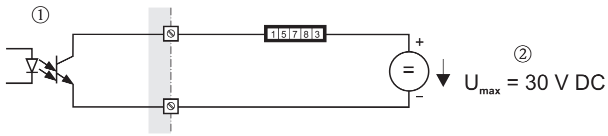
Factory setting: PASSIVE - POSITIVE

Explanation
- PASSIVE = power is supplied to the pulse output by means of an external power supply.

Configuring the output signal level (POSITIVE or NEGATIVE) determines the quiescent behaviour (at zero flow) of the pulse output.
The internal transistor is activated as follows:
- If POSITIVE is selected, the internal transistor is activated with a **positive** signal level.
- If NEGATIVE is selected, the internal transistor is activated with a **negative** signal level (0 V).

✎ Note!
With the passive output configuration, the output signal levels of the pulse output depend on the external circuit (see examples).

Example for passive output circuit (PASSIVE)
If PASSIVE is selected, the pulse output is configured as an open collector.

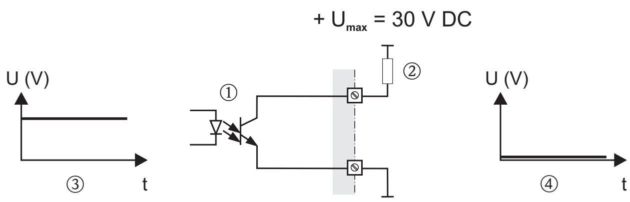


A0001225

① = *Open Collector*
② = *External power supply*

✎ Note!
For continuous currents up to 25 mA (I_{max} = 250 mA / 20 ms).

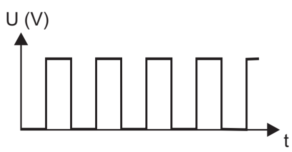
Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-up resistance.
In the quiescent state (at zero flow), the output signal level at the terminals is 0 V.



A0004687

① = *Open Collector*
② = *Pull-Up-Resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from 0 V to a positive voltage level.



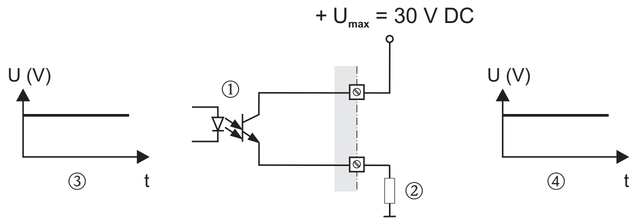
A0001975

(continued on next page)

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL
(continued)

Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-down resistance. In the quiescent state (at zero flow), a positive voltage level is measured via the pull-down resistance.



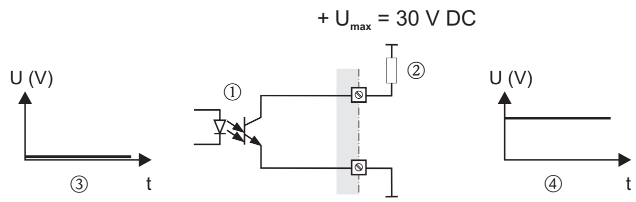
A0004689

① = *Open Collector*
② = *Pull-Down-Resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.

A0001981

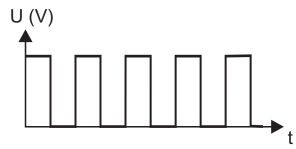
Example for output configuration PASSIVE-NEGATIVE:
Output configuration with an external pull-up resistance. In the quiescent state (at zero flow), the output signal level at the terminals is at a positive voltage level.



A0004690

① = *Open Collector*
② = *Pull-Up-Resistance*
③ = *Transistor activation in "NEGATIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.



A0001981

Function description PULSE/FREQUENCY OUTPUT	
FAILSAFE MODE	✎ Note! This function is not available unless the PULSE setting was selected in the function OPERATION MODE. For safety reasons it is advisable to ensure that the pulse output assumes a predefined state in the event of a fault. Use this function to define this state. The setting you select here affects only the pulse output. It has no effect on other outputs and the display (e.g. totalizers). **Options:** FALLBACK VALUE Output is 0 pulse. ACTUAL VALUE Measuring value output is based on the current flow measurement. The fault is ignored. **Factory setting:** FALLBACK VALUE
SIMULATION PULSE	✎ Note! This function is not available unless the PULSE option was selected in the OPERATION MODE function. Use this function to activate simulation of the pulse output. **Options:** OFF COUNTDOWN The pulses specified in the VALUE SIMULATION PULSE function are output. CONTINUOUSLY Pulses are continuously output with the pulse width specified in the PULSE WIDTH function. Simulation is started once the CONTINUOUSLY option is confirmed with the E key. ✎ Note! Simulation is started by confirming the CONTINUOUSLY option with the E key. The simulation can be switched off again via the SIMULATION PULSE function. **Factory setting:** OFF ✎ Note! ▪ The notice message #631 "SIM. PULSE" indicates that simulation is active. ▪ The on/off ratio is 1:1 for both types of simulation. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measured values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.

Function description PULSE/FREQUENCY OUTPUT	
VALUE SIMULATION PULSE	Note! This function is not available unless the COUNTDOWN option was selected in the SIMULATION PULSE function. Use this function to specify the number of pulses (e.g. 50) which are output during the simulation. This value is used to test downstream devices and the measuring device itself. The pulses are output with the pulse width specified in the PULSE WIDTH function. The on/off ratio is 1:1. Simulation is started once the specified value is confirmed with the E key. The display remains at "0" if the specified pulses have been output. **User input:** 0...10000 **Factory setting:** 0 Note! Simulation is started by confirming the simulation value with the E key. The simulation can be switched off again via the SIMULATION PULSE function. Caution! The setting is not saved if the power supply fails.

11 Group STATUS OUTPUT

<table>
<tr><th colspan="2">Function description STATUS OUTPUT</th></tr>
<tr><td colspan="2">This group is not available unless the measuring device is equipped with a status output.</td></tr>
<tr><td>ASSIGN STATUS OUTPUT</td><td>Use this function to assign a switching function to the status output.

Options:
OFF
ON (operation)
FAULT MESSAGE
NOTICE MESSAGE
FAULT MESSAGE or NOTICE MESSAGE
EPD or OED (Empty Pipe Detection / Open Electrode Detection, only if active)
FLOW DIRECTION
VOLUME FLOW LIMIT VALUE

Factory setting:
FAULT MESSAGE

Note!
■ The behaviour of the status output is a normally closed behaviour, in other words the output is closed (transistor conductive) when normal, error-free measuring is in progress.
■ It is very important to read and comply with the information on the switching characteristics of the status output, (see Page 34).
■ If you select OFF, the only function shown in this function group is the function ASSIGN STATUS OUTPUT.</td></tr>
<tr><td>ON-VALUE</td><td>Note!
This function is not available unless LIMIT VALUE or FLOW DIRECTION was selected in the function ASSIGN STATUS OUTPUT.

Use this function to assign a value to the switch-on point (status output pulls up). The value can be equal to, greater than or less than the switch-off point. Positive and negative values are permissible.

User input:
5-digit floating-point number, [unit]

Factory setting:
0 [unit]

Note!
■ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8).
■ Only the switch-on point is available for flow direction output (no switch-off point). If you enter a value not equal to the zero flow (e.g. 5), the difference between the zero flow and the value entered corresponds to half the switchover hysteresis.</td></tr>
</table>

Function description STATUS OUTPUT	
OFF-VALUE	✎ Note! This function is not available unless LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. Use this function to assign a value to the switch-off point (status output drops out). The value can be equal to, greater than or less than the switch-on point. Positive and negative values are permissible. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] ✎ Note! ■ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ■ If SYMMETRY is selected in the function MEASURING MODE (Page 45) and values with different signs are entered for the switch-on and switch-off points, the notice message "INPUT RANGE EXCEEDED" appears.
TIME CONSTANT	Use this function to enter a time constant defining how the measuring signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). The purpose of damping, therefore, is to prevent the status output changing state continuously in response to fluctuations in flow. **User input:** fixed-point number 0.00...100.00 s **Factory setting:** 0.00 s
ACTUAL STATUS OUTPUT	Use this function to check the current status of the status output. **User interface:** NOT CONDUCTIVE CONDUCTIVE
SIMULATION SWITCH POINT	Use this function to activate simulation of the status output. **Options:** OFF ON **Factory setting:** OFF ✎ Note! ■ The "SIMULATION STATUS OUTPUT" message indicates that simulation is active. ■ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.

Function description STATUS OUTPUT	
VALUE SIMULATION SWITCH POINT	✎ Note! This function is not available unless the function SIMULATION SWITCH POINT is active (= ON). Use this function to define the switching response of the status output during the simulation. This value is used to test downstream devices and the measuring device itself. **Options:** NOT CONDUCTIVE CONDUCTIVE **Factory setting:** NOT CONDUCTIVE Caution! The setting is not saved if the power supply fails.

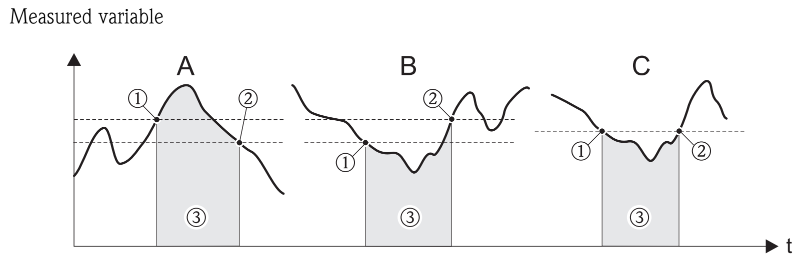
11.1 Information on the response of the status output

General

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

Status output configured for limit value

The status output switches as soon as the measured variable undershoots or overshoots a defined switch point. Application: Monitoring flow or process-related boundary conditions.

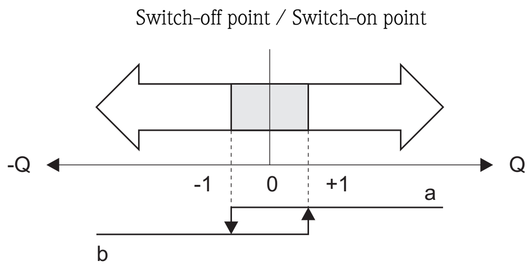


A0001235

A = Maximum safety → ① SWITCH-OFF POINT > ② SWITCH-ON POINT
B = Maximum safety → ① SWITCH-OFF POINT < ② SWITCH-ON POINT
C = Maximum safety → ① SWITCH-OFF POINT = ② SWITCH-ON POINT (this configuration is to avoid)
③ = Status output switched off (not conductive)

Status output configured for flow direction

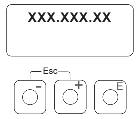
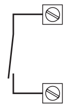
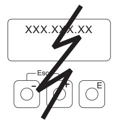
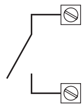
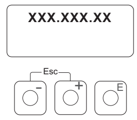
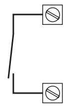
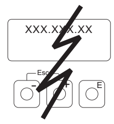
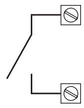
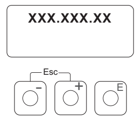
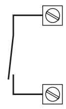
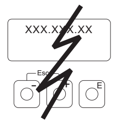
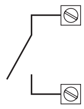
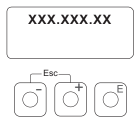
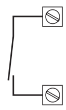
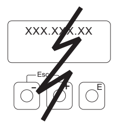
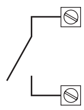
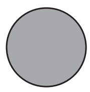
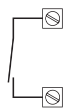
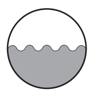
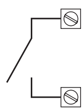
The value entered in the function SWITCH-ON POINT defines the switch point for the positive and negative directions of flow. If, for example, the switch point entered is = 1 m^3/h, the status output switches off at –1 m^3/h (not conductive) and switches on again at +1 m^3/h (conductive).
Set the switch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

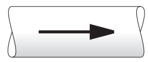
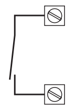
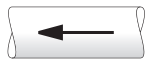
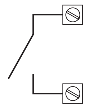
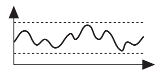
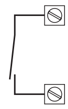
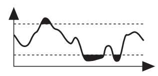
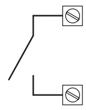


A0001236

a = Status output conductive
b = Status output not conductive

11.2 Switching response of the status output

Function	Status		Open collector response (transistor)	
ON (operation)	System in measuring mode	 A0001052	conductive	 A0001237
	System not in measuring mode (power supply failed)	 A0001291	not conductive	 A0001238
Fault message	System OK	 A0001052	conductive	 A0001237
	(System or process error) Fault → Error response of outputs/inputs and totalizer	 A0001291	not conductive	 A0001238
Notice message	System OK	 A0001052	conductive	 A0001237
	(System or process error) Fault → Continuation of measuring	 A0001291	not conductive	 A0001238
Fault message or notice message	System OK	 A0001052	conductive	 A0001237
	(System or process error) Fault → Response to error or Note → Continuation of measuring	 A0001291	not conductive	 A0001238
Empty pipe detection (EPD) / Open electrode detection (OED)	Measuring tube full	 A0001292	conductive	 A0001237
	Measuring tube partially filled / empty measuring tube	 A0001293	not conductive	 A0001238

Function	Status	Open collector response (transistor)
Flow direction	Forward  A0001241	conduc-tive  A0001237
	Reverse  A0001242	not conduc-tive  A0001238
Limit value Volume flow	Limit value not overshot or undershot  A0001243	conduc-tive  A0001237
	Limit value overshot or undershot  A0001244	not conduc-tive  A0001238

12 Group STATUS INPUT

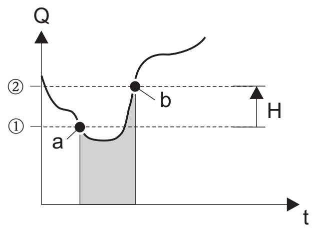
Function description STATUS INPUT	
This group is not available unless the measuring device is equipped with a status input.	
ASSIGN STATUS INPUT	Use this function to assign a switching function to the status input. **Options:** OFF RESET TOTALIZER 1 POSITIVE ZERO RETURN RESET TOTALIZER 2 RESET ALL TOTALIZERS **Factory setting:** OFF ✎ Note! Positive zero return is active as long as the active level is available at the status input (continuous signal). All other assignments react to a change in level (pulse) at the status input.
ACTIVE LEVEL	Use this function to define whether the assigned switch function, (see function ASSIGN STATUS INPUT) is released or sustained when the level is present (HIGH) or not present (LOW). **Options:** HIGH LOW **Factory setting:** HIGH
MINIMUM PULSE WIDTH	Use this function to define a minimum pulse width which the input pulse must achieve in order to trigger the selected switching function. **User input:** 20...100 ms **Factory setting:** 50 ms
SIMULATION STATUS INPUT	Use this function to activate simulation of the status input, i.e. to trigger the function assigned to the status input, (see function ASSIGN STATUS INPUT on Page 31). **Options:** OFF ON **Factory setting:** OFF ✎ Note! ▪ The "SIMULATION STATUS INPUT" notice message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the outputs. Caution! The setting is not saved if the power supply fails.

Function description STATUS INPUT	
VALUE SIMULATION STATUS INPUT	✎ Note! This function is not available unless the function SIMULATION STATUS INPUT is active (= ON). Use this function to select the level to be simulated at the status input. **Options:** HIGH LOW **Factory setting:** LOW Caution! The setting is not saved if the power supply fails.

13 Group COMMUNICATION

Function description COMMUNICATION	
TAG NAME	Use this function to enter a tag name for the measuring device. You can edit and read this tag name at the local display or via the HART protocol. **User input:** max. 8-character text, permitted characters are: A–Z, 0–9, +, –, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _" (no text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag description at the local display or via the HART protocol. **User input:** max. 16-character text, permitted characters are: A–Z, 0–9, +, –, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _" (No text)
BUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. **User input:** 0...15 **Factory setting:** 0 ✎ Note! Addresses 1...15: a constant 4 mA current is applied.
HART PROTOCOL	Use this function to display if the HART protocol is active. **User interface:** OFF = HART protocol not active ON = HART protocol active ✎ Note! The HART protocol is activated by selecting 4–20 mA HART or 4–20 mA (25 mA) HART in the function CURRENT SPAN (see Page 20).
MANUFACTURER ID	Use this function to view the manufacturer. **User interface:** – Endress+Hauser – 17 (≅ 11 hex) for Endress+Hauser
DEVICE ID	Use this function to view the device ID in hexadecimal numerical format. **User interface:** 41 (≅ 65 dez) for Promag 50
DEVICE REVISION	Use this function to view the device-specific revision of the HART command interface. **User interface:** E.g.: 5

14 Group PROCESS PARAMETER

Function description PROCESS PARAMETER	
ASSIGN LOW FLOW CUT OFF	Use this function to assign the switch point for low flow cut off. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW
ON-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-on point for low flow cut off. Low flow cut off is active if the value entered is not equal to 0. The sign of the flow value is highlighted on the display to indicate that low flow cut off is active. **User input:** 5-digit floating-point number, [unit] **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! The appropriate unit is taken from the group SYSTEM UNITS (see Page 8).
OFF-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-off point for low flow cut off. Enter the switch-off point as a positive hysteresis value from the switch-on point. **User input:** Integer 0...100% **Factory setting:** 50%  A0003882 ① = *switch-on point* , ② = *switch-off point* *a = Low flow cut off is switched on* *b = Low flow cut off is switched off (a + a · H)* *H = Hysteresis value: 0 to 100%* *= Low flow cut off active* *Q = Flow*

<table>
<tr><th colspan="2">Function description PROCESS PARAMETER</th></tr>
<tr><td>EMPTY PIPE DETECTION (EPD)</td><td>
Flow cannot be measured correctly unless the measuring tube is full. This status can be monitored at all times with the Empty Pipe Detection function. Use this function to activate Empty Pipe Detection (EPD) or Open Electrode Detection (OED).
▪ 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).

Options:
OFF – ON SPECIAL – OED – ON STANDARD

OFF (neither EPD nor OED are active)

ON SPECIAL (only for DN <400):
Switching on the Empty Pipe Detection (EPD) for devices in remote version (transmitter and sensor are installed separately).

OED:
Switching on the Open Electrode Detection (OED).

ON STANDARD:
Switching on the Empty Pipe Detection (EPD) for:
– Devices in compact version (transmitter and sensor form a single mechanical unit).
– Applications where a facing and coating of the fluid on the measuring tube line and measuring electrode accrues.

Factory setting:
OFF

✎ Note!
▪ The options ON STANDARD and ON SPECIAL are not available unless the sensor is equipped with an EPD electrode.
▪ The default setting for the EPD/OED functions when the device is delivered is OFF. The functions must be activated as required.
▪ The devices are calibrated at the factory with water (approx. 500 µS/cm). If the conductivity of certain fluids deviates from this reference, empty pipe/full pipe adjustment must be performed again on site (see function EPD/OED ADJUSTMENT on page 46).
▪ The adjustment coefficients must be valid before you can switch on the EPD or OED. If these coefficients are not available, the function EPD/OED ADJUSTMENT is displayed (see Page 44).
▪ If there are problems with the adjustment, the following error messages appear on the screen:
– 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 as the fluid conductivity values are outside the permitted range.

(continued on next page)
</td></tr>
</table>

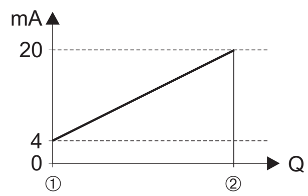
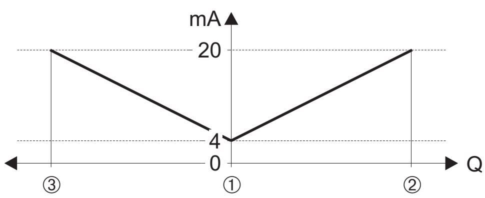
Function description PROCESS PARAMETER	
EMPTY PIPE DETECTION (EPD) (continued)	**Notes on empty pipe detection (EPD and OED)** ▪ Flow cannot be measured correctly unless the measuring pipe is completely full. This status can be monitored at all times by means of the EPD/OED. ▪ An empty or partially filled pipe is a process error. A default factory setting defines that a fault message is issued and that this process error has an effect on the outputs. ▪ The EPD/OED process error can be output via the configurable status output. ▪ Use the function ASSIGN PROCESS ERROR to define whether a notice or fault message should be triggered (see Page 54). ▪ A plausibility check of the adjustment values will only be executed by activating the empty pipe detection. If an empty or full pipe adjustment is performed during the empty pipe detection is active, the empty pipe detection has to be de- and again activated, after finishing the adjustment, to start the plausibility check. **Response to partially filled pipes** If the EPD/OED is switched on and responds to a partially filled or empty pipe, the fault message "EMPTY PIPE" appears on the display. If the pipe is partially empty and the EPD/OED is **not** switched on, the response can vary in identically configured systems: ▪ Flow reading fluctuates ▪ Zero flow ▪ Excessively high flow values **Notes on Open Electrode Detection (OED)** Open Electrode Detection (OED) functions like the Empty Pipe Detection (EPD). In contrast to the EPD where the measuring device must be equipped with a separate (optional) electrode, the OED detects partial filling by means of the two measuring electrodes which are present as standard (fluid no longer covers the measuring electrodes). Open electrode detection can also be used if: ▪ the sensor is not installed in the optimal position for using EPD (optimal = installed horizontally). ▪ the sensor is not equipped with an additional (optional) EPD electrode. ✎ Note! ▪ Cable connection length: When mounting a remote version, please observe the maximum permissible cable length of 15 metres in order to keep the OED function. ▪ OED empty pipe adjustment: To achieve the best results for the open electrode detection, it is important to have the electrodes surface as dry as possible (no liquid film) while the empty-pipe adjustment is being made. Even during normal operation, the OED function is only secured if there is no longer any liquid film present on the electrodes when the measuring pipe is empty.

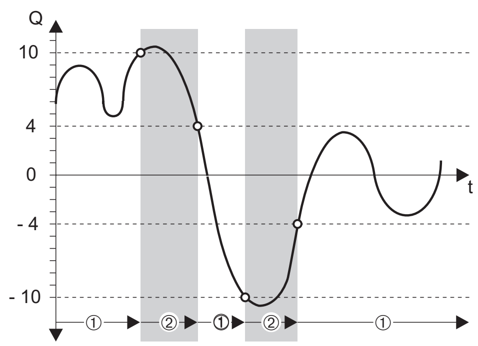
Function description PROCESS PARAMETER	
EPD/OED ADJUSTMENT	Use this function to activate the EPD/OED adjustment for an empty or full measuring tube. ✎ Note! A detailed description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found on Page 44. **Options:** OFF FULL PIPE ADJUST EMPTY PIPE ADJUST OED FULL ADJUST OED EMPTY ADJUST **Factory setting:** OFF **Procedure for EPD or OED empty-pipe / full-pipe adjustment** 1. 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! 2. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E to confirm. 3. After empty-pipe adjustment, fill the piping with fluid. 4. Start full-pipe adjustment: Select "FULL PIPE ADJUST" or "OED FULL ADJUST" and press E to confirm. 5. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E . 6. Now select the "EMPTY PIPE DETECTION" function. Switch on Empty Pipe Detection by selecting the following settings: – EPD ⟶ Select ON STANDARD or ON SPECIAL and press E to confirm. – OED ⟶ Select OED and confirm with E . Caution! The adjustment coefficients must be valid before you can activate the EPD/OED function. If adjustment is incorrect the following messages might appear on the display: – FULL = EMPTY The adjustment values for empty pipe and full pipe are identical. In cases of this nature you **must** repeat empty-pipe or full-pipe adjustment **again**! – ADJUSTMENT NOT OK Adjustment is not possible because the fluid's conductivity is out of range.

Function description PROCESS PARAMETER	
EPD/OED RESPONSE TIME	✎ Note! This function is not available unless ON STANDARD, ON SPECIAL or OED was selected in the EMPTY PIPE DETECTION function. Use this function to enter the time span for which the criteria for an "empty" pipe have to be satisfied without interruption before a notice message or fault message is generated. The setting defined here is used by the active empty pipe detection (EPD) or open electrode detection (OED). **User input:** fixed-point number 1.0...100 s **Factory setting:** 1.0 s ✎ Note! OED detection time: The recognition of open electrodes is, in contrast to the empty pipe detection (EPD), very slow reacting (delay at least 25 seconds) and is only activated after an aditional delay from the programmed response time! We recommend in most applications to use the empty pipe detection (EPD) which is an optimal solution for detecting partly filled measuring tubes.
ECC	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to activate cyclical electrode cleaning. **Options:** OFF ON **Factory setting:** ON (only if the optional electrode cleaning function ECC is available) **Notes on electrode cleaning (ECC)** Conductive deposits on the electrodes and on the walls of the measuring tube (e.g. magnetite) can falsify measurement values. The Electrode Cleaning Circuitry (ECC) was developed to prevent such conductive deposits accreting in the vicinity of the electrodes. ECC functions as described above for all available electrode materials except tantalum. If tantalum is used as the electrode material, the ECC protects the electrode surface only against oxidation. Caution! If the ECC is switched off for a prolonged period in applications with conductive deposits, a layer forms inside the measuring tube and this can falsify measurement values. If the layer is allowed to accrete beyond a certain level, it might no longer be possible to remove it by switching on the ECC. If this happens the measuring tube must be cleaned and the layer removed.
ECC DURATION	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the electrode cleaning duration. **User input:** fixed-point number 0.01...30.0 s **Factory setting:** 2.0 s

Function description PROCESS PARAMETER	
ECC RECOVERY TIME	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the recovery time for which the last flow value measured prior to cleaning is retained. A recovery time is necessary as the signal outputs can fluctuate after electrode cleaning on account of electrochemical interference voltages. **User input:** max. 3-digit number: 1... 600 s **Factory setting:** 5 s Caution! The last value measured prior to cleaning is output for the duration of the recovery time (max. 600 s). This in turn means that the measuring system does not register changes in flow, e.g. stoppage, during this time span.
ECC CLEANING CYCLE	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the cleaning cycle for electrode cleaning. **User input:** Integer: 30...10080 min **Factory setting:** 40 min

15 Group SYSTEM PARAMETERS

Function description SYSTEM PARAMETERS	
INSTALLATION DIRECTION SENSOR	Use this function to reverse the sign of the flow quantity, if necessary. **Options:** NORMAL (flow as indicated by the arrow) INVERSE (flow opposite to direction indicated by the arrow) **Factory setting:** NORMAL ✎ Note! Ascertain the actual direction of fluid flow with reference to the direction indicated by the arrow on the sensor (nameplate).
MEASURING MODE	Use this function to select the measuring mode for all outputs. **Options:** STANDARD SYMMETRY **Factory setting:** STANDARD The responses of the individual outputs in each of the measuring modes are described in detail on the following pages: **Current output and frequency output** STANDARD Only the flow components for the selected flow direction are totalled, (positive or negative full scale value ② = flow direction). Flow components in the opposite direction are not taken into account (suppression). Example for current output:  A0001248 SYMMETRY The output signals of the current and frequency outputs are independent of the direction of flow (absolute amount of the measured variable). The "VALUE 20 mA" or "VALUE-f HIGH" ③ (e.g. backflow) corresponds to the mirrored VALUE 20 mA or VALUE-f HIGH ② (e.g. flow). Positive and negative flow components are taken into account. Example for current output:  A0001249 ✎ Note! The direction of flow can be output via the configurable status output. (continued on next page)

Function description SYSTEM PARAMETERS	
MEASURING MODE (continued)	**Pulse output** STANDARD Only positive flow components are totalled. Negative components are not taken into account. SYMMETRY Positive and negative flow components are taken into account. ✎ Note! The direction of flow can be output via the configurable status output. **Status output** ✎ Note! The information is only applicable if LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. STANDARD The status output signal switches at the defined switch points. SYMMETRY The status output signal switches at the defined switch points, irrespective of the sign. In other words, if you define a switch point with a positive sign, the status output signal switches as soon as the value is reached in the negative direction (negative sign), (see illustration). Example for the SYMMETRY measuring mode: Switch-on point: Q = 4 Switch-off point: Q = 10 ① = Status output switched on (conductive) ② = Status output switched off (not conductive)  A0001247
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a piping system is being cleaned, for example. This setting acts on all function and outputs of the measuring device. **Options:** OFF ON → Signal output is set to the "ZERO FLOW" value. **Factory setting:** OFF

Function description SYSTEM PARAMETERS	
SYSTEM DAMPING	Use this function to set the filter depth of the digital filter. This reduces the sensitivity of the measuring signal to interference peaks (e.g. high solids content, gas bubbles in the fluid, etc.). The system reaction time decreases with an increasing filter setting. **User input:** 0...15 **Factory setting:** 9 ✎ Note! The system damping acts on all functions and outputs of the measuring device.
INTEGRATION TIME	Use this function to set the integration time. Under normal circumstances it is not necessary to change the factory settings. **User input:** 3.3...65 ms **Factory setting:** 20 ms at 50 Hz → mains frequency (e.g. Europe) 16.7 ms at 60 Hz → mains frequency (e.g. USA) Caution! The integration time must not be selected with a greater value than the measuring period (see Page 53). ✎ Note! The integration time defines the duration of internal totaling of the induced voltage in the fluid (measured by the measuring electrode), i.e. the time in which the measuring device records the true flow (afterwards the magnetic field for the next integration is created from the opposite pole).

16 Group SENSOR DATA

Function description SENSOR DATA	
All sensor data (calibration factors, zero point and nominal diameter etc.) are set at the factory and saved on the S-DAT sensor memory chip. Caution! Under normal circumstances you should not change the following parameter settings, because changes affect numerous functions of the entire measuring facility in general and the accuracy of the measuring system in particular. For this reason, the functions described below cannot be changed even when you enter your personal code. Contact the Endress+Hauser service organization if you have any questions about these functions.	
CALIBRATION DATE	Use this function to view the current calibration date and time for the sensor. **User interface:** Calibration date and time **Factory setting:** Calibration date and time of the current calibration. Note! The calibration date and time format is defined in the FORMAT DATE TIME function, → Page 9.
K-FACTOR	Use this function to display the current calibration factor for the sensor. The calibration factor is determined and set at the factory. **User interface:** 5-digit fixed-point number: 0.5000...2.0000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
ZERO POINT	This function shows the current zero-point correction value for the sensor. Zero-point correction is determined and set at the factory. **User interface:** max. 4-digit number: –1000...+1000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
NOMINAL DIAMETER	This function shows the nominal diameter for the sensor. The nominal diameter depends on the size of the sensor and is set at the factory. **User interface:** 2...2000 mm or 1/12...78" **Factory setting:** Depends on the size of the sensor Note! This value is also provided on the sensor nameplate.

Function description SENSOR DATA	
MEASURING PERIOD	Use this function to set the time for a full measuring period. The duration of the measuring period is calculated from the rise time of the magnetic field, the brief recovery time, the integration time (which can be set) and the empty pipe detection time. **User input:** 0.0...1000 ms **Factory setting:** Depends on nominal diameter ✎ Note! The system checks the time entered and sets the measuring period which is actually used internally to a plausible value. If you enter 0 ms, the system automatically computes the shortest time.
OVERVOLTAGE TIME	Use this function to specify the time in which overvoltage is applied to the coil circuit in order to build up the magnetic field as fast as possible. The overvoltage time is adjusted automatically while measuring is in progress. The overvoltage time depends on the sensor type and the nominal diameter and is set at the factory. **User interface:** 4-digit floating-point number: 0.0...100.0 ms **Factory setting:** Depends on nominal diameter
EPD ELECTRODE	Use this function to check whether the sensor is equipped with an EPD electrode. **User interface:** YES NO **Factory setting:** YES → Electrode fitted as standard
POLARITY ECC	Use this function to display the actual current polarity for optional electrode cleaning (ECC). Electrode cleaning uses either a positive or negative current, depending on the electrode material. The measuring device automatically selects the correct polarity on the basis of the electrode-material data stored in the S-DAT. **User interface:** POSITIVE → for electrodes made of: 1.4435, Hastelloy C, platinum, titanium NEGATIVE → for electrodes made of: tantalum Caution! If the incorrect current is applied to the electrodes, the electrode material is destroyed.

17 Group SUPERVISION

Function description SUPERVISION	
CURRENT SYSTEM CONDITION	Use this function to check the present system status. **User interface:** "SYSTEM OK" or the fault / notice message with the highest priority.
PREVIOUS SYSTEM CONDITIONS	Use this function to view the fifteen most recent fault and notice messages since measuring last started. **User interface:** The last 15 fault/notice messages appear on the display
ASSIGN SYSTEM ERROR	Use this function to view all system errors and the associated error categories (fault message or notice message). By selecting a certain system error, its error category can be changed in the subsequent function ERROR CATEGORY. **Options:** CANCEL List of system errors ✎ Note! ▪ You can exit this function as follows: select "CANCEL" and confirm with E. ▪ A list of possible system errors is provided in the Operating Instructions Promag 50, BA 046D/06/en
ERROR CATEGORY	✎ Note! This function is only available if a system error has been selected in the function ASSIGN SYSTEM ERROR. Use this function to define whether a system error triggers a notice message or a fault message. If you select FAULT MESSAGES, all outputs respond to an error in accordance with their defined error response patterns. **Options:** NOTICE MESSAGES (display only) FAULT MESSAGES (outputs and display) ✎ Note! Press the E key twice to call up the ASSIGN SYSTEM ERROR function.
ASSIGN PROCESS ERROR	Use this function to view all process errors and the associated error categories (fault message or notice message). By selecting an individual process error, its error category can be changed in the subsequent function ERROR CATEGORY. **Options:** CANCEL List of process errors ✎ Note! ▪ You can exit this function as follows: select "CANCEL" and confirm with E. ▪ A list of possible process errors is provided in the Operating Instructions Promag 50, BA 046D/06/en

Function description SUPERVISION	
ERROR CATEGORY	✎ Note! This function is only available if a process error has been selected in the function ASSIGN PROCESS ERROR. Use this function to define whether a process error triggers a notice message or a fault message. If you select FAULT MESSAGES, all outputs respond to an error in accordance with their defined error response patterns. **Options:** NOTICE MESSAGES (display only) FAULT MESSAGES (outputs and display) ✎ Note! Press the E key twice to call up the ASSIGN PROCESS ERROR function.
ALARM DELAY	Use this function to define a time span in which the criteria for an error have to be satisfied without interruption before an error or notice message is generated. Depending on the setting and the type of error, this suppression acts on: ▪ Display ▪ Status output ▪ Current output ▪ Frequency output **User input:** 0...100 s (in steps of one second) **Factory setting:** 0 s Caution! If this function is activated error and notice messages are delayed by the time correspon-ding to the setting before being forwarded to the higher-order controller (process control-ler, etc.). It is therefore imperative to check in advance in order to make sure whether a delay of this nature could affect the safety requirements of the process. If error and notice messages cannot be suppressed, a value of 0 seconds must be entered here.
SYSTEM RESET	Use this function to perform a reset of the measuring system. **Options:** NO RESTART SYSTEM (restart without interrupting power supply) **Factory setting:** NO
OPERATION HOURS	The hours of operation of the device appear on the display. **Display:** Depends on the number of hours of operation elapsed: Hours of operation < 10 hours → display format = 0:00:00 (hr:min:sec) Hours of operation 10...10,000 hours → display format = 0000:00 (hr:min) Hours of operation > 10,000 hours → display format = 000000 (hr)
PERMANENT STORAGE	This function indicates whether permanent storage of all parameters in the EEPROM has been switched on or off. **Display:** 0 = OFF 1 = ON **Factory setting:** ON

18 Group SIMULATION SYSTEM

Function description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all inputs, outputs and the totalizer to their defined failsafe modes, in order to check whether they respond correctly. During this time, the words "SIMULATION FAILSAFE MODE" appear on the display. **Options:** ON OFF **Factory setting:** OFF
SIMULATION MEASURED VARIABLE	Use this function to set all inputs, outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the words "SIMULATION MEASURAND" appear on the display. **Options:** OFF VOLUME FLOW **Factory setting:** OFF Caution! ▪ The measuring device cannot be used for measuring while this simulation is in progress. ▪ The setting is not saved if the power supply fails.
VALUE SIMULATION MEASURED VARIABLE	Note! This function is not available unless the SIMULATION MEASURED VARIABLE function is active (= VOLUME FLOW). Use this function to specify a selectable value (e.g. 12 m^3/s). This value is used to test downstream devices and the measuring device itself. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] Caution! The setting is not saved if the power supply fails. Note! The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8)

19 Group SENSOR VERSION

Function description SENSOR VERSION	
SERIAL NUMBER	Use this function to view the serial number of the sensor.
SENSOR TYPE	Use this function to view the sensor type.
HARDWARE REVISION NUMBER SENSOR	Use this function to view the hardware revision number of the sensor.
SOFTWARE REVISION NUMBER S-DAT	Use this function to view the software revision number of the software used to create the content of the S-DAT

20 Group AMPLIFIER VERSION

Function description AMPLIFIER VERSION	
DEVICE SOFTWARE	Displays the current device software version.
SOFTWARE REVISION NUMBER AMPLIFIER	Use this function to view the software revision number of the amplifier.
LANGUAGE GROUP	Use this function to view the language group. The following language groups can be ordered: WEST EU / USA, EAST EU / SCAND., ASIA. **Display:** available language group ✎ Note! ▪ The language options of the available language group are displayed in the LANGUAGE function. ▪ You can change the language group via the configuration software FieldCare. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.
I/O MODULE TYPE	Use this function to view the configuration of the I/O module complete with terminal numbers.
SOFTWARE REVISION NUMBER I/O MODULE	Use this function to view the software revision number of the I/O module.

21 Factory settings

21.1 SI units (not for USA and Canada)

Low flow, full scale value, pulse value, totalizer

Nominal diameter		Low flow		Full scale value		Pulse value		Totalizer
[mm]	[inch]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
2	1/12"	0.01	dm^3/min	0.5	dm^3/min	0.005	dm^3	dm^3
4	5/32"	0.05	dm^3/min	2	dm^3/min	0.025	dm^3	dm^3
8	5/16"	0.1	dm^3/min	8	dm^3/min	0.10	dm^3	dm^3
15	1/2"	0.5	dm^3/min	25	dm^3/min	0.20	dm^3	dm^3
25	1"	1	dm^3/min	75	dm^3/min	0.50	dm^3	dm^3
32	1 1/4"	2	dm^3/min	125	dm^3/min	1.00	dm^3	dm^3
40	1 1/2"	3	dm^3/min	200	dm^3/min	1.50	dm^3	dm^3
50	2"	5	dm^3/min	300	dm^3/min	2.50	dm^3	dm^3
65	2 1/2"	8	dm^3/min	500	dm^3/min	5.00	dm^3	dm^3
80	3"	12	dm^3/min	750	dm^3/min	5.00	dm^3	dm^3
100	4"	20	dm^3/min	1200	dm^3/min	10.00	dm^3	dm^3
125	5"	30	dm^3/min	1850	dm^3/min	15.00	dm^3	dm^3
150	6"	2.5	m^3/h	150	m^3/h	0.025	m^3	m^3
200	8"	5.0	m^3/h	300	m^3/h	0.05	m^3	m^3
250	10"	7.5	m^3/h	500	m^3/h	0.05	m^3	m^3
300	12"	10	m^3/h	750	m^3/h	0.10	m^3	m^3
350	14"	15	m^3/h	1000	m^3/h	0.10	m^3	m^3
400	16"	20	m^3/h	1200	m^3/h	0.15	m^3	m^3
450	18"	25	m^3/h	1500	m^3/h	0.25	m^3	m^3
500	20"	30	m^3/h	2000	m^3/h	0.25	m^3	m^3
600	24"	40	m^3/h	2500	m^3/h	0.30	m^3	m^3
700	28"	50	m^3/h	3500	m^3/h	0.50	m^3	m^3
–	30"	60	m^3/h	4000	m^3/h	0.50	m^3	m^3
800	32"	75	m^3/h	4500	m^3/h	0.75	m^3	m^3
900	36"	100	m^3/h	6000	m^3/h	0.75	m^3	m^3
1000	40"	125	m^3/h	7000	m^3/h	1.00	m^3	m^3
–	42"	125	m^3/h	8000	m^3/h	1.00	m^3	m^3
1200	48"	150	m^3/h	10000	m^3/h	1.50	m^3	m^3
–	54"	200	m^3/h	13000	m^3/h	1.50	m^3	m^3
1400	–	225	m^3/h	14000	m^3/h	2.00	m^3	m^3
–	60"	250	m^3/h	16000	m^3/h	2.00	m^3	m^3
1600	–	300	m^3/h	18000	m^3/h	2.50	m^3	m^3
–	66"	325	m^3/h	20500	m^3/h	2.50	m^3	m^3
1800	72"	350	m^3/h	23000	m^3/h	3.00	m^3	m^3
–	78"	450	m^3/h	28500	m^3/h	3.50	m^3	m^3
2000	–	450	m^3/h	28500	m^3/h	3.50	m^3	m^3

Language

Country	Language
Australia	English
Austria	Deutsch
Belgium	English
Czech Republic	Czech
Denmark	English
England	English
Finland	Suomi
France	Francais
Germany	Deutsch
Hong Kong	English
Hungary	English
India	English
Indonesia	Bahasa Indonesia
Instruments International	English
Italy	Italiano
Japan	Japanese
Malaysia	English
Netherlands	Nederlands
Norway	Norsk
Poland	Polish
Portugal	Portuguese
Russia	Russian
Singapore	English
South Africa	English
Spain	Espanol
Sweden	Svenska
Switzerland	Deutsch
Thailand	English

Length

	Unit
Length	mm

21.2 US units (only for USA and Canada)

Low flow, full scale value, pulse value, totalizer

Nominal diameter		Low flow		Full scale value		Pulse value		Totalizer
[inch]	[mm]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
$^{1}/_{12}$"	2	0.002	gal/min	0.1	gal/min	0.001	gal	gal
$^{5}/_{32}$"	4	0.008	gal/min	0.5	gal/min	0.005	gal	gal
$^{5}/_{16}$"	8	0.025	gal/min	2	gal/min	0.02	gal	gal
$^{1}/_{2}$"	15	0.10	gal/min	6	gal/min	0.05	gal	gal
1"	25	0.25	gal/min	18	gal/min	0.20	gal	gal
1 $^{1}/_{4}$"	32	0.50	gal/min	30	gal/min	0.20	gal	gal
1 $^{1}/_{2}$"	40	0.75	gal/min	50	gal/min	0.50	gal	gal
2"	50	1.25	gal/min	75	gal/min	0.50	gal	gal
2 $^{1}/_{2}$"	65	2.0	gal/min	130	gal/min	1	gal	gal
3"	80	2.5	gal/min	200	gal/min	2	gal	gal
4"	100	4.0	gal/min	300	gal/min	2	gal	gal
5"	125	7.0	gal/min	450	gal/min	5	gal	gal
6"	150	12	gal/min	600	gal/min	5	gal	gal
8"	200	15	gal/min	1200	gal/min	10	gal	gal
10"	250	30	gal/min	1500	gal/min	15	gal	gal
12"	300	45	gal/min	2400	gal/min	25	gal	gal
14"	350	60	gal/min	3600	gal/min	30	gal	gal
16"	400	60	gal/min	4800	gal/min	50	gal	gal
18"	450	90	gal/min	6000	gal/min	50	gal	gal
20"	500	120	gal/min	7500	gal/min	75	gal	gal
24"	600	180	gal/min	10500	gal/min	100	gal	gal
28"	700	210	gal/min	13500	gal/min	125	gal	gal
30"	–	270	gal/min	16500	gal/min	150	gal	gal
32"	800	300	gal/min	19500	gal/min	200	gal	gal
36"	900	360	gal/min	24000	gal/min	225	gal	gal
40"	1000	480	gal/min	30000	gal/min	250	gal	gal
42"	–	600	gal/min	33000	gal/min	250	gal	gal
48"	1200	600	gal/min	42000	gal/min	400	gal	gal
54"	–	1.3	Mgal/d	75	Mgal/d	0.0005	Mgal	Mgal
–	1400	1.3	Mgal/d	85	Mgal/d	0.0005	Mgal	Mgal
60"	–	1.3	Mgal/d	95	Mgal/d	0.0005	Mgal	Mgal
–	1600	1.7	Mgal/d	110	Mgal/d	0.0008	Mgal	Mgal
66"	–	2.2	Mgal/d	120	Mgal/d	0.0008	Mgal	Mgal
72"	1800	2.6	Mgal/d	140	Mgal/d	0.0008	Mgal	Mgal
78"	–	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal
–	2000	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal

Language, length

	Unit
Language	English
Length	inch

22 Index of key words

Numerics

A

B

C

D

E

F

G

H

I

K

L

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Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Technical Information

Proline Promag 50P, 53P

Electromagnetic Flow Measuring System
Flow measurement of liquids in chemical or process applications

Application
Electromagnetic flowmeter for bidirectional measurement of liquids with a minimum conductivity of ≥ 5 µS/cm:

- Acid, alkalis
- Paints
- Pastes
- Water, wastewater etc.

- Flow measurement up to 9600 m³/h (42268 gal/min)
- Fluid temperature up to +180 °C (356 °F)
- Process pressures up to 40 bar (580 psi)
- Lengths in accordance with DVGW/ISO

Application-specific lining materials:
- PTFE
- PFA

Approvals for hazardous area:
- ATEX
- IECEx
- FM
- CSA
- NEPSI
- TIIS

Connection to process control system:
- HART
- PROFIBUS DP/PA
- FOUNDATION Fieldbus
- MODBUS RS485

Your benefits
Promag measuring devices offer you cost-effective flow measurement with a high degree of accuracy for a wide range of process conditions.

The uniform Proline transmitter concept comprises:
- Modular device and operating concept resulting in a higher degree of efficiency
- Software options for batching, electrode cleaning and for measuring pulsating flow
- High degree of reliability and measuring stability
- Uniform operating concept

The tried-and-tested Promag sensors offer:
- No pressure loss
- Not sensitive to vibrations
- Simple installation and commissioning

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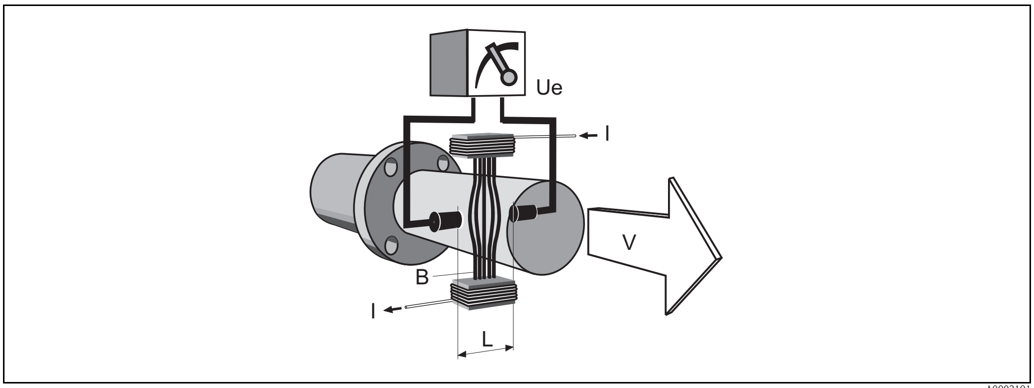
Table of contents

Function and system design

Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.
In the electromagnetic measuring principle, the flowing medium is the moving conductor.
The voltage induced is proportional to the flow velocity and is supplied to the amplifier by means of two measuring electrodes. The flow volume is calculated by means of the pipe cross-sectional area.
The DC magnetic field is created through a switched direct current of alternating polarity.



Ue = B · L · v
Q = A · v

Ue *Induced voltage*
B *Magnetic induction (magnetic field)*
L *Electrode spacing*
v *Flow velocity*
Q *Volume flow*
A *Pipe cross-section*
I *Current strength*

Measuring system

The measuring system consists of a transmitter and a sensor.
Two versions are available:
- Compact version: Transmitter and sensor form a mechanical unit.
- Remote version: Sensor is mounted separate from the transmitter.

Transmitter:
- Promag 50 (user interface with push buttons for operation, two-line display, illuminated)
- Promag 53 ("Touch Control" without opening the housing, four-line display, unilluminated)

Sensor:
- Promag P (DN 15 to 600 / ½ to 24")

Input

Measured variable

Flow velocity (proportional to induced voltage)

Measuring ranges

Measuring ranges for liquids
Typically v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Operable flow range

Over 1000 : 1

Input signal

Status input (auxiliary input)
- U = 3 to 30 V DC, R_i = 5 kΩ, galvanically isolated
- Configurable for: totalizer(s) reset, measured value suppression, error-message reset

Status input (auxiliary input) with PROFIBUS DP and MODBUS RS485
- U = 3 to 30 V DC, R_i = 3 kΩ, galvanically isolated
- Switching level: 3 to 30 V DC, independent of polarity
- Configurable for: totalizer(s) reset, measured value suppression, error-message reset, batching start/stop (optional), batch totalizer reset (optional)

Current input (only Promag 53)
- active/passive selectable, galvanically isolated, full scale value selectable, resolution: 3 µA, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading)
- active: 4 to 20 mA, $R_i \leq 150\ \Omega$, max. 24 V DC, short-circuit-proof
- passive: 0/4 to 20 mA, $R_i < 150\ \Omega$, max. 30 V DC

Output

Output signal

Promag 50

Current output
active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s), full scale value selectable, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading), resolution: 0.5 µA
- active: 0/4 to 20 mA, $R_L < 700\ \Omega$ (HART: $R_L \geq 250\ \Omega$)
- passive: 4 to 20 mA, operating voltage V_S: 18 to 30 V DC, $R_i \geq 150\ \Omega$

Pulse/frequency output
passive, open collector, 30 V DC, 250 mA, galvanically isolated
- Frequency output: full scale frequency 2 to 1000 Hz (f_{max} = 1250 Hz), on/off ratio 1:1, pulse width max. 10s
- Pulse output: pulse value and pulse polarity selectable, max. pulse width configurable (0.5 to 2000 ms)

PROFIBUS DP interface
- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- Profil version 3.0
- Data transmission rate: 9,6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Function blocks: 1 × analog Input, 1 × totalizer
- Output data: volume flow, totalizer
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

PROFIBUS PA interface
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profil version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 1 × analog input, 2 × totalizer
- Output data: volume flow, totalizer
- Input data: positive zero return (ON/OFF), control totalizer, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

Promag 53

Current output

active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s), full scale value selectable, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading), resolution: 0.5 µA

- active: 0/4 to 20 mA, R_L < 700 Ω (HART: R_L ≥ 250 Ω)
- passive: 4 to 20 mA, operating voltage V_S: 18 to 30 V DC, R_i ≥ 150 Ω

Pulse/frequency output

active/passive selectable, galvanically isolated (Ex i version: only passive)

- 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_{max} = 12500 Hz), EEx-ia: 2 to 5000 Hz; on/off ratio 1:1, pulse width max. 10 s
- Pulse output: pulse value and pulse polarity selectable, max. pulse width configurable (0.05 to 2000 ms)

PROFIBUS DP interface

- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- Profil version 3.0
- Data transmission rate: 9,6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Function blocks: 2 × analog Input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Available output combination → 🗎 8

PROFIBUS PA interface

- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profil version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 2 × analog input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

MODBUS RS485 interface

- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- MODBUS device type: Slave
- Adress range: 1 to 247
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Supported MODBUS function codes: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Übertragungsmodus: RTU oder ASCII
- Supported baudrate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Response time:
  - Direct data access = typically 25 to 50 ms
  - Auto-scan buffer (data range) = typically 3 to 5 ms
- Available output combination → 🗎 8

FOUNDATION Fieldbus interface

- FOUNDATION Fieldbus H1
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- ITK version 5.01
- Current consumption: 12 mA
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Bus connection with integrated reverse polarity protection
- Function blocks:
  - 5 × Analog Input (execution time: 18 ms each)
  - 1 × PID (25 ms)
  - 1 × Digital Output (18 ms)
  - 1 × Signal Characterizer (20 ms)
  - 1 × Input Selector (20 ms)
  - 1 × Arithmetic (20 ms)
  - 1 × Integrator (18 ms)
- Output data: volume flow, calculated mass flow, temperature, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), reset totalizer
- Link Master (LM) functionality is supported

Signal on alarm

- Current output → failure response selectable (e.g. in accordance with NAMUR recommendation NE 43)
- Pulse/frequency output → failure response selectable
- Status output (Promag 50) → non-conductive by fault or power supply failure
- Relay output (Promag 53) → de-energized by fault or power supply failure

Load

see "Output signal"

Low flow cutoff

Switch points for low flow cutoff are selectable.

Galvanic isolation

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

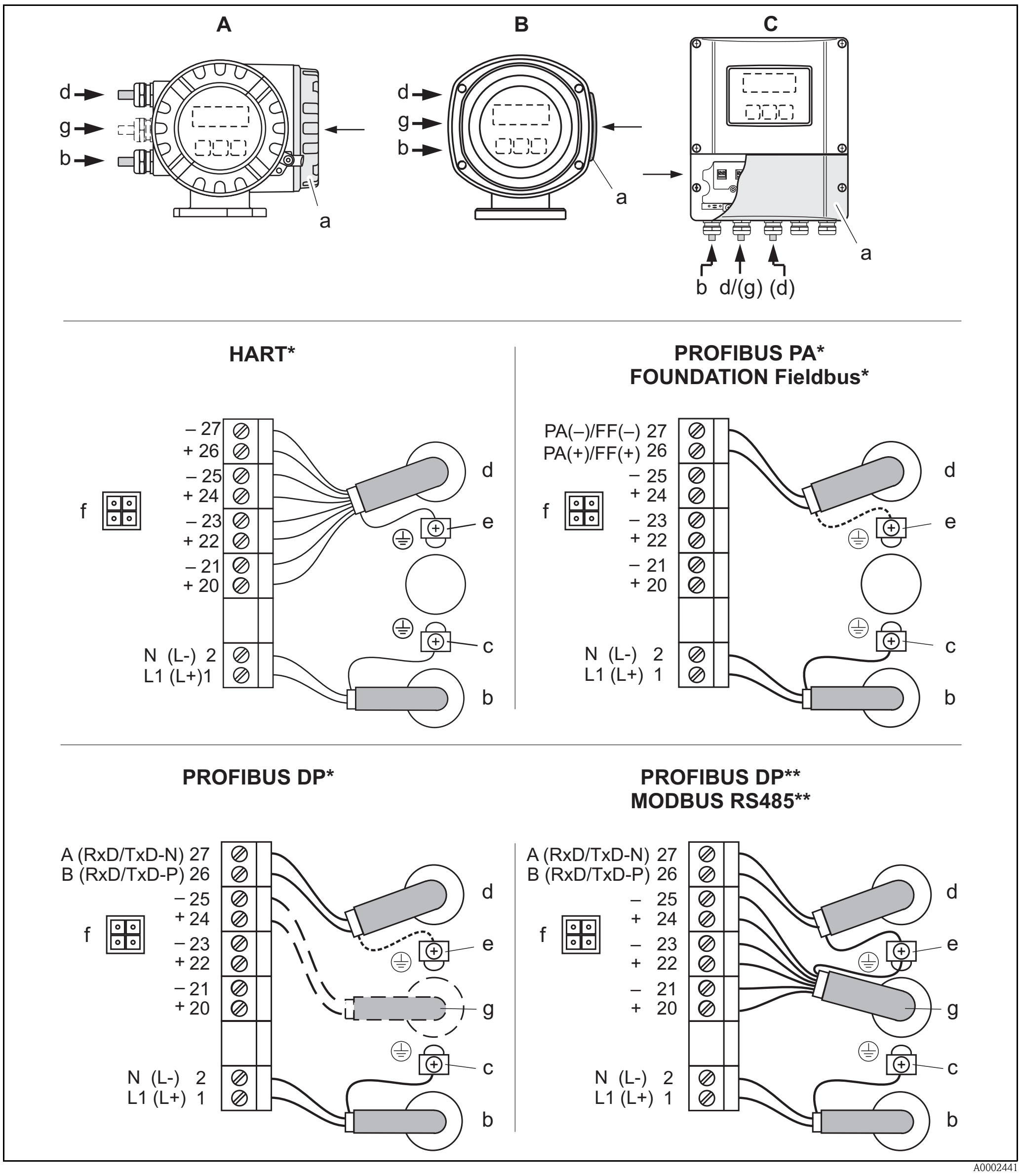
Switching output

Status output (Promag 50, Promag 53)
Open collector, max. 30 V DC / 250 mA, galvanically isolated.
Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values.

Relay outputs (Promag 53)
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.
Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values, batching contacts.

Power supply

Electrical connection, measuring unit



Connecting the transmitter, cable cross-section max. 2.5 mm² (14 AWG)

A	*View A (field housing)*
B	*View B (stainless steel field housing)*
C	*View C (wall-mount housing)*

**)*	*fixed communication boards*
***)*	*flexible communication boards*
a	*Connection compartment cover*
b	*Cable for power supply: 85 to 260 V AC / 20 to 55 V AC / 16 to 62 V DC* *- Terminal No. 1: L1 for AC, L+ for DC* *- Terminal No. 2: N for AC, L– for DC*
c	*Ground terminal for protective conductor*
d	*Signal cable: see "Electrical connection, terminal assignment" → 8* *Fieldbus cable:* *- Terminal No. 26: DP (B) / PA + / FF + / MODBUS RS485 (B) / (PA, FF: with polarity protection)* *- Terminal No. 27: DP (A) / PA – / FF – / MODBUS RS485 (A) / (PA, FF: with polarity protection)*
e	*Ground terminal for signal cable shield / Fieldbus cable / RS485 line*
f	*Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)*
g	*Signal cable: see "Electrical connection, terminal assignment" → 8* *Cable for external termination (only for PROFIBUS DP with fixed assignment communication board):* *- Terminal No. 24: +5 V* *- Terminal No. 25: DGND*

Electrical connection, terminal assignment

Terminal assignment, Promag 50

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (–)	**22 (+) / 23 (–)**	**24 (+) / 25 (–)**	**26 (+) / 27 (–)**
50***-***********W	–	–	–	Current output HART
50***-***********A	–	–	Frequency output	Current output HART
50***-***********D	Status input	Status output	Frequency output	Current output HART
50***-***********H	–	–	–	PROFIBUS PA
50***-***********J	–	–	+5 V (external termination)	PROFIBUS DP
50***-***********S	–	–	Frequency output, Ex i, passive	Current output, Ex i, passive, HART
50***-***********T	–	–	Frequency output, Ex i, passive	Current output, Ex i, passive, HART

Ground terminal → 🗎 7

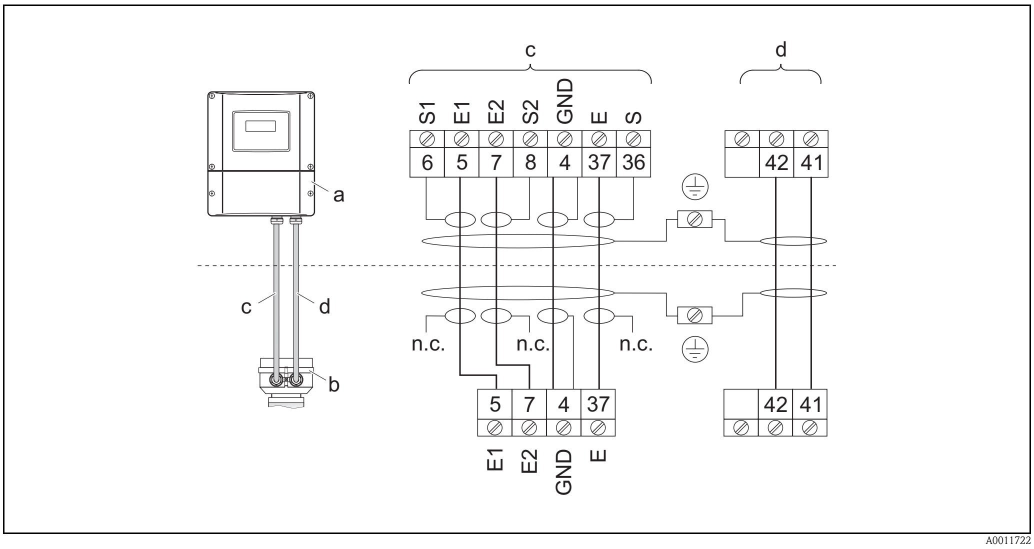
Terminal assignment, Promag 53

The inputs and outputs on the communication board can be either permanently assigned or variable, depending on the version ordered (see table). Replacements for modules which are defective or which have to be replaced can be ordered as accessories.

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (–)	**22 (+) / 23 (–)**	**24 (+) / 25 (–)**	**26 (+) / 27 (–)**
Fixed communication boards (fixed assignment)				
53***-***********A	–	–	Frequency output	Current output HART
53***-***********B	Relay output 2	Relay output 1	Frequency output	Current output HART
53***-***********F	–	–	–	PROFIBUS PA, Ex i
53***-***********G	–	–	–	FOUNDATION Fieldbus, Ex i
53***-***********H	–	–	–	PROFIBUS PA
53***-***********J	–	–	–	PROFIBUS DP
53***-***********K	–	–	–	FOUNDATION Fieldbus
53***-***********Q	–	–	Status input	MODBUS RS485
53***-***********S	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
53***-***********T	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
Flexible communication boards				
53***-***********C	Relay output 2	Relay output 1	Frequency output	Current output HART
53***-***********D	Status input	Relay output	Frequency output	Current output HART
53***-***********L	Status input	Relay output 2	Relay output 1	Current output HART
53***-***********M	Status input	Frequency output	Frequency output	Current output HART
53***-***********N	Current output	Frequency output	Status input	MODBUS RS485
53***-***********P	Current output	Frequency output	Status input	PROFIBUS DP
53***-***********V	Relay output 2	Relay output 1	Status input	PROFIBUS DP
53***-***********2	Relay output	Current output	Frequency output	Current output HART
53***-***********4	Current input	Relay output	Frequency output	Current output HART
53***-***********5	Status input	Current input	Frequency output	Current output HART
53***-***********7	Relay output 2	Relay output 1	Status input	MODBUS RS485

Ground terminal → 🗎 7

Electrical connection, remote version



Connecting the remote version

a Wall-mount housing connection compartment
b Sensor connection housing cover
c Signal cable
d Coil current cable
n.c. Not connected, insulated cable shields
Terminal no. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

Supply voltage (power supply)

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

PROFIBUS PA and FOUNDATION Fieldbus
- Non-Ex: 9 to 32 V DC
- Ex i: 9 to 24 V DC
- Ex d: 9 to 32 V DC

Cable entry

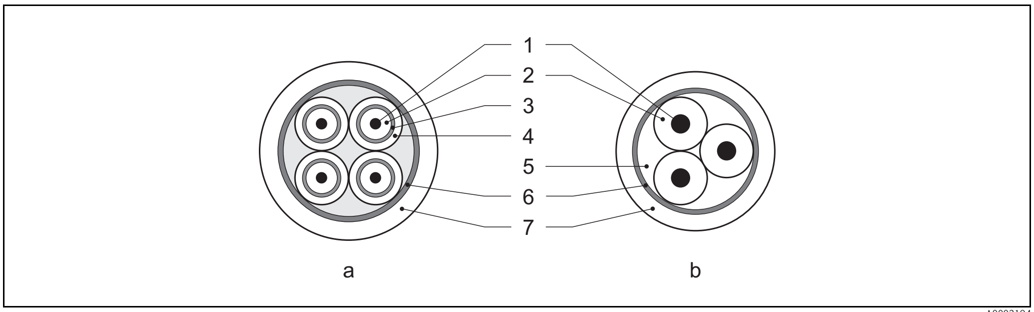
Power supply and signal cables (inputs/ outputs):
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Sensor cable entry for armoured cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63")
- Thread for cable entries, ½" NPT, G ½"

Connecting cable for remote version:
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Sensor cable entry for armoured cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63")
- Thread for cable entries, ½" NPT, G ½"

Remote version cable specifications

Coil cable
- 2 × 0.75 mm^2 (18 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28")
- Conductor resistance: ≤ 37 Ω/km (≤ 0.011 Ω/ft)
- Capacitance core/core, shield grounded: ≤ 120 pF/m (≤ 37 pF/ft)
- Operating temperature: –20 to +80 °C (–68 to +176 °F)
- Cable cross-section: max. 2.5 mm^2 (14 AWG)
- Test voltage for cable insulation: ≤ 1433 AC r.m.s. 50/60 Hz or ≥ 2026 V DC

Signal cable
- 3 × 0.38 mm^2 (20 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28") and individual shielded cores
- With empty pipe detection (EPD): 4 × 0.38 mm^2 (20 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28") and individual shielded cores
- Conductor resistance: ≤ 50 Ω/km (≤ 0.015 Ω/ft)
- Capacitance core/shield: ≤ 420 pF/m (≤ 128 pF/ft)
- Operating temperature: –20 to +80 °C (–68 to +176 °F)
- Cable cross-section: max. 2.5 mm^2 (14 AWG)



a *Signal cable*
b *Coil current cable*

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

Operation in zones of severe electrical interference
The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326 and NAMUR recommendation NE 21.

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

Power consumption

- AC: < 15 VA (incl. sensor)
- DC: < 15 W (incl. sensor)

Switch-on current:
- Max. 3 A (< 5 ms) for 260 V AC
- Max. 13.5 A (< 50 ms) for 24 V DC

Power supply failure

Lasting min. ½ cycle frequency: EEPROM saves measuring system data
- EEPROM or T-DAT (Promag 53 only) retain the measuring system data in the event of a power supply failure
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)

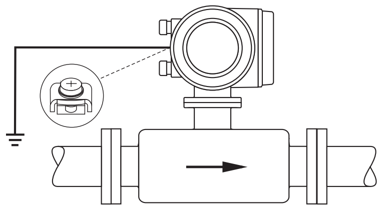
Potential equalization

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

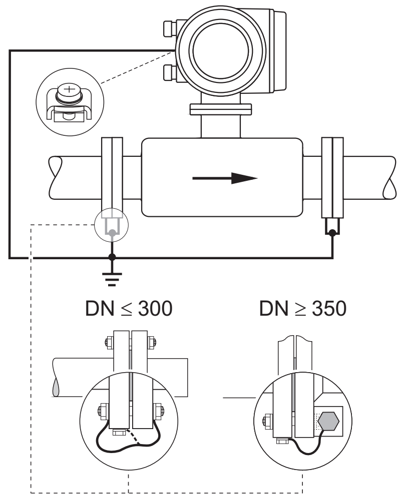
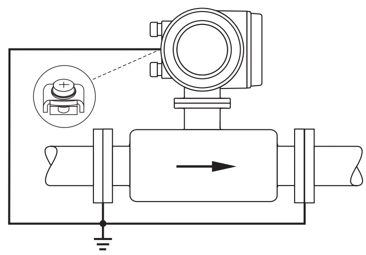
Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.

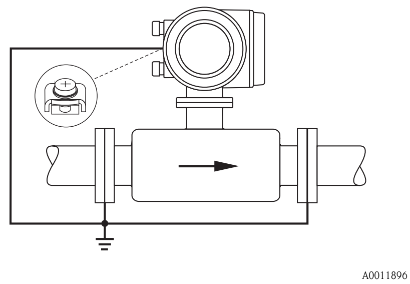
The following should also be taken into consideration for potential equalization:
- Internal grounding concepts in the company
- Operating conditions, such as the material/ grounding of the pipes (see table)

Standard situation

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal, grounded pipe Potential equalization takes place via the ground terminal of the transmitter. ✎ Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 A0011892 *Via the ground terminal of the transmitter*

Special situations

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal pipe that is not grounded This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured. ▪ Excessively high equalizing currents can be expected. Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, at least 6 mm² / 0.0093 in²) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. ▪ DN ≤ 300 (12"): the ground cable is mounted directly on the conductive flange coating with the flange screws. ▪ DN ≥ 350 (14"): the ground cable is mounted directly on the transportation metal support. ✎ Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 A0011893 *Via the ground terminal of the transmitter and the flanges of the pipe*
When using the measuring device in a: ▪ Plastic pipe ▪ Pipe with insulating lining This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured. ▪ Excessively high equalizing currents can be expected. Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, at least 6 mm² / 0.0093 in²). When installing the ground disks, please comply with the enclosed Installation Instructions.	 A0011895 *Via the ground terminal of the transmitter and the optionally available ground disks*

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Pipe with a cathodic protection unit The device is installed potential-free in the pipe. Only the two flanges of the pipe are connected with a ground cable (copper wire, at least 6 mm² / 0.0093 in²). Here, the ground cable is mounted directly on the conductive flange coating with flange screws. Note the following when installing: ▪ The applicable regulations regarding potential-free installation must be observed. ▪ There should be **no** electrically conductive connection between the pipe and the device. ▪ The mounting material must withstand the applicable torques.	 *Potential equalization and cathodic protection* *1 Power supply isolation transformer* *2 Electrically isolated*

Performance characteristics

Reference operating conditions

As per DIN EN 29104 and VDI/VDE 2641:
- Fluid temperature: +28 °C ± 2 K (+82 °F ± 2 K)
- Ambient temperature: +22 °C ±2 K (+72 °F ± 2 K)
- Warm-up period: 30 minutes

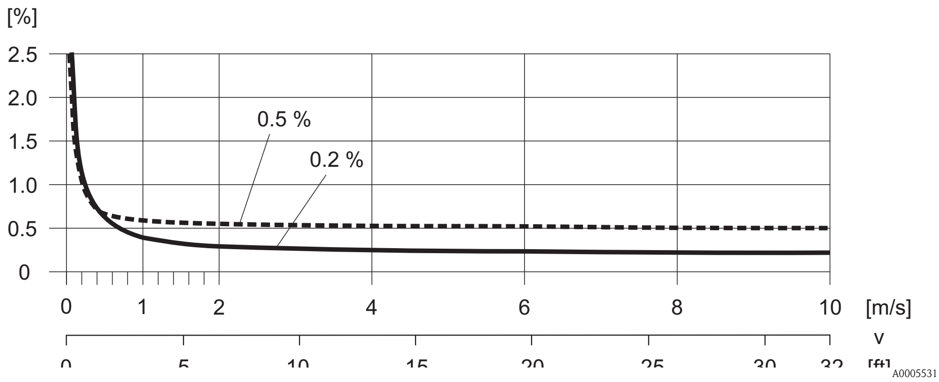
Installation conditions:
- Inlet run > 10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

Maximum measured error

Promag 50:
- Current output: also typically ± 5 µA
- Pulse output: ±0.5% o.r. ± 1 mm/s (±0.5% o.r. ± 0.04 in/s)
  optional: ±0.2% o.r. ± 2 mm/s (±0.2% o.r. ± 0.08 in/s) (o.r. = of reading)

Promag 53:
- Current output: also typically ± 5 µA
- Pulse output: ±0.2% o.r. ± 2 mm/s (±0.2% o.r. ± 0.08 in/s) (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.



Max. measured error in % of reading

Repeatability

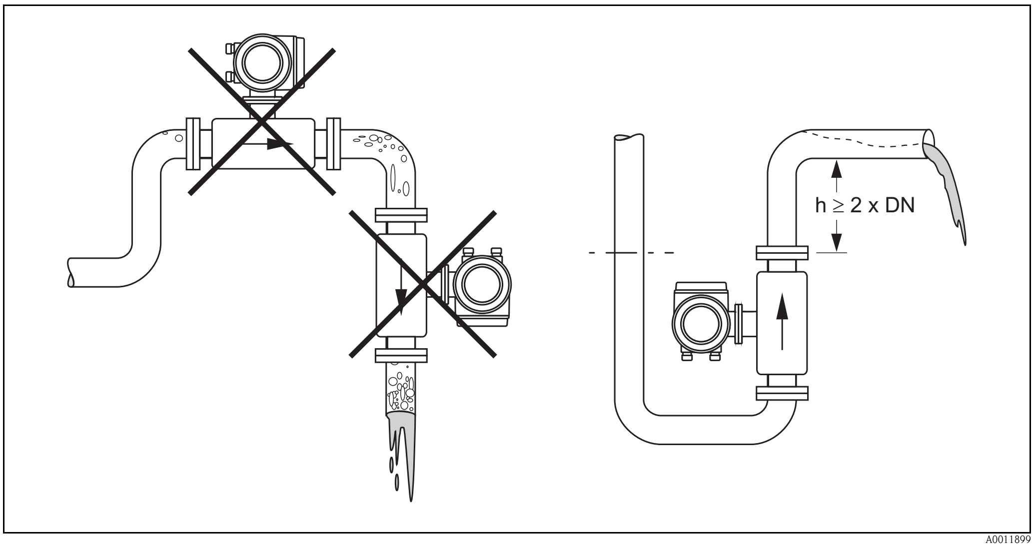
Max. ±0.1% o.r. ± 0.5 mm/s (±0.1% o.r. ± 0.02 in/s) (o.r. = of reading)

Operating conditions: Installations

Installation instructions

Mounting location

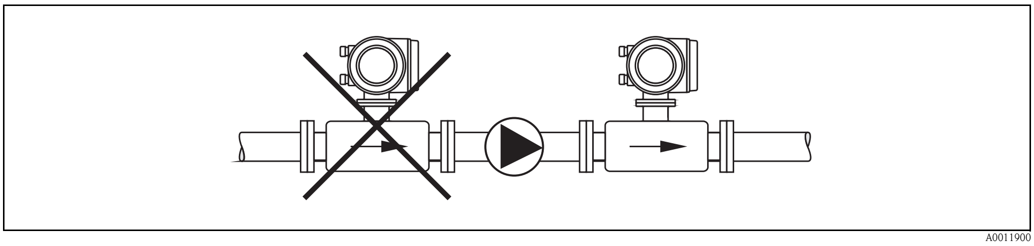
Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following installation locations in the pipe:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.



Mounting location

Installation of pumps

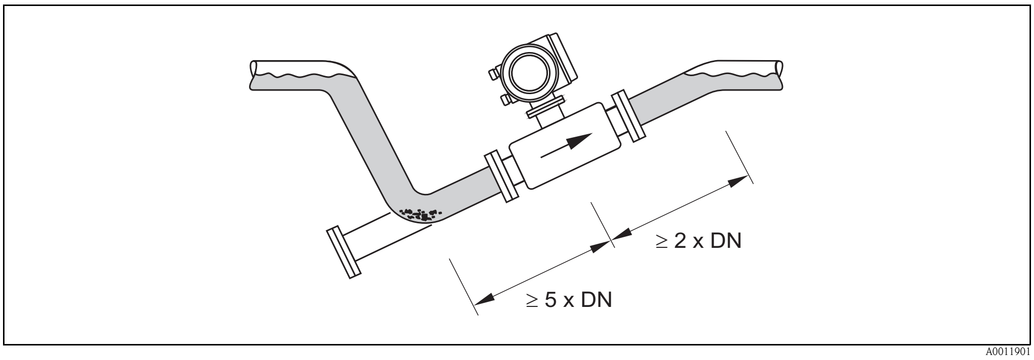
Sensors may not be installed on the pump suction side. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the pressure tightness of the measuring tube lining → 22, Section "Pressure tightness".
Pulsation dampers may be needed when using piston pumps, piston diaphragm pumps or hose pumps. Information on the shock and vibration resistance of the measuring system → 20, Section "Shock and vibration resistance".



Installation of pumps

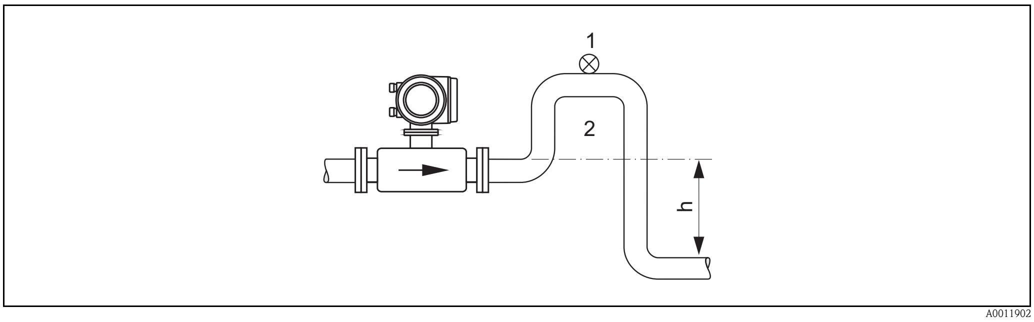
Partially filled pipes
Partially filled pipes with gradients necessitate a drain-type configuration.
The empty pipe detection function (EPD) provides additional security in detecting empty or partially filled pipes.

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



Installation with partially filled pipes

Down pipes
Install a siphon or a vent valve downstream of the sensor in down pipes h ≥ 5 m (16.4 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 liquid current stopping in the pipe which could cause air locks. Information on the pressure tightness of the measuring tube lining → 22, Section "Pressure tightness".



Installation measures for vertical pipes

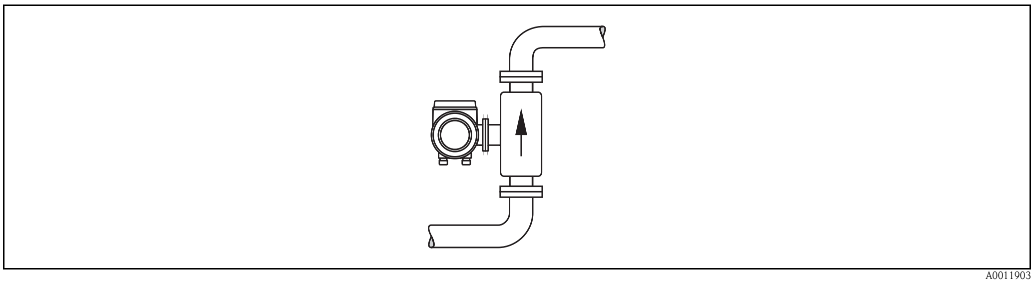
1 Vent valve
2 Pipe siphon
h Length of the down pipe

Orientation

An optimum orientation helps avoid gas and air accumulations and deposits in the measuring tube. However, the measuring device also offers the additional function of empty pipe detection (EPD) for detecting partially filled measuring tubes or if outgassing fluids or fluctuating operating pressures are present.

Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with empty pipe detection.

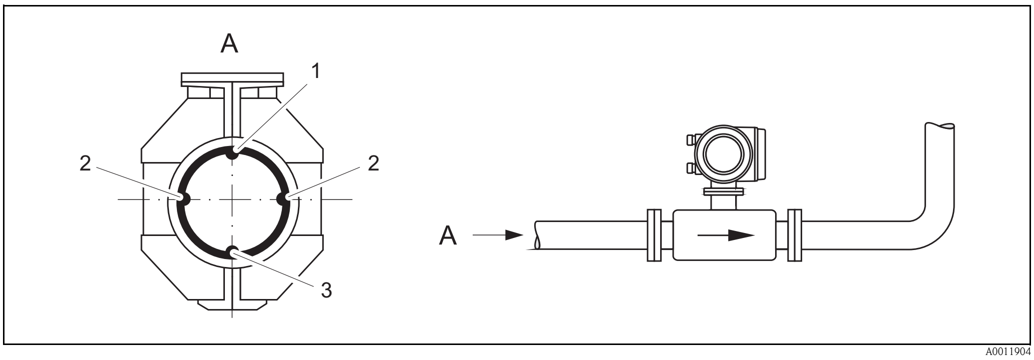


Vertical orientation

Horizontal orientation

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

Caution!
Empty pipe detection only works correctly with horizontal orientation if the transmitter housing is facing upwards. Otherwise there is no guarantee that empty pipe detection will respond if the measuring tube is only partially filled or empty.

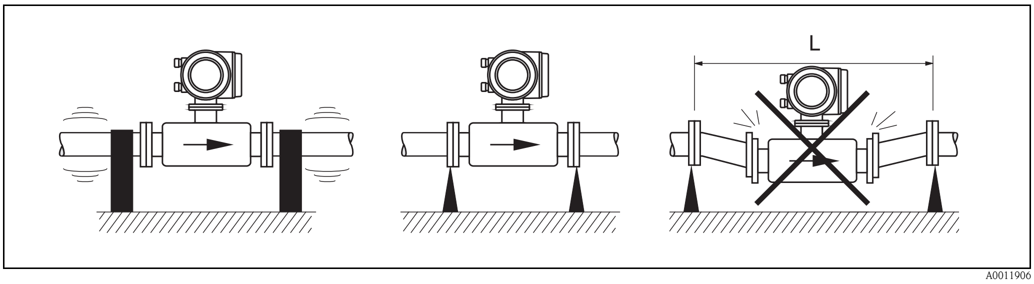


Horizontal orientation

1 *EPD electrode for empty pipe detection*
2 *Measuring electrodes for signal detection*
3 *Reference electrode for potential equalization*

Vibrations
Secure the piping and the sensor if vibration is severe.

Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on the permitted shock and vibration resistance → 20, Section "Shock and vibration resistance".

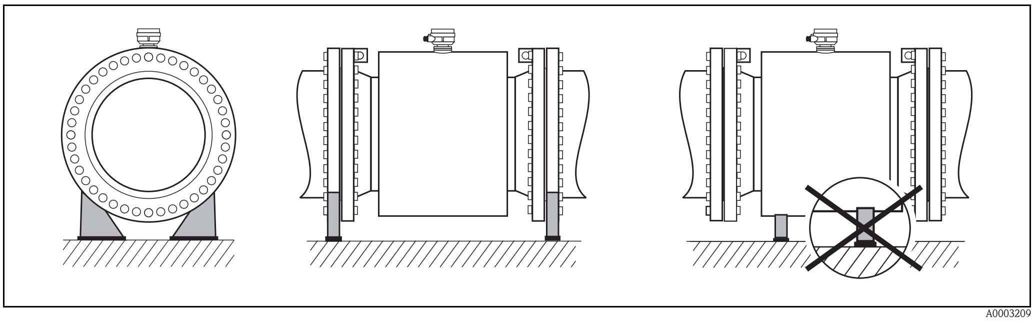


Measures to prevent vibration of the measuring device

L > 10 m (33 ft)

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

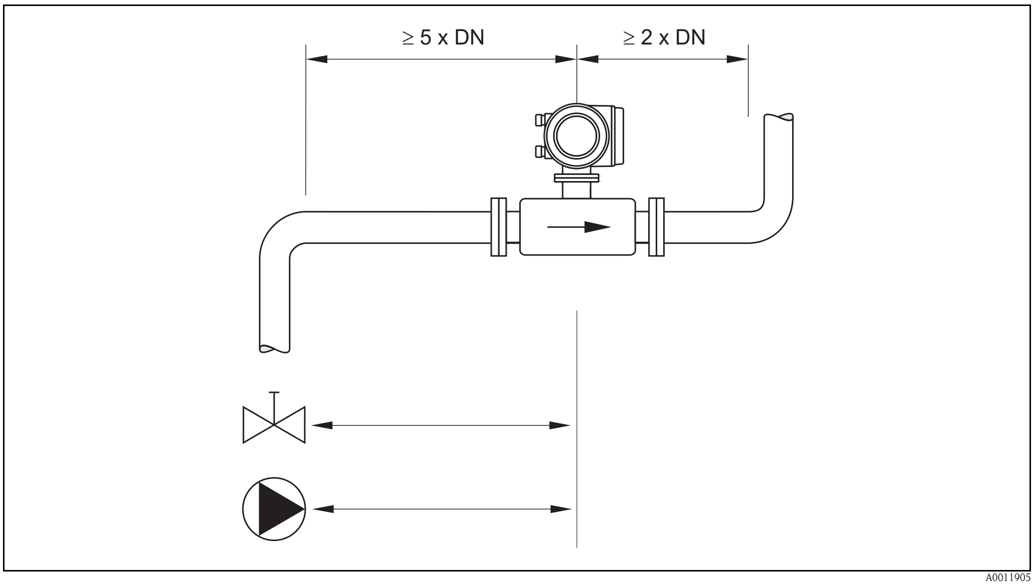
Caution!
Do not allow the casing to take the weight of the sensor. This would buckle the casing and damage the internal magnetic coils.



Inlet and outlet run

If possible, install the sensor well clear of assemblies such as valves, T-pieces, elbows etc.

Note the following inlet and outlet runs to comply with measuring accuracy specifications:
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN



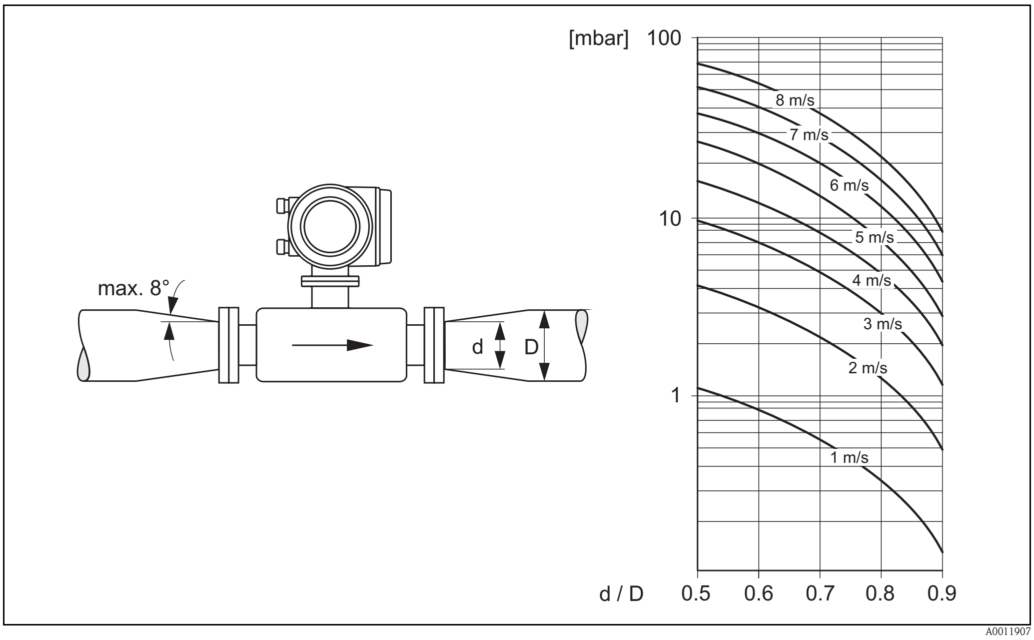
Inlet and outlet run

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 reducers and expanders.

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 flow velocity (downstream from the reduction) and the d/D ratio.

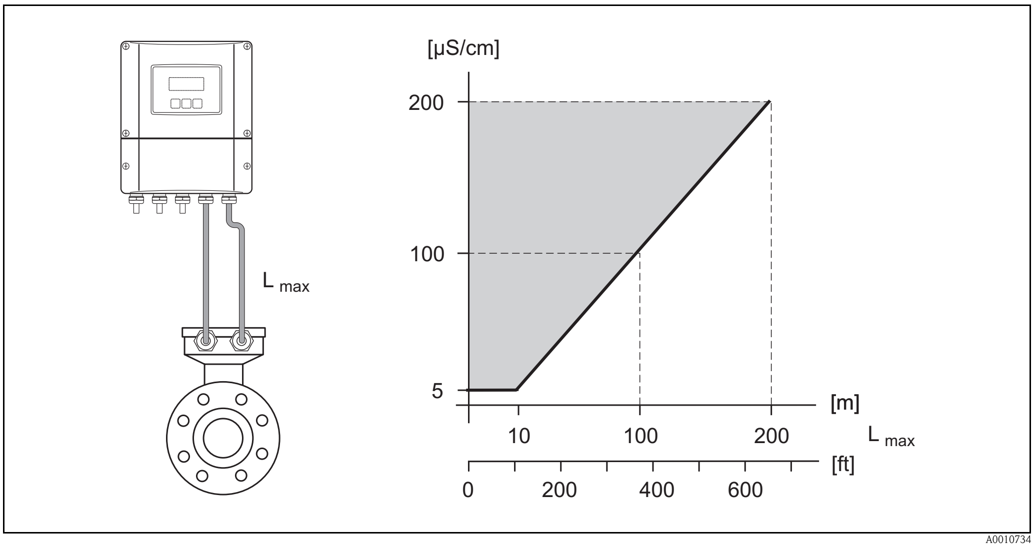


Pressure loss due to adapters

Length of connecting cable

When mounting the remote version, please note the following to achieve correct measuring results:

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- If necessary, ensure potential equalization between sensor and transmitter.
- The permitted cable length L_{max} is determined by the fluid conductivity. A minimum conductivity of 20 µS/cm is required for measuring demineralized water.
- When the empty pipe detection function is switched on (EPD), the maximum connecting cable length is 10 m (33 ft).



Permitted length of connecting cable for remote version
Area marked in gray = permitted range; L_{max} = length of connecting cable in [m] ([ft]); fluid conductivity in [µS/cm]

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!
The permitted temperature range of the measuring tube lining may not be undershot or overshot
→ 🗎 21, Section "Medium temperature range".

Please note the following points:
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.
- Do not remove the protective plates or caps on the process connections until the device is ready to install.

Degree of protection

- Standard: IP 67 (NEMA 4X) for transmitter and sensor.
- Optional: IP 68 (NEMA 6P) for sensor for remote version.
- For information regarding applications where the device is buried directly in the soil or is installed in a flooded wastewater basin please contact your local Endress+Hauser Sales Center.

Shock and vibration resistance

Acceleration up to 2 g following IEC 600 68-2-6

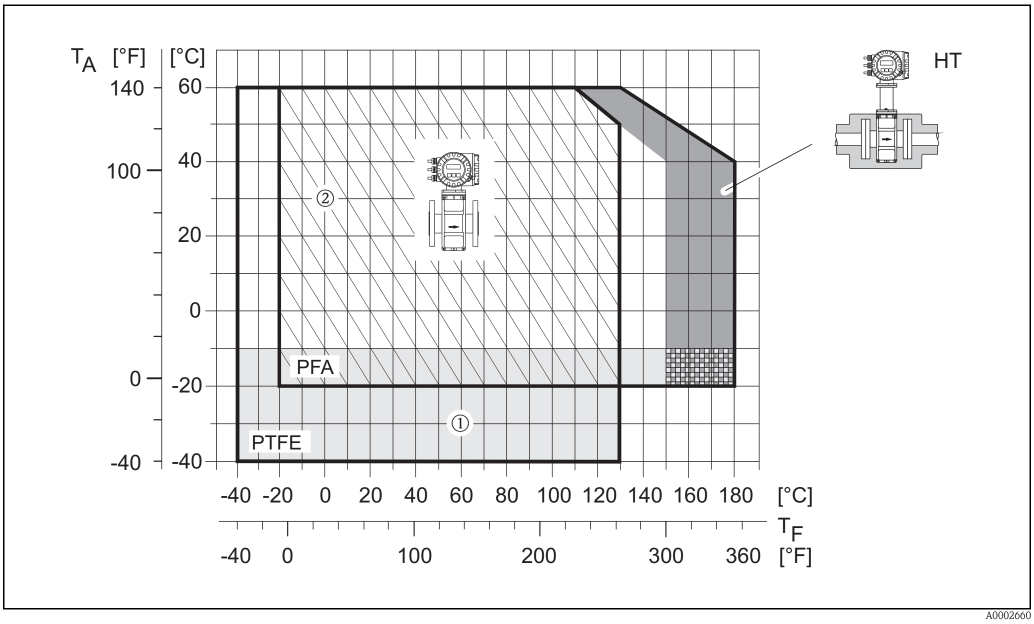
Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR recommendation NE 21.

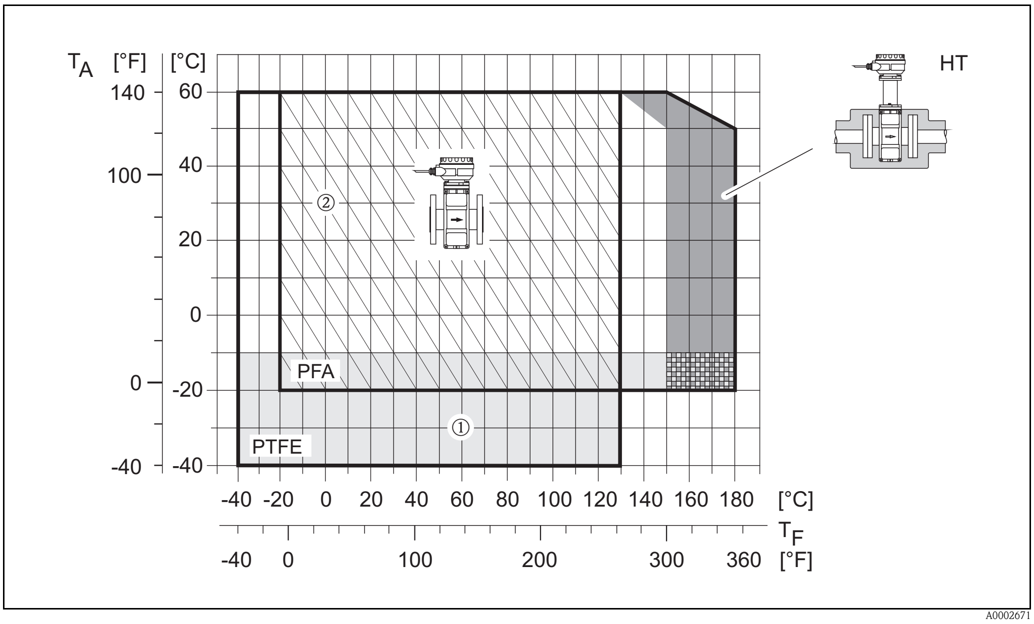
Operating conditions: Process

Medium temperature range

The permitted temperature depends on the lining of the measuring tube:
- PTFE: –40 to +130 °C (–40 to +266 °F) (DN 15 to 600 / ½ to 24"), restrictions → see diagrams
- PFA: –20 to +180 °C (–4 to +356 °F) (DN 25 to 200 / 1 to 8"), restrictions → see diagrams



Compact version (with PFA or PTFE lining)
T_A = Ambient temperature, T_F = Fluid temperature, HT = High temperature version with insulatio
① Gray shaded area → temperature range from –10 to –40 °C (–14 to –40 °F) applies only to stainless steel flanges
② HE + IP 68 to 130 °C (266 °F) only



Remote version (with PFA or PTFE lining)
T_A = Ambient temperature, T_F = Fluid temperature, HT = High temperature version with insulatio
① Gray shaded area → temperature range from –10 to –40 °C (–14 to –40 °F) applies only to stainless steel flanges
② HE + IP 68 to 130 °C (266 °F) only

Conductivity

The minimum conductivity is:
- ≥ 5 μS/cm for fluids generally
- ≥ 20 μS/cm for demineralized water

Note!
In the remote version, the necessary minimum conductivity also depends on the cable length (→ 19, Section "Length of connecting cable").

Medium pressure range (nominal pressure)

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 25 (DN 200 to 600 / 8 to 24")
  - PN 40 (DN 15 to 150 / ½ to 6")
- ANSI B 16.5
  - Class 150 (DN ½ to 24")
  - Class 300 (DN ½ to 6")
- JIS B2220
  - 10 K (DN 50 to 300 / 2 to 12")
  - 20 K (DN 15 to 300 / ½ to 12")
- AS 2129
  - Table E (DN 25, 50 / 1", 2")
- AS 4087
  - PN 16 (DN 50 / 2")

Pressure tightness

Measuring tube lining: PTFE

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:							
		25 °C (77 °F)		80 °C (176 °F)		100 °C (212 °F)		130 °C (266 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]
15	½"	0	0	0	0	0	0	100	1.45
25	1"	0	0	0	0	0	0	100	1.45
32	–	0	0	0	0	0	0	100	1.45
40	1½"	0	0	0	0	0	0	100	1.45
50	2"	0	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	10.6
400	16"	540	7.83	*	*	670	9.72	800	11.6
450	18"	Partial vacuum is impermissible!							
500	20"								
600	24"								

* No value can be specified.

Measuring tube lining: PFA

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:					
		25 °C (77 °F)		80 °C (176 °F)		100 to 180 °C (212 to 356 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]
25	1"	0	0	0	0	0	0
32	–	0	0	0	0	0	0
40	1½"	0	0	0	0	0	0
50	2"	0	0	0	0	0	0
65	–	0	0	*	*	0	0
80	3"	0	0	*	*	0	0
100	4"	0	0	*	*	0	0
125	–	0	0	*	*	0	0
150	6"	0	0	*	*	0	0
200	8"	0	0	*	*	0	0

* No value can be specified.

Limiting flow

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor.
The optimum flow velocity is between 2 to 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 (6.5 ft/s): for abrasive fluids such as potter's clay, lime milk, ore slurry etc.
- v > 2 m/s (6.5 ft/s): for fluids causing build-up such as wastewater sludges etc.

