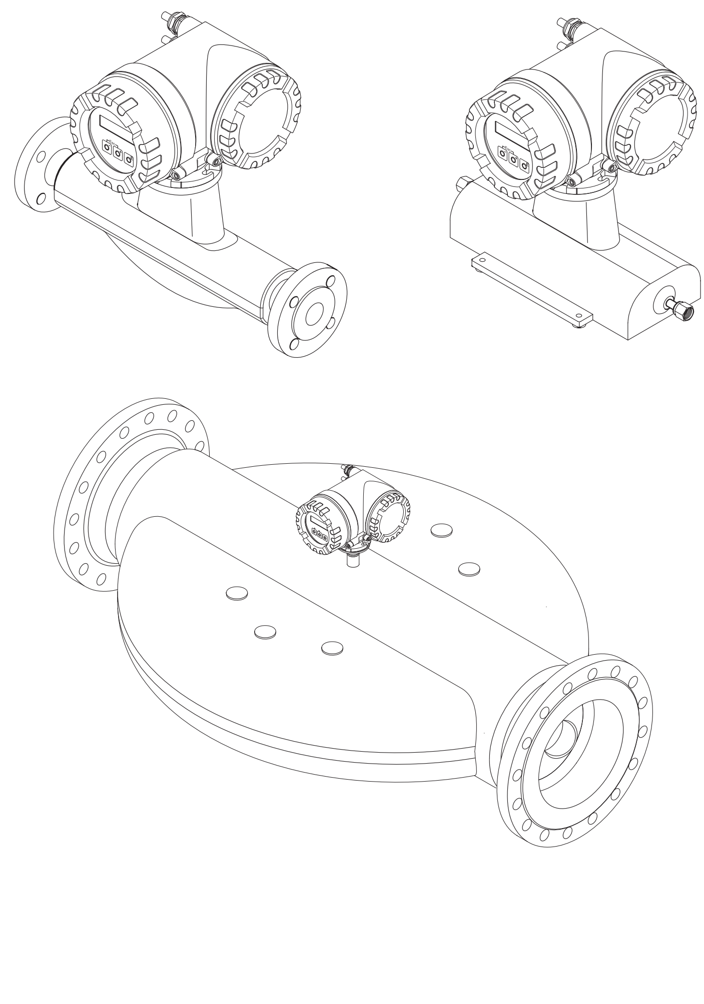
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Operating Instructions

Proline Promass 84

Coriolis Mass Flow Measuring System for Custody Transfer



BA00109D/06/EN/14.12
71197492

Valid as of version
V 3.01.XX (Device software)

Endress+Hauser
People for Process Automation

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1 Safety instructions

1.1 Designated use

The measuring device described in these Operating Instructions is to be used only for measuring the mass flow rate of liquids and gases. At the same time, the system also measures fluid density and fluid temperature. These parameters are then used to calculate other variables such as volume flow. Fluids with widely differing properties can be measured.

Examples:
- Oils, fats
- Acids, alkalis, lacquers, paints, solvents and cleaning agents
- Pharmaceuticals, catalysts, inhibitors
- Suspensions
- Gases, liquefied gases, etc.
- Chocolate, condensed milk, liquid sugar

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

1.2 Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the measuring instrument must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator.
  The specialist must have read and understood these Operating Instructions and must follow the instructions they contain.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Instruction is mandatory.
- Endress+Hauser will be happy to assist in clarifying the corrosion resistance properties of materials wetted by special fluids, including fluids used for cleaning. However, small changes of temperature, concentration or degree of contamination in the process can result in differences in corrosion resistance. Therefore, Endress+Hauser provides no warranty and assumes no liability with regard to corrosion resistance of fluid wetted materials in an application. The user is responsible for choosing suitable fluid wetted materials in the process.
- If carrying out welding work on the piping, the welding unit may not be grounded by means of the measuring device.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be earthed unless special protection measures have been taken e.g. galvanically isolated power supply SELV or PELV (SELV = Save Extra Low Voltage; PELV = Protective Extra Low Voltage).
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:

- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body (e.g. 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 recommendation NE 21, NE 43 and NE 53.
- For measuring systems used in SIL 2 applications, the separate manual on functional safety must be observed.
- External surface temperature of the transmitter can increase by 10 K due to power consumption of internal electronical components. Hot process fluids passing through the measuring device will further increase the surface temperature of the measuring device. Especially the surface of the sensor can reach temperatures which are close to process temperature. Additionally safety precautions are required when increased process temperatures are present.
- The separate document on the Pressure Equipment Directive must be observed for devices used in Category II, III or IV installations in accordance with the Pressure Equipment Directive.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser representative will supply you with current information and updates to these Operating Instructions.