Flow characteristic values (SI units)					
Diameter		Recommended flow rate	Factory settings		
[mm]	[inch]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value, current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow cut off (v ~ 0.04 m/s)
15	½"	4 to 100 dm³/min	25 dm³/min	0.20 dm³	0.50 dm³/min
25	1"	9 to 300 dm³/min	75 dm³/min	0.50 dm³	1.00 dm³/min
32	–	15 to 500 dm³/min	125 dm³/min	1.00 dm³	2.00 dm³/min
40	1½"	25 to 700 dm³/min	200 dm³/min	1.50 dm³	3.00 dm³/min
50	2"	35 to 1100 dm³/min	300 dm³/min	2.50 dm³	5.00 dm³/min
65	–	60 to 2000 dm³/min	500 dm³/min	5.00 dm³	8.00 dm³/min
80	3"	90 to 3000 dm³/min	750 dm³/min	5.00 dm³	12.0 dm³/min
100	4"	145 to 4700 dm³/min	1200 dm³/min	10.0 dm³	20.0 dm³/min
125	–	220 to 7500 dm³/min	1850 dm³/min	15.0 dm³	30.0 dm³/min
150	6"	20 to 600 m³/h	150 m³/h	0.03 m³	2.50 m³/h
200	8"	35 to 1100 m³/h	300 m³/h	0.05 m³	5.00 m³/h
250	10"	55 to 1700 m³/h	500 m³/h	0.05 m³	7.50 m³/h
300	12"	80 to 2400 m³/h	750 m³/h	0.10 m³	10.0 m³/h
350	14"	110 to 3300 m³/h	1000 m³/h	0.10 m³	15.0 m³/h
400	16"	140 to 4200 m³/h	1200 m³/h	0.15 m³	20.0 m³/h
450	18"	180 to 5400 m³/h	1500 m³/h	0.25 m³	25.0 m³/h
500	20"	220 to 6600 m³/h	2000 m³/h	0.25 m³	30.0 m³/h
600	24"	310 to 9600 m³/h	2500 m³/h	0.30 m³	40.0 m³/h

Flow characteristic values (US units)					
Diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value, current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow cut off (v ~ 0.04 m/s)
½"	25	1.0 to 26 gal/min	6 gal/min	0.10 gal	0.15 gal/min
1"	25	2.5 to 80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1½"	40	7 to 190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10 to 300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
3"	80	24 to 800 gal/min	200 gal/min	2.00 gal	2.50 gal/min
4"	100	40 to 1250 gal/min	300 gal/min	2.00 gal	4.00 gal/min
6"	150	90 to 2650 gal/min	600 gal/min	5.00 gal	12.0 gal/min
8"	200	155 to 4850 gal/min	1200 gal/min	10.0 gal	15.0 gal/min
10"	250	250 to 7500 gal/min	1500 gal/min	15.0 gal	30.0 gal/min
12"	300	350 to 10600 gal/min	2400 gal/min	25.0 gal	45.0 gal/min
14"	350	500 to 15000 gal/min	3600 gal/min	30.0 gal	60.0 gal/min
16"	400	600 to 19000 gal/min	4800 gal/min	50.0 gal	60.0 gal/min
18"	450	800 to 24000 gal/min	6000 gal/min	50.0 gal	90.0 gal/min
20"	500	1000 to 30000 gal/min	7500 gal/min	75.0 gal	120.0 gal/min
24"	600	1400 to 44000 gal/min	10500 gal/min	100.0 gal	180.0 gal/min

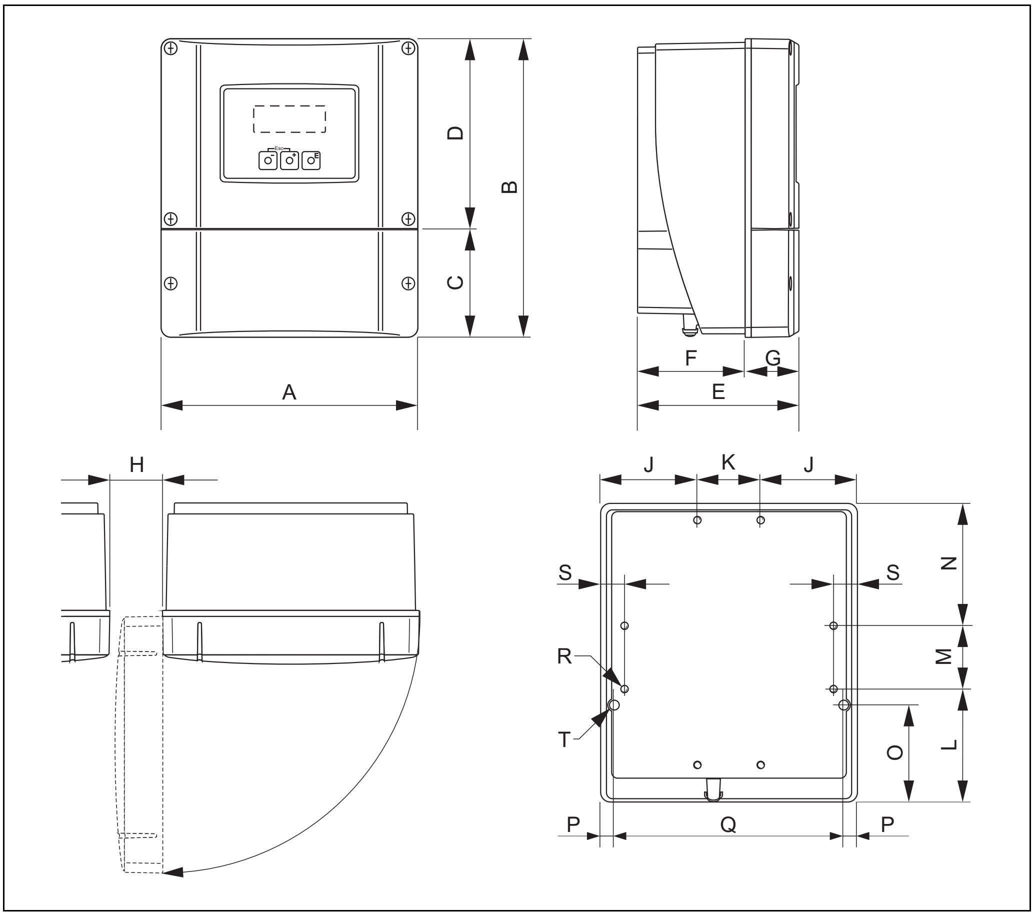
Pressure loss

- No pressure loss if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 (→ 🗎 18, Section "Adapters").

Mechanical construction

Design, dimensions

Transmitter remote version, wall-mount housing (non Ex-zone and II3G/Zone 2)



A0001150

Dimensions (SI units)

A	B	C	D	E	F	G	H	J
215	250	90.5	159.5	135	90	45	> 50	81
K	L	M	N	O	P	Q	R	S
53	95	53	102	81.5	11.5	192	8 × M5	20

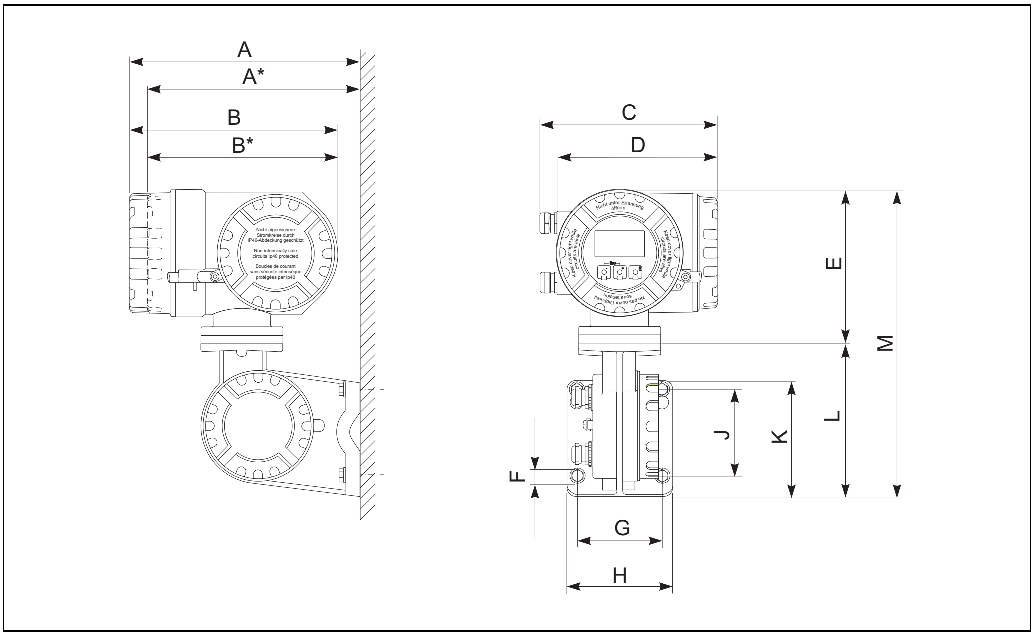
All dimensions in [mm]

Dimensions (US units)

A	B	C	D	E	F	G	H	J
8.46	9.84	3.56	6.27	5.31	3.54	1.77	> 1.97	3.18
K	L	M	N	O	P	Q	R	S
2.08	3.74	2.08	4.01	3.20	0.45	7.55	8 × M5	0.79

All dimensions in [inch]

Transmitter remote version, connection housing (II2GD/Zone 1)



A0002128

Dimensions (SI units)

A	A*	B	B*	C	D	E	Ø F	G	H	J	K	L	M
265	242	240	217	206	186	178	8.6 (M8)	100	130	100	144	170	355

All dimensions in [mm]

Dimensions (US units)

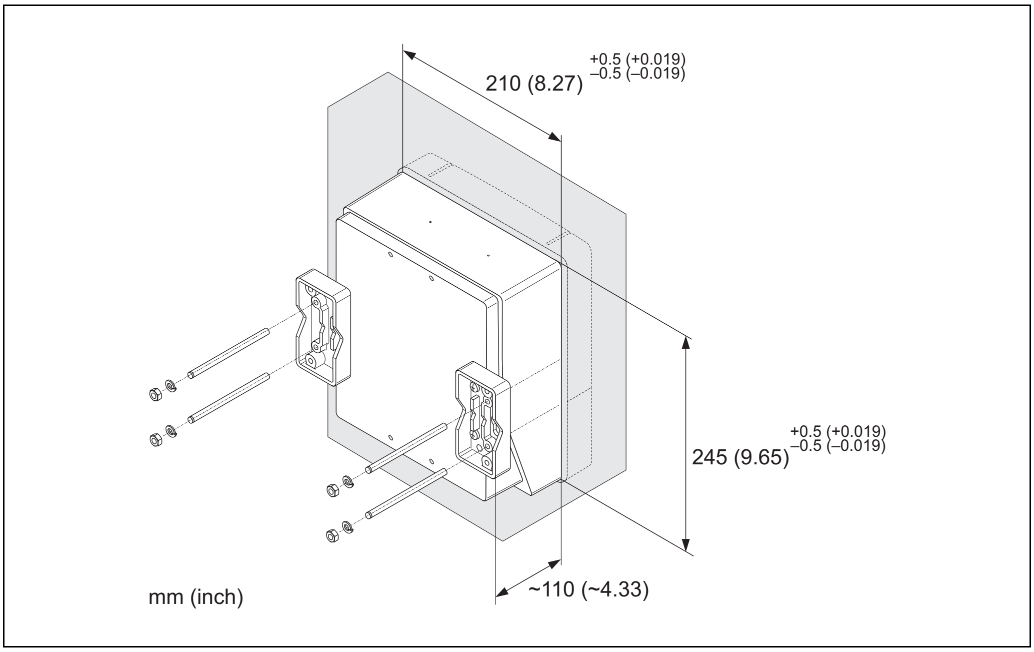
A	A*	B	B*	C	D	E	Ø F	G	H	J	K	L	M
10.4	9.53	9.45	8.54	8.11	7.32	7.01	0.34 (M8)	3.94	5.12	3.94	5.67	6.69	14.0

All dimensions in [inch]

There is a separate mounting kit for the wall-mounted housing. It can be ordered from Endress+Hauser as an accessory. The following installation variants are possible:

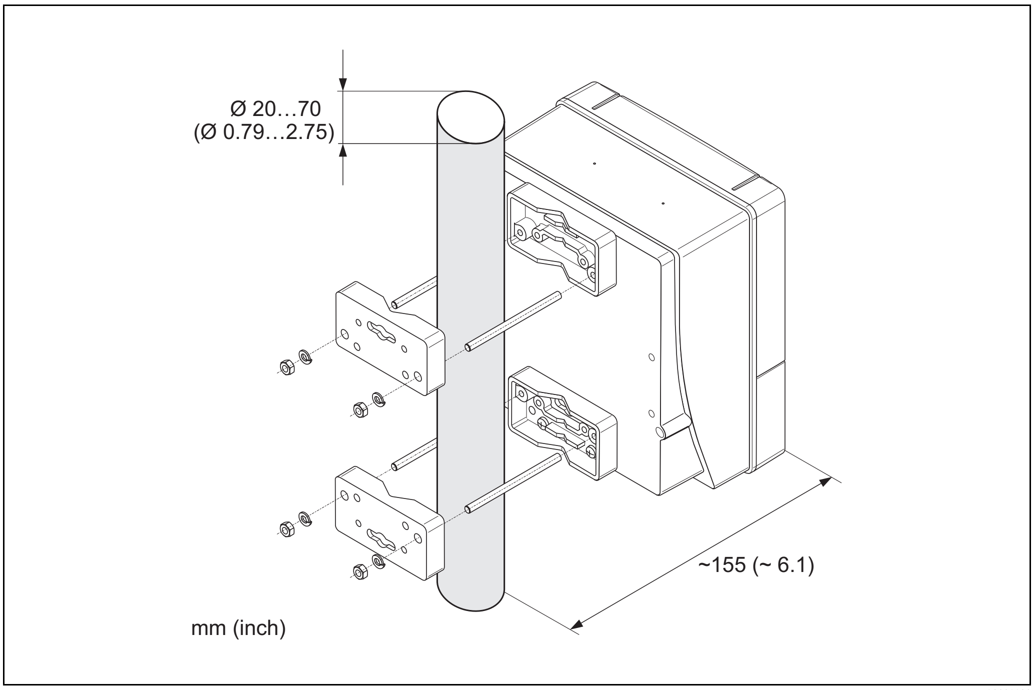
- Panel-mounted installation
- Pipe mounting

Installation in control panel



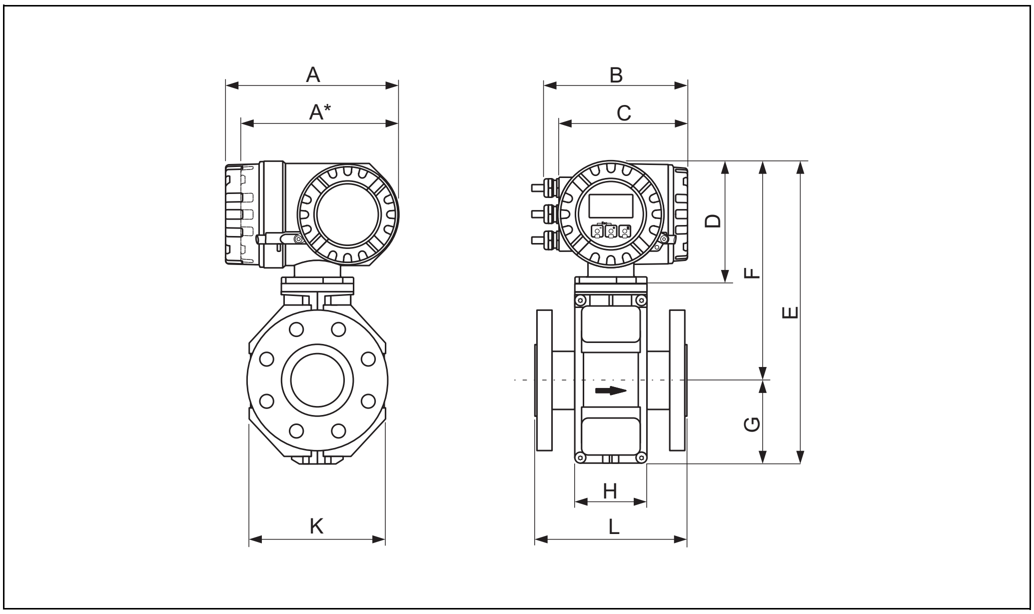
A0001131

Pipe mounting



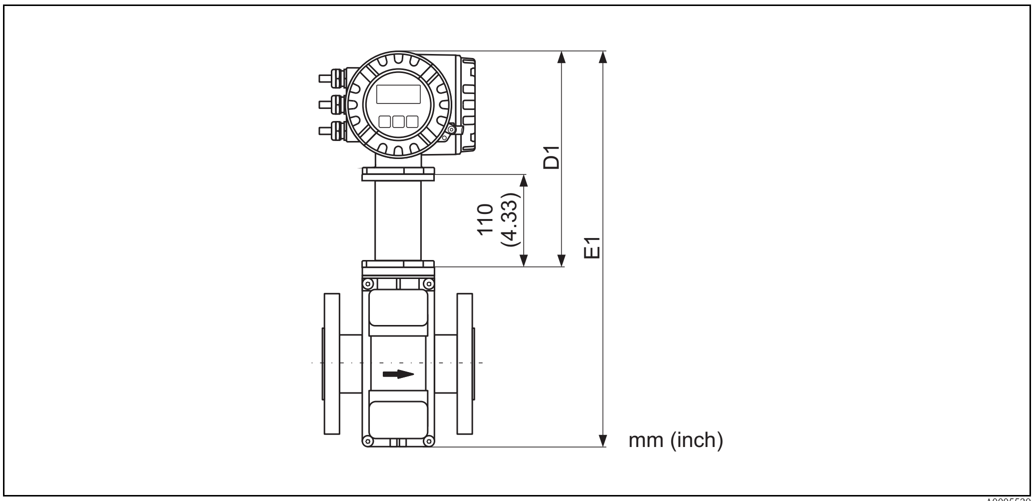
A0001132

Compact version DN ≤ 300 (12")



A0005423

High temperature version DN ≤ 300 (12")



A0005529

Measurement D1, E1 = Measurement D, E of the standard compact version plus 110 mm (4.33")

Dimensions (SI units)

DN EN (DIN) / JIS / AS [2]	L [1]	A	A*	B	C	D	E	F	G	H	K
15	200						341	257	84	94	120
25	200						341	257	84	94	120
32	200						341	257	84	94	120
40	200						341	257	84	94	120
50	200						341	257	84	94	120
65	200						391	282	109	94	180
80	200	227	207	187	168	160	391	282	109	94	180
100	250						391	282	109	94	180
125	250						472	322	150	140	260
150	300						472	322	150	140	260
200	350						527	347	180	156	324
250	450						577	372	205	166	400
300	500						627	397	230	166	460

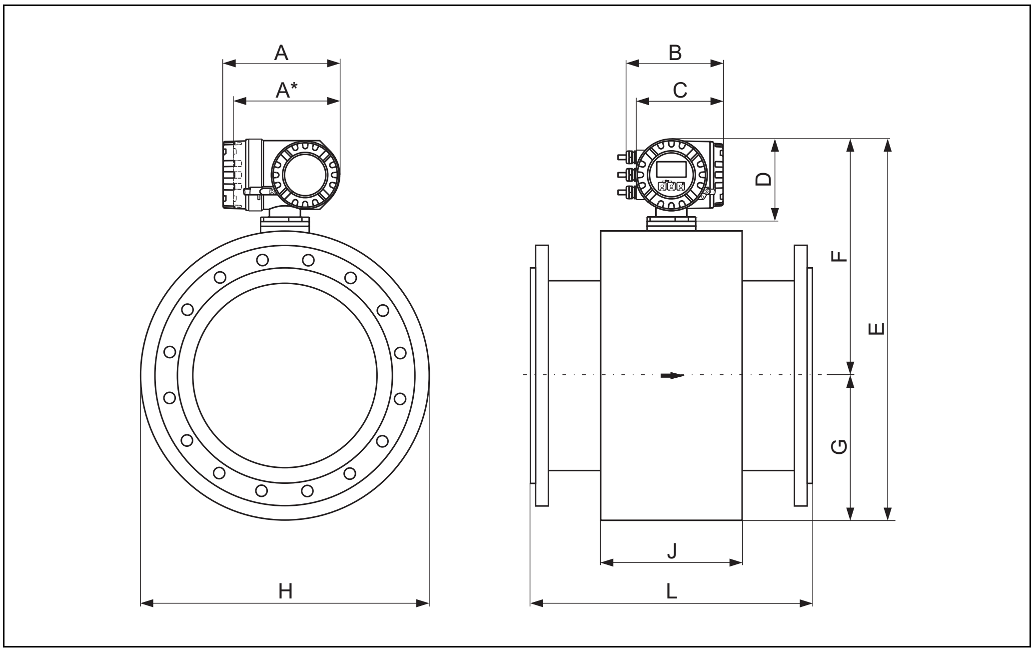
[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] Only DN 25 and DN 50 are available for flanges according to AS.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L [1]	A	A*	B	C	D	E	F	G	H	K
½"	7.87						13.4	10.1	3.31	3.70	4.72
1"	7.87						13.4	10.1	3.31	3.70	4.72
1½"	7.87						13.4	10.1	3.31	3.70	4.72
2"	7.87						13.4	10.1	3.31	3.70	4.72
3"	7.87	8.94	8.15	7.36	6.61	6.30	15.4	11.1	4.29	3.70	7.09
4"	9.84						15.4	11.1	4.29	3.70	7.09
6"	11.8						18.6	12.7	5.91	5.51	10.2
8"	13.8						20.8	13.7	7.09	6.14	12.8
10"	17.7						22.7	14.7	8.07	6.54	15.8
12"	19.7						24.7	15.6	9.06	6.54	18.1

[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Compact version DN ≥ 350 (14")



A0005424

Dimensions (SI units)

DN EN (DIN)	L 1)	A	A*	B	C	D	E	F	G	H	J
350	550	227	207	187	168	160	738.5	456.5	282.0	564	276
400	600						790.5	482.5	308.0	616	276
450	650						840.5	507.5	333.0	666	292
500	650						891.5	533.0	358.5	717	292
600	780						995.5	585.0	410.5	821	402

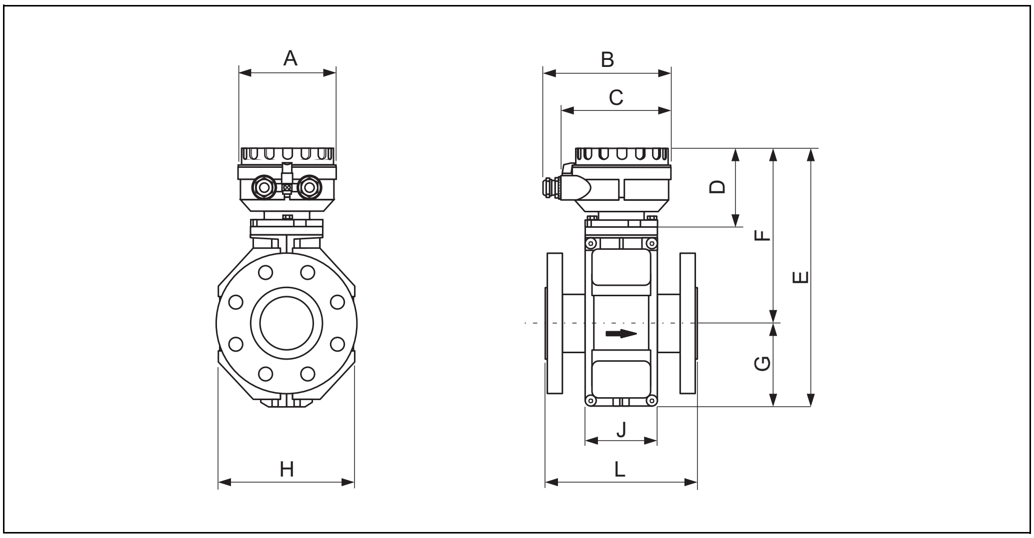
1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L 1)	A	A*	B	C	D	E	F	G	H	J
14"	21.7	8.94	8.15	7.36	6.61	6.30	29.1	18.0	11.1	22.2	10.9
16"	23.6						31.1	19.0	12.1	24.3	10.9
18"	25.6						33.1	20.0	13.1	26.2	11.5
20"	25.6						35.1	21.0	14.1	28.2	11.5
24"	30.7						39.2	23.0	16.2	32.3	15.8

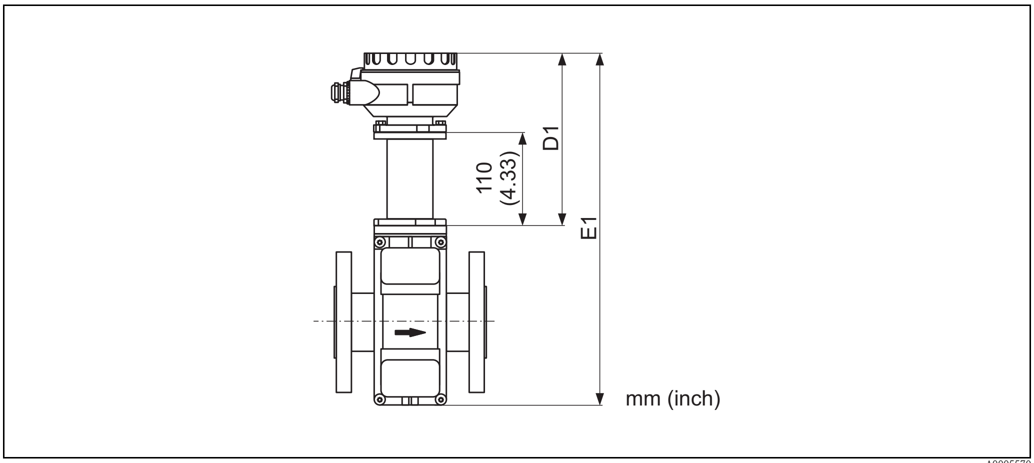
1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Sensor, remote version DN ≤ 300 (12")



A0012462

High temperature version DN ≤ 300 (12")



A0005570

Measurement D1, E1 = Measurement D, E of the standard remote version plus 110 mm (4.33")

Dimensions (SI units)

DN EN (DIN) / JIS / AS [2]	L [1]	A	B	C	D	E	F	G	H	J
15	200	129	163	143	102	286	202	84	120	94
25	200					286	202	84	120	94
32	200					286	202	84	120	94
40	200					286	202	84	120	94
50	200					286	202	84	120	94
65	200					336	227	109	180	94
80	200					336	227	109	180	94
100	250					336	227	109	180	94
125	250					417	267	150	260	140
150	300					417	267	150	260	140
200	350					472	292	180	324	156
250	450					522	317	205	400	166
300	500					572	342	230	460	166

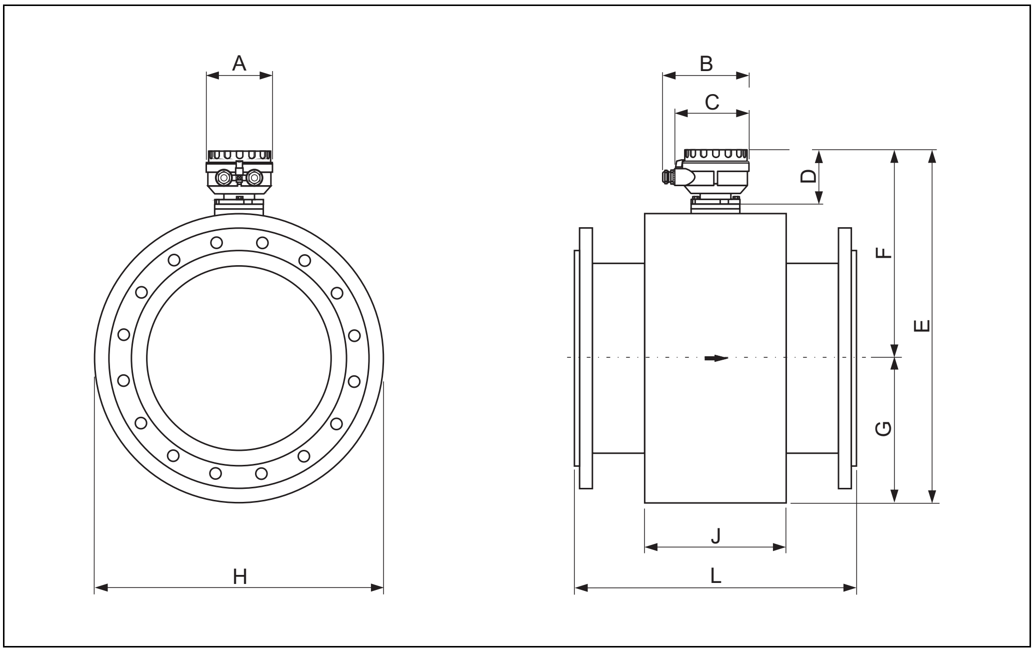
[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2] Only DN 25 and DN 50 are available for flanges according to AS.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L [1]	A	B	C	D	E	F	G	H	J
½"	7.87	5.08	6.42	5.63	4.02	11.3	7.95	3.31	4.72	3.70
1"	7.87					11.3	7.95	3.31	4.72	3.70
1½"	7.87					11.3	7.95	3.31	4.72	3.70
2"	7.87					11.3	7.95	3.31	4.72	3.70
3"	7.87					13.2	8.94	4.29	7.09	3.70
4"	9.84					13.2	8.94	4.29	7.09	3.70
6"	11.8					16.4	10.5	5.91	10.2	5.51
8"	13.8					18.6	11.5	7.08	12.8	6.14
10"	17.7					20.6	12.5	8.07	15.8	6.54
12"	19.7					22.5	13.5	9.06	18.1	6.54

[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Sensor, remote version DN ≥ 350 (14")



A0003220

Dimensions (SI units)

DN EN (DIN)	L [1]	A	B	C	D	E	F	G	H	J
350	550	129	163	143	102	683.5	401.5	282.0	564	276
400	600					735.5	427.5	308.0	616	276
450	650					785.5	452.5	333.0	666	292
500	650					836.5	478.0	358.5	717	292
600	780					940.5	530.0	410.5	821	402

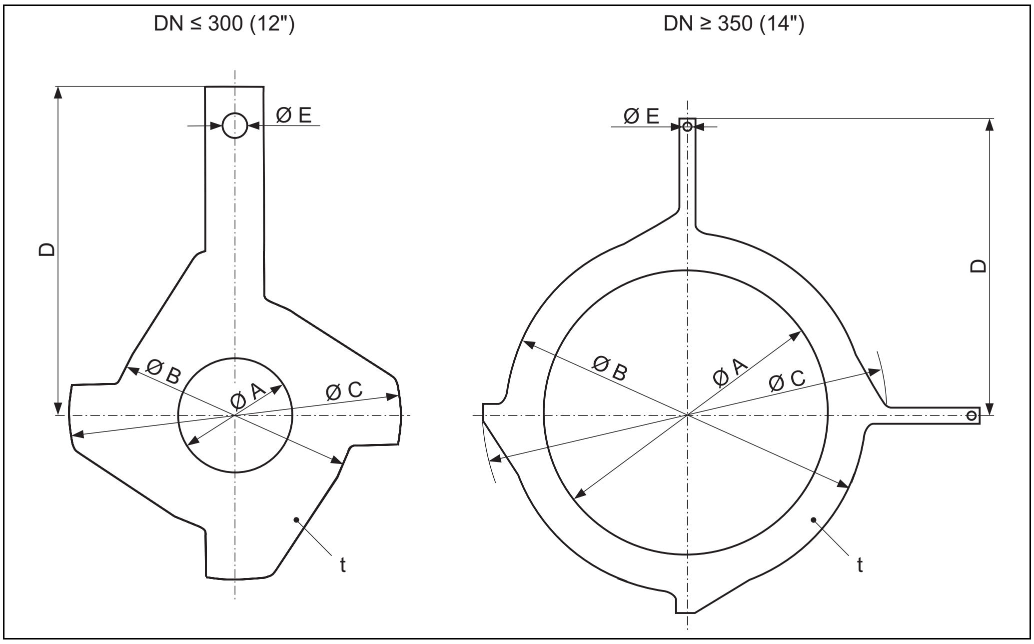
[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L [1]	A	B	C	D	E	F	G	H	J
14"	21.7	5.08	6.42	5.63	4.02	26.9	15.8	11.1	22.2	10.9
16"	23.6					29.0	16.8	12.1	24.3	10.9
18"	25.6					30.9	17.8	13.1	26.2	11.5
20"	25.6					32.9	18.8	14.1	28.2	11.5
24"	30.7					37.0	20.9	16.2	32.3	15.8

[1] The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Ground disk for flange connections



Dimensions (SI units)

DN [1] EN (DIN) / JIS / AS [2]	A PTFE, PFA	B	C	D	E	t
15	16	43	61.5	73	6.5	2
25	26	62	77.5	87.5		
32	35	80	87.5	94.5		
40	41	82	101	103		
50	52	101	115.5	108		
65	68	121	131.5	118		
80	80	131	154.5	135		
100	104	156	186.5	153		
125	130	187	206.5	160		
150	158	217	256	184		
200	206	267	288	205		
250	260	328	359	240		
300 [3]	312	375	413	273		
300 [4]	310	375	404	268		
350 [3]	343	433	479	365	9.0	
400 [3]	393	480	542	395		
450 [3]	439	538	583	417		
500 [3]	493	592	650	460		
600 [3]	593	693	766	522		

[1] Ground disks at DN 15 to 250 (½ to 10") can be used for all flange standards/pressure ratings.
[2] Only DN 25 and DN 50 are available for flanges according to AS.
[3] PN 10/16
[4] PN 25, JIS 10K/20K
All dimensions in [mm]

Dimensions (US units)

<table>
<tr><th>DN [1)]
ANSI</th><th>A
PTFE, PFA</th><th>B</th><th>C</th><th>D</th><th>E</th><th>t</th></tr>
<tr><td>½"</td><td>0.63</td><td>1.69</td><td>2.42</td><td>2.87</td><td rowspan="10">0.26</td><td rowspan="15">0.08</td></tr>
<tr><td>1"</td><td>1.02</td><td>2.44</td><td>3.05</td><td>3.44</td></tr>
<tr><td>1½"</td><td>1.61</td><td>3.23</td><td>3.98</td><td>4.06</td></tr>
<tr><td>2"</td><td>2.05</td><td>3.98</td><td>4.55</td><td>4.25</td></tr>
<tr><td>3"</td><td>3.15</td><td>5.16</td><td>6.08</td><td>5.31</td></tr>
<tr><td>4"</td><td>4.09</td><td>6.14</td><td>7.34</td><td>6.02</td></tr>
<tr><td>6"</td><td>6.22</td><td>8.54</td><td>10.08</td><td>7.24</td></tr>
<tr><td>8"</td><td>8.11</td><td>10.5</td><td>11.3</td><td>8.07</td></tr>
<tr><td>10"</td><td>10.2</td><td>12.9</td><td>14.1</td><td>9.45</td></tr>
<tr><td>12"</td><td>12.3</td><td>14.8</td><td>16.3</td><td>10.8</td></tr>
<tr><td>14"</td><td>13.5</td><td>17.1</td><td>18.9</td><td>14.4</td><td rowspan="5">0.35</td></tr>
<tr><td>16"</td><td>15.45</td><td>18.9</td><td>21.3</td><td>15.6</td></tr>
<tr><td>18"</td><td>17.3</td><td>21.2</td><td>23.0</td><td>16.4</td></tr>
<tr><td>20"</td><td>19.4</td><td>23.3</td><td>25.6</td><td>18.1</td></tr>
<tr><td>24"</td><td>23.4</td><td>27.3</td><td>30.1</td><td>20.6</td></tr>
</table>

[1)] Ground disks can be used for all flange standards/pressure ratings.
All dimensions in [inch]

Weight

Weight in SI units

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

1) For flanges to AS, only DN 25 and 50 are available.

- Transmitter (compact version): 3.4 kg, high temperature version: +1.5 kg
- Weight data valid for standard pressure ratings and without packaging material.

Weight in US units (only ANSI)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
				Sensor		Transmitter
[mm]	[inch]	ANSI		ANSI		Wall-mount housing
15	½"	Class 150	14.3	Class 150	9.92	13.2
25	1"		16.1		11.7	
40	1½"		20.7		16.3	
50	2"		23.4		19.0	
80	3"		30.9		26.5	
100	4"		35.3		30.9	
150	6"		56.2		51.8	
200	8"		99.2		94.8	
250	10"		165.4		161.0	
300	12"		242.6		238.1	
350	14"		385.9		381.5	
400	16"		452.0		447.6	
450	18"		562.3		557.9	
500	20"		628.4		624.0	
600	24"		893.0		888.6	

- Transmitter (compact version): 7.50 lbs, high temperature version: +3.31 lbs
- Weight data valid for standard pressure ratings and without packaging material.

Measuring tube specifications

Diameter		Pressure rating					Internal diameter			
		EN (DIN)	AS 2129	AS 4087	ANSI	JIS	PFA		PTFE	
[mm]	[inch]	[bar]			[lbs]		[mm]	[inch]	[mm]	[inch]
15	½"	PN 40	–	–	Cl.150	20K	–	–	15	0.59
25	1"	PN 40	Table E	–	Cl.150	20K	23	0.91	26	1.02
32	–	PN 40	–	–	–	20K	32	1.26	35	1.38
40	1½"	PN 40	–	–	Cl.150	20K	36	1.42	41	1.61
50	2"	PN 40	Table E	PN 16	Cl.150	10K	48	1.89	52	2.05
65	–	PN 16	–	–	–	10K	63	2.48	67	2.64
80	3"	PN 16	–	–	Cl.150	10K	75	2.95	80	3.15
100	4"	PN 16	–	–	Cl.150	10K	101	3.98	104	4.09
125	–	PN 16	–	–	–	10K	126	4.96	129	5.08
150	6"	PN 16	–	–	Cl.150	10K	154	6.06	156	6.14
200	8"	PN 10	–	–	Cl.150	10K	201	7.91	202	7.95
250	10"	PN 10	–	–	Cl.150	10K	–	–	256	10.1
300	12"	PN 10	–	–	Cl.150	10K	–	–	306	12.0
350	14"	PN 10	–	–	Cl.150	–	–	–	337	13.3
400	16"	PN 10	–	–	Cl.150	–	–	–	387	15.2
450	18"	PN 10	–	–	Cl.150	–	–	–	432	17.0
500	20"	PN 10	–	–	Cl.150	–	–	–	487	19.2
600	24"	PN 10	–	–	Cl.150	–	–	23	593	23.3

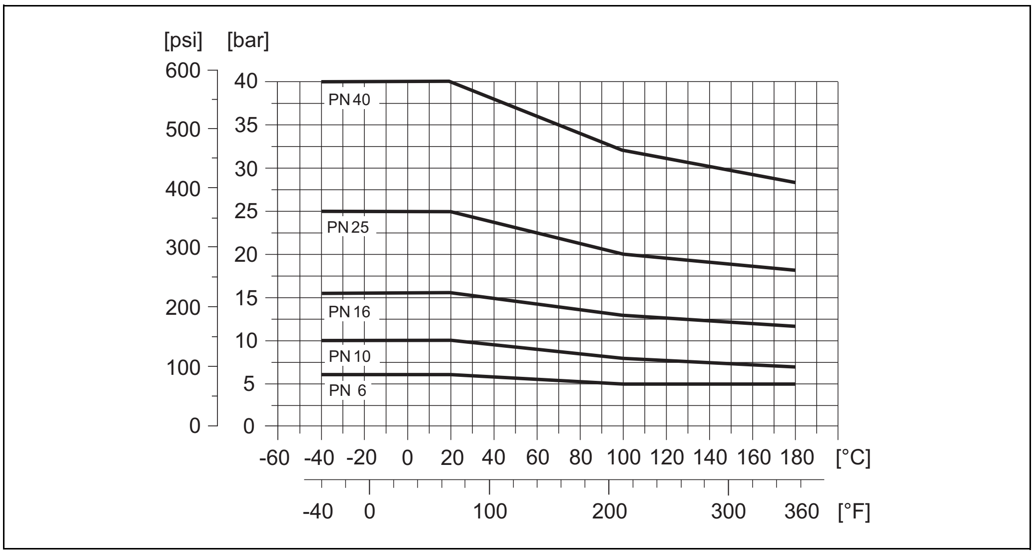
Material

- Transmitter housing
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 600 (14 to 24"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 or 1.4306/304L;
    (for flanges made of carbon steel with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 or 1.4306/304L;
    (for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435, Platinum, Alloy C-22, Tantalum, Titanium
- Flanges
  - EN 1092-1 (DIN 2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B
    (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ANSI: A105; F316L
    (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AWWA: 1.0425
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L
    (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129
    - DN 25 (1"): A105 or RSt37-2 (S235JRG2)
    - DN 40 (1 ½"): A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L or Alloy C-22

Material load diagram

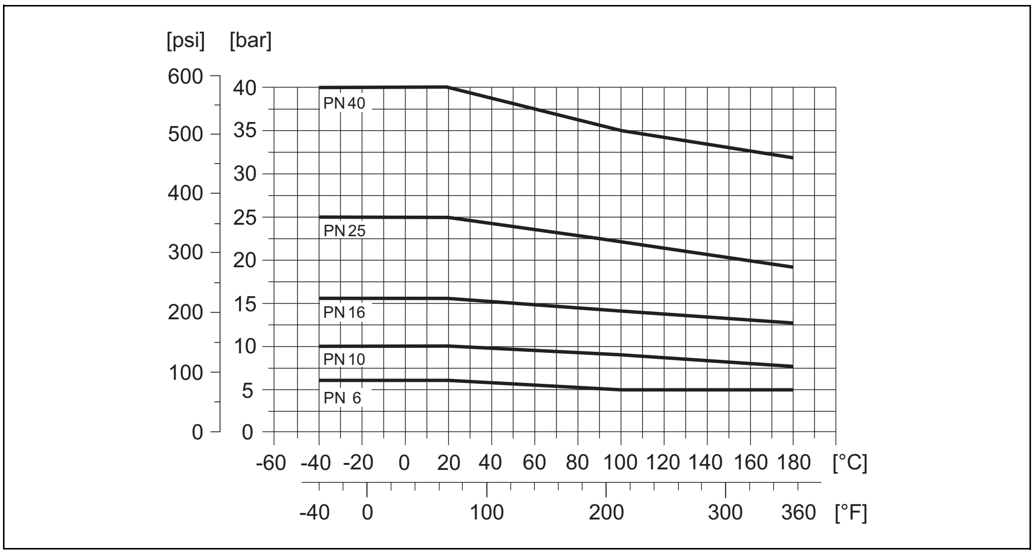
Caution!
The following diagrams contain material load diagrams (reference curves) for flange materials with regard to the medium temperature. However, the maximum medium temperatures permitted always depend on the lining material of the sensor and/or the sealing material (→ 21).

Flange connection to EN 1092-1 (DIN 2501)
Material: RSt37-2 (S235JRG2) / C22 / Fe 410W B



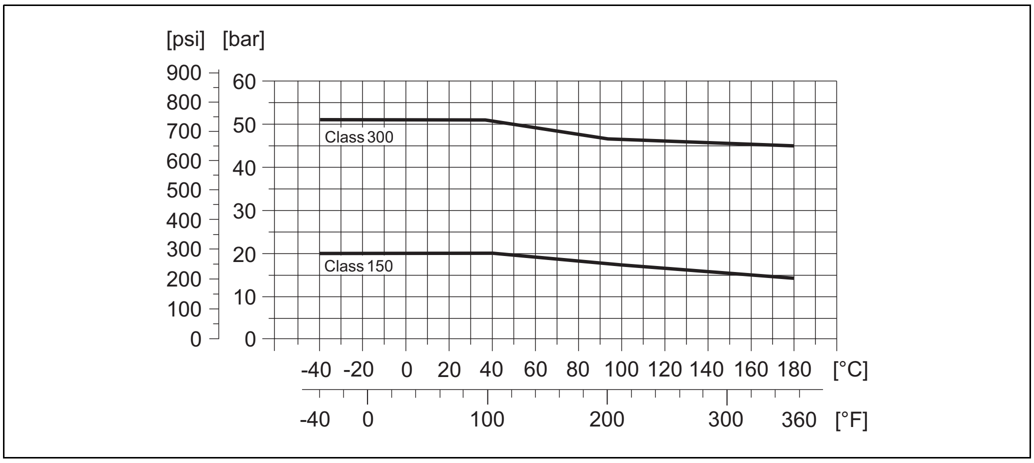
A0005594

Flange connection to EN 1092-1 (DIN 2501)
Material: 316L / 1.4571



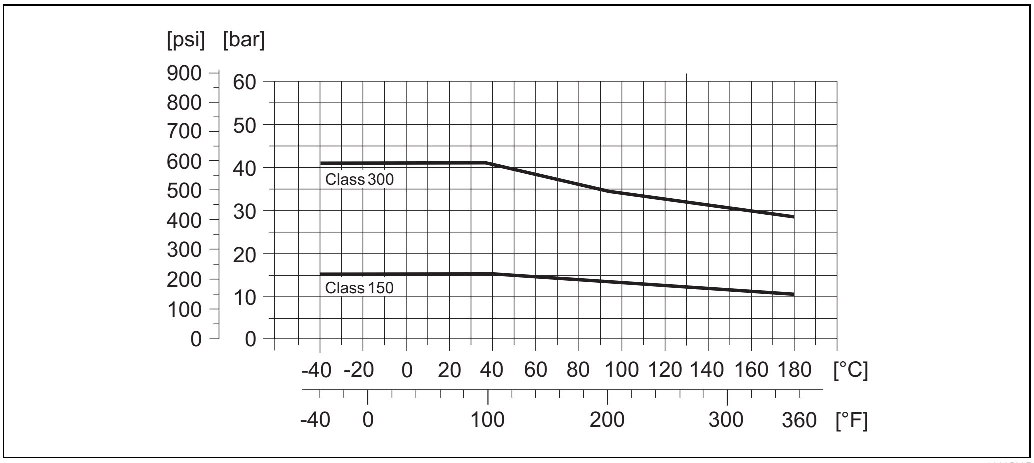
A0005304

Flange connection to ANSI B16.5
Material: A 105



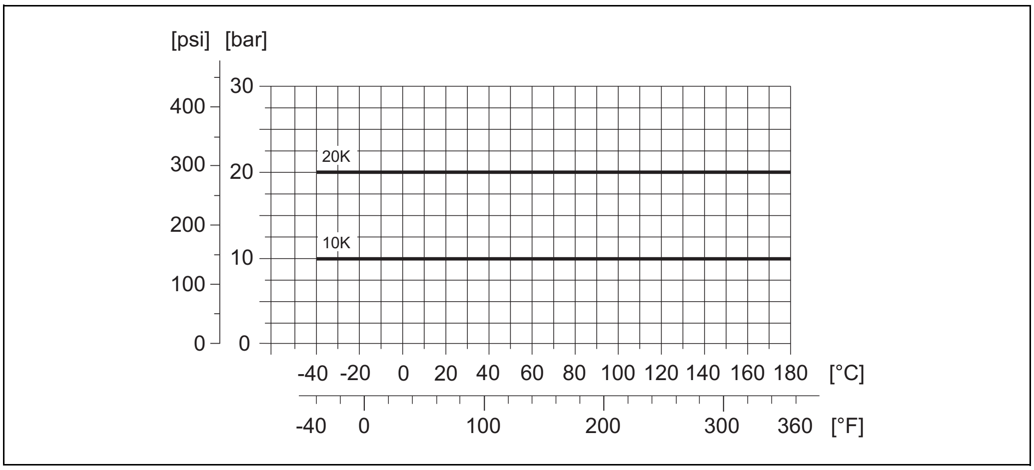
A0003226

Flange connection to ANSI B16.5
Material: F316L



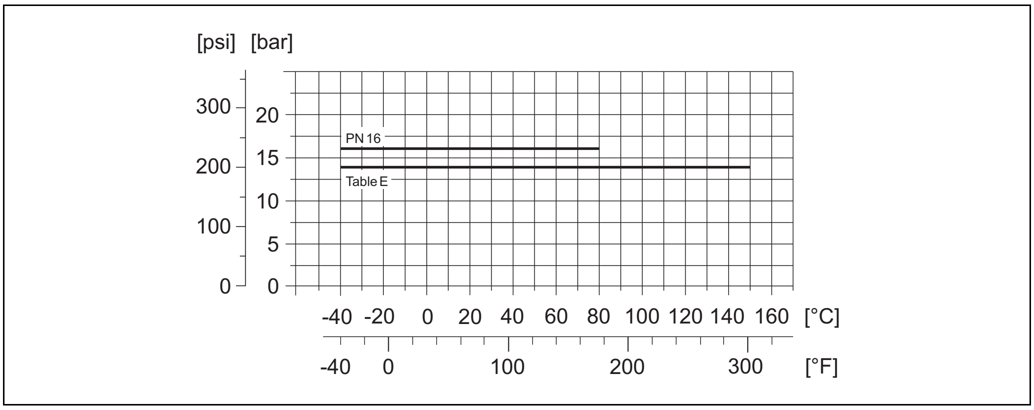
A0005307

Flange connection to JIS B2220
Material: RSt37-2 (S235JRG2) / HII / 1.0425 / 316L



A0003228

Flange connection to AS 2129 Table E or AS 4087 PN 16
Material: A105 / RSt37-2 (S235JRG2) / St44-2 (S275JR)



A0005595

Fitted electrodes

Measuring electrodes, reference electrodes and empty pipe detection electrodes:
- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20, titanium
- Optional: measuring electrodes made of platinum/rhodium 80/20

Process connections

Flange connection:
- EN 1092-1 (DIN 2501), DN ≤ 300 (12") form A, DN ≥ 350 (14") form B
  (Dimensions to DIN 2501, DN 65 PN 16 and DN 600 (24") PN 16 exclusively to EN 1092-1)
- ANSI B16.5
- JIS B2220
- AS 2129 Table E
- AS 4087 PN 16

Surface roughness

- PFA liner: ≤ 0.4 µm (15.7 µin)
- Elektroden
  - 1.4435, Alloy C-22, titanium: ≤ 0.3 to 0.5 µm (≤ 11.8 to 19.7 µin)
  - Tantal, Platin/Rhodium: ≤ 0.3 to 0.5 µm (≤ 11.8 to 19.7 µin)

(All data refer to parts in contact with medium)

Human interface

Display elements

- Liquid crystal display: backlit, two lines (Promag 50) or four lines (Promag 53) with 16 characters per line
- Custom configurations for presenting different measured-value and status variables
- Totalizer
  – Promag 50: 2 totalizers
  – Promag 53: 3 totalizers

Operating elements

Unified operation concept for both types of transmitter:

Promag 50:
- Local operation via three keys (−, +, E)
- Quick Setup menus for straightforward commissioning

Promag 53:
- Local operation via three keys (−, +, E)
- Application-specific Quick Setup menus for straightforward commissioning

Language groups

Language groups available for operation in different countries:

Promag 50, Promag 53:
- Western Europe and America (WEA):
  English, German, Spanish, Italian, French, Dutch, Portuguese
- Eastern Europe and Scandinavia (EES):
  English, Russian, Polish, Norwegian, Finnish, Swedish, Czech
- South and east Asia (SEA):
  English, Japanese, Indonesian

Promag 53:
- China (CN):
  English, Chinese

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

Remote operation

- Promag 50: Remote control via HART, PROFIBUS DP/PA
- Promag 53: Remote control via HART, PROFIBUS DP/PA, MODBUS RS485, FOUNDATION Fieldbus

Certificates and approvals

CE mark

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

C-tick mark

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Pressure measuring 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. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.

Ex approval

Information about currently available Ex versions (ATEX, IECEx, FM, CSA, NEPSI) 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.

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code)
- EN 61010
  Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.
- IEC/EN 61326
  "Emission in accordance with requirements for Class A".
  Electromagnetic compatibility (EMC requirements)
- 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.
- ANSI/ISA-S82.01
  Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements Pollution degree 2, Installation Category II.
- CAN/CSA-C22.2 No. 1010.1-92
  Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use.
  Pollution degree 2, Installation Category II

FOUNDATION Fieldbus certification

The flow device has successfully passed all the test procedures carried out and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specifications:

- Certified to FOUNDATION Fieldbus Specification
- The device meets all the specifications of the FOUNDATION Fieldbus H1.
- Interoperability Test Kit (ITK), revision status 5.01 (device certification number: on request)
- The device can also be operated with certified devices of other manufacturers
- Physical Layer Conformance Test of the Fieldbus Foundation

MODBUS RS485 certification

The measuring device meets all the requirements of the MODBUS/TCP conformity test and has 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.

PROFIBUS DP/PA certification

The flow device has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organisation). The device thus meets all the requirements of the following specifications:

- Certified to PROFIBUS PA, profile version 3.0 (device certification number: on request)
- The device can also be operated with certified devices of other manufacturers (interoperability)

Ordering information

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

Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the order codes in question.

Documentation

- Flow Measurement (FA005D/06)
- Operating Instructions Promag Promag 50 (BA046D/06 and BA049D/06)
- Operating Instructions Promag Promag 50 PROFIBUS PA (BA055D/06 and BA056D/06)
- Operating Instructions Promag Promag 53 (BA047D/06 and BA048D/06)
- Operating Instructions Promag Promag 53 FOUNDATION Fieldbus (BA051D/06 and BA052D/06)
- Operating Instructions Promag Promag 53 MODBUS RS485 (BA117D/06 and BA118D/06)
- Operating Instructions Promag Promag 53 PROFIBUS DP/PA (BA053D/06 and BA054D/06)
- Supplementary documentation on Ex-ratings: ATEX, IECEx, FM, CSA, NEPSI

Registered trademarks

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

PROFIBUS®
Registered trademark of the PROFIBUS Nutzerorganisation e.V., Karlsruhe, D

FOUNDATION™ Fieldbus
Registered trademark of the Fieldbus Foundation, Austin, USA

MODBUS®
Registered trademark of the MODBUS Organisation

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, FieldCare®, Fieldcheck®, FieldXpert™, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

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Endress+Hauser
People for Process Automation

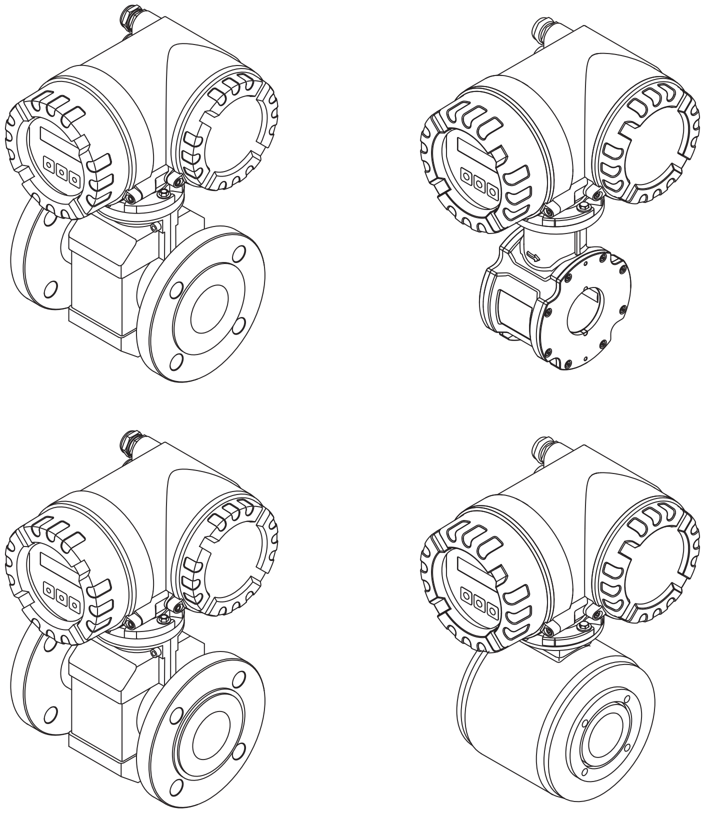
TI047D/06/en/11.09
71106271
FM+SGML6.0 ProMoDo

BA00046D/06/EN/15.14
71249447

Valid as of version
V 2.04.XX (device software)

Operating Instructions
Proline Promag 50 HART

Electromagnetic flowmeter



Endress+Hauser
People for Process Automation

Table of contents

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 μS/cm is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 μS/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

Please note the following:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood this Operating Manual and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual is mandatory.
- With regard to special fluids, including fluids used for cleaning, Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials. However, minor changes in temperature, concentration or in the degree of contamination in the process may result in variations in corrosion resistance. For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of wetted materials in a specific application.
  The user is responsible for the choice of suitable wetted materials in the process.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded apart from when special protective measures are taken (e.g. galvanically isolated SELV or PELV power supply)
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Please note the following:
- Measuring systems for use in hazardous environments are accompanied by separate Ex documentation, which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this Ex documentation indicates the approval and the certification body (e.g. Europe, USA, Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 and NAMUR Recommendations NE 21 and NE 43.
- 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.

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 "Safety requirements for electrical equipment for measurement, control and laboratory use".
The devices can, however, be a source of danger if used incorrectly or for anything other than the designated use. Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:

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

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

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

2 Identification

2.1 Device designation

The flow measuring system consists of the following components:

- Promag 50 transmitter
- Promag D/E/H/L/P/W sensor

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

2.1.1 Nameplate of the transmitter

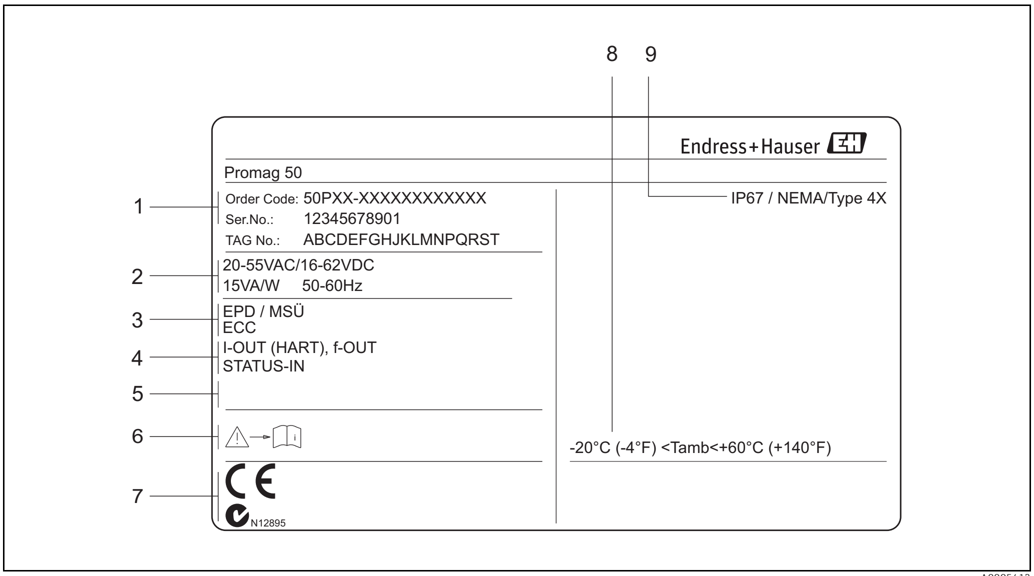


Fig. 1: Nameplate specifications for the "Promag 50" transmitter (example)

1 *Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *Power supply, frequency, power consumption*
3 *Additional information:*
EPD/MSÜ: with Empty Pipe Detection
ECC: with electrode cleaning
4 *Outputs available:*
I-OUT (HART): with current output (HART)
f-OUT (HART): with frequency output
STATUS-IN: with status input (power supply)
5 *Reserved for information on special products*
6 *Observe device documentation*
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

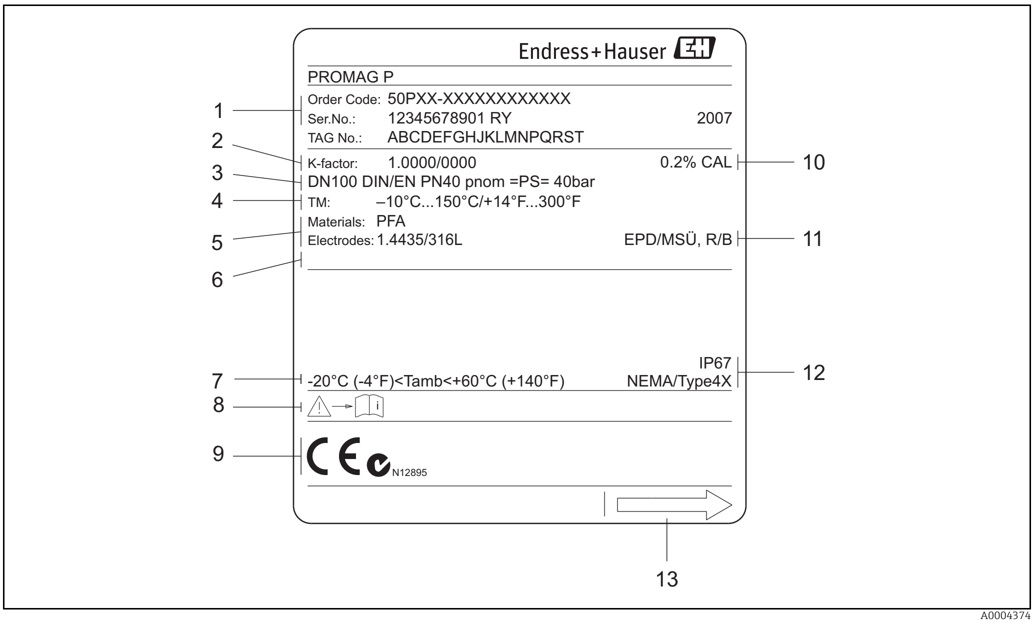


Fig. 2: Nameplate specifications for the "Promag" sensor (example)

1 *Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *Calibration factor with zero point*
3 *Nominal diameter / Pressure rating*
4 *Fluid temperature range*
5 *Materials: lining/measuring electrodes*
6 *Reserved for information on special products*
7 *Permitted ambient temperature range*
8 *Observe device documentation*
9 *Reserved for additional information on device version (approvals, certificates)*
10 *Calibration tolerance*
11 *Additional information (examples):*
- *EPD/MSÜ: with Empty Pipe Detection electrode*
- *R/B: with reference electrode*

12 *Degree of protection*
13 *Flow direction*

2.1.3 Nameplate, connections

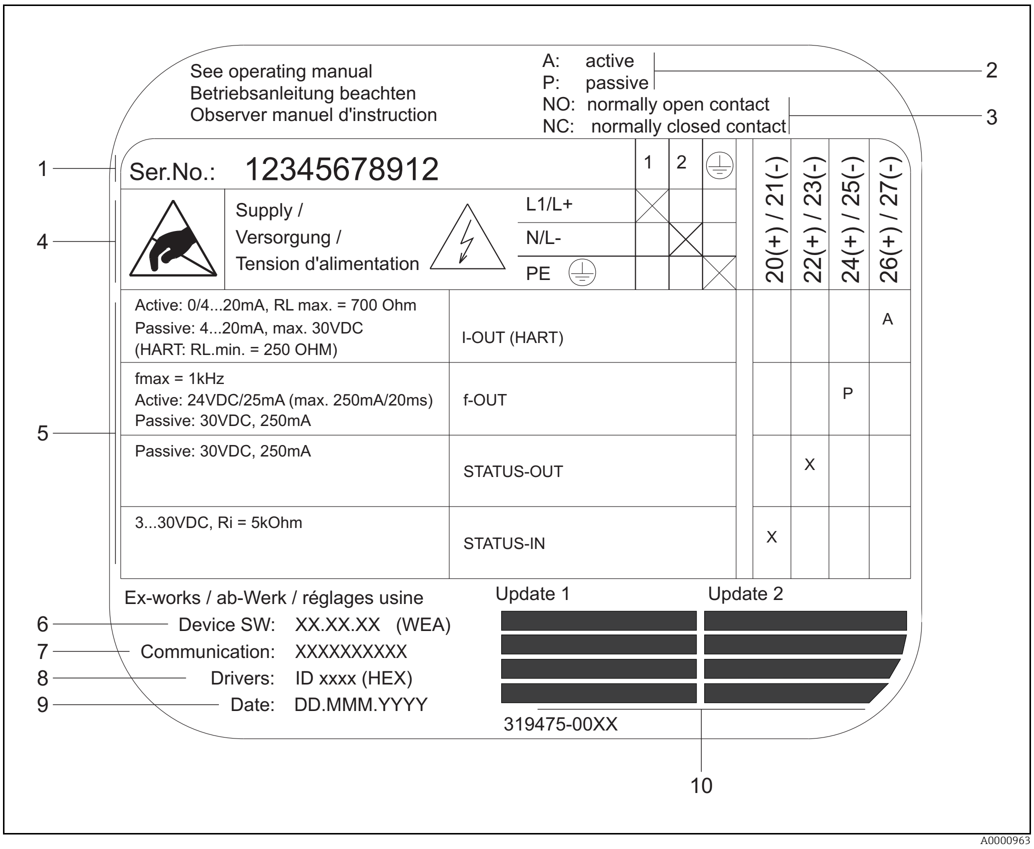


Fig. 3: Nameplate specifications for transmitter (example)

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

2.2 Certificates and approvals

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate.

The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use" and with the EMC requirements of IEC/EN 61326/A1.

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

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

2.3 Registered trademarks

KALREZ® and VITON®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

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

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

HistoROM™, S-DAT®, Field Xpert™, 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:
- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until 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 from the factory protect the linings on the flanges during storage and transportation. In case of Promag L they are additionally used to hold the lap joint flanges in place. Do not remove these covers until **immediately before** the device in the pipe.
- Do not lift flanged devices by the transmitter housing, or the connection housing in the case of the remote version.

Transporting flanged devices DN ≤ 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.

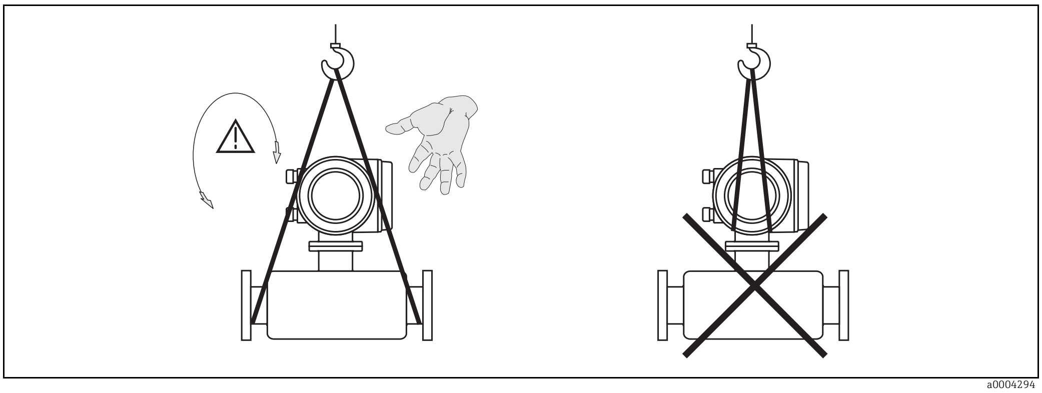


Fig. 4: Transporting sensors with DN ≤ 300 (12")

Transporting flangeddevices 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.

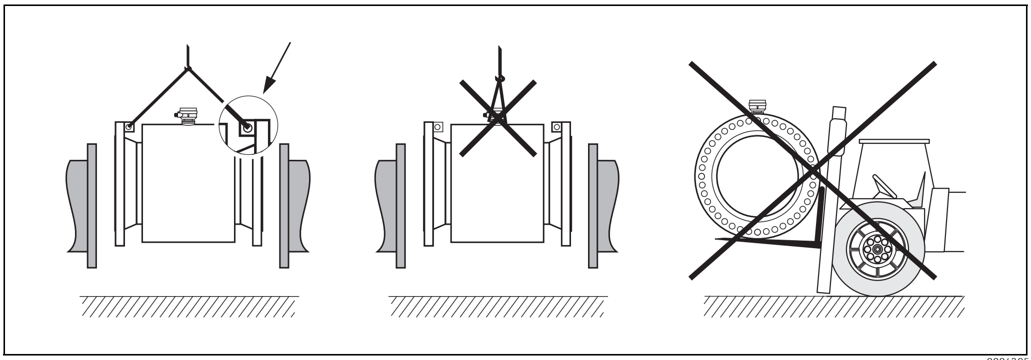


Fig. 5: Transporting sensors with DN > 300 (12")

3.1.3 Storage

Please note the following:
- 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 → 101.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

3.2 Installation conditions

3.2.1 Dimensions

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 → 124.

3.2.2 Mounting location

Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following locations:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.

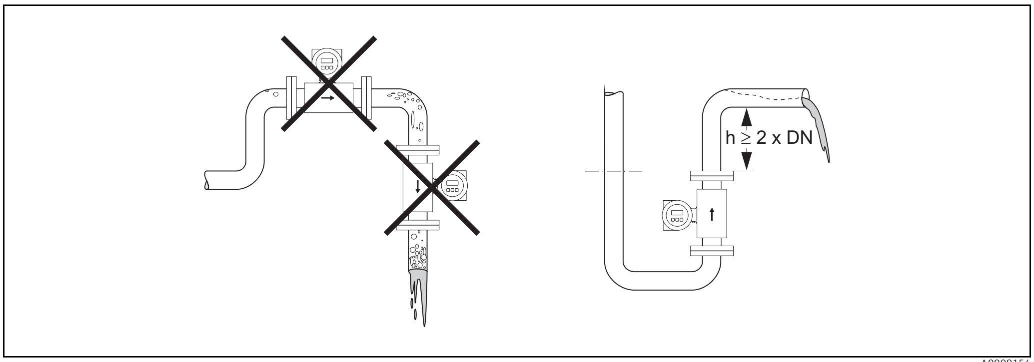


Fig. 6: Mounting location

Installation of pumps

Do **not** install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum can be found on → 106.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on → 102.

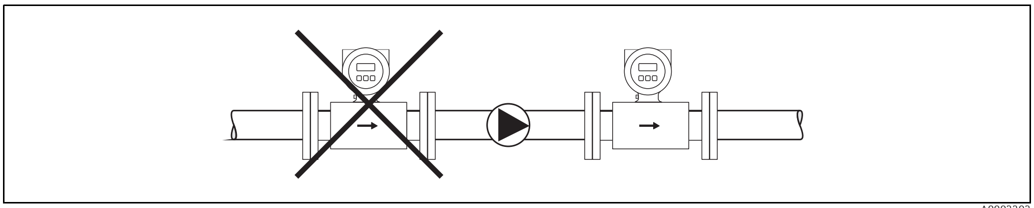


Fig. 7: Installation of pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration.
The Empty Pipe Detection function (EPD → 75) offers additional protection by detecting empty or partially filled pipes.

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

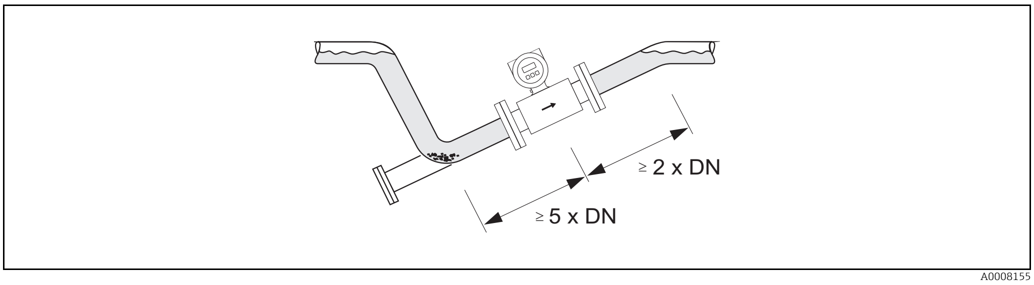


Fig. 8: Installation in a partially filled pipe

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 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 pockets.
Information on the lining's resistance to partial vacuum can be found on → 106.

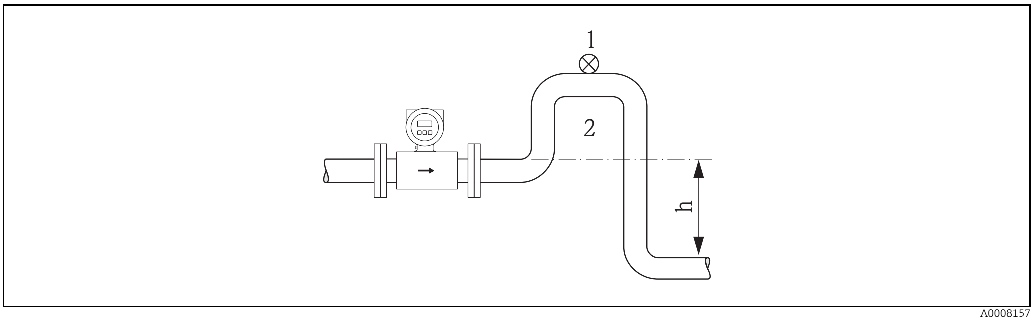


Fig. 9: Measures for installation in a down pipe

1 Vent valve
2 Pipe siphon
h Length of down pipe

3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. However, Promag offers the additional Empty Pipe Detection (EPD) function to ensure the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressure:

- Electrode Cleaning Circuit (ECC) for applications with accretive fluids, e.g. electrically conductive deposits (→ "Description of Device Functions" manual).
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids (→ 75)
- Exchangeable Measuring Electrodes for abrasive fluids (→ 94)

Vertical orientation

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

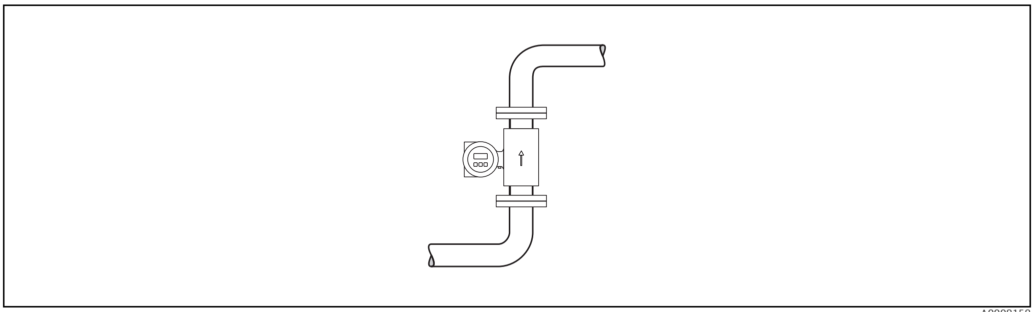


Fig. 10: Vertical orientation

Horizontal orientation

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

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

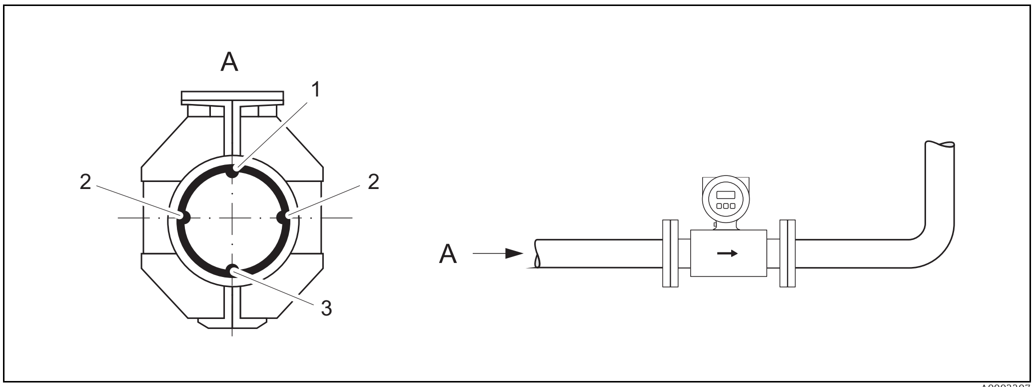
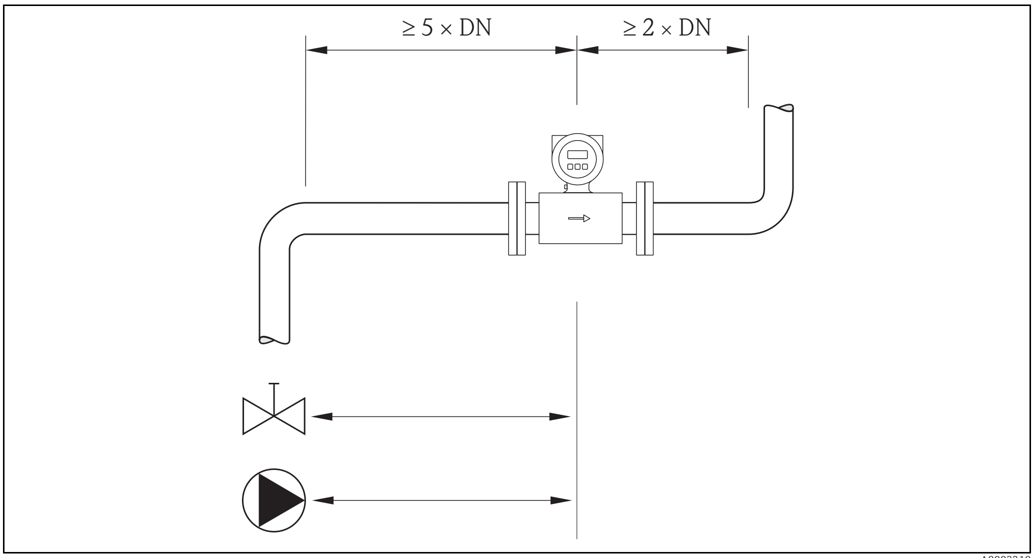


Fig. 11: Horizontal orientation

1 EPD electrode for the detection of empty pipes (not with Promag D and Promag H (DN 2 to 15 / 1/12 to ½"))
2 Measuring electrodes for signal detection
3 Reference electrode for the potential equalization (not with Promag D and H)

Inlet and outlet run

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications:
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN



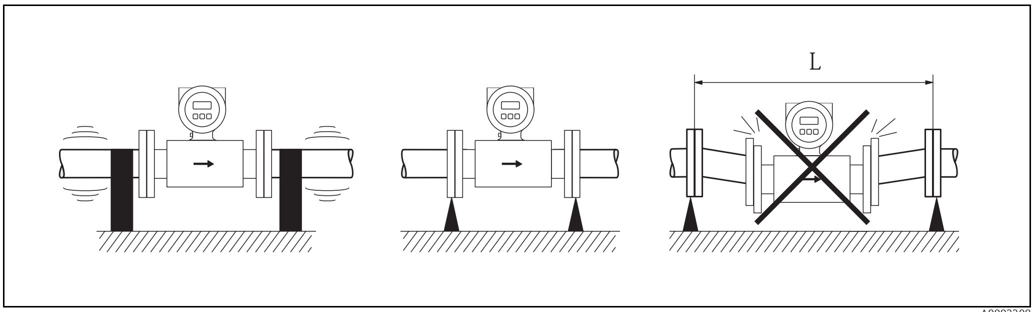
A0003210

Fig. 12: Inlet and outlet runs

3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on resistance to vibration and shock can be found on → 🖹 102.



A0003208

Fig. 13: Measures to prevent vibration of the device (L > 10 m (32.8 ft))

3.2.5 Foundations, supports

If the nominal diameter is DN ≥ 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.

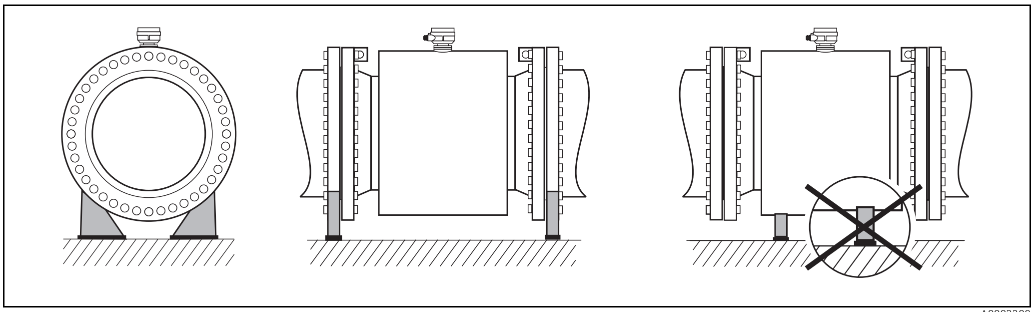


Fig. 14: Correct support for large nominal diameters (DN ≥ 350 / 14")

3.2.6 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes.
The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.

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 flow velocity (*downstream* from the reduction) and the d/D ratio.

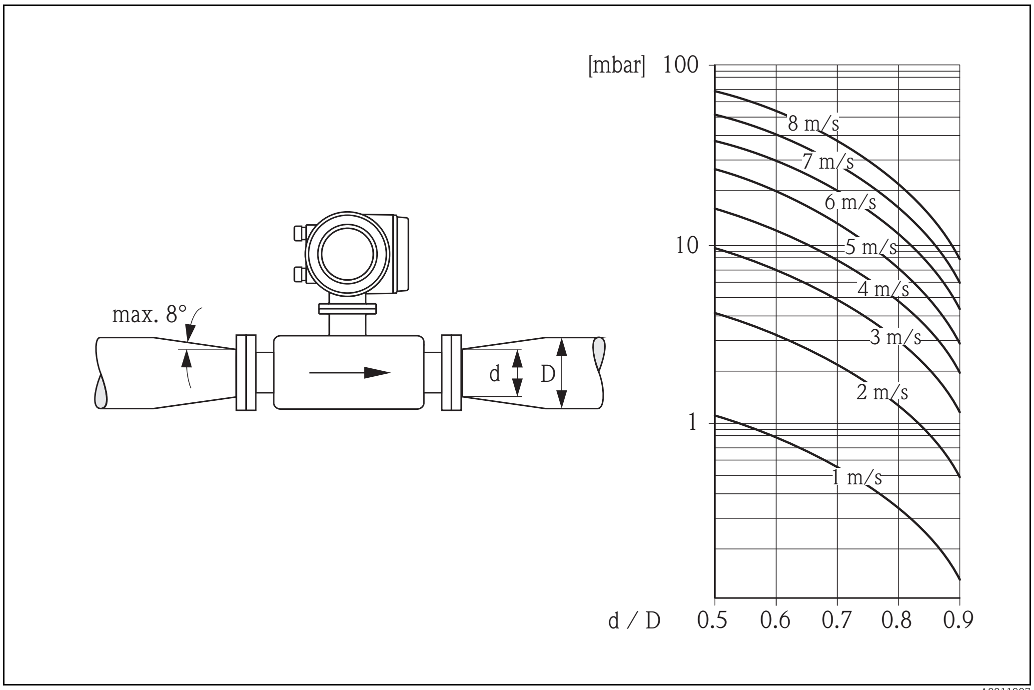


Fig. 15: Pressure loss due to adapters

3.2.7 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is 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 (→ 16).

Recommended flow (SI units)

Nominal diameter	Promag D	Promag E/P	Promag H	Promag L	Promag W
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [dm³/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	–	9 to 300
32	–	15 to 500	–	–	15 to 500
40	25 to 700	25 to 700	25 to 700	–	25 to 700
50	35 to 1100	35 to 1100	35 to 1100	35 to 1100	35 to 1100
65	60 to 2000	60 to 2000	60 to 2000	60 to 2000	60 to 2000
80	90 to 3000	90 to 3000	90 to 3000	90 to 3000	90 to 3000
100	145 to 4700	145 to 4700	145 to 4700	145 to 4700	145 to 4700
125	–	220 to 7500	–	220 to 7500	220 to 7500
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [m³/h]				
150	–	20 to 600	–	20 to 600	20 to 600
200	–	35 to 1100	–	35 to 1100	35 to 1100
250	–	55 to 1700	–	55 to 1700	55 to 1700
300	–	80 to 2400	–	80 to 2400	80 to 2400
350	–	110 to 3300	–	110 to 3300	110 to 3300
375	–	–	–	140 to 4200	140 to 4200
400	–	140 to 4200	–	140 to 4200	140 to 4200
450	–	180 to 5400	–	180 to 5400	180 to 5400
500	–	220 to 6600	–	220 to 6600	220 to 6600
600	–	310 to 9600	–	310 to 9600	310 to 9600
700	–	–	–	420 to 13500	420 to 13500
750	–	–	–	480 to 15200	480 to 15200
800	–	–	–	550 to 18000	550 to 18000
900	–	–	–	690 to 22500	690 to 22500
1000	–	–	–	850 to 28000	850 to 28000
1050	–	–	–	950 to 40000	950 to 40000
1200	–	–	–	1250 to 40000	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	Promag D	Promag E/P	Promag H	Promag L	Promag W
[inch]	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	–	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	7 to 190	7 to 190
2"	10 to 300	10 to 300	10 to 300	10 to 300	10 to 300
2 $^{1}/_{2}$"	16 to 500	16 to 500	16 to 500	16 to 500	16 to 500
3"	24 to 800	24 to 800	24 to 800	24 to 800	24 to 800
4"	40 to 1250	40 to 1250	40 to 1250	40 to 1250	40 to 1250
5"	–	60 to 1950	–	60 to 1950	60 to 1950
6"	–	90 to 2650	–	90 to 2650	90 to 2650
8"	–	155 to 4850	–	155 to 4850	155 to 4850
10"	–	250 to 7500	–	250 to 7500	250 to 7500
12"	–	350 to 10600	–	350 to 10600	350 to 10600
14"	–	500 to 15000	–	500 to 15000	500 to 15000
15"	–	–	–	600 to 19000	600 to 19000
16"	–	600 to 19000	–	600 to 19000	600 to 19000
18"	–	800 to 24000	–	800 to 24000	800 to 24000
20"	–	1000 to 30000	–	1000 to 30000	1000 to 30000
24"	–	1400 to 44000	–	1400 to 44000	1400 to 44000
28"	–	–	–	1900 to 60000	1900 to 60000
30"	–	–	–	2150 to 67000	2150 to 67000
32"	–	–	–	2450 to 80000	2450 to 80000
36"	–	–	–	3100 to 100000	3100 to 100000
40"	–	–	–	3800 to 125000	3800 to 125000
42"	–	–	–	4200 to 135000	4200 to 135000
48"	–	–	–	5500 to 175000	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

3.2.8 Length of connecting cable

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

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permitted connecting cable length L_{max} is determined by the fluid conductivity (→ 16). A minimum conductivity of 20 µS/cm is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 µS/cm.
- The maximum connecting cable length is 10 m (32.8 ft) when empty pipe detection (EPD → 75) is switched on.

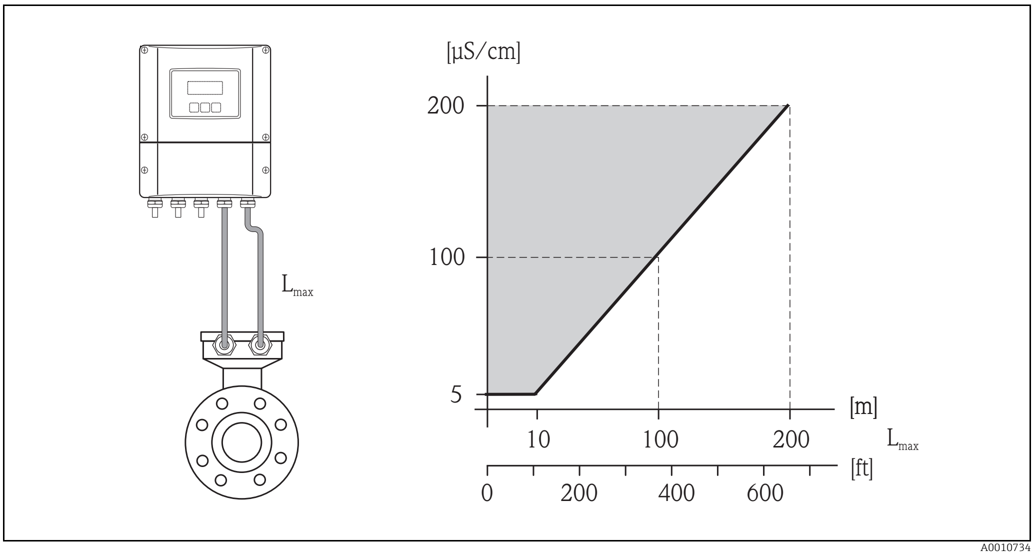


Fig. 16: Permissible cable length for the remote version

Area shaded gray = permitted range
Lmax = connecting cable length in [m]
Fluid conductivity in [µS/cm]

3.3 Installation instructions

3.3.1 Installing the Promag D sensor

The sensor is installed between the pipe flanges with a mounting kit. The device is centered using recesses on the sensor (→ 21).

Note!
A mounting kit consisting of mounting bolts, seals, nuts and washers can be ordered separately (→ 78). Centering sleeves are provided with the device if they are required for the installation.

Caution!
When installing the transmitter in the pipe, observe the necessary torques (→ 22).

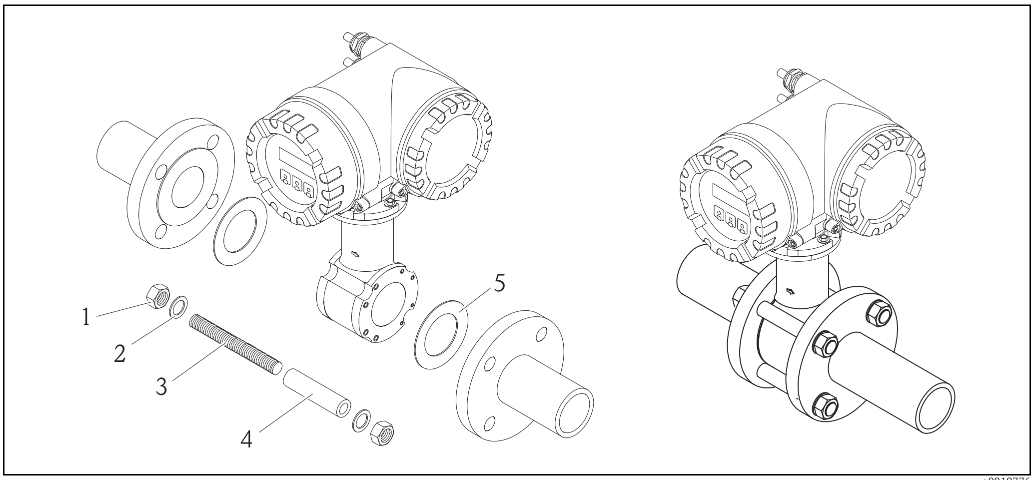


Fig. 17: Mounting the sensor

1 Nut
2 Washer
3 Mounting bolt
4 Centering sleeve
5 Seal

Seals

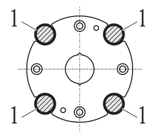
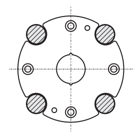
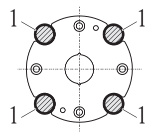
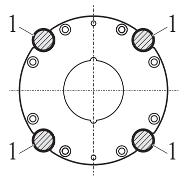
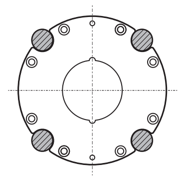
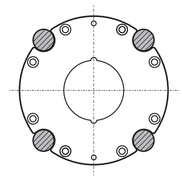
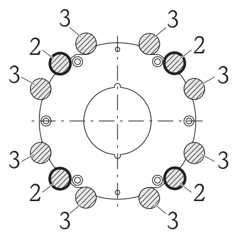
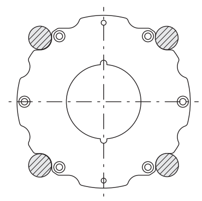
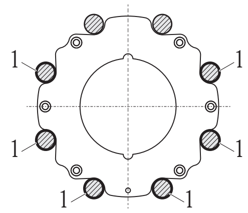
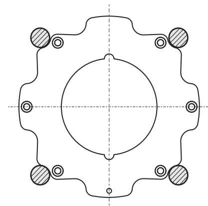
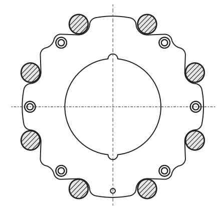
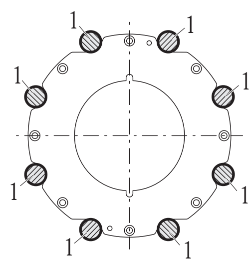
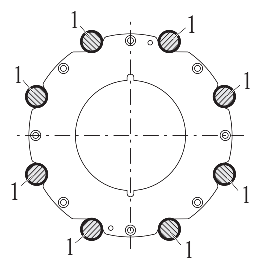
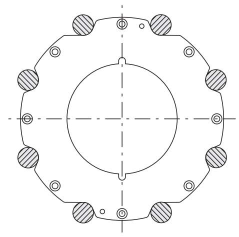
When installing the sensor, make sure that the seals used do not project into the pipe cross-section.

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

Note!
Use seals with a hardness rating of 70° Shore.

Arrangement of the mounting bolts and centering sleeves

The device is centered using recesses on the sensor. The arrangement of the mounting bolts and the use of the centering sleeves supplied depend on the nominal diameter, the flange standard und the pitch circle diameter.

	Process connection		
	EN (DIN)	ASME	JIS
DN 25 to 40 (1 to 1 ½")	 A0010896	 A0010824	 A0010896
DN 50 (2")	 A0010897	 A0010825	 A0010825
DN 65 (–)	 A0012170	------------------	 A0012171
DN 80 (3")	 A0010898	 A0010827	 A0010826
DN 100 (4")	 A0012168	 A0012168	 A0012169
1 = Mounting bolts with centering sleeves 2 = EN (DIN) flanges: 4-hole → with centering sleeves 3 = EN (DIN) flanges: 8-hole → without centering sleeves			

Screw tightening torques (Promag D)

Please note the following:
- 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.

The tightening torques apply to situations where an EPDM soft material flat seal (e.g. 70 Shore) is used.

Tightening torques, mounting bolts and centering sleeves for EN (DIN) PN 16

Nominal diameter [mm]	Mounting bolts [mm]	Centering sleeve length [mm]	Tightening torque [Nm] with a process flange with a smooth seal face	raised face
25	4 × M12 × 145	54	19	19
40	4 × M16 × 170	68	33	33
50	4 × M16 × 185	82	41	41
65[1]	4 × M16 × 200	92	44	44
65[2]	8 × M16 × 200	– [3]	29	29
80	8 × M16 × 225	116	36	36
100	8 × M16 × 260	147	40	40

[1] EN (DIN) flanges: 4-hole → with centering sleeves
[2] EN (DIN) flanges: 8-hole → without centering sleeves
[3] A centering sleeve is not required. The device is centered directly via the sensor housing.

Tightening torques, mounting bolts and centering sleeves for JIS 10K

Nominal diameter [mm]	Mounting bolts [mm]	Centering sleeve length [mm]	Tightening torque [Nm] with a process flange with a smooth seal face	raised face
25	4 × M16 × 170	54	24	24
40	4 × M16 × 170	68	32	25
50	4 × M16 × 185	– *	38	30
65	4 × M16 × 200	– *	42	42
80	8 × M16 × 225	– *	36	28
100	8 × M16 × 260	– *	39	37

* A centering sleeve is not required. The device is centered directly via the sensor housing.

Tightening torques, mounting bolts and centering sleeves for ASME Class 150

Nominal diameter [inch]	Mounting bolts [inch]	Centering sleeve length [inch]	Tightening torque [lbf · ft] with a process flange with a smooth seal face	raised face
1"	4 × UNC 1/2" × 5.70"	– *	14	7
1 ½"	4 × UNC 1/2" × 6.50"	– *	21	14
2"	4 × UNC 5/8" × 7.50"	– *	30	27
3"	4 × UNC 5/8" × 9.25"	– *	31	31
4"	8 × UNC 5/8" × 10,4"	5,79	28	28

* A centering sleeve is not required. The device is centered directly via the sensor housing.