1.4 Return

- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.
- Please note the measures on → 88

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 measuring instruments comply with the applicable standards and regulations in accordance with EN 61010-1, "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". They can, however, be a source of danger if used incorrectly or for other than the designated use. Consequently, always pay particular attention to the safety instructions indicated in these Operating Instructions by the following icons:

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

Caution!
"Caution" indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the measuring instrument. 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 measuring instrument.

2 Identification

The following options are available for identification of the measuring device:
- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter serial numbers from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer): All information about the measuring device is displayed.

For an overview of the scope of the Technical Documentation provided, refer to the following:
- The chapters "Supplementary documentation" → 🗎 117
- Der *W@M Device Viewer*: Enter the serial number from the nameplate (www.endress.com/deviceviewer)

Reorder
The measuring device is reordered using the order code.

Extended order code:
- The device type (product root) and basic specifications (mandatory features) are always listed.
- Of the optional specifications (optional features), only the safety and approval-related specifications are listed (e.g. LA). If other optional specifications are also ordered, these are indicated collectively using the # placeholder symbol (e.g. #LA#).
- If the ordered optional specifications do not include any safety and approval-related specifications, they are indicated by the + placeholder symbol (e.g. 83F50-AACCCAAD2S1+).

2.1 Device designation

The "Promass 84" flow measuring system consists of the following components:
- Promass 84 transmitter
- Promass F, Promass A, Promass O or Promass X sensor

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

2.1.1 Nameplate of the transmitter

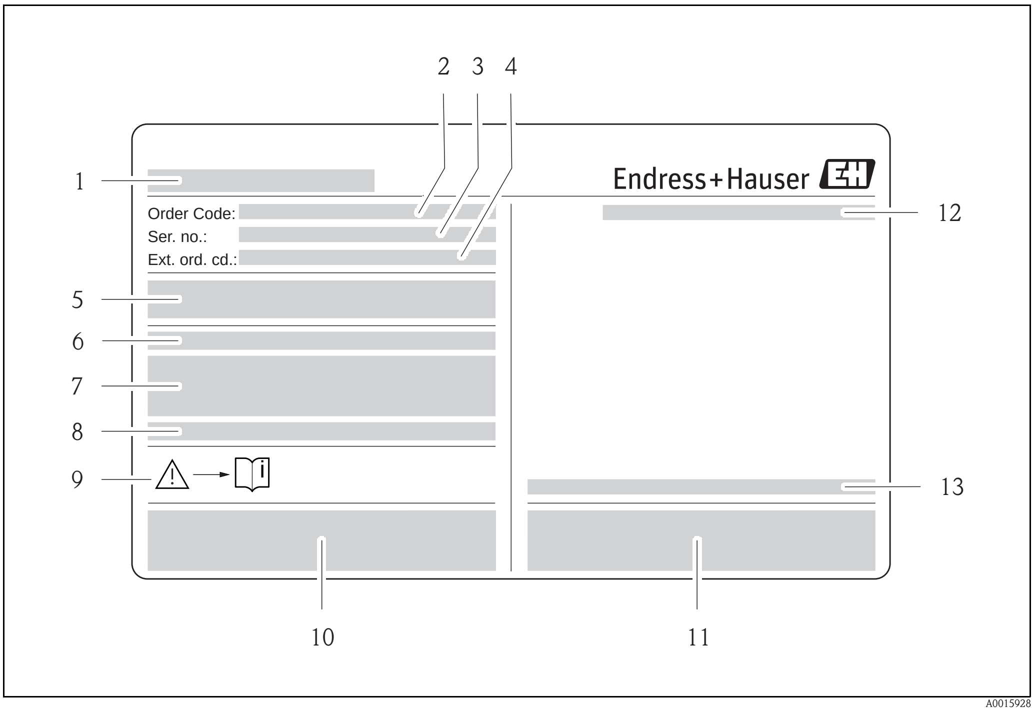

Fig. 1: Example of a transmitter nameplate

1 Name of the transmitter
2 Order code
3 Serial number (Ser. no.)
4 Extended order code (Ext. ord. cd.)
5 Power supply, frequency and power consumption
6 Additional function and software
7 Available inputs / outputs
8 Reserved for information on special products
9 Please refer to operating instructions / documentation
10 Reserved for certificates, approvals and for additional information on device version
11 Patents
12 Degree of protection
13 Ambient temperature range

2.1.2 Nameplate of the sensor

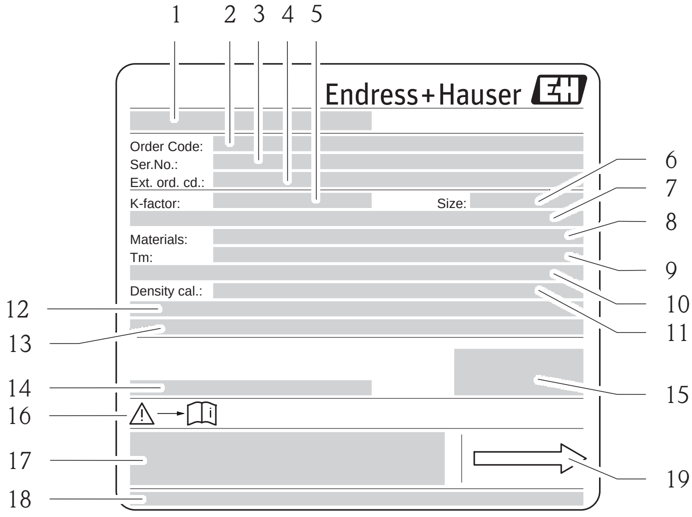

Fig. 2: Example of a sensor nameplate

1 Name of the sensor
2 Order code
3 Serial number (Ser. no.)
4 Extended order code (Ext. ord. cd.)
5 Calibration factor with zero point (K-factor)
6 Nominal diameter device (Size)
7 Flange nominal diameter/Nominal pressure
8 Material of measuring tubes (Materials)
9 Max. fluid temperature (Tm)
10 Pressure range of secondary containment
11 Accuracy of density measurement (Density cal.)
12 Additional information
13 Reserved for information on special products
14 Ambient temperature range
15 Degree of protection
16 Please refer to operating instructions / documentation
17 Reserved for additional information on device version (approvals, certificates)
18 Patents
19 Flow direction

2.1.3 Additional nameplate for suitability for custody transfer measurement

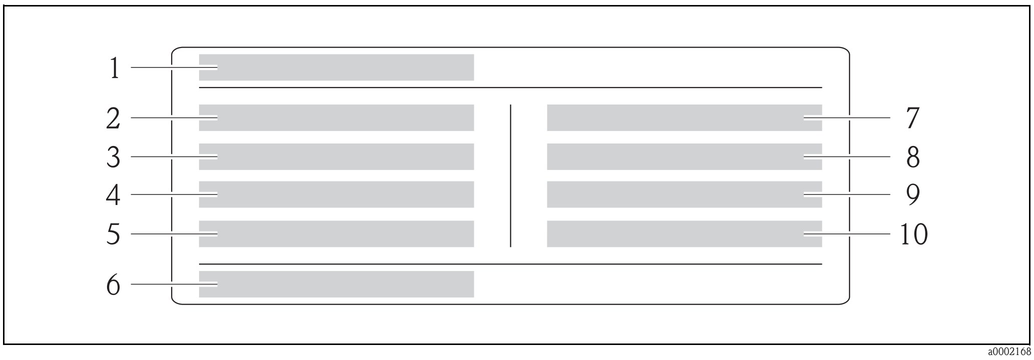

Fig. 3: Nameplate specifications for the suitability of "Promass 84" for custody transfer measurement (example)

1 Name of the device
2 Environmental class
3 Accuracy class
4 Minimum/Maximum measured quantity for liquids
5 Minimum/Maximum measured quantity for gases
6 Symbol for custody transfer consisting of the number and issue date
7 Gas temperature
8 Ambient temperature
9 Gas type
10 Pulse value