3.3.2 Installing the Promag E sensor

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

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 24
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

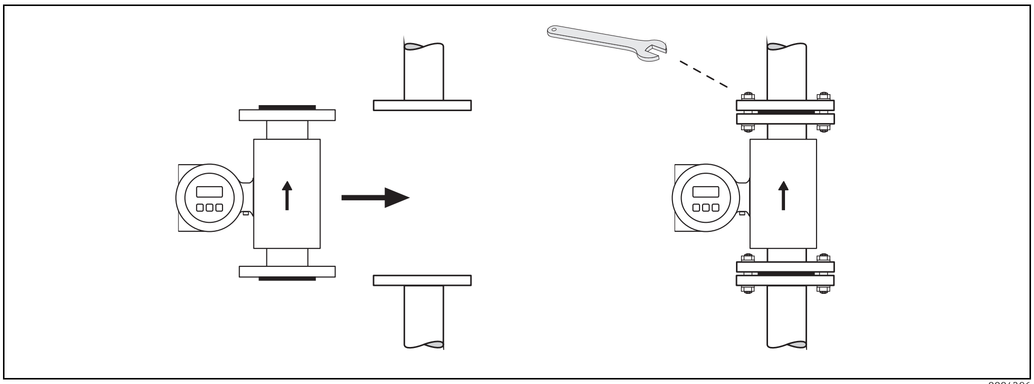

a0004296

Fig. 18: Installing the Promag E sensor

Seals

Comply with the following instructions when installing seals:
- PFA or PTFE lining → **No** seals are required!
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 55

Tightening torques for threaded fasteners (Promag E)

Please note the following:
- 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) → 24
- ASME → 25
- JIS → 25

Promag E tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]
15	PN 40	4 × M 12	11
25	PN 40	4 × M 12	26
32	PN 40	4 × M 16	41
40	PN 40	4 × M 16	52
50	PN 40	4 × M 16	65
65 *	PN 16	8 × M 16	43
80	PN 16	8 × M 16	53
100	PN 16	8 × M 16	57
125	PN 16	8 × M 16	75
150	PN 16	8 × M 20	99
200	PN 10	8 × M 20	141
200	PN 16	12 × M 20	94
250	PN 10	12 × M 20	110
250	PN 16	12 × M 24	131
300	PN 10	12 × M 20	125
300	PN 16	12 × M 24	179
350	PN 6	12 × M 20	200
350	PN 10	16 × M 20	188
350	PN 16	16 × M 24	254
400	PN 6	16 × M 20	166
400	PN 10	16 × M 24	260
400	PN 16	16 × M 27	330
450	PN 6	16 × M 20	202
450	PN 10	20 × M 24	235
450	PN 16	20 × M 27	300
500	PN 6	20 × M 20	176
500	PN 10	20 × M 24	265
500	PN 16	20 × M 30	448
600	PN 6	20 × M 24	242
600	PN 10	20 × M 27	345
600 *	PN 16	20 × M 33	658
* Designed acc. to EN 1092-1 (not to DIN 2501)			

Promag E tightening torques for ASME

Nominal diameter		ASME		Max. tightening torque PTFE	
[mm]	[inch]	Pressure rating [lbs]	Threaded fasteners	[Nm]	[lbf · ft]
15	½"	Class 150	4 × ½"	6	4
25	1"	Class 150	4 × ½"	11	8
40	1 ½"	Class 150	4 × ½"	24	18
50	2"	Class 150	4 × 5/8"	47	35
80	3"	Class 150	4 × 5/8"	79	58
100	4"	Class 150	8 × 5/8"	56	41
150	6"	Class 150	8 × ¾"	106	78
200	8"	Class 150	8 × ¾"	143	105
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 E tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
15	20K	4 × M 12	16
25	20K	4 × M 16	32
32	20K	4 × M 16	38
40	20K	4 × M 16	41
50	10K	4 × M 16	54
65	10K	4 × M 16	74
80	10K	8 × M 16	38
100	10K	8 × M 16	47
125	10K	8 × M 20	80
150	10K	8 × M 20	99
200	10K	12 × M 20	82
250	10K	12 × M 22	133
300	10K	16 × M 22	99

3.3.3 Installing the Promag H sensor

The sensor is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with 4 or 6 hex-head threaded fasteners.

Caution!
The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory (→ 78).

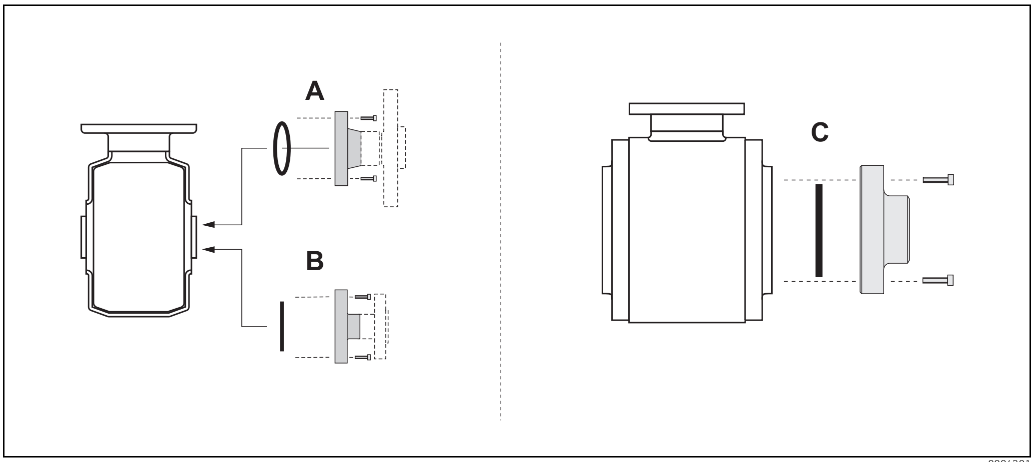


Abb. 19: Promag H process connections (DN 2 to 25 / 1/12 to 1", DN 40 to 100 / 1½ to 4")

A = DN 2 to 25 / 1/12 to 1": process connections with O-ring
- *welding flanges (DIN EN ISO 1127, ODT / SMS),*
- *flange (EN (DIN), ASME, JIS), flange PVDF (EN (DIN), ASME, JIS)*
- *external and internal thread, hose connection, PVC adhesive fitting*

B = DN 2 to 25 / 1/12 to 1": process connections with aseptic gasket vseal
- *weld nipples (DIN 11850, ODT/SMS)*
- *Clamp (ISO 2852, DIN 32676, L14 AM7)*
- *coupling (DIN 11851, DIN 11864-1, SMS 1145)*
- *flange DIN 11864-2*

C = DN 40 to 100 / 1½ to 4": process connections with aseptic gasket seal
- *weld nipples (DIN 11850, ODT/SMS)*
- *Clamp (ISO 2852, DIN 32676, L14 AM7)*
- *coupling (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145)*
- *flange DIN 11864-2*

Seals

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

Caution!
- With metal process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)!
  The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature. Replacement seals can be ordered as accessories → 78.

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

In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalized using additional ground rings. If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the electrochemical erosion of the electrodes.

Caution!
- Depending on the option ordered, plastic disks may be installed at the process connections instead of ground rings. These plastic disks serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic disks/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from Endress+Hauser as accessories (→ 78). When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information about the materials can be found on → 117.
- 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 disk (3), including the two O-ring seals (2).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (2) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again.
   With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft).

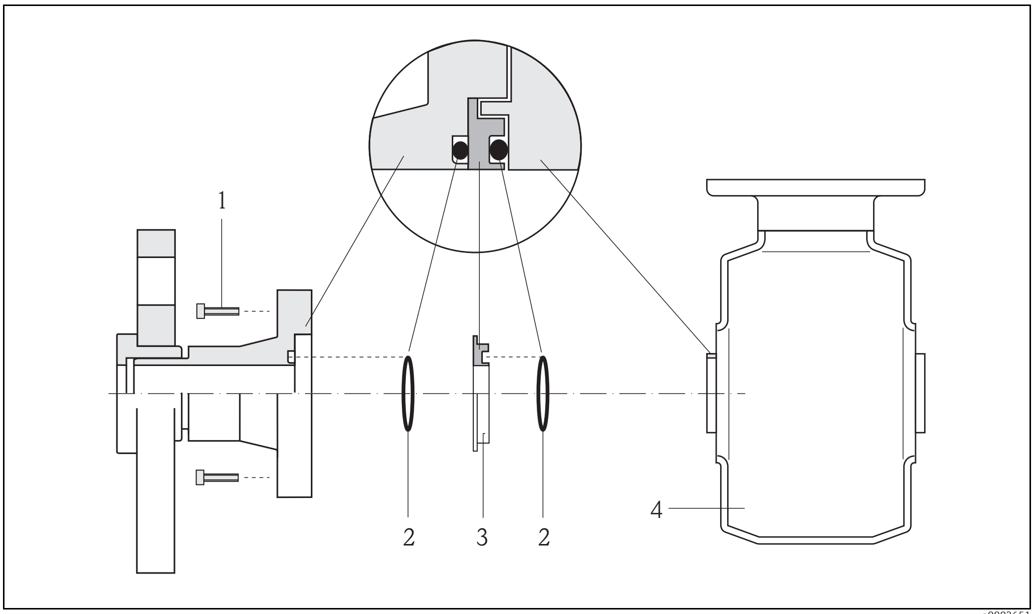


Fig. 20: Installing ground rings with Promag H (DN 2 to 25 / 1/12 to 1")

1 = Hexagonal-headed bolt (process connection)
2 = O-ring seals
3 = Ground ring or plastic disk (spacer)
4 = Sensor

Welding the transmitter into the piping (weld nipples)

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

1. Tack-weld the sensor into the pipe. A suitable welding jig can be ordered separately as an accessory (→ 🖹 78).
2. Loosen the screws on the process connection flange and remove the sensor, complete with the seal, from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

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

Cleaning with pigs

If pigs are used for cleaning, it is essential to take the inside diameters of the measuring tube and process connection into account. All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Documentation" → 🖹 124.

3.3.4 Installing the Promag L sensor

Caution!
- The protective covers mounted on the two sensor flanges (DN 50 to 300 / 2 to 12") are used to hold the lap joint flanges in place and to protect the PTFE liner during transportation. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 30
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment
- To comply with the device specification, a concentrical installation in the measuring section is required

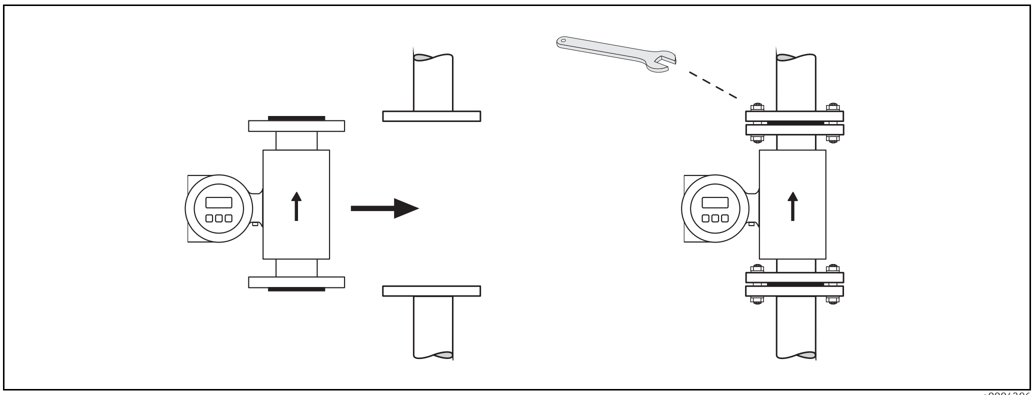


Fig. 21: Installing the Promag L sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- PTFE lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 57.

Screw tightening torques (Promag L)

Please note the following:
- 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.

Promag L tightening torques for EN (DIN)

Nominal diameter	EN (DIN)		Max. tightening torque		
			Hard rubber	Polyurethane	PTFE
[mm]	Pressure rating [bar]	Threaded fasteners	[Nm]	[Nm]	[Nm]
50	PN 10/16	4 × M 16	-	15	40
65*	PN 10/16	8 × M 16	-	10	22
80	PN 10/16	8 × M 16	-	15	30
100	PN 10/16	8 × M 16	-	20	42
125	PN 10/16	8 × M 16	-	30	55
150	PN 10/16	8 × M 20	-	50	90
200	PN 10	8 × M 20	-	65	130
250	PN 10	12 × M 20	-	50	90
300	PN 10	12 × M 20	-	55	100
350	PN 6	12 × M 20	111	120	-
350	PN 10	16 × M 20	112	118	-
400	PN 6	16 × M 20	90	98	-
400	PN 10	16 × M 24	151	167	-
450	PN 6	16 × M 20	112	126	-
450	PN 10	20 × M 24	153	133	-
500	PN 6	20 × M 20	119	123	-
500	PN 10	20 × M 24	155	171	-
600	PN 6	20 × M 24	139	147	-
600	PN 10	20 × M 27	206	219	-
700	PN 6	24 × M 24	148	139	-
700	PN 10	24 × M 27	246	246	-
800	PN 6	24 × M 27	206	182	-
800	PN 10	24 × M 30	331	316	-
900	PN 6	24 × M 27	230	637	-
900	PN 10	28 × M 30	316	307	-
1000	PN 6	28 × M 27	218	208	-
1000	PN 10	28 × M 33	402	405	-
1200	PN 6	32 × M 30	319	299	-
1200	PN 10	32 × M 36	564	568	-
* Designed acc. to EN 1092-1 (not to DIN 2501)					

Promag L tightening torques for ASME

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hard rubber		Polyurethane		PTFE	
[mm]	[inch]	[lbs]		[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
50	2"	Class 150	4 × 5/8"	-	-	15	11	40	29
80	3"	Class 150	4 × 5/8"	-	-	25	18	65	48
100	4"	Class 150	8 × 5/8"	-	-	20	15	44	32
150	6"	Class 150	8 × ¾"	-	-	45	33	90	66
200	8"	Class 150	8 × ¾"	-	-	65	48	125	92
250	10"	Class 150	12 × 7/8"	-	-	55	41	100	74
300	12"	Class 150	12 × 7/8"	-	-	68	56	115	85
350	14"	Class 150	12 × 1"	135	100	158	117	-	-
400	16"	Class 150	16 × 1"	128	94	150	111	-	-

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hard rubber		Polyurethane		PTFE	
[mm]	[inch]	[lbs]		[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
450	18"	Class 150	16 × 1 1/8"	204	150	234	173	-	-
500	20"	Class 150	20 × 1 1/8"	183	135	217	160	-	-
600	24"	Class 150	20 × 1 ¼"	268	198	307	226	-	-

Promag L tightening torques for AWWA

Nominal diameter		AWWA	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hartgummi		Polyurethane		PTFE	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215	-	-
750	30"	Class D	28 × 1 ¼"	287	212	302	223	-	-
800	32"	Class D	28 × 1 ½"	394	291	422	311	-	-
900	36"	Class D	32 × 1 ½"	419	309	430	317	-	-
1000	40"	Class D	36 × 1 ½"	420	310	477	352	-	-
1050	42"	Class D	36 × 1 ½"	528	389	518	382	-	-
1200	48"	Class D	44 × 1 ½"	552	407	531	392	-	-

Promag L tightening torques for AS 2129

Nominal diameter	AS 2129	Threaded fasteners	Max. tightening torque		
	Pressure rating		Hard rubber	Polyurethane	PTFE
[mm]			[Nm]	[Nm]	[Nm]
350	Table E	12 × M 24	203	-	-
400	Table E	12 × M 24	226	-	-
450	Table E	16 × 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 L tightening torques for AS 4087

Nominal diameter	AS 4087	Threaded fasteners	Max. tightening torque		
	Pressure rating		Hard rubber	Polyurethane	PTFE
[mm]			[Nm]	[Nm]	[Nm]
350	PN 16	12 × M 24	203	-	-
375	PN 16	12 × M 24	137	-	-
400	PN 16	12 × M 24	226	-	-
450	PN 16	12 × M 24	301	-	-
500	PN 16	16 × M 24	271	-	-
600	PN 16	16 × M 27	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	-	-

3.3.5 Installing the Promag P sensor

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

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 📄 33
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

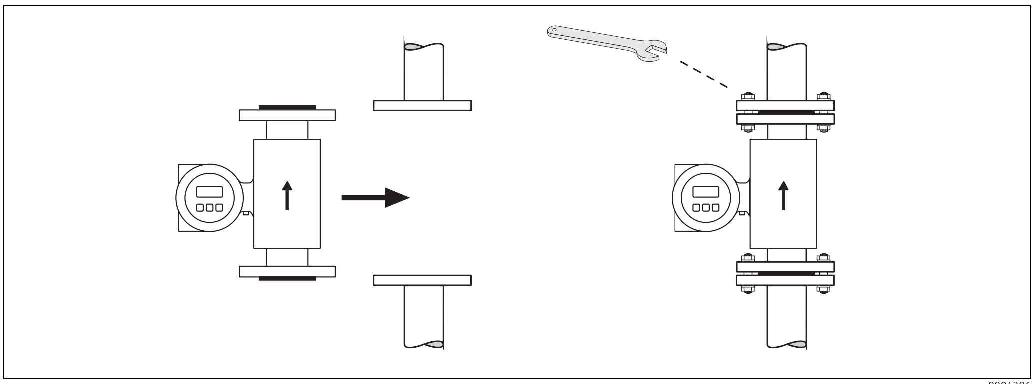


Fig. 22: Installing the Promag P sensor

Seals

Comply with the following instructions when installing seals:
- PFA or PTFE lining → **No** seals are required!
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 📄 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 📄 55

Installing the high-temperature version (with PFA lining)

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

Note!
You will find information on permissible temperature ranges on → 103

Insulation

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

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

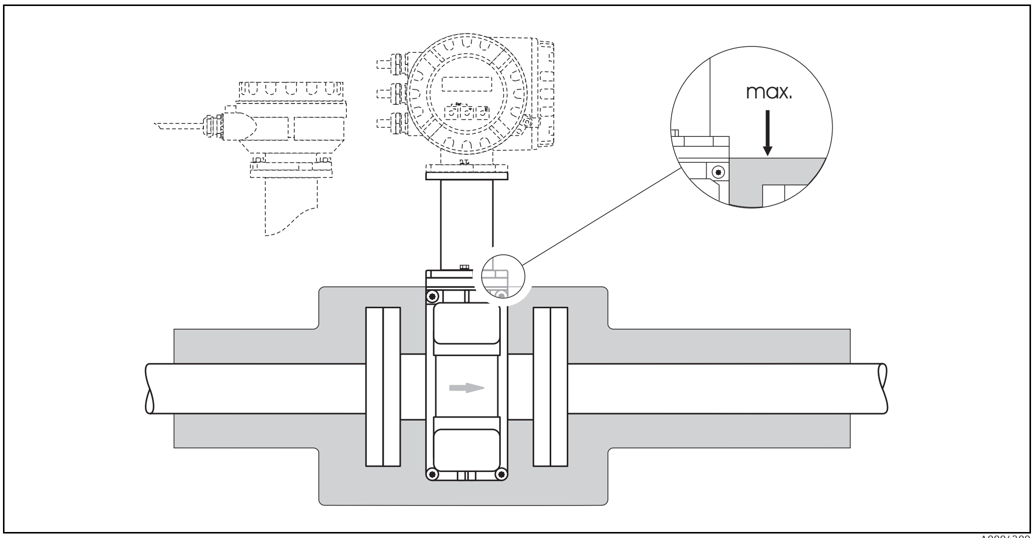


Fig. 23: Promag P (high-temperature version): Insulating the pipe

Tightening torques for threaded fasteners (Promag P)

Please note the following:
- 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) → 34
- ASME → 34
- JIS → 35
- AS 2129 → 35
- AS 4087 → 35

Promag P tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	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 ASME

Nominal diameter [mm]	[inch]	ASME Pressure rating [lbs]	Threaded fasteners	Max. tightening torque PTFE [Nm]	PTFE [lbf · ft]	PFA [Nm]	PFA [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

Nominal diameter		ASME		Max. tightening torque			
		Pressure	Threaded	PTFE		PFA	
[mm]	[inch]	rating [lbs]	fasteners	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
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	JIS		Max. tightening torque [Nm]	
[mm]	Pressure rating	Threaded fasteners	PTFE	PFA
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
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	Threaded fasteners	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	Threaded fasteners	Max. tightening torque [Nm] PTFE
50	PN 16	4 × M 16	42

3.3.6 Installing the Promag W sensor

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 36
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

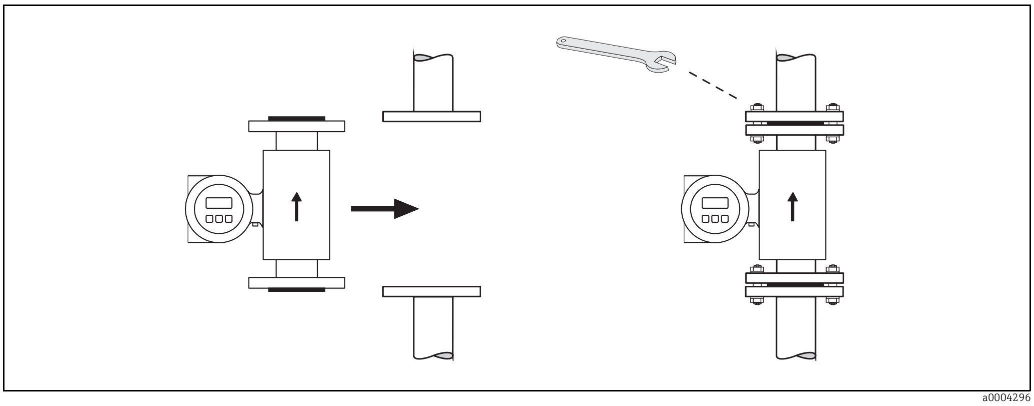


Fig. 24: Installing the Promag W sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 57

Screw tightening torques (Promag W)

Please note the following:
- 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)→ 📄 37
- JIS→ 📄 39
- ASME→ 📄 38
- AWWA → 📄 39
- AS 2129 → 📄 40
- AS 4087 → 📄 40

Promag W tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	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	48	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
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

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
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 ASME

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque			
		Pressure rating		Hard rubber		Polyurethane	
[mm]	[inch]	[lbs]		[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
25	1"	Class 150	4 × ½"	-	-	7	5
25	1"	Class 300	4 × 5/8"	-	-	8	6
40	1 ½"	Class 150	4 × ½"	-	-	10	7
40	1 ½"	Class 300	4 × ¾"	-	-	15	11
50	2"	Class 150	4 × 5/8"	35	26	22	16
50	2"	Class 300	8 × 5/8"	18	13	11	8
80	3"	Class 150	4 × 5/8"	60	44	43	32
80	3"	Class 300	8 × ¾"	38	28	26	19
100	4"	Class 150	8 × 5/8"	42	31	31	23
100	4"	Class 300	8 × ¾"	58	43	40	30
150	6"	Class 150	8 × ¾"	79	58	59	44
150	6"	Class 300	12 × ¾"	70	52	51	38
200	8"	Class 150	8 × ¾"	107	79	80	59
250	10"	Class 150	12 × 7/8"	101	74	75	55
300	12"	Class 150	12 × 7/8"	133	98	103	76
350	14"	Class 150	12 × 1"	135	100	158	117
400	16"	Class 150	16 × 1"	128	94	150	111
450	18"	Class 150	16 × 1 1/8"	204	150	234	173
500	20"	Class 150	20 × 1 1/8"	183	135	217	160
600	24"	Class 150	20 × 1 ¼"	268	198	307	226

Promag W tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	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	40	33
50	20K	8 × M 16	20	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 AWWA

Nominal diameter		AWWA		Max. tightening torque			
		Pressure rating	Threaded fasteners	Hard rubber		Polyurethane	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215
750	30"	Class D	28 × 1 ¼"	287	212	302	223
800	32"	Class D	28 × 1 ½"	394	291	422	311
900	36"	Class D	32 × 1 ½"	419	309	430	317
1000	40"	Class D	36 × 1 ½"	420	310	477	352
1050	42"	Class D	36 × 1 ½"	528	389	518	382
1200	48"	Class D	44 × 1 ½"	552	407	531	392
1350	54"	Class D	44 × 1 ¾"	730	538	633	467
1500	60"	Class D	52 × 1 ¾"	758	559	832	614
1650	66"	Class D	52 × 1 ¾"	946	698	955	704
1800	72"	Class D	60 × 1 ¾"	975	719	1087	802
2000	78"	Class D	64 × 2"	853	629	786	580

Promag W tightening torques for AS 2129

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
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
450	Table E	16 × 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

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
80	PN 16	4 × M 16	49
100	PN 16	4 × M 16	76
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
450	PN 16	12 × M 24	301
500	PN 16	16 × M 24	271
600	PN 16	16 × M 27	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

3.3.7 Turning the transmitter housing

Turning the aluminum field housing

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

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing:
   – Promag D: approx. 10 mm (0.39 inch) above the securing screws
   – Promag E/H/L/P/W: to the stop
4. Turn the transmitter housing to the desired position:
   – Promag D: max. 180° clockwise or max. 180° counterclockwise
   – Promag E/H/L/P/W: max. 280° clockwise or max. 20° counterclockwise
5. Lower the housing into position and re-engage the bayonet catch.
6. Retighten the two securing screws.

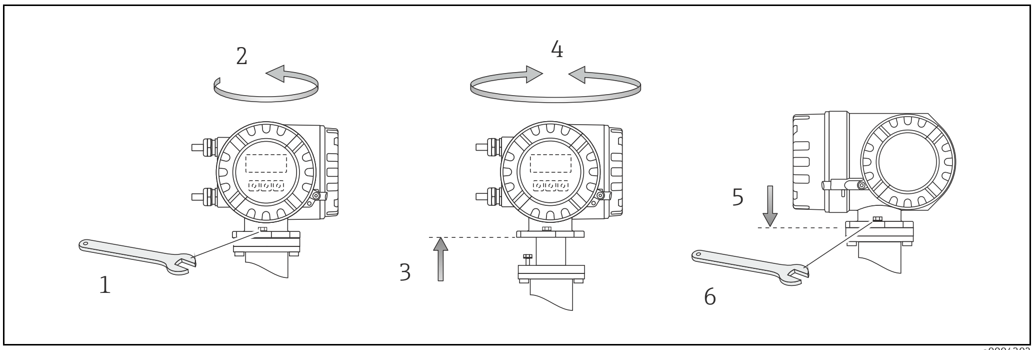


Fig. 25: Turning the transmitter housing (aluminum field housing)

Turning the stainless-steel field housing

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

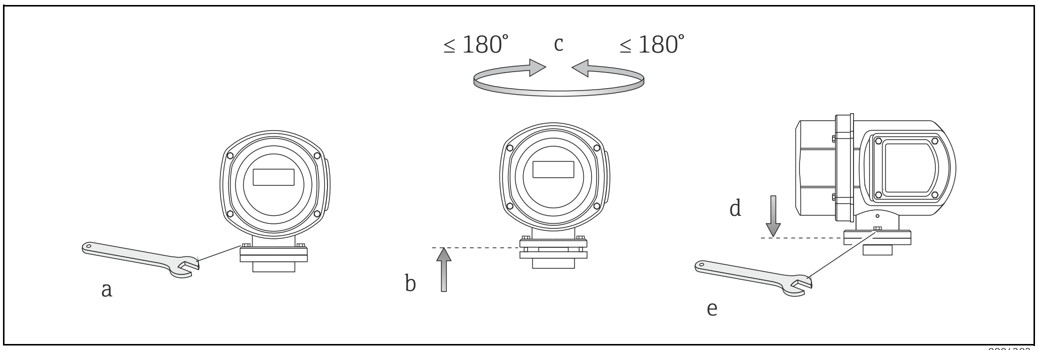


Fig. 26: Turning the transmitter housing (stainless-steel field housing)

3.3.8 Turning the onsite display

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

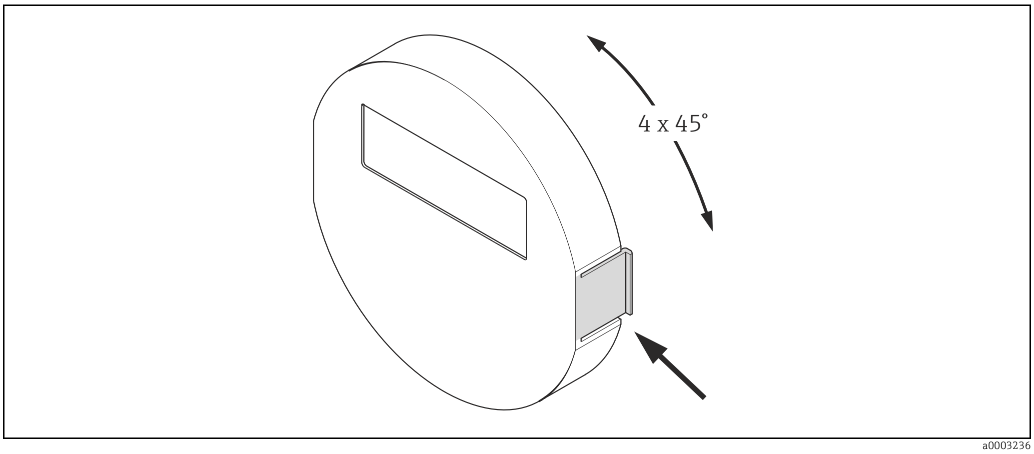


Fig. 27: Turning the local display (field housing)

3.3.9 Installing the wall-mount housing

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

- Direct wall mounting
- Installation in control panel (with separate mounting kit, accessories) → 📄 44
- Pipe mounting (with separate mounting kit, accessories) → 📄 44

Caution!
- Make sure that the ambient temperature does not exceed the permissible range at the mounting location, –20 to +60 °C (–4 to +140 °F), optional –40 to +60 °C (–40 to +140 °F). Install the device at a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Direct wall mounting

1. Drill the holes as illustrated in the graphic.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm (0.26")
   – Screw head: max. Ø 10.5 mm (0.41")
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

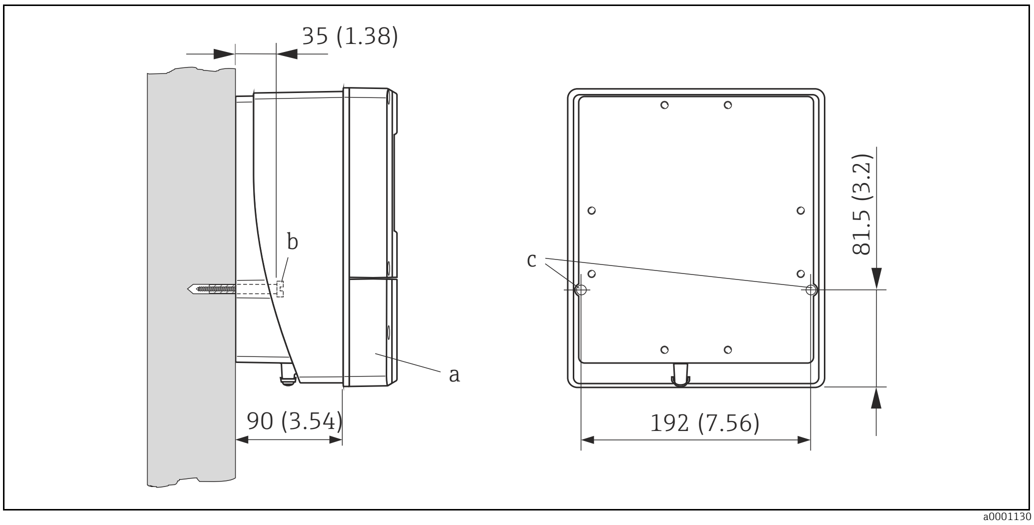


Fig. 28: Mounted directly on the wall

Panel-mounted installation

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

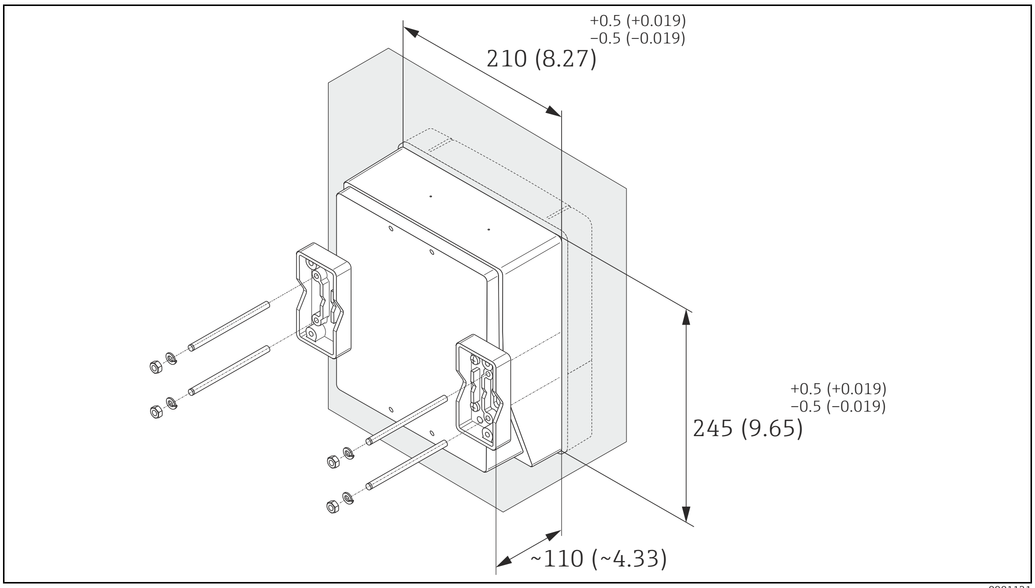


Fig. 29: Panel installation (wall-mount housing)

Pipe mounting

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

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

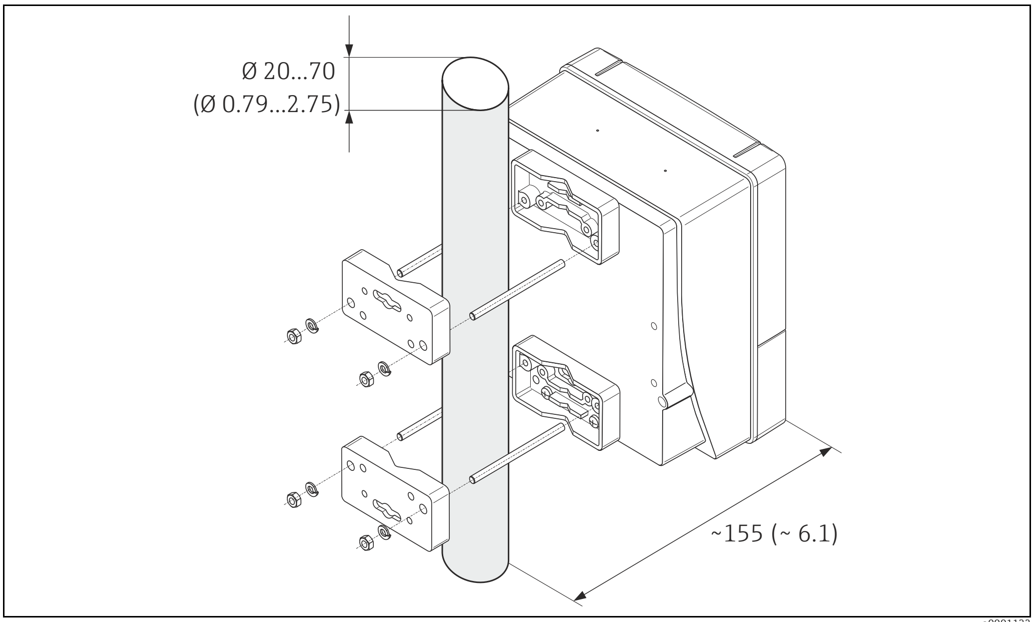


Fig. 30: Pipe mounting (wall-mount housing)

3.4 Post-installation check

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

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	-
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	→ 🖹 103
Installation	**Notes**
Does the arrow on the sensor nameplate match the actual direction of flow through the pipe?	-
Is the position of the measuring electrode plane correct?	→ 🖹 14
Is the position of the empty pipe detection electrode correct?	→ 🖹 14
Were all screws tightened to the specified torques when the sensor was installed?	Promag D → 🖹 22 Promag E → 🖹 24 Promag L → 🖹 30 Promag P → 🖹 33 Promag W → 🖹 36
Were the correct seals used (type, material, installation)?	Promag D → 🖹 20 Promag E → 🖹 23 Promag H → 🖹 26 Promag L→ 🖹 29 Promag P → 🖹 32 Promag W → 🖹 36
Are the measuring point number and labeling correct (visual inspection)?	-
Process environment / process conditions	**Notes**
Were the inlet and outlet runs respected?	Inlet run ≥ 5 × DN Outlet run ≥ 2 × DN
Is the measuring device protected against moisture and direct sunlight?	-
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g by analogy with IEC 600 68-2-8

4 Wiring

Warning!
When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.
Please do not hesitate to contact your Endress+Hauser representative if you have any questions.

Note!
The device does not have an internal circuit breaker. For this reason, assign the device a switch or power-breaker switch capable of disconnecting the power supply line from the mains.

4.1 Connecting the remote version

4.1.1 Connecting Promag D/E/H/L/P/W

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" → 19).
4. Terminate the signal and coil current cable as indicated in the table:
   Promag D/E/L/P/W → Refer to the table → 49
   Promag H → Refer to the "Cable termination" table → 50
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:
     → 31 (Promag D) → 32 (Promag E/L/P/W); → 33 (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 → 50)

   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 D

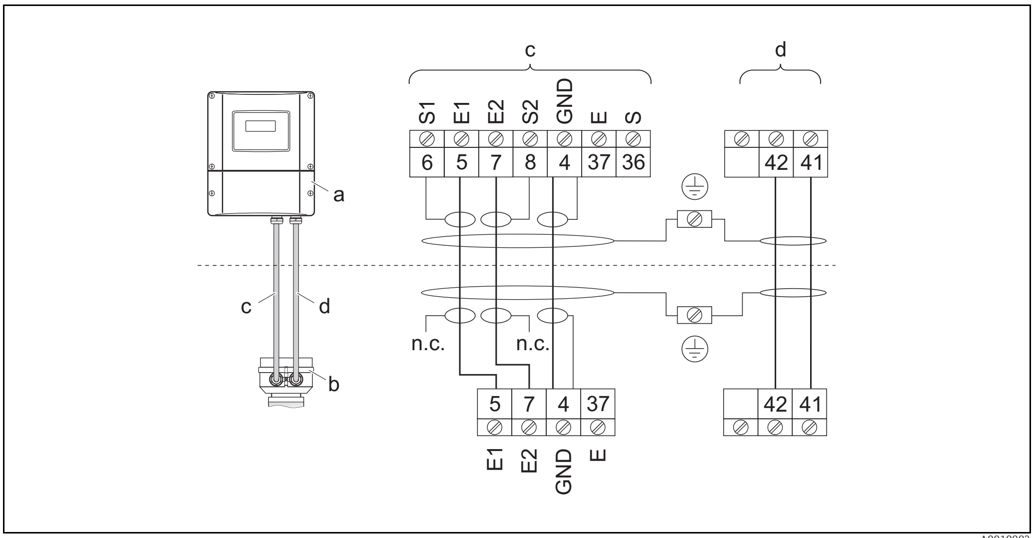


Fig. 31: Connecting the remote version of Promag D

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 = braun, 7/8 = white, 4 = green, 37/36 = yellow

Promag E/L/P/W

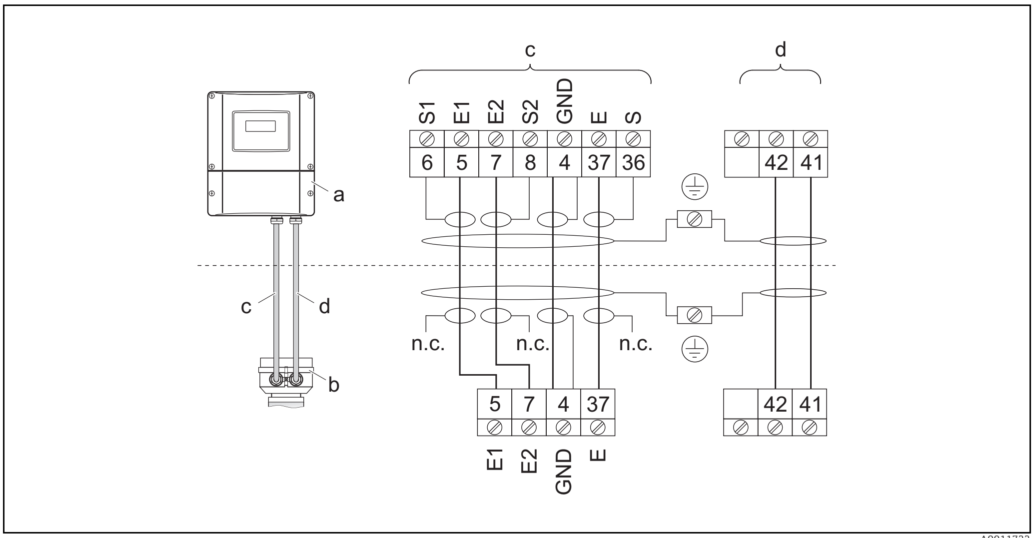


Fig. 32: Connecting the remote version of Promag E/L/P/W

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 = braun, 7/8 = white, 4 = green, 37/36 = yellow

Promag H

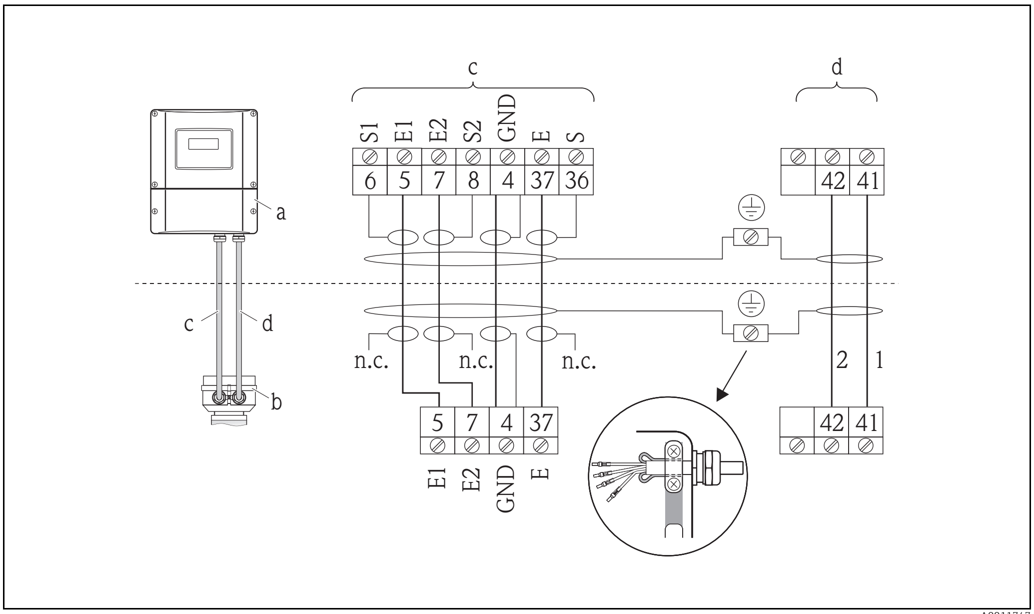


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Fig. 33: Connecting the remote version of Promag H

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 = braun, 7/8 = white, 4 = green, 37/36 = yellow

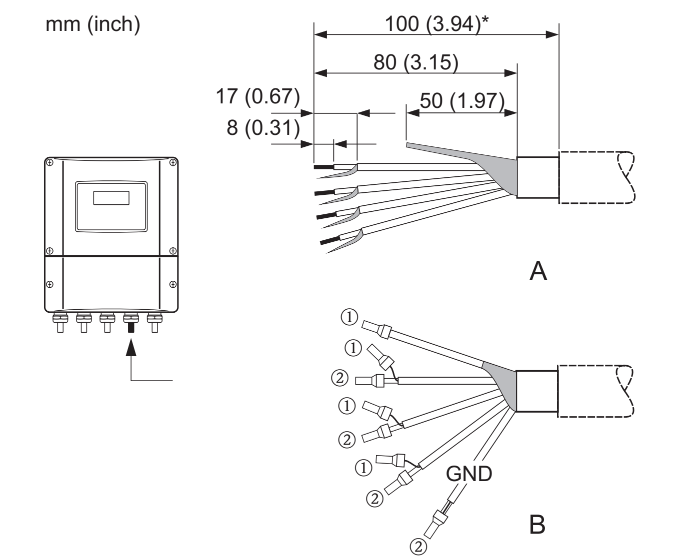
Cable termination for the remote version
Promag D/E/L/P/W

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).
* Stripping only for reinforced cables

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

TRANSMITTER

Signal cable



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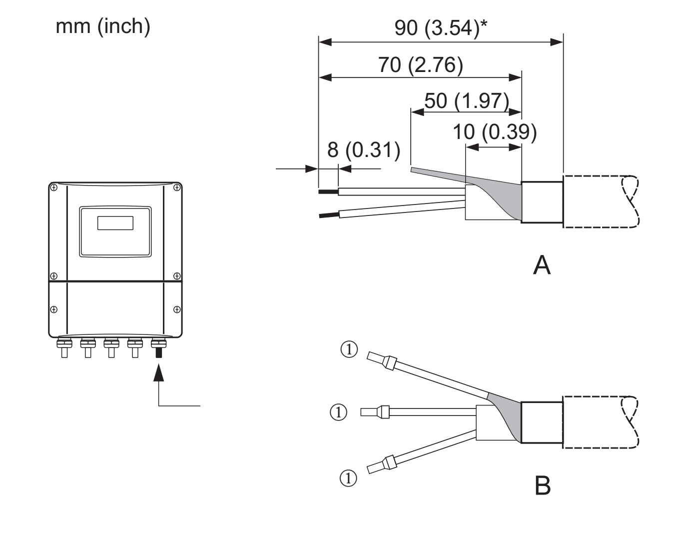
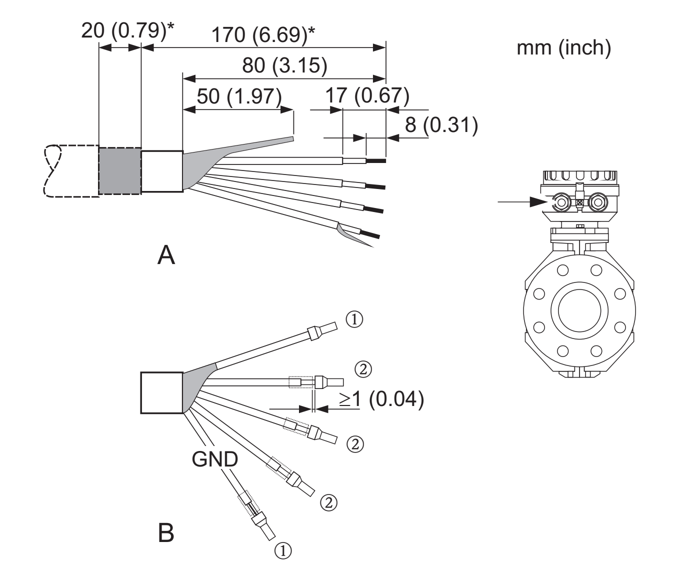
Coil current cable



A0002688

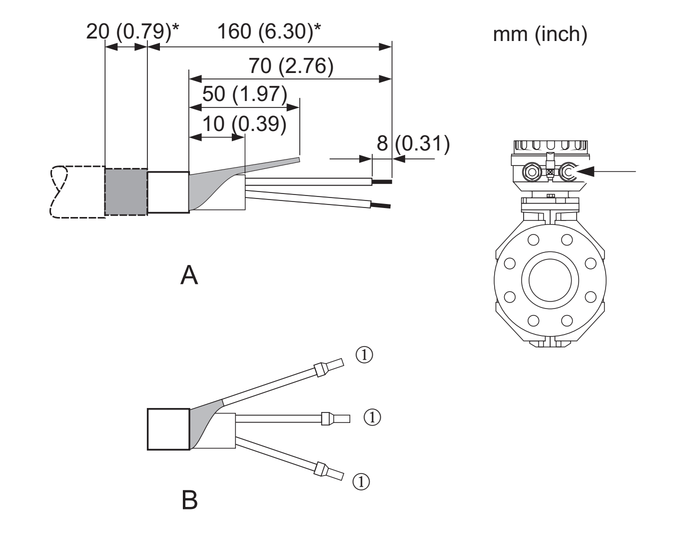
SENSOR

Signal cable



A0002646

Coil current cable



A0002650

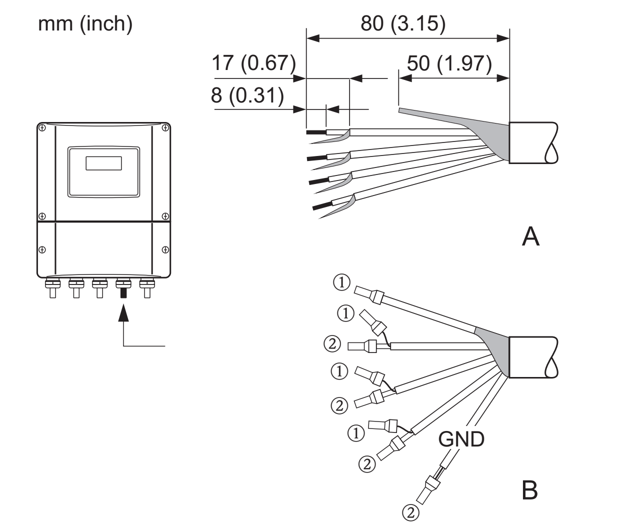
Cable termination for the remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).

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

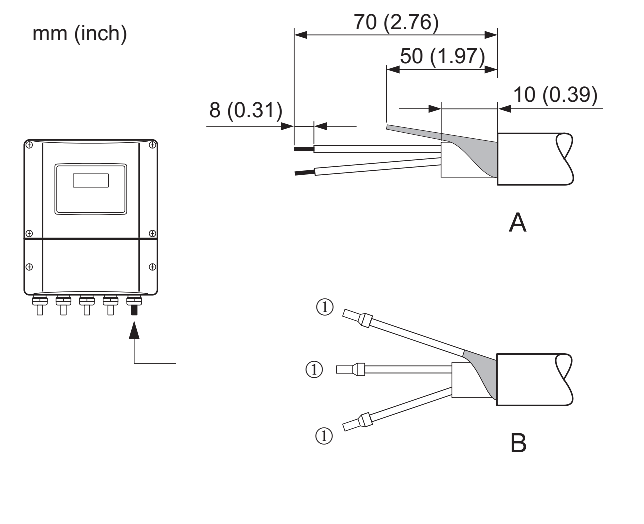
TRANSMITTER

Signal cable



A0002686

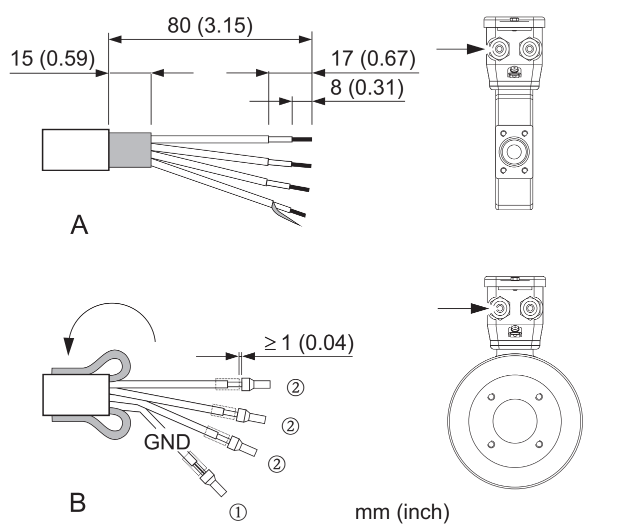
Coil current cable



A0002684

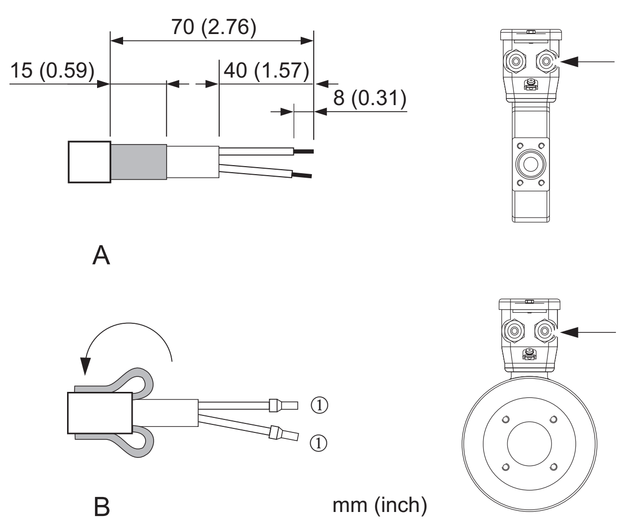
SENSOR

Signal cable



A0002647

Coil current cable



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4.1.2 Cable specifications

Signal cable

- 3 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Permanent operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²

Coil cable

- 2 × 0.75 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²
- Test voltage for cable insulation: ≥1433 V AC r.m.s. 50/60 Hz or ≥2026 V DC

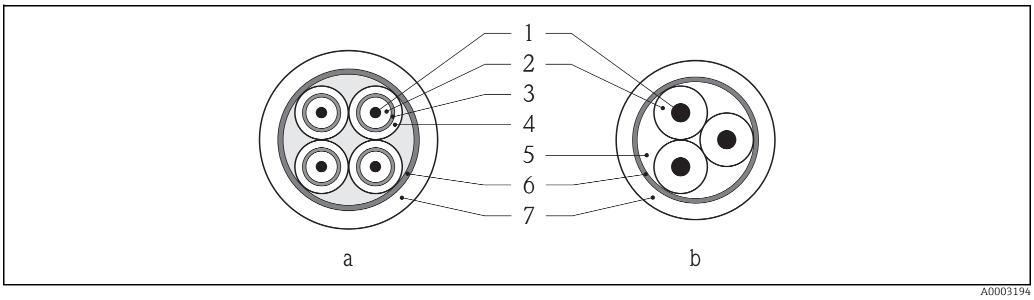


Fig. 34: Cable cross-section

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. Reinforced connecting cables should be used when laying the cable directly in the ground, if there is a risk of damage from rodents or if using the measuring device below IP 68 degree 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. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.

4.2 Connecting the measuring unit

4.2.1 Connecting the transmitter

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

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and the signal cable (b) through the appropriate cable entries.
3. Perform the wiring:
   – Wiring diagram (aluminum housing) → 🖻 35
   – Wiring diagram (stainless steel housing) → 🖻 36
   – Wiring diagram (wall-mount housing) → 🖻 37
   – Terminal assignment → 🗎 54
4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.

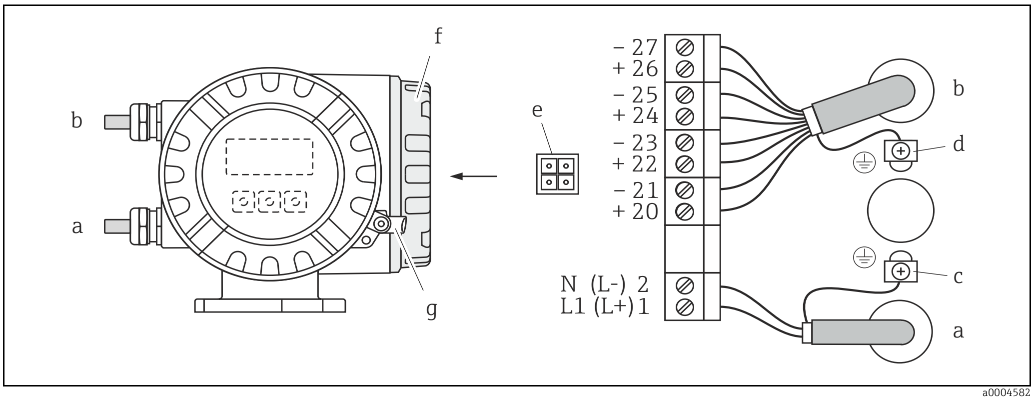
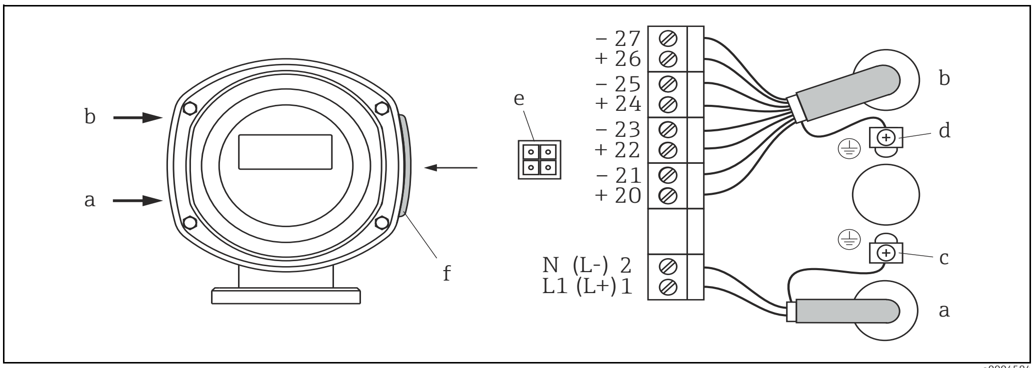


Fig. 35: Connecting the transmitter (aluminum field housing). Cable cross-section: max. 2.5 mm²

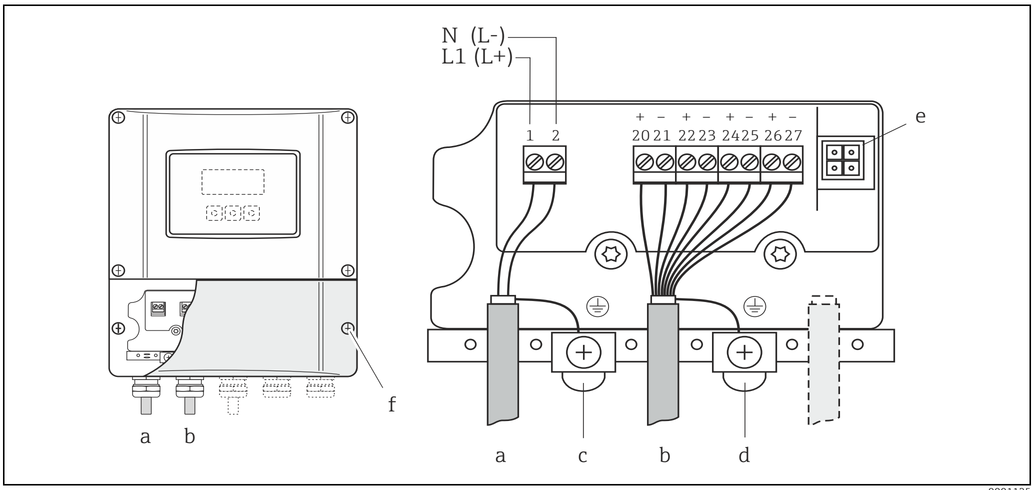
a Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
*b Signal cable: Terminals **Nos. 20–27** → 🗎 54*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment
g Securing clamp



a0004584

Fig. 36: Connecting the transmitter (stainless steel field housing); cable cross-section: max. 2.5 mm²

a 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*
*b Signal cable: Terminals **Nos. 20–27** → 54*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment



a0001135

Fig. 37: Connecting the transmitter (wall-mount housing); cable cross-section: max. 2.5 mm²

a 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*
*b Signal cable: Terminals **Nos. 20–27** → 54*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment

4.2.2 Terminal assignment

	Terminal No. (inputs / outputs)			
Order version	20 (+) / 21 (–)	22 (+) / 23 (–)	24 (+) / 25 (–)	26 (+) / 27 (–)
50***-***********W	-	-	-	Current output HART
50***-***********A	-	-	Frequency output	Current output HART
50***-***********D	Status input	Status output	Frequency output	Current output HART
50***-***********S	-	-	Frequency output Ex i	Current output, Ex i, active, HART
50***-***********T	-	-	Frequency output Ex i	Current output, Ex i, passive, HART

Note!
Functional values of the inputs and outputs → 📄 98

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) and 27 (–)
- Connection by means of the 4 to 20 mA circuit.

Note!
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
- CURRENT SPAN function → "4–20 mA HART"
- Switch HART write protection on or off → 📄 65

Connection of the HART handheld communicator

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

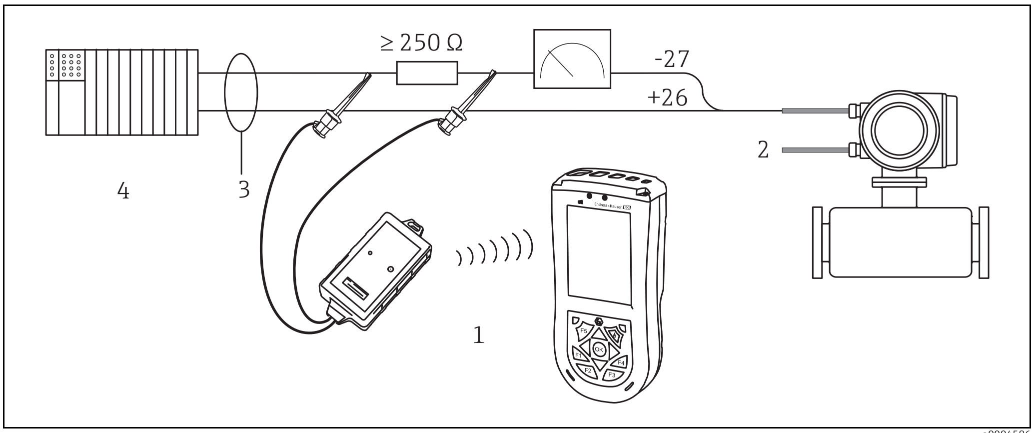


Fig. 38: Electrical connection of HART handheld Field Xpert SFX100

1 HART handheld Field Xpert SFX100
2 Auxiliary energy
3 Shielding
4 Other devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with operating software (e.g. "FieldCare"), a HART modem (e.g. "Commubox FXA195") is needed.

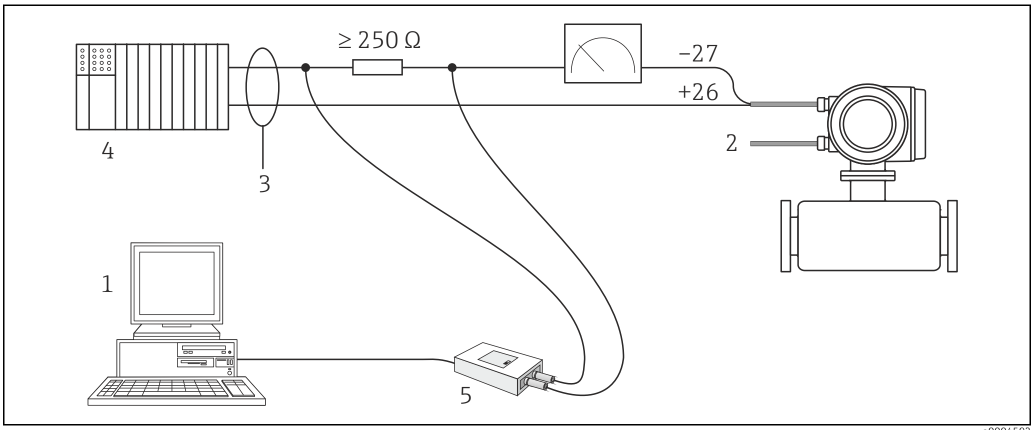


Fig. 39: Electrical connection of a PC with operating software

1 PC with operating software
2 Auxiliary energy
3 Shielding
4 Other devices or PLC with passive input
5 HART modem, e.g. Commubox FXA195

4.3 Potential equalization

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

Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.

The following should also be taken into consideration for potential equalization:
- Internal grounding concepts in the company
- Operating conditions, such as the material/grounding of the pipes (see Table)

4.3.1 Potential equalization for Promag D

- No reference electrode is integrated!
  For the two ground disks of the sensor an electrical connection to the fluid is always ensured.
- Exampels for connections → 56

4.3.2 Potential equalization for Promag E/L/P/W

- Reference electrode integrated in the sensor as standard
- Exampels for connections → 57

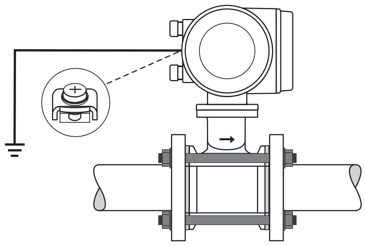
4.3.3 Potential equalization for Promag H

No reference electrode is integrated!
For the metal process connections of the sensor an electrical connection to the fluid is always ensured.

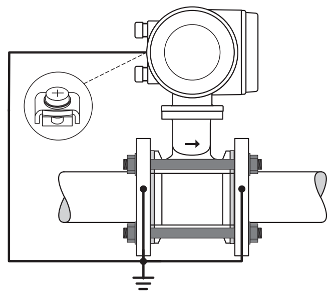
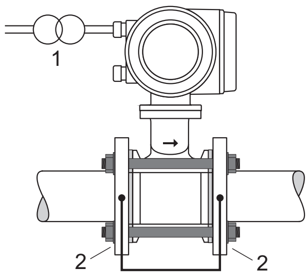
Caution!
If using process connections made of a synthetic material, ground rings have to be used to ensure that potential is equalized (→ 27). The necessary ground rings can be ordered separately from Endress+Hauser as accessories (→ 78).

4.3.4 Exampels for potential equalization connections for Promag D

Standard case

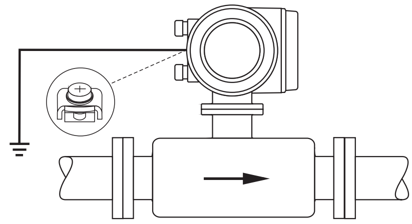
Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal, grounded pipe ▪ Plastic pipe ▪ Pipe with insulating lining Potential equalization takes place via the ground terminal of the transmitter (standard situation). ✎ Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 a00012172 *Fig. 40: Via the ground terminal of the transmitter*

Special cases

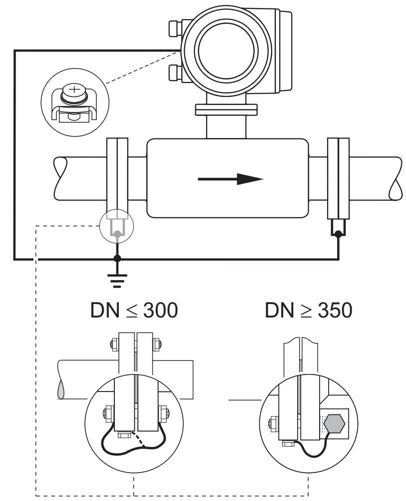
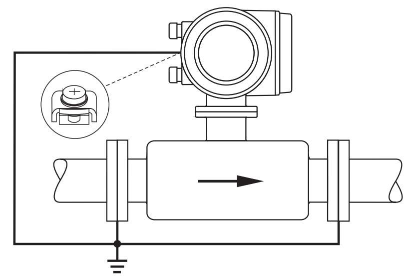
Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal pipe that is not grounded This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured ▪ Excessively high equalizing currents can be expected Potential equalization takes place via the ground terminal of the transmitter and the two pipe flanges. Here, the ground cable (copper wire, 6 mm² / 0.0093 in²) is mounted directly on the conductive flange coating with flange screws.	 a00012173 *Fig. 41: Via the ground terminal of the transmitter and the flanges of the pipe .*
When using the measuring device in a: ▪ Pipe with a cathodic protection unit The device is installed potential-free in the pipe. Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² (0.0093 in²)). Here, the ground cable is mounted directly on the conductive flange coating with flange screws. Note the following when installing: ▪ The applicable regulations regarding potential-free installation must be observed. ▪ There should be **no** electrically conductive connection between the pipe and the device. ▪ The mounting material must withstand the applicable torques.	 a00012174 *Fig. 42: Potential equalization and cathodic protection* *1 Power supply isolation transformer* *2 Electrically isolated*

4.3.5 Exampels for potential equalization connections for Promag E/L/P/W

Standard case

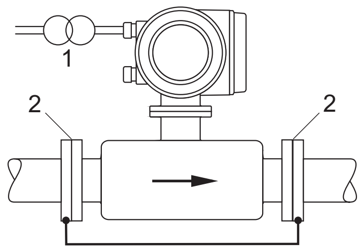
Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal, grounded pipe Potential equalization takes place via the ground terminal of the transmitter (standard situation). Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 A0011892 *Fig. 43: Via the ground terminal of the transmitter*

Special cases

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal pipe that is not grounded This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured ▪ Excessively high equalizing currents can be expected Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, 6 mm² / 0.0093 in²) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. Ground cable installation depends on the nominal diameter: ▪ DN ≤ 300 (12"): The ground cable is mounted directly on the conductive flange coating with the flange screws. ▪ DN ≥ 350 (14"): The ground cable is mounted directly on the metal transport bracket. Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 A0011893 *Fig. 44: Via the ground terminal of the transmitter and the flanges of the pipe*
When using the measuring device in a: ▪ Plastic pipe ▪ Pipe with insulating lining This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured ▪ Excessively high equalizing currents can be 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 *Fig. 45: Via the ground terminal of the transmitter*

<table>
<tr><th>Operating conditions</th><th>Potential equalization</th></tr>
<tr><td>When using the measuring device in a:
▪ Pipe with a cathodic protection unit

The device is installed potential-free in the pipe.
Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² / 0.0093 in²). Here, the ground cable is mounted directly on the conductive flange coating with flange screws.

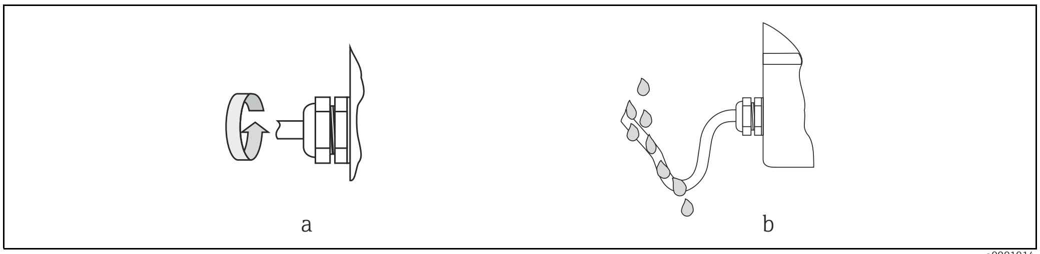
Note the following when installing:
▪ The applicable regulations regarding potential-free installation must be observed.
▪ There should be no electrically conductive connection between the pipe and the device.
▪ The mounting material must withstand the applicable torques.</td><td>
A0011896
Fig. 46: Potential equalization and cathodic protection

1 Power supply isolation transformer
2 Electrically isolated</td></tr>
</table>

4.4 Degree of protection

The devices meet all the requirements of IP 67 degree of protection.

Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP 67 protection is maintained:
- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → 📄 51.
- Firmly tighten the cable entries.
- The cables must loop down before they enter the cable entries ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.



a0001914

Fig. 47: Installation instructions, cable entries

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

Note!
The Promag E/L/P/W sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters (10 ft)). In this case the transmitter must be installed remote from the sensor.
The Promag L sensors with IP 68 rating are only available with stainless steel flanges.

4.5 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	-
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	▪ 85 to 250 V AC (50 to 60 Hz) ▪ 20 to 28 V AC (50 to 60 Hz) 11 to 40 V DC
Do the cables used comply with the necessary specifications?	→ 🗎 51
Do the cables have adequate strain relief?	-
Is the cable type route completely isolated? Without loops and crossovers?	-
Are the power-supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Only remote version: Is the flow sensor connected to the matching transmitter electronics?	Check serial number on nameplates of sensor and connected transmitter.
Only remote version: Is the connecting cable between sensor and transmitter connected correctly?	→ 🗎 46
Are all screw terminals firmly tightened?	-
Have the measures for grounding/potential equalization been correctly implemented?	→ 🗎 55
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 🗎 58
Are all housing covers installed and firmly tightened?	-

5 Operation

5.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device.
The display area consists of two lines; this is where measured values are displayed, and/or status variables (direction of flow, partially filled pipe, bar graph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ "Description of Device Functions" manual).

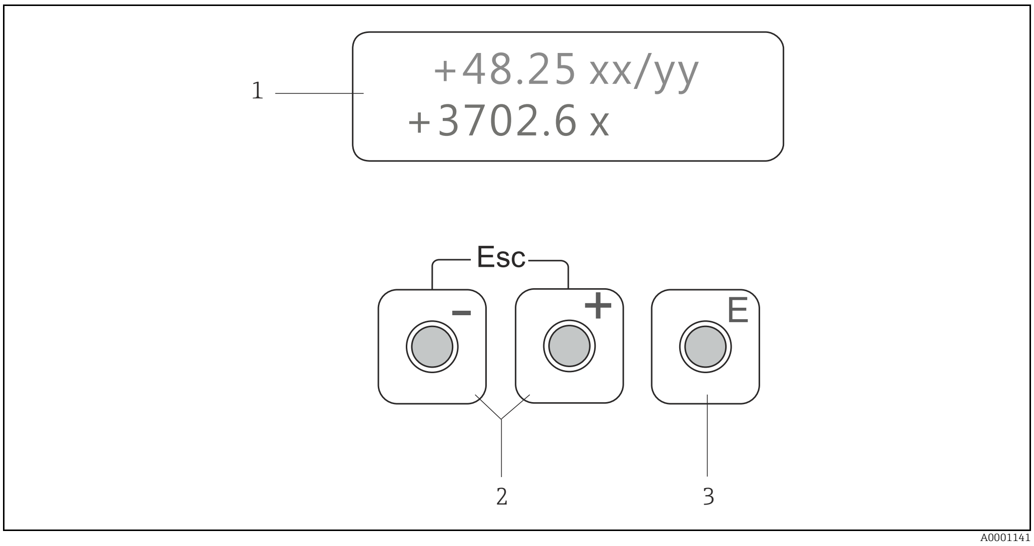


Fig. 48: Display and operating elements

1 Liquid crystal display
The two-line liquid-crystal display shows measured values, dialog texts, error messages and information messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).
- *Upper display line: Shows primary measured values, e.g. volume flow in [ml/min] or in [%].*
- *Lower display line: Shows supplementary measured variables and status variables, e.g. totalizer reading in [m3], bar graph, measuring point designation*

2 Plus/minus keys
- *Enter numerical values, select parameters*
- *Select different function groups within the function matrix*

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

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

5.2 Brief operating instructions on the function matrix

Note!
- See the general notes on → 62.
- Detailed description of all the functions → "Description of Device Functions" manual

The function matrix comprises two levels, namely the function groups and the functions of the function groups.
The groups are the highest-level grouping of the control options for the device. A number of functions is assigned to each group. You select a group in order to access the individual functions for operating and configuring the device.

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g. OPERATION)
3. Select a function (e.g. LANGUAGE)
   Change parameter/enter numerical values:
   +/- → select or enter enable code, parameters, numerical values
   E → save your entries
4. Exit the function matrix:
   – Press and hold down Esc key (-/+) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (-/+) → return step by step to HOME position

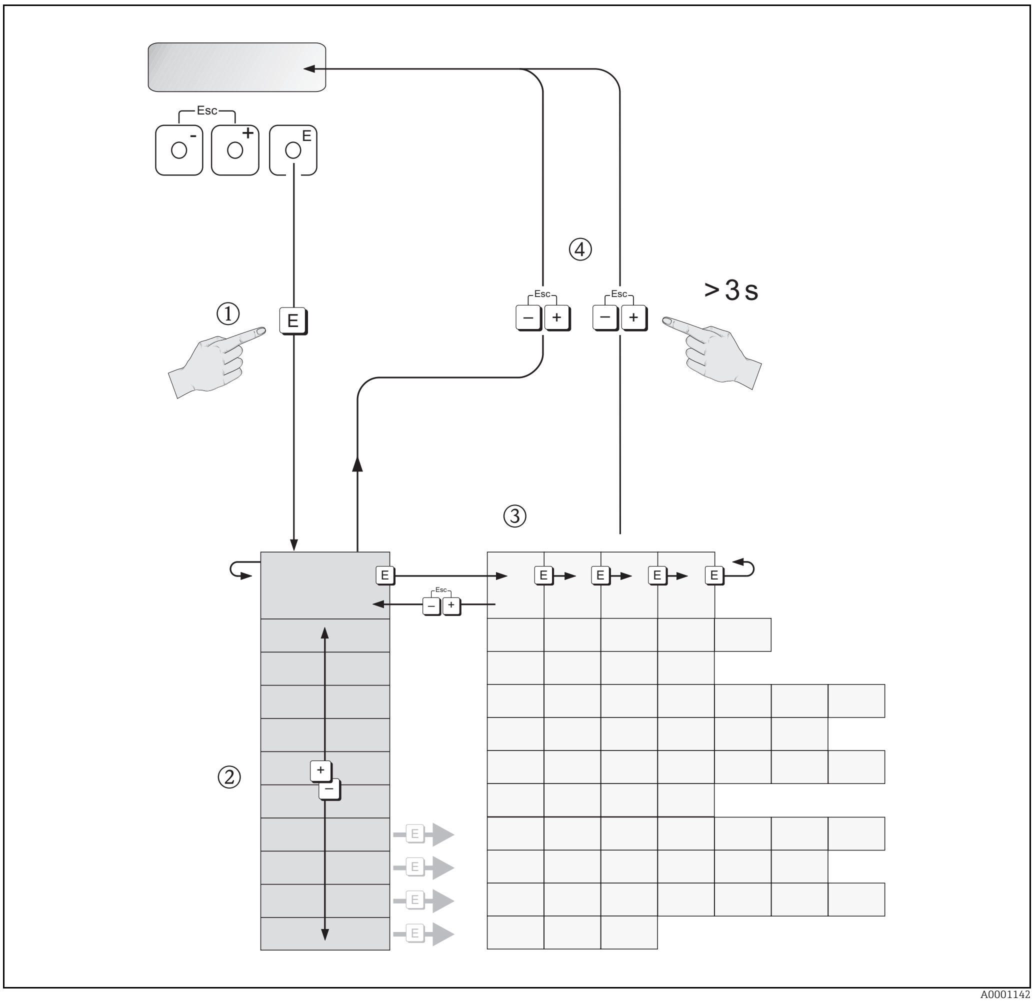


Fig. 49: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

The Quick Setup menu (→ 72) is adequate for commissioning in most instances. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on → 61.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries.
  Press to select "SURE [YES]" and press again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

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

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.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 50) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is specified as the customer's code, programming is always enabled.
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.

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

5.2.3 Disabling the programming mode

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

5.3 Displaying error messages

5.3.1 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* → 📄 82:
  This group comprises all device errors, e.g. communication errors, hardware faults, etc.
- *Process errors* → 📄 84:
  This group comprises all application errors, e.g. empty pipe, etc.

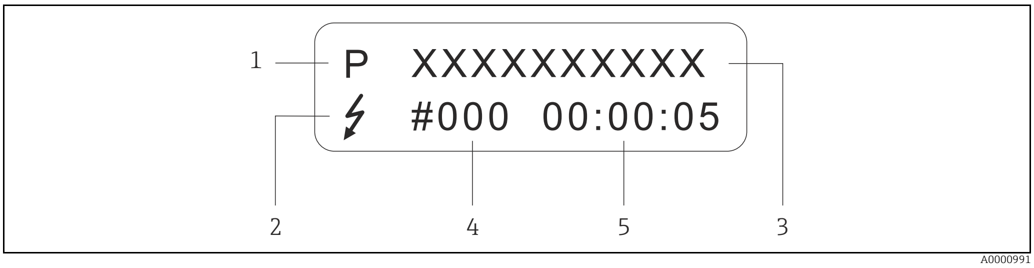


Fig. 50: Error messages on the display (example)

1 Error type:
– P = process error
– S = system error
2 Error message type:
– ϟ = fault message
– ! = notice message
3 Error designation: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty
4 Error number: e.g. #401
5 Duration of most recent error occurrence (in hours, minutes and seconds)

5.3.2 Error message types

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 (→ "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 (ϟ)

- Displayed as → Lightning flash (ϟ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the individual outputs (failsafe mode) can be defined in the function matrix using the "FAILSAFE MODE" function (→ "Description of Device Functions" manual).

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

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → 🖹 54.

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

- *Universal commands:*
  All HART device support and use universal commands.
  The following functionalities are linked to them:
  – Identify HART devices
  – Reading digital measured values (volume flow, totalizer, etc.)
- *Common practice commands:*
  Common practice commands offer functions which are supported and can be executed by most but not all field devices.
- *Device-specific commands:*
  These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cutoff settings, etc.

✎ Note!
The device has access to all three command classes. A list of all the "Universal commands" and "Common practice commands" is provided on → 🖹 66.

5.4.1 Operating options

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

Field Xpert HART Communicator

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

Operating program "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.

Operating program "SIMATIC PDM" (Siemens)

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

Operating program "AMS" (Emerson Process Management)

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

5.4.2 Current device description files

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

HART protocol:

Valid for device software:	2.04.XX	→ Function DEVICE SOFTWARE
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 41_{hex}	 → Function MANUFACTURER ID → Function DEVICE ID
HART version data:	Device Revision 6/ DD Revision 1	
Software release:	01.2011	

Operating program:	**Sources for obtaining device descriptions:**
Handheld Field Xpert SFX100	Use update function of handheld terminal
FieldCare / DTM	▪ www.endress.com → Download ▪ CD-ROM (Endress+Hauser order number 56004088) ▪ DVD (Endress+Hauser order number 70100690)
AMS	www.endress.com → Download
SIMATIC PDM	www.endress.com → Download

Tester/simulator:	**Sources for obtaining device descriptions:**
Fieldcheck	Update by means of FieldCare with 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 out and used for official certification. Contact your Endress+Hauser representative for more information.

5.4.3 Device variables

The following device variables are available using the HART protocol:

Code (decimal)	Device variable
0	OFF (not assigned)
1	Volume flow
250	Totalizer 1
251	Totalizer 2

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → not assigned
- Fourth process variable (FV) → not assigned

Note!
You can set or change the assignment of device variables to process variables using Command 51.

5.4.4 Switching HART write protection on/off

The HART write protection can be switched on and off using the HART WRITE PROTECT device function (→ "Description of Device Functions" manual).

5.4.5 Universal and common practice HART commands

The following table contains all the universal commands supported by the device.

Command No. HART command / Access type		**Command data (numeric data in decimal form)**	**Response data (numeric data in decimal form)**
Universal commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable Factory setting: Primary process variable = Volume flow Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: actual current of the primary process variable in mA – Bytes 4-7: % value of the set measuring range Factory setting: Primary process variable = Volume flow Note! You can change the assignment of device variables to process variables using Command 51.
3	Read the primary process variable as current in mA and four dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* ▪ Primary process variable = Volume flow ▪ Second process variable = Totalizer 1 ▪ Third process variable = OFF (not assigned) ▪ Fourth process variable = OFF (not assigned) Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
6	Set HART shortform address Access type = write	Byte 0: desired address (0 to 15) Factory setting: 0 Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
12	Read user message Access type = read	none	Bytes 0-24: User message Note! You can write the user message using Command 17.
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date Note! You can write the TAG, descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span Note! ▪ The data relate to the primary process variable (= volume flow). ▪ Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: upper range, value for 20 mA – Bytes 7-10: lower range, value for 4 mA – Bytes 11-14: Damping constant in [s] – Byte 15: Write protection ID – Byte 16: OEM dealer ID, 17 = E+H Factory setting: Primary process variable = Volume flow Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
16	Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date
19	Write the device production number Access = write	Bytes 0-2: Production number	Bytes 0-2: Production number

The following table contains all the common practice commands supported by the device.

Command No.	HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Common practice commands			
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable "volume flow" in seconds *Factory setting:* Primary process variable = Current output damping	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA *Factory setting:* Primary process variable = Volume flow Note! ▪ The start of the measuring range (4 mA) must correspond to the zero flow. ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
38	Device status reset (configuration changed) Access = write	none	none Note! It is also possible to execute this HART command when write protection is activated (= ON)!
40	Simulate input current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0-3: Output current in mA *Factory setting:* Primary process variable = Volume flow Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0-3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only units which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Volume flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ If you change the unit of the primary process variable, this has a direct impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table → 70

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Code 1 for volume flow ▪ Second process variable: Code 250 for totalizer ▪ Third process variable: Code 0 for OFF (not assigned) ▪ Fourth process variable: Code 0 for OFF (not assigned)
51	Write assignment of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Volume flow ▪ Second process variable: Totalizer 1 ▪ Third process variable: OFF (not assigned) ▪ Fourth process variable: OFF (not assigned)	The variable assignment of the process variables is displayed as a response: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable
53	Write device variable unit Access = write	This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: Device variable code – Byte 1: HART unit code Code of the supported device variables: See information → 65 Note! ▪ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ▪ If you change the unit of the device variable, this has a direct impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: Device variable code – Byte 1: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (4 to 20)	The current number of preambles is displayed in the response telegram: Byte 0: Number of preambles

5.4.6 Device status and error messages

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

Note!
- You can find a detailed explanation of the device status and error messages and their elimination on → 70
- Bits and bytes not listed are not assigned.

Byte	Bit	Error No.	Short error description
0	0	001	Serious device error
	1	011	Measuring amplifier has faulty EEPROM
	2	012	Error when accessing data of the measuring amplifier EEPROM
1	1	031	S-DAT: defective or missing
	2	032	S-DAT: Error accessing saved values
	5	051	I/O and the amplifier are not compatible.
3	3	111	Totalizer checksum error
	4	121	I/O board and amplifier not compatible.
4	3	251	Internal communication fault on the amplifier board.
	4	261	No data reception between amplifier and I/O board
5	0	321	Coil current of the sensor is outside the tolerance.
	7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6	0	340	
	1	341	
	2	342	
	3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
	4	344	
	5	345	
	6	346	
	7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7	0	348	
	1	349	
	2	350	
	3	351	Current output: Flow is out of range.
	4	352	
	5	353	
	6	354	
	7	355	Frequency output: Flow is out of range.
8	0	356	
	1	357	
	2	358	

Byte	Bit	Error No.	Short error description
8	3	359	Pulse output: Flow is out of range.
	4	360	
	5	361	
	6	362	
10	7	401	Measuring tube partially filled or empty
11	2	461	EPD calibration not possible because the fluid's conductivity is either too low or too high.
	4	463	The EPD calibration values for empty pipe and full pipe are identical, and therefore incorrect.
12	1	474	Maximum flow value entered is overshot
	7	501	Amplifier software version is loaded. Currently no other commands are possible.
13	0	502	Upload/download of device files. Currently no other commands are possible.
14	3	601	Positive zero return active
	7	611	Simulation current output active
15	0	612	
	1	613	
	2	614	
	3	621	Simulation frequency output active
	4	622	
	5	623	
	6	624	
	7	631	Simulation pulse output active
16	0	632	
	1	633	
	2	634	
	3	641	Simulation status output active
	4	642	
	5	643	
	6	644	
17	7	671	Simulation of the status input active
18	0	672	
	1	673	
	2	674	
	3	691	Simulation of response to error (outputs) active
	4	692	Simulation of volume flow active

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" → 45
- Checklist for "Post-connection check" → 59

6.2 Switching on the measuring device

Once the connection checks have been successfully completed, it is time to switch on the power supply. The device is now operational. The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:

PROMAG 50 STARTUP. . .	Start-up message
▼	
DEVICE SOFTWARE V XX.XX.XX	Current software version
▼	
SYSTEM OK →OPERATION	Beginning of normal measuring mode
▼	

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

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

6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the operating 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 menu.

6.3.1 "Commissioning" Quick Setup menu

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

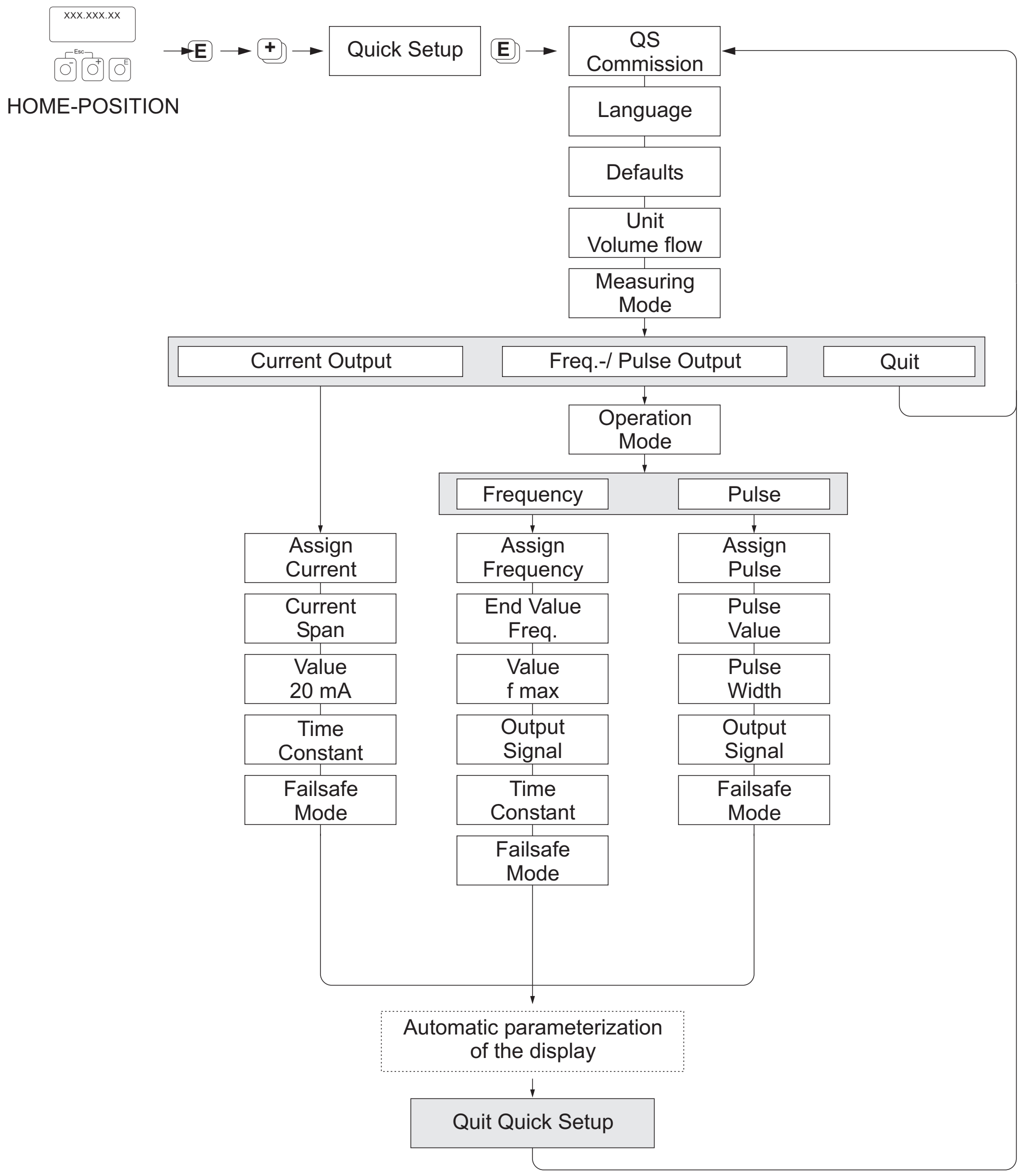


Fig. 51: "QUICK SETUP COMMISSIONING" menu for the rapid configuration of important device functions

6.4 Configuration

6.4.1 Current output: active/passive

The current output is configured as "active" or "passive" by means of various jumpers on the I/O board.

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 → 89
3. Position the jumper → 52

   Caution!
   Risk of destroying the measuring device. Set the jumpers exactly as shown in the graphic. Pay strict attention to the position of the jumpers as indicated in the graphic.
4. Installation of the I/O board is the reverse of the removal procedure.

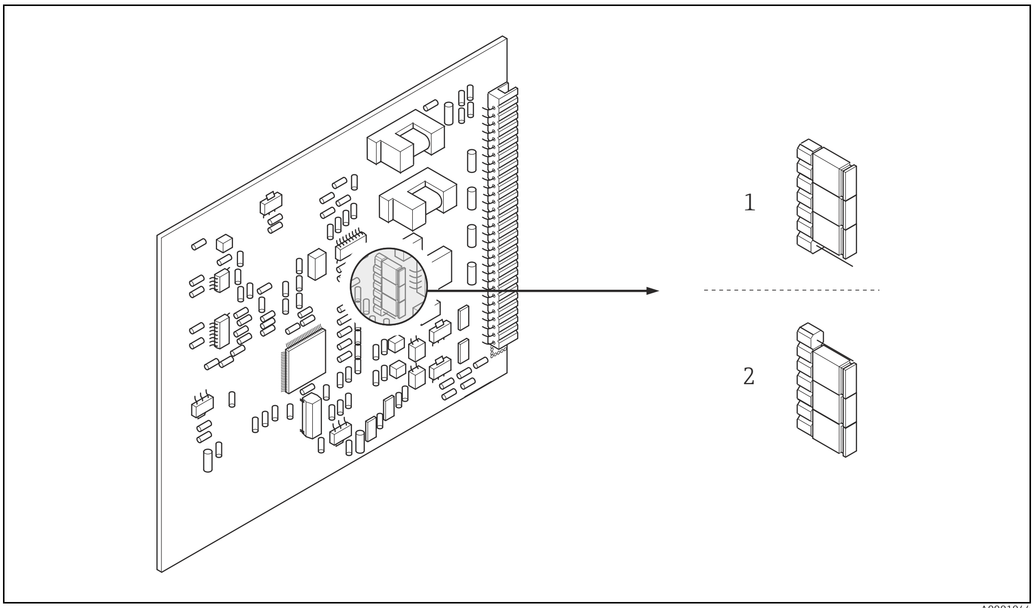


Fig. 52: Configuring current outputs using jumpers (I/O board)

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

6.5 Adjustment

6.5.1 Empty-pipe/full-pipe adjustment

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

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

Caution!
Detailed information on the empty-pipe/full-pipe adjustment procedure can be found in the "Description of Device Functions" manual:
- EPD/OED ADJUSTMENT (carrying out the adjustment).
- EPD (switching on and off EPD/OED).
- EPD RESPONSE TIME (input of the response time for EPD/OED).

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

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

1. Select the appropriate function in the function matrix:
   HOME → E → + → PROCESS PARAMETER → E → + → EPD ADJUSTMENT
2. Empty the piping:
   – The wall of the measuring tube should still be wet with fluid during EPD empty pipe adjustment
   – The wall of the measuring tube/the measuring electrodes should **no longer** be wet with fluid during OED empty pipe adjustment
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E 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 E to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E.
7. Switch on empty pipe detection in the EPD function:
   – EPD empty pipe adjustment: Select ON STANDARD or ON SPECIAL and press E to confirm
   – OED empty pipe adjustment: Select OED and confirm with E.

   Caution!
   The adjustment coefficients must be valid before you can activate the EPD function. If adjustment is incorrect the following messages might appear on the display:
   – FULL = EMPTY
   The adjustment values for empty pipe and full pipe are identical. In cases of this nature you must repeat empty-pipe or full-pipe adjustment!
   – ADJUSTMENT NOT OK
   Adjustment is not possible because the fluid’s conductivity is out of range.

6.6 Data storage device (HistoROM)

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored. It is possible to plug these modules into other devices to copy device configurations from one device to another, for example.

6.6.1 HistoROM/S-DAT (sensor-DAT)

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

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

Replacement seals (accessories) → 📄 78.