2.1.4 Nameplate for connections

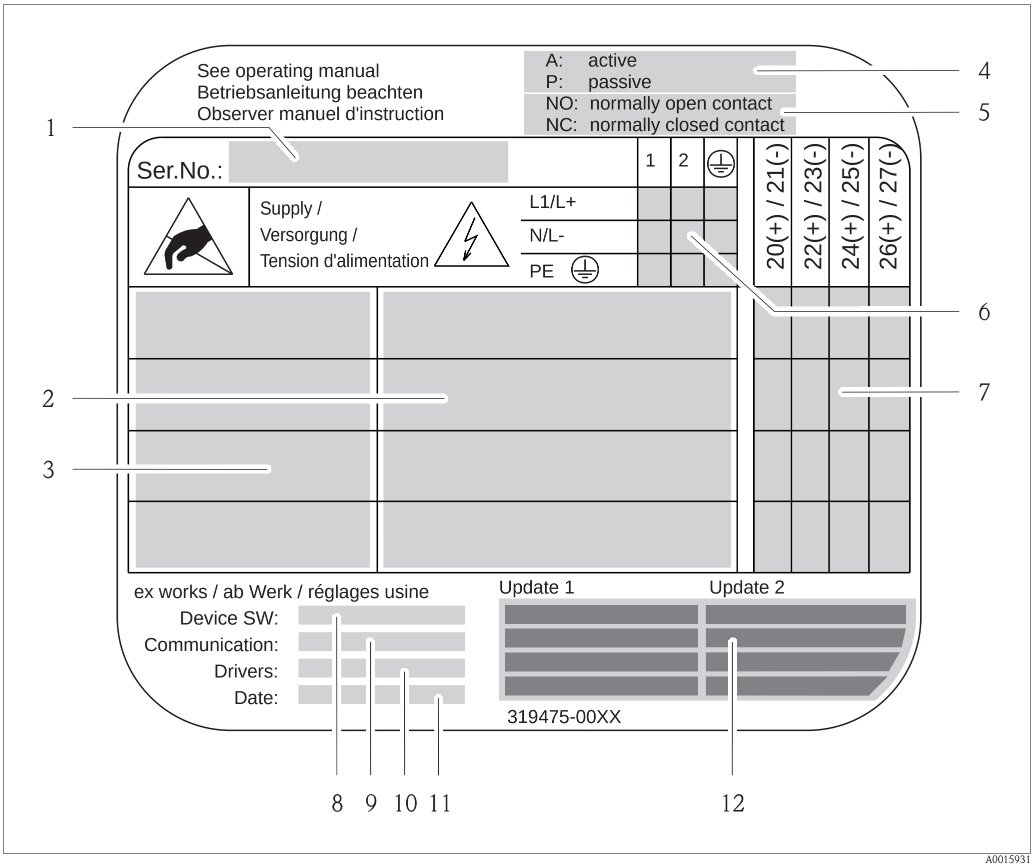

Fig. 4: Example of a connection nameplate

1 *Serial number (Ser. no.)*
2 *Possible inputs and outputs*
3 *Signals present at inputs and outputs*
4 *Possible configuration of current output*
5 *Possible configuration of relay contacts*
6 *Terminal assignment, cable for power supply*
7 *Terminal assignment and configuration (see point 4 and 5) of inputs and outputs*
8 *Version of device software currently installed (Device SW)*
9 *Installed communication type (Communication)*
10 *Information on current communication software (Drivers: Device Revision and Device Description),*
11 *Date of installation (Date)*
12 *Current updates to data specified in points 8 to 11 (Update1, Update 2)*

2.2 Certificates and approvals

The devices are designed in accordance with good engineering practice to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate.
The measuring instruments comply with the applicable standards and regulations in accordance with EN 61010 -1, "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of IEC/EN 61326.
The measuring system described in these Operating Instructions thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
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

SWAGELOK®
Registered trademark of Swagelok & Co., Solon, USA

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

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

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

On receipt of the goods, check the following points:

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

3.1.2 Transport

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

- Transport the devices in the containers in which they are delivered.
- The covers or caps fitted to the process connections prevent mechanical damage to the sealing faces and the ingress of foreign matter to the measuring tube during transportation and storage. Consequently, do not remove these covers or caps until immediately before installation.
- Do not lift measuring devices of nominal diameters > DN 40 (> 1½") by the transmitter housing or the connection housing in the case of the remote version (→ 5). – Use webbing slings slung round the two process connections. Do not use chains, as they could damage the housing.
- Promass X and Promass O sensor: see special instructions for transporting → 13