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

8.1 Device-specific accessories

Accessory	Description	Order code
Proline Promag 50 transmitter	Transmitter for replacement or storage. Use the order code to define the following specifications: ▪ Approvals ▪ Degree of protection/version ▪ Cable for remote version ▪ Cable entry ▪ Display/power supply/operation ▪ Software ▪ Outputs/inputs	50XXX – XXXXX******

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for Promag 50 transmitter	Mounting set for the transmitter (remote version). Suitable for: ▪ Wall mounting ▪ Pipe mounting ▪ Panel-mounted installation Mounting set for aluminum field housing. Suitable for: ▪ Pipe mounting	DK5WM – *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor.	DK5HM – **
Cable for remote version	Coil and signal cables, various lengths.	DK5CA – **
Mounting kit for Promag D, wafer version	▪ Mounting bolts ▪ Nuts incl. washers ▪ Flange seals ▪ Centering sleeves (if required for the flange)	DKD** – **
Set of seals for Promag D	Set of seals consisting of two flange seals.	DK5DD – ***
Mounting kit for Promag H	▪ 2 process connections ▪ Threaded fasteners ▪ Seals	DKH** – ****
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – ***
Welding jig for Promag H	Weld nipple as process connection: welding jig for installation in pipe.	DK5HW – ***
Adapter connection for Promag A, H	Adapter connections for installing a Promag 10 H instead of a Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA – *****
Ground rings for Promag H	Ground rings for potential equalization.	DK5HR – ***
Ground cable for Promag E/L/P/W	Ground cable for potential equalization.	DK5GC – ***
Ground disk for Promag E/L/P/W	Ground disk for potential equalization.	DK5GD – * * ***
Process display RIA45	Multifunctional 1-channel display unit: ▪ Universal input ▪ Transmitter power supply ▪ Limit relay ▪ Analog output	RIA45 – ******

Accessory	Description	Order code
Process display RIA251	Digital display device for looping into the 4 to 20 mA current loop.	RIA251 – **
Field display unit RIA16	Digital field display device for looping into the 4 to 20 mA current loop.	RIA16 – ***
Application Manager RMM621	Electronic recording, display, balancing, control, saving and event and alarm monitoring of analog and digital input signals. Values and conditions determined are output by means of analog and digital output signals. Remote transmission of alarms, input values and calculated values using a PSTN or GSM modem.	RMM621 – **********

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator Field Xpert SFX 100	Handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA) and FOUNDATION Fieldbus. Contact your Endress+Hauser representative for more information.	SFX100 – *******
Fieldgate FXA320	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ 2-channel analog input (4 to 20 mA) ▪ 4 binary inputs with event counter function and frequency measurement ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values.	FXA320 – *****
Fieldgate FXA520	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ Web server for remote monitoring of up to 30 measuring points ▪ Intrinsically safe version [EEx ia]IIC for applications in hazardous areas ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values ▪ Remote diagnosis and remote configuration of connected HART devices	FXA520 – ****
FXA195	The Commubox FXA195 connects intrinsically safe Smart transmitters with HART protocol to the USB port of a personal computer. This makes the remote operation of the transmitters possible with the aid of configuration programs (e.g. FieldCare). Power is supplied to the Commubox by means of the USB port	FXA195 – *

8.4 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and planning flowmeters. The Applicator software 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.	DXA80 – *
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 out and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based asset management tool. It can configure all intelligent field units in your system and helps you manage them. By using status information, it is also a simple but effective way of checking their status and condition.	See the product page on the Endress+Hauser Web site: www.endress.com
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 – ************
FXA193	Service interface from the device to the PC for operation via FieldCare.	FXA193 – *

9 Troubleshooting

9.1 Troubleshooting instructions

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

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → terminals 1, 2 2. Check the power line fuse → 🖹 93 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC / 16 to 62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 🖹 88
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 → 🖹 89 2. Display module defective → order spare parts → 🖹 88 3. Measuring electronics defective → order spare parts → 🖹 88
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the OS buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output.	Electronics board defective → order spare parts → 🖹 88
↓	
Error messages on display	
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons: the meanings of these icons are as follows (example): – Error type: **S** = system error, **P** = process error – Error message type: ϟ = 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 → 🖹 63! ▪ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice message only.	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → 🖹 82
Error number: No. 401 - 499	Process error (application error) has occurred → 🖹 84
↓	
Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → 🖹 85

9.2 System error messages

Serious system errors are **always** recognized by the device as "Fault message", and are shown as a lightning flash (ϟ) on the display. Fault messages immediately affect the outputs.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The necessary procedures on → 🗎 5 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed "Declaration of Contamination" form. You will find a master copy of this form at the back of this manual.

Note!
Also observe the information on → 🗎 63.

No.	Error message / Type	Cause	Remedy (spare part → 🗎 88)
S = System error ϟ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE $: # 001	Serious device error	Replace the amplifier board.
011	S: AMP HW EEPROM $: # 011	Amplifier: Defective EEPROM	Replace the amplifier board.
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. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111 / CHECKSUM TOTAL).
031	S: SENSOR HW DAT $: # 031	1. S-DAT is not plugged into the amplifier board correctly (or is missing). 2. S-DAT is defective.	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.
032	S: SENSOR SW DAT $: # 032		
No. # 1xx → Software error			
101	S: GAIN ERROR AMP $: # 101	Gain deviation compared to reference gain > 25%.	Replace the amplifier board.
111	S: CHECKSUM TOTAL $: # 111	Totalizer checksum error.	1. Restart the measuring device. 2. Replace the amplifier board if necessary.
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! – This message is only listed in the error history. – Nothing is shown on the display.	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.	Error message / Type	Cause	Remedy (spare part → 🖹 88)
No. # 2xx → Error in DAT / no communication			
251	S: COMMUNICATION I/O $: # 251	Internal communication fault on the amplifier board.	Replace the amplifier board.
261	S: COMMUNICATION I/O $: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts.
No. # 3xx → System limits exceeded			
321	S: TOL. COIL CURR. $: # 321	Sensor: Coil current is out of tolerance.	⚠ Warning! Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards! Remote version: 1. Check wiring of terminals 41/42 → 🖹 46 2. Check coil current cable connector. Compact and remote version: Replace measuring electronics boards if necessary
339 to 342	S: STACK CUR OUT n !: # 339 to 342	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE ($) ▪ 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.
343 to 346	S: STACK FREQ. OUT n !: # 343 to 346		
347 to 350	S: STACK PULSE OUT n !: # 343 to 346	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. Recommendations in the event of fault category = FAULT MESSAGE ($) ▪ 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.
351 to 354	S: CURRENT RANGE n !: # 351 to 354	Current output: flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 to 358	S: FREQ. RANGE n !: # 355 to 358	Frequency output: flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 to 362	S: PULSE RANGE !: # 359 to 362	Pulse output: the pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ a0004437 3. Reduce flow.

No.	Error message / Type	Cause	Remedy (spare part → 📄 88)
No. # 5xx → Application error			
501	S: SW.-UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT !: # 502	Uploading or downloading the device data via operating program. Currently no other functions are possible.	Wait until the procedure is finished.
No. # 6xx → Simulation mode active			
601	S: POS. ZERO-RETURN !: # 601	Positive zero return active Caution! This message has the highest display priority!	Switch off positive zero return
611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	Simulation current output active	
621 to 624	S: SIM. FREQ. OUT. n !: # 621 to 624	Simulation frequency output active	Switch off simulation
631 to 634	S: SIM. PULSE n !: # 631 to 634	Simulation pulse output active	Switch off simulation
641 to 644	S: SIM. STAT. OUT n !: # 641 to 644	Simulation status output active	Switch off simulation
671 to 674	S: SIM. STATUS IN n !: # 671 to 674	Simulation status input active	Switch off simulation
691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active	Switch off simulation
692	S: SIM. MEASURAND !: # 692	Simulation of a measured variable active (e.g. mass flow).	Switch off simulation
698	S: DEV. TEST ACT. !: # 698	The measuring device is being checked on site via the test and simulation device.	–

9.3 Process error messages

Note!
Also observe the information on → 📄 63.

No.	Error message / Type	Cause	Remedy (spare part → 📄 88)
P = Process error $ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
401	EMPTY PIPE $: # 401	Measuring tube partially filled or empty	1. Check the process conditions of the plant 2. Fill the measuring tube
461	ADJ. NOT OK !: # 461	EPD calibration not possible because the fluid's conductivity is either too low or too high.	The EPD function cannot be used with fluids of this nature.
463	FULL = EMPTY $: # 463	The EPD calibration values for empty pipe and full pipe are identical, therefore incorrect.	Repeat calibration, making sure procedure is correct → 📄 75.

9.4 Process errors without messages

Symptoms	Rectification
Remark: You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Remote version: – Switch off the power supply and check the wiring → 📄 46 – If necessary, reverse the connections at terminals 41 and 42 2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly
Measured-value reading fluctuates even though flow is steady.	1. Check grounding and potential equalization → 📄 55 2. Check the fluid for presence of gas bubbles. 3. In the "SYSTEM DAMPING" function → increase the value
Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalization → 📄 55 2. Check the fluid for presence of gas bubbles. 3. Activate the "LOW FLOW CUTOFF" function, i.e. enter or increase the value for the switching point.
Measured-value reading on display, even though measuring tube is empty.	1. Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe detection → 📄 75 2. Remote version: Check the terminals of the EPD cable → 📄 46 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Select the "BUS ADDRESS" function and change the setting to "0". 2. Value for creepage too high. Reduce the value in the "LOW FLOW CUTOFF" 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 (→ 📄 6): order code, serial number **Returning devices to Endress+Hauser** The necessary procedures (→ 📄 5) must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a master copy of this form at the back of this manual. **Replace transmitter electronics** Components in the measuring electronics defective → order spare parts → 📄 88

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 set the signals of the current, pulse and status outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions: simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	Process/system error is current	**Positive zero return is activated**
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on → 66		
Current output	MINIMUM VALUE 0–20 mA → 0 mA 4–20 mA → 2 mA 4–20 mA HART → 2 mA 4–20 mA NAMUR →3.5 mA 4–20 mA HART NAMUR →3.5 mA 4–20 mA US → 3.75 mA 4–20 mA HART US → 3,75 mA 0–20 mA (25 mA) → 0 mA 4–20 mA (25 mA) → 2 mA 4–20 mA (25 mA) HART → 2 mA MAXIMUM VALUE 0–20 mA → 22 mA 4–20 mA → 22 mA 4–20 mA HART → 22 mA 4–20 mA NAMUR → 22.6 mA 4–20 mA HART NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 4–20 mA HART US → 22.6 mA 0–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) HART → 25 mA HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	MIN/MAX VALUE → FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	*FALLBACK VALUE* Signal output → 0 Hz *FAILSAFE LEVEL* Output of the frequency specified in the FALÌLSAFE VALUE function. *HOLD VALUE* Measured value display on the basis of the last saved value preceding occurrence of the fault. *ACTUAL VALUE* Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"

Failsafe mode of outputs and totalizers		
	Process/system error is current	**Positive zero return is activated**
Totalizer	*STOP* The totalizers are paused until the error is rectified. *ACTUAL VALUE* The fault is ignored. The totalizer continues to count in accordance with the current flow value. *HOLD VALUE* The totalizer continues to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Status output	In the event of a fault or power supply failure: Status output → non-conductive	No effect on status output

9.6 Spare parts

Detailed troubleshooting instructions are provided in the previous sections → 📄 81
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 → 📄 6

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

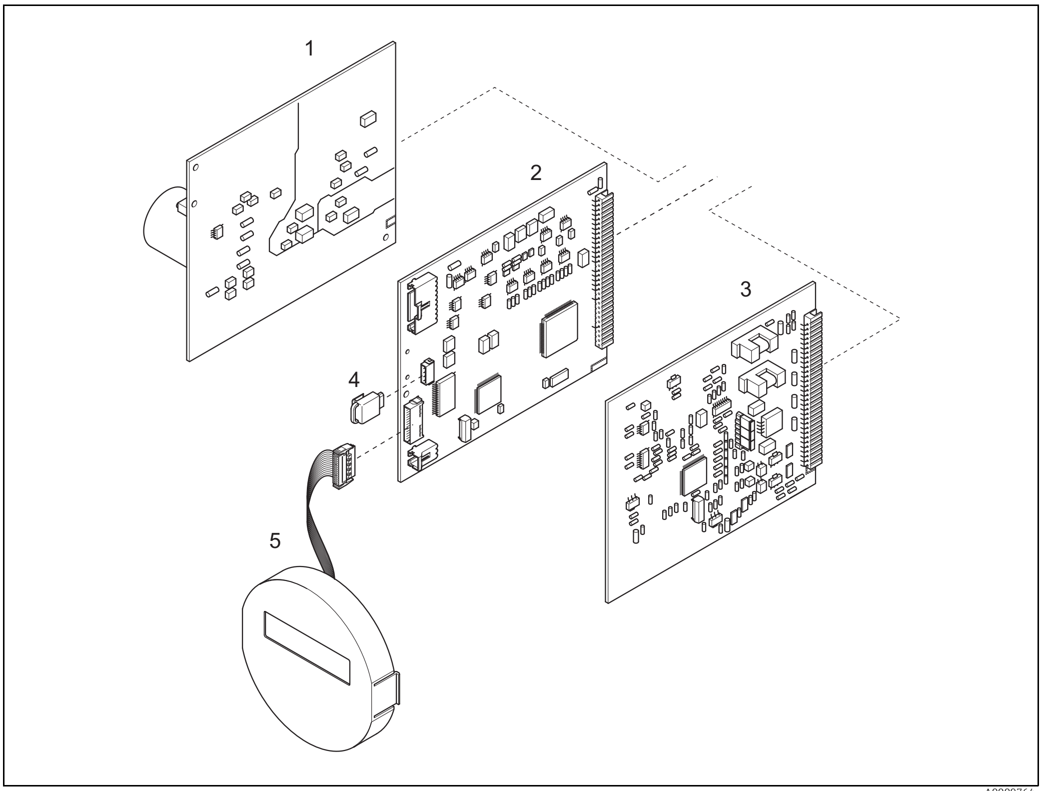


Fig. 53: Spare parts for Promag 50 transmitter (field and wall-mounted housings)

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)
4 HistoROM / S-DAT (sensor data memory)
5 Display module

9.6.1 Removing and installing printed circuit boards

Field housing: removing and installing printed circuit boards → 54

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.

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. 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.
4. Remove the screws and remove the cover (2) from the electronics compartment.
5. Remove the boards (4, 6): Insert a suitable tool into the hole (3) provided for the purpose and pull the board clear of its holder.
6. Remove amplifier board (5):
   – Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
   – Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

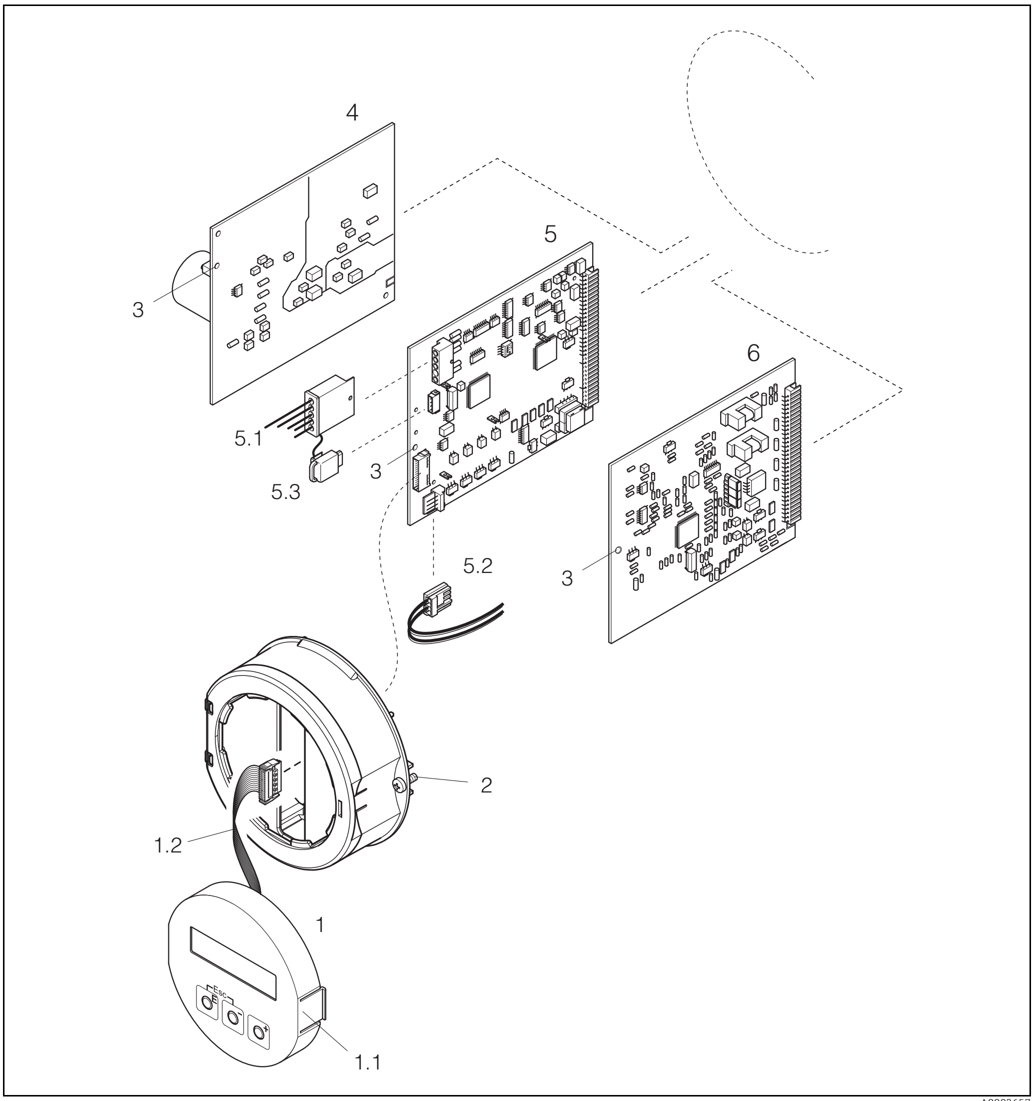


Fig. 54: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws of electronics compartment cover
3 Aperture for installing/removing boards
4 Power supply board
5 Amplifier board
5.1 Electrode signal cable (sensor)
5.2 Coil current cable (sensor)
5.3 Histo-ROM / S-DAT (sensor data memory)
6 I/O board

Wall-mount housing: removing and installing printed circuit boards → 55

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.

1. Switch off power supply.
2. Remove the screws and open the hinged cover (1) of the housing. Remove screws of the electronics module (2).
3. Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
4. Disconnect the following cable plugs from amplifier board (7):
   – Electrode signal cable plug (7.1) including S-DAT (7.3).
   – Plug of coil current cable (7.2). To do so, loosen the plug locking of the coil current cable and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Ribbon cable plug (3) of the display module.
5. Remove the screws and remove the cover (4) from the electronics compartment.
6. Remove the boards (6, 7, 8): Insert a suitable tool into the hole (5) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

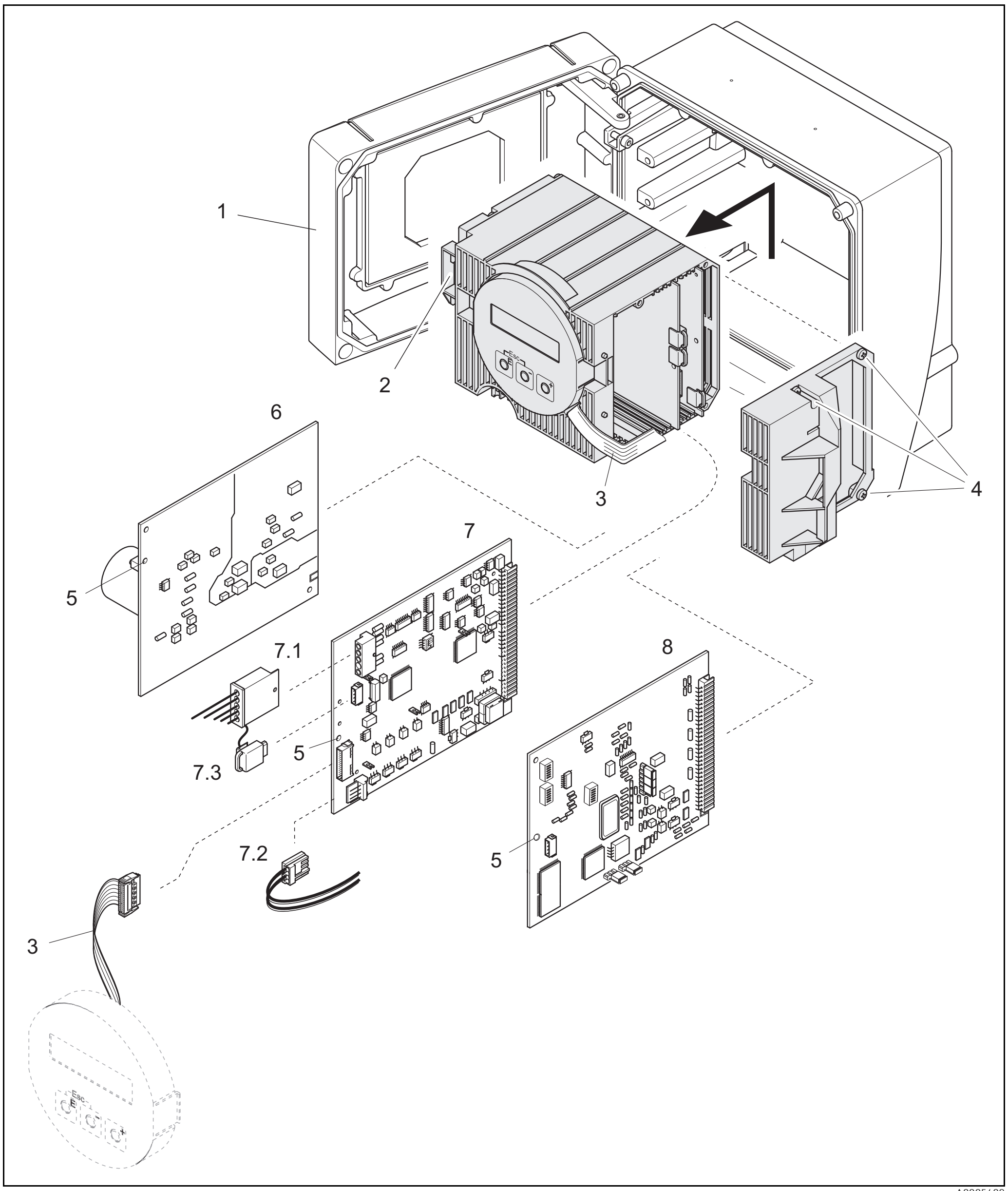


Fig. 55: Wall-mount housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Cover of electronics compartment (3 screws)
5 Aperture for installing/removing boards
6 Power supply board
7 Amplifier board
7.1 Electrode signal cable (sensor)
7.2 Coil current cable (sensor)
7.3 Histo-ROM / S-DAT (sensor data memory)
8 I/O board

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 (→ 56).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power supply board: field housing → 89, wall-mount housing → 91
3. Remove cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – Power supply 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 × 20 mm
   – Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 × 20 mm
   – Ex-rated devices → see the Ex documentation.
4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

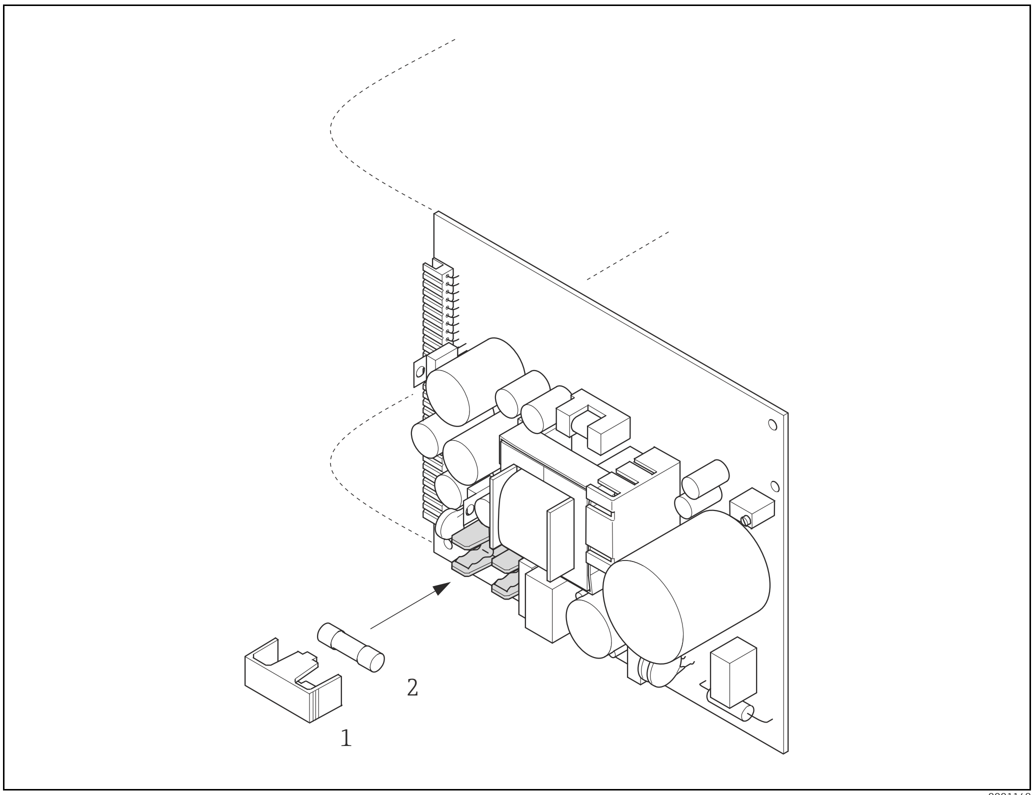


Fig. 56: Replacing the device fuse on the power supply board

1 Protective cap
2 Device fuse

9.6.3 Replacing the exchangeable electrode

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

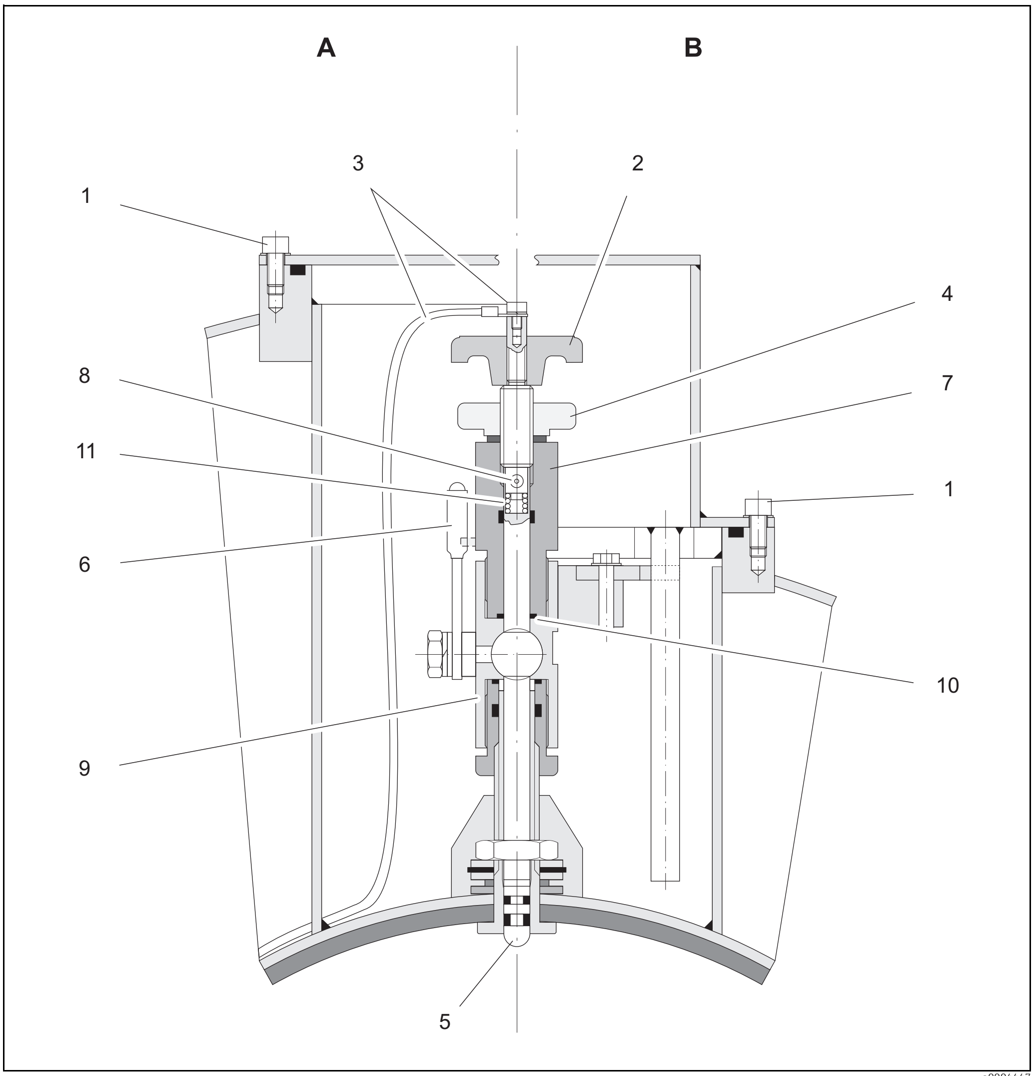


Fig. 57: Apparatus for replacing exchangeable measuring electrodes

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

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

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

Removing the electrode	Installing the electrode
1 Loosen Allen screw (1) and remove the cover.	1 Insert new electrode (5) into retaining cylinder (7) from below. Make sure that the seals at the tip of the electrode are clean.
2 Remove electrode cable (3) secured to handle (2).	2 Mount handle (2) on the electrode and insert locking pin (8) to secure it in position. Caution! Make sure that coil spring (11) is inserted. This is essential to ensure correct electrical contact and correct measuring signals.
3 Loosen knurled nut (4) by hand. This knurled nut acts as a locknut.	3 Pull the electrode back until the tip of the electrode no longer protrudes from retaining cylinder (7).
4 Remove electrode (5) by turning handle (2). The electrode can now be pulled out of retaining cylinder (7) as far as a defined stop. Warning! Risk of injury. Under process conditions (pressure in the piping system) the electrode can recoil suddenly against its stop. Apply counter-pressure while releasing the electrode.	4 Screw the retaining cylinder (7) onto ball-valve housing (9) and tighten it by hand. Seal (10) on the cylinder must be correctly seated and clean. Note! Make sure that the rubber hoses on retaining cylinder (7) and stop cock (6) are of the same color (red or blue).
5 Close stop cock (6) after pulling out the electrode as far as it will go. Warning! Do not subsequently open the stop cock, in order to prevent fluid escaping.	5 Open stop cock (6) and turn handle (2) to screw the electrode all the way into the retaining cylinder.
6 Remove the electrode complete with retaining cylinder (7).	6 Screw knurled nut (4) onto the retaining cylinder. This firmly locates the electrode in position.
7 Remove handle (2) from electrode (5) by pressing out locking pin (8). Take care not to lose coil spring (11).	7 Use the Allen screw to secure electrode cable (3) to handle (2). Caution! Make sure that the machine screw securing the electrode cable is firmly tightened. This is essential to ensure correct electrical contact and correct measuring signals.
8 Remove the old electrode and insert the new electrode. Replacement electrodes can be ordered separately from Endress+Hauser.	8 Reinstall the cover and tighten Allen 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
01.2011	Amplifier: V 2.04.XX	Introduction of new nominal diameters; calf values to 2.5	71249447 / 15.14
11.2009	Amplifier: V 2.03.XX	Introduction of Calf history	71106181 / 12.09 71105332 / 11.09
06.2009	Amplifier: V 2.02.XX	Introduction of Promag L	71095684 / 06.09
03.2009	Amplifier: V 2.02.XX	Introduction of Promag D Introduction of new nominal diameter	71088677 / 03.09
11.2004	Amplifier: 1.06.01 Communication module: 1.04.00	Software update relevant only for production	50097089 / 10.03
10.2003	Amplifier: 1.06.00 Communication module: 1.03.00	Software expASMEon: ▪ Language groups ▪ Flow direction pulse output selectable New functionalities: ▪ Second Totalizer ▪ Adjustable backlight (display) ▪ Operation hours counter ▪ Simulation function for pulse output ▪ Counter for access code ▪ Reset function (fault history) ▪ Up-/download with FieldTool	50097089 / 10.03

Date	Software version	Changes to software	Operating Instructions
08.2003	Communication module: 1.02.01	Software expASMEon: ▪ New / revised functionalities New functionalities: ▪ Current span NAMUR NE 43 ▪ Failsafe mode function ▪ Troubleshooting function ▪ System and process error messages ▪ Response of status output	50097089 / 08.03
08.2002	Amplifier: 1.04.00	Software expASMEon: ▪ New / revised functionalities New functionalities: ▪ Current span NAMUR NE 43 ▪ EPD (new mode) ▪ Failsafe mode function ▪ Acknowledge fault function ▪ Troubleshooting function ▪ System and process error messages ▪ Response of status output	50097089 / 08.02
03.2002	Amplifier: 1.03.00	Software expASMEon: ▪ Suitability for custody transfer measurement Promag 50/51	none
06.2001	Amplifier: 1.02.00 Communication module: 1.02.00	Software expASMEon: ▪ New functionalities: New functionalities: ▪ General device functions ▪ "OED" software function ▪ "Pulse width" software function	50097089 / 06.01
09.2000	Amplifier: 1.01.01 Communication module: 1.01.00	Software expASMEon: ▪ Functional adaptations	none
08.2000	Amplifier: 1.01.00	Software expASMEon: ▪ Functional adaptations	none
04.2000	Amplifier: 1.00.00 Communication module: 1.00.00	Original software Compatible with: ▪ FieldTool ▪ Commuwin II (version 2.05.03 and higher) ▪ HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD1	50097089 / 04.00

✎ Note!
Uploads or downloads between the individual software versions are only possible with a special service software.

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

→ 📄 4

10.1.2 Function and system design

Measuring principle

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

Measuring system

→ 📄 6

10.1.3 Input

Measured variable

Flow velocity (proportional to induced voltage)

Measuring range

Typically v = 0.01 to 10 m/s (0.033 to 33 ft/s) with the specified accuracy

Operable flow range

Over 1000 : 1

Input signal

Status input (auxiliary input)

- Galvanically isolated
- U = 3 to 30 V DC
- Ri = 5 kΩ
- Can be configured for: totalizer reset, positive zero return, error message reset.

10.1.4 Output

Output signal

Current output

- Galvanically isolated
- Active/passive can be selected:
  - Active: 0/4 to 20 mA, R_L < 700 Ω (HART: $R_L \geq 250$ Ω)
  - Passive: 4 to 20 mA, supply voltage V_S 18 to 30 V DC, $R_i \geq 150$ Ω)
- Time constant can be selected (0.01 to 100s)
- Full scale value adjustable
- Temperature coefficient: typ. 0.005% o.f.s./°C, resolution: 0.5 µA

o.f.s. = of full scale value

Pulse/frequency output

- Galvanically isolated
- Passive: 30 V DC / 250 mA
- Open collector
- Can be configured as:
  - Pulse output
    Pulse value and pulse polarity can be selected, max. pulse width adjustable (0.5 to 2000 ms)
  - Frequency output
    Full scale frequency 2 to 1000 Hz (f_{max} = 1.25 Hz), on/off ratio 1:1, pulse width max. 10 s

Signal on alarm

Current output

Failsafe mode can be selected (e.g. in accordance with NAMUR Recommendation NE 43)

Pulse/frequency output

Failsafe mode can be selected

Status output

"Not conductive" in the event of fault or power supply failure

Load

See "Output signal"

Switching output

Status output

- Galvanically isolated
- Max. 30 V DC/250 mA
- Open collector
- Can be configured for: error messages, empty pipe detection (EPD), flow direction, limit values

Low flow cut off

Low flow cut off, switch-on point can be selected as required

Galvanic isolation

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

10.1.5 Power supply

Electrical connections

→ 🗎 46

Supply voltage (power supply)

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

Cable entry

Power supply and signal cables (inputs/outputs):

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

Connecting cable for remote version:

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

Cable specifications

→ 📄 51

Power consumption

Power consumption

- AC: <15 VA (incl. sensor)
- DC: <15 W (incl. sensor)

Switch-on current

- max. 3 A (<5 ms) for 24 V DC
- max. 8.5 A (<5 ms) for 260 V AC

Power supply failure

- Lasting min. 1 cycle frequency:
- EEPROM saves measuring system data
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)

Potential equalization

→ 📄 55

10.1.6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:

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

Installation:

- Inlet run >10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

Maximum measured error

- Current output: plus typically ± 5 μA
- Pulse output: ± 0.5% o.r. ± 1 mm/s
  Option: ± 0.2% o.r. ± 2 mm/s (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.

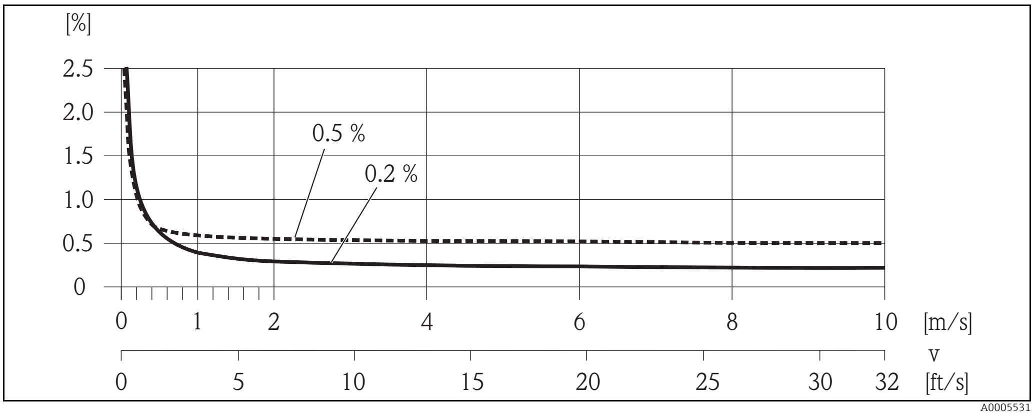


Fig. 58: Max. measured error in % of reading

Repeatability

Max. ± 0.1% o.r. ± 0.5 mm/s (o.r. = of reading)

10.1.7 Installation

Installation instructions

Any orientation (vertical, horizontal), restrictions and installation instructions → 🖹 12

Inlet and outlet run

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications (→ 🖹 15, → 🖻 12):

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

Adapters

→ 🖹 16

Length of connecting cable

→ 🖹 19

10.1.8 Environment

Ambient temperature range

- Transmitter: –20 to +60 °C (–4 to +140 °F)

  ✎ Note!
  At ambient temperatures below –20 (–4 °F) the readability of the display may be impaired.

- Sensor (Flange material carbon steel): –10 to +60 °C (+14 to +140 °F)

Caution!
- The permitted temperature range of the measuring tube lining may not be undershot or overshot (→ "Operating conditions: Process" → "Medium temperature range").
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

Degree of protection

- Standard: IP 67 (NEMA 4X) for transmitter and sensor
- Optional: IP 68 (NEMA 6P) for remote version of Promag E/L/P/W sensor. Promag L only with stainless steel flanges.

Shock and vibration resistance

Acceleration up to 2 g following IEC 60068-2-6
(high-temperature version: no data available)

CIP cleaning

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

CIP cleaning is possible:
Promag E (100 °C / 212 °F), Promag H/P

CIP cleaning is not possible:
Promag D/L/W

SIP cleaning

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

SIP cleaning is possible:
Promag H

SIP cleaning is not possible:
Promag D/E/L/P/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 Process

Medium temperature range

The permissible temperature depends on the lining of the measuring tube

Promag D

0 to +60 °C (+32 to +140 °F) for polyamide

Promag E

–10 to +110 °C (+14 to +230 °F) for PTFE,
Restrictions → see the following diagram

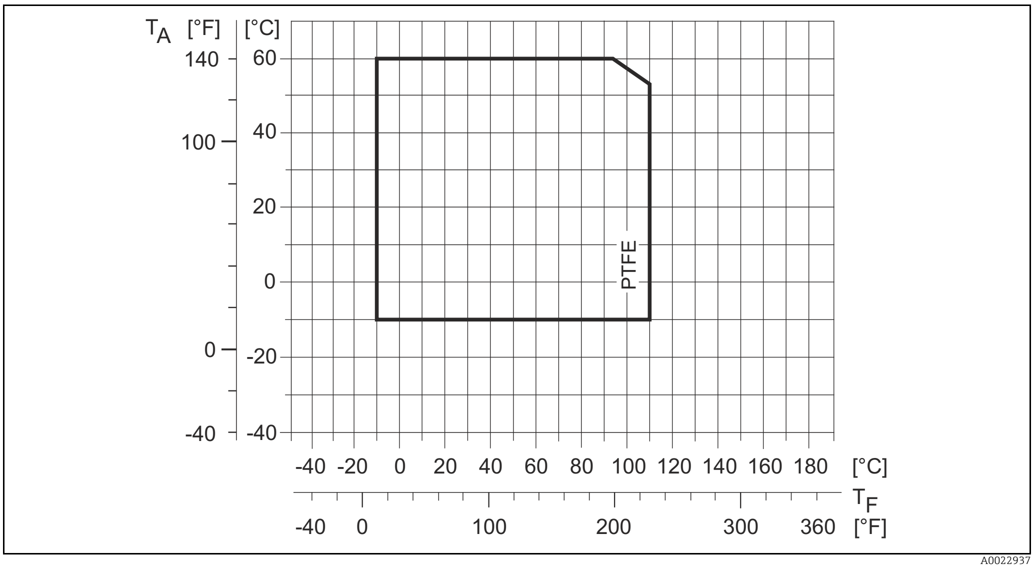


Fig. 59: Compact and remote version Promag E (TA = ambient temperature; TF = fluid temperature)

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)

Promag L

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 350 to 1200)
- –20 to +50 °C (–4 to +122 °F) for polyurethane (DN 50 to 1200)
- –20 to +90 °C (–4 to +194 °F) for PTFE (DN 50 to 300)

Promag P

Standard
- –40 to +130 °C (–40 to +266 °F) for PTFE (DN 15 to 600 / 1/2 to 24"),
  Restrictions → see the following diagrams
- –20 to +130 °C (–4 to +266 °F) for PFA/HE (DN 25 to 200 / 1 to 8"),
  Restrictions → see the following diagrams
- –20 to +150 °C (–4 to +302 °F) for PFA (DN 25 to 200 / 1 to 8"),
  Restrictions → see the following diagrams

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

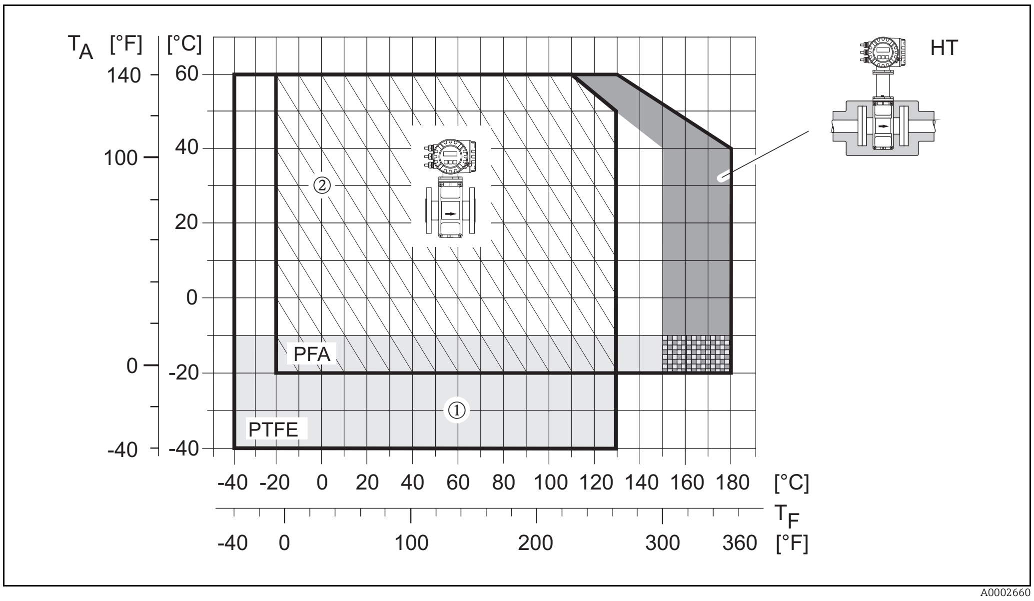


Abb. 60: Compact version Promag P (with PFA- or PTFE-lining)

TA = ambient temperature; TF = fluid temperature; HT = high-temperature version with insulation
m = light gray area → temperature range from –10 to –40 °C (–14 to –40 °F) is valid for stainless steel version only
n = diagonal hatched area → foam lining (HE) and degree of protection IP 68 = fluid temperature max. 130°C / 266 °F

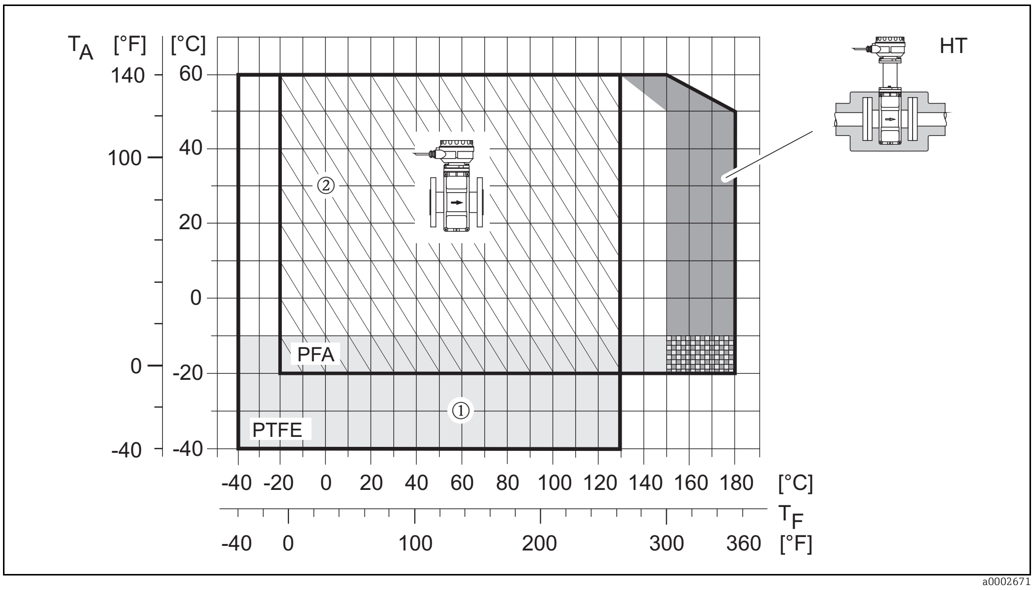


Abb. 61: Remote version Promag P (with PFA- or PTFE-lining)

TA = ambient temperature; TF = fluid temperature; HT = high-temperature version with insulation
m = light gray area → temperature range from –10 to –40 °C (–14 to –40 °F) is valid for stainless steel version only
n = diagonal hatched area → foam lining (HE) and degree of protection IP68 = fluid temperature max. 130°C / 266 °F

Promag W

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 50 to 2000)
- –20 to +50 °C (–4 to +122 °F) for polyurethane (DN 25 to 1200)

Conductivity

The minimum conductivity is ≥ 5 μS/cm (≥ 20 μS/cm for demineralized water)

Note!
Note that in the case of the remote version, the requisite minimum conductivity is also influenced by the length of the connecting cable → 19

Medium pressure range (nominal pressure)

Promag D

- EN 1092-1 (DIN 2501)
  - PN 16
- ASME B 16.5
  - Class 150
- JIS B2220
  - 10K

Promag E

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 40 (DN 15 to 150 / ½ to 2")
- ASME B 16.5
  - Class 150 (½ to 24")
- JIS B2220
  - 10K (DN 50 to 300 / 2 to 12")
  - 20K (DN 15 to 40 / ½ to 1½")

Promag H

The permissible 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

Promag L

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 1200 / 14 to 48")
  - PN 10 (DN 50 to 1200 / 2 to 48")
  - PN 16 (DN 50 to 150 / 2 to 6")
- EN 1092-1, lap joint flange, stampel plate
  - PN 10 (DN 50 to 300 / 2 to 12")
- ASME B 16.5
  - Class 150 (2 to 24")
- AWWA
  - Class D (28 to 48")
- AS2129
  - Table E (DN 350 to 1200 / 14 to 48")
- AS4087
  - PN 16 (DN 350 to 1200 / 14 to 48")

Promag P

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 25 (DN 200 to 600 / 8 to 24")
  - PN 40 (DN 25 to 150 / 1 to 6")

- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- JIS B2220
  - 10K (DN 50 to 300 / 2 to 12")
  - 20K (DN 25 to 300 / 1 to 12")
- AS 2129
  - Table E (DN 25 / 1"), 50 / 2")
- AS 4087
  - PN 16 (DN 50 / 2")

Promag W

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 2000 / 14 to 84")
  - PN 10 (DN 200 to 2000 / 8 to 84")
  - PN 16 (DN 65 to 2000 / 3 to 84")
  - PN 25 (DN 200 to 1000 / 8 to 40")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- AWWA
  - Class D (28 to 78")
- JIS B2220
  - 10K (DN 50 to 300 / 2 to 12")
  - 20K (DN 25 to 300 / 1 to 12")
- AS 2129
  - Table E (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")
- AS 4087
  - PN 16 (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")

Pressure tightness

Promag D

Measuring tube: 0 mbar abs (0 psi abs) with a fluid temperature of ≤ 60 °C (140 °F)

Promag E (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures							
		25 °C		80 °C		100 °C		110 °C	
		77 °F		176 °F		212 °F		230 °F	
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]
15	½"	0	0	0	0	0	0	100	1.45
25	1"	0	0	0	0	0	0	100	1.45
32	–	0	0	0	0	0	0	100	1.45
40	1 ½"	0	0	0	0	0	0	100	1.45
50	2"	0	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

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures							
		25 °C		80 °C		100 °C		110 °C	
		77 °F		176 °F		212 °F		230 °F	
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]
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)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures					
		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	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

Promag L (Measuring tube lining: Polyurethane, Hard rubber)

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures		
			25 °C	50 °C	80 °C
[mm]	[inch]		77 °F	122 °F	176 °F
50 to 1200	2 to 48"	Polyurethane	0	0	–
350 to 1200	14 to 48"	Hard rubber	0	0	0

Promag L (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures			
		25 °C		90 °C	
		77 °F		194 °F	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]
50	2"	0	0	0	0
65	–	0	0	40	0.58
80	3"	0	0	40	0.58
100	4"	0	0	135	1.96
125	–	135	1.96	240	3.48
150	6"	135	1.96	240	3.48
200	8"	200	2.90	290	4.21
250	10"	330	4.79	400	5.80
300	12"	400	5.80	500	7.25

Promag P (Measuring tube lining: PFA)

Promag P Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures					
		25 °C	80° C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	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)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures									
		25 °C		80 °C		100 °C		130 °C		150 °C	180 °C
		77 °F		176 °F		212 °F		266 °F		302 °F	356 °F
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]		
25	1"	0	0	0	0	0	0	100	1.45	–	–
32	–	0	0	0	0	0	0	100	1.45	–	–
40	1 ½"	0	0	0	0	0	0	100	1.45	–	–
50	2"	0	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 W

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures						
			25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]		77 °F	122 °F	176 °F	212 °F	266 °F	302 °F	356 °F
25 to 1200	1 to 40"	Polyurethane	0	0	–	–	–	–	–
50 to 2000	2 to 78"	Hard rubber	0	0	0	–	–	–	–

Limiting flow

→ 17

Pressure loss

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

10.1.10 Mechanical construction

Design, 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 → 124.

Weight (SI units)

Promag D

Weight data in kg				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transmitter
25	1"	4.5	2.5	6.0
40	1 ½"	5.1	3.1	6.0
50	2"	5.9	3.9	6.0
65	2 ½"	6.7	4.7	6.0
80	3"	7.7	5.7	6.0
100	4"	10.4	8.4	6.0
Transmitter Promag (compact version): 3.4 kg (Weight data valid without packaging material)				

Promag E

Weight data in kg							
Nominal diameter		Compact version					
		EN (DIN)				ASME	JIS
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K
15	½"	–	–	–	6.5	6.5	6.5
25	1"	–	–	–	7.3	7.3	7.3
32	–	–	–	–	8.0	–	7.3
40	1½"	–	–	–	9.4	9.4	8.3
50	2"	–	–	–	10.6	10.6	9.3
65	–	–	–	12.0	–	–	11.1
80	3"	–	–	14.0	–	14.0	12.5
100	4"	–	–	16.0	–	16.0	14.7
125	–	–	–	21.5	–	–	21.0
150	6"	–	–	25.5	–	25.5	24.5
200	8"	–	45.0	46.0	–	45.0	41.9
250	10"	–	65.0	70.0	–	75.0	69.4
300	12"	–	70.0	81.0	–	110.0	72.3
350	14"	77.4	88.4	99.4	–	137.4	–
400	16"	89.4	104.4	120.4	–	168.4	–
450	18"	99.4	112.4	133.4	–	191.4	–
500	20"	114.4	132.4	182.4	–	228.4	–
600	24"	155.4	162.4	260.4	–	302.4	–

- Transmitter (compact version): 1.8 kg
- Weight data without packaging material

Weight data in kg								
Nominal diameter		Remote version (without cable)						
		Sensor						Transmitter
		EN (DIN)				ASME	JIS	
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K	Wall-mount housing
15	½"	–	–	–	4.5	4.5	4.5	6.0
25	1"	–	–	–	5.3	5.3	5.3	
32	–	–	–	–	6.0	–	5.3	
40	1½"	–	–	–	7.4	7.4	6.3	
50	2"	–	–	–	8.6	8.6	7.3	
65	–	–	–	10.0	–	–	9.1	
80	3"	–	–	12.0	–	12.0	10.5	
100	4"	–	–	14.0	–	14.0	12.7	
125	–	–	–	19.5	–	–	19.0	
150	6"	–	–	23.5	–	23.5	22.5	
200	8"	–	43.0	44.0	–	43.0	39.9	
250	10"	–	63.0	68.0	–	73.0	67.4	
300	12"	–	68.0	79.0	–	108.0	70.3	
350	14"	73.1	84.1	95.1	–	133.1		
400	16"	85.1	100.1	116.1	–	164.1		
450	18"	95.1	108.1	129.1	–	187.1		
500	20"	110.1	128.1	178.1	–	224.1		
600	24"	158.1	158.1	256.1	–	298.1		

- Transmitter (remote version): 3.1 kg
- Weight data without packaging material

Promag H

Weight data in kg				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Sensor	Transmitter
2	1/12"	5.2	2	6.0
4	5/32"	5.2	2	6.0
8	5/16"	5.3	2	6.0
15	½"	5.4	1.9	6.0
25	1"	5.5	2.8	6.0
40	1 ½"	6.5	4.5	6.0
50	2"	9.0	7.0	6.0
65	2 ½"	9.5	7.5	6.0
80	3"	19.0	17.0	6.0
100	4"	18.5	16.5	6.0
Transmitter Promag (compact version): 3.4 kg (Weight data valid for standard pressure ratings and without packaging material)				

Promag L compact version (lap joint flanges / welded flanges DN > 350)

<table>
<tr><th colspan="10">Weight data in kg</th></tr>
<tr><th colspan="2">Nominal diameter</th><th colspan="8">Compact version
(including transmitter)</th></tr>
<tr><th>[mm]</th><th>[inch]</th><th colspan="2">EN (DIN)</th><th colspan="2">EN (DIN)</th><th colspan="2">ASME / AWWA</th><th colspan="2">AS</th></tr>
<tr><td>50</td><td>2"</td><td rowspan="6">PN 16</td><td>10.6</td><td rowspan="22">PN 6</td><td>–</td><td rowspan="15">ASME / Class 150</td><td>10.6</td><td rowspan="22">PN 16. Tabelle E</td><td>–</td></tr>
<tr><td>65</td><td>2 ½"</td><td>12.0</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>80</td><td>3"</td><td>14.0</td><td>–</td><td>14.0</td><td>–</td></tr>
<tr><td>100</td><td>4"</td><td>16.0</td><td>–</td><td>16.0</td><td>–</td></tr>
<tr><td>125</td><td>5"</td><td>21.5</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>150</td><td>6"</td><td>25.5</td><td>–</td><td>25.5</td><td>–</td></tr>
<tr><td>200</td><td>8"</td><td rowspan="16">PN 10</td><td>45</td><td>–</td><td>45</td><td>–</td></tr>
<tr><td>250</td><td>10"</td><td>65</td><td>–</td><td>65</td><td>–</td></tr>
<tr><td>300</td><td>12"</td><td>70</td><td>–</td><td>70</td><td>–</td></tr>
<tr><td>350</td><td>14"</td><td>90</td><td>79</td><td>139</td><td>101</td></tr>
<tr><td>375</td><td>15"</td><td>–</td><td>–</td><td>–</td><td>107</td></tr>
<tr><td>400</td><td>16"</td><td>106</td><td>91</td><td>170</td><td>122</td></tr>
<tr><td>450</td><td>18"</td><td>114</td><td>101</td><td>193</td><td>135/145*</td></tr>
<tr><td>500</td><td>20"</td><td>134</td><td>116</td><td>230</td><td>184</td></tr>
<tr><td>600</td><td>24"</td><td>157</td><td>157</td><td>304</td><td>262</td></tr>
<tr><td>700</td><td>28"</td><td>248</td><td>200</td><td rowspan="7">AWWA / Class D</td><td>277</td><td>354</td></tr>
<tr><td>750</td><td>30"</td><td>–</td><td>–</td><td>329</td><td>441</td></tr>
<tr><td>800</td><td>32"</td><td>322</td><td>248</td><td>396</td><td>501</td></tr>
<tr><td>900</td><td>36"</td><td>402</td><td>316</td><td>482</td><td>698</td></tr>
<tr><td>1000</td><td>40"</td><td>475</td><td>366</td><td>601</td><td>769</td></tr>
<tr><td></td><td>42"</td><td>–</td><td>–</td><td>684</td><td>–</td></tr>
<tr><td>1200</td><td>48"</td><td>724</td><td>537</td><td>914</td><td>1227</td></tr>
<tr><td colspan="10">Transmitter Promag (compact version): 3,4 kg
(Weight data valid without packaging material)
* DN 450 AS Tab E</td></tr>
</table>

Promag L remote version (lap joint flanges / welded flanges DN > 350)

Weight data in kg									
Nominal diameter		Remote version (sensor plus sensor housing without cable)							
[mm]	[inch]	EN (DIN)		EN (DIN)		ASME / AWWA		AS	
50	2"	PN 16	8.6	PN 6	–	ASME / Class 150	8.6	PN 16, Tabelle E	–
65	2 ½"		10.0		–		–		–
80	3"		12.0		–		12.0		–
100	4"		14.0		–		14.0		–
125	5"		19.5		–		–		–
150	6"		23.5		–		23.5		–
200	8"	PN 10	43		–		43		–
250	10"		63		–		63		–
300	12"		68		–		108		–
350	14"		87		76		136		98
375	15"		–		–		–		104
400	16"		103		88		167		119
450	18"		111		98		190		132/142*
500	20"		131		113		227		181
600	24"		154		154		301		259
700	28"		–		198	AWWA / Class D	275		352
750	30"		–		–		327		439
800	32"		320		246		394		499
900	36"		400		314		480		696
1000	40"		473		364		599		767
	42"		–		–		682		–
1200	48"		722		535		912		1225

Transmitter Promag (remote version): 6 kg
(Weight data valid without packaging material)
*DN 450 AS Tab E

Promag L (lap joint flanges, stamped plate)

Weight data in kg						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]	EN (DIN)		Sensor EN (DIN)		Transmitter
50	2"	PN 10	7.2	PN 10	5.2	6.0
65	2 ½"		8.0		6.0	6.0
80	3"		9.0		7.0	6.0
100	4"		11.5		9.5	6.0
125	5"		15.0		13.0	6.0
150	6"		19.0		17.0	6.0
200	8"		37.5		35.5	6.0
250	10"		56.0		54.0	6.0
300	12"		57.0		55.0	6.0

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

Promag P

Weight data in kg														
Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Trans-mitter
[mm]	[inch]	EN (DIN) / AS*		JIS		ASME/ AWWA		EN (DIN) / AS*		JIS		ASME/ AWWA		
15	½"	PN 40	6.5	10K	6.5	Class 150	6.5	PN 40	4.5	10K	4.5	Class 150	4.5	6.0
25	1"		7.3		7.3		7.3		5.3		5.3		5.3	6.0
32	1 ¼"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 ½"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 ½"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		14.4		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		16.0		21.0		–		19.5		19.0		–	6.0
150	6"		21.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0

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

Promag W

Weight data in kg														
Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Trans- mitter
[mm]	[inch]	EN (DIN) / AS*		JIS		ASME/ AWWA		EN (DIN) / AS*		JIS		ASME/ AWWA		
25	1"	PN 40	7.3	10K	7.3	Class 150	7.3	PN 40	5.3	10K	5.3	Class 150	5.3	6.0
32	1 ¼"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 ½"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 ½"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		16.0		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		21.5		21.0		–		19.5		19.0		–	6.0
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		65		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0
700	28"		355			Class D	400		353			Class D	398	6.0
–	30"		–				460		–				458	6.0
800	32"		435				550		433				548	6.0
900	36"		575				800		573				798	6.0
1000	40"		700				900		698				898	6.0
–	42"	PN 6	–				1100	PN 6	–				1098	6.0
1200	48"		850				1400		848				1398	6.0
–	54"		–				2200		–				2198	6.0
1400	–		1300				–		1298				–	6.0
–	60"		–				2700		–				2698	6.0
1600	–		1700				–		1698				–	6.0
–	66"		–				3700		–				3698	6.0
1800	72"		2200				4100		2198				4098	6.0
–	78"		–				4600		–				4598	6.0
2000	–		2800				–		2798				–	6.0
Transmitter Promag (compact version): 3.4 kg (Weight data valid for standard pressure ratings and without packaging material) *Flanges according to AS are only available for DN 80, 100, 150 to 400, 500 and 600														

Weight (US units)

Promag D

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transmitter
25	1"	10	6	13
40	1 ½"	11	7	13
50	2"	13	9	13
80	3"	17	13	13
100	4"	23	19	13
Transmitter Promag (compact version): 7.5 lbs (Weight data valid without packaging material)				

Promag E (ASME)

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
			Sensor	Transmitter
		ASME	ASME	
[mm]	[inch]	Class 150	Class 150	Wall-mount housing
15	½"	14.3	9.92	13.2
25	1"	16.1	11.7	
40	1½"	20.7	16.3	
50	2"	23.4	19.0	
80	3"	30.9	26.5	
100	4"	35.3	30.9	
150	6"	56.2	51.8	
200	8"	99.2	94.8	
250	10"	165.4	161.0	
300	12"	242.6	238.1	
350	14"	303.0	293.5	
400	16"	371.3	361.8	
450	18"	422.0	412.6	
500	20"	503.6	494.1	
600	24"	666.8	657.3	

- Transmitter: 4.0 lbs (compact version); 6.8 lbs (remote version)
- Weight data without packaging material

Promag H

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transmitter
2	1/12"	11	4	13
4	5/32"	11	4	13
8	5/16"	12	4	13
15	½"	12	4	13
25	1"	12	6	13
40	1 ½"	14	10	13
50	2"	20	15	13
65	2 ½"	21	17	13
80	3"	42	37	13
100	4"	41	36	13
Transmitter Promag (compact version): 7.5 lbs (Weight data valid for standard pressure ratings and without packaging material)				

Promag L (ASME / AWWA: lap joint flanges / welded flanges DN > 700)

Weight data in lbs					
Nominal diameter		Compact version		Remote version (without cable)	
[mm]	[inch]	ASME / AWWA		ASME / AWWA	
50	2"	ASME / Class 150	23	ASME / Class 150	19
65	2 ½"		–		–
80	3"		31		26
100	4"		35		31
125	5"		–		–
150	6"		56		52
200	8"		99		95
250	10"		143		139
300	12"		243		238
350	14"		–		–
400	16"		–		–
450	18"		–		–
500	20"		–		–
600	24"		–		–
700	28"	AWWA / Class D	611	AWWA / Class D	606
750	30"		725		721
800	32"		873		869
900	36"		1063		1058
1000	40"		1324		1320
	42"		1508		1504
1200	48"		2015		2011
Transmitter Promag (compact version): 7,5 lbs Transmitter Promag (remote version): 13 lbs (Weight data valid without packaging material)					

Promag P (ASME/AWWA)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]				Sensor	Transmitter
15	½"	Class 150	14	Class 150	10	13
25	1"		16		12	13
40	1 ½"		21		16	13
50	2"		23		19	13
80	3"		31		26	13
100	4"		35		31	13
150	6"		56		52	13
200	8"		99		95	13
250	10"		165		161	13
300	12"		243		238	13
350	14"		386		381	13
400	16"		452		448	13
450	18"		562		558	13
500	20"		628		624	13
600	24"		893		889	13
Transmitter Promag (compact version): 7.5 lbs High-temperature version: 3.3 lbs (Weight data valid for standard pressure ratings and without packaging material)						

Promag W (ASME/AWWA)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]			Sensor		Transmitter
25	1"	Class 150	16	Class 150	12	13
40	1 ½"		21		16	13
50	2"		23		19	13
80	3"		31		26	13
100	4"		35		31	13
150	6"		56		52	13
200	8"		99		95	13
250	10"		143		161	13
300	12"		243		238	13
350	14"		386		381	13
400	16"		452		448	13
450	18"		562		558	13
500	20"		628		624	13
600	24"		893		889	13
700	28"	Class D	882	Class D	878	13
–	30"		1014		1010	13
800	32"		1213		1208	13
900	36"		1764		1760	13
1000	40"		1985		1980	13
–	42"		2426		2421	13
1200	48"		3087		3083	13
–	54"		4851		4847	13
–	60"		5954		5949	13
–	66"		8159		8154	13
1800	72"		9041		9036	13
–	78"		10143		10139	13
Transmitter Promag (compact version): 7.5 lbs (Weight data valid for standard pressure ratings and without packaging material)						

Material

Promag D

- Transmitter housing: powder-coated die-cast aluminum
- Sensor housing: powder-coated die-cast aluminum
- Measuring tube: polyamide, O-rings EPDM
  (Drinking water approvals: WRAS BS 6920, ACS, NSF 61, KTW/W270)
- Electrodes: 1.4435 (316, 316L)
- Ground disks: 1.4301 (304)

Promag E

- Transmitter housing
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 600 (14 to 24"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L) (with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304L) (with protective lacquering)
- Electrodes: 1.4435 (316, 316L), Alloy C22, Tantalum
- Flanges (with protective lacquering)
  - EN 1092-1 (DIN2501): RSt37-2 (S235JRG2); Alloy C22; Fe 410W B
  - ANSI: A105
  - JIS: RSt37-2 (S235JRG2); HII
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag H

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum or stainless steel field housing (1.4301 (316L))
  - Wall-mounted housing: powder-coated die-cast aluminum
  - Window material: glas or polycarbonate
- Sensor housing: stainless steel 1.4301 (304)
- Wall mounting kit: stainless steel 1.4301 (304)
- Measuring tube: stainless steel 1.4301 (304)
- Liner: PFA (USP class VI; FDA 21 CFR 177.1550: 3A)
- Electrodes:
  - Standard: 1.4435 (316, 316L)
  - Option: Alloy C22, Tantalum, Platinum
- Flange:
  - All connections stainless-steel 1.4404 (316L)
  - EN (DIN), ASME, JIS made of PVDF
  - Adhesive fitting made of PVC
- Seals
  - DN 2 to 25 (1/12 to 1"): O-ring (EPDM, Viton, Kalrez), gasket seal (EPDM*, Viton, Silicone*)
  - DN 40 to 100 (1½ to 4"): gasket seal (EPDM*, Silicone*)
    * = USP class VI; FDA 21 CFR 177.2600: 3A
- Ground rings: 1.4435 (316, 316L) (optional: Tantalum, Alloy C22)

Promag L

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 50 to 300 (2 to 12"): powder-coated die-cast aluminum
  - DN 350 to 1200 (14 to 84"): with protective lacquering

- Measuring tube:
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L)
  - DN ≥ 350 (14"): stainless steel 202 or 304
- Electrodes: 1.4435 (316, 316L), Alloy C22
- Flange
  - EN 1092-1 (DIN 2501): DN ≤ 300: 1.4306; 1.4307; 1.4301 (304); 1.0038 (S235JRG2)
  - EN 1092-1 (DIN 2501): DN ≥ 350: A105; 1.0038 (S235JRG2)
  - AWWA: A181/A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
  - AS 2129: A105; 1.0345 (P235GH); 1.0425 (316L) (P265GH); 1.0038 (S235JRG2); FE 410 WB
  - AS 4087: A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag P

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 15 to 300 (½ to 12"): powder-coated die-cast aluminum
  - DN 350 to 2000 (14 to 84"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L); for flanges made of carbon steel with Al/Zn protective coating
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304L); for flanges made of carbon steel with Al/Zn protective coating
- Electrodes: 1.4435 (316, 316L), Platinum, Alloy C22, Tantalum, Titanium
- Flange
  - EN 1092-1 (DIN2501): 1.4571 (316L); RSt37-2 (S235JRG2); Alloy C22; FE 410W B (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ASME: A105; F316L
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AWWA: 1.0425
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425 (316L)
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129
    - DN 25 (1"): A105 or RSt37-2 (S235JRG2)
    - DN 40 (1½"): A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag W

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 2000 (14 to 84"): with protective lacquering

- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L)
    (for flanges made of carbon steel with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304)
    (for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435 (316, 316L) or Alloy C22, Tantalum
- Flange
  - EN 1092-1 (DIN2501): 1.4571 (316L); RSt37-2 (S235JRG2); Alloy C22; FE 410 WB
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ASME: A105; F316L
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AWWA: 1.0425
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425 (316L)
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129
    - DN 150 to 300 (6 to 12"), DN 600 (24"): A105 or RSt37-2 (S235JRG2)
    - DN 80 to 100 (3 to 4"), 350 to 500 (14 to 20"): A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L), Alloy C22, Titanium, Tantalum

Pressure-temperature ratings

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the "Technical Information" documents of the device in question:
List of supplementary documentation → 📄 124.

Fitted electrodes

Promag D

- 2 measuring electrodes for signal detection

Promag E/L/P/W

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

Promag H

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection (apart from DN 2 to 15)

Process connections

Promag D

Wafer version → without process connections

Promag E

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 (12") = form A
  - DN ≥ 350 (14") = flat face
  - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1
- ASME
- JIS

Promag H

With O-ring:
- Weld nipple DIN (EN), ISO 1127, ODT/SMS
- Flange EN (DIN), ASME, JIS
- Flange made of PVDF EN (DIN), ASME, JIS
- External thread
- Internal thread
- Hose connection
- PVC adhesive fitting

With gasket seal:
- Weld nipple DIN 11850, ODT/SMS
- Clamp ISO 2852, DIN 32676, L14 AM7
- Threaded joint DIN 11851, DIN 11864-1, ISO 2853, SMS 1145
- Flange DIN 11864-2

Promag L

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 = Form A
  - DN ≥ 350 = Form B
- ASME
- AWWA
- AS

Promag P/W

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 = form A
  - DN ≥ 350 = flat face
  - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1
- ASME
- AWWA (only Promag W)
- JIS
- AS

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, two-line, 16 characters per line
- Custom configurations for presenting different measured-value and status variables
- 2 totalizers

✎ Note!
At ambient temperatures below –20 (–4 °F) the readability of the display may be impaired.

Operating elements

- Local operation with three keys (⊟ ⊞ Ⓔ)
- "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/Scandinavia (EES):
  English, Russian, Polish, Norwegian, Finnish, Swedish and Czech
- Southeast Asia (SEA):
  English, Japanese, Indonesian

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

Remote operation

Operation via HART protocol and Fieldtool

10.1.12 Certificates and approvals

CE mark

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

C-tick mark

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex approval

Information about currently available Ex versions (ATEX, FM, CSA, 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

Promag D/E/L/P/W

No applicable approvals or certification

Promag H

- 3A authorization and EHEDG-tested
- Seals: in conformity with FDA (except Kalrez seals)

Drinking water approval

Promag D/L/W

- WRAS BS 6920
- ACS
- NSF 61
- KTW/W270

Promag E/H/P

No drinking water approval

Pressure Equipment Directive

Promag D/L

No pressure measuring device approval

Promag E/H/P/W

The devices can be ordered with or without a PED approval. If a device with a PED approval is required, this must be explicitly stated in the order. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary.

- With the PED/G1/x (x = category) marking on the sensor nameplate, Endress+Hauser confirms compliance with the "Essential Safety Requirements" specified in Annex I of the Pressure Equipment Directive 97/23/EC.
- Devices bearing this marking (PED) are suitable for the following types of medium: Media in Group 1 and 2 with a vapor pressure greater than, or smaller and equal to 0.5 bar (7.3 psi)
- Devices not bearing this marking (PED) are designed and manufactured according to good engineering practice. They meet the requirements of Art.3 Section 3 of the Pressure Equipment Directive 97/23/EC. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive.

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code).
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  Electromagnetic compatibility (EMC requirements)
- ASME/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.

10.1.13 Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

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

10.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor → 78.
Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

10.1.15 Documentation

- Flow measuring technology (FA00005D/06)
- Technical Information Promag 50D (TI00082D/06)
- Technical Information Promag 50E (TI01161D/06)
- Technical Information Promag 50L (TI00097D/06)
- Technical Information Promag 50/53H (TI00048D/06)
- Technical Information Promag 50/53P (TI00047D/06)
- Technical Information Promag 50/53W (TI00046D/06)
- Description of Device Functions Promag 50 HART (BA00049D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

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www.addresses.endress.com

Endress+Hauser

People for Process Automation

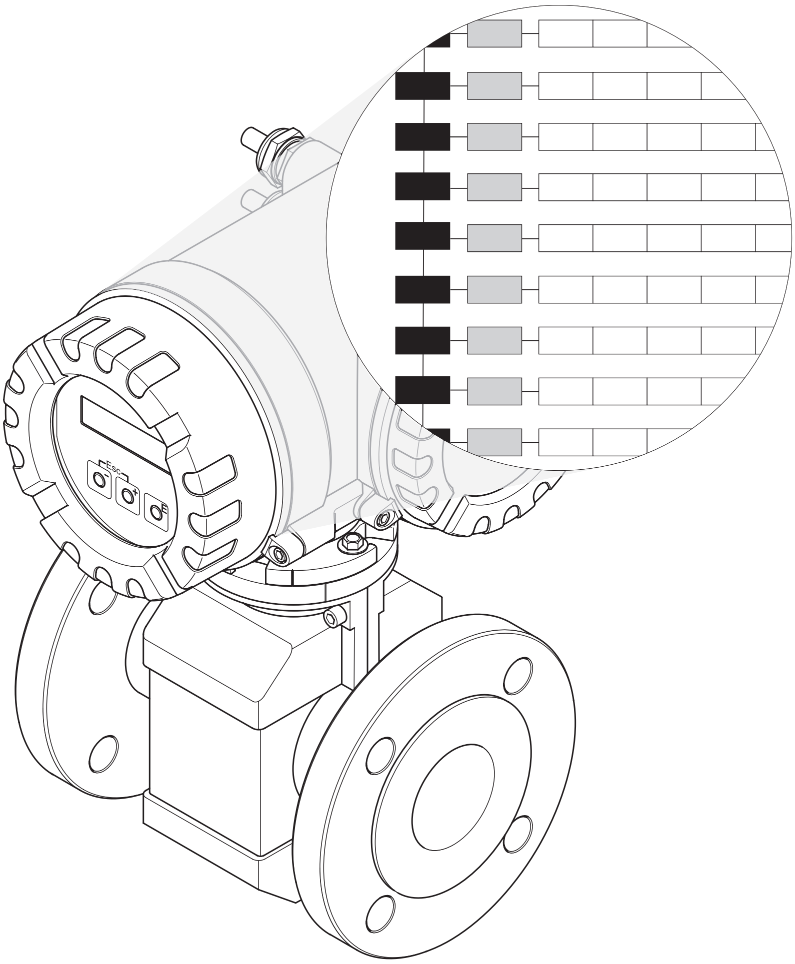
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Description of Device Functions

Proline Promag 50

Electromagnetic Flow Measuring System

HART
FIELD COMMUNICATION PROTOCOL



BA049D/06/en/11.09
71105948
Valid as of version:
V 2.03.XX (Device software)

Endress+Hauser
People for Process Automation

Contents

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HistoROM™, S-DAT®, FieldCare®
Registered trademarks of Endress+Hauser Flowtec AG, Reinach, CH

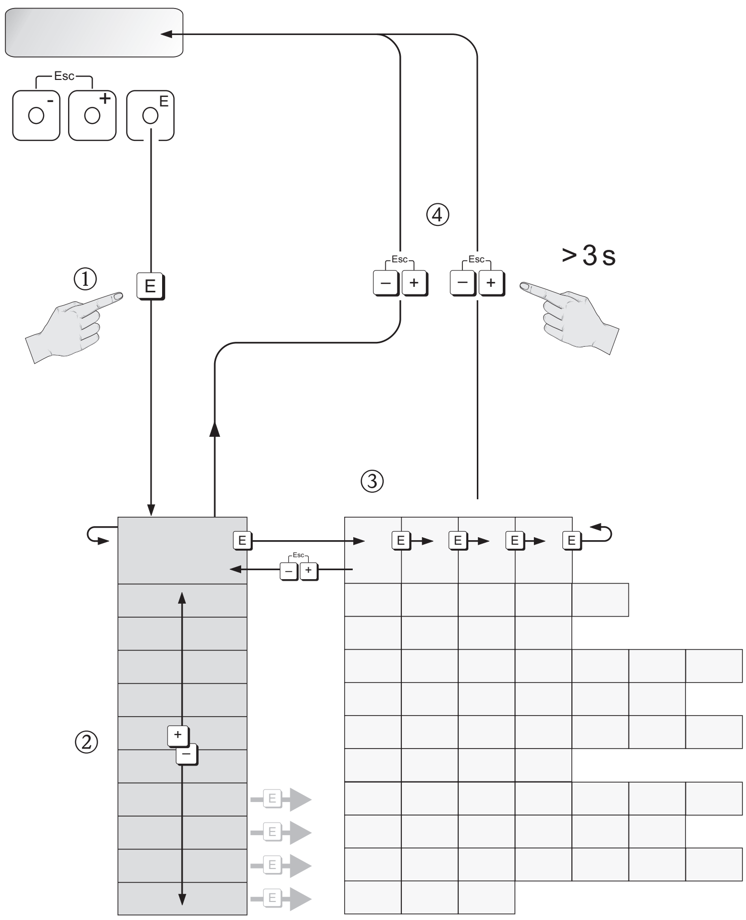
1 Function matrix Promag 50

1.1 The function matrix: layout and use

The function matrix is a two-level construct: the groups form one level and the groups' functions the other.
The groups are the highest-level grouping of the operating options for the measuring device.
A number of functions is assigned to each group.
You select a group in order to access the individual functions for operating and parameterizing the measuring device.
An overview of all the groups available is provided in the table of contents on Page 3 and in the graphical representation of the function matrix on Page 6.
An overview of all the functions available is provided on Page 6, complete with page references to the detailed function descriptions.
The descriptions of the individual functions start on Page 7.

Example of how to parameterize a function (in this case changing the language for the UI):

1. Enter into the function matrix (E-key).
2. Select the OPERATION group.
3. Select the LANGUAGE function, change the setting from ENGLISH to DEUTSCH with +- and save with E (all text on the display now appears in German).
4. Exit the function matrix (ESC > 3 seconds).



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1.2 Illustration of the function matrix

Function groups	Functions →									
MEASURING VALUES (P. 7)	VOLUME FLOW (P. 7)									
SYSTEM UNITS (P. 8)	UNIT VOL. FLOW (P. 8)	UNIT VOLUME (P. 8)	UNIT LENGTH (P. 9)	FORMAT DATE/TIME (P. 9)						
QUICK SETUP (P. 10)	QUICK SETUP COMMISSION (P. 10)									
OPERATION (P. 11)	LANGUAGE (P. 11)	ACCESS CODE (P. 12)	PRIVATE CODE (P. 12)	STATUS ACCESS (P. 12)	ACCESS CODE COUNTER (P. 12)					
USER INTERFACE (P. 13)	ASSIGN LINE 1 (P. 13)	ASSIGN LINE 2 (P. 13)	100% VALUE (P. 13)	FORMAT (P. 14)	DISPL. DAMPING (P. 14)	CONTRAST LCD (P. 14)	BACKLIGHT (P. 15)	DISPLAY TEST (P. 15)		
TOTALIZER 1/2 (P. 16)	ASSIGN TOTALIZER (P. 16)	SUM (P. 16)	OVERFLOW (P. 16)	UNIT TOTALIZER (P. 16)	TOTALIZER MODE (P. 17)	RESET TOTALIZ. (P. 17)				
HANDLING TOTALIZ. (P. 18)	RESET ALL TOTAL. (P. 18)	FAILSAFE MODE (P. 18)								
CURRENT OUTPUT (P. 19)	ASSIGN CURRENT OUTP. (P. 19)	CURRENT SPAN (P. 20)	VALUE 20 mA (P. 21)	TIME CONSTANT (P. 21)	FAILSAFE MODE (P. 21)	ACTUAL CURRENT (P. 21)	SIMUL. CURRENT (P. 22)	VALUE SIM. CURRENT (P. 22)		
PULSE/FREQ. OUTP. (P. 23)	OPERATION MODE (P. 23)	ASSIGN FREQ. (P. 23)	END VALUE FREQ. (P. 23)	VALUE-f HIGH (P. 24)	OUTPUT SIGNAL (P. 25)	TIME CONSTANT (P. 27)	FAILSAFE MODE (P. 27)	FAILSAFE VALUE (P. 27)	ACTUAL FREQ. (P. 27)	SIMUL. FREQ. (P. 28)
	VALUE SIM. FREQ. (P. 28)	ASSIGN PULSE (P. 28)	PULSE VALUE (P. 29)	PULSE WIDTH (P. 29)	OUTPUT SIGNAL (P. 30)	FAILSAFE MODE (P. 32)	SIMULATION PULSE (P. 32)	VALUE SIM. PULSE (P. 33)		
STATUS OUTPUT (P. 34)	ASSIGN STATUS (P. 34)	ON-VALUE (P. 34)	OFF-VALUE (P. 35)	TIME CONSTANT (P. 35)	ACTUAL STATUS (P. 35)	SIM. SWITCH POINT (P. 35)	VAL. SIM. SWIT. PT. (P. 36)			
STATUS INPUT (P. 40)	ASSIGN STATUS (P. 40)	ACTIVE LEVEL (P. 40)	MIN. PULSE WIDTH (P. 40)	SIM. STATUS INP. (P. 40)	VALUE SIM. STATUS (P. 41)					
COMMUNICATION (P. 42)	TAG NAME (P. 42)	TAG DESCR. (P. 42)	BUS ADDRESS (P. 42)	HART PROTOCOL (P. 42)	MANUFACT. ID (P. 42)	DEVICE ID (P. 42)	DEVICE REVISION (P. 42)			
PROCESS PARAM. (P. 43)	ASSIGN LF CUT OFF (P. 43)	ON-VALUE (P. 43)	OFF-VALUE (P. 43)	EMPTY PIPE DET. (P. 44)	EPD/OED ADJ. (P. 46)	EPD/OED RES.TIME (P. 47)	ECC (P. 47)	ECC DURATION (P. 47)	ECC RECOVERY TIME (P. 48)	ECC CLEAN. CYCL. (P. 48)
SYSTEM PARAM. (P. 49)	INSTALL. DIRECT. (P. 49)	MEASURING MODE (P. 49)	POS. ZERO RETURN (P. 50)	SYSTEM DAMPING (P. 51)	INTEGRAT. TIME (P. 51)					
SENSOR DATA (P. 52)	CALIBRATION DATE (P. 52)	K-FACTOR (P. 52)	ZERO POINT (P. 52)	NOM. DIAMETER (P. 52)	MEAS. PERIOD (P. 53)	OVERVLTG TIME (P. 53)	EPD ELECTRODE (P. 53)	POLARITY ECC (P. 53)		
SUPERVISION (P. 54)	CURR. SYS. COND. (P. 54)	PREV. SYS. COND. (P. 54)	ASSIGN SYS. ERR. (P. 54)	ERROR CATEG. (P. 54)	ASSIGN PROC. ERR. (P. 54)	ERROR CATEG. (P. 55)	ALARM DELAY (P. 55)	SYSTEM RESET (P. 55)	OPERAT. HRS. (P. 55)	
SIMULAT. SYSTEM (P. 56)	SIM. FAILS. MODE (P. 56)	SIM. MEAS. VARIAB. (P. 56)	VAL.SIM.MEAS.VAR. (P. 56)							
SENSOR VERSION (P. 57)	SERIAL NUMBER (P. 57)	SENSOR TYPE (P. 57)	HW REV. SENS. (P. 57)	SW REV. NO. S-DAT (P. 57)						
AMPLIFIER VERS. (P. 57)	DEVICE SOFTWARE (P. 57)	SW REV. AMPL. (P. 57)	LANGUAGE GROUP (P. 57)	I/O MODULE TYPE (P. 57)	SW REV. I/O MOD. (P. 57)					

2 Group MEASURING VALUES

Function description MEASURING VALUES	
✎ Note! ▪ The engineering unit of the measured variable displayed here can be set in the SYSTEM UNITS group, (see Page 8). ▪ If the fluid in the pipe flows backwards, a negative sign prefixes the flow reading on the display.	
VOLUME FLOW	The volume flow currently measured appears on the display. **User interface:** 5-digit floating-point number, including unit and sign (e.g. 5.5445 dm^3/min; 1.4359 m^3/h; –731.63 gal/d; etc.)

3 Group SYSTEM UNITS

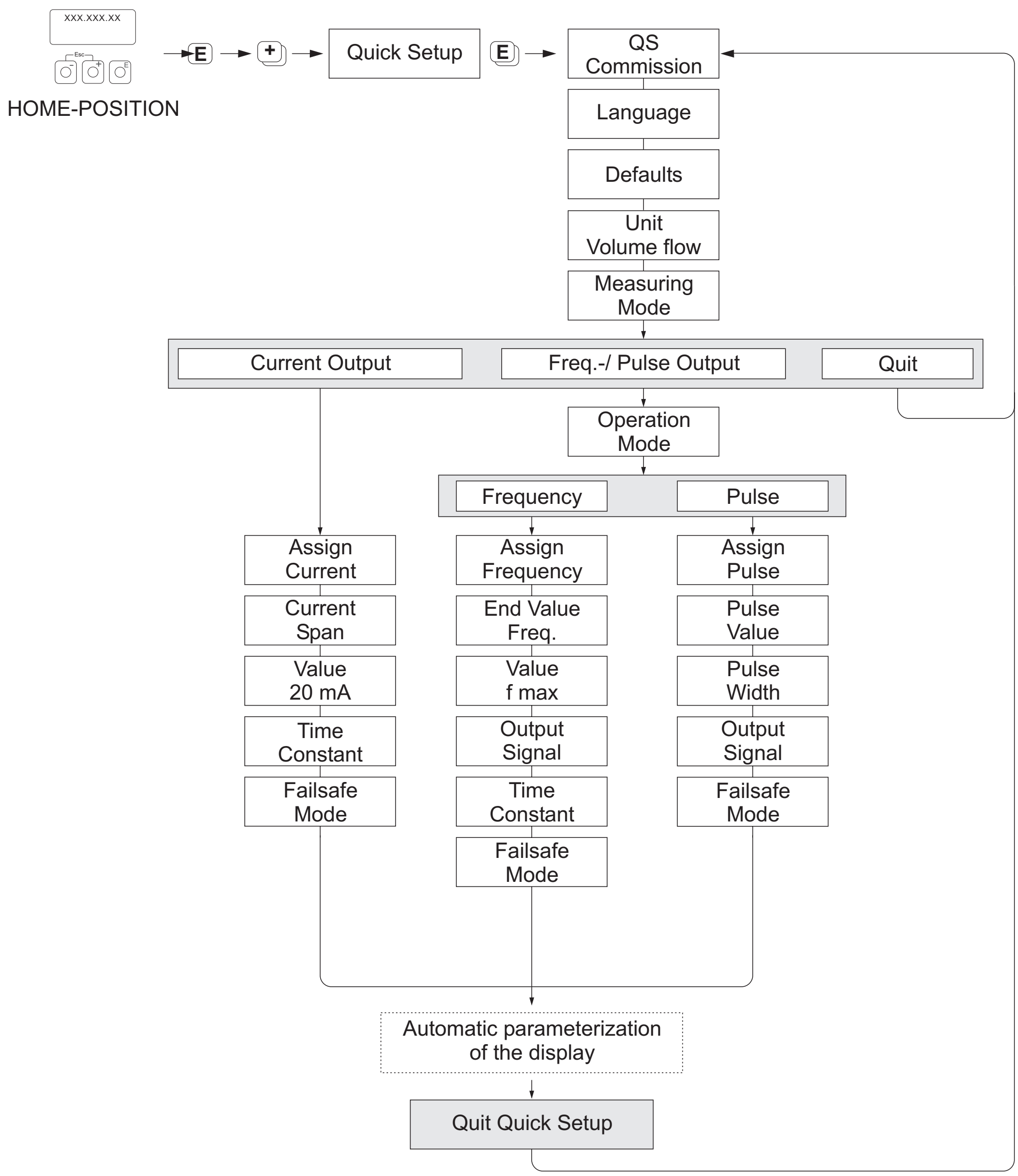
Function description SYSTEM UNITS	
Use this function group to select the unit for the measured variable.	
UNIT VOLUME FLOW	Use this function to select the unit for displaying the volume flow. The unit you select here is also valid for: ▪ Current output ▪ Frequency output ▪ Switch points (limit value for volume flow, flow direction) ▪ Low flow **Options:** Metric: Cubic centimeter → cm^3/s; cm^3/min; cm^3/h; cm^3/day Cubic decimeter → dm^3/s; dm^3/min; dm^3/h; dm^3/day Cubic meter → m^3/s; m^3/min; m^3/h; m^3/day Milliliter → ml/s; ml/min; ml/h; ml/day Liter → l/s; l/min; l/h; l/day Hectoliter → hl/s; hl/min; hl/h; hl/day Megaliter → Ml/s; Ml/min; Ml/h; Ml/day US: Cubic centimeter → cc/s; cc/min; cc/h; cc/day Acre foot → af/s; af/min; af/h; af/day Cubic foot → ft^3/s; ft^3/min; ft^3/h; ft^3/day Fluid ounce → oz f/s; oz f/min; oz f/h; oz f/day Gallon → gal/s; gal/min; gal/h; gal/day Kilo gallon → Kgal/s; Kgal/min; Kgal/h; Kgal/day Million gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (normal fluids: 31.5 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (beer: 31.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 42.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (filling tanks: 55.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Imperial: Gallon → gal/s; gal/min; gal/h; gal/day Mega gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (beer: 36.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 34.97 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).
UNIT VOLUME	Use this function to select the unit for displaying the volume. The unit you select here is also valid for: ▪ Pulse weighting (e.g. m^3/p) **Options:** Metric → cm^3; dm^3; m^3; ml; l; hl; Ml Mega US → cc; af; ft^3; oz f; gal; Kgal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals) → bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! The unit of the totalizers is independent of your choice here. The unit for each totalizer is selected separately for the totalizer in question.

Function description SYSTEM UNITS	
UNIT LENGTH	Use this function to select the unit for displaying the length of the nominal diameter. The unit you select here is also valid for: ▪ Nominal diameter of sensor (see function NOMINAL DIAMETER on Page 48) **Options:** MILLIMETER INCH **Factory setting:** MILLIMETER (SI units: not for USA and Canada) INCH (US units: only for USA and Canada)
FORMAT DATE/TIME	Use this function to select the format for the date and the time. The unit you select here is also valid for: Displaying the current calibration date (function CALIBRATION DATE on Seite 52) **Options:** DD.MM.YY 24H MM/DD/YY 12H A/P DD.MM.YY 12H A/P MM/DD/YY 24H **Factory setting:** DD.MM.YY 24H (SI units) MM/DD/YY 12H A/P (US units)

4 Group QUICK SETUP

Function description QUICK SETUP	
QUICK SETUP COMMISSION	Use this function to start the Quick Setup menu for commissioning. **Options:** YES NO **Factory setting:** NO

Note!
The display returns to the QUICK SETUP COMMISSION cell if you press the ESC key combination during interrogation.



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5 Group OPERATION

Function description OPERATION	
LANGUAGE	Use this function to select the language for all texts, parameters and messages shown on the local display. ✎ Note! The displayed options depend on the available language group shown in the LANGUAGE GROUP function. **Options:** Language group WEST EU / USA: ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO NEDERLANDS PORTUGUESE Language group EAST EU / SCAND: ENGLISH NORSK SVENSKA SUOMI POLISH RUSSIAN CZECH Language group ASIA: ENGLISH BAHASA INDONESIA JAPANESE (Silbenschrift) **Factory setting:** Country-dependent (see Page 58 ff.) ✎ Note! ▪ If you press the +- keys simultaneously at startup, the language defaults to "ENGLISH". ▪ You can change the language group via the configuration program FieldCare. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

Function description OPERATION	
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the + − keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can enable programming by entering your personal code, (**factory setting = 50**, see function PRIVATE CODE on Page 12) **User input:** max. 4-digit number: 0...9999 ✎ Note! ▪ The programming levels are disabled if you do not press a key within 60 seconds following automatic return to the HOME position. ▪ You can also disable programming in this function by entering any number (other than the defined private code). ▪ The Endress+Hauser service organization can be of assistance if you mislay your personal code.
PRIVATE CODE	Use this function to enter a personal code number for enabling programming. **User input:** 0...9999 (max. 4-digit number) **Factory setting:** 50 ✎ Note! ▪ Programming is always enabled with the code "0". ▪ Programming has to be enabled before this code can be changed. When programming is disabled this function is not available, thus preventing others from accessing your personal code.
STATUS ACCESS	Use this function to check the access status for the function matrix. **User interface:** ACCESS CUSTOMER (parameterization possible) LOCKED (parameterization disabled)
ACCESS CODE COUNTER	Displays how often the customer code, service code or the digit "0" (code-free) has been entered to gain access to the function matrix. **Display:** max. 7-digit number: 0...9999999 **Factory setting:** 0

6 Group USER INTERFACE

Function description USER INTERFACE	
ASSIGN LINE 1	Use this function to define which display value is assigned to the main line (top line of the local display) for display during normal measuring operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % TOTALIZER 1 TOTALIZER 2 **Factory setting:** VOLUME FLOW
ASSIGN LINE 2	Use this function to define which display value is assigned to the additional line (bottom line of the local display) for display during normal measuring operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % VOLUME FLOW BARGRAPH IN % TOTALIZER 1 TAG NAME OPERATING/SYSTEM CONDITION FLOW DIRECTION TOTALIZER 2 **Factory setting:** TOTALIZER 1
100% VALUE	✎ Note! This function is only available if VOLUME FLOW IN % or VOLUME FLOW BARGRAPH IN % was selected in the function ASSIGN LINE 1 or ASSIGN LINE 2. Use this function to define the flow value to be shown on the display as the 100% value. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).

Function description USER INTERFACE	
FORMAT	Use this function to define the maximum number of places after the decimal point displayed for the reading in the main line. **Options:** XXXXX. – XXXX.X – XXX.XX – XX.XXX – X.XXXX **Factory setting:** X.XXXX ✎ Note! ▪ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ▪ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In such instances an arrow appears on the display between the measuring value and the engineering unit (e.g. 1.2 → l/h), indicating that the measuring system is computing with more decimal places than can be shown on the display.
DISPLAY DAMPING	Use this function to enter a time constant defining how the display reacts to severely fluctuating flow variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** 0...100 seconds **Factory setting:** 3 s ✎ Note! Setting the time constant to zero seconds switches off damping.
CONTRAST LCD	Use this function to optimize display contrast to suit local operating conditions. **User input:** 10...100% **Factory setting:** 50%

Function description USER INTERFACE	
BACKLIGHT	Use this function to optimize the backlight to suit local operating conditions. **User input:** 0...100% ✎ Note! Entering the value "0" means that the backlight is "switched off". The display then no longer emits any light, i.e. the display texts can no longer be read in the dark. **Factory setting:** 50%
DISPLAY TEST	Use this function to test the operability of the local display and its pixels. **Options:** OFF ON **Factory setting:** OFF Test sequence: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for at least 0.75 seconds. 3. The main line and additional line show an "8" in each field for at least 0.75 seconds. 4. The main line and additional line show a "0" in each field for at least 0.75 seconds. 5. The main line and additional line show nothing (blank display) for at least 0.75 seconds. When the test completes the local display returns to its initial state and the setting changes to OFF.

7 Group TOTALIZER 1/2

Function description TOTALIZER 1/2	
ASSIGN TOTALIZER	Use this function to assign a measured variable (volume flow) to the totalizer. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! The totalizer is reset to "0" as soon as the selection is changed.
SUM	Use this function to view the total for the totalizer measured variable aggregated since measuring commenced. The value can be positive or negative. **User interface:** max. 7-digit floating-point number, including sign and unit (e.g. 896,845.7 dm^3) ✎ Note! The totalizer response to faults is defined in the FAILSAFE MODE function (see Page 18).
OVERFLOW	Use this function to view the overflow for the totalizer aggregated since measuring commenced. Total flow quantity is represented by a floating decimal point number consisting of max. 7 digits. You can use this function to view higher numerical values (>9 999 999) as overflows. The effective quantity is thus the total of OVERFLOW plus the value returned by the SUM function. Example: Reading for 2 overflows: 2 E7 kg (= 2 000 000 dm^3) The value returned by the SUM function = 896,845.7 dm^3 Effective total quantity = 2,896,845.7 dm^3 **Display shows:** Integer with exponent, including sign and unit, e.g. 2 E7 dm^3
UNIT TOTALIZER	Use this function to define the unit for the totalizer. **Options:** Metric → cm^3; dm^3; m^3; ml; l; hl; Ml Mega US → cc; af; ft^3; oz f; gal; Kgal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals); bbl (filling tanks) Imperial → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.).

Function description TOTALIZER 1/2	
TOTALIZER MODE	Use this function to define how the flow components are to be totalised. **Options:** BALANCE Positive and negative flow components. The positive and negative flow components are balanced. In other words, net flow in the flow direction is registered. FORWARD Positive flow components only REVERSE Negative flow components only **Factory setting:** Totalizer 1 = BALANCE Totalizer 2 = FORWARD
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to "zero" (= RESET). **Options:** NO YES **Factory setting:** NO ✎ Note! If the device is equipped with a status input and if it is appropriately configured, totalizer resetting can also be triggered by a pulse.

8 Group HANDLING TOTALIZER

Function description HANDLING TOTALIZER	
RESET ALL TOTALIZERS	Use this function to reset the totals (including all overflows) of the totalizers (1...2) to "zero". **Options:** NO YES **Factory setting:** NO ✎ Note! If the device has a status input and if it is appropriately configured, a reset for the totalizer (1...2) can also be triggered by a pulse (see the ASSIGN STATUS INPUT function on Page 31).
FAILSAFE MODE	Use this function to define the totalizer response in case of fault. **Options:** STOP The totalizer is paused until the fault is rectified. ACTUAL VALUE The totalizer continues to count on the basis of the current flow measuring value. The fault is ignored. HOLD VALUE The totalizer continues to count the flow that is based on the last valid flow measuring value (before the fault occurred). **Factory setting:** STOP

9 Group CURRENT OUTPUT

Function description CURRENT OUTPUT	
ASSIGN CURRENT OUT-PUT	Use this function to assign a measured variable to the current output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! If you select OFF, the only function shown in this group is the function (ASSIGN CURRENT OUTPUT).

Function description CURRENT OUTPUT

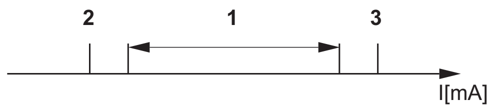
CURRENT SPAN

Use this function to define the current span. The selection specifies the operational range and the lower and upper signal on alarm. For the current output the option HART can be defined additionally.

Options:
0–20 mA
4–20 mA
4–20 mA HART
4–20 mA NAMUR
4–20 mA HART NAMUR
4–20 mA US
4–20 mA HART US
0–20 mA (25 mA)
4–20 mA (25 mA)
4–20 mA (25 mA) HART

Factory setting:
4–20 mA HART NAMUR

Current span, operational range and signal on alarm level



a	1	2	3
0-20 mA	0 - 20.5 mA	0	22
4-20 mA	4 - 20.5 mA	2	22
4-20 mA HART	4 - 20.5 mA	2	22
4-20 mA NAMUR	3.8 - 20.5 mA	3.5	22.6
4-20 mA HART NAMUR	3.8 - 20.5 mA	3.5	22.6
4-20 mA US	3.9 - 20.8 mA	3.75	22.6
4-20 mA HART US	3.9 - 20.8 mA	3.75	22.6
0-20 mA (25 mA)	0 - 24 mA	0	25
4-20 mA (25 mA)	4 - 24 mA	2	25
4-20 mA (25 mA) HART	4 - 24 mA	2	25

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a = Current span
1 = Operational range (measuring information)
2 = Lower signal on alarm level
3 = Upper signal on alarm level

✎ Note!

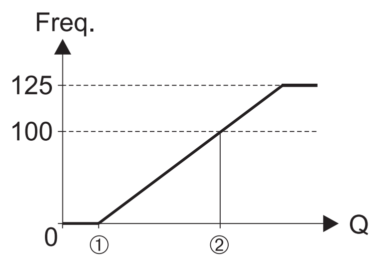
- When switching the hardware from an active (factory setting) to a passive output signal select a current span of 4–20 mA.
- If the measured value exceeds the measuring range a notice message is generated (#351...354, current span).
- In case of a fault the behaviour of the current output is according to the selected option in the function FAILSAFE MODE (see Page 21). Change the error category in the function ASSIGN SYSTEM ERROR (see Page 54) to generate a fault message instead of a notice message.

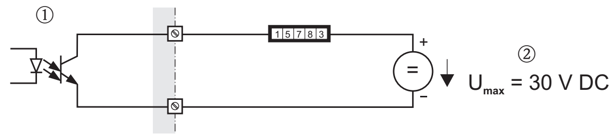
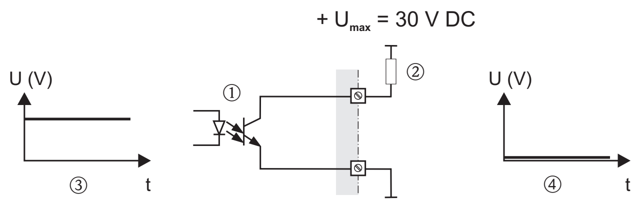
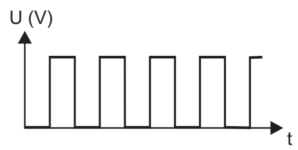
Function description CURRENT OUTPUT	
VALUE 20 mA	Use this function to assign the 20 mA current a full scale value. Positive and negative values are permissible. The required measuring range is defined by defining the VALUE 20 mA. In the SYMMETRY measuring mode, (see Page 45), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input:** 5-digit floating-point number, with sign **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! ▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ▪ The value for 0 or 4 mA always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.
TIME CONSTANT	Use this function to enter a time constant defining how the current output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** fixed-point number 0.01...100.00 s **Factory setting:** 3.00 s
FAILSAFE MODE	For safety reasons it is advisable to ensure that the current output assumes a predefined state in the event of a fault. The setting you select here affects only the current output. The failsafe mode of other outputs and the totalizers is defined in the corresponding function groups. **Options:** MIN. CURRENT The current output adopts the value of the lower signal on alarm level (as defined in the function CURRENT SPAN). MAX. CURRENT The current output adopts the value of the upper signal on alarm level (as defined in the function CURRENT SPAN). HOLD VALUE (**not recommended**) Measuring value output is based on the last measuring value saved before the error occurred . ACTUAL VALUE Measured value output is based on the current flow measurement. The fault is ignored . **Factory setting:** MIN. CURRENT
ACTUAL CURRENT	Use this function to view the computed actual value of the output current. **User interface:** 0.00...25.00 mA

Function description CURRENT OUTPUT	
SIMULATION CURRENT	Use this function to activate simulation of the current output. **Options:** OFF ON **Factory setting:** OFF Note! ▪ The "SIMULATION CURRENT OUTPUT" notice message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION CURRENT	Note! This function is not available unless the function SIMULATION CURRENT is active (= ON). Use this function to define a selectable value (e.g. 12 mA) to be output at the current output. This value is used to test downstream devices and the measuring device itself. **User input:** Floating-point number: 0.00...25.00 mA **Factory setting:** 0.00 mA Caution! The setting is not saved if the power supply fails.

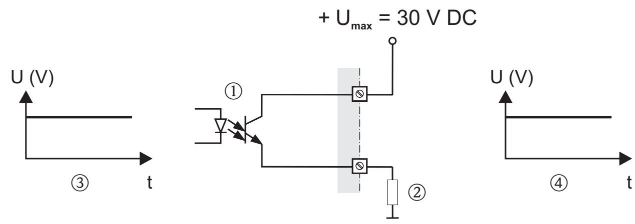
10 Group PULSE/FREQUENCY OUTPUT

Function description PULSE/FREQUENCY OUTPUT	
This group is not available unless the measuring device is equipped with a pulse/frequency output.	
OPERATION MODE	Use this function to configure the output as a pulse output or frequency output. The functions available in this function group vary, depending on which option you select here. **Options:** PULSE FREQUENCY **Factory setting:** PULSE
ASSIGN FREQUENCY	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to assign a measured variable to the frequency output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! If you select OFF, the only functions shown in this function group are the functions ASSIGN FREQUENCY and OPERATION MODE.
END VALUE FREQ.	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to define a full scale frequency for the frequency output. You define the associated measured value of the measuring range in the function VALUE-f HIGH on Page 24. **User input:** 4-digit fixed-point number 2...1250 Hz **Factory setting:** 1000 Hz Example: ▪ VALUE-f HIGH = 1000 l/h, end frequency = 1000 Hz: i.e. at a flow of 1000 l/h, a frequency of 1000 Hz is output. ▪ VALUE-f HIGH = 3600 l/h, end frequency = 1000 Hz: i.e. at a flow of 3600 l/h, a frequency of 1000 Hz is output. ✎ Note! ▪ In the FREQUENCY operating mode the output signal is symmetrical (on/off ratio = 1:1). At low frequencies the pulse duration is limited to a maximum of 2 seconds, i.e. the on/off ratio is no longer symmetrical. ▪ The initial frequency is always 0 Hz. This value is fixed and cannot be edited.

Function description PULSE/FREQUENCY OUTPUT	
VALUE-f HIGH	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to assign a value to the end value frequency. Positive and negative values are permissible. The required measuring range is defined by defining the VALUE-f HIGH. In the SYMMETRY measuring mode, (see Page 45), the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter and country, [value] / [dm^3...m^3 or US-gal...US-Mgal] corresponds to the factory setting for the final value (see Page 58 ff.) .  ① = *Value-f min.* ② = *Value-f high* ✎ Note! ▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ▪ The value-f min. for the initial frequency always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.

Function description PULSE/FREQUENCY OUTPUT	
OUTPUT SIGNAL	✎ Note! Function is not available unless the FREQUENCY setting was selected in the OPERATION MODE function. For selecting the output configuration of the frequency output. **Options:** PASSIVE - POSITIVE PASSIVE - NEGATIVE **Factory setting:** PASSIVE - POSITIVE **Explanation** ▪ PASSIVE = power is supplied to the frequency output by means of an external power supply. Configuring the output signal level (POSITIVE or NEGATIVE) determines the quiescent behaviour (at zero flow) of the frequency output. The internal transistor is activated as follows: ▪ If POSITIVE is selected, the internal transistor is activated with a **positive** signal level. ▪ If NEGATIVE is selected, the internal transistor is activated with a **negative** signal level (0 V). ✎ Note! With the passive output configuration, the output signal levels of the frequency output depend on the external circuit (see examples). **Example for passive output circuit (PASSIVE)** If PASSIVE is selected, the frequency output is configured as an open collector.  A0001225 ① = *Open collector* ② = *External power supply* ✎ Note! For continuous currents up to 25 mA (I_{max} = 250 mA / 20 ms). **Example for output configuration PASSIVE-POSITIVE:** Output configuration with an external pull-up resistance. In the quiescent state (at zero flow), the output signal level at the terminals is 0 V.  A0004687 ① = *Open collector* ② = *Pull-up resistance* ③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)* ④ = *Output signal level in quiescent state (at zero flow)* In the operating status (flow present), the output signal level changes from 0 V to a positive voltage level.  A0001975 (continued on next page)

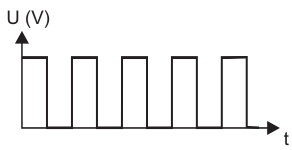
Function description PULSE/FREQUENCY OUTPUT	
OUTPUT SIGNAL (continued)	**Example for output configuration PASSIVE-POSITIVE:** Output configuration with an external pull-down resistance. In the quiescent state (at zero flow), a positive voltage level is measured via the pull-down resistance.



A0004689

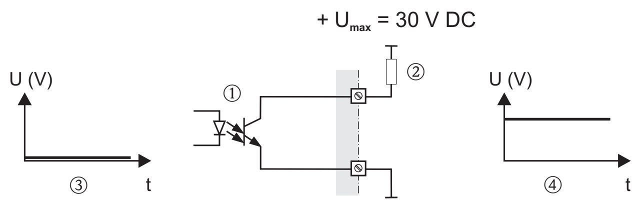
① = *Open collector*
② = *Pull-down resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.



A0001981

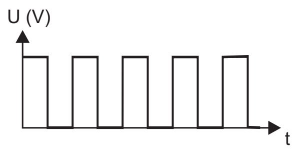
Example for output configuration PASSIVE-NEGATIVE:
Output configuration with an external pull-up resistance.
In the quiescent state (at zero flow), the output signal level at the terminals is at a positive voltage level.



A0004690

① = *Open collector*
② = *Pull-up resistance*
③ = *Transistor activation in "NEGATIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

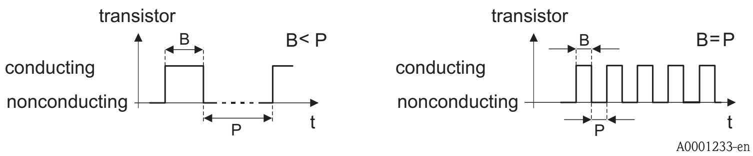
In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.



A0001981

Function description PULSE/FREQUENCY OUTPUT	
TIME CONSTANT	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to enter a time constant defining how the frequency output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** Floating-point number 0.00...100.00 s **Factory setting:** 0.00 s
FAILSAFE MODE	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. For safety reasons it is advisable to ensure that the frequency output assumes a predefined state in the event of a fault. Use this function to define this state. The setting you select here affects only the frequency output. It has no effect on other outputs and the display (e.g. totalizers). **Options:** FALLBACK VALUE Output is 0 Hz. FAILSAFE LEVEL Output is the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Measuring value output is based on the last measuring value saved before the error occurred. ACTUAL VALUE Measuring value output is based on the current flow measurement. The fault is ignored. **Factory setting:** FALLBACK VALUE
FAILSAFE VALUE	✎ Note! This function is not available unless FREQUENCY was selected in the OPERATION MODE function and FAILSAFE LEVEL was selected in the function FAILSAFE MODE. Use this function to define the frequency that the measuring device should output in the event of a fault. **User input:** max. 4-digit number: 0...1250 Hz **Factory setting:** 1250 Hz
ACTUAL FREQUENCY	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to view the computed value of the output frequency. **User interface:** 0...1250 Hz

Function description PULSE/FREQUENCY OUTPUT	
SIMULATION FREQUENCY	✎ Note! This function is not available unless the FREQUENCY setting was selected in the function OPERATION MODE. Use this function to activate simulation of the frequency output. **Options:** OFF ON **Factory setting:** OFF ✎ Note! ▪ The "SIMULATION FREQUENCY OUTPUT" notice message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION FREQUENCY	✎ Note! This function is not available unless FREQUENCY was selected in the OPERATION MODE function and the function VALUE SIMULATION FREQUENCY is active (= ON). Use this function to define a selectable frequency value (e.g. 500 Hz) to be output at the frequency output. This value is used to test downstream devices and the measuring device itself. **User input:** 0...1250 Hz **Factory setting:** 0 Hz Caution! The setting is not saved if the power supply fails.
ASSIGN PULSE	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to assign a measured variable to the pulse output. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW ✎ Note! If you select OFF, the only functions shown in this function group are the functions ASSIGN PULSE and OPERATION MODE.

Function description PULSE/FREQUENCY OUTPUT	
PULSE VALUE	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to define the flow at which a pulse is triggered. These pulses can be totalled by an external totalizer and in this way the total flow since measuring commenced can be registered. **User input:** 5-digit floating-point number, [unit] **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! The appropriate unit is taken from the group SYSTEM UNITS (see Page 8).
PULSE WIDTH	✎ Note! This function is not available unless the PULSE setting was selected in the OPERATION MODE function. Use this function to enter the maximum pulse width of the output pulses. **User input:** 0.5...2000 ms **Factory setting:** 100 ms Pulse output is **always** with the pulse width (B) entered in this function. The intervals (P) between the individual pulses are automatically configured. However, they must at least correspond to the pulse width (B = P).  B = Pulse width entered (the illustration applies to positive pulses) P= Intervals between the individual pulses ✎ Note! When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC, etc.). Caution! If the pulse number or frequency resulting from the pulse value entered, (see function PULSE VALUE on Page 27), and from the current flowis too large to maintain the pulse width selected (interval P is smaller than the pulse width B entered), a system error message (pulse memory) is generated after buffering/balancing time.

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL

✎ Note!
Function is not available unless the PULSE setting was selected in the OPERATION MODE function.

For selecting the output configuration of the pulse output.

Options:
PASSIVE - POSITIVE
PASSIVE - NEGATIVE

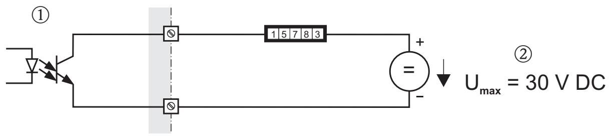
Factory setting: PASSIVE - POSITIVE

Explanation
- PASSIVE = power is supplied to the pulse output by means of an external power supply.

Configuring the output signal level (POSITIVE or NEGATIVE) determines the quiescent behaviour (at zero flow) of the pulse output.
The internal transistor is activated as follows:
- If POSITIVE is selected, the internal transistor is activated with a **positive** signal level.
- If NEGATIVE is selected, the internal transistor is activated with a **negative** signal level (0 V).

✎ Note!
With the passive output configuration, the output signal levels of the pulse output depend on the external circuit (see examples).

Example for passive output circuit (PASSIVE)
If PASSIVE is selected, the pulse output is configured as an open collector.

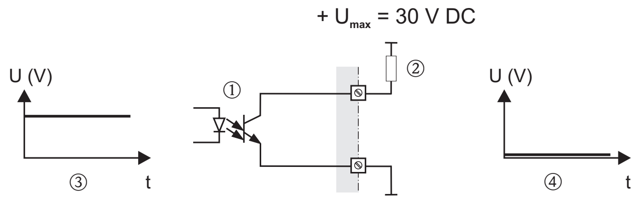


A0001225

① = *Open Collector*
② = *External power supply*

✎ Note!
For continuous currents up to 25 mA (I_{max} = 250 mA / 20 ms).

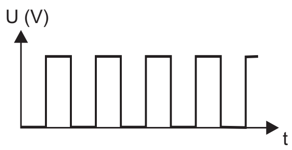
Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-up resistance.
In the quiescent state (at zero flow), the output signal level at the terminals is 0 V.



A0004687

① = *Open Collector*
② = *Pull-Up-Resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from 0 V to a positive voltage level.



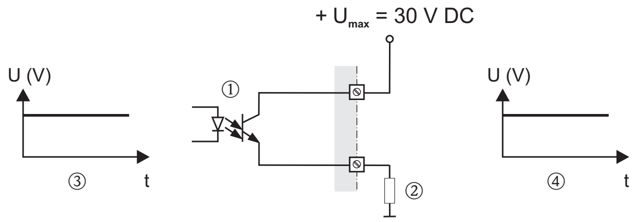
A0001975

(continued on next page)

Function description PULSE/FREQUENCY OUTPUT

OUTPUT SIGNAL
(continued)

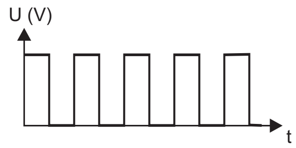
Example for output configuration PASSIVE-POSITIVE:
Output configuration with an external pull-down resistance. In the quiescent state (at zero flow), a positive voltage level is measured via the pull-down resistance.



A0004689

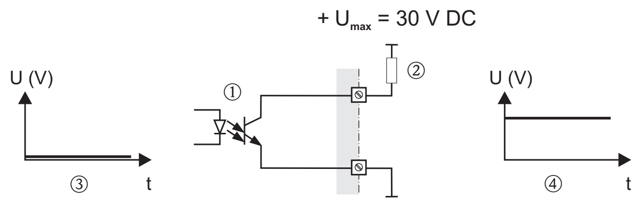
① = *Open Collector*
② = *Pull-Down-Resistance*
③ = *Transistor activation in "POSITIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.



A0001981

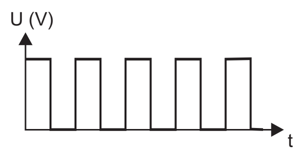
Example for output configuration PASSIVE-NEGATIVE:
Output configuration with an external pull-up resistance. In the quiescent state (at zero flow), the output signal level at the terminals is at a positive voltage level.



A0004690

① = *Open Collector*
② = *Pull-Up-Resistance*
③ = *Transistor activation in "NEGATIVE" quiescent state (at zero flow)*
④ = *Output signal level in quiescent state (at zero flow)*

In the operating status (flow present), the output signal level changes from a positive voltage level to 0 V.



A0001981

Function description PULSE/FREQUENCY OUTPUT	
FAILSAFE MODE	✎ Note! This function is not available unless the PULSE setting was selected in the function OPERATION MODE. For safety reasons it is advisable to ensure that the pulse output assumes a predefined state in the event of a fault. Use this function to define this state. The setting you select here affects only the pulse output. It has no effect on other outputs and the display (e.g. totalizers). **Options:** FALLBACK VALUE Output is 0 pulse. ACTUAL VALUE Measuring value output is based on the current flow measurement. The fault is ignored. **Factory setting:** FALLBACK VALUE
SIMULATION PULSE	✎ Note! This function is not available unless the PULSE option was selected in the OPERATION MODE function. Use this function to activate simulation of the pulse output. **Options:** OFF COUNTDOWN The pulses specified in the VALUE SIMULATION PULSE function are output. CONTINUOUSLY Pulses are continuously output with the pulse width specified in the PULSE WIDTH function. Simulation is started once the CONTINUOUSLY option is confirmed with the E key. ✎ Note! Simulation is started by confirming the CONTINUOUSLY option with the E key. The simulation can be switched off again via the SIMULATION PULSE function. **Factory setting:** OFF ✎ Note! ▪ The notice message #631 "SIM. PULSE" indicates that simulation is active. ▪ The on/off ratio is 1:1 for both types of simulation. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measured values are output correctly via the other outputs. ☝ Caution! The setting is not saved if the power supply fails.

Function description PULSE/FREQUENCY OUTPUT	
VALUE SIMULATION PULSE	✎ Note! This function is not available unless the COUNTDOWN option was selected in the SIMULATION PULSE function. Use this function to specify the number of pulses (e.g. 50) which are output during the simulation. This value is used to test downstream devices and the measuring device itself. The pulses are output with the pulse width specified in the PULSE WIDTH function. The on/off ratio is 1:1. Simulation is started once the specified value is confirmed with the E key. The display remains at "0" if the specified pulses have been output. **User input:** 0...10000 **Factory setting:** 0 ✎ Note! Simulation is started by confirming the simulation value with the E key. The simulation can be switched off again via the SIMULATION PULSE function. Caution! The setting is not saved if the power supply fails.

11 Group STATUS OUTPUT

<table>
<tr><th colspan="2">Function description STATUS OUTPUT</th></tr>
<tr><td colspan="2">This group is not available unless the measuring device is equipped with a status output.</td></tr>
<tr><td>ASSIGN STATUS OUTPUT</td><td>Use this function to assign a switching function to the status output.

Options:
OFF
ON (operation)
FAULT MESSAGE
NOTICE MESSAGE
FAULT MESSAGE or NOTICE MESSAGE
EPD or OED (Empty Pipe Detection / Open Electrode Detection, only if active)
FLOW DIRECTION
VOLUME FLOW LIMIT VALUE

Factory setting:
FAULT MESSAGE

✎ Note!
▪ The behaviour of the status output is a normally closed behaviour, in other words the output is closed (transistor conductive) when normal, error-free measuring is in progress.
▪ It is very important to read and comply with the information on the switching characteristics of the status output, (see Page 34).
▪ If you select OFF, the only function shown in this function group is the function ASSIGN STATUS OUTPUT.</td></tr>
<tr><td>ON-VALUE</td><td>✎ Note!
This function is not available unless LIMIT VALUE or FLOW DIRECTION was selected in the function ASSIGN STATUS OUTPUT.

Use this function to assign a value to the switch-on point (status output pulls up). The value can be equal to, greater than or less than the switch-off point. Positive and negative values are permissible.

User input:
5-digit floating-point number, [unit]

Factory setting:
0 [unit]

✎ Note!
▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8).
▪ Only the switch-on point is available for flow direction output (no switch-off point). If you enter a value not equal to the zero flow (e.g. 5), the difference between the zero flow and the value entered corresponds to half the switchover hysteresis.</td></tr>
</table>

Function description STATUS OUTPUT	
OFF-VALUE	✎ Note! This function is not available unless LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. Use this function to assign a value to the switch-off point (status output drops out). The value can be equal to, greater than or less than the switch-on point. Positive and negative values are permissible. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] ✎ Note! ▪ The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8). ▪ If SYMMETRY is selected in the function MEASURING MODE (Page 45) and values with different signs are entered for the switch-on and switch-off points, the notice message "INPUT RANGE EXCEEDED" appears.
TIME CONSTANT	Use this function to enter a time constant defining how the measuring signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). The purpose of damping, therefore, is to prevent the status output changing state continuously in response to fluctuations in flow. **User input:** fixed-point number 0.00...100.00 s **Factory setting:** 0.00 s
ACTUAL STATUS OUTPUT	Use this function to check the current status of the status output. **User interface:** NOT CONDUCTIVE CONDUCTIVE
SIMULATION SWITCH POINT	Use this function to activate simulation of the status output. **Options:** OFF ON **Factory setting:** OFF ✎ Note! ▪ The "SIMULATION STATUS OUTPUT" message indicates that simulation is active. ▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the other outputs. ☝ Caution! The setting is not saved if the power supply fails.

Function description STATUS OUTPUT	
VALUE SIMULATION SWITCH POINT	✎ Note! This function is not available unless the function SIMULATION SWITCH POINT is active (= ON). Use this function to define the switching response of the status output during the simulation. This value is used to test downstream devices and the measuring device itself. **Options:** NOT CONDUCTIVE CONDUCTIVE **Factory setting:** NOT CONDUCTIVE Caution! The setting is not saved if the power supply fails.

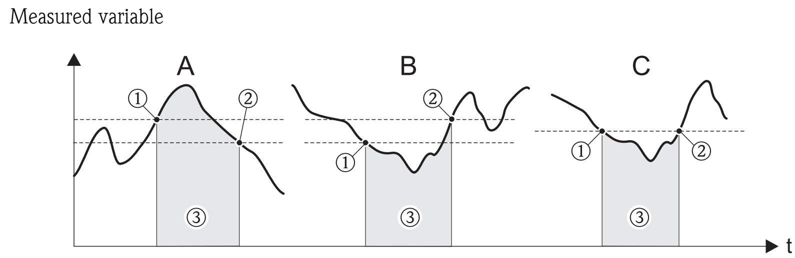
11.1 Information on the response of the status output

General

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

Status output configured for limit value

The status output switches as soon as the measured variable undershoots or overshoots a defined switch point. Application: Monitoring flow or process-related boundary conditions.

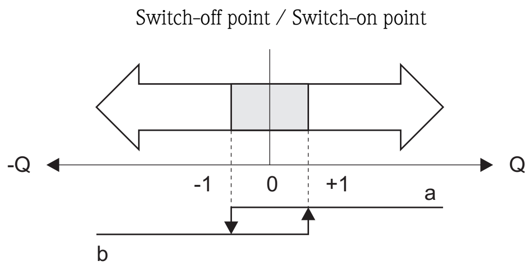


A0001235

A = Maximum safety → ① SWITCH-OFF POINT > ② SWITCH-ON POINT
B = Maximum safety → ① SWITCH-OFF POINT < ② SWITCH-ON POINT
C = Maximum safety → ① SWITCH-OFF POINT = ② SWITCH-ON POINT (this configuration is to avoid)
③ = Status output switched off (not conductive)

Status output configured for flow direction

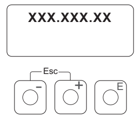
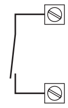
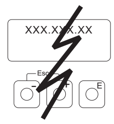
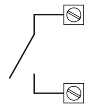
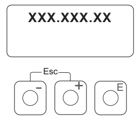
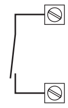
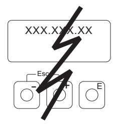
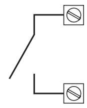
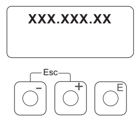
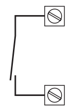
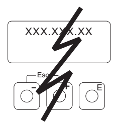
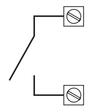
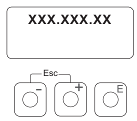
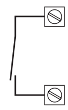
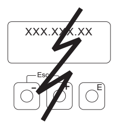
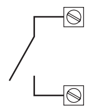
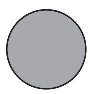
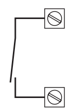
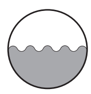
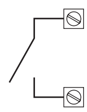
The value entered in the function SWITCH-ON POINT defines the switch point for the positive and negative directions of flow. If, for example, the switch point entered is = 1 m^3/h, the status output switches off at –1 m^3/h (not conductive) and switches on again at +1 m^3/h (conductive).
Set the switch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

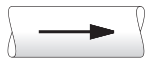
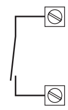
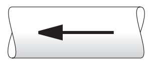
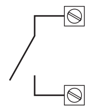
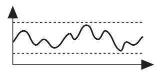
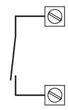
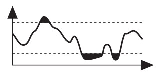
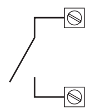


A0001236

a = Status output conductive
b = Status output not conductive

11.2 Switching response of the status output

Function	Status		Open collector response (transistor)	
ON (operation)	System in measuring mode	 A0001052	conduc-tive	 A0001237
	System not in measuring mode (power supply failed)	 A0001291	not conduc-tive	 A0001238
Fault message	System OK	 A0001052	conduc-tive	 A0001237
	(System or process error) Fault ⟶ Error response of outputs/inputs and totalizer	 A0001291	not conduc-tive	 A0001238
Notice message	System OK	 A0001052	conduc-tive	 A0001237
	(System or process error) Fault ⟶ Continuation of measuring	 A0001291	not conduc-tive	 A0001238
Fault message or notice message	System OK	 A0001052	conduc-tive	 A0001237
	(System or process error) Fault ⟶ Response to error or Note ⟶ Continuation of measuring	 A0001291	not conduc-tive	 A0001238
Empty pipe detection (EPD) / Open electrode detection (OED)	Measuring tube full	 A0001292	conduc-tive	 A0001237
	Measuring tube partially filled / empty measuring tube	 A0001293	not conduc-tive	 A0001238

Function	Status	Open collector response (transistor)
Flow direction	Forward  A0001241	conduc-tive  A0001237
	Reverse  A0001242	not conduc-tive  A0001238
Limit value Volume flow	Limit value not overshot or undershot  A0001243	conduc-tive  A0001237
	Limit value overshot or undershot  A0001244	not conduc-tive  A0001238

12 Group STATUS INPUT

<table>
<tr><th colspan="2">Function description STATUS INPUT</th></tr>
<tr><td colspan="2">This group is not available unless the measuring device is equipped with a status input.</td></tr>
<tr><td>ASSIGN STATUS INPUT</td><td>Use this function to assign a switching function to the status input.

Options:
OFF
RESET TOTALIZER 1
POSITIVE ZERO RETURN
RESET TOTALIZER 2
RESET ALL TOTALIZERS

Factory setting:
OFF

Note!
Positive zero return is active as long as the active level is available at the status input (continuous signal). All other assignments react to a change in level (pulse) at the status input.</td></tr>
<tr><td>ACTIVE LEVEL</td><td>Use this function to define whether the assigned switch function, (see function ASSIGN STATUS INPUT) is released or sustained when the level is present (HIGH) or not present (LOW).

Options:
HIGH
LOW

Factory setting:
HIGH</td></tr>
<tr><td>MINIMUM PULSE WIDTH</td><td>Use this function to define a minimum pulse width which the input pulse must achieve in order to trigger the selected switching function.

User input:
20...100 ms

Factory setting:
50 ms</td></tr>
<tr><td>SIMULATION STATUS INPUT</td><td>Use this function to activate simulation of the status input, i.e. to trigger the function assigned to the status input, (see function ASSIGN STATUS INPUT on Page 31).

Options:
OFF
ON

Factory setting:
OFF

Note!
▪ The "SIMULATION STATUS INPUT" notice message indicates that simulation is active.
▪ The measuring device continues to measure while simulation is in progress, i.e. the current measuring values are output correctly via the outputs.

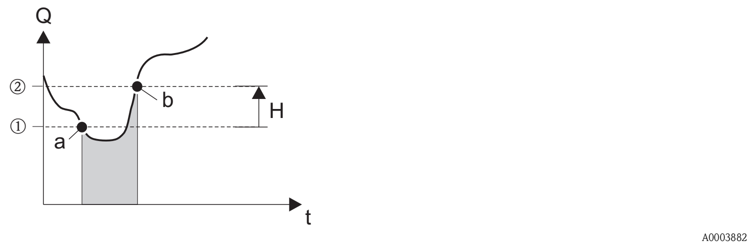
Caution!
The setting is not saved if the power supply fails.</td></tr>
</table>

Function description STATUS INPUT	
VALUE SIMULATION STATUS INPUT	✎ Note! This function is not available unless the function SIMULATION STATUS INPUT is active (= ON). Use this function to select the level to be simulated at the status input. **Options:** HIGH LOW **Factory setting:** LOW Caution! The setting is not saved if the power supply fails.

13 Group COMMUNICATION

Function description COMMUNICATION	
TAG NAME	Use this function to enter a tag name for the measuring device. You can edit and read this tag name at the local display or via the HART protocol. **User input:** max. 8-character text, permitted characters are: A–Z, 0–9, +, –, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _" (no text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag description at the local display or via the HART protocol. **User input:** max. 16-character text, permitted characters are: A–Z, 0–9, +, –, punctuation marks **Factory setting:** "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _" (No text)
BUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. **User input:** 0...15 **Factory setting:** 0 ✎ Note! Addresses 1...15: a constant 4 mA current is applied.
HART PROTOCOL	Use this function to display if the HART protocol is active. **User interface:** OFF = HART protocol not active ON = HART protocol active ✎ Note! The HART protocol is activated by selecting 4–20 mA HART or 4–20 mA (25 mA) HART in the function CURRENT SPAN (see Page 20).
MANUFACTURER ID	Use this function to view the manufacturer. **User interface:** – Endress+Hauser – 17 (≅ 11 hex) for Endress+Hauser
DEVICE ID	Use this function to view the device ID in hexadecimal numerical format. **User interface:** 41 (≅ 65 dez) for Promag 50
DEVICE REVISION	Use this function to view the device-specific revision of the HART command interface. **User interface:** E.g.: 5

14 Group PROCESS PARAMETER

Function description PROCESS PARAMETER	
ASSIGN LOW FLOW CUT OFF	Use this function to assign the switch point for low flow cut off. **Options:** OFF VOLUME FLOW **Factory setting:** VOLUME FLOW
ON-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-on point for low flow cut off. Low flow cut off is active if the value entered is not equal to 0. The sign of the flow value is highlighted on the display to indicate that low flow cut off is active. **User input:** 5-digit floating-point number, [unit] **Factory setting:** Depends on nominal diameter and country (see Page 58 ff.). ✎ Note! The appropriate unit is taken from the group SYSTEM UNITS (see Page 8).
OFF-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-off point for low flow cut off. Enter the switch-off point as a positive hysteresis value from the switch-on point. **User input:** Integer 0...100% **Factory setting:** 50%  *① = switch-on point , ② = switch-off point* *a = Low flow cut off is switched on* *b = Low flow cut off is switched off (a + a · H)* *H = Hysteresis value: 0 to 100%* *■ = Low flow cut off active* *Q = Flow*

Function description PROCESS PARAMETER	
EMPTY PIPE DETECTION (EPD)	Flow cannot be measured correctly unless the measuring tube is full. This status can be monitored at all times with the Empty Pipe Detection function. Use this function to activate Empty Pipe Detection (EPD) or Open Electrode Detection (OED). ▪ 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). **Options:** OFF – ON SPECIAL – OED – ON STANDARD OFF (neither EPD nor OED are active) ON SPECIAL (only for DN <400): Switching on the Empty Pipe Detection (EPD) for devices in remote version (transmitter and sensor are installed separately). OED: Switching on the Open Electrode Detection (OED). ON STANDARD: Switching on the Empty Pipe Detection (EPD) for: – Devices in compact version (transmitter and sensor form a single mechanical unit). – Applications where a facing and coating of the fluid on the measuring tube line and measuring electrode accrues. **Factory setting:** OFF ✎ Note! ▪ The options ON STANDARD and ON SPECIAL are not available unless the sensor is equipped with an EPD electrode. ▪ The default setting for the EPD/OED functions when the device is delivered is OFF. The functions must be activated as required. ▪ The devices are calibrated at the factory with water (approx. 500 μS/cm). If the conductivity of certain fluids deviates from this reference, empty pipe/full pipe adjustment must be performed again on site (see function EPD/OED ADJUSTMENT on page 46). ▪ The adjustment coefficients must be valid before you can switch on the EPD or OED. If these coefficients are not available, the function EPD/OED ADJUSTMENT is displayed (see Page 44). ▪ If there are problems with the adjustment, the following error messages appear on the screen: – 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 as the fluid conductivity values are outside the permitted range. (continued on next page)

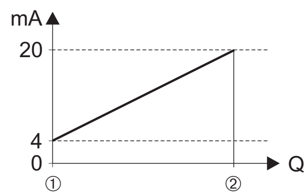
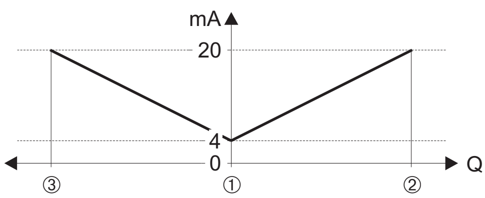
Function description PROCESS PARAMETER	
EMPTY PIPE DETECTION (EPD) (continued)	**Notes on empty pipe detection (EPD and OED)** ▪ Flow cannot be measured correctly unless the measuring pipe is completely full. This status can be monitored at all times by means of the EPD/OED. ▪ An empty or partially filled pipe is a process error. A default factory setting defines that a fault message is issued and that this process error has an effect on the outputs. ▪ The EPD/OED process error can be output via the configurable status output. ▪ Use the function ASSIGN PROCESS ERROR to define whether a notice or fault message should be triggered (see Page 54). ▪ A plausibility check of the adjustment values will only be executed by activating the empty pipe detection. If an empty or full pipe adjustment is performed during the empty pipe detection is active, the empty pipe detection has to be de- and again activated, after finishing the adjustment, to start the plausibility check. **Response to partially filled pipes** If the EPD/OED is switched on and responds to a partially filled or empty pipe, the fault message "EMPTY PIPE" appears on the display. If the pipe is partially empty and the EPD/OED is **not** switched on, the response can vary in identically configured systems: ▪ Flow reading fluctuates ▪ Zero flow ▪ Excessively high flow values **Notes on Open Electrode Detection (OED)** Open Electrode Detection (OED) functions like the Empty Pipe Detection (EPD). In contrast to the EPD where the measuring device must be equipped with a separate (optional) electrode, the OED detects partial filling by means of the two measuring electrodes which are present as standard (fluid no longer covers the measuring electrodes). Open electrode detection can also be used if: ▪ the sensor is not installed in the optimal position for using EPD (optimal = installed horizontally). ▪ the sensor is not equipped with an additional (optional) EPD electrode. ✎ Note! ▪ Cable connection length: When mounting a remote version, please observe the maximum permissible cable length of 15 metres in order to keep the OED function. ▪ OED empty pipe adjustment: To achieve the best results for the open electrode detection, it is important to have the electrodes surface as dry as possible (no liquid film) while the empty-pipe adjustment is being made. Even during normal operation, the OED function is only secured if there is no longer any liquid film present on the electrodes when the measuring pipe is empty.

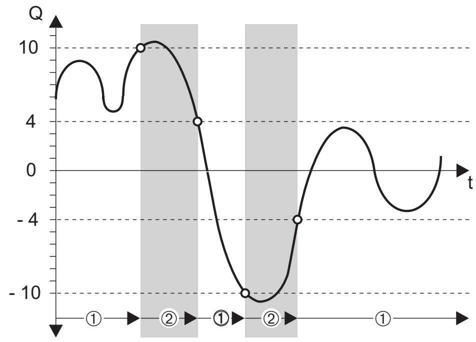
Function description PROCESS PARAMETER	
EPD/OED ADJUSTMENT	Use this function to activate the EPD/OED adjustment for an empty or full measuring tube. ✎ Note! A detailed description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found on Page 44. **Options:** OFF FULL PIPE ADJUST EMPTY PIPE ADJUST OED FULL ADJUST OED EMPTY ADJUST **Factory setting:** OFF **Procedure for EPD or OED empty-pipe / full-pipe adjustment** 1. 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! 2. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E to confirm. 3. After empty-pipe adjustment, fill the piping with fluid. 4. Start full-pipe adjustment: Select "FULL PIPE ADJUST" or "OED FULL ADJUST" and press E to confirm. 5. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E . 6. Now select the "EMPTY PIPE DETECTION" function. Switch on Empty Pipe Detection by selecting the following settings: – EPD → Select ON STANDARD or ON SPECIAL and press E to confirm. – OED → Select OED and confirm with E . Caution! The adjustment coefficients must be valid before you can activate the EPD/OED function. If adjustment is incorrect the following messages might appear on the display: – FULL = EMPTY The adjustment values for empty pipe and full pipe are identical. In cases of this nature you **must** repeat empty-pipe or full-pipe adjustment **again**! – ADJUSTMENT NOT OK Adjustment is not possible because the fluid’s conductivity is out of range.

Function description PROCESS PARAMETER	
EPD/OED RESPONSE TIME	✎ Note! This function is not available unless ON STANDARD, ON SPECIAL or OED was selected in the EMPTY PIPE DETECTION function. Use this function to enter the time span for which the criteria for an "empty" pipe have to be satisfied without interruption before a notice message or fault message is generated. The setting defined here is used by the active empty pipe detection (EPD) or open electrode detection (OED). **User input:** fixed-point number 1.0...100 s **Factory setting:** 1.0 s ✎ Note! OED detection time: The recognition of open electrodes is, in contrast to the empty pipe detection (EPD), very slow reacting (delay at least 25 seconds) and is only activated after an aditional delay from the programmed response time! We recommend in most applications to use the empty pipe detection (EPD) which is an optimal solution for detecting partly filled measuring tubes.
ECC	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to activate cyclical electrode cleaning. **Options:** OFF ON **Factory setting:** ON (only if the optional electrode cleaning function ECC is available) **Notes on electrode cleaning (ECC)** Conductive deposits on the electrodes and on the walls of the measuring tube (e.g. magnetite) can falsify measurement values. The Electrode Cleaning Circuitry (ECC) was developed to prevent such conductive deposits accreting in the vicinity of the electrodes. ECC functions as described above for all available electrode materials except tantalum. If tantalum is used as the electrode material, the ECC protects the electrode surface only against oxidation. Caution! If the ECC is switched off for a prolonged period in applications with conductive deposits, a layer forms inside the measuring tube and this can falsify measurement values. If the layer is allowed to accrete beyond a certain level, it might no longer be possible to remove it by switching on the ECC. If this happens the measuring tube must be cleaned and the layer removed.
ECC DURATION	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the electrode cleaning duration. **User input:** fixed-point number 0.01...30.0 s **Factory setting:** 2.0 s

Function description PROCESS PARAMETER	
ECC RECOVERY TIME	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the recovery time for which the last flow value measured prior to cleaning is retained. A recovery time is necessary as the signal outputs can fluctuate after electrode cleaning on account of electrochemical interference voltages. **User input:** max. 3-digit number: 1... 600 s **Factory setting:** 5 s Caution! The last value measured prior to cleaning is output for the duration of the recovery time (max. 600 s). This in turn means that the measuring system does not register changes in flow, e.g. stoppage, during this time span.
ECC CLEANING CYCLE	✎ Note! This function is not available unless the measuring device is equipped with the optional electrode cleaning function (ECC). Use this function to specify the cleaning cycle for electrode cleaning. **User input:** Integer: 30...10080 min **Factory setting:** 40 min

15 Group SYSTEM PARAMETERS

Function description SYSTEM PARAMETERS	
INSTALLATION DIRECTION SENSOR	Use this function to reverse the sign of the flow quantity, if necessary. **Options:** NORMAL (flow as indicated by the arrow) INVERSE (flow opposite to direction indicated by the arrow) **Factory setting:** NORMAL ✎ Note! Ascertain the actual direction of fluid flow with reference to the direction indicated by the arrow on the sensor (nameplate).
MEASURING MODE	Use this function to select the measuring mode for all outputs. **Options:** STANDARD SYMMETRY **Factory setting:** STANDARD The responses of the individual outputs in each of the measuring modes are described in detail on the following pages: **Current output and frequency output** STANDARD Only the flow components for the selected flow direction are totalled, (positive or negative full scale value ② = flow direction). Flow components in the opposite direction are not taken into account (suppression). Example for current output:  A0001248 SYMMETRY The output signals of the current and frequency outputs are independent of the direction of flow (absolute amount of the measured variable). The "VALUE 20 mA" or "VALUE-f HIGH" ③ (e.g. backflow) corresponds to the mirrored VALUE 20 mA or VALUE-f HIGH ② (e.g. flow). Positive and negative flow components are taken into account. Example for current output:  A0001249 ✎ Note! The direction of flow can be output via the configurable status output. (continued on next page)

Function description SYSTEM PARAMETERS	
MEASURING MODE (continued)	**Pulse output** STANDARD Only positive flow components are totalled. Negative components are not taken into account. SYMMETRY Positive and negative flow components are taken into account. Note! The direction of flow can be output via the configurable status output. **Status output** Note! The information is only applicable if LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. STANDARD The status output signal switches at the defined switch points. SYMMETRY The status output signal switches at the defined switch points, irrespective of the sign. In other words, if you define a switch point with a positive sign, the status output signal switches as soon as the value is reached in the negative direction (negative sign), (see illustration). Example for the SYMMETRY measuring mode: Switch-on point: Q = 4 Switch-off point: Q = 10 ① = Status output switched on (conductive) ② = Status output switched off (not conductive)  A0001247
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a piping system is being cleaned, for example. This setting acts on all function and outputs of the measuring device. **Options:** OFF ON → Signal output is set to the "ZERO FLOW" value. **Factory setting:** OFF

Function description SYSTEM PARAMETERS	
SYSTEM DAMPING	Use this function to set the filter depth of the digital filter. This reduces the sensitivity of the measuring signal to interference peaks (e.g. high solids content, gas bubbles in the fluid, etc.). The system reaction time decreases with an increasing filter setting. **User input:** 0...15 **Factory setting:** 9 Note! The system damping acts on all functions and outputs of the measuring device.
INTEGRATION TIME	Use this function to set the integration time. Under normal circumstances it is not necessary to change the factory settings. **User input:** 3.3...65 ms **Factory setting:** 20 ms at 50 Hz → mains frequency (e.g. Europe) 16.7 ms at 60 Hz → mains frequency (e.g. USA) Caution! The integration time must not be selected with a greater value than the measuring period (see Page 53). Note! The integration time defines the duration of internal totaling of the induced voltage in the fluid (measured by the measuring electrode), i.e. the time in which the measuring device records the true flow (afterwards the magnetic field for the next integration is created from the opposite pole).

16 Group SENSOR DATA

Function description SENSOR DATA	
All sensor data (calibration factors, zero point and nominal diameter etc.) are set at the factory and saved on the S-DAT sensor memory chip. Caution! Under normal circumstances you should not change the following parameter settings, because changes affect numerous functions of the entire measuring facility in general and the accuracy of the measuring system in particular. For this reason, the functions described below cannot be changed even when you enter your personal code. Contact the Endress+Hauser service organization if you have any questions about these functions.	
CALIBRATION DATE	Use this function to view the current calibration date and time for the sensor. **User interface:** Calibration date and time **Factory setting:** Calibration date and time of the current calibration. Note! The calibration date and time format is defined in the FORMAT DATE TIME function, → Page 9.
K-FACTOR	Use this function to display the current calibration factor for the sensor. The calibration factor is determined and set at the factory. **User interface:** 5-digit fixed-point number: 0.5000...2.0000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
ZERO POINT	This function shows the current zero-point correction value for the sensor. Zero-point correction is determined and set at the factory. **User interface:** max. 4-digit number: –1000...+1000 **Factory setting:** Depends on nominal diameter and calibration Note! This value is also provided on the sensor nameplate.
NOMINAL DIAMETER	This function shows the nominal diameter for the sensor. The nominal diameter depends on the size of the sensor and is set at the factory. **User interface:** 2...2000 mm or 1/12...78" **Factory setting:** Depends on the size of the sensor Note! This value is also provided on the sensor nameplate.

Function description SENSOR DATA	
MEASURING PERIOD	Use this function to set the time for a full measuring period. The duration of the measuring period is calculated from the rise time of the magnetic field, the brief recovery time, the integration time (which can be set) and the empty pipe detection time. **User input:** 0.0...1000 ms **Factory setting:** Depends on nominal diameter ✎ Note! The system checks the time entered and sets the measuring period which is actually used internally to a plausible value. If you enter 0 ms, the system automatically computes the shortest time.
OVERVOLTAGE TIME	Use this function to specify the time in which overvoltage is applied to the coil circuit in order to build up the magnetic field as fast as possible. The overvoltage time is adjusted automatically while measuring is in progress. The overvoltage time depends on the sensor type and the nominal diameter and is set at the factory. **User interface:** 4-digit floating-point number: 0.0...100.0 ms **Factory setting:** Depends on nominal diameter
EPD ELECTRODE	Use this function to check whether the sensor is equipped with an EPD electrode. **User interface:** YES NO **Factory setting:** YES → Electrode fitted as standard
POLARITY ECC	Use this function to display the actual current polarity for optional electrode cleaning (ECC). Electrode cleaning uses either a positive or negative current, depending on the electrode material. The measuring device automatically selects the correct polarity on the basis of the electrode-material data stored in the S-DAT. **User interface:** POSITIVE → for electrodes made of: 1.4435, Hastelloy C, platinum, titanium NEGATIVE → for electrodes made of: tantalum Caution! If the incorrect current is applied to the electrodes, the electrode material is destroyed.

17 Group SUPERVISION

Function description SUPERVISION	
CURRENT SYSTEM CONDITION	Use this function to check the present system status. **User interface:** "SYSTEM OK" or the fault / notice message with the highest priority.
PREVIOUS SYSTEM CONDITIONS	Use this function to view the fifteen most recent fault and notice messages since measuring last started. **User interface:** The last 15 fault/notice messages appear on the display
ASSIGN SYSTEM ERROR	Use this function to view all system errors and the associated error categories (fault message or notice message). By selecting a certain system error, its error category can be changed in the subsequent function ERROR CATEGORY. **Options:** CANCEL List of system errors ✎ Note! ▪ You can exit this function as follows: select "CANCEL" and confirm with E. ▪ A list of possible system errors is provided in the Operating Instructions Promag 50, BA 046D/06/en
ERROR CATEGORY	✎ Note! This function is only available if a system error has been selected in the function ASSIGN SYSTEM ERROR. Use this function to define whether a system error triggers a notice message or a fault message. If you select FAULT MESSAGES, all outputs respond to an error in accordance with their defined error response patterns. **Options:** NOTICE MESSAGES (display only) FAULT MESSAGES (outputs and display) ✎ Note! Press the E key twice to call up the ASSIGN SYSTEM ERROR function.
ASSIGN PROCESS ERROR	Use this function to view all process errors and the associated error categories (fault message or notice message). By selecting an individual process error, its error category can be changed in the subsequent function ERROR CATEGORY. **Options:** CANCEL List of process errors ✎ Note! ▪ You can exit this function as follows: select "CANCEL" and confirm with E. ▪ A list of possible process errors is provided in the Operating Instructions Promag 50, BA 046D/06/en

Function description SUPERVISION	
ERROR CATEGORY	Note! This function is only available if a process error has been selected in the function ASSIGN PROCESS ERROR. Use this function to define whether a process error triggers a notice message or a fault message. If you select FAULT MESSAGES, all outputs respond to an error in accordance with their defined error response patterns. **Options:** NOTICE MESSAGES (display only) FAULT MESSAGES (outputs and display) Note! Press the E key twice to call up the ASSIGN PROCESS ERROR function.
ALARM DELAY	Use this function to define a time span in which the criteria for an error have to be satisfied without interruption before an error or notice message is generated. Depending on the setting and the type of error, this suppression acts on: ▪ Display ▪ Status output ▪ Current output ▪ Frequency output **User input:** 0...100 s (in steps of one second) **Factory setting:** 0 s Caution! If this function is activated error and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-order controller (process controller, etc.). It is therefore imperative to check in advance in order to make sure whether a delay of this nature could affect the safety requirements of the process. If error and notice messages cannot be suppressed, a value of 0 seconds must be entered here.
SYSTEM RESET	Use this function to perform a reset of the measuring system. **Options:** NO RESTART SYSTEM (restart without interrupting power supply) **Factory setting:** NO
OPERATION HOURS	The hours of operation of the device appear on the display. **Display:** Depends on the number of hours of operation elapsed: Hours of operation < 10 hours → display format = 0:00:00 (hr:min:sec) Hours of operation 10...10,000 hours → display format = 0000:00 (hr:min) Hours of operation > 10,000 hours → display format = 000000 (hr)
PERMANENT STORAGE	This function indicates whether permanent storage of all parameters in the EEPROM has been switched on or off. **Display:** 0 = OFF 1 = ON **Factory setting:** ON

18 Group SIMULATION SYSTEM

Function description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all inputs, outputs and the totalizer to their defined failsafe modes, in order to check whether they respond correctly. During this time, the words "SIMULATION FAILSAFE MODE" appear on the display. **Options:** ON OFF **Factory setting:** OFF
SIMULATION MEASURED VARIABLE	Use this function to set all inputs, outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the words "SIMULATION MEASURAND" appear on the display. **Options:** OFF VOLUME FLOW **Factory setting:** OFF Caution! ▪ The measuring device cannot be used for measuring while this simulation is in progress. ▪ The setting is not saved if the power supply fails.
VALUE SIMULATION MEASURED VARIABLE	Note! This function is not available unless the SIMULATION MEASURED VARIABLE function is active (= VOLUME FLOW). Use this function to specify a selectable value (e.g. 12 m^3/s). This value is used to test downstream devices and the measuring device itself. **User input:** 5-digit floating-point number, [unit] **Factory setting:** 0 [unit] Caution! The setting is not saved if the power supply fails. Note! The appropriate unit is taken from the group SYSTEM UNITS, (see Page 8)

19 Group SENSOR VERSION

Function description SENSOR VERSION	
SERIAL NUMBER	Use this function to view the serial number of the sensor.
SENSOR TYPE	Use this function to view the sensor type.
HARDWARE REVISION NUMBER SENSOR	Use this function to view the hardware revision number of the sensor.
SOFTWARE REVISION NUMBER S-DAT	Use this function to view the software revision number of the software used to create the content of the S-DAT

20 Group AMPLIFIER VERSION

Function description AMPLIFIER VERSION	
DEVICE SOFTWARE	Displays the current device software version.
SOFTWARE REVISION NUMBER AMPLIFIER	Use this function to view the software revision number of the amplifier.
LANGUAGE GROUP	Use this function to view the language group. The following language groups can be ordered: WEST EU / USA, EAST EU / SCAND., ASIA. **Display:** available language group ✎ Note! ▪ The language options of the available language group are displayed in the LANGUAGE function. ▪ You can change the language group via the configuration software FieldCare. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.
I/O MODULE TYPE	Use this function to view the configuration of the I/O module complete with terminal numbers.
SOFTWARE REVISION NUMBER I/O MODULE	Use this function to view the software revision number of the I/O module.

21 Factory settings

21.1 SI units (not for USA and Canada)

Low flow, full scale value, pulse value, totalizer

Nominal diameter		Low flow		Full scale value		Pulse value		Totalizer
[mm]	[inch]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
2	$^1/_{12}$"	0.01	dm^3/min	0.5	dm^3/min	0.005	dm^3	dm^3
4	$^5/_{32}$"	0.05	dm^3/min	2	dm^3/min	0.025	dm^3	dm^3
8	$^5/_{16}$"	0.1	dm^3/min	8	dm^3/min	0.10	dm^3	dm^3
15	$^1/_2$"	0.5	dm^3/min	25	dm^3/min	0.20	dm^3	dm^3
25	1"	1	dm^3/min	75	dm^3/min	0.50	dm^3	dm^3
32	1 $^1/_4$"	2	dm^3/min	125	dm^3/min	1.00	dm^3	dm^3
40	1 $^1/_2$"	3	dm^3/min	200	dm^3/min	1.50	dm^3	dm^3
50	2"	5	dm^3/min	300	dm^3/min	2.50	dm^3	dm^3
65	2 $^1/_2$"	8	dm^3/min	500	dm^3/min	5.00	dm^3	dm^3
80	3"	12	dm^3/min	750	dm^3/min	5.00	dm^3	dm^3
100	4"	20	dm^3/min	1200	dm^3/min	10.00	dm^3	dm^3
125	5"	30	dm^3/min	1850	dm^3/min	15.00	dm^3	dm^3
150	6"	2.5	m^3/h	150	m^3/h	0.025	m^3	m^3
200	8"	5.0	m^3/h	300	m^3/h	0.05	m^3	m^3
250	10"	7.5	m^3/h	500	m^3/h	0.05	m^3	m^3
300	12"	10	m^3/h	750	m^3/h	0.10	m^3	m^3
350	14"	15	m^3/h	1000	m^3/h	0.10	m^3	m^3
400	16"	20	m^3/h	1200	m^3/h	0.15	m^3	m^3
450	18"	25	m^3/h	1500	m^3/h	0.25	m^3	m^3
500	20"	30	m^3/h	2000	m^3/h	0.25	m^3	m^3
600	24"	40	m^3/h	2500	m^3/h	0.30	m^3	m^3
700	28"	50	m^3/h	3500	m^3/h	0.50	m^3	m^3
–	30"	60	m^3/h	4000	m^3/h	0.50	m^3	m^3
800	32"	75	m^3/h	4500	m^3/h	0.75	m^3	m^3
900	36"	100	m^3/h	6000	m^3/h	0.75	m^3	m^3
1000	40"	125	m^3/h	7000	m^3/h	1.00	m^3	m^3
–	42"	125	m^3/h	8000	m^3/h	1.00	m^3	m^3
1200	48"	150	m^3/h	10000	m^3/h	1.50	m^3	m^3
–	54"	200	m^3/h	13000	m^3/h	1.50	m^3	m^3
1400	–	225	m^3/h	14000	m^3/h	2.00	m^3	m^3
–	60"	250	m^3/h	16000	m^3/h	2.00	m^3	m^3
1600	–	300	m^3/h	18000	m^3/h	2.50	m^3	m^3
–	66"	325	m^3/h	20500	m^3/h	2.50	m^3	m^3
1800	72"	350	m^3/h	23000	m^3/h	3.00	m^3	m^3
–	78"	450	m^3/h	28500	m^3/h	3.50	m^3	m^3
2000	–	450	m^3/h	28500	m^3/h	3.50	m^3	m^3

Language

Country	Language
Australia	English
Austria	Deutsch
Belgium	English
Czech Republic	Czech
Denmark	English
England	English
Finland	Suomi
France	Francais
Germany	Deutsch
Hong Kong	English
Hungary	English
India	English
Indonesia	Bahasa Indonesia
Instruments International	English
Italy	Italiano
Japan	Japanese
Malaysia	English
Netherlands	Nederlands
Norway	Norsk
Poland	Polish
Portugal	Portuguese
Russia	Russian
Singapore	English
South Africa	English
Spain	Espanol
Sweden	Svenska
Switzerland	Deutsch
Thailand	English

Length

	Unit
Length	mm

21.2 US units (only for USA and Canada)

Low flow, full scale value, pulse value, totalizer

Nominal diameter		Low flow		Full scale value		Pulse value		Totalizer
[inch]	[mm]	(approx. v = 0.04 m/s)		(approx. v = 2.5 m/s)		(approx. 2 pulses/s at v = 2.5 m/s)		
$^{1}/_{12}$"	2	0.002	gal/min	0.1	gal/min	0.001	gal	gal
$^{5}/_{32}$"	4	0.008	gal/min	0.5	gal/min	0.005	gal	gal
$^{5}/_{16}$"	8	0.025	gal/min	2	gal/min	0.02	gal	gal
$^{1}/_{2}$"	15	0.10	gal/min	6	gal/min	0.05	gal	gal
1"	25	0.25	gal/min	18	gal/min	0.20	gal	gal
1 $^{1}/_{4}$"	32	0.50	gal/min	30	gal/min	0.20	gal	gal
1 $^{1}/_{2}$"	40	0.75	gal/min	50	gal/min	0.50	gal	gal
2"	50	1.25	gal/min	75	gal/min	0.50	gal	gal
2 $^{1}/_{2}$"	65	2.0	gal/min	130	gal/min	1	gal	gal
3"	80	2.5	gal/min	200	gal/min	2	gal	gal
4"	100	4.0	gal/min	300	gal/min	2	gal	gal
5"	125	7.0	gal/min	450	gal/min	5	gal	gal
6"	150	12	gal/min	600	gal/min	5	gal	gal
8"	200	15	gal/min	1200	gal/min	10	gal	gal
10"	250	30	gal/min	1500	gal/min	15	gal	gal
12"	300	45	gal/min	2400	gal/min	25	gal	gal
14"	350	60	gal/min	3600	gal/min	30	gal	gal
16"	400	60	gal/min	4800	gal/min	50	gal	gal
18"	450	90	gal/min	6000	gal/min	50	gal	gal
20"	500	120	gal/min	7500	gal/min	75	gal	gal
24"	600	180	gal/min	10500	gal/min	100	gal	gal
28"	700	210	gal/min	13500	gal/min	125	gal	gal
30"	–	270	gal/min	16500	gal/min	150	gal	gal
32"	800	300	gal/min	19500	gal/min	200	gal	gal
36"	900	360	gal/min	24000	gal/min	225	gal	gal
40"	1000	480	gal/min	30000	gal/min	250	gal	gal
42"	–	600	gal/min	33000	gal/min	250	gal	gal
48"	1200	600	gal/min	42000	gal/min	400	gal	gal
54"	–	1.3	Mgal/d	75	Mgal/d	0.0005	Mgal	Mgal
–	1400	1.3	Mgal/d	85	Mgal/d	0.0005	Mgal	Mgal
60"	–	1.3	Mgal/d	95	Mgal/d	0.0005	Mgal	Mgal
–	1600	1.7	Mgal/d	110	Mgal/d	0.0008	Mgal	Mgal
66"	–	2.2	Mgal/d	120	Mgal/d	0.0008	Mgal	Mgal
72"	1800	2.6	Mgal/d	140	Mgal/d	0.0008	Mgal	Mgal
78"	–	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal
–	2000	3.0	Mgal/d	175	Mgal/d	0.001	Mgal	Mgal

Language, length

	Unit
Language	English
Length	inch

22 Index of key words

Z

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Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Technical Information

Proline Promag 50P, 53P

Electromagnetic Flow Measuring System
Flow measurement of liquids in chemical or process applications

Application
Electromagnetic flowmeter for bidirectional measurement of liquids with a minimum conductivity of ≥ 5 µS/cm:

- Acid, alkalis
- Paints
- Pastes
- Water, wastewater etc.

- Flow measurement up to 9600 m³/h (42268 gal/min)
- Fluid temperature up to +180 °C (356 °F)
- Process pressures up to 40 bar (580 psi)
- Lengths in accordance with DVGW/ISO

Application-specific lining materials:
- PTFE
- PFA

Approvals for hazardous area:
- ATEX
- IECEx
- FM
- CSA
- NEPSI
- TIIS

Connection to process control system:
- HART
- PROFIBUS DP/PA
- FOUNDATION Fieldbus
- MODBUS RS485

Your benefits
Promag measuring devices offer you cost-effective flow measurement with a high degree of accuracy for a wide range of process conditions.

The uniform Proline transmitter concept comprises:
- Modular device and operating concept resulting in a higher degree of efficiency
- Software options for batching, electrode cleaning and for measuring pulsating flow
- High degree of reliability and measuring stability
- Uniform operating concept

The tried-and-tested Promag sensors offer:
- No pressure loss
- Not sensitive to vibrations
- Simple installation and commissioning

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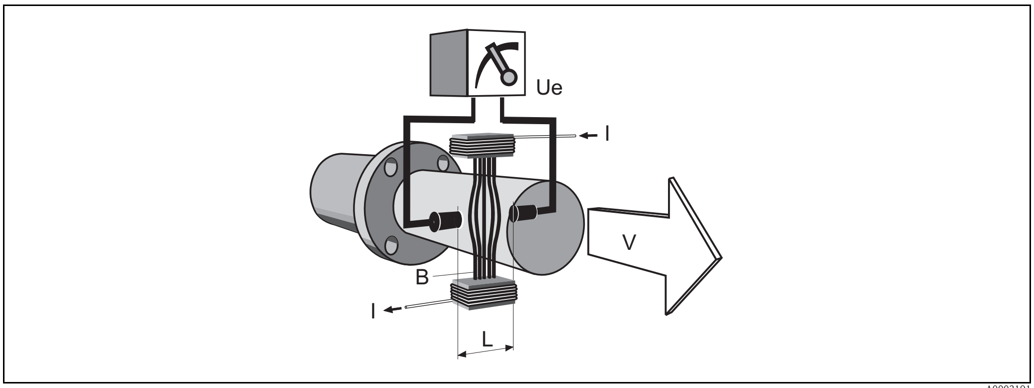
Table of contents

Function and system design

Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.
In the electromagnetic measuring principle, the flowing medium is the moving conductor.
The voltage induced is proportional to the flow velocity and is supplied to the amplifier by means of two measuring electrodes. The flow volume is calculated by means of the pipe cross-sectional area.
The DC magnetic field is created through a switched direct current of alternating polarity.



Ue = B · L · v
Q = A · v

Ue	*Induced voltage*
B	*Magnetic induction (magnetic field)*
L	*Electrode spacing*
v	*Flow velocity*
Q	*Volume flow*
A	*Pipe cross-section*
I	*Current strength*

Measuring system

The measuring system consists of a transmitter and a sensor.
Two versions are available:
- Compact version: Transmitter and sensor form a mechanical unit.
- Remote version: Sensor is mounted separate from the transmitter.

Transmitter:
- Promag 50 (user interface with push buttons for operation, two-line display, illuminated)
- Promag 53 ("Touch Control" without opening the housing, four-line display, unilluminated)

Sensor:
- Promag P (DN 15 to 600 / ½ to 24")

Input

Measured variable

Flow velocity (proportional to induced voltage)

Measuring ranges

Measuring ranges for liquids
Typically v = 0.01 to 10 m/s (0.03 to 33 ft/s) with the specified accuracy

Operable flow range

Over 1000 : 1

Input signal

Status input (auxiliary input)
- U = 3 to 30 V DC, R_i = 5 kΩ, galvanically isolated
- Configurable for: totalizer(s) reset, measured value suppression, error-message reset

Status input (auxiliary input) with PROFIBUS DP and MODBUS RS485
- U = 3 to 30 V DC, R_i = 3 kΩ, galvanically isolated
- Switching level: 3 to 30 V DC, independent of polarity
- Configurable for: totalizer(s) reset, measured value suppression, error-message reset, batching start/stop (optional), batch totalizer reset (optional)

Current input (only Promag 53)
- active/passive selectable, galvanically isolated, full scale value selectable, resolution: 3 µA, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading)
- active: 4 to 20 mA, $R_i \leq 150\ \Omega$, max. 24 V DC, short-circuit-proof
- passive: 0/4 to 20 mA, $R_i < 150\ \Omega$, max. 30 V DC

Output

Output signal

Promag 50

Current output
active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s), full scale value selectable, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading), resolution: 0.5 µA
- active: 0/4 to 20 mA, $R_L < 700\ \Omega$ (HART: $R_L \geq 250\ \Omega$)
- passive: 4 to 20 mA, operating voltage V_S: 18 to 30 V DC, $R_i \geq 150\ \Omega$

Pulse/frequency output
passive, open collector, 30 V DC, 250 mA, galvanically isolated
- Frequency output: full scale frequency 2 to 1000 Hz (f_{max} = 1250 Hz), on/off ratio 1:1, pulse width max. 10s
- Pulse output: pulse value and pulse polarity selectable, max. pulse width configurable (0.5 to 2000 ms)

PROFIBUS DP interface
- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- Profil version 3.0
- Data transmission rate: 9,6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Function blocks: 1 × analog Input, 1 × totalizer
- Output data: volume flow, totalizer
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

PROFIBUS PA interface
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profil version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 1 × analog input, 2 × totalizer
- Output data: volume flow, totalizer
- Input data: positive zero return (ON/OFF), control totalizer, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

Promag 53

Current output

active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s),
full scale value selectable, temperature coefficient: typ. 0.005% o.r./°C (o.r. = of reading), resolution: 0.5 µA

- active: 0/4 to 20 mA, R_L < 700 Ω (HART: R_L ≥ 250 Ω)
- passive: 4 to 20 mA, operating voltage V_S: 18 to 30 V DC, R_i ≥ 150 Ω

Pulse/frequency output

active/passive selectable, galvanically isolated (Ex i version: only passive)

- 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_{max} = 12500 Hz), EEx-ia: 2 to 5000 Hz; on/off ratio 1:1, pulse width max. 10 s
- Pulse output: pulse value and pulse polarity selectable, max. pulse width configurable (0.05 to 2000 ms)

PROFIBUS DP interface

- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- Profil version 3.0
- Data transmission rate: 9,6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Function blocks: 2 × analog Input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Available output combination → 📄 8

PROFIBUS PA interface

- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profil version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 2 × analog input, 3 × totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 33
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

MODBUS RS485 interface

- Transmission technology (Physical Layer): RS485 in accordance with ANSI/TIA/EIA-485-A: 1998, galvanically isolated
- MODBUS device type: Slave
- Adress range: 1 to 247
- Bus address adjustable via miniature switches or local display (optional) at the measuring device
- Supported MODBUS function codes: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Übertragungsmodus: RTU oder ASCII
- Supported baudrate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Response time:
  – Direct data access = typically 25 to 50 ms
  – Auto-scan buffer (data range) = typically 3 to 5 ms
- Available output combination → 📄 8

FOUNDATION Fieldbus interface
- FOUNDATION Fieldbus H1
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- ITK version 5.01
- Current consumption: 12 mA
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Bus connection with integrated reverse polarity protection
- Function blocks:
  - 5 × Analog Input (execution time: 18 ms each)
  - 1 × PID (25 ms)
  - 1 × Digital Output (18 ms)
  - 1 × Signal Characterizer (20 ms)
  - 1 × Input Selector (20 ms)
  - 1 × Arithmetic (20 ms)
  - 1 × Integrator (18 ms)
- Output data: volume flow, calculated mass flow, temperature, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), reset totalizer
- Link Master (LM) functionality is supported

Signal on alarm

- Current output → failure response selectable (e.g. in accordance with NAMUR recommendation NE 43)
- Pulse/frequency output → failure response selectable
- Status output (Promag 50) → non-conductive by fault or power supply failure
- Relay output (Promag 53) → de-energized by fault or power supply failure

Load

see "Output signal"

Low flow cutoff

Switch points for low flow cutoff are selectable.

Galvanic isolation

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

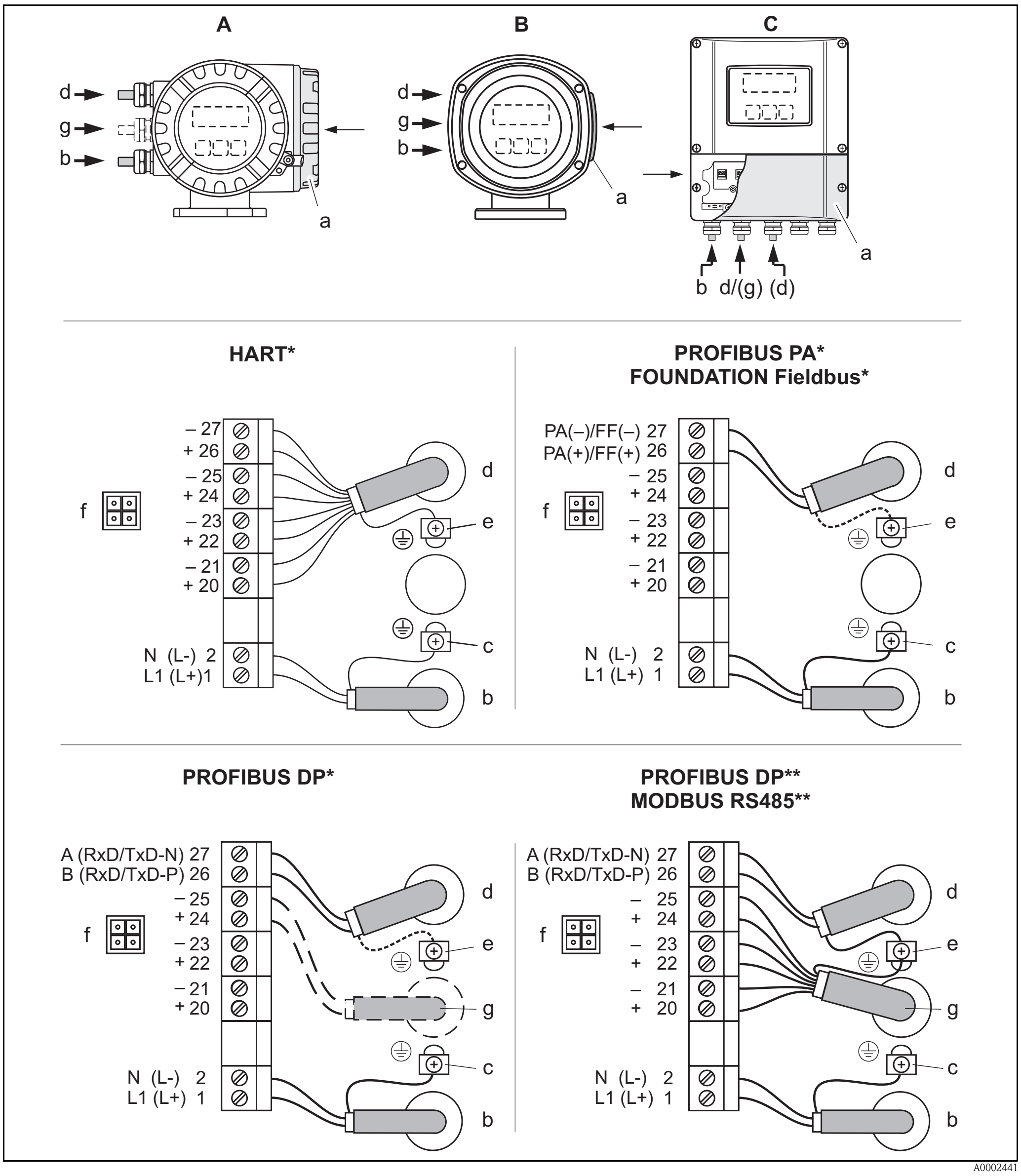
Switching output

Status output (Promag 50, Promag 53)
Open collector, max. 30 V DC / 250 mA, galvanically isolated.
Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values.

Relay outputs (Promag 53)
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.
Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values, batching contacts.

Power supply

Electrical connection, measuring unit



Connecting the transmitter, cable cross-section max. 2.5 mm² (14 AWG)

A	*View A (field housing)*
B	*View B (stainless steel field housing)*
C	*View C (wall-mount housing)*

**)*	*fixed communication boards*
***)*	*flexible communication boards*
a	*Connection compartment cover*
b	*Cable for power supply: 85 to 260 V AC / 20 to 55 V AC / 16 to 62 V DC* *- Terminal No. 1: L1 for AC, L+ for DC* *- Terminal No. 2: N for AC, L– for DC*
c	*Ground terminal for protective conductor*
d	*Signal cable: see "Electrical connection, terminal assignment" → 🗎 8* *Fieldbus cable:* *- Terminal No. 26: DP (B) / PA + / FF + / MODBUS RS485 (B) / (PA, FF: with polarity protection)* *- Terminal No. 27: DP (A) / PA – / FF – / MODBUS RS485 (A) / (PA, FF: with polarity protection)*
e	*Ground terminal for signal cable shield / Fieldbus cable / RS485 line*
f	*Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)*
g	*Signal cable: see "Electrical connection, terminal assignment" → 🗎 8* *Cable for external termination (only for PROFIBUS DP with fixed assignment communication board):* *- Terminal No. 24: +5 V* *- Terminal No. 25: DGND*

Electrical connection, terminal assignment

Terminal assignment, Promag 50

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (–)	22 (+) / 23 (–)	24 (+) / 25 (–)	26 (+) / 27 (–)
50***-***********W	–	–	–	Current output HART
50***-***********A	–	–	Frequency output	Current output HART
50***-***********D	Status input	Status output	Frequency output	Current output HART
50***-***********H	–	–	–	PROFIBUS PA
50***-***********J	–	–	+5 V (external termination)	PROFIBUS DP
50***-***********S	–	–	Frequency output, Ex i, passive	Current output, Ex i, passive, HART
50***-***********T	–	–	Frequency output, Ex i, passive	Current output, Ex i, passive, HART

Ground terminal → 🗎 7

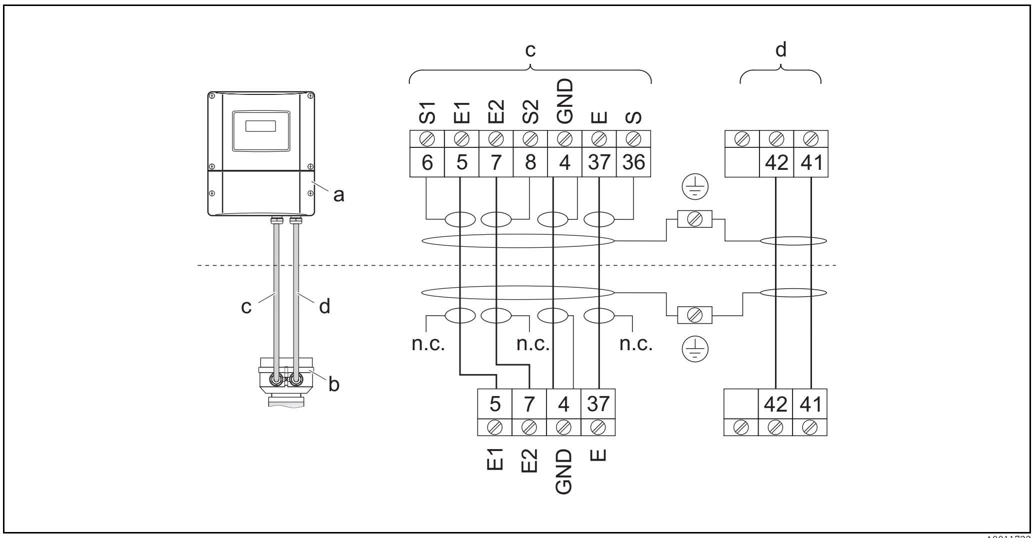
Terminal assignment, Promag 53

The inputs and outputs on the communication board can be either permanently assigned or variable, depending on the version ordered (see table). Replacements for modules which are defective or which have to be replaced can be ordered as accessories.

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (–)	22 (+) / 23 (–)	24 (+) / 25 (–)	26 (+) / 27 (–)
Fixed communication boards (fixed assignment)				
53***-***********A	–	–	Frequency output	Current output HART
53***-***********B	Relay output 2	Relay output 1	Frequency output	Current output HART
53***-***********F	–	–	–	PROFIBUS PA, Ex i
53***-***********G	–	–	–	FOUNDATION Fieldbus, Ex i
53***-***********H	–	–	–	PROFIBUS PA
53***-***********J	–	–	–	PROFIBUS DP
53***-***********K	–	–	–	FOUNDATION Fieldbus
53***-***********Q	–	–	Status input	MODBUS RS485
53***-***********S	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
53***-***********T	–	–	Frequency output, Ex i	Current output, Ex i, passive, HART
Flexible communication boards				
53***-***********C	Relay output 2	Relay output 1	Frequency output	Current output HART
53***-***********D	Status input	Relay output	Frequency output	Current output HART
53***-***********L	Status input	Relay output 2	Relay output 1	Current output HART
53***-***********M	Status input	Frequency output	Frequency output	Current output HART
53***-***********N	Current output	Frequency output	Status input	MODBUS RS485
53***-***********P	Current output	Frequency output	Status input	PROFIBUS DP
53***-***********V	Relay output 2	Relay output 1	Status input	PROFIBUS DP
53***-***********2	Relay output	Current output	Frequency output	Current output HART
53***-***********4	Current input	Relay output	Frequency output	Current output HART
53***-***********5	Status input	Current input	Frequency output	Current output HART
53***-***********7	Relay output 2	Relay output 1	Status input	MODBUS RS485

Ground terminal → 🗎 7

Electrical connection, remote version



A0011722

Connecting the remote version

a *Wall-mount housing connection compartment*
b *Sensor connection housing cover*
c *Signal cable*
d *Coil current cable*
n.c. *Not connected, insulated cable shields*
Terminal no. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

Supply voltage (power supply)

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

PROFIBUS PA and FOUNDATION Fieldbus
- Non-Ex: 9 to 32 V DC
- Ex i: 9 to 24 V DC
- Ex d: 9 to 32 V DC

Cable entry

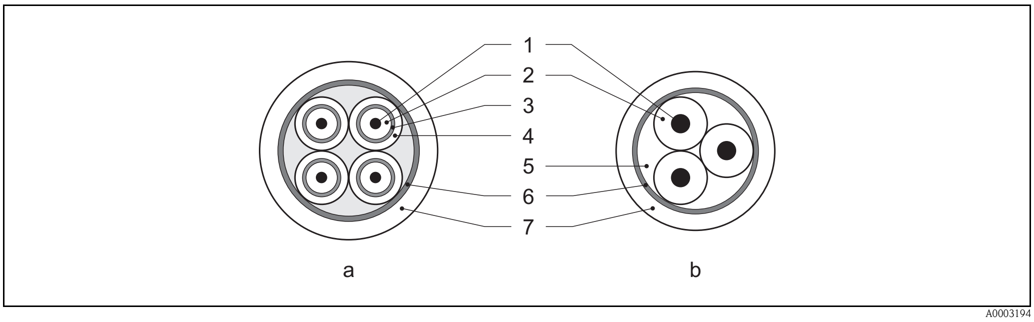
Power supply and signal cables (inputs/ outputs):
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Sensor cable entry for armoured cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63")
- Thread for cable entries, ½" NPT, G ½"

Connecting cable for remote version:
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Sensor cable entry for armoured cables M20 × 1.5 (9.5 to 16 mm / 0.37 to 0.63")
- Thread for cable entries, ½" NPT, G ½"

Remote version cable specifications

Coil cable
- 2 × 0.75 mm^2 (18 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28")
- Conductor resistance: ≤ 37 Ω/km (≤ 0.011 Ω/ft)
- Capacitance core/core, shield grounded: ≤ 120 pF/m (≤ 37 pF/ft)
- Operating temperature: –20 to +80 °C (–68 to +176 °F)
- Cable cross-section: max. 2.5 mm^2 (14 AWG)
- Test voltage for cable insulation: ≤ 1433 AC r.m.s. 50/60 Hz or ≥ 2026 V DC

Signal cable
- 3 × 0.38 mm^2 (20 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28") and individual shielded cores
- With empty pipe detection (EPD): 4 × 0.38 mm^2 (20 AWG) PVC cable with common, braided copper shield (∅ ~ 7 mm / 0.28") and individual shielded cores
- Conductor resistance: ≤ 50 Ω/km (≤ 0.015 Ω/ft)
- Capacitance core/shield: ≤ 420 pF/m (≤ 128 pF/ft)
- Operating temperature: –20 to +80 °C (–68 to +176 °F)
- Cable cross-section: max. 2.5 mm^2 (14 AWG)



a *Signal cable*
b *Coil current cable*

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

Operation in zones of severe electrical interference
The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326 and NAMUR recommendation NE 21.

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

Power consumption

- AC: < 15 VA (incl. sensor)
- DC: < 15 W (incl. sensor)

Switch-on current:

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

Power supply failure

Lasting min. ½ cycle frequency: EEPROM saves measuring system data

- EEPROM or T-DAT (Promag 53 only) retain the measuring system data in the event of a power supply failure
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)

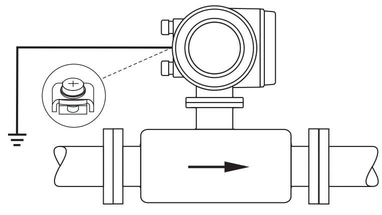
Potential equalization

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

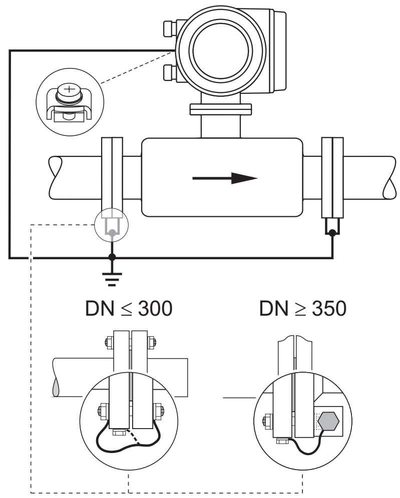
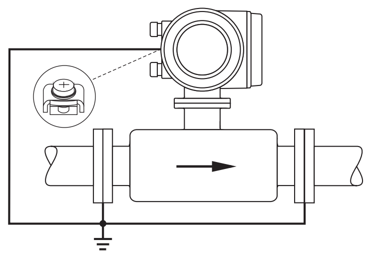
Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.

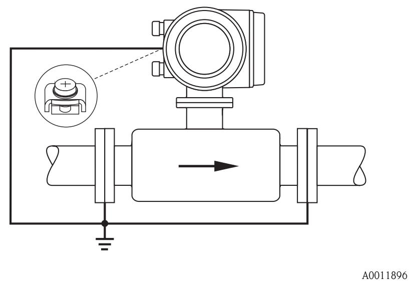
The following should also be taken into consideration for potential equalization:
- Internal grounding concepts in the company
- Operating conditions, such as the material/ grounding of the pipes (see table)

Standard situation

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal, grounded pipe Potential equalization takes place via the ground terminal of the transmitter. ✎ Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 A0011892 *Via the ground terminal of the transmitter*

Special situations

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal pipe that is not grounded This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured. ▪ Excessively high equalizing currents can be expected. Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, at least 6 mm² / 0.0093 in²) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. ▪ DN ≤ 300 (12"): the ground cable is mounted directly on the conductive flange coating with the flange screws. ▪ DN ≥ 350 (14"): the ground cable is mounted directly on the transportation metal support. ✎ Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 A0011893 *Via the ground terminal of the transmitter and the flanges of the pipe*
When using the measuring device in a: ▪ Plastic pipe ▪ Pipe with insulating lining This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured. ▪ Excessively high equalizing currents can be expected. Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, at least 6 mm² / 0.0093 in²). When installing the ground disks, please comply with the enclosed Installation Instructions.	 A0011895 *Via the ground terminal of the transmitter and the optionally available ground disks*

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Pipe with a cathodic protection unit The device is installed potential-free in the pipe. Only the two flanges of the pipe are connected with a ground cable (copper wire, at least 6 mm² / 0.0093 in²). Here, the ground cable is mounted directly on the conductive flange coating with flange screws. Note the following when installing: ▪ The applicable regulations regarding potential-free installation must be observed. ▪ There should be **no** electrically conductive connection between the pipe and the device. ▪ The mounting material must withstand the applicable torques.	 *Potential equalization and cathodic protection* *1 Power supply isolation transformer* *2 Electrically isolated*

Performance characteristics

Reference operating conditions

As per DIN EN 29104 and VDI/VDE 2641:
- Fluid temperature: +28 °C ± 2 K (+82 °F ± 2 K)
- Ambient temperature: +22 °C ±2 K (+72 °F ± 2 K)
- Warm-up period: 30 minutes

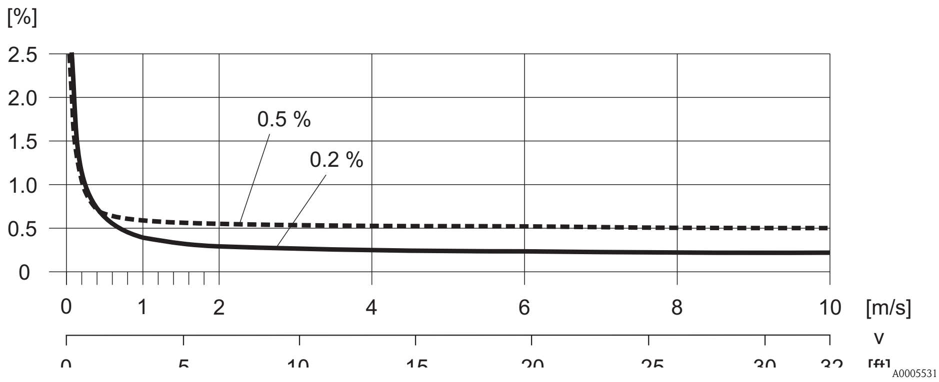
Installation conditions:
- Inlet run > 10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

Maximum measured error

Promag 50:
- Current output: also typically ± 5 µA
- Pulse output: ±0.5% o.r. ± 1 mm/s (±0.5% o.r. ± 0.04 in/s)
  optional: ±0.2% o.r. ± 2 mm/s (±0.2% o.r. ± 0.08 in/s) (o.r. = of reading)

Promag 53:
- Current output: also typically ± 5 µA
- Pulse output: ±0.2% o.r. ± 2 mm/s (±0.2% o.r. ± 0.08 in/s) (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.



Max. measured error in % of reading

Repeatability

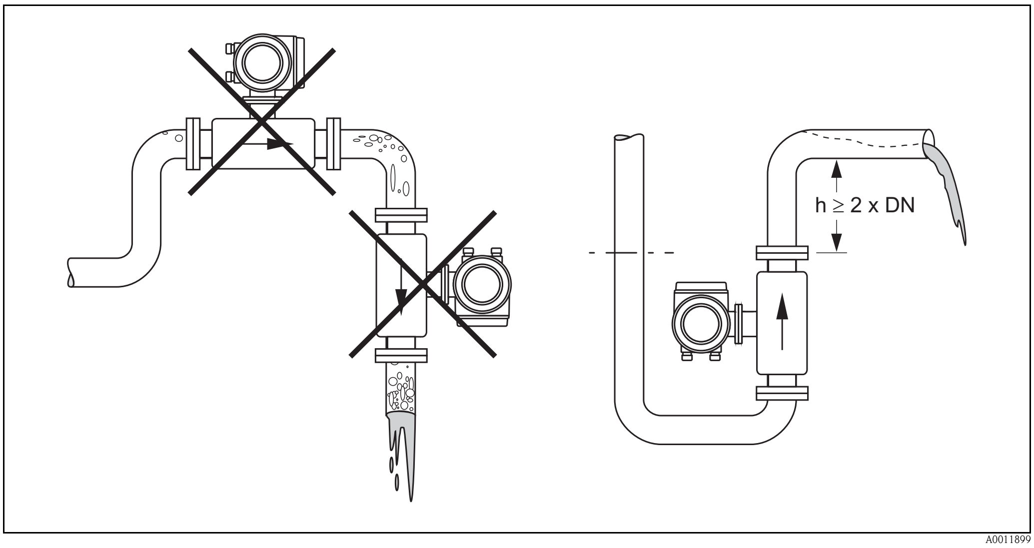
Max. ±0.1% o.r. ± 0.5 mm/s (±0.1% o.r. ± 0.02 in/s) (o.r. = of reading)

Operating conditions: Installations

Installation instructions

Mounting location

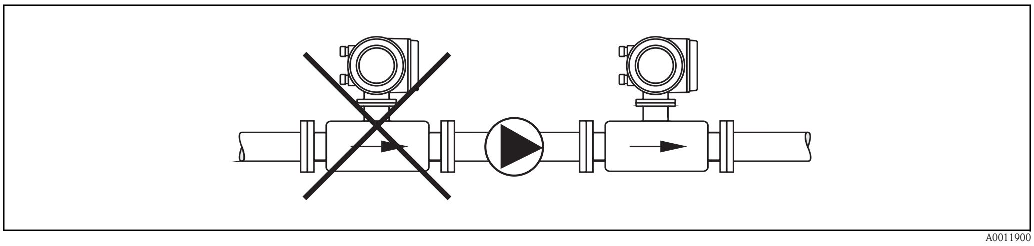
Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following installation locations in the pipe:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.



Mounting location

Installation of pumps

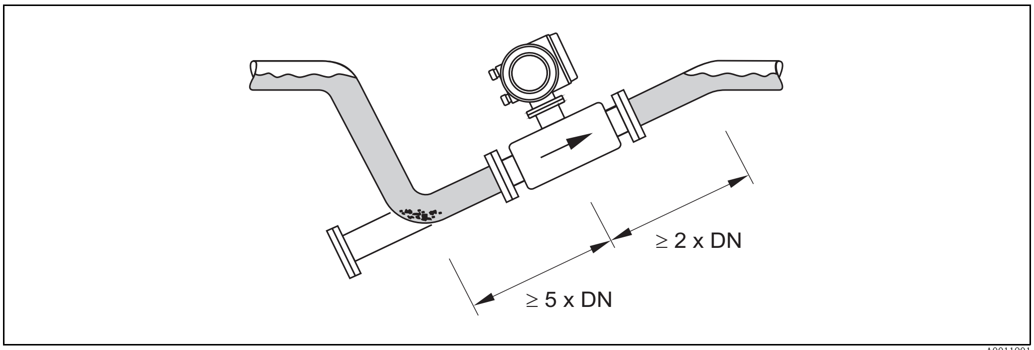
Sensors may not be installed on the pump suction side. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the pressure tightness of the measuring tube lining → 22, Section "Pressure tightness".
Pulsation dampers may be needed when using piston pumps, piston diaphragm pumps or hose pumps. Information on the shock and vibration resistance of the measuring system → 20, Section "Shock and vibration resistance".



Installation of pumps

Partially filled pipes
Partially filled pipes with gradients necessitate a drain-type configuration.
The empty pipe detection function (EPD) provides additional security in detecting empty or partially filled pipes.

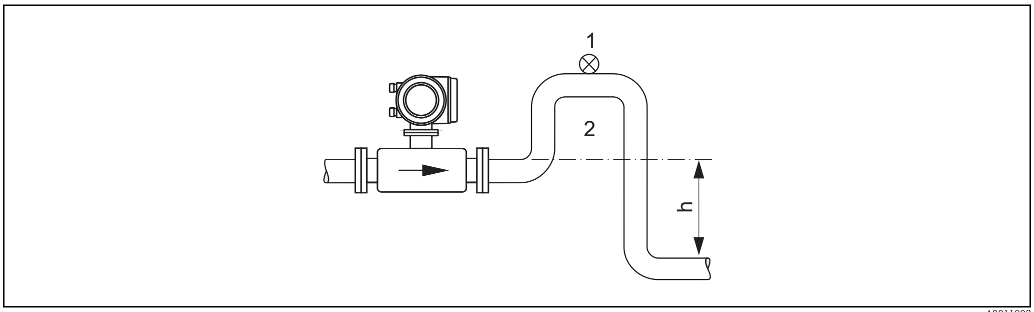
Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.



A0011901

Installation with partially filled pipes

Down pipes
Install a siphon or a vent valve downstream of the sensor in down pipes h ≥ 5 m (16.4 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 liquid current stopping in the pipe which could cause air locks. Information on the pressure tightness of the measuring tube lining → 🗎 22, Section "Pressure tightness".



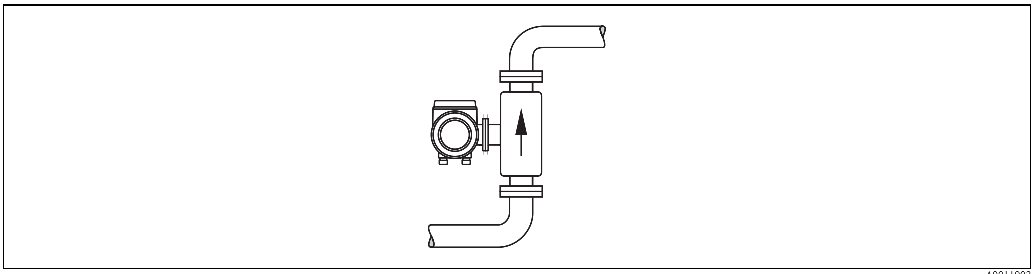
A0011902

Installation measures for vertical pipes

1 Vent valve
2 Pipe siphon
h Length of the down pipe

Orientation
An optimum orientation helps avoid gas and air accumulations and deposits in the measuring tube. However, the measuring device also offers the additional function of empty pipe detection (EPD) for detecting partially filled measuring tubes or if outgassing fluids or fluctuating operating pressures are present.

Vertical orientation
This is the ideal orientation for self-emptying piping systems and for use in conjunction with empty pipe detection.

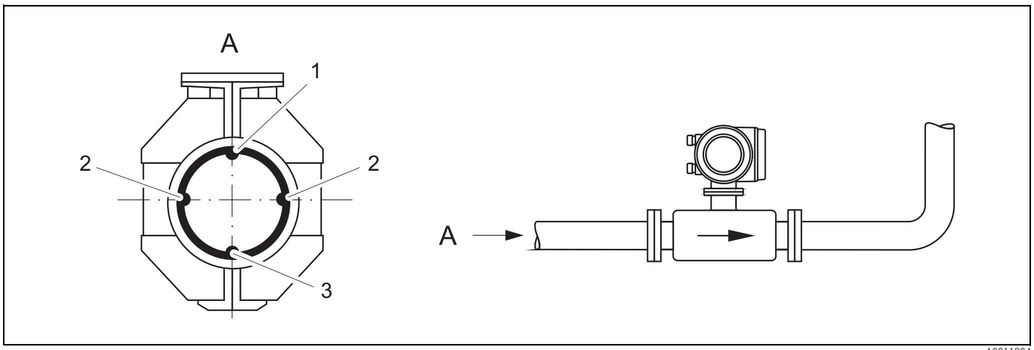


A0011903

Vertical orientation

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

Caution!
Empty pipe detection only works correctly with horizontal orientation if the transmitter housing is facing upwards. Otherwise there is no guarantee that empty pipe detection will respond if the measuring tube is only partially filled or empty.



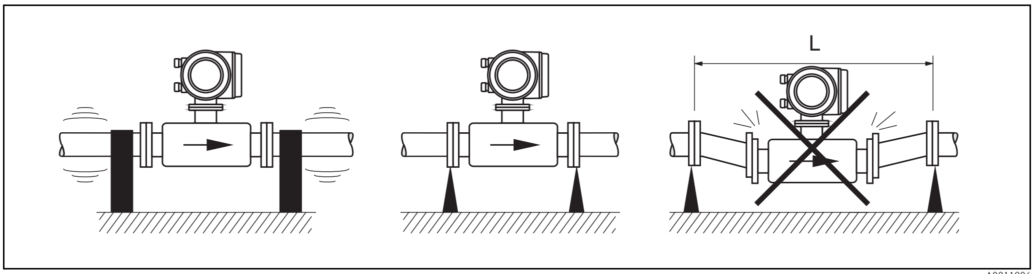
A0011904

Horizontal orientation

1 EPD electrode for empty pipe detection
2 Measuring electrodes for signal detection
3 Reference electrode for potential equalization

Vibrations
Secure the piping and the sensor if vibration is severe.

Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on the permitted shock and vibration resistance → 🗎 20, Section "Shock and vibration resistance".



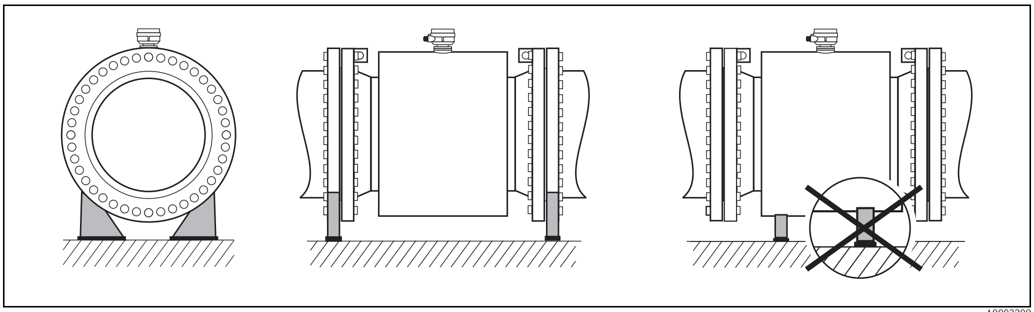
A0011906

Measures to prevent vibration of the measuring device

L > 10 m (33 ft)

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

Caution!
Do not allow the casing to take the weight of the sensor. This would buckle the casing and damage the internal magnetic coils.

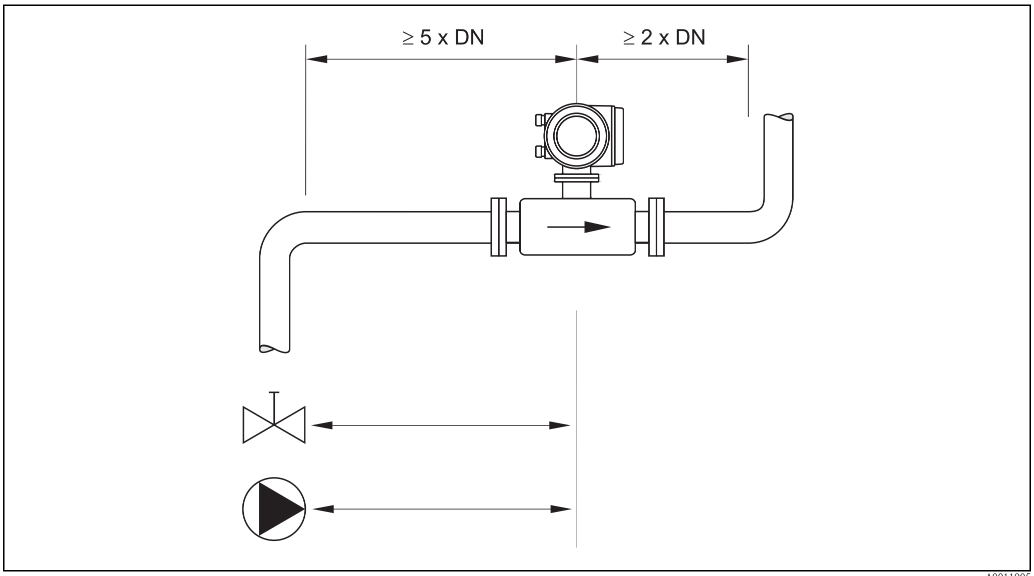


A0003209

Inlet and outlet run

If possible, install the sensor well clear of assemblies such as valves, T-pieces, elbows etc.

Note the following inlet and outlet runs to comply with measuring accuracy specifications:
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN



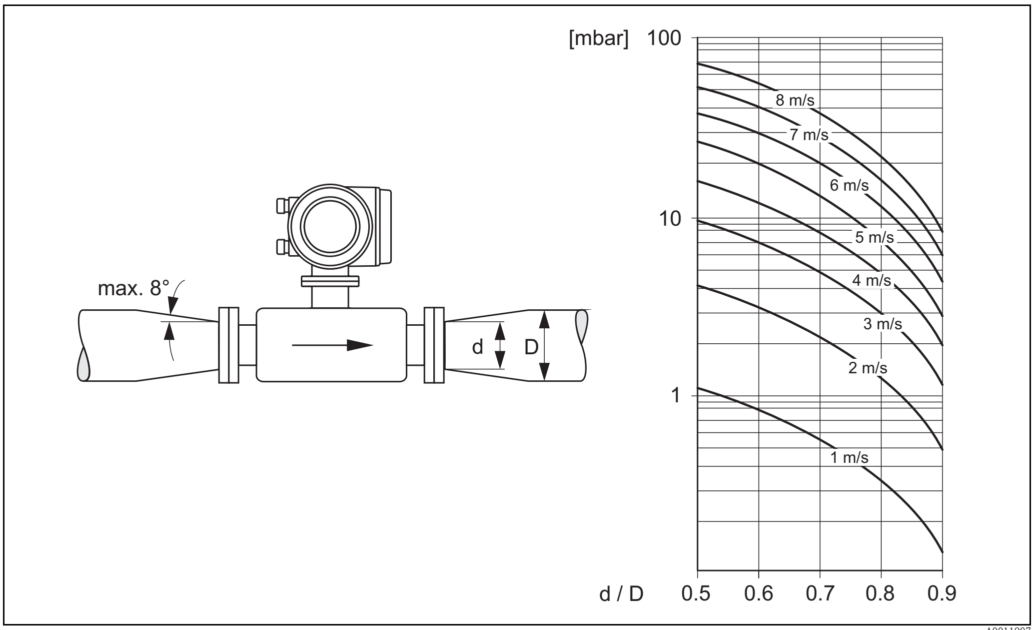
Inlet and outlet run

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 reducers and expanders.

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 flow velocity (downstream from the reduction) and the d/D ratio.

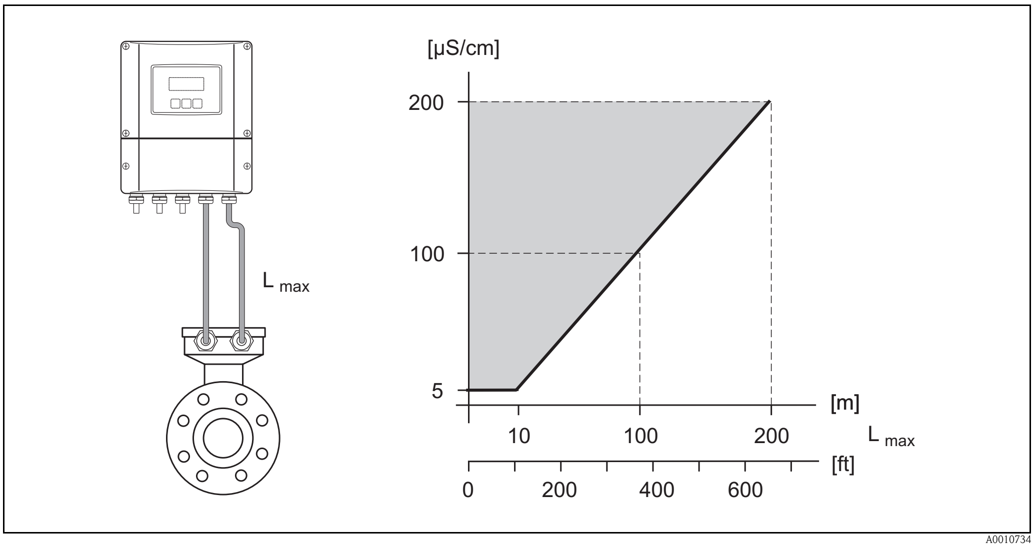


Pressure loss due to adapters

Length of connecting cable

When mounting the remote version, please note the following to achieve correct measuring results:

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- If necessary, ensure potential equalization between sensor and transmitter.
- The permitted cable length L_{max} is determined by the fluid conductivity. A minimum conductivity of 20 µS/cm is required for measuring demineralized water.
- When the empty pipe detection function is switched on (EPD), the maximum connecting cable length is 10 m (33 ft).



Permitted length of connecting cable for remote version
Area marked in gray = permitted range; L_{max} = length of connecting cable in [m] ([ft]); fluid conductivity in [µS/cm]

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!
The permitted temperature range of the measuring tube lining may not be undershot or overshot → 21, Section "Medium temperature range".

Please note the following points:
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.
- Do not remove the protective plates or caps on the process connections until the device is ready to install.

Degree of protection

- Standard: IP 67 (NEMA 4X) for transmitter and sensor.
- Optional: IP 68 (NEMA 6P) for sensor for remote version.
- For information regarding applications where the device is buried directly in the soil or is installed in a flooded wastewater basin please contact your local Endress+Hauser Sales Center.

Shock and vibration resistance

Acceleration up to 2 g following IEC 600 68-2-6

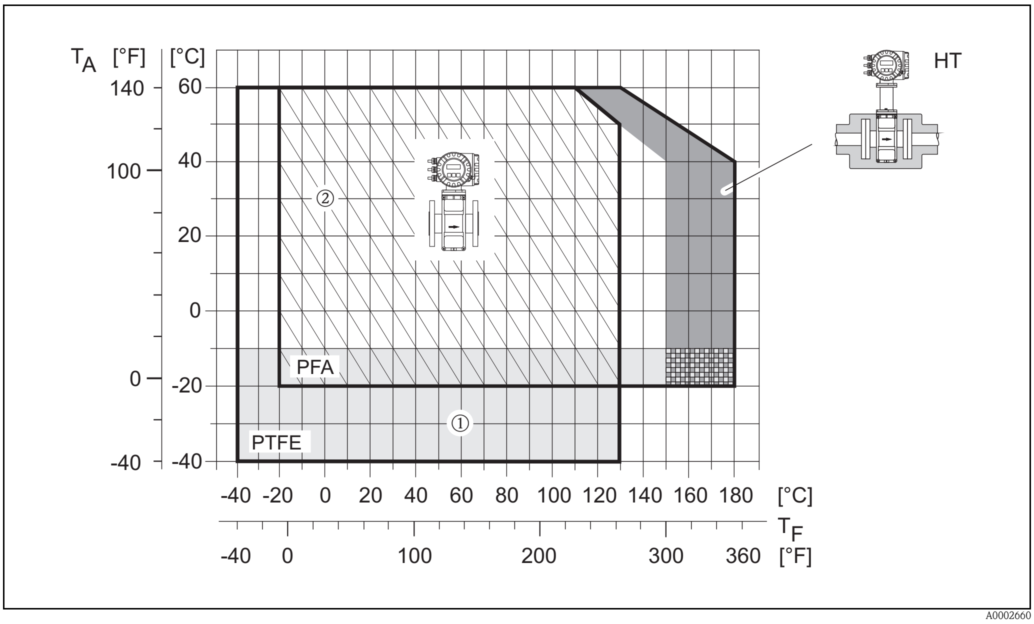
Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR recommendation NE 21.

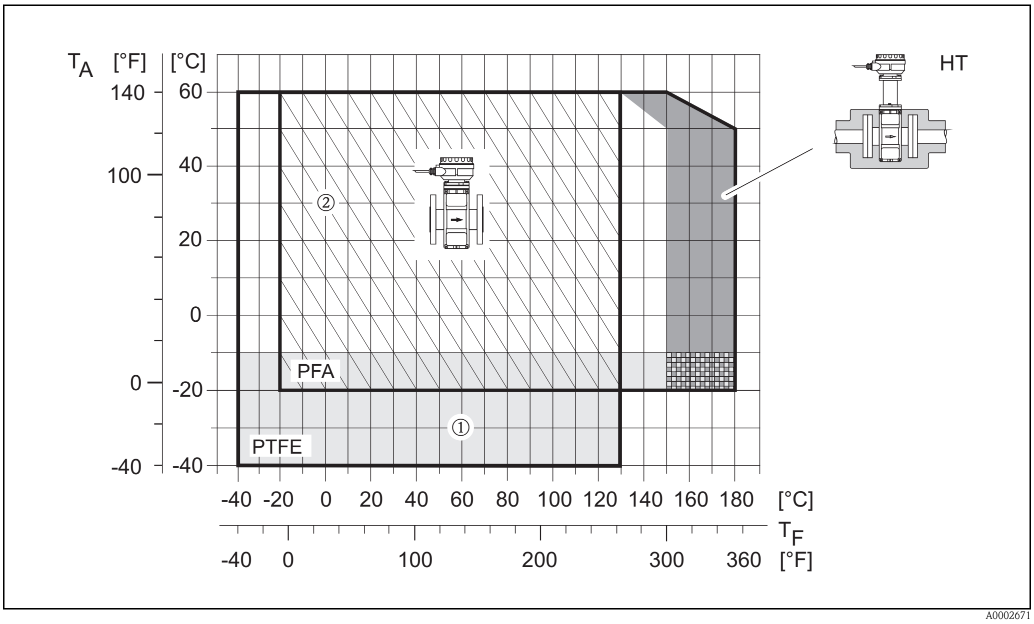
Operating conditions: Process

Medium temperature range

The permitted temperature depends on the lining of the measuring tube:
- PTFE: –40 to +130 °C (–40 to +266 °F) (DN 15 to 600 / ½ to 24"), restrictions → see diagrams
- PFA: –20 to +180 °C (–4 to +356 °F) (DN 25 to 200 / 1 to 8"), restrictions → see diagrams



Compact version (with PFA or PTFE lining)
T_A = Ambient temperature, T_F = Fluid temperature, HT = High temperature version with insulatio
① Gray shaded area → temperature range from –10 to –40 °C (–14 to –40 °F) applies only to stainless steel flanges
② HE + IP 68 to 130 °C (266 °F) only



Remote version (with PFA or PTFE lining)
T_A = Ambient temperature, T_F = Fluid temperature, HT = High temperature version with insulatio
① Gray shaded area → temperature range from –10 to –40 °C (–14 to –40 °F) applies only to stainless steel flanges
② HE + IP 68 to 130 °C (266 °F) only

Conductivity

The minimum conductivity is:
- ≥ 5 µS/cm for fluids generally
- ≥ 20 µS/cm for demineralized water

Note!
In the remote version, the necessary minimum conductivity also depends on the cable length
(→ 19, Section "Length of connecting cable").

Medium pressure range (nominal pressure)

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 25 (DN 200 to 600 / 8 to 24")
  - PN 40 (DN 15 to 150 / ½ to 6")
- ANSI B 16.5
  - Class 150 (DN ½ to 24")
  - Class 300 (DN ½ to 6")
- JIS B2220
  - 10 K (DN 50 to 300 / 2 to 12")
  - 20 K (DN 15 to 300 / ½ to 12")
- AS 2129
  - Table E (DN 25, 50 / 1", 2")
- AS 4087
  - PN 16 (DN 50 / 2")

Pressure tightness

Measuring tube lining: PTFE

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:							
		25 °C (77 °F)		80 °C (176 °F)		100 °C (212 °F)		130 °C (266 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]
15	½"	0	0	0	0	0	0	100	1.45
25	1"	0	0	0	0	0	0	100	1.45
32	–	0	0	0	0	0	0	100	1.45
40	1½"	0	0	0	0	0	0	100	1.45
50	2"	0	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	10.6
400	16"	540	7.83	*	*	670	9.72	800	11.6
450	18"	Partial vacuum is impermissible!							
500	20"								
600	24"								

* No value can be specified.

Measuring tube lining: PFA

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:					
		25 °C (77 °F)		80 °C (176 °F)		100 to 180 °C (212 to 356 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]
25	1"	0	0	0	0	0	0
32	–	0	0	0	0	0	0
40	1½"	0	0	0	0	0	0
50	2"	0	0	0	0	0	0
65	–	0	0	*	*	0	0
80	3"	0	0	*	*	0	0
100	4"	0	0	*	*	0	0
125	–	0	0	*	*	0	0
150	6"	0	0	*	*	0	0
200	8"	0	0	*	*	0	0

* No value can be specified.

Limiting flow

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor.
The optimum flow velocity is between 2 to 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 (6.5 ft/s): for abrasive fluids such as potter's clay, lime milk, ore slurry etc.
- v > 2 m/s (6.5 ft/s): for fluids causing build-up such as wastewater sludges etc.

Flow characteristic values (SI units)					
Diameter		Recommended flow rate	Factory settings		
[mm]	[inch]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value, current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow cut off (v ~ 0.04 m/s)
15	½"	4 to 100 dm^3/min	25 dm^3/min	0.20 dm^3	0.50 dm^3/min
25	1"	9 to 300 dm^3/min	75 dm^3/min	0.50 dm^3	1.00 dm^3/min
32	–	15 to 500 dm^3/min	125 dm^3/min	1.00 dm^3	2.00 dm^3/min
40	1½"	25 to 700 dm^3/min	200 dm^3/min	1.50 dm^3	3.00 dm^3/min
50	2"	35 to 1100 dm^3/min	300 dm^3/min	2.50 dm^3	5.00 dm^3/min
65	–	60 to 2000 dm^3/min	500 dm^3/min	5.00 dm^3	8.00 dm^3/min
80	3"	90 to 3000 dm^3/min	750 dm^3/min	5.00 dm^3	12.0 dm^3/min
100	4"	145 to 4700 dm^3/min	1200 dm^3/min	10.0 dm^3	20.0 dm^3/min
125	–	220 to 7500 dm^3/min	1850 dm^3/min	15.0 dm^3	30.0 dm^3/min
150	6"	20 to 600 m^3/h	150 m^3/h	0.03 m^3	2.50 m^3/h
200	8"	35 to 1100 m^3/h	300 m^3/h	0.05 m^3	5.00 m^3/h
250	10"	55 to 1700 m^3/h	500 m^3/h	0.05 m^3	7.50 m^3/h
300	12"	80 to 2400 m^3/h	750 m^3/h	0.10 m^3	10.0 m^3/h
350	14"	110 to 3300 m^3/h	1000 m^3/h	0.10 m^3	15.0 m^3/h
400	16"	140 to 4200 m^3/h	1200 m^3/h	0.15 m^3	20.0 m^3/h
450	18"	180 to 5400 m^3/h	1500 m^3/h	0.25 m^3	25.0 m^3/h
500	20"	220 to 6600 m^3/h	2000 m^3/h	0.25 m^3	30.0 m^3/h
600	24"	310 to 9600 m^3/h	2500 m^3/h	0.30 m^3	40.0 m^3/h

Flow characteristic values (US units)					
Diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value, current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow cut off (v ~ 0.04 m/s)
½"	25	1.0 to 26 gal/min	6 gal/min	0.10 gal	0.15 gal/min
1"	25	2.5 to 80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1½"	40	7 to 190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10 to 300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
3"	80	24 to 800 gal/min	200 gal/min	2.00 gal	2.50 gal/min
4"	100	40 to 1250 gal/min	300 gal/min	2.00 gal	4.00 gal/min
6"	150	90 to 2650 gal/min	600 gal/min	5.00 gal	12.0 gal/min
8"	200	155 to 4850 gal/min	1200 gal/min	10.0 gal	15.0 gal/min
10"	250	250 to 7500 gal/min	1500 gal/min	15.0 gal	30.0 gal/min
12"	300	350 to 10600 gal/min	2400 gal/min	25.0 gal	45.0 gal/min
14"	350	500 to 15000 gal/min	3600 gal/min	30.0 gal	60.0 gal/min
16"	400	600 to 19000 gal/min	4800 gal/min	50.0 gal	60.0 gal/min
18"	450	800 to 24000 gal/min	6000 gal/min	50.0 gal	90.0 gal/min
20"	500	1000 to 30000 gal/min	7500 gal/min	75.0 gal	120.0 gal/min
24"	600	1400 to 44000 gal/min	10500 gal/min	100.0 gal	180.0 gal/min

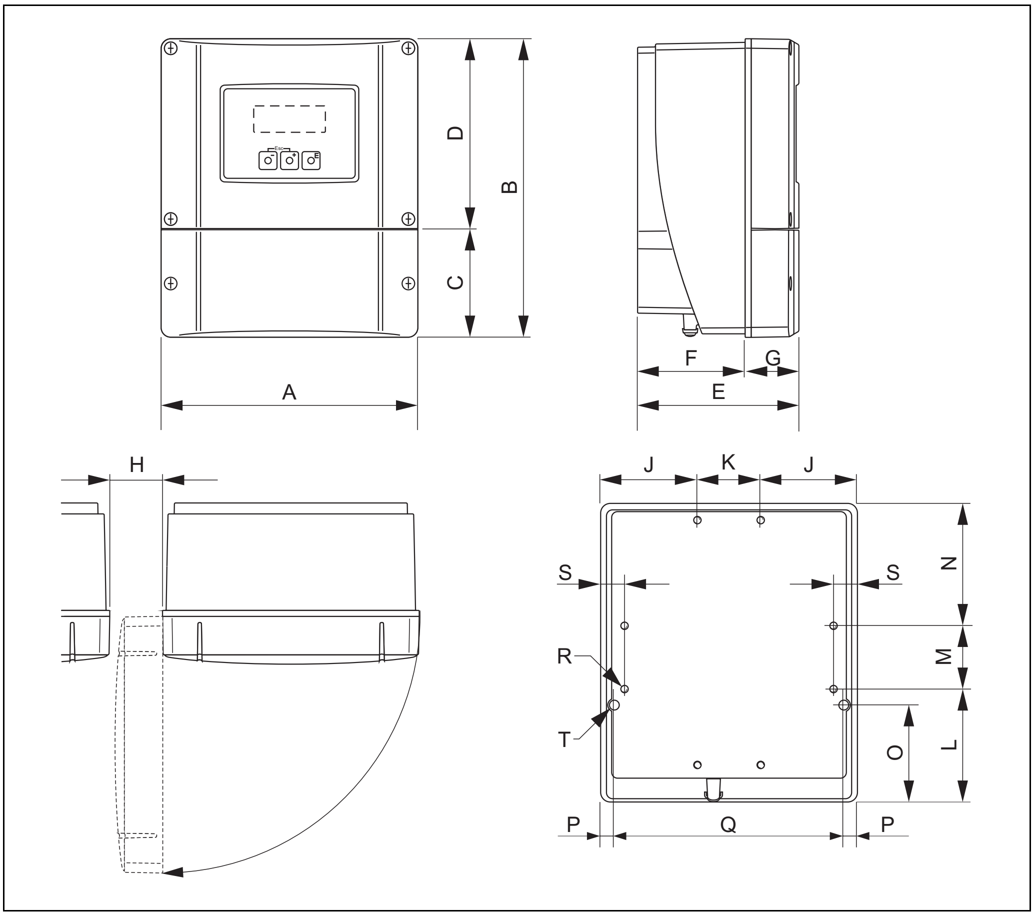
Pressure loss

- No pressure loss if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 (→ 🗎 18, Section "Adapters").

Mechanical construction

Design, dimensions

Transmitter remote version, wall-mount housing (non Ex-zone and II3G/Zone 2)



A0001150

Dimensions (SI units)

A	B	C	D	E	F	G	H	J
215	250	90.5	159.5	135	90	45	> 50	81
K	L	M	N	O	P	Q	R	S
53	95	53	102	81.5	11.5	192	8 × M5	20

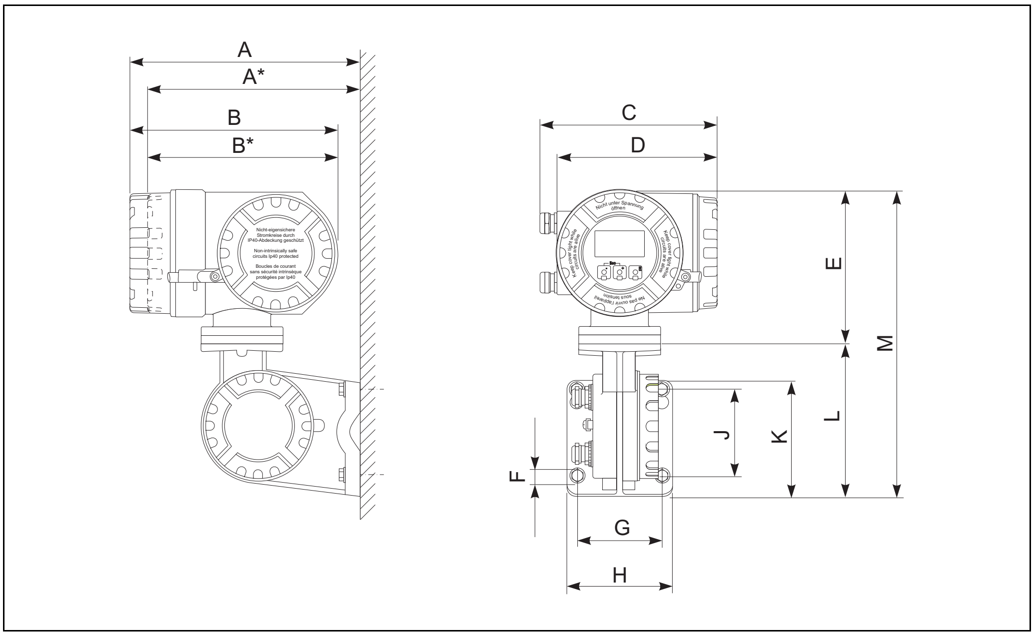
All dimensions in [mm]

Dimensions (US units)

A	B	C	D	E	F	G	H	J
8.46	9.84	3.56	6.27	5.31	3.54	1.77	> 1.97	3.18
K	L	M	N	O	P	Q	R	S
2.08	3.74	2.08	4.01	3.20	0.45	7.55	8 × M5	0.79

All dimensions in [inch]

Transmitter remote version, connection housing (II2GD/Zone 1)



A0002128

Dimensions (SI units)

A	A*	B	B*	C	D	E	Ø F	G	H	J	K	L	M
265	242	240	217	206	186	178	8.6 (M8)	100	130	100	144	170	355

All dimensions in [mm]

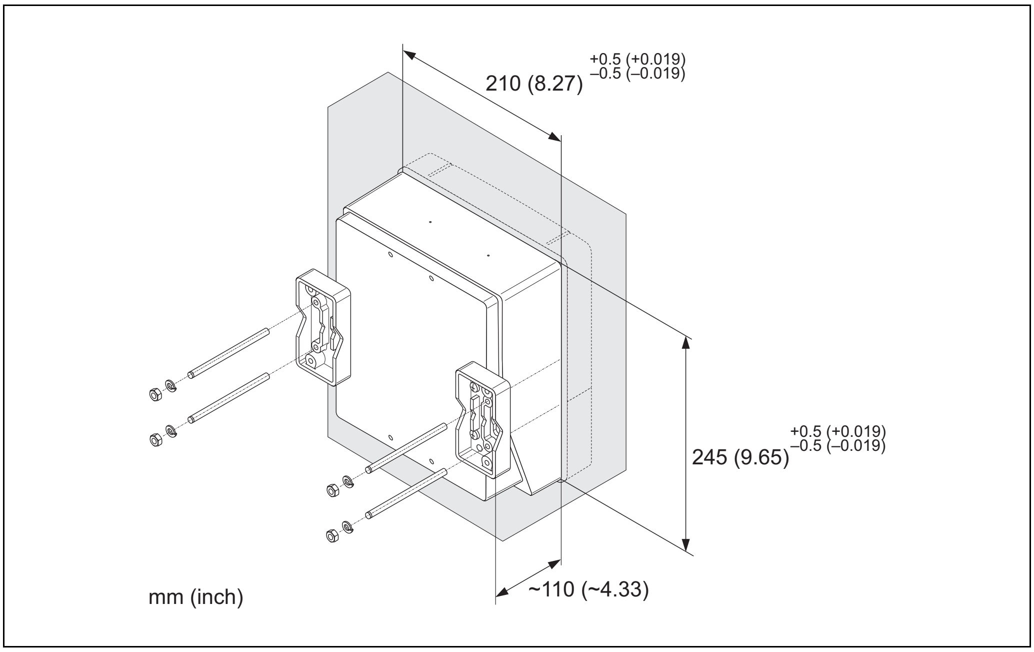
Dimensions (US units)

A	A*	B	B*	C	D	E	Ø F	G	H	J	K	L	M
10.4	9.53	9.45	8.54	8.11	7.32	7.01	0.34 (M8)	3.94	5.12	3.94	5.67	6.69	14.0

All dimensions in [inch]

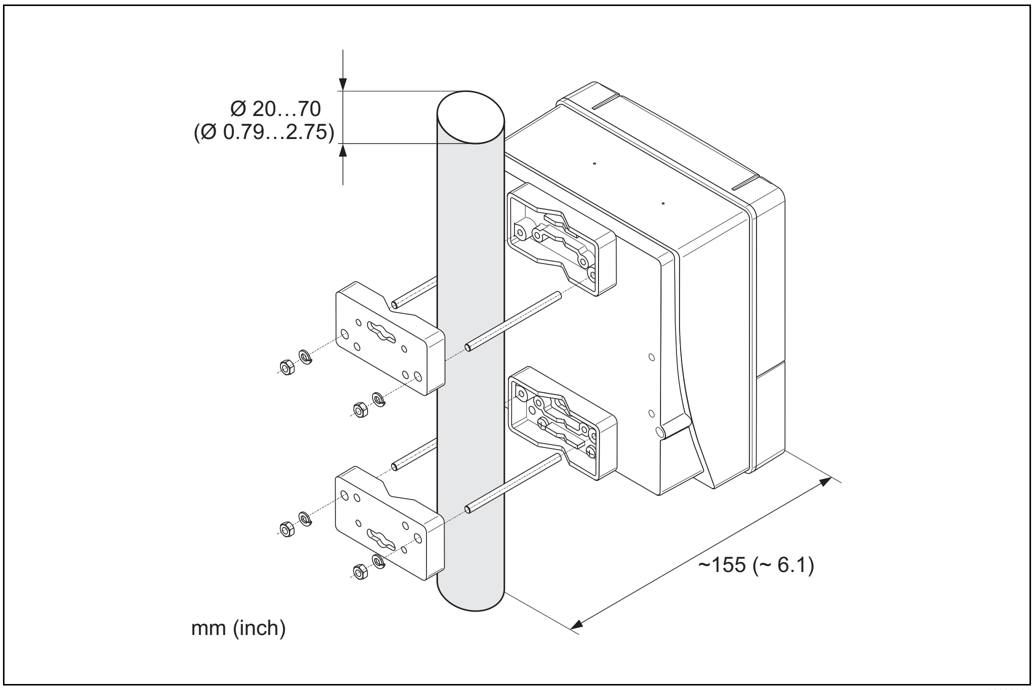
There is a separate mounting kit for the wall-mounted housing. It can be ordered from Endress+Hauser as an accessory. The following installation variants are possible:
- Panel-mounted installation
- Pipe mounting

Installation in control panel



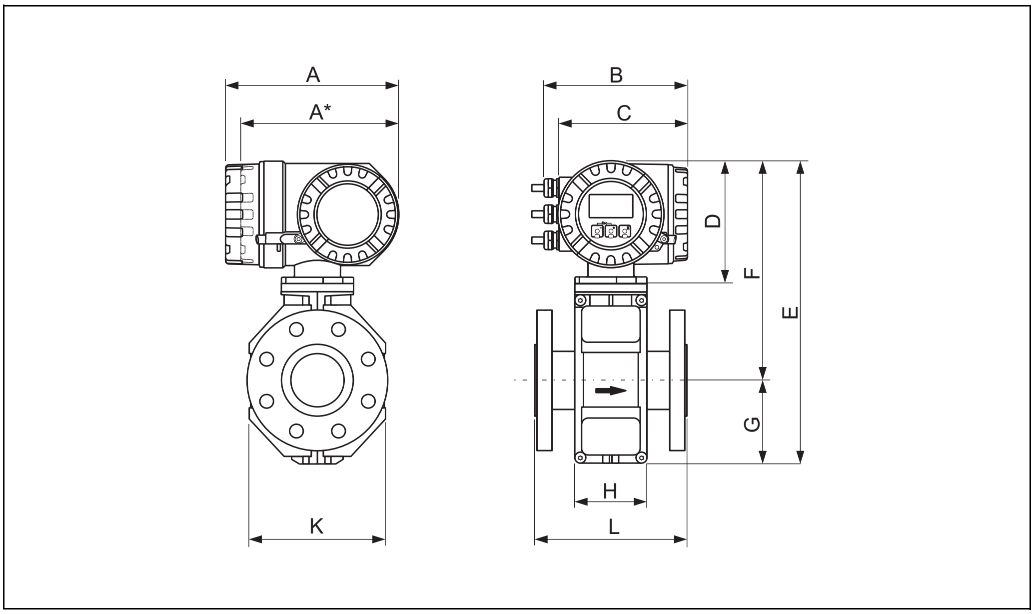
A0001131

Pipe mounting



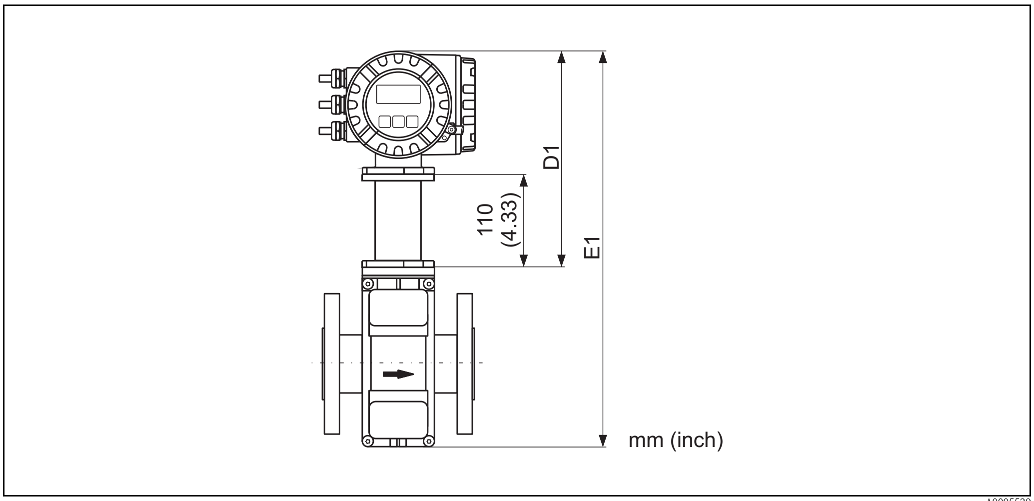
A0001132

Compact version DN ≤ 300 (12")



A0005423

High temperature version DN ≤ 300 (12")



A0005529

Measurement D1, E1 = Measurement D, E of the standard compact version plus 110 mm (4.33")

Dimensions (SI units)

<table>
<tr><th>DN
EN (DIN) / JIS / AS [2)]</th><th>L [1)]</th><th>A</th><th>A*</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>K</th></tr>
<tr><td>15</td><td>200</td><td rowspan="13">227</td><td rowspan="13">207</td><td rowspan="13">187</td><td rowspan="13">168</td><td rowspan="13">160</td><td>341</td><td>257</td><td>84</td><td>94</td><td>120</td></tr>
<tr><td>25</td><td>200</td><td>341</td><td>257</td><td>84</td><td>94</td><td>120</td></tr>
<tr><td>32</td><td>200</td><td>341</td><td>257</td><td>84</td><td>94</td><td>120</td></tr>
<tr><td>40</td><td>200</td><td>341</td><td>257</td><td>84</td><td>94</td><td>120</td></tr>
<tr><td>50</td><td>200</td><td>341</td><td>257</td><td>84</td><td>94</td><td>120</td></tr>
<tr><td>65</td><td>200</td><td>391</td><td>282</td><td>109</td><td>94</td><td>180</td></tr>
<tr><td>80</td><td>200</td><td>391</td><td>282</td><td>109</td><td>94</td><td>180</td></tr>
<tr><td>100</td><td>250</td><td>391</td><td>282</td><td>109</td><td>94</td><td>180</td></tr>
<tr><td>125</td><td>250</td><td>472</td><td>322</td><td>150</td><td>140</td><td>260</td></tr>
<tr><td>150</td><td>300</td><td>472</td><td>322</td><td>150</td><td>140</td><td>260</td></tr>
<tr><td>200</td><td>350</td><td>527</td><td>347</td><td>180</td><td>156</td><td>324</td></tr>
<tr><td>250</td><td>450</td><td>577</td><td>372</td><td>205</td><td>166</td><td>400</td></tr>
<tr><td>300</td><td>500</td><td>627</td><td>397</td><td>230</td><td>166</td><td>460</td></tr>
</table>

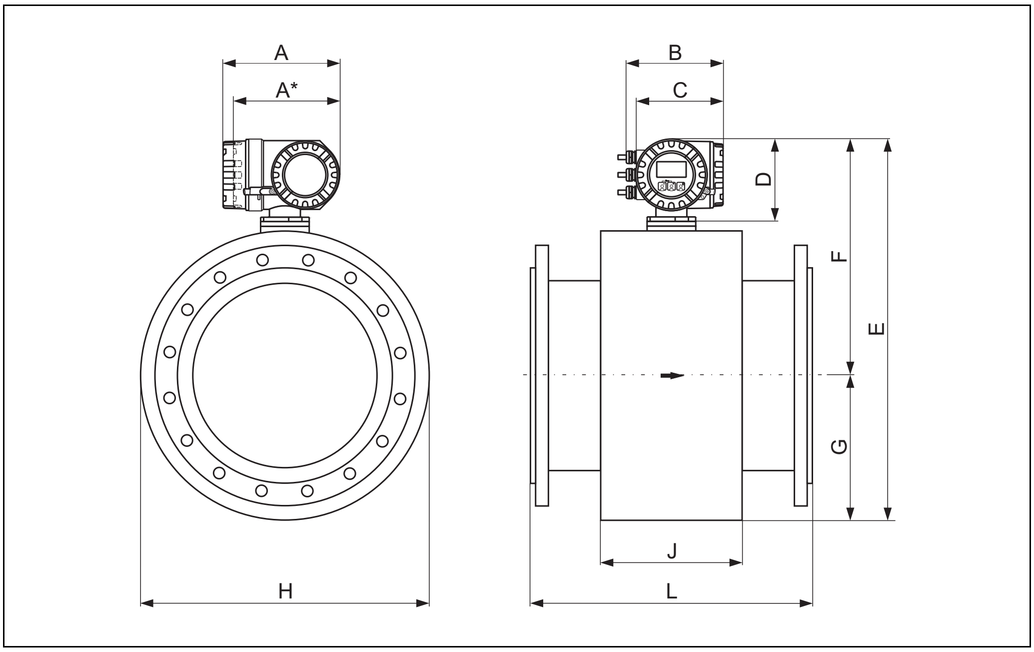
[1)] The length is regardless of the pressure rating selected. Fitting length to DVGW.
[2)] Only DN 25 and DN 50 are available for flanges according to AS.
All dimensions in [mm]

Dimensions (US units)

<table>
<tr><th>DN
ANSI</th><th>L [1)]</th><th>A</th><th>A*</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>K</th></tr>
<tr><td>½"</td><td>7.87</td><td rowspan="10">8.94</td><td rowspan="10">8.15</td><td rowspan="10">7.36</td><td rowspan="10">6.61</td><td rowspan="10">6.30</td><td>13.4</td><td>10.1</td><td>3.31</td><td>3.70</td><td>4.72</td></tr>
<tr><td>1"</td><td>7.87</td><td>13.4</td><td>10.1</td><td>3.31</td><td>3.70</td><td>4.72</td></tr>
<tr><td>1½"</td><td>7.87</td><td>13.4</td><td>10.1</td><td>3.31</td><td>3.70</td><td>4.72</td></tr>
<tr><td>2"</td><td>7.87</td><td>13.4</td><td>10.1</td><td>3.31</td><td>3.70</td><td>4.72</td></tr>
<tr><td>3"</td><td>7.87</td><td>15.4</td><td>11.1</td><td>4.29</td><td>3.70</td><td>7.09</td></tr>
<tr><td>4"</td><td>9.84</td><td>15.4</td><td>11.1</td><td>4.29</td><td>3.70</td><td>7.09</td></tr>
<tr><td>6"</td><td>11.8</td><td>18.6</td><td>12.7</td><td>5.91</td><td>5.51</td><td>10.2</td></tr>
<tr><td>8"</td><td>13.8</td><td>20.8</td><td>13.7</td><td>7.09</td><td>6.14</td><td>12.8</td></tr>
<tr><td>10"</td><td>17.7</td><td>22.7</td><td>14.7</td><td>8.07</td><td>6.54</td><td>15.8</td></tr>
<tr><td>12"</td><td>19.7</td><td>24.7</td><td>15.6</td><td>9.06</td><td>6.54</td><td>18.1</td></tr>
</table>

[1)] The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Compact version DN ≥ 350 (14")



A0005424

Dimensions (SI units)

DN EN (DIN)	L 1)	A	A*	B	C	D	E	F	G	H	J
350	550	227	207	187	168	160	738.5	456.5	282.0	564	276
400	600						790.5	482.5	308.0	616	276
450	650						840.5	507.5	333.0	666	292
500	650						891.5	533.0	358.5	717	292
600	780						995.5	585.0	410.5	821	402

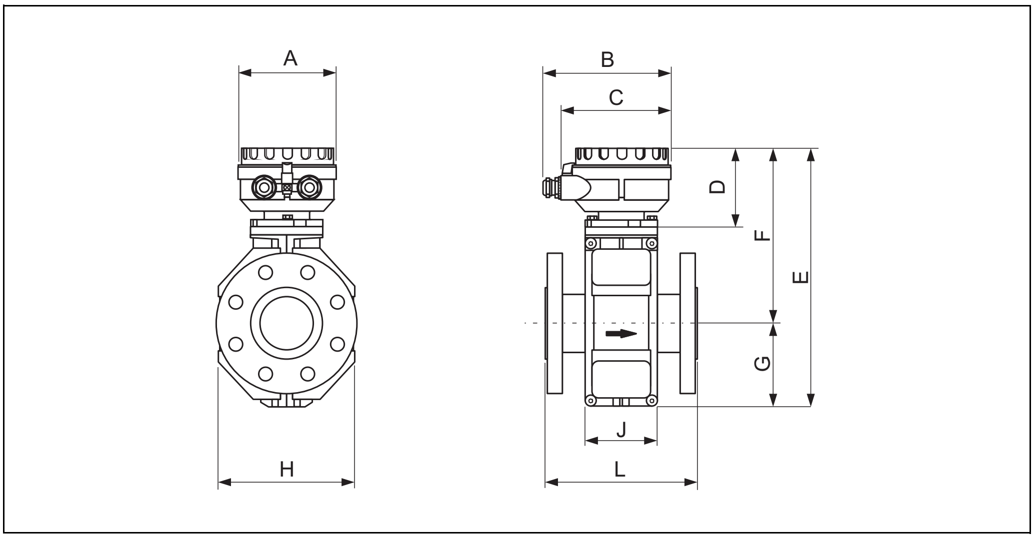
1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L 1)	A	A*	B	C	D	E	F	G	H	J
14"	21.7	8.94	8.15	7.36	6.61	6.30	29.1	18.0	11.1	22.2	10.9
16"	23.6						31.1	19.0	12.1	24.3	10.9
18"	25.6						33.1	20.0	13.1	26.2	11.5
20"	25.6						35.1	21.0	14.1	28.2	11.5
24"	30.7						39.2	23.0	16.2	32.3	15.8

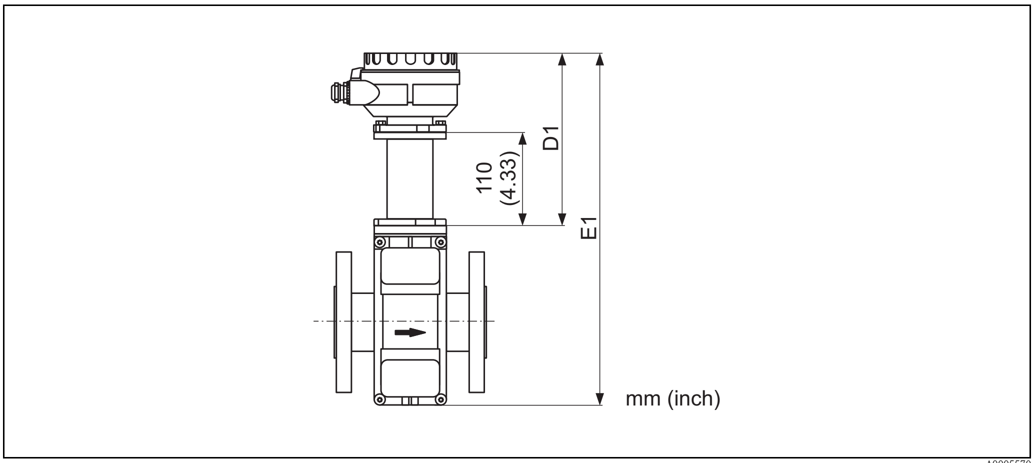
1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Sensor, remote version DN ≤ 300 (12")



A0012462

High temperature version DN ≤ 300 (12")



A0005570

Measurement D1, E1 = Measurement D, E of the standard remote version plus 110 mm (4.33")

Dimensions (SI units)

DN EN (DIN) / JIS / AS 2)	L 1)	A	B	C	D	E	F	G	H	J
15	200	129	163	143	102	286	202	84	120	94
25	200					286	202	84	120	94
32	200					286	202	84	120	94
40	200					286	202	84	120	94
50	200					286	202	84	120	94
65	200					336	227	109	180	94
80	200					336	227	109	180	94
100	250					336	227	109	180	94
125	250					417	267	150	260	140
150	300					417	267	150	260	140
200	350					472	292	180	324	156
250	450					522	317	205	400	166
300	500					572	342	230	460	166

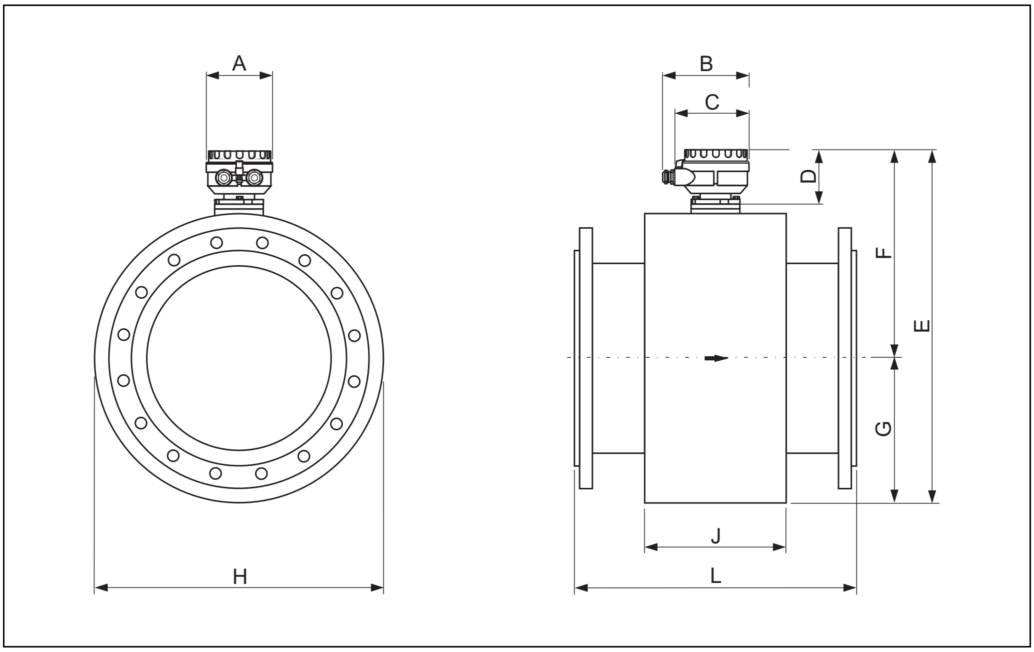
1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
2) Only DN 25 and DN 50 are available for flanges according to AS.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L 1)	A	B	C	D	E	F	G	H	J
½"	7.87	5.08	6.42	5.63	4.02	11.3	7.95	3.31	4.72	3.70
1"	7.87					11.3	7.95	3.31	4.72	3.70
1½"	7.87					11.3	7.95	3.31	4.72	3.70
2"	7.87					11.3	7.95	3.31	4.72	3.70
3"	7.87					13.2	8.94	4.29	7.09	3.70
4"	9.84					13.2	8.94	4.29	7.09	3.70
6"	11.8					16.4	10.5	5.91	10.2	5.51
8"	13.8					18.6	11.5	7.08	12.8	6.14
10"	17.7					20.6	12.5	8.07	15.8	6.54
12"	19.7					22.5	13.5	9.06	18.1	6.54

1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Sensor, remote version DN ≥ 350 (14")



A0003220

Dimensions (SI units)

DN EN (DIN)	L 1)	A	B	C	D	E	F	G	H	J
350	550	129	163	143	102	683.5	401.5	282.0	564	276
400	600					735.5	427.5	308.0	616	276
450	650					785.5	452.5	333.0	666	292
500	650					836.5	478.0	358.5	717	292
600	780					940.5	530.0	410.5	821	402

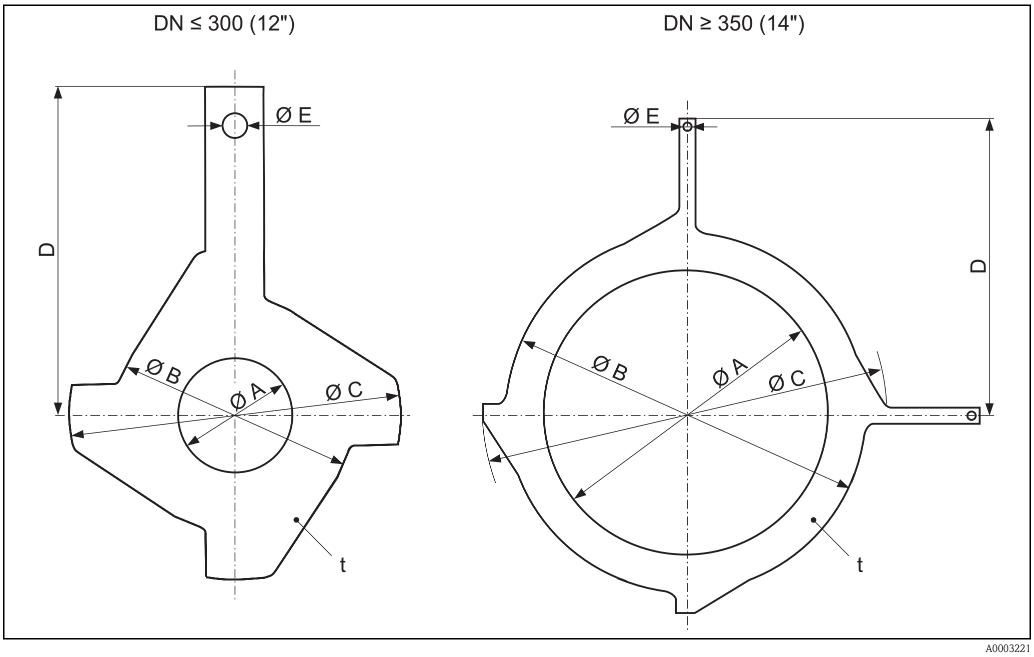
1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [mm]

Dimensions (US units)

DN ANSI	L 1)	A	B	C	D	E	F	G	H	J
14"	21.7	5.08	6.42	5.63	4.02	26.9	15.8	11.1	22.2	10.9
16"	23.6					29.0	16.8	12.1	24.3	10.9
18"	25.6					30.9	17.8	13.1	26.2	11.5
20"	25.6					32.9	18.8	14.1	28.2	11.5
24"	30.7					37.0	20.9	16.2	32.3	15.8

1) The length is regardless of the pressure rating selected. Fitting length to DVGW.
All dimensions in [inch]

Ground disk for flange connections



Dimensions (SI units)

DN [1] EN (DIN) / JIS / AS [2]	A PTFE, PFA	B	C	D	E	t
15	16	43	61.5	73		
25	26	62	77.5	87.5		
32	35	80	87.5	94.5		
40	41	82	101	103		
50	52	101	115.5	108		
65	68	121	131.5	118		
80	80	131	154.5	135		
100	104	156	186.5	153	6.5	
125	130	187	206.5	160		
150	158	217	256	184		2
200	206	267	288	205		
250	260	328	359	240		
300 [3]	312	375	413	273		
300 [4]	310	375	404	268		
350 [3]	343	433	479	365		
400 [3]	393	480	542	395		
450 [3]	439	538	583	417	9.0	
500 [3]	493	592	650	460		
600 [3]	593	693	766	522		

[1] Ground disks at DN 15 to 250 (½ to 10") can be used for all flange standards/pressure ratings.
[2] Only DN 25 and DN 50 are available for flanges according to AS.
[3] PN 10/16
[4] PN 25, JIS 10K/20K
All dimensions in [mm]

Dimensions (US units)

DN [1] ANSI	A PTFE, PFA	B	C	D	E	t
½"	0.63	1.69	2.42	2.87	0.26	0.08
1"	1.02	2.44	3.05	3.44		
1½"	1.61	3.23	3.98	4.06		
2"	2.05	3.98	4.55	4.25		
3"	3.15	5.16	6.08	5.31		
4"	4.09	6.14	7.34	6.02		
6"	6.22	8.54	10.08	7.24		
8"	8.11	10.5	11.3	8.07		
10"	10.2	12.9	14.1	9.45		
12"	12.3	14.8	16.3	10.8		
14"	13.5	17.1	18.9	14.4	0.35	
16"	15.45	18.9	21.3	15.6		
18"	17.3	21.2	23.0	16.4		
20"	19.4	23.3	25.6	18.1		
24"	23.4	27.3	30.1	20.6		

[1] Ground disks can be used for all flange standards/pressure ratings.
All dimensions in [inch]

Weight

Weight in SI units

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

[1)] For flanges to AS, only DN 25 and 50 are available.

- Transmitter (compact version): 3.4 kg, high temperature version: +1.5 kg
- Weight data valid for standard pressure ratings and without packaging material.

Weight in US units (only ANSI)

Weight data in lbs							
Nominal diameter		Compact version		Remote version (without cable)			
				Sensor		Transmitter	
[mm]	[inch]	ANSI		ANSI		Wall-mount housing	
15	½"	Class 150	14.3	Class 150	9.92	13.2	
25	1"		16.1		11.7		
40	1½"		20.7		16.3		
50	2"		23.4		19.0		
80	3"		30.9		26.5		
100	4"		35.3		30.9		
150	6"		56.2		51.8		
200	8"		99.2		94.8		
250	10"		165.4		161.0		
300	12"		242.6		238.1		
350	14"		385.9		381.5		
400	16"		452.0		447.6		
450	18"		562.3		557.9		
500	20"		628.4		624.0		
600	24"		893.0		888.6		

- Transmitter (compact version): 7.50 lbs, high temperature version: +3.31 lbs
- Weight data valid for standard pressure ratings and without packaging material.

Measuring tube specifications

Diameter		Pressure rating					Internal diameter			
		EN (DIN)	AS 2129	AS 4087	ANSI	JIS	PFA		PTFE	
[mm]	[inch]	[bar]			[lbs]		[mm]	[inch]	[mm]	[inch]
15	½"	PN 40	–	–	Cl.150	20K	–	–	15	0.59
25	1"	PN 40	Table E	–	Cl.150	20K	23	0.91	26	1.02
32	–	PN 40	–	–	–	20K	32	1.26	35	1.38
40	1½"	PN 40	–	–	Cl.150	20K	36	1.42	41	1.61
50	2"	PN 40	Table E	PN 16	Cl.150	10K	48	1.89	52	2.05
65	–	PN 16	–	–	–	10K	63	2.48	67	2.64
80	3"	PN 16	–	–	Cl.150	10K	75	2.95	80	3.15
100	4"	PN 16	–	–	Cl.150	10K	101	3.98	104	4.09
125	–	PN 16	–	–	–	10K	126	4.96	129	5.08
150	6"	PN 16	–	–	Cl.150	10K	154	6.06	156	6.14
200	8"	PN 10	–	–	Cl.150	10K	201	7.91	202	7.95
250	10"	PN 10	–	–	Cl.150	10K	–	–	256	10.1
300	12"	PN 10	–	–	Cl.150	10K	–	–	306	12.0
350	14"	PN 10	–	–	Cl.150	–	–	–	337	13.3
400	16"	PN 10	–	–	Cl.150	–	–	–	387	15.2
450	18"	PN 10	–	–	Cl.150	–	–	–	432	17.0
500	20"	PN 10	–	–	Cl.150	–	–	–	487	19.2
600	24"	PN 10	–	–	Cl.150	–	–	23	593	23.3

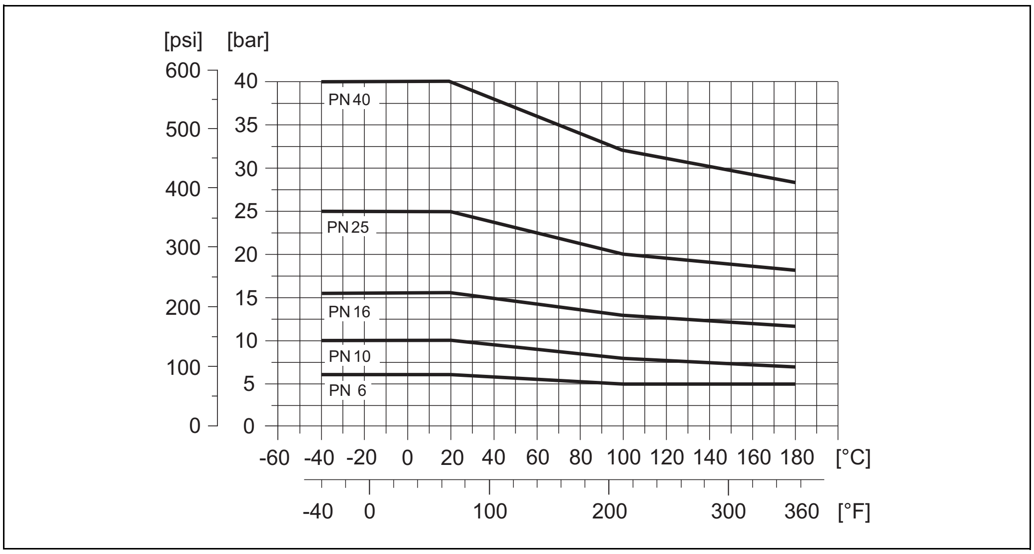
Material

- Transmitter housing
  – Compact housing: powder-coated die-cast aluminum
  – Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
  – DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  – DN 350 to 600 (14 to 24"): with protective lacquering
- Measuring tube
  – DN ≤ 300 (12"): stainless steel 1.4301 or 1.4306/304L;
  (for flanges made of carbon steel with Al/Zn protective coating)
  – DN ≥ 350 (14"): stainless steel 1.4301 or 1.4306/304L;
  (for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435, Platinum, Alloy C-22, Tantalum, Titanium
- Flanges
  – EN 1092-1 (DIN 2501): 1.4571/316L; RSt37-2 (S235JRG2); C22; FE 410W B
  (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  – ANSI: A105; F316L
  (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  – AWWA: 1.0425
  – JIS: RSt37-2 (S235JRG2); HII; 1.0425/316L
  (DN ≤ 300 (12"): with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  – AS 2129
    – DN 25 (1"): A105 or RSt37-2 (S235JRG2)
    – DN 40 (1 ½"): A105 or St44-2 (S275JR)
  – AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435/316L or Alloy C-22

Material load diagram

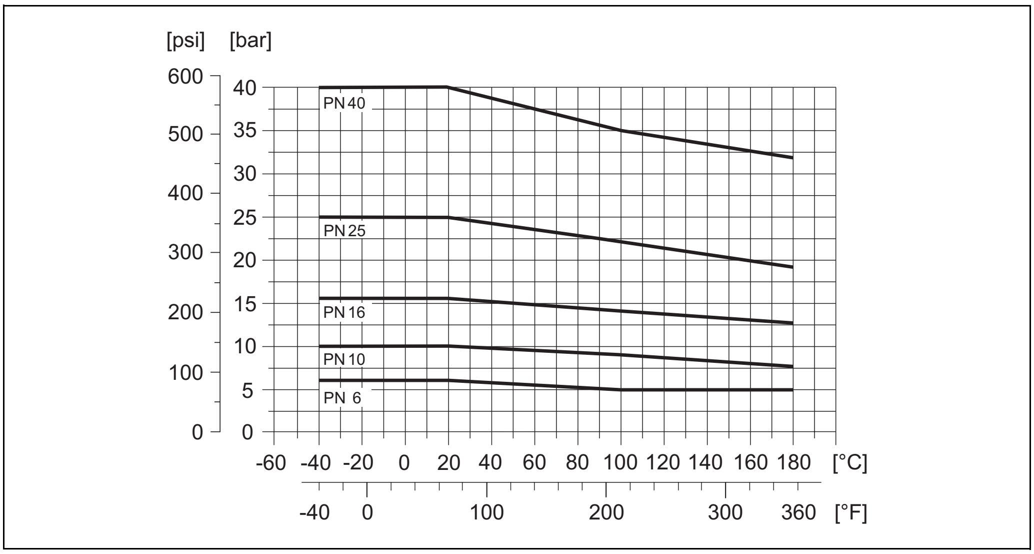
Caution!
The following diagrams contain material load diagrams (reference curves) for flange materials with regard to the medium temperature. However, the maximum medium temperatures permitted always depend on the lining material of the sensor and/or the sealing material (→ 21).

Flange connection to EN 1092-1 (DIN 2501)
Material: RSt37-2 (S235JRG2) / C22 / Fe 410W B



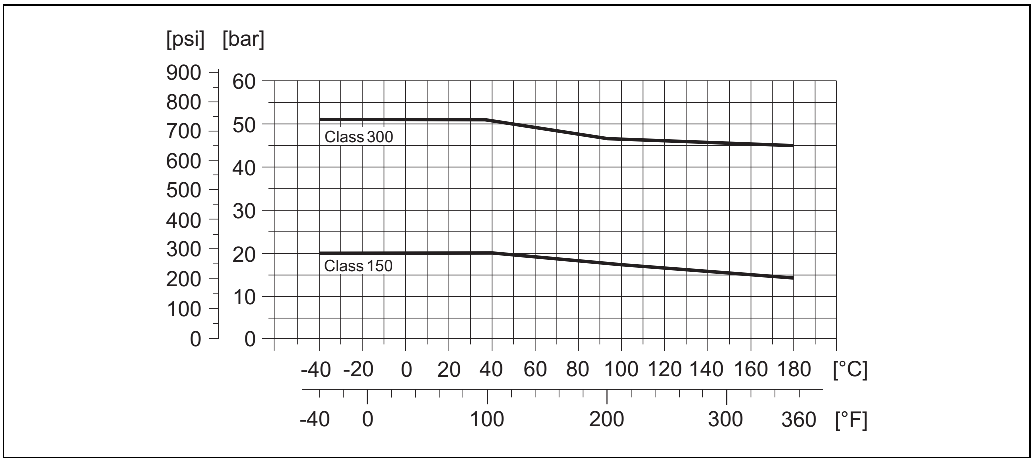
A0005594

Flange connection to EN 1092-1 (DIN 2501)
Material: 316L / 1.4571



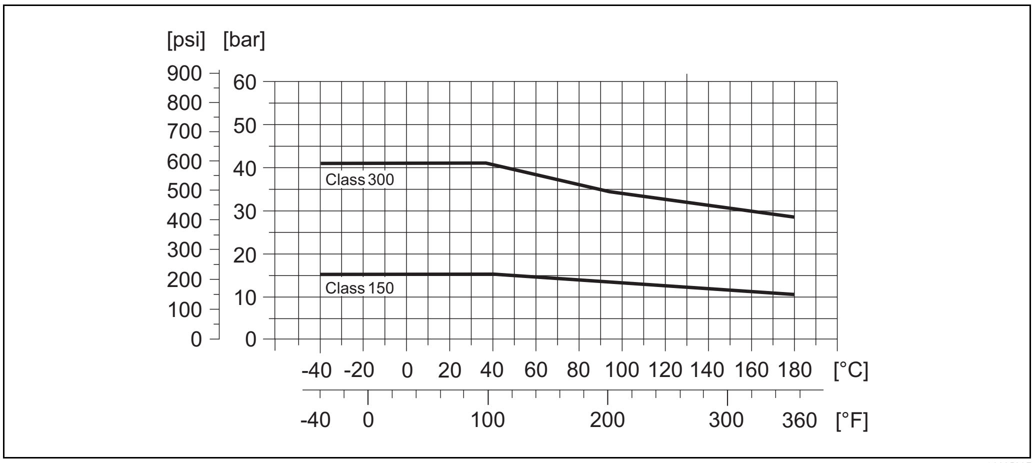
A0005304

Flange connection to ANSI B16.5
Material: A 105



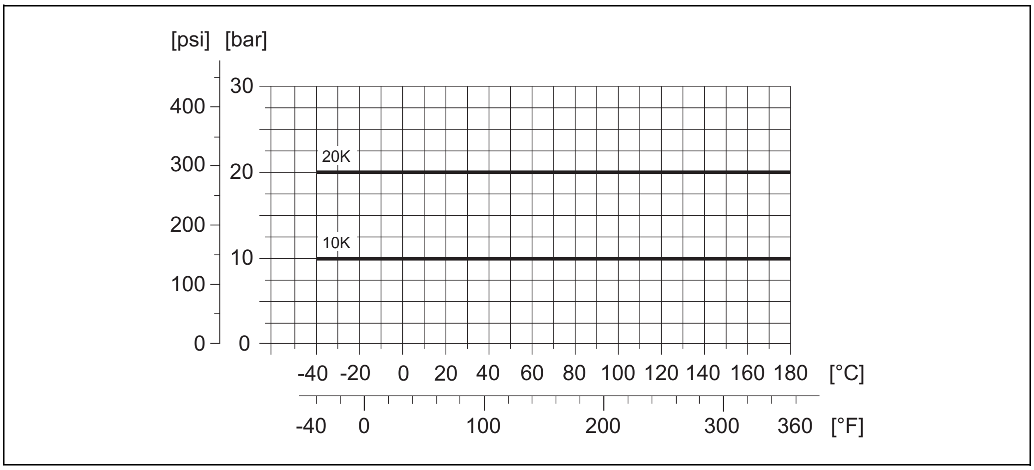
A0003226

Flange connection to ANSI B16.5
Material: F316L



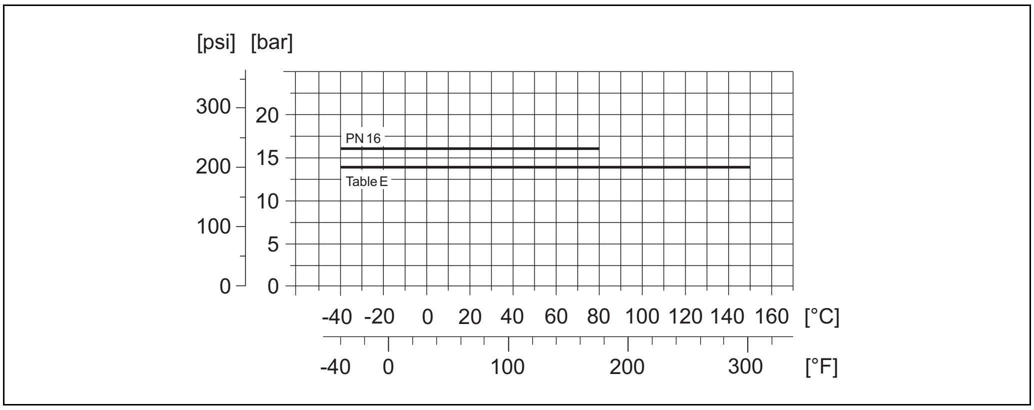
A0005307

Flange connection to JIS B2220
Material: RSt37-2 (S235JRG2) / HII / 1.0425 / 316L



A0003228

Flange connection to AS 2129 Table E or AS 4087 PN 16
Material: A105 / RSt37-2 (S235JRG2) / St44-2 (S275JR)



A0005595

Fitted electrodes

Measuring electrodes, reference electrodes and empty pipe detection electrodes:
- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20, titanium
- Optional: measuring electrodes made of platinum/rhodium 80/20

Process connections

Flange connection:
- EN 1092-1 (DIN 2501), DN ≤ 300 (12") form A, DN ≥ 350 (14") form B
  (Dimensions to DIN 2501, DN 65 PN 16 and DN 600 (24") PN 16 exclusively to EN 1092-1)
- ANSI B16.5
- JIS B2220
- AS 2129 Table E
- AS 4087 PN 16

Surface roughness

- PFA liner: ≤ 0.4 µm (15.7 µin)
- Elektroden
  – 1.4435, Alloy C-22, titanium: ≤ 0.3 to 0.5 µm (≤ 11.8 to 19.7 µin)
  – Tantal, Platin/Rhodium: ≤ 0.3 to 0.5 µm (≤ 11.8 to 19.7 µin)

(All data refer to parts in contact with medium)

Human interface

Display elements	■ Liquid crystal display: backlit, two lines (Promag 50) or four lines (Promag 53) with 16 characters per line ■ Custom configurations for presenting different measured-value and status variables ■ Totalizer – Promag 50: 2 totalizers – Promag 53: 3 totalizers
Operating elements	Unified operation concept for both types of transmitter: Promag 50: ■ Local operation via three keys (−, +, E) ■ Quick Setup menus for straightforward commissioning Promag 53: ■ Local operation via three keys (−, +, E) ■ Application-specific Quick Setup menus for straightforward commissioning
Language groups	Language groups available for operation in different countries: Promag 50, Promag 53: ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch, Portuguese ■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish, Czech ■ South and east Asia (SEA): English, Japanese, Indonesian Promag 53: ■ China (CN): English, Chinese You can change the language group via the operating program "FieldCare".
Remote operation	■ Promag 50: Remote control via HART, PROFIBUS DP/PA ■ Promag 53: Remote control via HART, PROFIBUS DP/PA, MODBUS RS485, FOUNDATION Fieldbus

Certificates and approvals

CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
C-tick mark	The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Pressure measuring 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. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.
Ex approval	Information about currently available Ex versions (ATEX, IECEx, FM, CSA, NEPSI) 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.
Other standards and guidelines	▪ EN 60529 Degrees of protection by housing (IP code) ▪ EN 61010 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures. ▪ IEC/EN 61326 “Emission in accordance with requirements for Class A”. Electromagnetic compatibility (EMC requirements) ▪ 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. ▪ ANSI/ISA-S82.01 Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements Pollution degree 2, Installation Category II. ▪ CAN/CSA-C22.2 No. 1010.1-92 Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category II
FOUNDATION Fieldbus certification	The flow device has successfully passed all the test procedures carried out and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specifications: ▪ Certified to FOUNDATION Fieldbus Specification ▪ The device meets all the specifications of the FOUNDATION Fieldbus H1. ▪ Interoperability Test Kit (ITK), revision status 5.01 (device certification number: on request) ▪ The device can also be operated with certified devices of other manufacturers ▪ Physical Layer Conformance Test of the Fieldbus Foundation
MODBUS RS485 certification	The measuring device meets all the requirements of the MODBUS/TCP conformity test and has 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.
PROFIBUS DP/PA certification	The flow device has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organisation). The device thus meets all the requirements of the following specifications: ▪ Certified to PROFIBUS PA, profile version 3.0 (device certification number: on request) ▪ The device can also be operated with certified devices of other manufacturers (interoperability)

Ordering information

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

Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the order codes in question.

Documentation

- Flow Measurement (FA005D/06)
- Operating Instructions Promag Promag 50 (BA046D/06 and BA049D/06)
- Operating Instructions Promag Promag 50 PROFIBUS PA (BA055D/06 and BA056D/06)
- Operating Instructions Promag Promag 53 (BA047D/06 and BA048D/06)
- Operating Instructions Promag Promag 53 FOUNDATION Fieldbus (BA051D/06 and BA052D/06)
- Operating Instructions Promag Promag 53 MODBUS RS485 (BA117D/06 and BA118D/06)
- Operating Instructions Promag Promag 53 PROFIBUS DP/PA (BA053D/06 and BA054D/06)
- Supplementary documentation on Ex-ratings: ATEX, IECEx, FM, CSA, NEPSI

Registered trademarks

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

PROFIBUS®
Registered trademark of the PROFIBUS Nutzerorganisation e.V., Karlsruhe, D

FOUNDATION™ Fieldbus
Registered trademark of the Fieldbus Foundation, Austin, USA

MODBUS®
Registered trademark of the MODBUS Organisation

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, FieldCare®, Fieldcheck®, FieldXpert™, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

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Endress+Hauser

People for Process Automation

TI047D/06/en/11.09
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FM+SGML6.0 ProMoDo

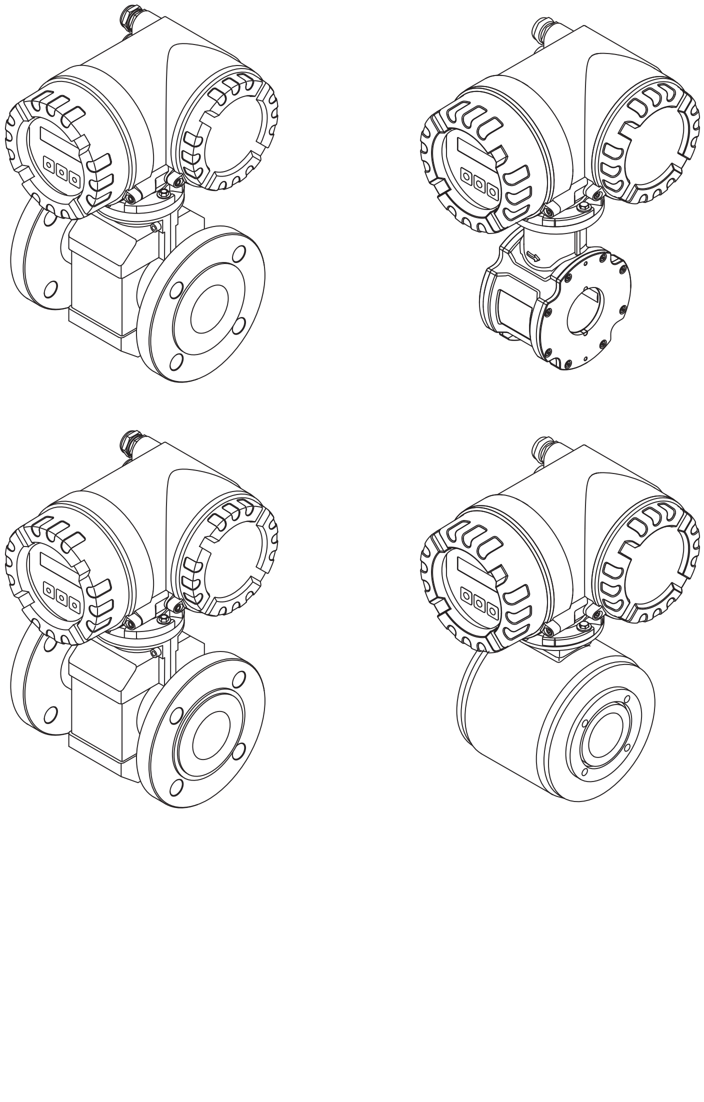
BA00046D/06/EN/15.14
71249447

Valid as of version
V 2.04.XX (device software)

Operating Instructions
Proline Promag 50 HART

Electromagnetic flowmeter

HART® FIELD COMMUNICATION PROTOCOL



Endress+Hauser

People for Process Automation

Table of contents

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 μS/cm is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 μS/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

Please note the following:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood this Operating Manual and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual is mandatory.
- With regard to special fluids, including fluids used for cleaning, Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials. However, minor changes in temperature, concentration or in the degree of contamination in the process may result in variations in corrosion resistance. For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of wetted materials in a specific application.
  The user is responsible for the choice of suitable wetted materials in the process.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded apart from when special protective measures are taken (e.g. galvanically isolated SELV or PELV power supply)
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Please note the following:
- Measuring systems for use in hazardous environments are accompanied by separate Ex documentation, which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this Ex documentation indicates the approval and the certification body (e.g. Ex Europe, FM USA, SP Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 and NAMUR Recommendations NE 21 and NE 43.
- 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.

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 "Safety requirements for electrical equipment for measurement, control and laboratory use".
The devices can, however, be a source of danger if used incorrectly or for anything other than the designated use. Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:

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

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

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

2 Identification

2.1 Device designation

The flow measuring system consists of the following components:

- Promag 50 transmitter
- Promag D/E/H/L/P/W sensor

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

2.1.1 Nameplate of the transmitter

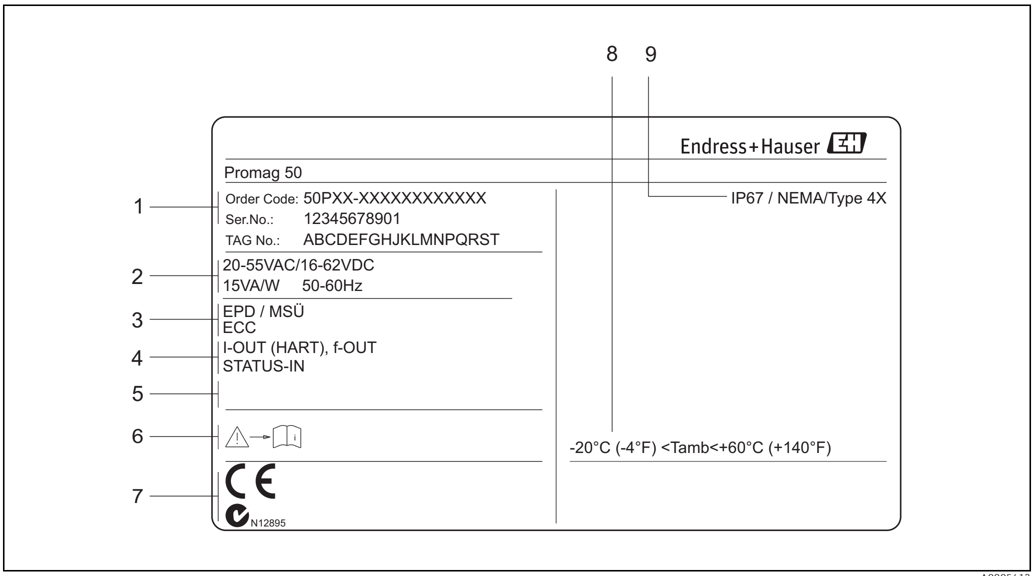


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Fig. 1: Nameplate specifications for the "Promag 50" transmitter (example)

1 *Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *Power supply, frequency, power consumption*
3 *Additional information:*
EPD/MSÜ: with Empty Pipe Detection
ECC: with electrode cleaning
4 *Outputs available:*
I-OUT (HART): with current output (HART)
f-OUT (HART): with frequency output
STATUS-IN: with status input (power supply)
5 *Reserved for information on special products*
6 *Observe device documentation*
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

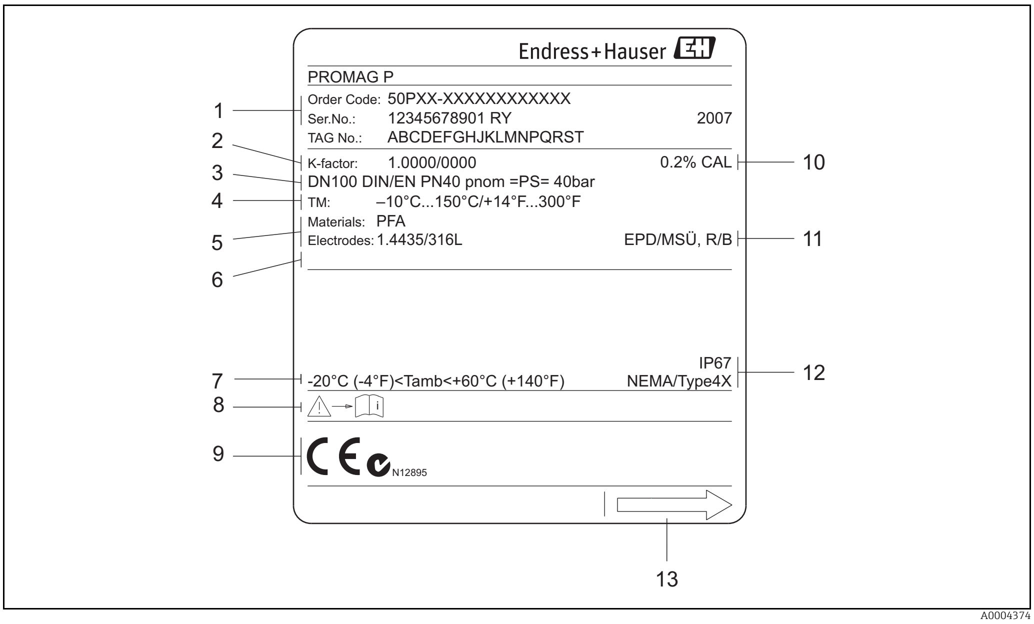

Fig. 2: Nameplate specifications for the "Promag" sensor (example)

1 *Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *Calibration factor with zero point*
3 *Nominal diameter / Pressure rating*
4 *Fluid temperature range*
5 *Materials: lining/measuring electrodes*
6 *Reserved for information on special products*
7 *Permitted ambient temperature range*
8 *Observe device documentation*
9 *Reserved for additional information on device version (approvals, certificates)*
10 *Calibration tolerance*
11 *Additional information (examples):*
- *EPD/MSÜ: with Empty Pipe Detection electrode*
- *R/B: with reference electrode*

12 *Degree of protection*
13 *Flow direction*

2.1.3 Nameplate, connections

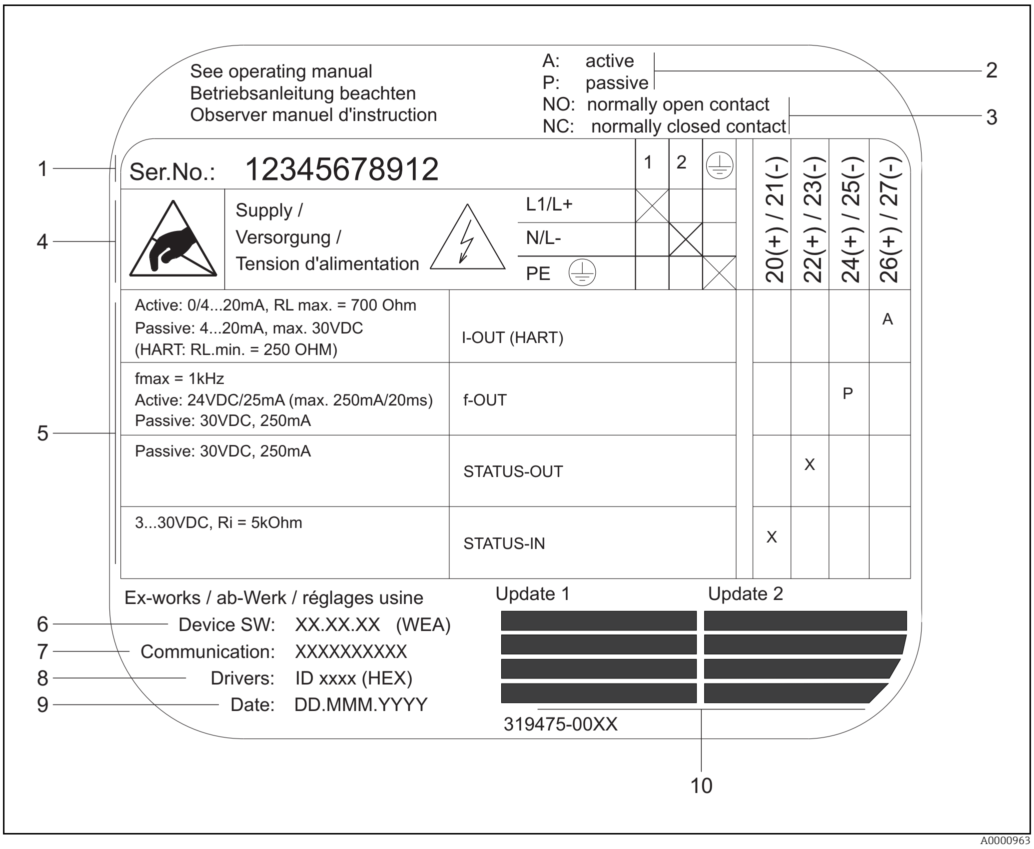

Fig. 3: Nameplate specifications for transmitter (example)

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

2.2 Certificates and approvals

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate.

The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Safety requirements for electrical equipment for measurement, control and laboratory use" and with the EMC requirements of IEC/EN 61326/A1.

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

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

2.3 Registered trademarks

KALREZ® and VITON®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

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

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

HistoROM™, S-DAT®, Field Xpert™, 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:
- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until 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 from the factory protect the linings on the flanges during storage and transportation. In case of Promag L they are additionally used to hold the lap joint flanges in place. Do not remove these covers until **immediately before** the device in the pipe.
- Do not lift flanged devices by the transmitter housing, or the connection housing in the case of the remote version.

Transporting flanged devices DN ≤ 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.

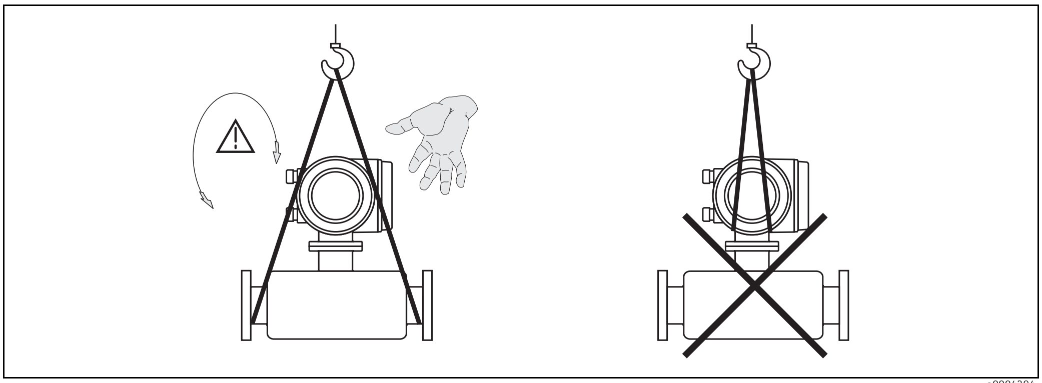

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Fig. 4: Transporting sensors with DN ≤ 300 (12")

Transporting flangeddevices 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.

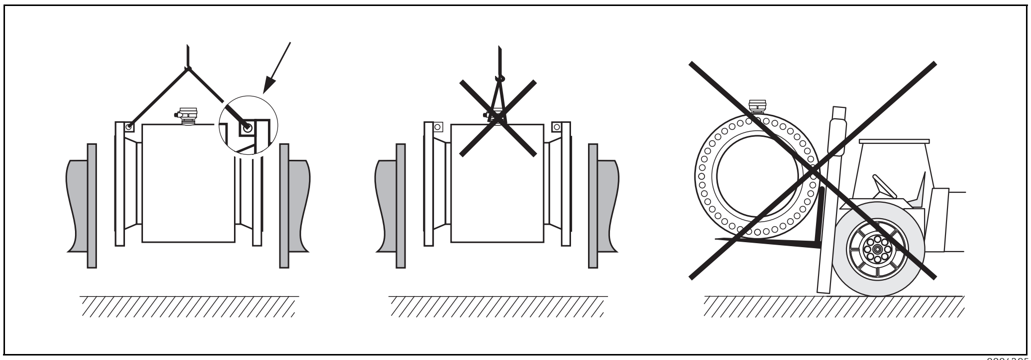


Fig. 5: Transporting sensors with DN > 300 (12")

3.1.3 Storage

Please note the following:
- 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 → 101.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

3.2 Installation conditions

3.2.1 Dimensions

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 → 🗎 124.

3.2.2 Mounting location

Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.
Avoid the following locations:
- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.

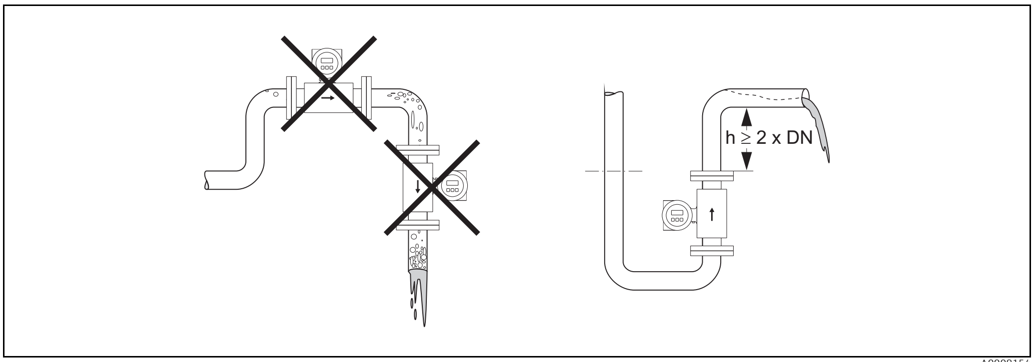


Fig. 6: Mounting location

Installation of pumps

Do **not** install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum can be found on → 🗎 106.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on → 🗎 102.

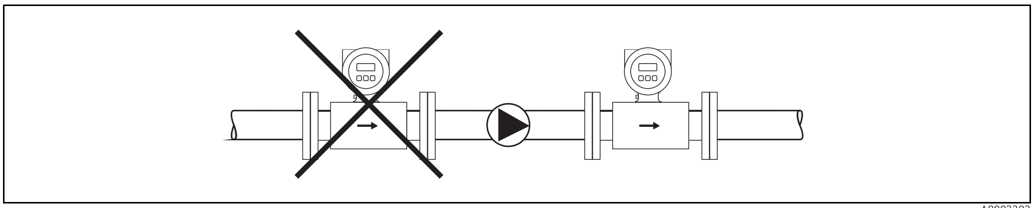


Fig. 7: Installation of pumps

Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration.
The Empty Pipe Detection function (EPD → 75) offers additional protection by detecting empty or partially filled pipes.

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

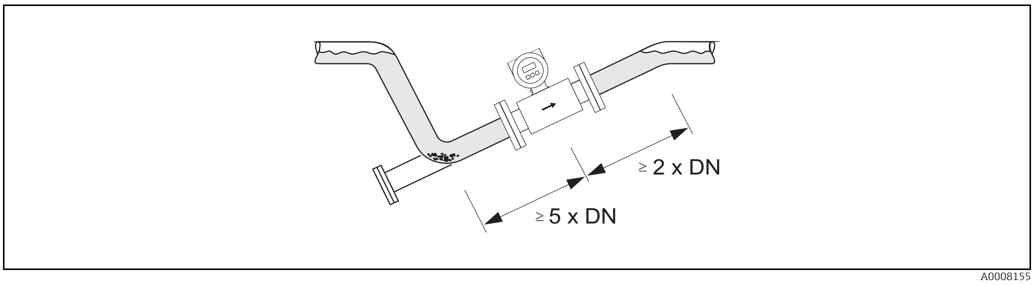


Fig. 8: Installation in a partially filled pipe

Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes whose length h ≥ 5 m (16.4 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 pockets.
Information on the lining's resistance to partial vacuum can be found on → 106.

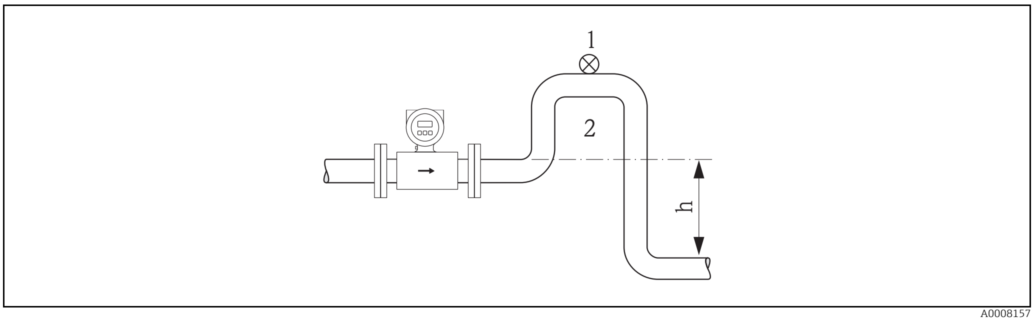


Fig. 9: Measures for installation in a down pipe

1 Vent valve
2 Pipe siphon
h Length of down pipe

3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. However, Promag offers the additional Empty Pipe Detection (EPD) function to ensure the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressure:

- Electrode Cleaning Circuit (ECC) for applications with accretive fluids, e.g. electrically conductive deposits (→ "Description of Device Functions" manual).
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids (→ 75)
- Exchangeable Measuring Electrodes for abrasive fluids (→ 94)

Vertical orientation

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

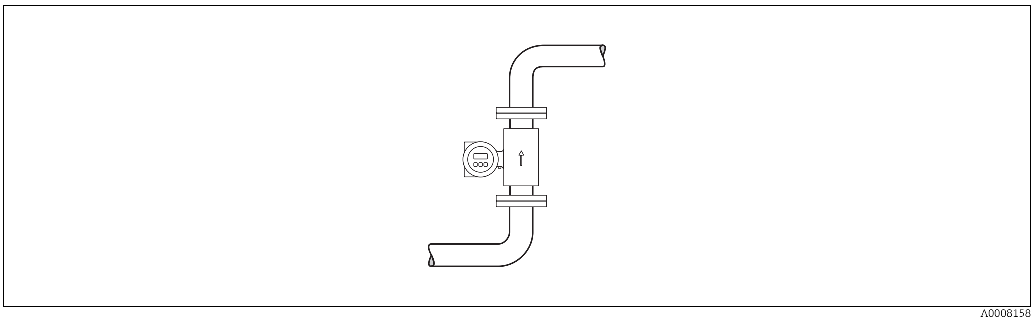


Fig. 10: Vertical orientation

Horizontal orientation

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

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

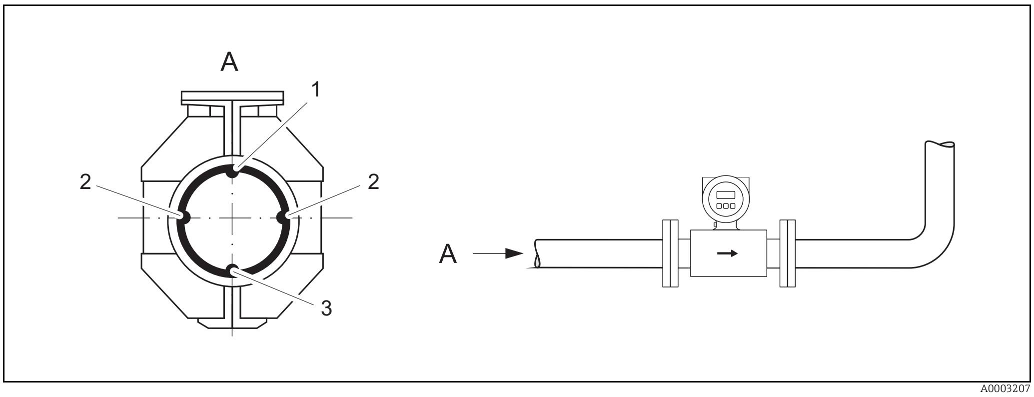


Fig. 11: Horizontal orientation

1 EPD electrode for the detection of empty pipes (not with Promag D and Promag H (DN 2 to 15 / 1/12 to ½"))
2 Measuring electrodes for signal detection
3 Reference electrode for the potential equalization (not with Promag D and H)

Inlet and outlet run

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications:
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN

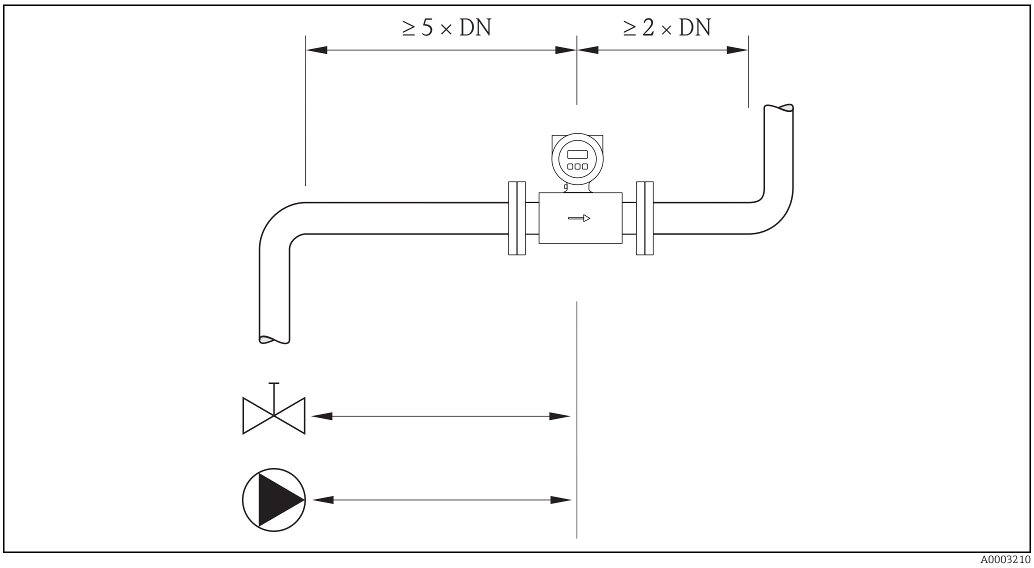


Fig. 12: Inlet and outlet runs

3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!
If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on resistance to vibration and shock can be found on → 📄 102.

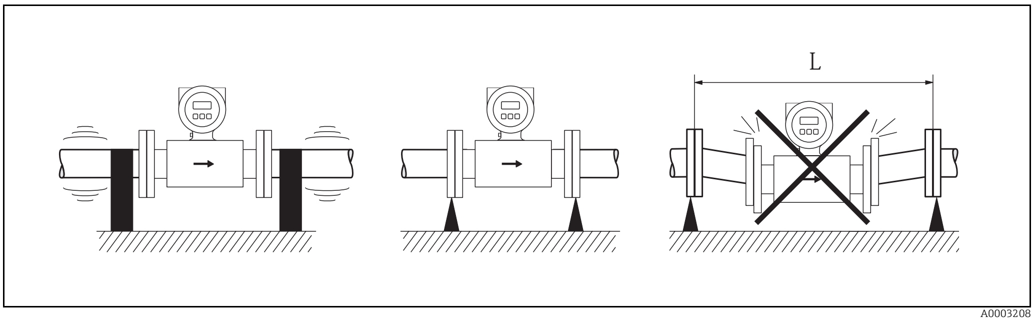


Fig. 13: Measures to prevent vibration of the device (L > 10 m (32.8 ft))

3.2.5 Foundations, supports

If the nominal diameter is DN ≥ 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.

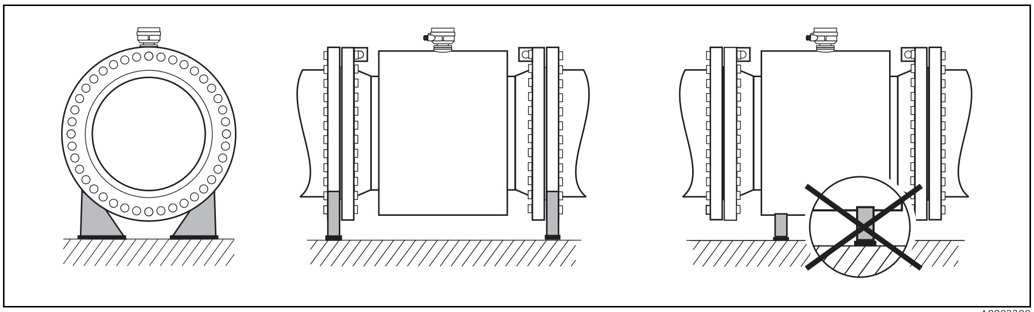


Fig. 14: Correct support for large nominal diameters (DN ≥ 350 / 14")

3.2.6 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes.
The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers and expanders.

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 flow velocity (*downstream* from the reduction) and the d/D ratio.

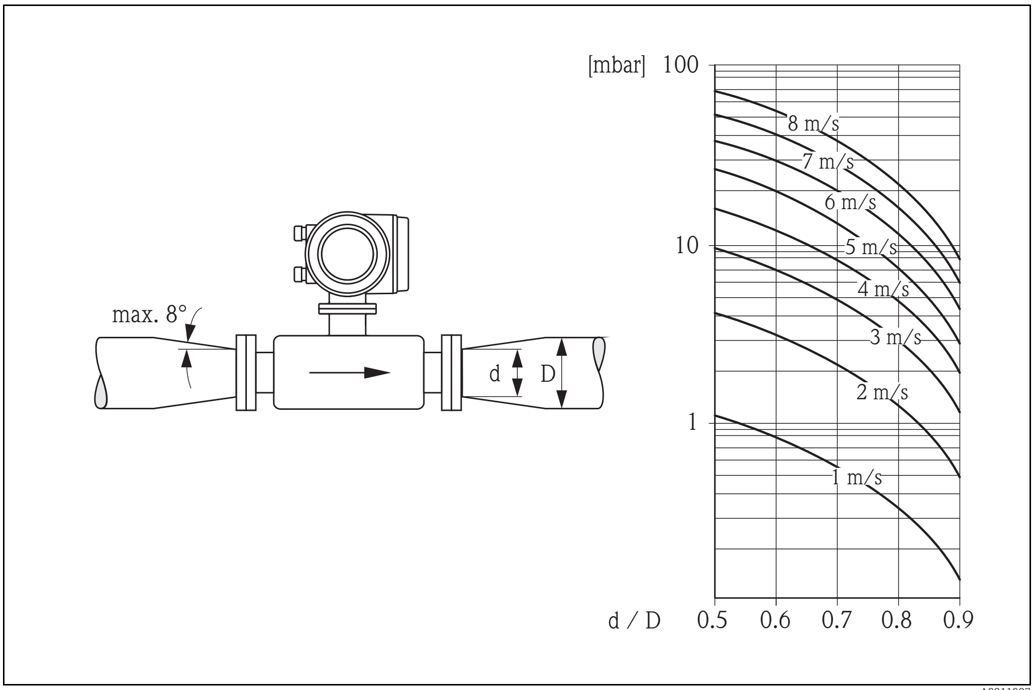


Fig. 15: Pressure loss due to adapters

3.2.7 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum velocity of flow is 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 (→ 16).

Recommended flow (SI units)

Nominal diameter	Promag D	Promag E/P	Promag H	Promag L	Promag W
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [dm³/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	–	9 to 300
32	–	15 to 500	–	–	15 to 500
40	25 to 700	25 to 700	25 to 700	–	25 to 700
50	35 to 1100	35 to 1100	35 to 1100	35 to 1100	35 to 1100
65	60 to 2000	60 to 2000	60 to 2000	60 to 2000	60 to 2000
80	90 to 3000	90 to 3000	90 to 3000	90 to 3000	90 to 3000
100	145 to 4700	145 to 4700	145 to 4700	145 to 4700	145 to 4700
125	–	220 to 7500	–	220 to 7500	220 to 7500
[mm]	Min./max. full scale value (v ≈ 0.3 or 10 m/s) in [m³/h]				
150	–	20 to 600	–	20 to 600	20 to 600
200	–	35 to 1100	–	35 to 1100	35 to 1100
250	–	55 to 1700	–	55 to 1700	55 to 1700
300	–	80 to 2400	–	80 to 2400	80 to 2400
350	–	110 to 3300	–	110 to 3300	110 to 3300
375	–	–	–	140 to 4200	140 to 4200
400	–	140 to 4200	–	140 to 4200	140 to 4200
450	–	180 to 5400	–	180 to 5400	180 to 5400
500	–	220 to 6600	–	220 to 6600	220 to 6600
600	–	310 to 9600	–	310 to 9600	310 to 9600
700	–	–	–	420 to 13500	420 to 13500
750	–	–	–	480 to 15200	480 to 15200
800	–	–	–	550 to 18000	550 to 18000
900	–	–	–	690 to 22500	690 to 22500
1000	–	–	–	850 to 28000	850 to 28000
1050	–	–	–	950 to 40000	950 to 40000
1200	–	–	–	1250 to 40000	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	Promag D	Promag E/P	Promag H	Promag L	Promag W
[inch]	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	–	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	7 to 190	7 to 190
2"	10 to 300	10 to 300	10 to 300	10 to 300	10 to 300
2 $^{1}/_{2}$"	16 to 500	16 to 500	16 to 500	16 to 500	16 to 500
3"	24 to 800	24 to 800	24 to 800	24 to 800	24 to 800
4"	40 to 1250	40 to 1250	40 to 1250	40 to 1250	40 to 1250
5"	–	60 to 1950	–	60 to 1950	60 to 1950
6"	–	90 to 2650	–	90 to 2650	90 to 2650
8"	–	155 to 4850	–	155 to 4850	155 to 4850
10"	–	250 to 7500	–	250 to 7500	250 to 7500
12"	–	350 to 10600	–	350 to 10600	350 to 10600
14"	–	500 to 15000	–	500 to 15000	500 to 15000
15"	–	–	–	600 to 19000	600 to 19000
16"	–	600 to 19000	–	600 to 19000	600 to 19000
18"	–	800 to 24000	–	800 to 24000	800 to 24000
20"	–	1000 to 30000	–	1000 to 30000	1000 to 30000
24"	–	1400 to 44000	–	1400 to 44000	1400 to 44000
28"	–	–	–	1900 to 60000	1900 to 60000
30"	–	–	–	2150 to 67000	2150 to 67000
32"	–	–	–	2450 to 80000	2450 to 80000
36"	–	–	–	3100 to 100000	3100 to 100000
40"	–	–	–	3800 to 125000	3800 to 125000
42"	–	–	–	4200 to 135000	4200 to 135000
48"	–	–	–	5500 to 175000	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

3.2.8 Length of connecting cable

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

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permitted connecting cable length L_{max} is determined by the fluid conductivity (→ 16). A minimum conductivity of 20 μS/cm is required for measuring demineralized water. Most liquids can be measured as of a minimum conductivity of 5 μS/cm.
- The maximum connecting cable length is 10 m (32.8 ft) when empty pipe detection (EPD → 75) is switched on.

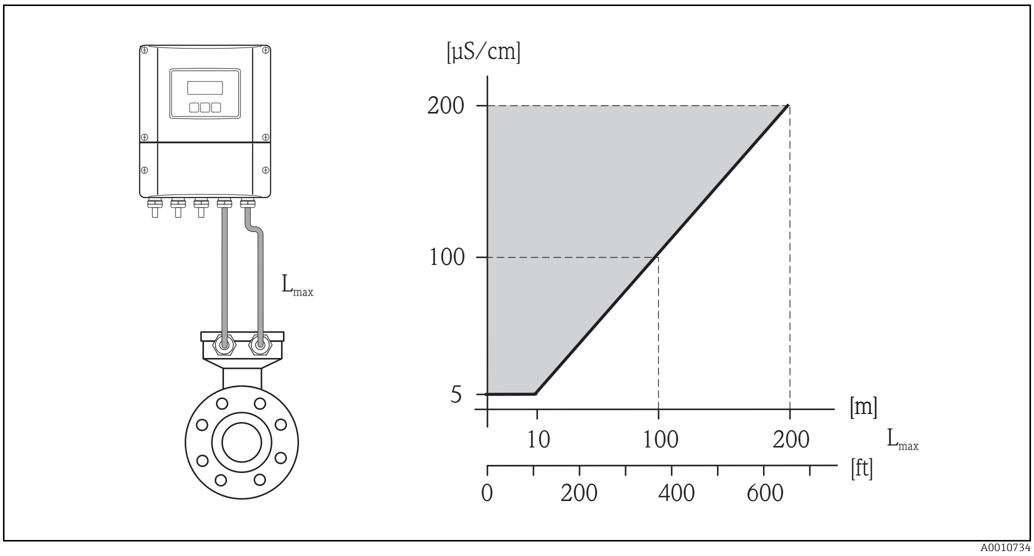


Fig. 16: Permissible cable length for the remote version

Area shaded gray = permitted range
Lmax = connecting cable length in [m]
Fluid conductivity in [μS/cm]

3.3 Installation instructions

3.3.1 Installing the Promag D sensor

The sensor is installed between the pipe flanges with a mounting kit. The device is centered using recesses on the sensor (→ 🗎 21).

Note!
A mounting kit consisting of mounting bolts, seals, nuts and washers can be ordered separately (→ 🗎 78). Centering sleeves are provided with the device if they are required for the installation.

Caution!
When installing the transmitter in the pipe, observe the necessary torques (→ 🗎 22).

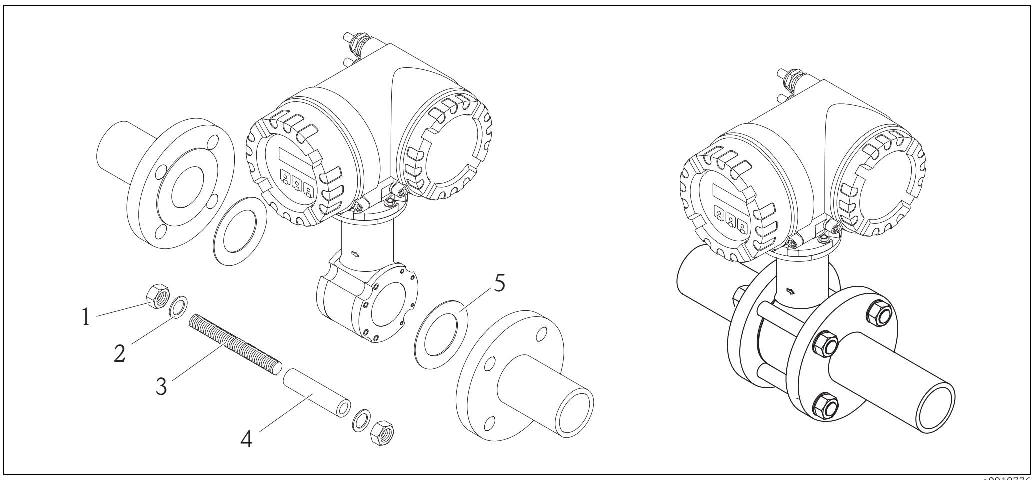


Fig. 17: Mounting the sensor

1 Nut
2 Washer
3 Mounting bolt
4 Centering sleeve
5 Seal

Seals

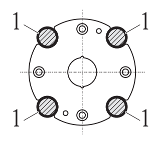
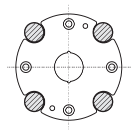
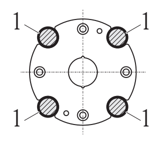
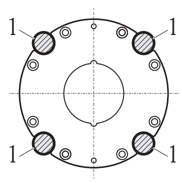
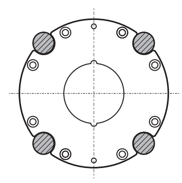
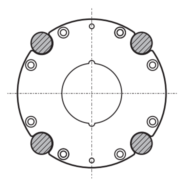
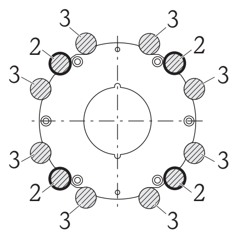
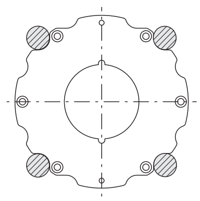
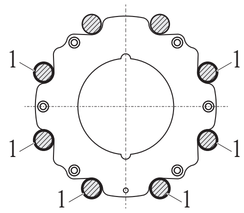
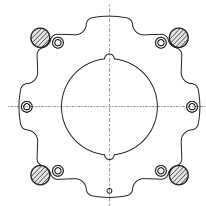
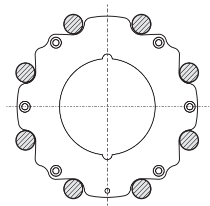
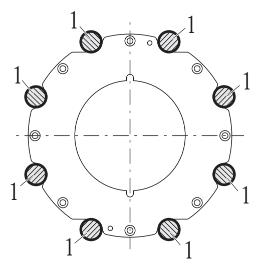
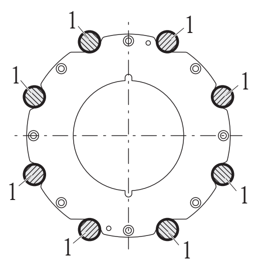
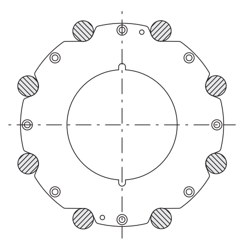
When installing the sensor, make sure that the seals used do not project into the pipe cross-section.

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

Note!
Use seals with a hardness rating of 70° Shore.

Arrangement of the mounting bolts and centering sleeves

The device is centered using recesses on the sensor. The arrangement of the mounting bolts and the use of the centering sleeves supplied depend on the nominal diameter, the flange standard und the pitch circle diameter.

	Process connection		
	EN (DIN)	ASME	JIS
DN 25 to 40 (1 to 1 ½")	 A0010896	 A0010824	 A0010896
DN 50 (2")	 A0010897	 A0010825	 A0010825
DN 65 (–)	 A0012170	----------------	 A0012171
DN 80 (3")	 A0010898	 A0010827	 A0010826
DN 100 (4")	 A0012168	 A0012168	 A0012169
1 = Mounting bolts with centering sleeves 2 = EN (DIN) flanges: 4-hole → with centering sleeves 3 = EN (DIN) flanges: 8-hole → without centering sleeves			

Screw tightening torques (Promag D)

Please note the following:
- 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.

The tightening torques apply to situations where an EPDM soft material flat seal (e.g. 70 Shore) is used.

Tightening torques, mounting bolts and centering sleeves for EN (DIN) PN 16

Nominal diameter	Mounting bolts	Centering sleeve length	Tightening torque [Nm] with a process flange with a	
[mm]	[mm]	[mm]	smooth seal face	raised face
25	4 × M12 × 145	54	19	19
40	4 × M16 × 170	68	33	33
50	4 × M16 × 185	82	41	41
65[1]	4 × M16 × 200	92	44	44
65[2]	8 × M16 × 200	– [3]	29	29
80	8 × M16 × 225	116	36	36
100	8 × M16 × 260	147	40	40

[1] EN (DIN) flanges: 4-hole → with centering sleeves
[2] EN (DIN) flanges: 8-hole → without centering sleeves
[3] A centering sleeve is not required. The device is centered directly via the sensor housing.

Tightening torques, mounting bolts and centering sleeves for JIS 10K

Nominal diameter	Mounting bolts	Centering sleeve length	Tightening torque [Nm] with a process flange with a	
[mm]	[mm]	[mm]	smooth seal face	raised face
25	4 × M16 × 170	54	24	24
40	4 × M16 × 170	68	32	25
50	4 × M16 × 185	– *	38	30
65	4 × M16 × 200	– *	42	42
80	8 × M16 × 225	– *	36	28
100	8 × M16 × 260	– *	39	37

* A centering sleeve is not required. The device is centered directly via the sensor housing.

Tightening torques, mounting bolts and centering sleeves for ASME Class 150

Nominal diameter	Mounting bolts	Centering sleeve length	Tightening torque [lbf · ft] with a process flange with a	
[inch]	[inch]	[inch]	smooth seal face	raised face
1"	4 × UNC 1/2" × 5.70"	– *	14	7
1 ½"	4 × UNC 1/2" × 6.50"	– *	21	14
2"	4 × UNC 5/8" × 7.50"	– *	30	27
3"	4 × UNC 5/8" × 9.25"	– *	31	31
4"	8 × UNC 5/8" × 10,4"	5,79	28	28

* A centering sleeve is not required. The device is centered directly via the sensor housing.

3.3.2 Installing the Promag E sensor

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

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 📄 24
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

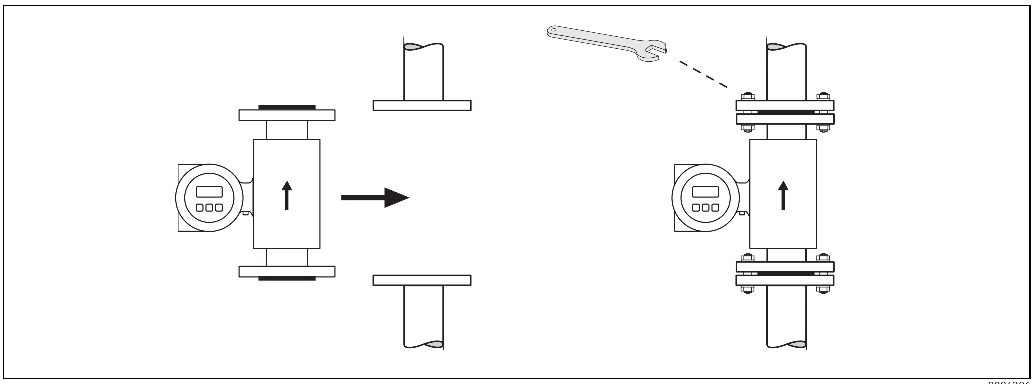


Fig. 18: Installing the Promag E sensor

Seals

Comply with the following instructions when installing seals:
- PFA or PTFE lining → **No** seals are required!
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 📄 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 📄 55

Tightening torques for threaded fasteners (Promag E)

Please note the following:
- 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) → 24
- ASME → 25
- JIS → 25

Promag E tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]
15	PN 40	4 × M 12	11
25	PN 40	4 × M 12	26
32	PN 40	4 × M 16	41
40	PN 40	4 × M 16	52
50	PN 40	4 × M 16	65
65 *	PN 16	8 × M 16	43
80	PN 16	8 × M 16	53
100	PN 16	8 × M 16	57
125	PN 16	8 × M 16	75
150	PN 16	8 × M 20	99
200	PN 10	8 × M 20	141
200	PN 16	12 × M 20	94
250	PN 10	12 × M 20	110
250	PN 16	12 × M 24	131
300	PN 10	12 × M 20	125
300	PN 16	12 × M 24	179
350	PN 6	12 × M 20	200
350	PN 10	16 × M 20	188
350	PN 16	16 × M 24	254
400	PN 6	16 × M 20	166
400	PN 10	16 × M 24	260
400	PN 16	16 × M 27	330
450	PN 6	16 × M 20	202
450	PN 10	20 × M 24	235
450	PN 16	20 × M 27	300
500	PN 6	20 × M 20	176
500	PN 10	20 × M 24	265
500	PN 16	20 × M 30	448
600	PN 6	20 × M 24	242
600	PN 10	20 × M 27	345
600 *	PN 16	20 × M 33	658
* Designed acc. to EN 1092-1 (not to DIN 2501)			

Promag E tightening torques for ASME

Nominal diameter		ASME		Max. tightening torque PTFE	
[mm]	[inch]	Pressure rating [lbs]	Threaded fasteners	[Nm]	[lbf · ft]
15	½"	Class 150	4 × ½"	6	4
25	1"	Class 150	4 × ½"	11	8
40	1 ½"	Class 150	4 × ½"	24	18
50	2"	Class 150	4 × 5/8"	47	35
80	3"	Class 150	4 × 5/8"	79	58
100	4"	Class 150	8 × 5/8"	56	41
150	6"	Class 150	8 × ¾"	106	78
200	8"	Class 150	8 × ¾"	143	105
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

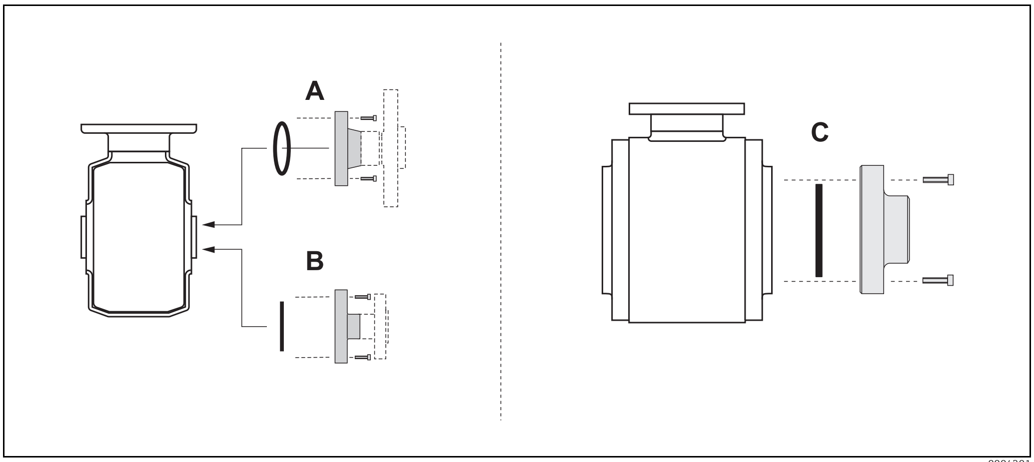
Promag E tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm] PTFE
15	20K	4 × M 12	16
25	20K	4 × M 16	32
32	20K	4 × M 16	38
40	20K	4 × M 16	41
50	10K	4 × M 16	54
65	10K	4 × M 16	74
80	10K	8 × M 16	38
100	10K	8 × M 16	47
125	10K	8 × M 20	80
150	10K	8 × M 20	99
200	10K	12 × M 20	82
250	10K	12 × M 22	133
300	10K	16 × M 22	99

3.3.3 Installing the Promag H sensor

The sensor is supplied to order, with or without pre-installed process connections. Pre-installed process connections are secured to the sensor with 4 or 6 hex-head threaded fasteners.

Caution!
The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory (→ 78).



a0004301

Abb. 19: Promag H process connections (DN 2 to 25 / 1/12 to 1", DN 40 to 100 / 1½ to 4")

A = DN 2 to 25 / 1/12 to 1": process connections with O-ring
- *welding flanges (DIN EN ISO 1127, ODT / SMS),*
- *flange (EN (DIN), ASME, JIS), flange PVDF (EN (DIN), ASME, JIS)*
- *external and internal thread, hose connection, PVC adhesive fitting*

B = DN 2 to 25 / 1/12 to 1": process connections with aseptic gasket vseal
- *weld nipples (DIN 11850, ODT/SMS)*
- *Clamp (ISO 2852, DIN 32676, L14 AM7)*
- *coupling (DIN 11851, DIN 11864-1, SMS 1145)*
- *flange DIN 11864-2*

C = DN 40 to 100 / 1½ to 4": process connections with aseptic gasket seal
- *weld nipples (DIN 11850, ODT/SMS)*
- *Clamp (ISO 2852, DIN 32676, L14 AM7)*
- *coupling (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145)*
- *flange DIN 11864-2*

Seals

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

Caution!
- With metal process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)!
  The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature. Replacement seals can be ordered as accessories → 78.

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

In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalized using additional ground rings. If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the electrochemical erosion of the electrodes.

Caution!
- Depending on the option ordered, plastic disks may be installed at the process connections instead of ground rings. These plastic disks serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic disks/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from Endress+Hauser as accessories (→ 78). When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information about the materials can be found on → 117.
- 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 disk (3), including the two O-ring seals (2).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (2) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again.
   With plastic process connections, note the max. torques for lubricated threads (7 Nm / 5.2 lbf ft).

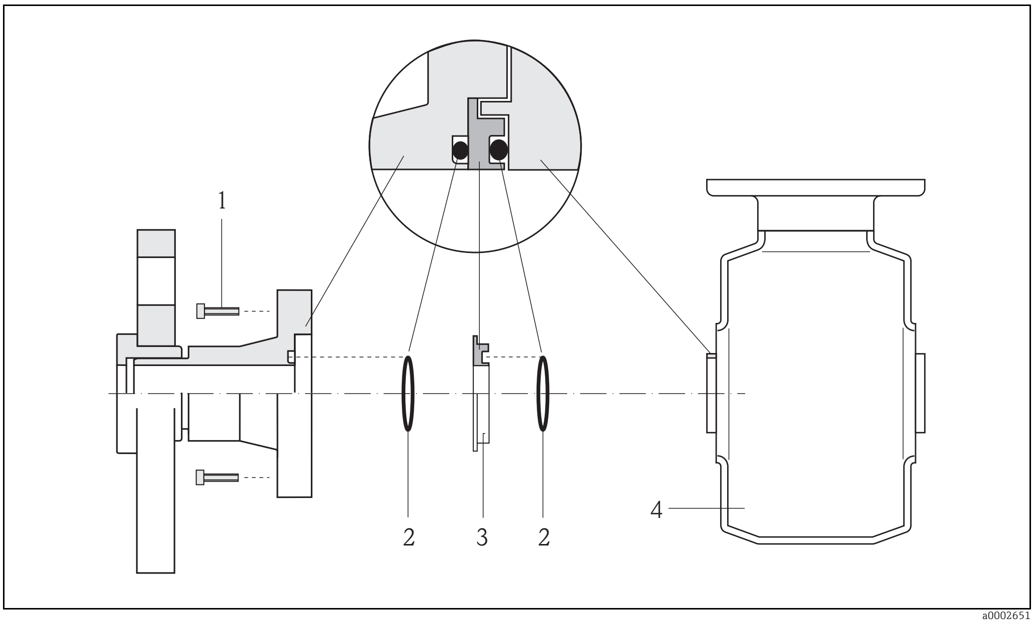


Fig. 20: Installing ground rings with Promag H (DN 2 to 25 / 1/12 to 1")

1 = Hexagonal-headed bolt (process connection)
2 = O-ring seals
3 = Ground ring or plastic disk (spacer)
4 = Sensor

Welding the transmitter into the piping (weld nipples)

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

1. Tack-weld the sensor into the pipe. A suitable welding jig can be ordered separately as an accessory (→ 🗎 78).
2. Loosen the screws on the process connection flange and remove the sensor, complete with the seal, from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

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

Cleaning with pigs

If pigs are used for cleaning, it is essential to take the inside diameters of the measuring tube and process connection into account. All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation "Technical Documentation" → 🗎 124.

3.3.4 Installing the Promag L sensor

Caution!
- The protective covers mounted on the two sensor flanges (DN 50 to 300 / 2 to 12") are used to hold the lap joint flanges in place and to protect the PTFE liner during transportation. Consequently, do not remove these covers until immediately before the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 30
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment
- To comply with the device specification, a concentrical installation in the measuring section is required

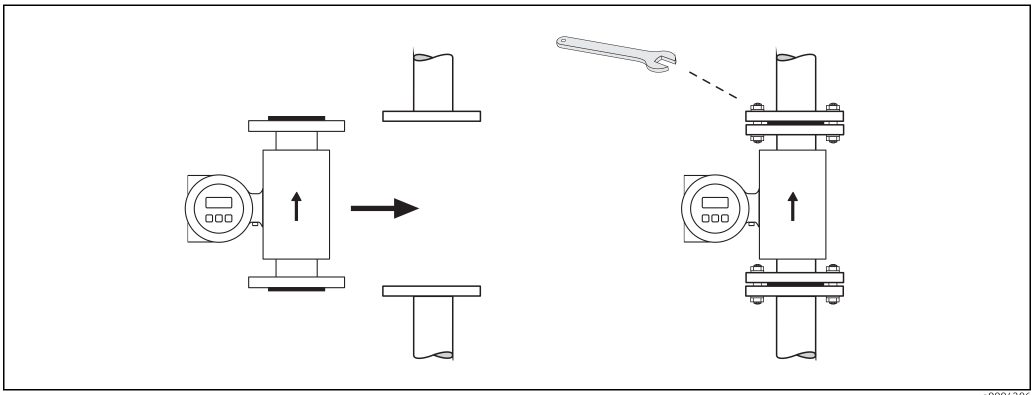


Fig. 21: Installing the Promag L sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- PTFE lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 57.

Screw tightening torques (Promag L)

Please note the following:
- 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.

Promag L tightening torques for EN (DIN)

Nominal diameter	EN (DIN)		Max. tightening torque		
			Hard rubber	Polyurethane	PTFE
[mm]	Pressure rating [bar]	Threaded fasteners	[Nm]	[Nm]	[Nm]
50	PN 10/16	4 × M 16	-	15	40
65*	PN 10/16	8 × M 16	-	10	22
80	PN 10/16	8 × M 16	-	15	30
100	PN 10/16	8 × M 16	-	20	42
125	PN 10/16	8 × M 16	-	30	55
150	PN 10/16	8 × M 20	-	50	90
200	PN 10	8 × M 20	-	65	130
250	PN 10	12 × M 20	-	50	90
300	PN 10	12 × M 20	-	55	100
350	PN 6	12 × M 20	111	120	-
350	PN 10	16 × M 20	112	118	-
400	PN 6	16 × M 20	90	98	-
400	PN 10	16 × M 24	151	167	-
450	PN 6	16 × M 20	112	126	-
450	PN 10	20 × M 24	153	133	-
500	PN 6	20 × M 20	119	123	-
500	PN 10	20 × M 24	155	171	-
600	PN 6	20 × M 24	139	147	-
600	PN 10	20 × M 27	206	219	-
700	PN 6	24 × M 24	148	139	-
700	PN 10	24 × M 27	246	246	-
800	PN 6	24 × M 27	206	182	-
800	PN 10	24 × M 30	331	316	-
900	PN 6	24 × M 27	230	637	-
900	PN 10	28 × M 30	316	307	-
1000	PN 6	28 × M 27	218	208	-
1000	PN 10	28 × M 33	402	405	-
1200	PN 6	32 × M 30	319	299	-
1200	PN 10	32 × M 36	564	568	-
* Designed acc. to EN 1092-1 (not to DIN 2501)					

Promag L tightening torques for ASME

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hard rubber		Polyurethane		PTFE	
[mm]	[inch]	[lbs]		[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
50	2"	Class 150	4 × 5/8"	-	-	15	11	40	29
80	3"	Class 150	4 × 5/8"	-	-	25	18	65	48
100	4"	Class 150	8 × 5/8"	-	-	20	15	44	32
150	6"	Class 150	8 × ¾"	-	-	45	33	90	66
200	8"	Class 150	8 × ¾"	-	-	65	48	125	92
250	10"	Class 150	12 × 7/8"	-	-	55	41	100	74
300	12"	Class 150	12 × 7/8"	-	-	68	56	115	85
350	14"	Class 150	12 × 1"	135	100	158	117	-	-
400	16"	Class 150	16 × 1"	128	94	150	111	-	-

Nominal diameter		ASME	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hard rubber		Polyurethane		PTFE	
[mm]	[inch]	[lbs]		[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
450	18"	Class 150	16 × 1 1/8"	204	150	234	173	-	-
500	20"	Class 150	20 × 1 1/8"	183	135	217	160	-	-
600	24"	Class 150	20 × 1 ¼"	268	198	307	226	-	-

Promag L tightening torques for AWWA

Nominal diameter		AWWA	Threaded fasteners	Max. tightening torque					
		Pressure rating		Hartgummi		Polyurethane		PTFE	
[mm]	[inch]			[Nm]	[lbf · ft]	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215	-	-
750	30"	Class D	28 × 1 ¼"	287	212	302	223	-	-
800	32"	Class D	28 × 1 ½"	394	291	422	311	-	-
900	36"	Class D	32 × 1 ½"	419	309	430	317	-	-
1000	40"	Class D	36 × 1 ½"	420	310	477	352	-	-
1050	42"	Class D	36 × 1 ½"	528	389	518	382	-	-
1200	48"	Class D	44 × 1 ½"	552	407	531	392	-	-

Promag L tightening torques for AS 2129

Nominal diameter	AS 2129	Threaded fasteners	Max. tightening torque		
	Pressure rating		Hard rubber	Polyurethane	PTFE
[mm]			[Nm]	[Nm]	[Nm]
350	Table E	12 × M 24	203	-	-
400	Table E	12 × M 24	226	-	-
450	Table E	16 × 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 L tightening torques for AS 4087

Nominal diameter	AS 4087	Threaded fasteners	Max. tightening torque		
	Pressure rating		Hard rubber	Polyurethane	PTFE
[mm]			[Nm]	[Nm]	[Nm]
350	PN 16	12 × M 24	203	-	-
375	PN 16	12 × M 24	137	-	-
400	PN 16	12 × M 24	226	-	-
450	PN 16	12 × M 24	301	-	-
500	PN 16	16 × M 24	271	-	-
600	PN 16	16 × M 27	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	-	-

3.3.5 Installing the Promag P sensor

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

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 📄 33
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

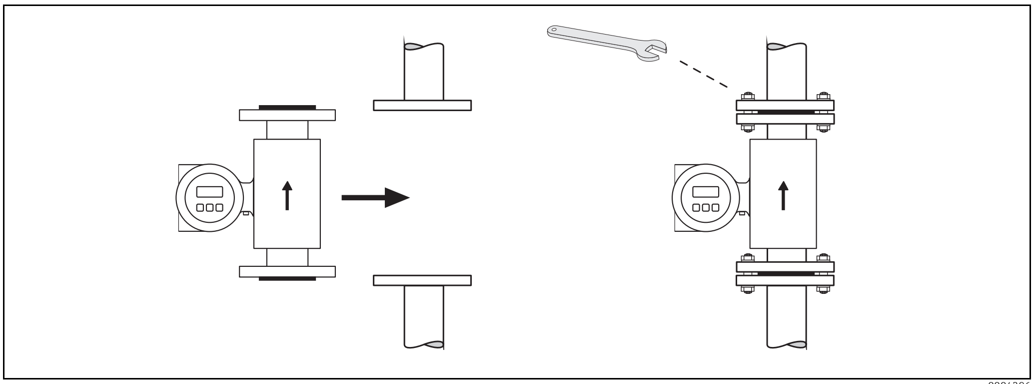


Fig. 22: Installing the Promag P sensor

Seals

Comply with the following instructions when installing seals:
- PFA or PTFE lining → **No** seals are required!
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit! Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 📄 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 📄 55

Installing the high-temperature version (with PFA lining)

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

Note!
You will find information on permissible temperature ranges on → 103

Insulation

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

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

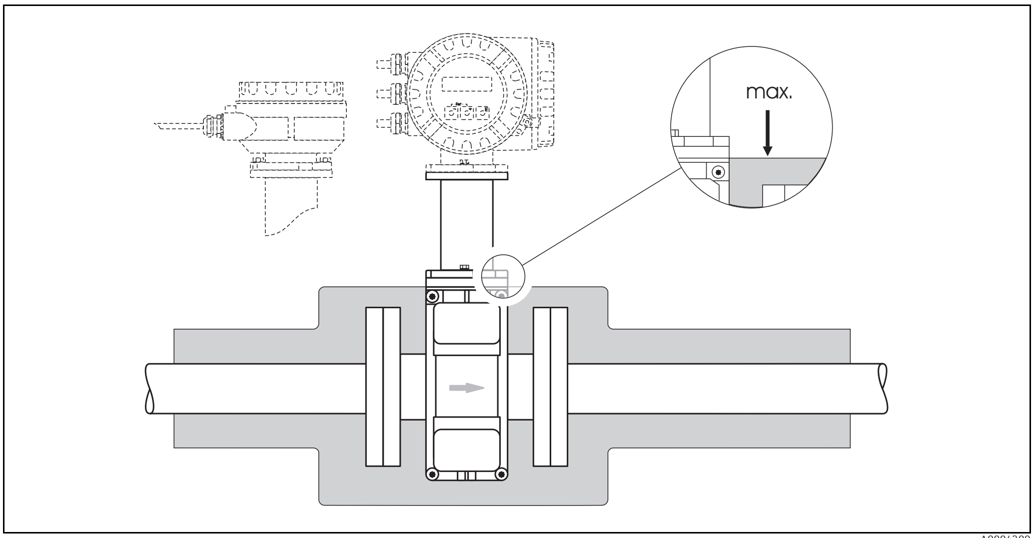


Fig. 23: Promag P (high-temperature version): Insulating the pipe

Tightening torques for threaded fasteners (Promag P)

Please note the following:
- 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) → 34
- ASME → 34
- JIS → 35
- AS 2129 → 35
- AS 4087 → 35

Promag P tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	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 ASME

Nominal diameter		ASME		Max. tightening torque			
		Pressure rating [lbs]	Threaded fasteners	PTFE		PFA	
[mm]	[inch]			[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

Nominal diameter		ASME		Max. tightening torque			
		Pressure	Threaded	PTFE		PFA	
[mm]	[inch]	rating [lbs]	fasteners	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
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	JIS		Max. tightening torque [Nm]	
[mm]	Pressure rating	Threaded fasteners	PTFE	PFA
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
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	Threaded fasteners	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	Threaded fasteners	Max. tightening torque [Nm] PTFE
50	PN 16	4 × M 16	42

3.3.6 Installing the Promag W sensor

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

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on → 36
- If grounding disks are used, follow the mounting instructions which will be enclosed with the shipment

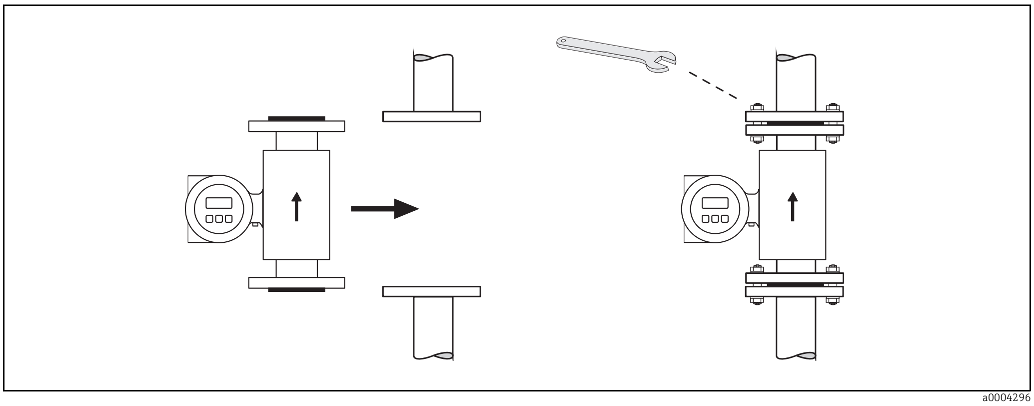


Fig. 24: Installing the Promag W sensor

Seals

Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → **no** seals are required.
- For DIN flanges, use only seals according to EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit!
Do not use electrically conductive sealing compounds 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 for potential equalization can be ordered as an accessory (→ 78).
- Information on potential equalization and detailed mounting instructions for the use of ground cables can be found on → 57

Screw tightening torques (Promag W)

Please note the following:
- 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)→ 📄 37
- JIS→ 📄 39
- ASME→ 📄 38
- AWWA → 📄 39
- AS 2129 → 📄 40
- AS 4087 → 📄 40

Promag W tightening torques for EN (DIN)

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	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	48	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
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

Nominal diameter [mm]	EN (DIN) Pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
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 ASME

Nominal diameter		ASME		Max. tightening torque			
		Pressure rating	Threaded	Hard rubber		Polyurethane	
[mm]	[inch]	[lbs]	fasteners	[Nm]	[lbf · ft]	[Nm]	[lbf · ft]
25	1"	Class 150	4 × ½"	-	-	7	5
25	1"	Class 300	4 × 5/8"	-	-	8	6
40	1 ½"	Class 150	4 × ½"	-	-	10	7
40	1 ½"	Class 300	4 × ¾"	-	-	15	11
50	2"	Class 150	4 × 5/8"	35	26	22	16
50	2"	Class 300	8 × 5/8"	18	13	11	8
80	3"	Class 150	4 × 5/8"	60	44	43	32
80	3"	Class 300	8 × ¾"	38	28	26	19
100	4"	Class 150	8 × 5/8"	42	31	31	23
100	4"	Class 300	8 × ¾"	58	43	40	30
150	6"	Class 150	8 × ¾"	79	58	59	44
150	6"	Class 300	12 × ¾"	70	52	51	38
200	8"	Class 150	8 × ¾"	107	79	80	59
250	10"	Class 150	12 × 7/8"	101	74	75	55
300	12"	Class 150	12 × 7/8"	133	98	103	76
350	14"	Class 150	12 × 1"	135	100	158	117
400	16"	Class 150	16 × 1"	128	94	150	111
450	18"	Class 150	16 × 1 1/8"	204	150	234	173
500	20"	Class 150	20 × 1 1/8"	183	135	217	160
600	24"	Class 150	20 × 1 ¼"	268	198	307	226

Promag W tightening torques for JIS

Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	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	40	33
50	20K	8 × M 16	20	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 AWWA

Nominal diameter [mm]	[inch]	AWWA Pressure rating	Threaded fasteners	Max. tightening torque Hard rubber [Nm]	Hard rubber [lbf · ft]	Polyurethane [Nm]	Polyurethane [lbf · ft]
700	28"	Class D	28 × 1 ¼"	247	182	292	215
750	30"	Class D	28 × 1 ¼"	287	212	302	223
800	32"	Class D	28 × 1 ½"	394	291	422	311
900	36"	Class D	32 × 1 ½"	419	309	430	317
1000	40"	Class D	36 × 1 ½"	420	310	477	352
1050	42"	Class D	36 × 1 ½"	528	389	518	382
1200	48"	Class D	44 × 1 ½"	552	407	531	392
1350	54"	Class D	44 × 1 ¾"	730	538	633	467
1500	60"	Class D	52 × 1 ¾"	758	559	832	614
1650	66"	Class D	52 × 1 ¾"	946	698	955	704
1800	72"	Class D	60 × 1 ¾"	975	719	1087	802
2000	78"	Class D	64 × 2"	853	629	786	580

Promag W tightening torques for AS 2129

Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
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
450	Table E	16 × 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

Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
50	Table E	4 × M 16	32
80	PN 16	4 × M 16	49
100	PN 16	4 × M 16	76
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
450	PN 16	12 × M 24	301
500	PN 16	16 × M 24	271
600	PN 16	16 × M 27	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

3.3.7 Turning the transmitter housing

Turning the aluminum field housing

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

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing:
   – Promag D: approx. 10 mm (0.39 inch) above the securing screws
   – Promag E/H/L/P/W: to the stop
4. Turn the transmitter housing to the desired position:
   – Promag D: max. 180° clockwise or max. 180° counterclockwise
   – Promag E/H/L/P/W: max. 280° clockwise or max. 20° counterclockwise
5. Lower the housing into position and re-engage the bayonet catch.
6. Retighten the two securing screws.

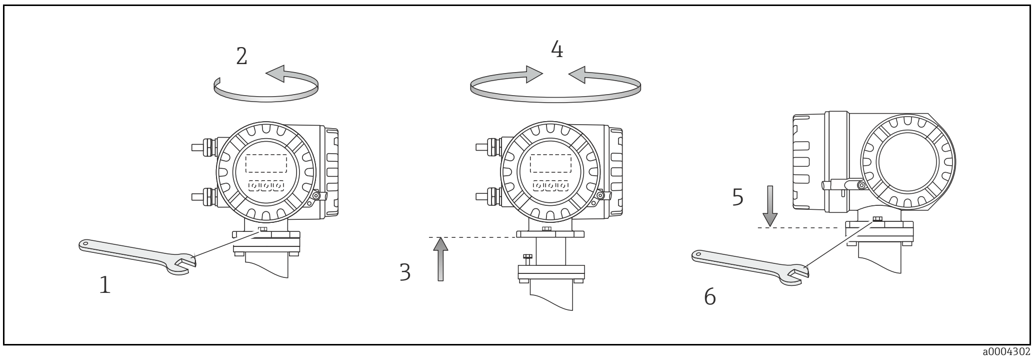


Fig. 25: Turning the transmitter housing (aluminum field housing)

Turning the stainless-steel field housing

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

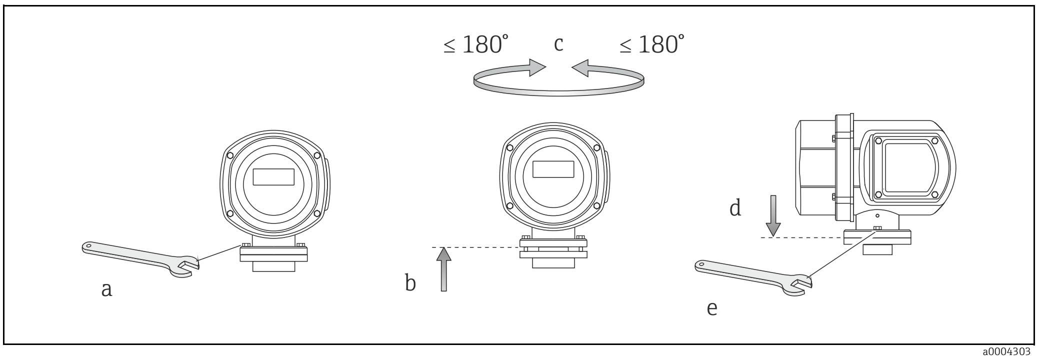


Fig. 26: Turning the transmitter housing (stainless-steel field housing)

3.3.8 Turning the onsite display

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

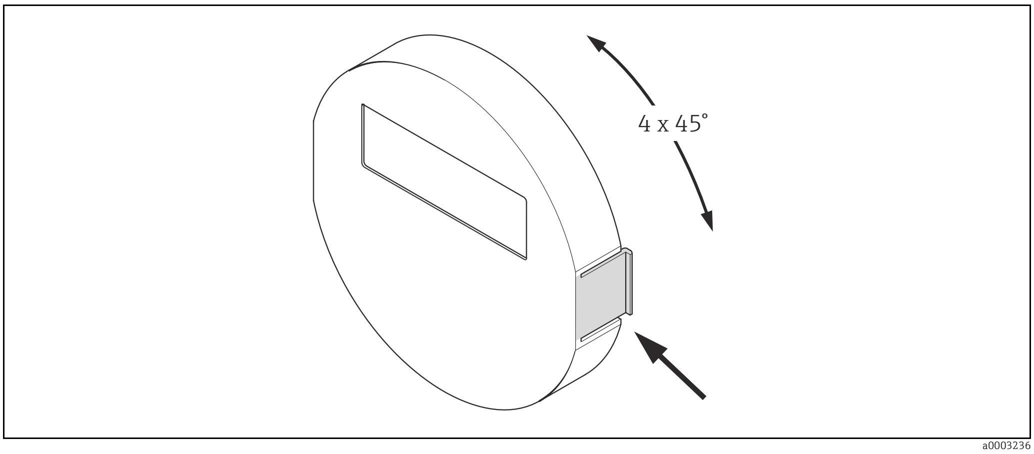


Fig. 27: Turning the local display (field housing)

3.3.9 Installing the wall-mount housing

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

- Direct wall mounting
- Installation in control panel (with separate mounting kit, accessories) → 🗎 44
- Pipe mounting (with separate mounting kit, accessories) → 🗎 44

Caution!
- Make sure that the ambient temperature does not exceed the permissible range at the mounting location, –20 to +60 °C (–4 to +140 °F), optional –40 to +60 °C (–40 to +140 °F). Install the device at a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Direct wall mounting

1. Drill the holes as illustrated in the graphic.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm (0.26")
   – Screw head: max. Ø 10.5 mm (0.41")
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

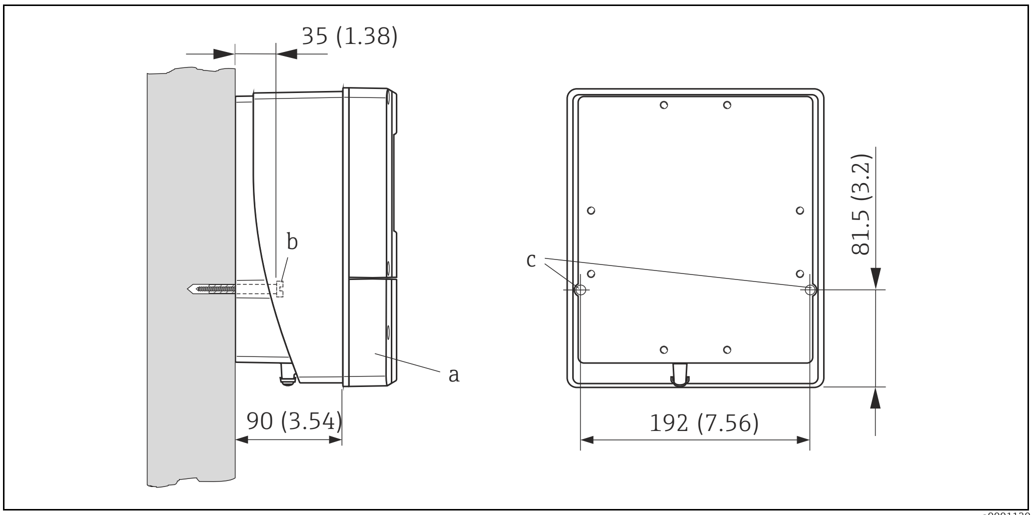


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Fig. 28: Mounted directly on the wall

Panel-mounted installation

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

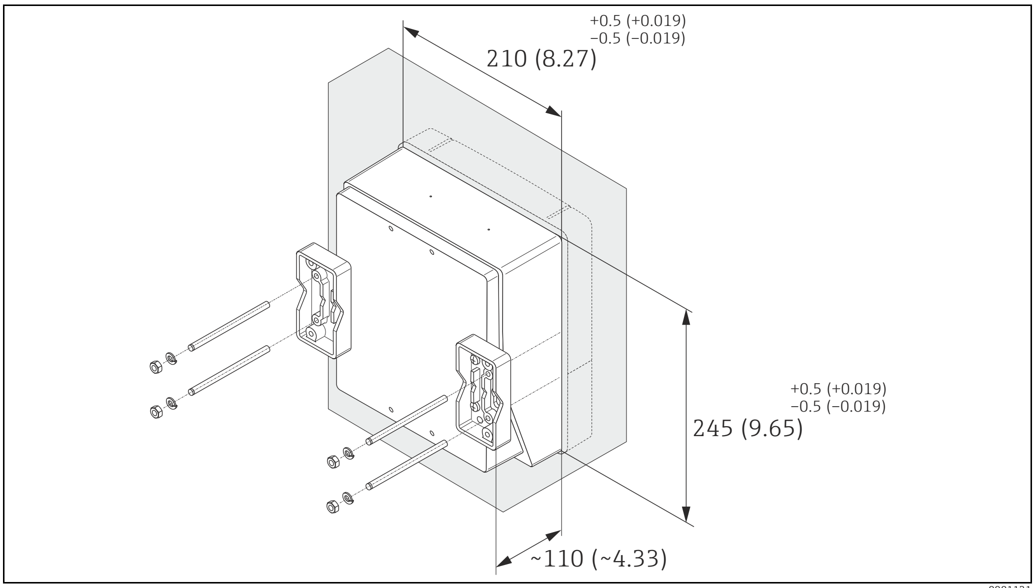

Fig. 29: Panel installation (wall-mount housing)

Pipe mounting

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

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

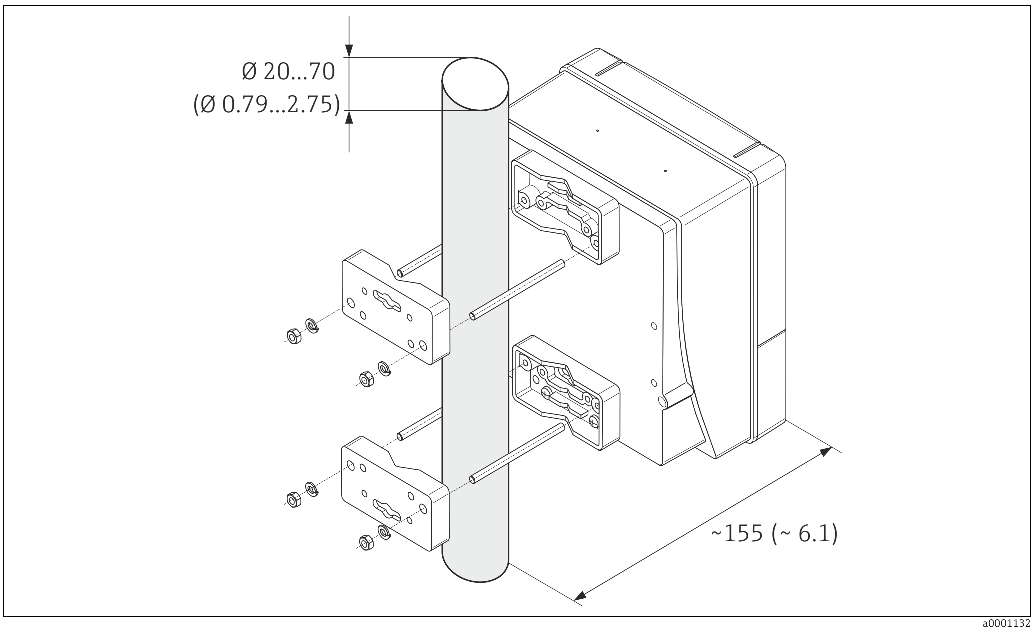

Fig. 30: Pipe mounting (wall-mount housing)

3.4 Post-installation check

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

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	-
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	→ 🖹 103
Installation	**Notes**
Does the arrow on the sensor nameplate match the actual direction of flow through the pipe?	-
Is the position of the measuring electrode plane correct?	→ 🖹 14
Is the position of the empty pipe detection electrode correct?	→ 🖹 14
Were all screws tightened to the specified torques when the sensor was installed?	Promag D → 🖹 22 Promag E → 🖹 24 Promag L → 🖹 30 Promag P → 🖹 33 Promag W → 🖹 36
Were the correct seals used (type, material, installation)?	Promag D → 🖹 20 Promag E → 🖹 23 Promag H → 🖹 26 Promag L→ 🖹 29 Promag P → 🖹 32 Promag W → 🖹 36
Are the measuring point number and labeling correct (visual inspection)?	-
Process environment / process conditions	**Notes**
Were the inlet and outlet runs respected?	Inlet run ≥ 5 × DN Outlet run ≥ 2 × DN
Is the measuring device protected against moisture and direct sunlight?	-
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g by analogy with IEC 600 68-2-8

4 Wiring

Warning!
When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.
Please do not hesitate to contact your Endress+Hauser representative if you have any questions.

Note!
The device does not have an internal circuit breaker. For this reason, assign the device a switch or power-breaker switch capable of disconnecting the power supply line from the mains.

4.1 Connecting the remote version

4.1.1 Connecting Promag D/E/H/L/P/W

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" → 19).
4. Terminate the signal and coil current cable as indicated in the table:
   Promag D/E/L/P/W → Refer to the table → 49
   Promag H → Refer to the "Cable termination" table → 50
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:
     → 31 (Promag D) → 32 (Promag E/L/P/W); → 33 (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 → 50)

   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 D

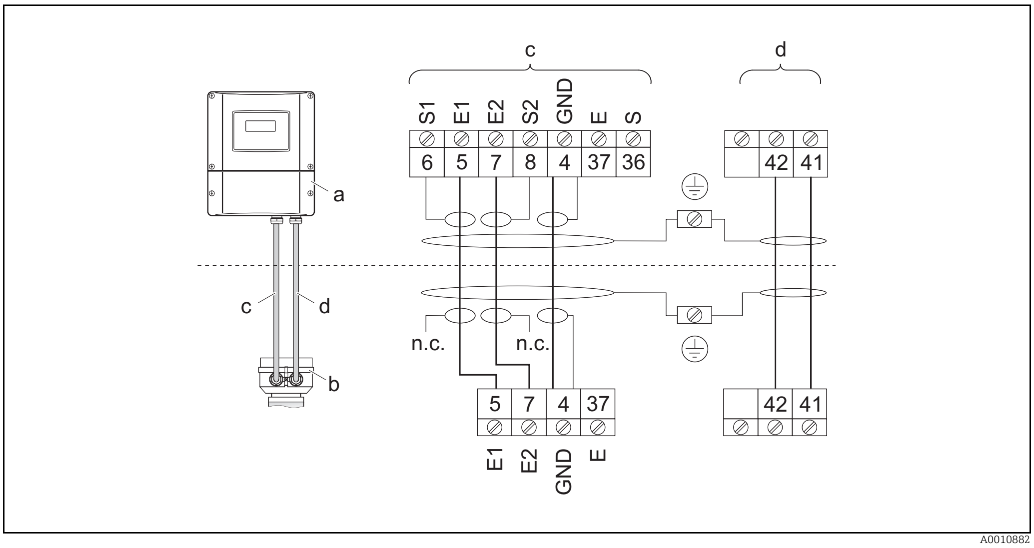

Fig. 31: Connecting the remote version of Promag D

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 = braun, 7/8 = white, 4 = green, 37/36 = yellow

Promag E/L/P/W

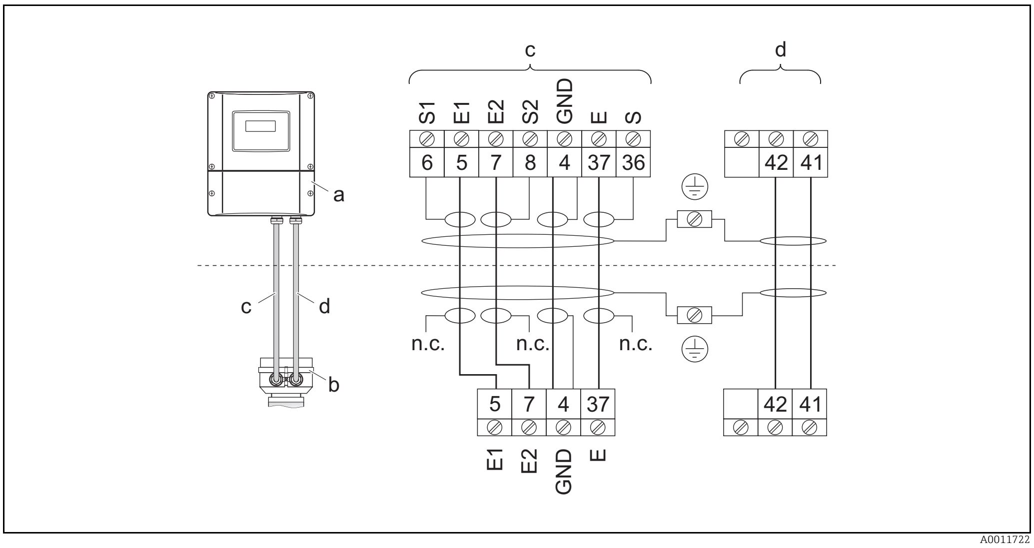

Fig. 32: Connecting the remote version of Promag E/L/P/W

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 = braun, 7/8 = white, 4 = green, 37/36 = yellow

Promag H

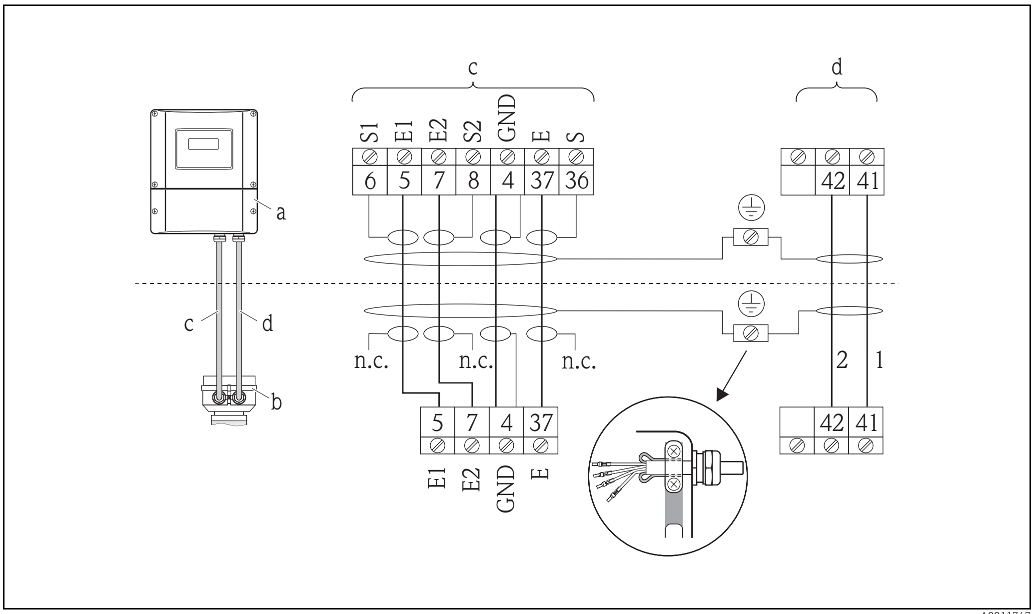

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Fig. 33: Connecting the remote version of Promag H

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 = braun, 7/8 = white, 4 = green, 37/36 = yellow

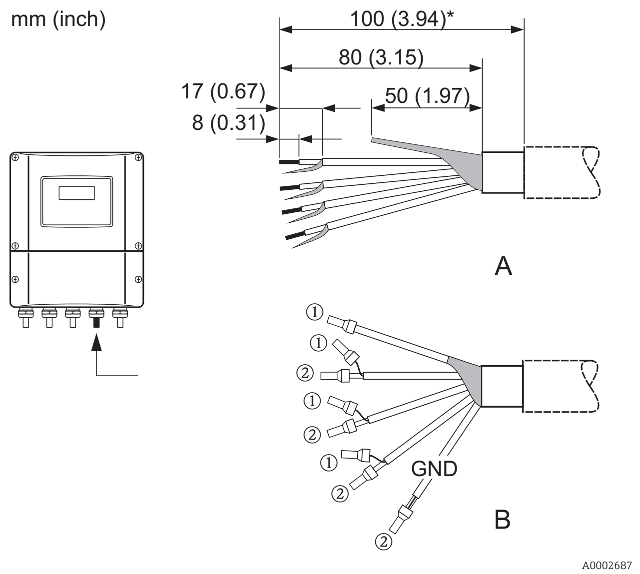
Cable termination for the remote version
Promag D/E/L/P/W

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).
* Stripping only for reinforced cables

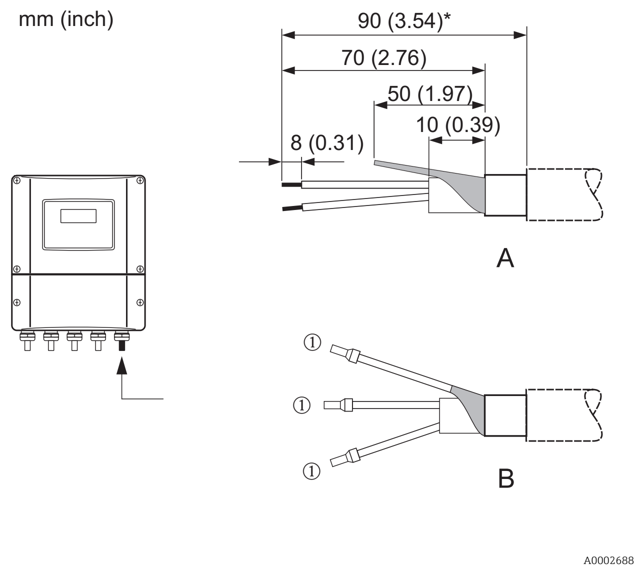
Caution!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the ferrules do not touch the wire shield on the sensor side.
  Minimum distance = 1 mm (exception "GND" = green cable)
- *Coil current cable* → Insulate one core of the three-core wire at the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

TRANSMITTER

Signal cable

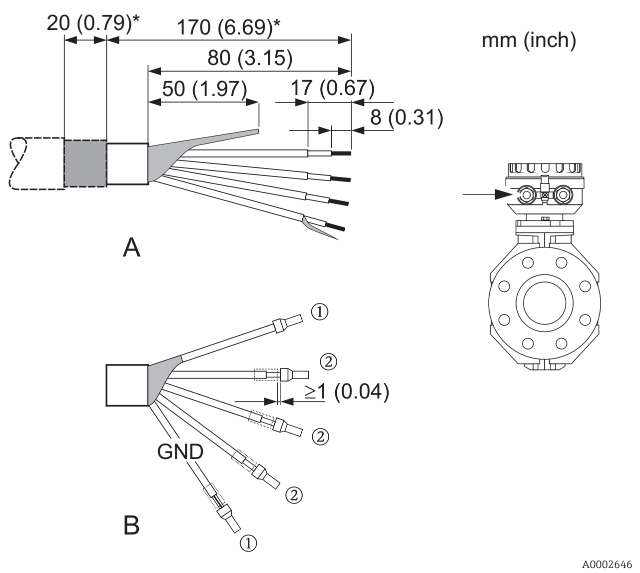


Coil current cable

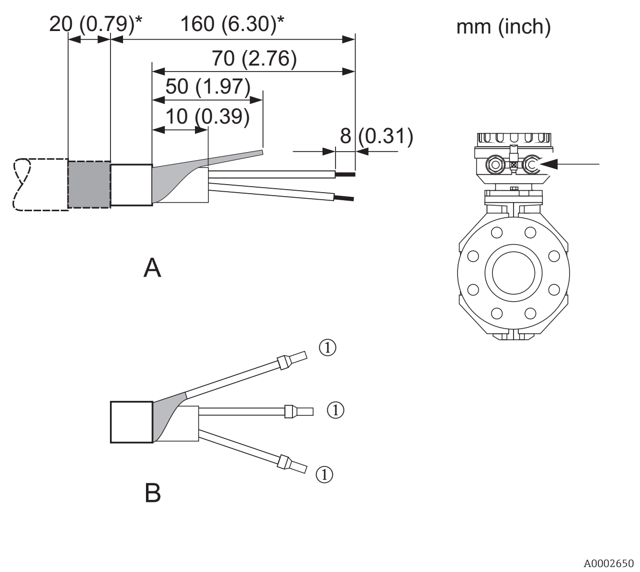


SENSOR

Signal cable



Coil current cable



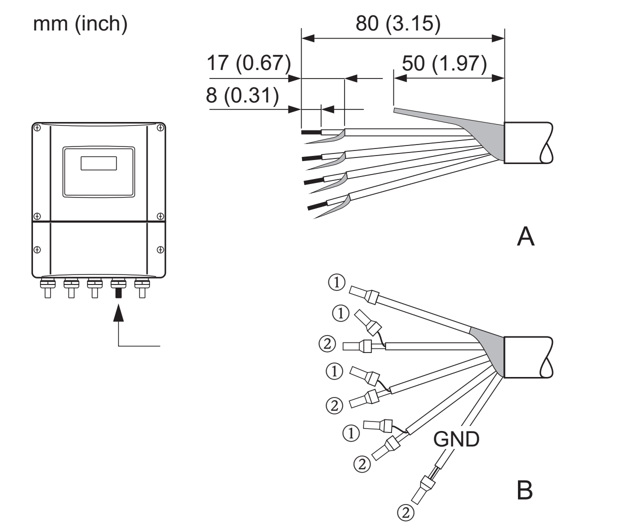
Cable termination for the remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Ferrules must be provided on the fine-wire cores (Detail B: ① = red ferrules, ∅ 1.0 mm; ② = white ferrules, ∅ 0.5 mm).

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

TRANSMITTER

Signal cable



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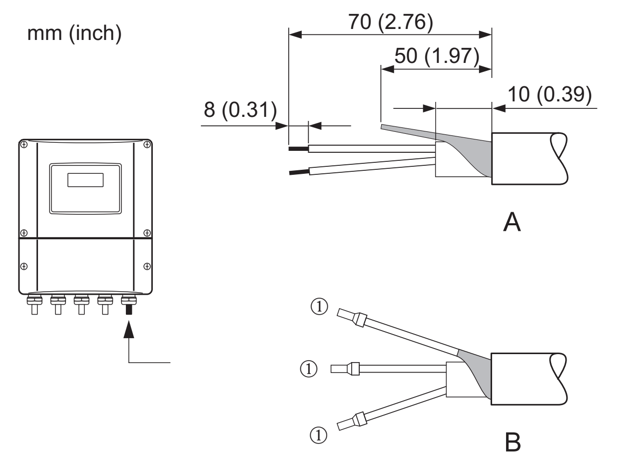
Coil current cable



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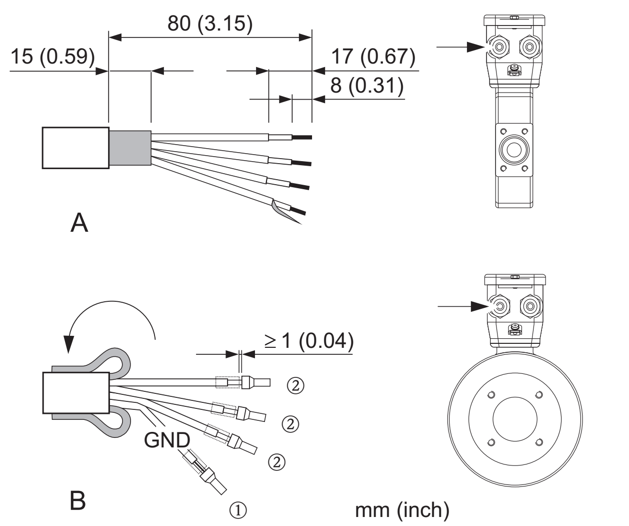
SENSOR

Signal cable



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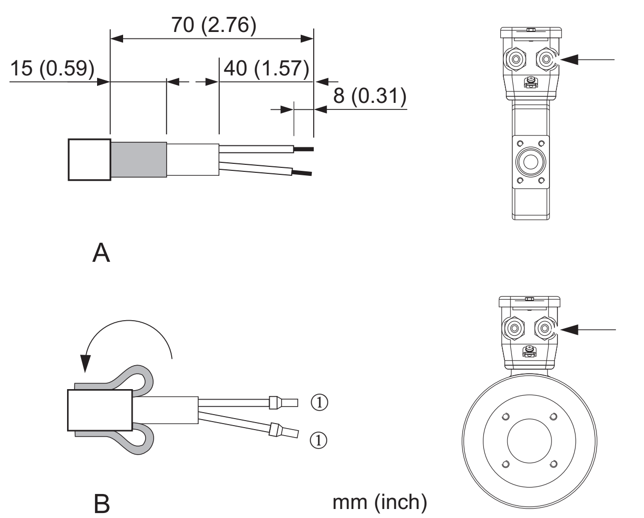
Coil current cable



A0002648

4.1.2 Cable specifications

Signal cable

- 3 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 × 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Permanent operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²

Coil cable

- 2 × 0.75 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Operating temperature: –20 to +80 °C
- Cable cross-section: max. 2.5 mm²
- Test voltage for cable insulation: ≥1433 V AC r.m.s. 50/60 Hz or ≥2026 V DC

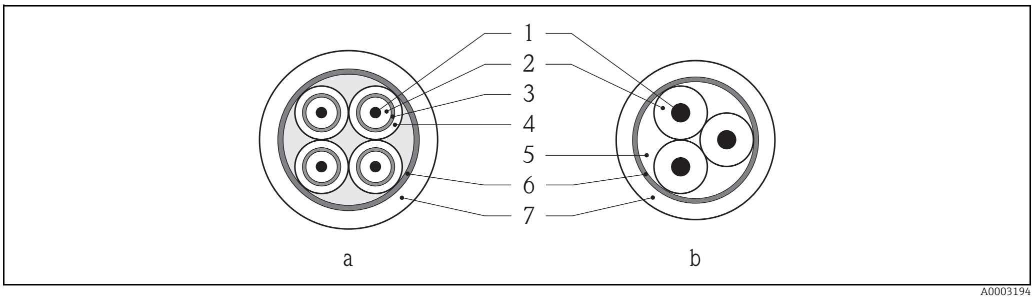


Fig. 34: Cable cross-section

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. Reinforced connecting cables should be used when laying the cable directly in the ground, if there is a risk of damage from rodents or if using the measuring device below IP 68 degree 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. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.

4.2 Connecting the measuring unit

4.2.1 Connecting the transmitter

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

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and the signal cable (b) through the appropriate cable entries.
3. Perform the wiring:
   – Wiring diagram (aluminum housing) → 35
   – Wiring diagram (stainless steel housing) → 36
   – Wiring diagram (wall-mount housing) → 37
   – Terminal assignment → 54
4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.

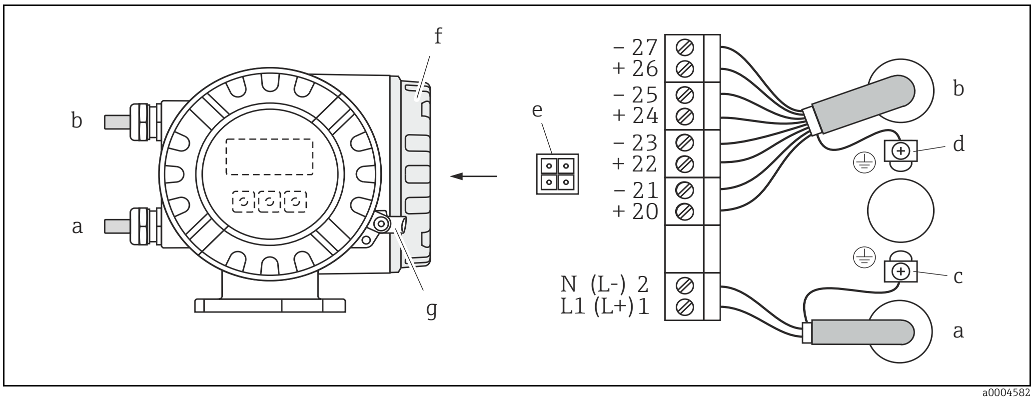


Fig. 35: Connecting the transmitter (aluminum field housing). Cable cross-section: max. 2.5 mm²

a 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*
*b Signal cable: Terminals **Nos. 20–27** → 54*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment
g Securing clamp

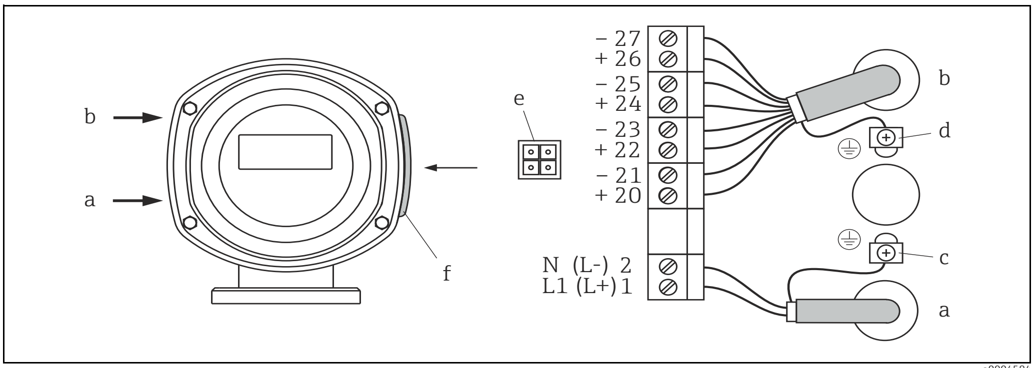


Fig. 36: Connecting the transmitter (stainless steel field housing); cable cross-section: max. 2.5 mm²

a 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*
*b Signal cable: Terminals **Nos. 20–27** →* *54*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment

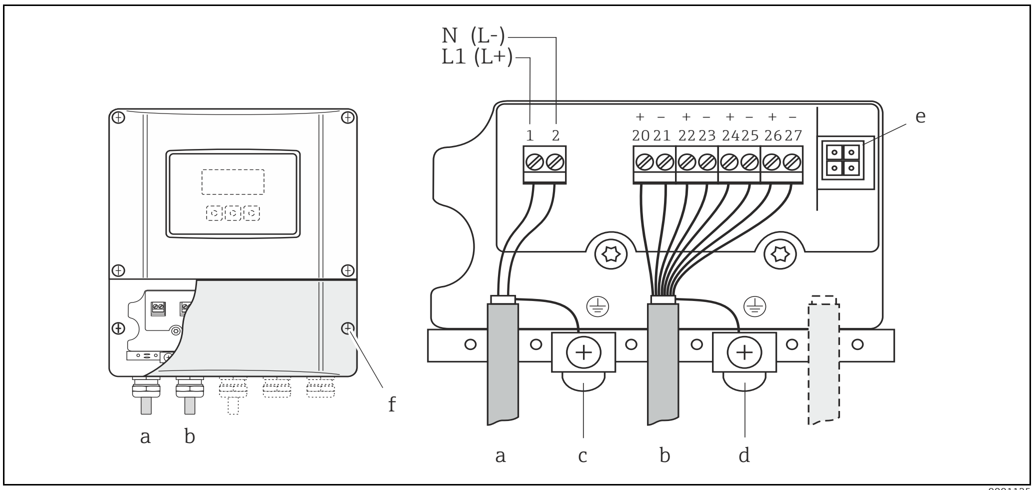


Fig. 37: Connecting the transmitter (wall-mount housing); cable cross-section: max. 2.5 mm²

a 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*
*b Signal cable: Terminals **Nos. 20–27** →* *54*
c Ground terminal for protective ground
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA193 (Fieldcheck, FieldCare)
f Cover of the connection compartment

4.2.2 Terminal assignment

Order version	Terminal No. (inputs / outputs)			
	20 (+) / 21 (–)	22 (+) / 23 (–)	24 (+) / 25 (–)	26 (+) / 27 (–)
50***-***********W	-	-	-	Current output HART
50***-***********A	-	-	Frequency output	Current output HART
50***-***********D	Status input	Status output	Frequency output	Current output HART
50***-***********S	-	-	Frequency output Ex i	Current output, Ex i, active, HART
50***-***********T	-	-	Frequency output Ex i	Current output, Ex i, passive, HART

Note!
Functional values of the inputs and outputs → 📄 98

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) and 27 (–)
- Connection by means of the 4 to 20 mA circuit.

Note!
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
- CURRENT SPAN function → "4–20 mA HART"
- Switch HART write protection on or off → 📄 65

Connection of the HART handheld communicator

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

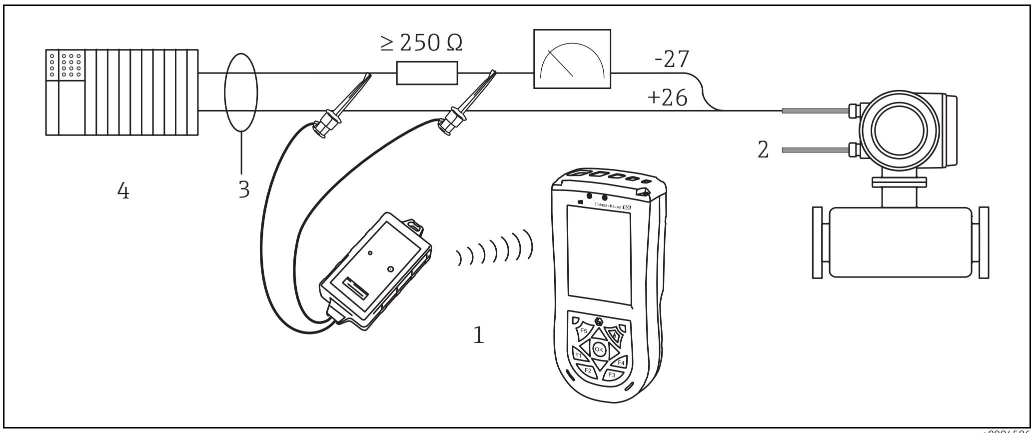


Fig. 38: Electrical connection of HART handheld Field Xpert SFX100

1 HART handheld Field Xpert SFX100
2 Auxiliary energy
3 Shielding
4 Other devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with operating software (e.g. "FieldCare"), a HART modem (e.g. "Commubox FXA195") is needed.

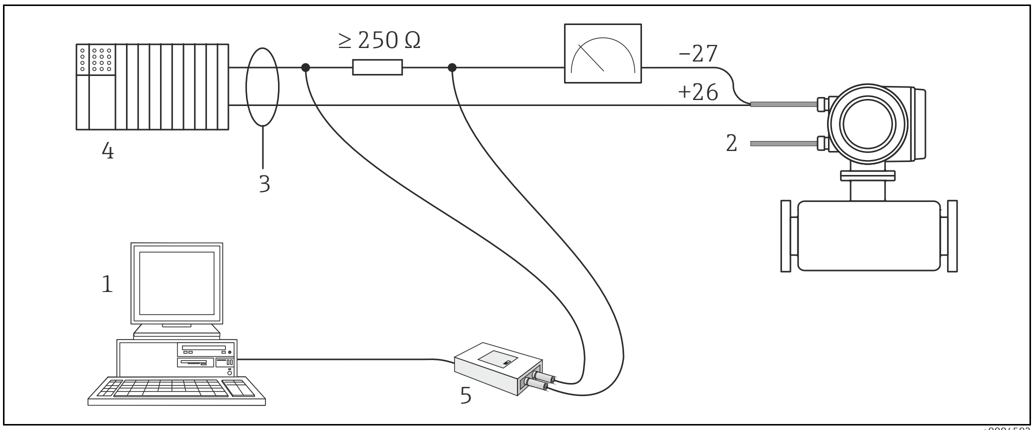


Fig. 39: Electrical connection of a PC with operating software

1 PC with operating software
2 Auxiliary energy
3 Shielding
4 Other devices or PLC with passive input
5 HART modem, e.g. Commubox FXA195

4.3 Potential equalization

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

Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.

The following should also be taken into consideration for potential equalization:
- Internal grounding concepts in the company
- Operating conditions, such as the material/grounding of the pipes (see Table)

4.3.1 Potential equalization for Promag D

- No reference electrode is integrated!
  For the two ground disks of the sensor an electrical connection to the fluid is always ensured.
- Exampels for connections → 56

4.3.2 Potential equalization for Promag E/L/P/W

- Reference electrode integrated in the sensor as standard
- Exampels for connections → 57

4.3.3 Potential equalization for Promag H

No reference electrode is integrated!
For the metal process connections of the sensor an electrical connection to the fluid is always ensured.

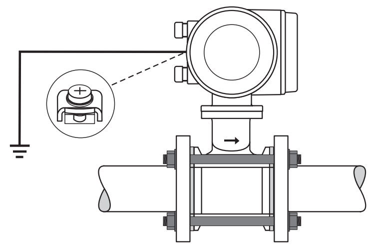
Caution!
If using process connections made of a synthetic material, ground rings have to be used to ensure that potential is equalized (→ 27). The necessary ground rings can be ordered separately from Endress+Hauser as accessories (→ 78).

4.3.4 Exampels for potential equalization connections for Promag D

Standard case

<table>
<tr><th>Operating conditions</th><th>Potential equalization</th></tr>
<tr><td>When using the measuring device in a:
▪ Metal, grounded pipe
▪ Plastic pipe
▪ Pipe with insulating lining

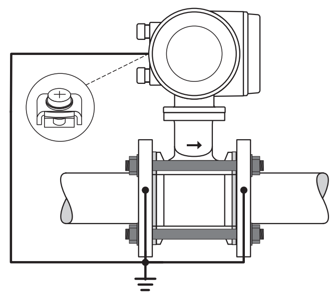
Potential equalization takes place via the ground terminal of the transmitter (standard situation).

Note!
When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.</td><td>
a00012172
Fig. 40: Via the ground terminal of the transmitter</td></tr>
</table>

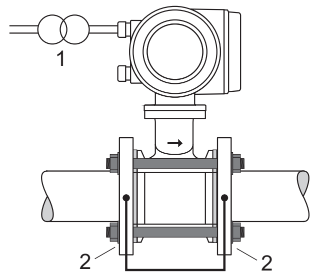
Special cases

<table>
<tr><th>Operating conditions</th><th>Potential equalization</th></tr>
<tr><td>When using the measuring device in a:
▪ Metal pipe that is not grounded

This connection method also applies in situations where:
▪ Customary potential equalization cannot be ensured
▪ Excessively high equalizing currents can be expected

Potential equalization takes place via the ground terminal of the transmitter and the two pipe flanges.
Here, the ground cable (copper wire, 6 mm² / 0.0093 in²) is mounted directly on the conductive flange coating with flange screws.</td><td>
a00012173
Fig. 41: Via the ground terminal of the transmitter and the flanges of the pipe .</td></tr>
<tr><td>When using the measuring device in a:
▪ Pipe with a cathodic protection unit

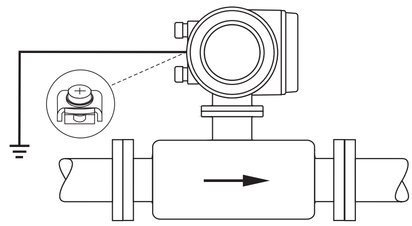
The device is installed potential-free in the pipe.
Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² (0.0093 in²)). Here, the ground cable is mounted directly on the conductive flange coating with flange screws.

Note the following when installing:
▪ The applicable regulations regarding potential-free installation must be observed.
▪ There should be no electrically conductive connection between the pipe and the device.
▪ The mounting material must withstand the applicable torques.</td><td>

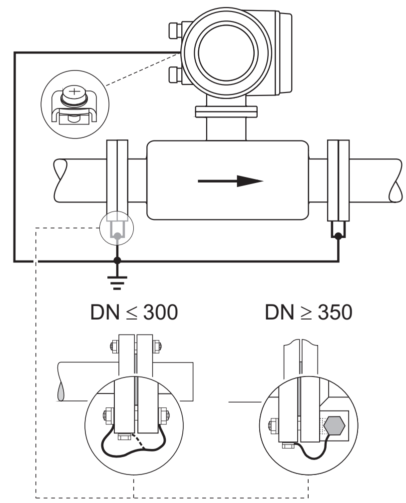
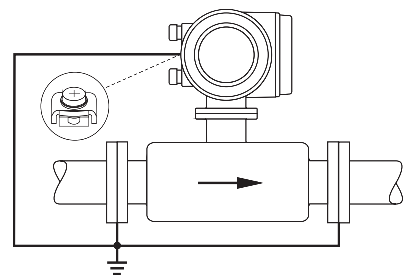
a00012174
Fig. 42: Potential equalization and cathodic protection
1 Power supply isolation transformer
2 Electrically isolated</td></tr>
</table>

4.3.5 Exampels for potential equalization connections for Promag E/L/P/W

Standard case

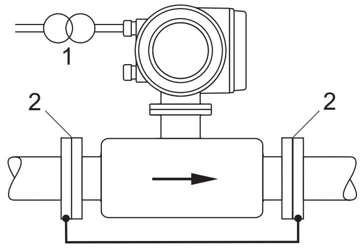
Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal, grounded pipe Potential equalization takes place via the ground terminal of the transmitter (standard situation). Note! When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.	 A0011892 *Fig. 43: Via the ground terminal of the transmitter*

Special cases

Operating conditions	Potential equalization
When using the measuring device in a: ▪ Metal pipe that is not grounded This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured ▪ Excessively high equalizing currents can be expected Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, 6 mm² / 0.0093 in²) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose. Ground cable installation depends on the nominal diameter: ▪ DN ≤ 300 (12"): The ground cable is mounted directly on the conductive flange coating with the flange screws. ▪ DN ≥ 350 (14"): The ground cable is mounted directly on the metal transport bracket. Note! The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.	 A0011893 *Fig. 44: Via the ground terminal of the transmitter and the flanges of the pipe*
When using the measuring device in a: ▪ Plastic pipe ▪ Pipe with insulating lining This connection method also applies in situations where: ▪ Customary potential equalization cannot be ensured ▪ Excessively high equalizing currents can be 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 *Fig. 45: Via the ground terminal of the transmitter*

<table>
<tr><th>Operating conditions</th><th>Potential equalization</th></tr>
<tr><td>When using the measuring device in a:
▪ Pipe with a cathodic protection unit

The device is installed potential-free in the pipe.
Only the two flanges of the pipe are connected with a ground cable (copper wire, 6 mm² / 0.0093 in²). Here, the ground cable is mounted directly on the conductive flange coating with flange screws.

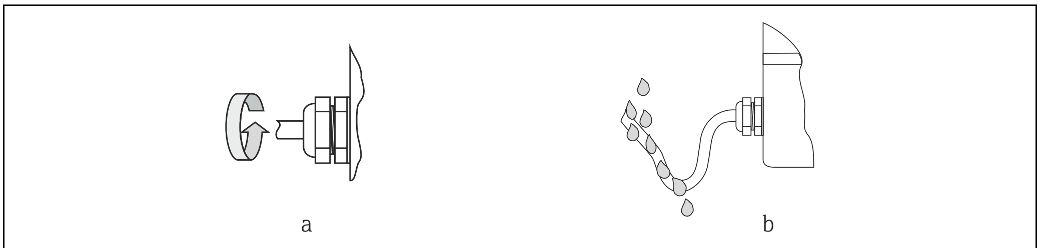
Note the following when installing:
▪ The applicable regulations regarding potential-free installation must be observed.
▪ There should be no electrically conductive connection between the pipe and the device.
▪ The mounting material must withstand the applicable torques.</td><td>
A0011896
Fig. 46: Potential equalization and cathodic protection

1 Power supply isolation transformer
2 Electrically isolated</td></tr>
</table>

4.4 Degree of protection

The devices meet all the requirements of IP 67 degree of protection.

Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP 67 protection is maintained:
- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → 51.
- Firmly tighten the cable entries.
- The cables must loop down before they enter the cable entries ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.



a0001914

Fig. 47: Installation instructions, cable entries

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

Note!
The Promag E/L/P/W sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters (10 ft)). In this case the transmitter must be installed remote from the sensor.
The Promag L sensors with IP 68 rating are only available with stainless steel flanges.

4.5 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	-
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	▪ 85 to 250 V AC (50 to 60 Hz) ▪ 20 to 28 V AC (50 to 60 Hz) 11 to 40 V DC
Do the cables used comply with the necessary specifications?	→ 🖹 51
Do the cables have adequate strain relief?	-
Is the cable type route completely isolated? Without loops and crossovers?	-
Are the power-supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Only remote version: Is the flow sensor connected to the matching transmitter electronics?	Check serial number on nameplates of sensor and connected transmitter.
Only remote version: Is the connecting cable between sensor and transmitter connected correctly?	→ 🖹 46
Are all screw terminals firmly tightened?	-
Have the measures for grounding/potential equalization been correctly implemented?	→ 🖹 55
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 🖹 58
Are all housing covers installed and firmly tightened?	-

5 Operation

5.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device.
The display area consists of two lines; this is where measured values are displayed, and/or status variables (direction of flow, partially filled pipe, bar graph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ "Description of Device Functions" manual).

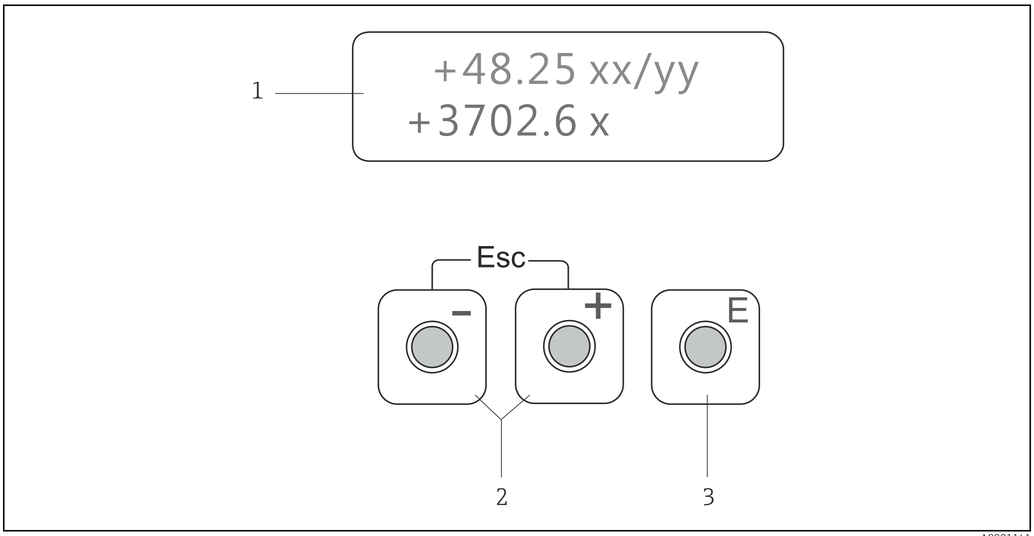


Fig. 48: Display and operating elements

1 Liquid crystal display
The two-line liquid-crystal display shows measured values, dialog texts, error messages and information messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).
- *Upper display line: Shows primary measured values, e.g. volume flow in [ml/min] or in [%].*
- *Lower display line: Shows supplementary measured variables and status variables, e.g. totalizer reading in [m3], bar graph, measuring point designation*

2 Plus/minus keys
- *Enter numerical values, select parameters*
- *Select different function groups within the function matrix*

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

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

5.2 Brief operating instructions on the function matrix

Note!
- See the general notes on → 62.
- Detailed description of all the functions → "Description of Device Functions" manual

The function matrix comprises two levels, namely the function groups and the functions of the function groups.
The groups are the highest-level grouping of the control options for the device. A number of functions is assigned to each group. You select a group in order to access the individual functions for operating and configuring the device.

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g. OPERATION)
3. Select a function (e.g. LANGUAGE)
   Change parameter/enter numerical values:
   +/- → select or enter enable code, parameters, numerical values
   E → save your entries
4. Exit the function matrix:
   – Press and hold down Esc key (-+) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (-+) → return step by step to HOME position

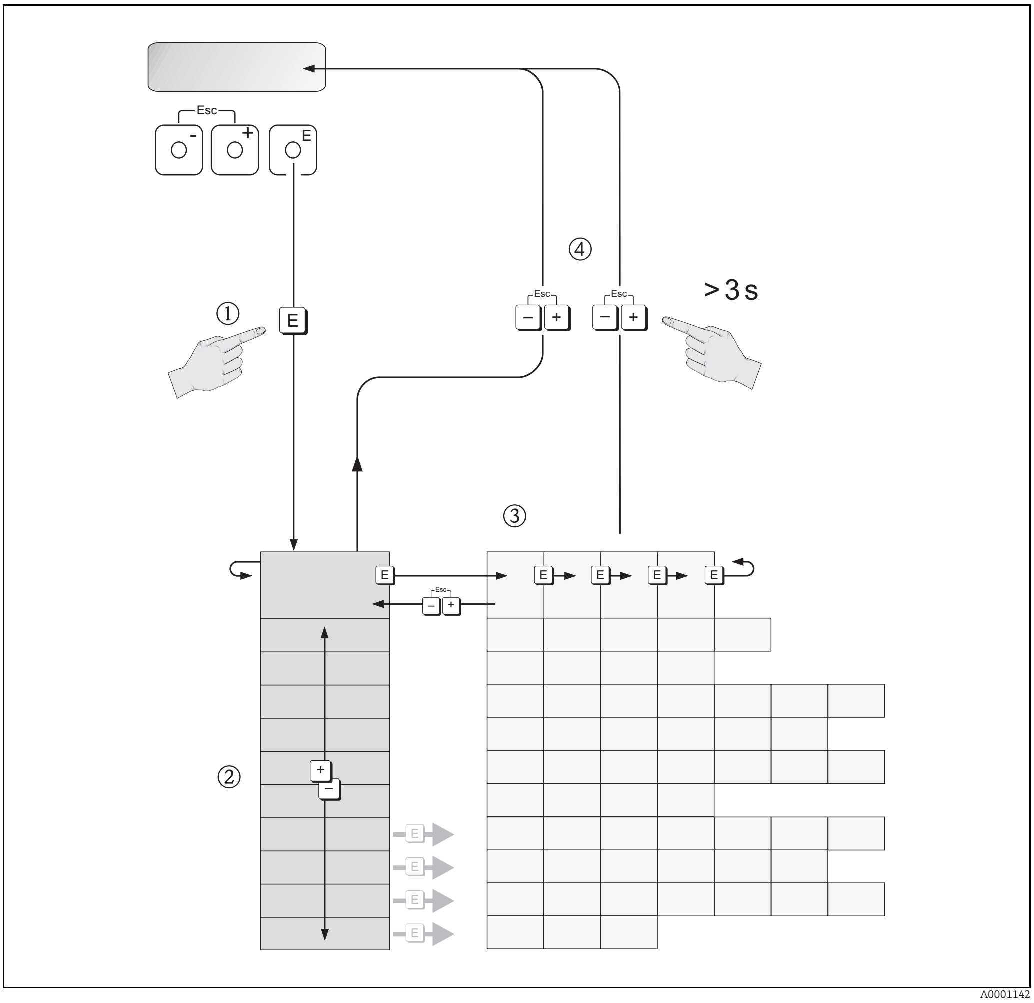


Fig. 49: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

The Quick Setup menu (→ 72) is adequate for commissioning in most instances. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on → 61.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries.
  Press to select "SURE [YES]" and press again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

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

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.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 50) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is specified as the customer's code, programming is always enabled.
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.

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

5.2.3 Disabling the programming mode

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

5.3 Displaying error messages

5.3.1 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* → 📄 82:
  This group comprises all device errors, e.g. communication errors, hardware faults, etc.
- *Process errors* → 📄 84:
  This group comprises all application errors, e.g. empty pipe, etc.

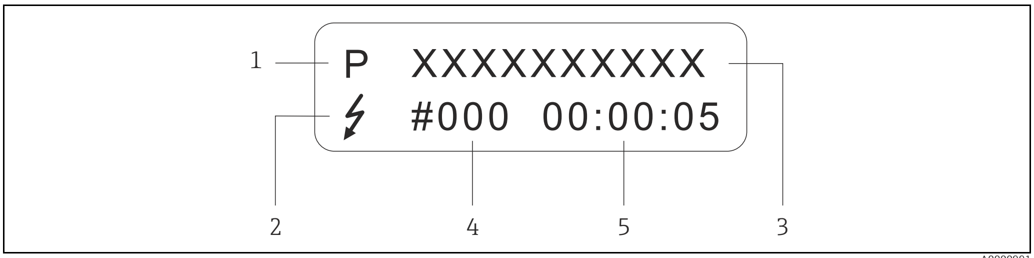


Fig. 50: Error messages on the display (example)

1 *Error type:*
– P = process error
– S = system error
2 *Error message type:*
– ϟ = fault message
– ! = notice message
3 *Error designation: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty*
4 *Error number: e.g. #401*
5 *Duration of most recent error occurrence (in hours, minutes and seconds)*

5.3.2 Error message types

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 (→ "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 (ϟ)

- Displayed as → Lightning flash (ϟ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the individual outputs (failsafe mode) can be defined in the function matrix using the "FAILSAFE MODE" function (→ "Description of Device Functions" manual).

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

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → 🖹 54.

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

- *Universal commands:*
  All HART device support and use universal commands.
  The following functionalities are linked to them:
  - Identify HART devices
  - Reading digital measured values (volume flow, totalizer, etc.)
- *Common practice commands:*
  Common practice commands offer functions which are supported and can be executed by most but not all field devices.
- *Device-specific commands:*
  These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cutoff settings, etc.

✎ Note!
The device has access to all three command classes. A list of all the "Universal commands" and "Common practice commands" is provided on → 🖹 66.

5.4.1 Operating options

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

Field Xpert HART Communicator

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

Operating program "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.

Operating program "SIMATIC PDM" (Siemens)

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

Operating program "AMS" (Emerson Process Management)

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

5.4.2 Current device description files

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

HART protocol:

Valid for device software:	2.04.XX	→ Function DEVICE SOFTWARE
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 41_{hex}	 → Function MANUFACTURER ID → Function DEVICE ID
HART version data:	Device Revision 6/ DD Revision 1	
Software release:	01.2011	
Operating program:	**Sources for obtaining device descriptions:**	
Handheld Field Xpert SFX100	Use update function of handheld terminal	
FieldCare / DTM	▪ www.endress.com → Download ▪ CD-ROM (Endress+Hauser order number 56004088) ▪ DVD (Endress+Hauser order number 70100690)	
AMS	www.endress.com → Download	
SIMATIC PDM	www.endress.com → Download	

Tester/simulator:	Sources for obtaining device descriptions:
Fieldcheck	Update by means of FieldCare with 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 out and used for official certification. Contact your Endress+Hauser representative for more information.

5.4.3 Device variables

The following device variables are available using the HART protocol:

Code (decimal)	Device variable
0	OFF (not assigned)
1	Volume flow
250	Totalizer 1
251	Totalizer 2

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → not assigned
- Fourth process variable (FV) → not assigned

Note!
You can set or change the assignment of device variables to process variables using Command 51.

5.4.4 Switching HART write protection on/off

The HART write protection can be switched on and off using the HART WRITE PROTECT device function (→ "Description of Device Functions" manual).

5.4.5 Universal and common practice HART commands

The following table contains all the universal commands supported by the device.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Universal commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable Factory setting: Primary process variable = Volume flow Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: actual current of the primary process variable in mA – Bytes 4-7: % value of the set measuring range Factory setting: Primary process variable = Volume flow Note! You can change the assignment of device variables to process variables using Command 51.
3	Read the primary process variable as current in mA and four dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* ▪ Primary process variable = Volume flow ▪ Second process variable = Totalizer 1 ▪ Third process variable = OFF (not assigned) ▪ Fourth process variable = OFF (not assigned) Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
6	Set HART shortform address Access type = write	Byte 0: desired address (0 to 15) Factory setting: 0 Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
12	Read user message Access type = read	none	Bytes 0-24: User message Note! You can write the user message using Command 17.
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date Note! You can write the TAG, descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span Note! ▪ The data relate to the primary process variable (= volume flow). ▪ Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: upper range, value for 20 mA – Bytes 7-10: lower range, value for 4 mA – Bytes 11-14: Damping constant in [s] – Byte 15: Write protection ID – Byte 16: OEM dealer ID, 17 = E+H Factory setting: Primary process variable = Volume flow Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
16	Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date
19	Write the device production number Access = write	Bytes 0-2: Production number	Bytes 0-2: Production number

The following table contains all the common practice commands supported by the device.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Common practice commands			
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable "volume flow" in seconds *Factory setting:* Primary process variable = Current output damping	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA *Factory setting:* Primary process variable = Volume flow Note! ▪ The start of the measuring range (4 mA) must correspond to the zero flow. ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA Note! ▪ Manufacturer-specific units are represented using the HART unit code "240". ▪ You can change the assignment of device variables to process variables using Command 51.
38	Device status reset (configuration changed) Access = write	none	none Note! It is also possible to execute this HART command when write protection is activated (= ON)!
40	Simulate input current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0-3: Output current in mA *Factory setting:* Primary process variable = Volume flow Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0-3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only units which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Volume flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ If you change the unit of the primary process variable, this has a direct impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table → 70

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Code 1 for volume flow ▪ Second process variable: Code 250 for totalizer ▪ Third process variable: Code 0 for OFF (not assigned) ▪ Fourth process variable: Code 0 for OFF (not assigned)
51	Write assignment of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ▪ Primary process variable: Volume flow ▪ Second process variable: Totalizer 1 ▪ Third process variable: OFF (not assigned) ▪ Fourth process variable: OFF (not assigned)	The variable assignment of the process variables is displayed as a response: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable
53	Write device variable unit Access = write	This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: Device variable code – Byte 1: HART unit code Code of the supported device variables: See information → 📄 65 Note! ▪ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ▪ If you change the unit of the device variable, this has a direct impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: Device variable code – Byte 1: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (4 to 20)	The current number of preambles is displayed in the response telegram: Byte 0: Number of preambles

5.4.6 Device status and error messages

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

Note!
- You can find a detailed explanation of the device status and error messages and their elimination on → 70
- Bits and bytes not listed are not assigned.

Byte	Bit	Error No.	Short error description
0	0	001	Serious device error
	1	011	Measuring amplifier has faulty EEPROM
	2	012	Error when accessing data of the measuring amplifier EEPROM
1	1	031	S-DAT: defective or missing
	2	032	S-DAT: Error accessing saved values
	5	051	I/O and the amplifier are not compatible.
3	3	111	Totalizer checksum error
	4	121	I/O board and amplifier not compatible.
4	3	251	Internal communication fault on the amplifier board.
	4	261	No data reception between amplifier and I/O board
5	0	321	Coil current of the sensor is outside the tolerance.
	7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6	0	340	
	1	341	
	2	342	
	3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
	4	344	
	5	345	
	6	346	
	7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7	0	348	
	1	349	
	2	350	
	3	351	Current output: Flow is out of range.
	4	352	
	5	353	
	6	354	
	7	355	Frequency output: Flow is out of range.
8	0	356	
	1	357	
	2	358	

Byte	Bit	Error No.	Short error description
8	3	359	Pulse output: Flow is out of range.
	4	360	
	5	361	
	6	362	
10	7	401	Measuring tube partially filled or empty
11	2	461	EPD calibration not possible because the fluid's conductivity is either too low or too high.
	4	463	The EPD calibration values for empty pipe and full pipe are identical, and therefore incorrect.
12	1	474	Maximum flow value entered is overshot
	7	501	Amplifier software version is loaded. Currently no other commands are possible.
13	0	502	Upload/download of device files. Currently no other commands are possible.
14	3	601	Positive zero return active
	7	611	Simulation current output active
15	0	612	
	1	613	
	2	614	
	3	621	Simulation frequency output active
	4	622	
	5	623	
	6	624	
	7	631	Simulation pulse output active
16	0	632	
	1	633	
	2	634	
	3	641	Simulation status output active
	4	642	
	5	643	
	6	644	
17	7	671	Simulation of the status input active
18	0	672	
	1	673	
	2	674	
	3	691	Simulation of response to error (outputs) active
	4	692	Simulation of volume flow active

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" → 45
- Checklist for "Post-connection check" → 59

6.2 Switching on the measuring device

Once the connection checks have been successfully completed, it is time to switch on the power supply. The device is now operational. The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:

PROMAG 50 STARTUP. . .	Start-up message
▼	
DEVICE SOFTWARE V XX.XX.XX	Current software version
▼	
SYSTEM OK →OPERATION	Beginning of normal measuring mode
▼	

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

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

6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the operating 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 menu.

6.3.1 "Commissioning" Quick Setup menu

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

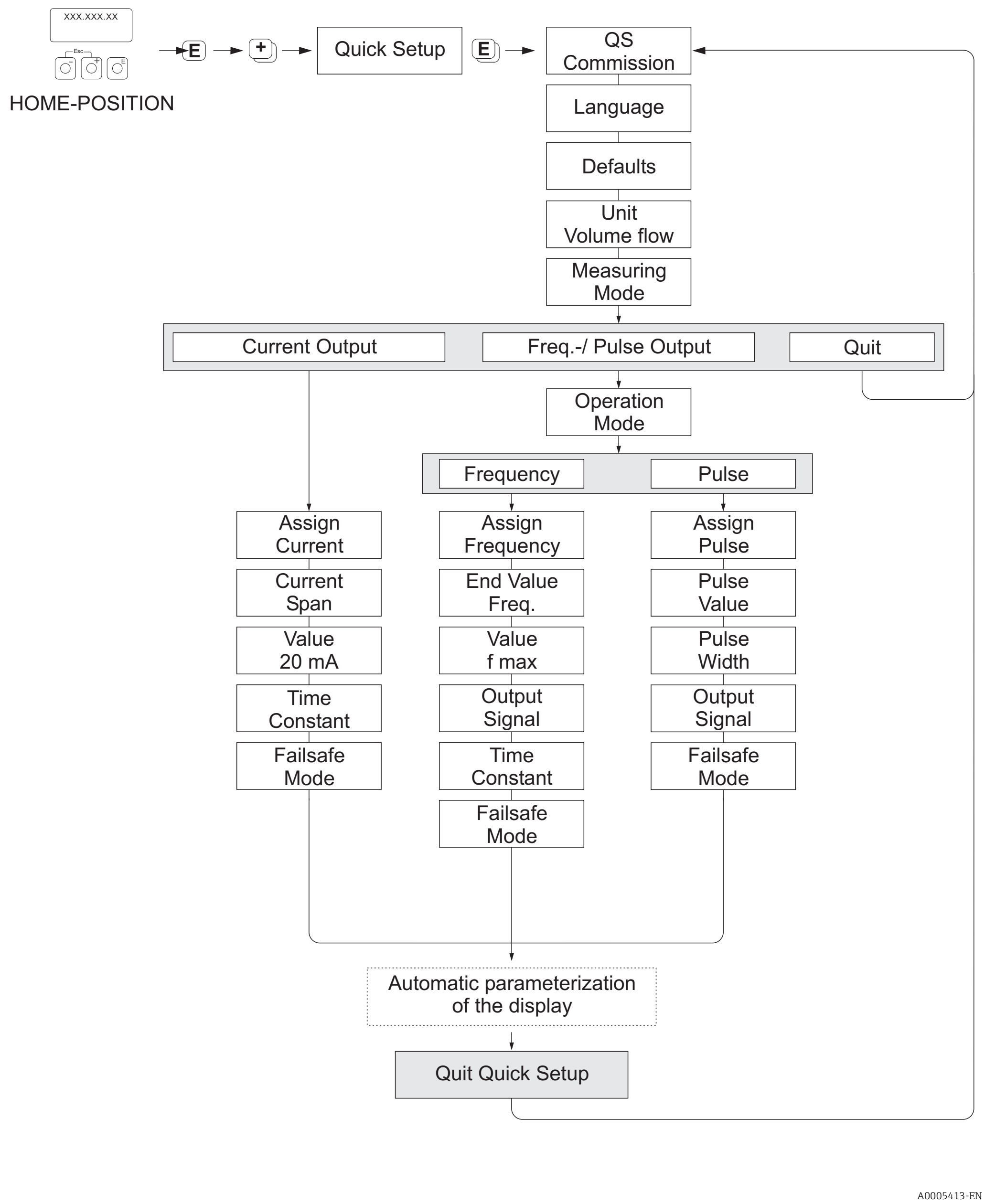


Fig. 51: "QUICK SETUP COMMISSIONING" menu for the rapid configuration of important device functions

6.4 Configuration

6.4.1 Current output: active/passive

The current output is configured as "active" or "passive" by means of various jumpers on the I/O board.

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 → 89
3. Position the jumper → 52

   Caution!
   Risk of destroying the measuring device. Set the jumpers exactly as shown in the graphic. Pay strict attention to the position of the jumpers as indicated in the graphic.
4. Installation of the I/O board is the reverse of the removal procedure.

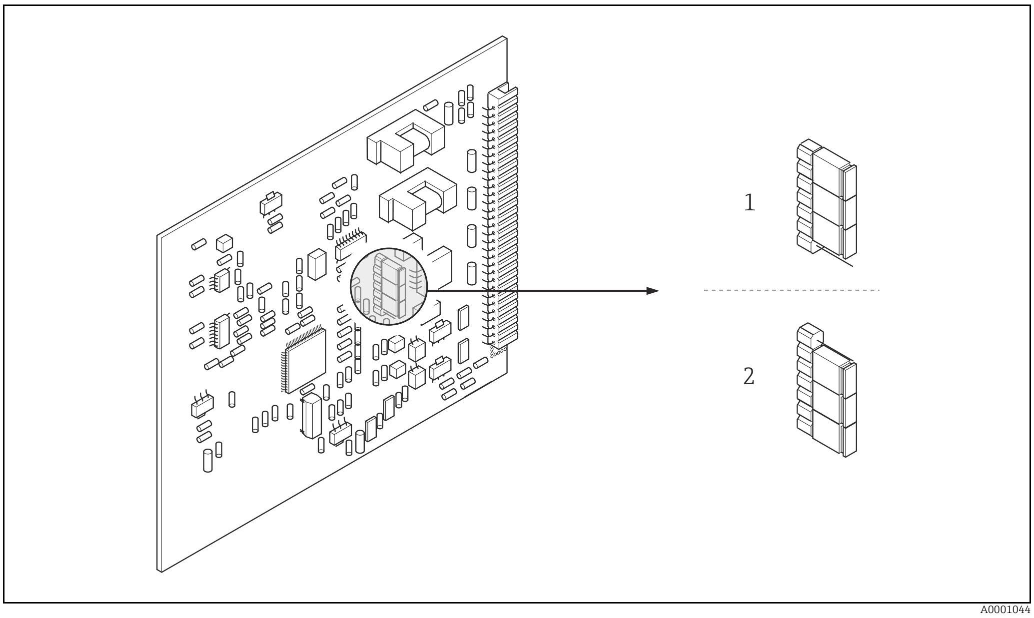


Fig. 52: Configuring current outputs using jumpers (I/O board)

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

6.5 Adjustment

6.5.1 Empty-pipe/full-pipe adjustment

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

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

Caution!
Detailed information on the empty-pipe/full-pipe adjustment procedure can be found in the "Description of Device Functions" manual:
- EPD/OED ADJUSTMENT (carrying out the adjustment).
- EPD (switching on and off EPD/OED).
- EPD RESPONSE TIME (input of the response time for EPD/OED).

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

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

1. Select the appropriate function in the function matrix:
   HOME → $\boxed{E}$ → $\boxed{+}$ → PROCESS PARAMETER → $\boxed{E}$ → $\boxed{+}$ → EPD ADJUSTMENT
2. Empty the piping:
   – The wall of the measuring tube should still be wet with fluid during EPD empty pipe adjustment
   – The wall of the measuring tube/the measuring electrodes should **no longer** be wet with fluid during OED empty pipe adjustment
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press $\boxed{E}$ 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 $\boxed{E}$ to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing $\boxed{E}$.
7. Switch on empty pipe detection in the EPD function:
   – EPD empty pipe adjustment: Select ON STANDARD or ON SPECIAL and press $\boxed{E}$ to confirm
   – OED empty pipe adjustment: Select OED and confirm with $\boxed{E}$.

   Caution!
   The adjustment coefficients must be valid before you can activate the EPD function. If adjustment is incorrect the following messages might appear on the display:
   – FULL = EMPTY
   The adjustment values for empty pipe and full pipe are identical. In cases of this nature you must repeat empty-pipe or full-pipe adjustment!
   – ADJUSTMENT NOT OK
   Adjustment is not possible because the fluid’s conductivity is out of range.

6.6 Data storage device (HistoROM)

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored. It is possible to plug these modules into other devices to copy device configurations from one device to another, for example.

6.6.1 HistoROM/S-DAT (sensor-DAT)

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

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

Replacement seals (accessories) → 78.

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

8.1 Device-specific accessories

Accessory	Description	Order code
Proline Promag 50 transmitter	Transmitter for replacement or storage. Use the order code to define the following specifications: ▪ Approvals ▪ Degree of protection/version ▪ Cable for remote version ▪ Cable entry ▪ Display/power supply/operation ▪ Software ▪ Outputs/inputs	50XXX – XXXXX******

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for Promag 50 transmitter	Mounting set for the transmitter (remote version). Suitable for: ▪ Wall mounting ▪ Pipe mounting ▪ Panel-mounted installation Mounting set for aluminum field housing. Suitable for: ▪ Pipe mounting	DK5WM – *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor.	DK5HM – **
Cable for remote version	Coil and signal cables, various lengths.	DK5CA – **
Mounting kit for Promag D, wafer version	▪ Mounting bolts ▪ Nuts incl. washers ▪ Flange seals ▪ Centering sleeves (if required for the flange)	DKD** – **
Set of seals for Promag D	Set of seals consisting of two flange seals.	DK5DD – ***
Mounting kit for Promag H	▪ 2 process connections ▪ Threaded fasteners ▪ Seals	DKH** – ****
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – ***
Welding jig for Promag H	Weld nipple as process connection: welding jig for installation in pipe.	DK5HW – ***
Adapter connection for Promag A, H	Adapter connections for installing a Promag 10 H instead of a Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA – *****
Ground rings for Promag H	Ground rings for potential equalization.	DK5HR – ***
Ground cable for Promag E/L/P/W	Ground cable for potential equalization.	DK5GC – ***
Ground disk for Promag E/L/P/W	Ground disk for potential equalization.	DK5GD – * * ***
Process display RIA45	Multifunctional 1-channel display unit: ▪ Universal input ▪ Transmitter power supply ▪ Limit relay ▪ Analog output	RIA45 – ******

Accessory	Description	Order code
Process display RIA251	Digital display device for looping into the 4 to 20 mA current loop.	RIA251 – **
Field display unit RIA16	Digital field display device for looping into the 4 to 20 mA current loop.	RIA16 – ***
Application Manager RMM621	Electronic recording, display, balancing, control, saving and event and alarm monitoring of analog and digital input signals. Values and conditions determined are output by means of analog and digital output signals. Remote transmission of alarms, input values and calculated values using a PSTN or GSM modem.	RMM621 – **********

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator Field Xpert SFX 100	Handheld terminal for remote configuration and for obtaining measured values via the HART current output (4 to 20 mA) and FOUNDATION Fieldbus. Contact your Endress+Hauser representative for more information.	SFX100 – *******
Fieldgate FXA320	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ 2-channel analog input (4 to 20 mA) ▪ 4 binary inputs with event counter function and frequency measurement ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values.	FXA320 – *****
Fieldgate FXA520	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ Web server for remote monitoring of up to 30 measuring points ▪ Intrinsically safe version [EEx ia]IIC for applications in hazardous areas ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values ▪ Remote diagnosis and remote configuration of connected HART devices	FXA520 – ****
FXA195	The Commubox FXA195 connects intrinsically safe Smart transmitters with HART protocol to the USB port of a personal computer. This makes the remote operation of the transmitters possible with the aid of configuration programs (e.g. FieldCare). Power is supplied to the Commubox by means of the USB port	FXA195 – *

8.4 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and planning flowmeters. The Applicator software 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.	DXA80 – *
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 out and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based asset management tool. It can configure all intelligent field units in your system and helps you manage them. By using status information, it is also a simple but effective way of checking their status and condition.	See the product page on the Endress+Hauser Web site: www.endress.com
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 – ************
FXA193	Service interface from the device to the PC for operation via FieldCare.	FXA193 – *

9 Troubleshooting

9.1 Troubleshooting instructions

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

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → terminals 1, 2 2. Check the power line fuse → 🖹 93 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC / 16 to 62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 🖹 88
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 → 🖹 89 2. Display module defective → order spare parts → 🖹 88 3. Measuring electronics defective → order spare parts → 🖹 88
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the OS buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output.	Electronics board defective → order spare parts → 🖹 88
↓	
Error messages on display	
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons: the meanings of these icons are as follows (example): – Error type: **S** = system error, **P** = process error – Error message type: ϟ = 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 → 🖹 63! ▪ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice message only.	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → 🖹 82
Error number: No. 401 - 499	Process error (application error) has occurred → 🖹 84
↓	
Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → 🖹 85

9.2 System error messages

Serious system errors are **always** recognized by the device as "Fault message", and are shown as a lightning flash (ϟ) on the display. Fault messages immediately affect the outputs.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The necessary procedures on → 🗎 5 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed "Declaration of Contamination" form. You will find a master copy of this form at the back of this manual.

Note!
Also observe the information on → 🗎 63.

No.	Error message / Type	Cause	Remedy (spare part → 🗎 88)
S = System error ϟ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE $: # 001	Serious device error	Replace the amplifier board.
011	S: AMP HW EEPROM $: # 011	Amplifier: Defective EEPROM	Replace the amplifier board.
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. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111 / CHECKSUM TOTAL).
031	S: SENSOR HW DAT $: # 031	1. S-DAT is not plugged into the amplifier board correctly (or is missing). 2. S-DAT is defective.	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.
032	S: SENSOR SW DAT $: # 032		
No. # 1xx → Software error			
101	S: GAIN ERROR AMP $: # 101	Gain deviation compared to reference gain > 25%.	Replace the amplifier board.
111	S: CHECKSUM TOTAL $: # 111	Totalizer checksum error.	1. Restart the measuring device. 2. Replace the amplifier board if necessary.
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! – This message is only listed in the error history. – Nothing is shown on the display.	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.	Error message / Type	Cause	Remedy (spare part → 🖹 88)
No. # 2xx → Error in DAT / no communication			
251	S: COMMUNICATION I/O $: # 251	Internal communication fault on the amplifier board.	Replace the amplifier board.
261	S: COMMUNICATION I/O $: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts.
No. # 3xx → System limits exceeded			
321	S: TOL. COIL CURR. $: # 321	Sensor: Coil current is out of tolerance.	⚠ Warning! Switch off power supply before manipulating the coil current cable, coil current cable connector or measuring electronics boards! Remote version: 1. Check wiring of terminals 41/42 → 🖹 46 2. Check coil current cable connector. Compact and remote version: Replace measuring electronics boards if necessary
339 to 342	S: STACK CUR OUT n !: # 339 to 342	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE ($) ▪ 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.
343 to 346	S: STACK FREQ. OUT n !: # 343 to 346		
347 to 350	S: STACK PULSE OUT n !: # 343 to 346	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. Recommendations in the event of fault category = FAULT MESSAGE ($) ▪ 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.
351 to 354	S: CURRENT RANGE n !: # 351 to 354	Current output: flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 to 358	S: FREQ. RANGE n !: # 355 to 358	Frequency output: flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 to 362	S: PULSE RANGE !: # 359 to 362	Pulse output: the pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ a0004437 3. Reduce flow.

No.	Error message / Type	Cause	Remedy (spare part → 📄 88)
No. # 5xx → Application error			
501	S: SW.-UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT !: # 502	Uploading or downloading the device data via operating program. Currently no other functions are possible.	Wait until the procedure is finished.
No. # 6xx → Simulation mode active			
601	S: POS. ZERO-RETURN !: # 601	Positive zero return active Caution! This message has the highest display priority!	Switch off positive zero return
611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	Simulation current output active	
621 to 624	S: SIM. FREQ. OUT. n !: # 621 to 624	Simulation frequency output active	Switch off simulation
631 to 634	S: SIM. PULSE n !: # 631 to 634	Simulation pulse output active	Switch off simulation
641 to 644	S: SIM. STAT. OUT n !: # 641 to 644	Simulation status output active	Switch off simulation
671 to 674	S: SIM. STATUS IN n !: # 671 to 674	Simulation status input active	Switch off simulation
691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active	Switch off simulation
692	S: SIM. MEASURAND !: # 692	Simulation of a measured variable active (e.g. mass flow).	Switch off simulation
698	S: DEV. TEST ACT. !: # 698	The measuring device is being checked on site via the test and simulation device.	–

9.3 Process error messages

Note!
Also observe the information on → 📄 63.

No.	Error message / Type	Cause	Remedy (spare part → 📄 88)
P = Process error $ = Fault message (with an effect on the outputs) ! = Notice message (without an effect on the outputs)			
401	EMPTY PIPE $: # 401	Measuring tube partially filled or empty	1. Check the process conditions of the plant 2. Fill the measuring tube
461	ADJ. NOT OK !: # 461	EPD calibration not possible because the fluid's conductivity is either too low or too high.	The EPD function cannot be used with fluids of this nature.
463	FULL = EMPTY $: # 463	The EPD calibration values for empty pipe and full pipe are identical, therefore incorrect.	Repeat calibration, making sure procedure is correct → 📄 75.

9.4 Process errors without messages

Symptoms	Rectification
Remark: You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Remote version: – Switch off the power supply and check the wiring → 🖹 46 – If necessary, reverse the connections at terminals 41 and 42 2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly
Measured-value reading fluctuates even though flow is steady.	1. Check grounding and potential equalization → 🖹 55 2. Check the fluid for presence of gas bubbles. 3. In the "SYSTEM DAMPING" function → increase the value
Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalization → 🖹 55 2. Check the fluid for presence of gas bubbles. 3. Activate the "LOW FLOW CUTOFF" function, i.e. enter or increase the value for the switching point.
Measured-value reading on display, even though measuring tube is empty.	1. Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe detection → 🖹 75 2. Remote version: Check the terminals of the EPD cable → 🖹 46 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Select the "BUS ADDRESS" function and change the setting to "0". 2. Value for creepage too high. Reduce the value in the "LOW FLOW CUTOFF" 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 (→ 🖹 6): order code, serial number **Returning devices to Endress+Hauser** The necessary procedures (→ 🖹 5) must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a master copy of this form at the back of this manual. **Replace transmitter electronics** Components in the measuring electronics defective → order spare parts → 🖹 88

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 set the signals of the current, pulse and status outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions: simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	Process/system error is current	**Positive zero return is activated**
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on → 66		
Current output	MINIMUM VALUE 0–20 mA → 0 mA 4–20 mA → 2 mA 4–20 mA HART → 2 mA 4–20 mA NAMUR →3.5 mA 4–20 mA HART NAMUR →3.5 mA 4–20 mA US → 3.75 mA 4–20 mA HART US → 3,75 mA 0–20 mA (25 mA) → 0 mA 4–20 mA (25 mA) → 2 mA 4–20 mA (25 mA) HART → 2 mA MAXIMUM VALUE 0–20 mA → 22 mA 4–20 mA → 22 mA 4–20 mA HART → 22 mA 4–20 mA NAMUR → 22.6 mA 4–20 mA HART NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 4–20 mA HART US → 22.6 mA 0–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) → 25 mA 4–20 mA (25 mA) HART → 25 mA HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	MIN/MAX VALUE → FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	*FALLBACK VALUE* Signal output → 0 Hz *FAILSAFE LEVEL* Output of the frequency specified in the FALÌLSAFE VALUE function. *HOLD VALUE* Measured value display on the basis of the last saved value preceding occurrence of the fault. *ACTUAL VALUE* Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"

Failsafe mode of outputs and totalizers		
	Process/system error is current	**Positive zero return is activated**
Totalizer	*STOP* The totalizers are paused until the error is rectified. *ACTUAL VALUE* The fault is ignored. The totalizer continues to count in accordance with the current flow value. *HOLD VALUE* The totalizer continues to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Status output	In the event of a fault or power supply failure: Status output → non-conductive	No effect on status output

9.6 Spare parts

Detailed troubleshooting instructions are provided in the previous sections → 📄 81
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 → 📄 6

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

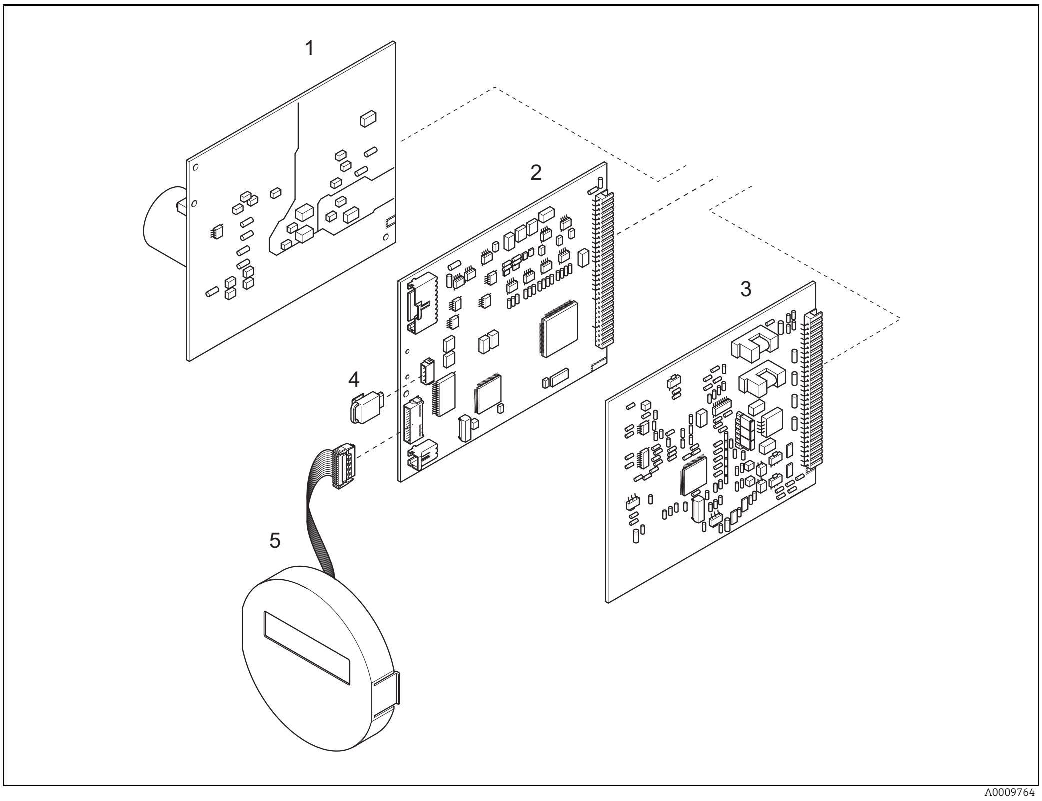


Fig. 53: Spare parts for Promag 50 transmitter (field and wall-mounted housings)

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)
4 HistoROM / S-DAT (sensor data memory)
5 Display module

9.6.1 Removing and installing printed circuit boards

Field housing: removing and installing printed circuit boards → 54

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.

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. 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.
4. Remove the screws and remove the cover (2) from the electronics compartment.
5. Remove the boards (4, 6): Insert a suitable tool into the hole (3) provided for the purpose and pull the board clear of its holder.
6. Remove amplifier board (5):
   – Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
   – Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

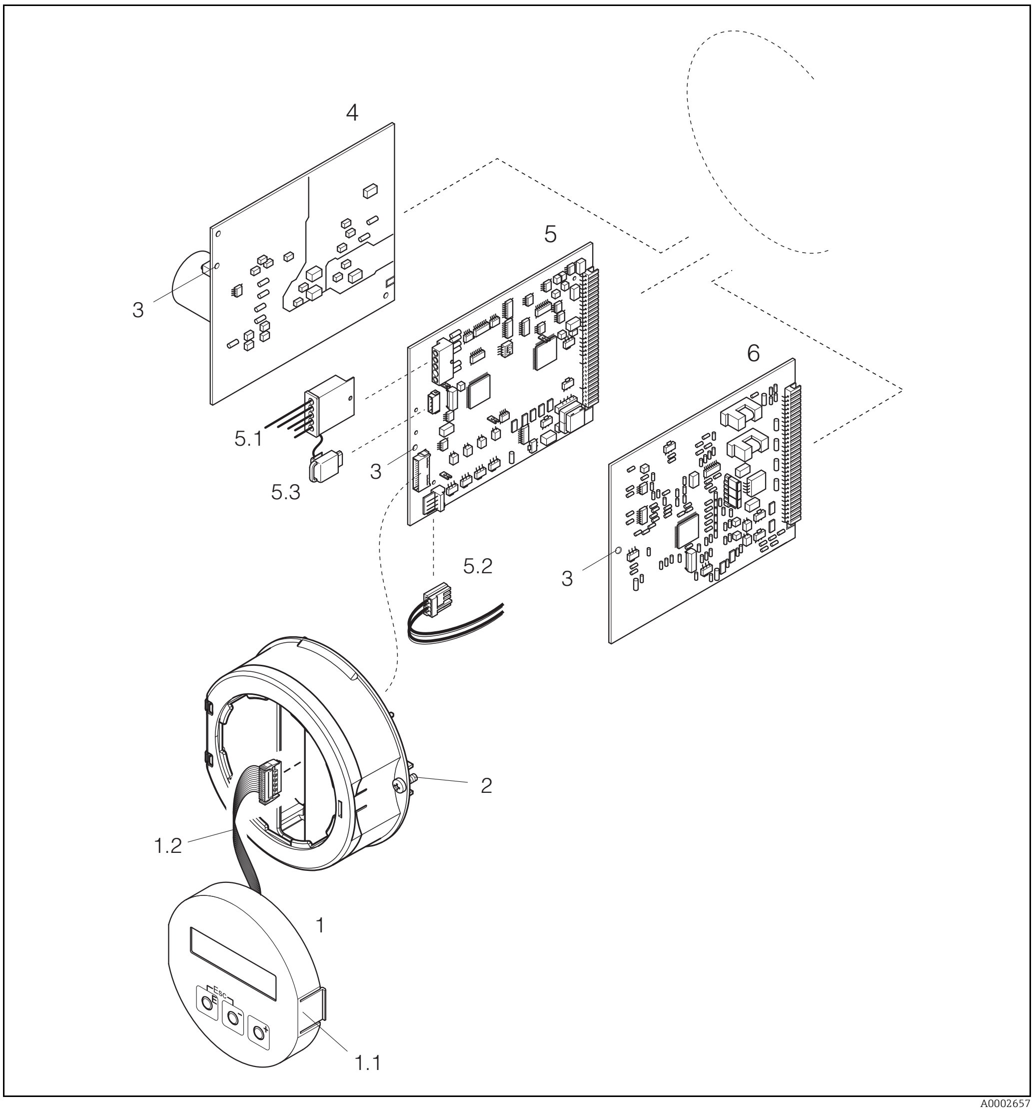


Fig. 54: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws of electronics compartment cover
3 Aperture for installing/removing boards
4 Power supply board
5 Amplifier board
5.1 Electrode signal cable (sensor)
5.2 Coil current cable (sensor)
5.3 Histo-ROM / S-DAT (sensor data memory)
6 I/O board

Wall-mount housing: removing and installing printed circuit boards → 55

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.

1. Switch off power supply.
2. Remove the screws and open the hinged cover (1) of the housing. Remove screws of the electronics module (2).
3. Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
4. Disconnect the following cable plugs from amplifier board (7):
   – Electrode signal cable plug (7.1) including S-DAT (7.3).
   – Plug of coil current cable (7.2). To do so, loosen the plug locking of the coil current cable and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Ribbon cable plug (3) of the display module.
5. Remove the screws and remove the cover (4) from the electronics compartment.
6. Remove the boards (6, 7, 8): Insert a suitable tool into the hole (5) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

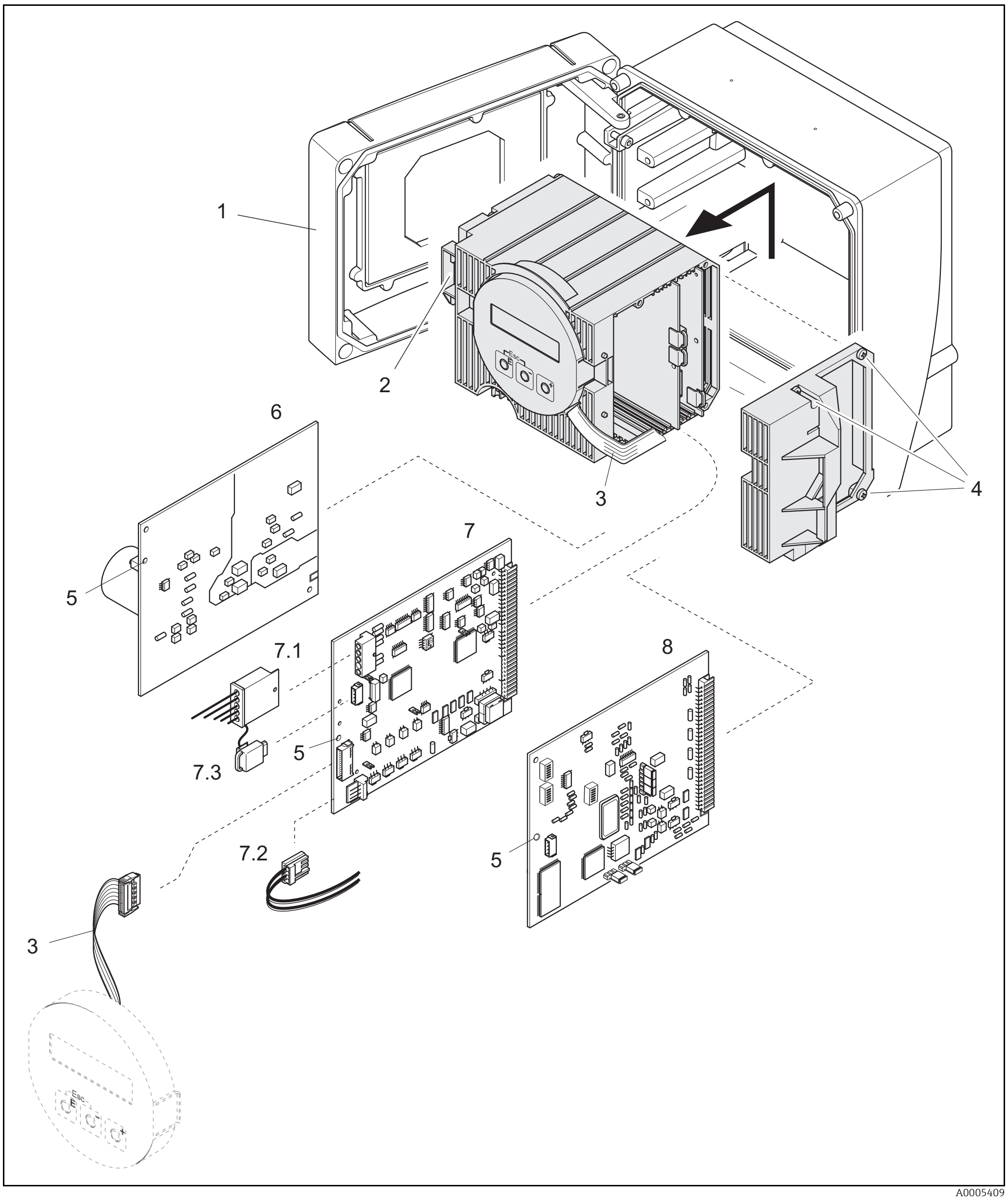


Fig. 55: Wall-mount housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Cover of electronics compartment (3 screws)
5 Aperture for installing/removing boards
6 Power supply board
7 Amplifier board
7.1 Electrode signal cable (sensor)
7.2 Coil current cable (sensor)
7.3 Histo-ROM / S-DAT (sensor data memory)
8 I/O board

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 (→ 56).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power supply board: field housing → 89, wall-mount housing → 91
3. Remove cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – Power supply 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 × 20 mm
   – Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 × 20 mm
   – Ex-rated devices → see the Ex documentation.
4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

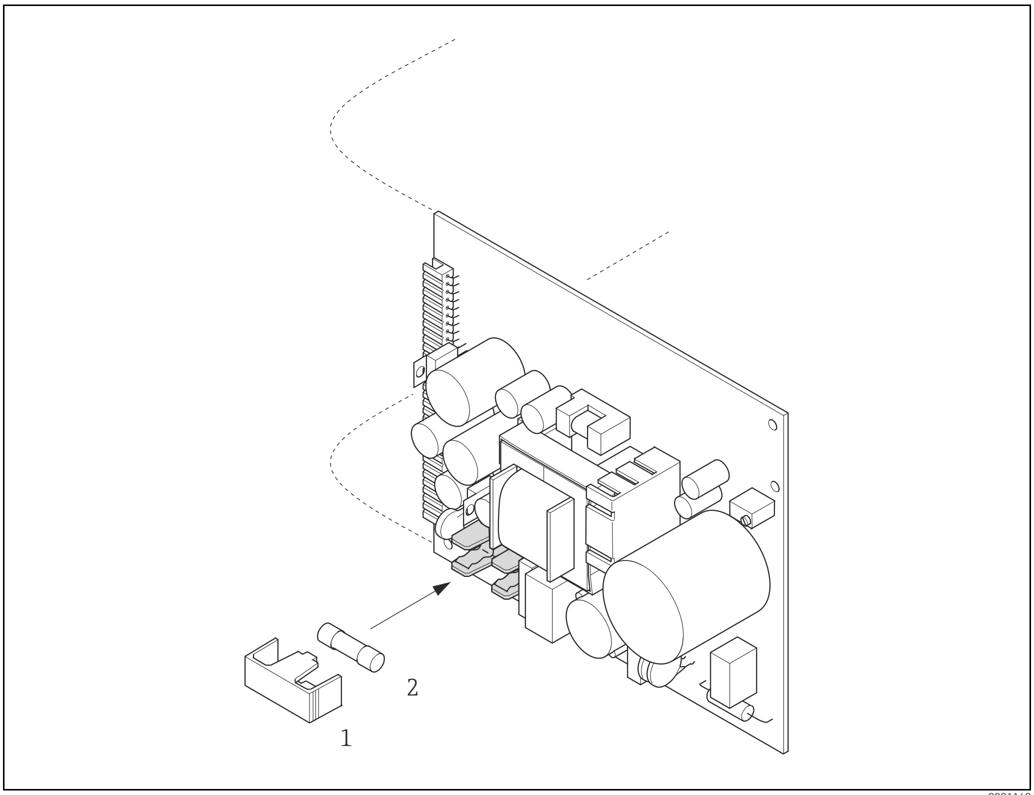


Fig. 56: Replacing the device fuse on the power supply board

1 Protective cap
2 Device fuse

9.6.3 Replacing the exchangeable electrode

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

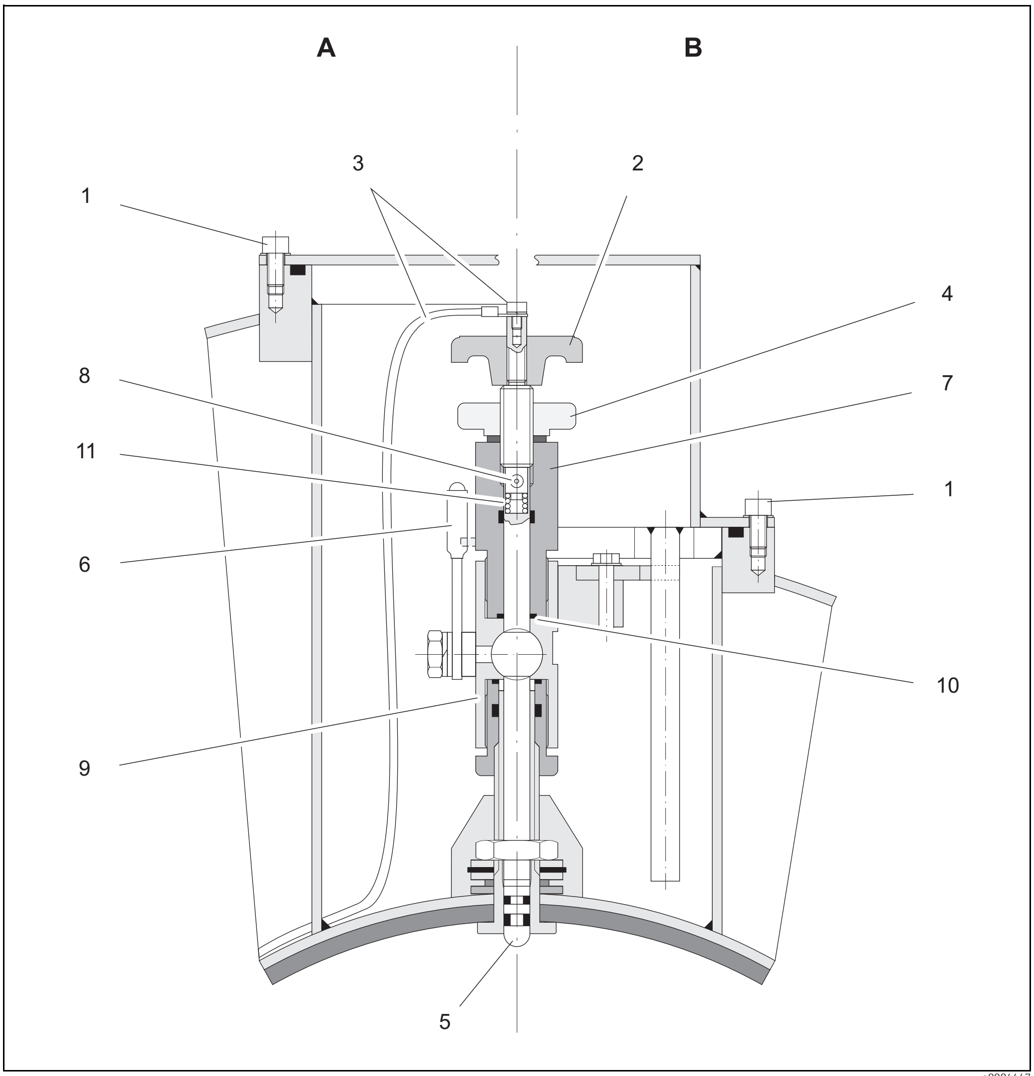


Fig. 57: Apparatus for replacing exchangeable measuring electrodes

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

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

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

Removing the electrode		Installing the electrode	
1	Loosen Allen screw (1) and remove the cover.	1	Insert new electrode (5) into retaining cylinder (7) from below. Make sure that the seals at the tip of the electrode are clean.
2	Remove electrode cable (3) secured to handle (2).	2	Mount handle (2) on the electrode and insert locking pin (8) to secure it in position. Caution! Make sure that coil spring (11) is inserted. This is essential to ensure correct electrical contact and correct measuring signals.
3	Loosen knurled nut (4) by hand. This knurled nut acts as a locknut.	3	Pull the electrode back until the tip of the electrode no longer protrudes from retaining cylinder (7).
4	Remove electrode (5) by turning handle (2). The electrode can now be pulled out of retaining cylinder (7) as far as a defined stop. Warning! Risk of injury. Under process conditions (pressure in the piping system) the electrode can recoil suddenly against its stop. Apply counter-pressure while releasing the electrode.	4	Screw the retaining cylinder (7) onto ball-valve housing (9) and tighten it by hand. Seal (10) on the cylinder must be correctly seated and clean. Note! Make sure that the rubber hoses on retaining cylinder (7) and stop cock (6) are of the same color (red or blue).
5	Close stop cock (6) after pulling out the electrode as far as it will go. Warning! Do not subsequently open the stop cock, in order to prevent fluid escaping.	5	Open stop cock (6) and turn handle (2) to screw the electrode all the way into the retaining cylinder.
6	Remove the electrode complete with retaining cylinder (7).	6	Screw knurled nut (4) onto the retaining cylinder. This firmly locates the electrode in position.
7	Remove handle (2) from electrode (5) by pressing out locking pin (8). Take care not to lose coil spring (11).	7	Use the Allen screw to secure electrode cable (3) to handle (2). Caution! Make sure that the machine screw securing the electrode cable is firmly tightened. This is essential to ensure correct electrical contact and correct measuring signals.
8	Remove the old electrode and insert the new electrode. Replacement electrodes can be ordered separately from Endress+Hauser.	8	Reinstall the cover and tighten Allen 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
01.2011	Amplifier: V 2.04.XX	Introduction of new nominal diameters; calf values to 2.5	71249447 / 15.14
11.2009	Amplifier: V 2.03.XX	Introduction of Calf history	71106181 / 12.09 71105332 / 11.09
06.2009	Amplifier: V 2.02.XX	Introduction of Promag L	71095684 / 06.09
03.2009	Amplifier: V 2.02.XX	Introduction of Promag D Introduction of new nominal diameter	71088677 / 03.09
11.2004	Amplifier: 1.06.01 Communication module: 1.04.00	Software update relevant only for production	50097089 / 10.03
10.2003	Amplifier: 1.06.00 Communication module: 1.03.00	Software expASMEon: ▪ Language groups ▪ Flow direction pulse output selectable New functionalities: ▪ Second Totalizer ▪ Adjustable backlight (display) ▪ Operation hours counter ▪ Simulation function for pulse output ▪ Counter for access code ▪ Reset function (fault history) ▪ Up-/download with FieldTool	50097089 / 10.03

Date	Software version	Changes to software	Operating Instructions
08.2003	Communication module: 1.02.01	Software expASMEon: ▪ New / revised functionalities New functionalities: ▪ Current span NAMUR NE 43 ▪ Failsafe mode function ▪ Troubleshooting function ▪ System and process error messages ▪ Response of status output	50097089 / 08.03
08.2002	Amplifier: 1.04.00	Software expASMEon: ▪ New / revised functionalities New functionalities: ▪ Current span NAMUR NE 43 ▪ EPD (new mode) ▪ Failsafe mode function ▪ Acknowledge fault function ▪ Troubleshooting function ▪ System and process error messages ▪ Response of status output	50097089 / 08.02
03.2002	Amplifier: 1.03.00	Software expASMEon: ▪ Suitability for custody transfer measurement Promag 50/51	none
06.2001	Amplifier: 1.02.00 Communication module: 1.02.00	Software expASMEon: ▪ New functionalities: New functionalities: ▪ General device functions ▪ "OED" software function ▪ "Pulse width" software function	50097089 / 06.01
09.2000	Amplifier: 1.01.01 Communication module: 1.01.00	Software expASMEon: ▪ Functional adaptations	none
08.2000	Amplifier: 1.01.00	Software expASMEon: ▪ Functional adaptations	none
04.2000	Amplifier: 1.00.00 Communication module: 1.00.00	Original software Compatible with: ▪ FieldTool ▪ Commuwin II (version 2.05.03 and higher) ▪ HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD1	50097089 / 04.00

✎ Note!
Uploads or downloads between the individual software versions are only possible with a special service software.

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

→ 📄 4

10.1.2 Function and system design

Measuring principle

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

Measuring system

→ 📄 6

10.1.3 Input

Measured variable

Flow velocity (proportional to induced voltage)

Measuring range

Typically v = 0.01 to 10 m/s (0.033 to 33 ft/s) with the specified accuracy

Operable flow range

Over 1000 : 1

Input signal

Status input (auxiliary input)

- Galvanically isolated
- U = 3 to 30 V DC
- Ri = 5 kΩ
- Can be configured for: totalizer reset, positive zero return, error message reset.

10.1.4 Output

Output signal

Current output

- Galvanically isolated
- Active/passive can be selected:
  - Active: 0/4 to 20 mA, R_L < 700 Ω (HART: $R_L \geq 250$ Ω)
  - Passive: 4 to 20 mA, supply voltage V_S 18 to 30 V DC, $R_i \geq 150$ Ω)
- Time constant can be selected (0.01 to 100s)
- Full scale value adjustable
- Temperature coefficient: typ. 0.005% o.f.s./°C, resolution: 0.5 µA

o.f.s. = of full scale value

Pulse/frequency output

- Galvanically isolated
- Passive: 30 V DC / 250 mA
- Open collector
- Can be configured as:
  - Pulse output
    Pulse value and pulse polarity can be selected, max. pulse width adjustable (0.5 to 2000 ms)
  - Frequency output
    Full scale frequency 2 to 1000 Hz (f_{max} = 1.25 Hz), on/off ratio 1:1, pulse width max. 10 s

Signal on alarm

Current output

Failsafe mode can be selected (e.g. in accordance with NAMUR Recommendation NE 43)

Pulse/frequency output

Failsafe mode can be selected

Status output

"Not conductive" in the event of fault or power supply failure

Load

See "Output signal"

Switching output

Status output

- Galvanically isolated
- Max. 30 V DC/250 mA
- Open collector
- Can be configured for: error messages, empty pipe detection (EPD), flow direction, limit values

Low flow cut off

Low flow cut off, switch-on point can be selected as required

Galvanic isolation

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

10.1.5 Power supply

Electrical connections

→ 📄 46

Supply voltage (power supply)

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

Cable entry

Power supply and signal cables (inputs/outputs):

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

Connecting cable for remote version:

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

Cable specifications

→ 📄 51

Power consumption

Power consumption

- AC: <15 VA (incl. sensor)
- DC: <15 W (incl. sensor)

Switch-on current

- max. 3 A (<5 ms) for 24 V DC
- max. 8.5 A (<5 ms) for 260 V AC

Power supply failure

- Lasting min. 1 cycle frequency:
- EEPROM saves measuring system data
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)

Potential equalization

→ 📄 55

10.1.6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:

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

Installation:

- Inlet run >10 × DN
- Outlet run > 5 × DN
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

Maximum measured error

- Current output: plus typically ± 5 μA
- Pulse output: ± 0.5% o.r. ± 1 mm/s
  Option: ± 0.2% o.r. ± 2 mm/s (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.

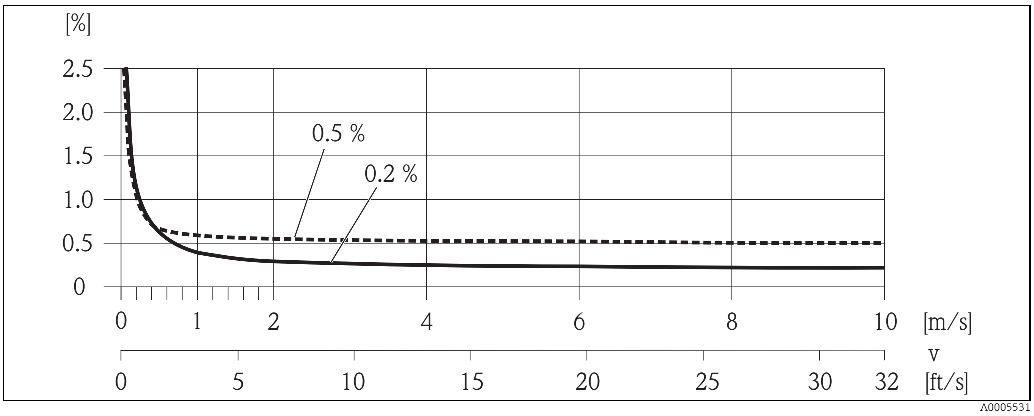


Fig. 58: Max. measured error in % of reading

Repeatability

Max. ± 0.1% o.r. ± 0.5 mm/s (o.r. = of reading)

10.1.7 Installation

Installation instructions

Any orientation (vertical, horizontal), restrictions and installation instructions → 📄 12

Inlet and outlet run

If possible, install the sensor upstream from fittings such as valves, T-pieces, elbows, etc. The following inlet and outlet runs must be observed in order to meet accuracy specifications (→ 📄 15, → 🖼 12):
- Inlet run: ≥ 5 × DN
- Outlet run: ≥ 2 × DN

Adapters

→ 📄 16

Length of connecting cable

→ 📄 19

10.1.8 Environment

Ambient temperature range

- Transmitter: –20 to +60 °C (–4 to +140 °F)

  ✎ Note!
  At ambient temperatures below –20 (–4 °F) the readability of the display may be impaired.
- Sensor (Flange material carbon steel): –10 to +60 °C (+14 to +140 °F)

Caution!
- The permitted temperature range of the measuring tube lining may not be undershot or overshot (→ "Operating conditions: Process" → "Medium temperature range").
- Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.

Caution!
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.

Degree of protection

- Standard: IP 67 (NEMA 4X) for transmitter and sensor
- Optional: IP 68 (NEMA 6P) for remote version of Promag E/L/P/W sensor. Promag L only with stainless steel flanges.

Shock and vibration resistance

Acceleration up to 2 g following IEC 60068-2-6
(high-temperature version: no data available)

CIP cleaning

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

CIP cleaning is possible:
Promag E (100 °C / 212 °F), Promag H/P

CIP cleaning is not possible:
Promag D/L/W

SIP cleaning

Caution!
The maximum fluid temperature permitted for the device may not be exceeded.

SIP cleaning is possible:
Promag H

SIP cleaning is not possible:
Promag D/E/L/P/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 Process

Medium temperature range

The permissible temperature depends on the lining of the measuring tube

Promag D

0 to +60 °C (+32 to +140 °F) for polyamide

Promag E

–10 to +110 °C (+14 to +230 °F) for PTFE,
Restrictions → see the following diagram

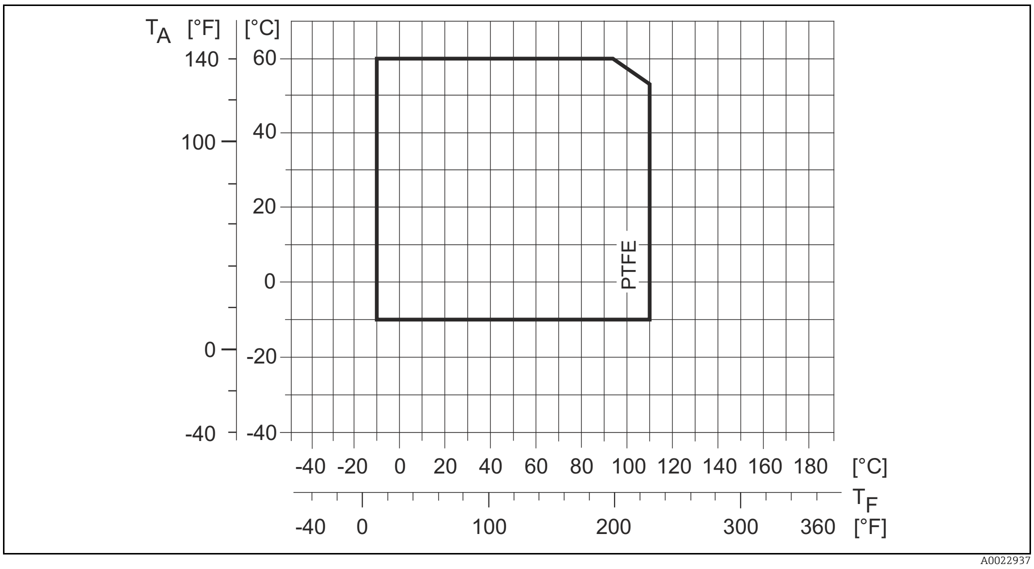


Fig. 59: Compact and remote version Promag E (TA = ambient temperature; TF = fluid temperature)

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)

Promag L

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 350 to 1200)
- –20 to +50 °C (–4 to +122 °F) for polyurethane (DN 50 to 1200)
- –20 to +90 °C (–4 to +194 °F) for PTFE (DN 50 to 300)

Promag P

Standard
- –40 to +130 °C (–40 to +266 °F) for PTFE (DN 15 to 600 / 1/2 to 24"),
  Restrictions → see the following diagrams
- –20 to +130 °C (–4 to +266 °F) for PFA/HE (DN 25 to 200 / 1 to 8"),
  Restrictions → see the following diagrams
- –20 to +150 °C (–4 to +302 °F) for PFA (DN 25 to 200 / 1 to 8"),
  Restrictions → see the following diagrams

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

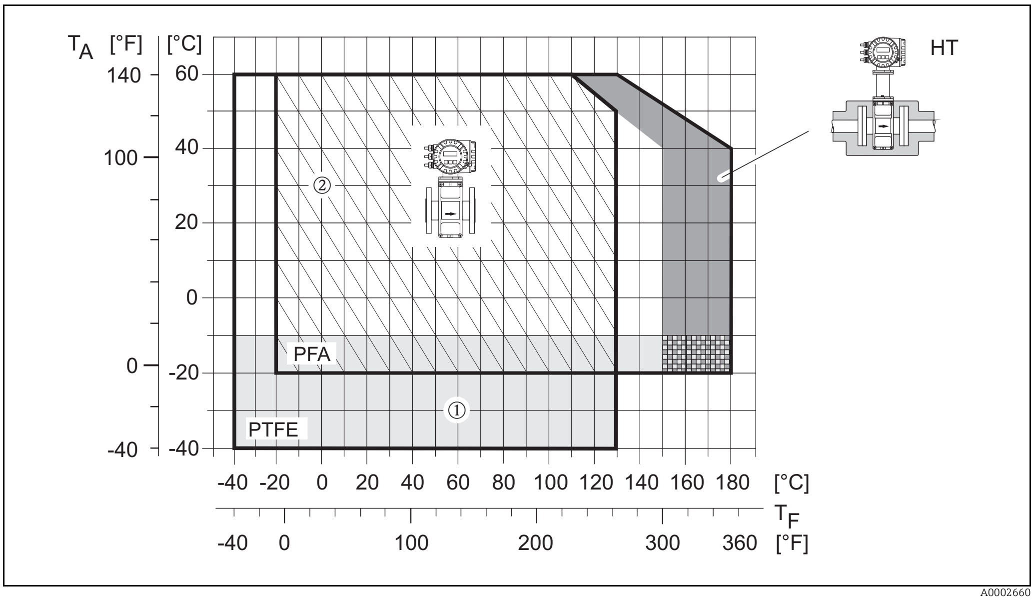


Abb. 60: Compact version Promag P (with PFA- or PTFE-lining)

TA = ambient temperature; TF = fluid temperature; HT = high-temperature version with insulation
m = light gray area → temperature range from –10 to –40 °C (–14 to –40 °F) is valid for stainless steel version only
n = diagonal hatched area → foam lining (HE) and degree of protection IP 68 = fluid temperature max. 130°C / 266 °F

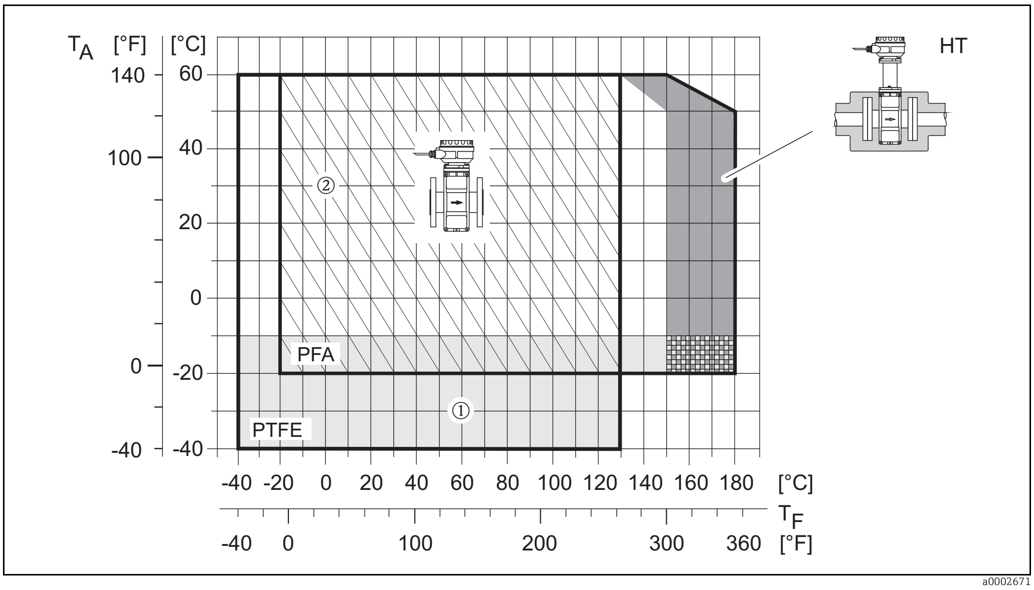


Abb. 61: Remote version Promag P (with PFA- or PTFE-lining)

TA = ambient temperature; TF = fluid temperature; HT = high-temperature version with insulation
m = light gray area → temperature range from –10 to –40 °C (–14 to –40 °F) is valid for stainless steel version only
n = diagonal hatched area → foam lining (HE) and degree of protection IP68 = fluid temperature max. 130°C / 266 °F

Promag W

- 0 to +80 °C (+32 to +176 °F) for hard rubber (DN 50 to 2000)
- –20 to +50 °C (–4 to +122 °F) for polyurethane (DN 25 to 1200)

Conductivity

The minimum conductivity is ≥ 5 μS/cm (≥ 20 μS/cm for demineralized water)

Note!
Note that in the case of the remote version, the requisite minimum conductivity is also influenced by the length of the connecting cable → 19

Medium pressure range (nominal pressure)

Promag D

- EN 1092-1 (DIN 2501)
  - PN 16
- ASME B 16.5
  - Class 150
- JIS B2220
  - 10K

Promag E

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 40 (DN 15 to 150 / ½ to 2")
- ASME B 16.5
  - Class 150 (½ to 24")
- JIS B2220
  - 10K (DN 50 to 300 / 2 to 12")
  - 20K (DN 15 to 40 / ½ to 1½")

Promag H

The permissible 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

Promag L

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 1200 / 14 to 48")
  - PN 10 (DN 50 to 1200 / 2 to 48")
  - PN 16 (DN 50 to 150 / 2 to 6")
- EN 1092-1, lap joint flange, stampel plate
  - PN 10 (DN 50 to 300 / 2 to 12")
- ASME B 16.5
  - Class 150 (2 to 24")
- AWWA
  - Class D (28 to 48")
- AS2129
  - Table E (DN 350 to 1200 / 14 to 48")
- AS4087
  - PN 16 (DN 350 to 1200 / 14 to 48")

Promag P

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 25 (DN 200 to 600 / 8 to 24")
  - PN 40 (DN 25 to 150 / 1 to 6")

- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- JIS B2220
  - 10K (DN 50 to 300 / 2 to 12")
  - 20K (DN 25 to 300 / 1 to 12")
- AS 2129
  - Table E (DN 25 / 1"), 50 / 2")
- AS 4087
  - PN 16 (DN 50 / 2")

Promag W

- EN 1092-1 (DIN 2501)
  - PN 6 (DN 350 to 2000 / 14 to 84")
  - PN 10 (DN 200 to 2000 / 8 to 84")
  - PN 16 (DN 65 to 2000 / 3 to 84")
  - PN 25 (DN 200 to 1000 / 8 to 40")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ASME B 16.5
  - Class 150 (1 to 24")
  - Class 300 (1 to 6")
- AWWA
  - Class D (28 to 78")
- JIS B2220
  - 10K (DN 50 to 300 / 2 to 12")
  - 20K (DN 25 to 300 / 1 to 12")
- AS 2129
  - Table E (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")
- AS 4087
  - PN 16 (DN 80 / 3", 100 / 4", 150 to 1200 / 6 to 48")

Pressure tightness

Promag D

Measuring tube: 0 mbar abs (0 psi abs) with a fluid temperature of ≤ 60 °C (140 °F)

Promag E (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures							
		25 °C		80 °C		100 °C		110 °C	
		77 °F		176 °F		212 °F		230 °F	
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]
15	½"	0	0	0	0	0	0	100	1.45
25	1"	0	0	0	0	0	0	100	1.45
32	–	0	0	0	0	0	0	100	1.45
40	1 ½"	0	0	0	0	0	0	100	1.45
50	2"	0	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

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures							
		25 °C		80 °C		100 °C		110 °C	
		77 °F		176 °F		212 °F		230 °F	
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]
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)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures					
		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	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

Promag L (Measuring tube lining: Polyurethane, Hard rubber)

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures		
			25 °C	50 °C	80 °C
[mm]	[inch]		77 °F	122 °F	176 °F
50 to 1200	2 to 48"	Polyurethane	0	0	–
350 to 1200	14 to 48"	Hard rubber	0	0	0

Promag L (Measuring tube lining: PTFE)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures			
		25 °C		90 °C	
		77 °F		194 °F	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]
50	2"	0	0	0	0
65	–	0	0	40	0.58
80	3"	0	0	40	0.58
100	4"	0	0	135	1.96
125	–	135	1.96	240	3.48
150	6"	135	1.96	240	3.48
200	8"	200	2.90	290	4.21
250	10"	330	4.79	400	5.80
300	12"	400	5.80	500	7.25

Promag P (Measuring tube lining: PFA)

Promag P Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures					
		25 °C	80° C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]	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)

Nominal diameter		Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures									
		25 °C		80 °C		100 °C		130 °C		150 °C	180 °C
		77 °F		176 °F		212 °F		266 °F		302 °F	356 °F
[mm]	[inch]	[mbar]	[psi]			[mbar]	[psi]	[mbar]	[psi]		
25	1"	0	0	0	0	0	0	100	1.45	–	–
32	–	0	0	0	0	0	0	100	1.45	–	–
40	1 ½"	0	0	0	0	0	0	100	1.45	–	–
50	2"	0	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 W

Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] ([psi]) at various fluid temperatures						
			25 °C	50 °C	80 °C	100 °C	130 °C	150 °C	180 °C
[mm]	[inch]		77 °F	122 °F	176 °F	212 °F	266 °F	302 °F	356 °F
25 to 1200	1 to 40"	Polyurethane	0	0	–	–	–	–	–
50 to 2000	2 to 78"	Hard rubber	0	0	0	–	–	–	–

Limiting flow

→ 📄 17

Pressure loss

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

10.1.10 Mechanical construction

Design, 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 → 📄 124.

Weight (SI units)

Promag D

Weight data in kg				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transmitter
25	1"	4.5	2.5	6.0
40	1 ½"	5.1	3.1	6.0
50	2"	5.9	3.9	6.0
65	2 ½"	6.7	4.7	6.0
80	3"	7.7	5.7	6.0
100	4"	10.4	8.4	6.0
Transmitter Promag (compact version): 3.4 kg (Weight data valid without packaging material)				

Promag E

Weight data in kg							
Nominal diameter		Compact version					
		EN (DIN)				ASME	JIS
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K
15	½"	–	–	–	6.5	6.5	6.5
25	1"	–	–	–	7.3	7.3	7.3
32	–	–	–	–	8.0	–	7.3
40	1½"	–	–	–	9.4	9.4	8.3
50	2"	–	–	–	10.6	10.6	9.3
65	–	–	–	12.0	–	–	11.1
80	3"	–	–	14.0	–	14.0	12.5
100	4"	–	–	16.0	–	16.0	14.7
125	–	–	–	21.5	–	–	21.0
150	6"	–	–	25.5	–	25.5	24.5
200	8"	–	45.0	46.0	–	45.0	41.9
250	10"	–	65.0	70.0	–	75.0	69.4
300	12"	–	70.0	81.0	–	110.0	72.3
350	14"	77.4	88.4	99.4	–	137.4	–
400	16"	89.4	104.4	120.4	–	168.4	–
450	18"	99.4	112.4	133.4	–	191.4	–
500	20"	114.4	132.4	182.4	–	228.4	–
600	24"	155.4	162.4	260.4	–	302.4	–

- Transmitter (compact version): 1.8 kg
- Weight data without packaging material

Weight data in kg								
Nominal diameter		Remote version (without cable)						
		Sensor						Transmitter
		EN (DIN)				ASME	JIS	
[mm]	[inch]	PN 6	PN 10	PN 16	PN 40	Class 150	10K	Wall-mount housing
15	½"	–	–	–	4.5	4.5	4.5	6.0
25	1"	–	–	–	5.3	5.3	5.3	
32	–	–	–	–	6.0	–	5.3	
40	1½"	–	–	–	7.4	7.4	6.3	
50	2"	–	–	–	8.6	8.6	7.3	
65	–	–	–	10.0	–	–	9.1	
80	3"	–	–	12.0	–	12.0	10.5	
100	4"	–	–	14.0	–	14.0	12.7	
125	–	–	–	19.5	–	–	19.0	
150	6"	–	–	23.5	–	23.5	22.5	
200	8"	–	43.0	44.0	–	43.0	39.9	
250	10"	–	63.0	68.0	–	73.0	67.4	
300	12"	–	68.0	79.0	–	108.0	70.3	
350	14"	73.1	84.1	95.1	–	133.1		
400	16"	85.1	100.1	116.1	–	164.1		
450	18"	95.1	108.1	129.1	–	187.1		
500	20"	110.1	128.1	178.1	–	224.1		
600	24"	158.1	158.1	256.1	–	298.1		

- Transmitter (remote version): 3.1 kg
- Weight data without packaging material

Promag H

Weight data in kg				
Nominal diameter		**Compact version**	**Remote version (without cable)**	
[mm]	**[inch]**	**DIN**	**Sensor**	**Transmitter**
2	1/12"	5.2	2	6.0
4	5/32"	5.2	2	6.0
8	5/16"	5.3	2	6.0
15	½"	5.4	1.9	6.0
25	1"	5.5	2.8	6.0
40	1 ½"	6.5	4.5	6.0
50	2"	9.0	7.0	6.0
65	2 ½"	9.5	7.5	6.0
80	3"	19.0	17.0	6.0
100	4"	18.5	16.5	6.0
Transmitter Promag (compact version): 3.4 kg (Weight data valid for standard pressure ratings and without packaging material)				

Promag L compact version (lap joint flanges / welded flanges DN > 350)

Weight data in kg									
Nominal diameter		**Compact version (including transmitter)**							
[mm]	**[inch]**	**EN (DIN)**		**EN (DIN)**		**ASME / AWWA**		**AS**	
50	2"	PN 16	10.6	PN 6	–	ASME / Class 150	10.6	PN 16. Tabelle E	–
65	2 ½"		12.0		–		–		–
80	3"		14.0		–		14.0		–
100	4"		16.0		–		16.0		–
125	5"		21.5		–		–		–
150	6"		25.5		–		25.5		–
200	8"	PN 10	45		–		45		–
250	10"		65		–		65		–
300	12"		70		–		70		–
350	14"		90		79		139		101
375	15"		–		–		–		107
400	16"		106		91		170		122
450	18"		114		101		193		135/145*
500	20"		134		116		230		184
600	24"		157		157		304		262
700	28"		248		200	AWWA / Class D	277		354
750	30"		–		–		329		441
800	32"		322		248		396		501
900	36"		402		316		482		698
1000	40"		475		366		601		769
	42"		–		–		684		–
1200	48"		724		537		914		1227
Transmitter Promag (compact version): 3,4 kg (Weight data valid without packaging material) * DN 450 AS Tab E									

Promag L remote version (lap joint flanges / welded flanges DN > 350)

Weight data in kg									
Nominal diameter		Remote version (sensor plus sensor housing without cable)							
[mm]	[inch]	EN (DIN)		EN (DIN)		ASME / AWWA		AS	
50	2"	PN 16	8.6	PN 6	–	ASME / Class 150	8.6	PN 16, Tabelle E	–
65	2 ½"		10.0		–		–		–
80	3"		12.0		–		12.0		–
100	4"		14.0		–		14.0		–
125	5"		19.5		–		–		–
150	6"		23.5		–		23.5		–
200	8"	PN 10	43		–		43		–
250	10"		63		–		63		–
300	12"		68		–		108		–
350	14"		87		76		136		98
375	15"		–		–		–		104
400	16"		103		88		167		119
450	18"		111		98		190		132/142*
500	20"		131		113		227		181
600	24"		154		154		301		259
700	28"		–		198	AWWA / Class D	275		352
750	30"		–		–		327		439
800	32"		320		246		394		499
900	36"		400		314		480		696
1000	40"		473		364		599		767
	42"		–		–		682		–
1200	48"		722		535		912		1225
Transmitter Promag (remote version): 6 kg (Weight data valid without packaging material) *DN 450 AS Tab E									

Promag L (lap joint flanges, stamped plate)

Weight data in kg						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]	EN (DIN)		Sensor EN (DIN)		Transmitter
50	2"	PN 10	7.2	PN 10	5.2	6.0
65	2 ½"		8.0		6.0	6.0
80	3"		9.0		7.0	6.0
100	4"		11.5		9.5	6.0
125	5"		15.0		13.0	6.0
150	6"		19.0		17.0	6.0
200	8"		37.5		35.5	6.0
250	10"		56.0		54.0	6.0
300	12"		57.0		55.0	6.0
Transmitter Promag (compact version): 3.4 kg (Weight data valid for standard pressure ratings and without packaging material)						

Promag P

Weight data in kg														
Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Trans- mitter
[mm]	[inch]	EN (DIN) / AS*		JIS		ASME/ AWWA		EN (DIN) / AS*		JIS		ASME/ AWWA		
15	½"	PN 40	6.5	10K	6.5	Class 150	6.5	PN 40	4.5	10K	4.5	Class 150	4.5	6.0
25	1"		7.3		7.3		7.3		5.3		5.3		5.3	6.0
32	1 ¼"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 ½"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 ½"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		14.4		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		16.0		21.0		–		19.5		19.0		–	6.0
150	6"		21.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0

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

Promag W

Weight data in kg														
Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Trans-mitter
[mm]	[inch]	EN (DIN) / AS*		JIS		ASME/ AWWA		EN (DIN) / AS*		JIS		ASME/ AWWA		
25	1"	PN 40	7.3	10K	7.3	Class 150	7.3	PN 40	5.3	10K	5.3	Class 150	5.3	6.0
32	1 ¼"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 ½"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 ½"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		16.0		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		21.5		21.0		–		19.5		19.0		–	6.0
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		65		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0
700	28"		355			Class D	400		353			Class D	398	6.0
–	30"		–				460		–				458	6.0
800	32"		435				550		433				548	6.0
900	36"		575				800		573				798	6.0
1000	40"		700				900		698				898	6.0
–	42"	PN 6	–				1100	PN 6	–				1098	6.0
1200	48"		850				1400		848				1398	6.0
–	54"		–				2200		–				2198	6.0
1400	–		1300				–		1298				–	6.0
–	60"		–				2700		–				2698	6.0
1600	–		1700				–		1698				–	6.0
–	66"		–				3700		–				3698	6.0
1800	72"		2200				4100		2198				4098	6.0
–	78"		–				4600		–				4598	6.0
2000	–		2800				–		2798				–	6.0

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

Weight (US units)

Promag D

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transmitter
25	1"	10	6	13
40	1 ½"	11	7	13
50	2"	13	9	13
80	3"	17	13	13
100	4"	23	19	13
Transmitter Promag (compact version): 7.5 lbs (Weight data valid without packaging material)				

Promag E (ASME)

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
			Sensor	Transmitter
		ASME	ASME	
[mm]	[inch]	Class 150	Class 150	Wall-mount housing
15	½"	14.3	9.92	13.2
25	1"	16.1	11.7	
40	1½"	20.7	16.3	
50	2"	23.4	19.0	
80	3"	30.9	26.5	
100	4"	35.3	30.9	
150	6"	56.2	51.8	
200	8"	99.2	94.8	
250	10"	165.4	161.0	
300	12"	242.6	238.1	
350	14"	303.0	293.5	
400	16"	371.3	361.8	
450	18"	422.0	412.6	
500	20"	503.6	494.1	
600	24"	666.8	657.3	

- Transmitter: 4.0 lbs (compact version); 6.8 lbs (remote version)
- Weight data without packaging material

Promag H

Weight data in lbs				
Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]		Sensor	Transmitter
2	1/12"	11	4	13
4	5/32"	11	4	13
8	5/16"	12	4	13
15	½"	12	4	13
25	1"	12	6	13
40	1 ½"	14	10	13
50	2"	20	15	13
65	2 ½"	21	17	13
80	3"	42	37	13
100	4"	41	36	13
Transmitter Promag (compact version): 7.5 lbs (Weight data valid for standard pressure ratings and without packaging material)				

Promag L (ASME / AWWA: lap joint flanges / welded flanges DN > 700)

Weight data in lbs					
Nominal diameter		Compact version		Remote version (without cable)	
[mm]	[inch]	ASME / AWWA		ASME / AWWA	
50	2"	ASME / Class 150	23	ASME / Class 150	19
65	2 ½"		–		–
80	3"		31		26
100	4"		35		31
125	5"		–		–
150	6"		56		52
200	8"		99		95
250	10"		143		139
300	12"		243		238
350	14"		–		–
400	16"		–		–
450	18"		–		–
500	20"		–		–
600	24"		–		–
700	28"	AWWA / Class D	611	AWWA / Class D	606
750	30"		725		721
800	32"		873		869
900	36"		1063		1058
1000	40"		1324		1320
	42"		1508		1504
1200	48"		2015		2011
Transmitter Promag (compact version): 7,5 lbs Transmitter Promag (remote version): 13 lbs (Weight data valid without packaging material)					

Promag P (ASME/AWWA)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]			Sensor		Transmitter
15	½"	Class 150	14	Class 150	10	13
25	1"		16		12	13
40	1 ½"		21		16	13
50	2"		23		19	13
80	3"		31		26	13
100	4"		35		31	13
150	6"		56		52	13
200	8"		99		95	13
250	10"		165		161	13
300	12"		243		238	13
350	14"		386		381	13
400	16"		452		448	13
450	18"		562		558	13
500	20"		628		624	13
600	24"		893		889	13
Transmitter Promag (compact version): 7.5 lbs High-temperature version: 3.3 lbs (Weight data valid for standard pressure ratings and without packaging material)						

Promag W (ASME/AWWA)

Weight data in lbs						
Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]				Sensor	Transmitter
25	1"	Class 150	16	Class 150	12	13
40	1 ½"		21		16	13
50	2"		23		19	13
80	3"		31		26	13
100	4"		35		31	13
150	6"		56		52	13
200	8"		99		95	13
250	10"		143		161	13
300	12"		243		238	13
350	14"		386		381	13
400	16"		452		448	13
450	18"		562		558	13
500	20"		628		624	13
600	24"		893		889	13
700	28"	Class D	882	Class D	878	13
–	30"		1014		1010	13
800	32"		1213		1208	13
900	36"		1764		1760	13
1000	40"		1985		1980	13
–	42"		2426		2421	13
1200	48"		3087		3083	13
–	54"		4851		4847	13
–	60"		5954		5949	13
–	66"		8159		8154	13
1800	72"		9041		9036	13
–	78"		10143		10139	13
Transmitter Promag (compact version): 7.5 lbs (Weight data valid for standard pressure ratings and without packaging material)						

Material

Promag D

- Transmitter housing: powder-coated die-cast aluminum
- Sensor housing: powder-coated die-cast aluminum
- Measuring tube: polyamide, O-rings EPDM
  (Drinking water approvals: WRAS BS 6920, ACS, NSF 61, KTW/W270)
- Electrodes: 1.4435 (316, 316L)
- Ground disks: 1.4301 (304)

Promag E

- Transmitter housing
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mount housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 600 (14 to 24"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L) (with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304L) (with protective lacquering)
- Electrodes: 1.4435 (316, 316L), Alloy C22, Tantalum
- Flanges (with protective lacquering)
  - EN 1092-1 (DIN2501): RSt37-2 (S235JRG2); Alloy C22; Fe 410W B
  - ANSI: A105
  - JIS: RSt37-2 (S235JRG2); HII
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag H

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum or stainless steel field housing (1.4301 (316L))
  - Wall-mounted housing: powder-coated die-cast aluminum
  - Window material: glas or polycarbonate
- Sensor housing: stainless steel 1.4301 (304)
- Wall mounting kit: stainless steel 1.4301 (304)
- Measuring tube: stainless steel 1.4301 (304)
- Liner: PFA (USP class VI; FDA 21 CFR 177.1550: 3A)
- Electrodes:
  - Standard: 1.4435 (316, 316L)
  - Option: Alloy C22, Tantalum, Platinum
- Flange:
  - All connections stainless-steel 1.4404 (316L)
  - EN (DIN), ASME, JIS made of PVDF
  - Adhesive fitting made of PVC
- Seals
  - DN 2 to 25 (1/12 to 1"): O-ring (EPDM, Viton, Kalrez), gasket seal (EPDM*, Viton, Silicone*)
  - DN 40 to 100 (1½ to 4"): gasket seal (EPDM*, Silicone*)
    * = USP class VI; FDA 21 CFR 177.2600: 3A
- Ground rings: 1.4435 (316, 316L) (optional: Tantalum, Alloy C22)

Promag L

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 50 to 300 (2 to 12"): powder-coated die-cast aluminum
  - DN 350 to 1200 (14 to 84"): with protective lacquering

- Measuring tube:
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L)
  - DN ≥ 350 (14"): stainless steel 202 or 304
- Electrodes: 1.4435 (316, 316L), Alloy C22
- Flange
  - EN 1092-1 (DIN 2501): DN ≤ 300: 1.4306; 1.4307; 1.4301 (304); 1.0038 (S235JRG2)
  - EN 1092-1 (DIN 2501): DN ≥ 350: A105; 1.0038 (S235JRG2)
  - AWWA: A181/A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
  - AS 2129: A105; 1.0345 (P235GH); 1.0425 (316L) (P265GH); 1.0038 (S235JRG2); FE 410 WB
  - AS 4087: A105; 1.0425 (316L) (P265GH); 1.0044 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag P

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 15 to 300 (½ to 12"): powder-coated die-cast aluminum
  - DN 350 to 2000 (14 to 84"): with protective lacquering
- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L); for flanges made of carbon steel with Al/Zn protective coating
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304L); for flanges made of carbon steel with Al/Zn protective coating
- Electrodes: 1.4435 (316, 316L), Platinum, Alloy C22, Tantalum, Titanium
- Flange
  - EN 1092-1 (DIN2501): 1.4571 (316L); RSt37-2 (S235JRG2); Alloy C22; FE 410W B (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ASME: A105; F316L
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AWWA: 1.0425
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425 (316L)
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129
    - DN 25 (1"): A105 or RSt37-2 (S235JRG2)
    - DN 40 (1½"): A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L) or Alloy C22

Promag W

- Transmitter housing:
  - Compact housing: powder-coated die-cast aluminum
  - Wall-mounted housing: powder-coated die-cast aluminum
- Sensor housing
  - DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum
  - DN 350 to 2000 (14 to 84"): with protective lacquering

- Measuring tube
  - DN ≤ 300 (12"): stainless steel 1.4301 (304) or 1.4306 (304L)
    (for flanges made of carbon steel with Al/Zn protective coating)
  - DN ≥ 350 (14"): stainless steel 1.4301 (304) or 1.4306 (304)
    (for flanges made of carbon steel with protective lacquering)
- Electrodes: 1.4435 (316, 316L) or Alloy C22, Tantalum
- Flange
  - EN 1092-1 (DIN2501): 1.4571 (316L); RSt37-2 (S235JRG2); Alloy C22; FE 410 WB
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - ASME: A105; F316L
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AWWA: 1.0425
  - JIS: RSt37-2 (S235JRG2); HII; 1.0425 (316L)
    (DN ≤ 300 (12") with Al/Zn protective coating; DN ≥ 350 (14") with protective lacquering)
  - AS 2129
    - DN 150 to 300 (6 to 12"), DN 600 (24"): A105 or RSt37-2 (S235JRG2)
    - DN 80 to 100 (3 to 4"), 350 to 500 (14 to 20"): A105 or St44-2 (S275JR)
  - AS 4087: A105 or St44-2 (S275JR)
- Seals: to DIN EN 1514-1
- Ground disks: 1.4435 (316, 316L), Alloy C22, Titanium, Tantalum

Pressure-temperature ratings

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the "Technical Information" documents of the device in question:
List of supplementary documentation → 124.

Fitted electrodes

Promag D

- 2 measuring electrodes for signal detection

Promag E/L/P/W

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

Promag H

- 2 measuring electrodes for signal detection
- 1 EPD electrode for empty pipe detection (apart from DN 2 to 15)

Process connections

Promag D

Wafer version → without process connections

Promag E

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 (12") = form A
  - DN ≥ 350 (14") = flat face
  - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1
- ASME
- JIS

Promag H

With O-ring:
- Weld nipple DIN (EN), ISO 1127, ODT/SMS
- Flange EN (DIN), ASME, JIS
- Flange made of PVDF EN (DIN), ASME, JIS
- External thread
- Internal thread
- Hose connection
- PVC adhesive fitting

With gasket seal:
- Weld nipple DIN 11850, ODT/SMS
- Clamp ISO 2852, DIN 32676, L14 AM7
- Threaded joint DIN 11851, DIN 11864-1, ISO 2853, SMS 1145
- Flange DIN 11864-2

Promag L

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 = Form A
  - DN ≥ 350 = Form B
- ASME
- AWWA
- AS

Promag P/W

Flange connections:
- EN 1092-1 (DIN 2501)
  - DN ≤ 300 = form A
  - DN ≥ 350 = flat face
  - DN 65 PN 16 and DN 600 PN 16 only as per EN 1092-1
- ASME
- AWWA (only Promag W)
- JIS
- AS

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, two-line, 16 characters per line
- Custom configurations for presenting different measured-value and status variables
- 2 totalizers

Note!
At ambient temperatures below –20 (–4 °F) the readability of the display may be impaired.

Operating elements

- Local operation with three keys (⊟⊞Ⓔ)
- "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/Scandinavia (EES):
  English, Russian, Polish, Norwegian, Finnish, Swedish and Czech
- Southeast Asia (SEA):
  English, Japanese, Indonesian

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

Remote operation

Operation via HART protocol and Fieldtool

10.1.12 Certificates and approvals

CE mark

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

C-tick mark

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex approval

Information about currently available Ex versions (ATEX, FM, CSA, 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

Promag D/E/L/P/W

No applicable approvals or certification

Promag H

- 3A authorization and EHEDG-tested
- Seals: in conformity with FDA (except Kalrez seals)

Drinking water approval

Promag D/L/W

- WRAS BS 6920
- ACS
- NSF 61
- KTW/W270

Promag E/H/P

No drinking water approval

Pressure Equipment Directive

Promag D/L

No pressure measuring device approval

Promag E/H/P/W

The devices can be ordered with or without a PED approval. If a device with a PED approval is required, this must be explicitly stated in the order. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary.

- With the PED/G1/x (x = category) marking on the sensor nameplate, Endress+Hauser confirms compliance with the "Essential Safety Requirements" specified in Annex I of the Pressure Equipment Directive 97/23/EC.
- Devices bearing this marking (PED) are suitable for the following types of medium: Media in Group 1 and 2 with a vapor pressure greater than, or smaller and equal to 0.5 bar (7.3 psi)
- Devices not bearing this marking (PED) are designed and manufactured according to good engineering practice. They meet the requirements of Art.3 Section 3 of the Pressure Equipment Directive 97/23/EC. The range of application is indicated in tables 6 to 9 in Annex II of the Pressure Equipment Directive.

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code).
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  Electromagnetic compatibility (EMC requirements)
- ASME/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.

10.1.13 Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

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

10.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor → 78.
Your Endress+Hauser service organization can provide detailed information on the specific order codes on request.

10.1.15 Documentation

- Flow measuring technology (FA00005D/06)
- Technical Information Promag 50D (TI00082D/06)
- Technical Information Promag 50E (TI01161D/06)
- Technical Information Promag 50L (TI00097D/06)
- Technical Information Promag 50/53H (TI00048D/06)
- Technical Information Promag 50/53P (TI00047D/06)
- Technical Information Promag 50/53W (TI00046D/06)
- Description of Device Functions Promag 50 HART (BA00049D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

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