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

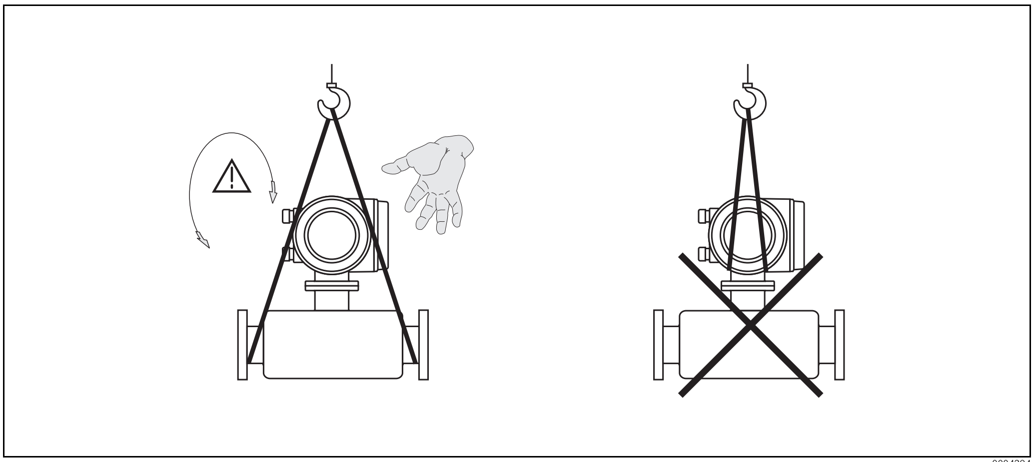

Fig. 5: Instructions for transporting sensors with > DN 40 (> 1½")

Special instructions for transporting Promass X and O

Warning!
- For transporting use only the lifting eyes on the flanges to lift the assembly.
- The assembly must always be attached to at least two lifting eyes.

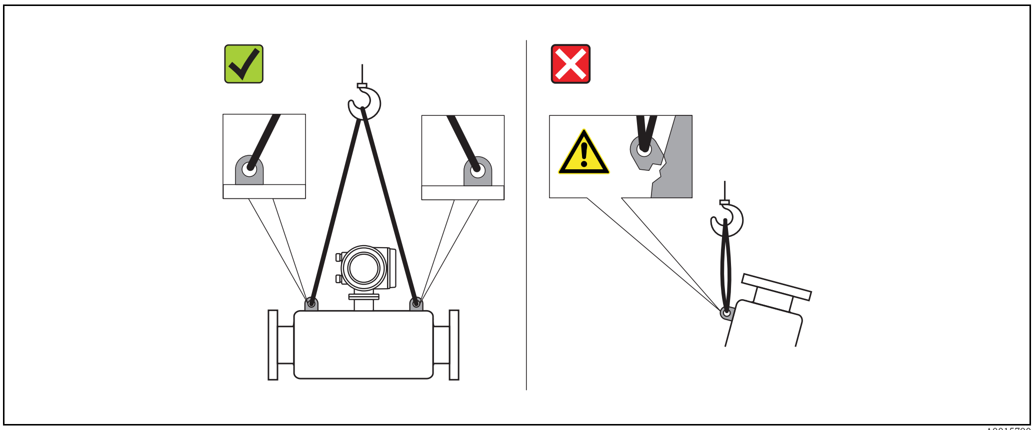

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Fig. 6: Instructions for transporting Promass O

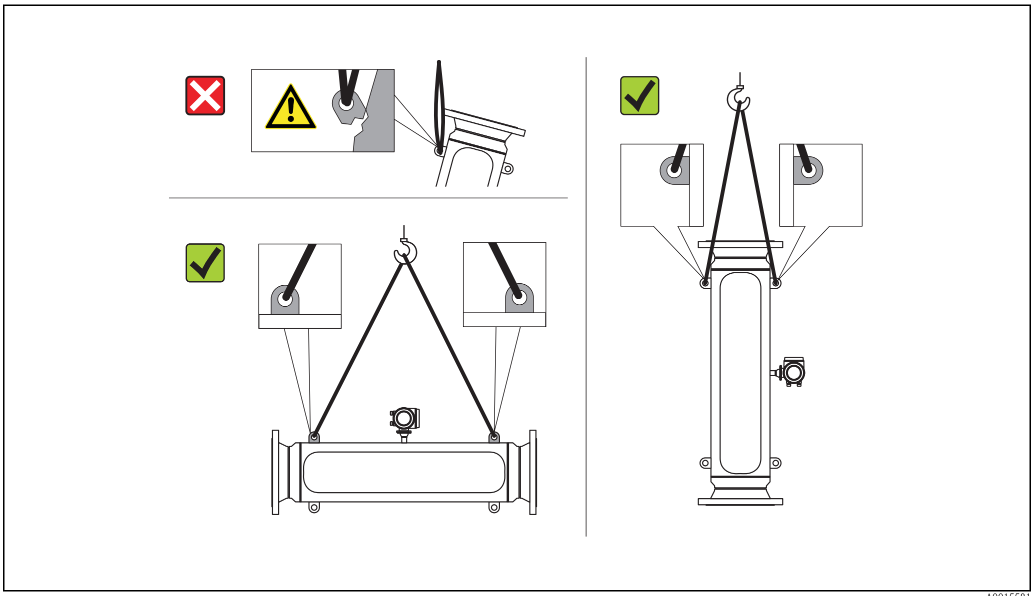

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Fig. 7: Instructions for transporting Promass X

3.1.3 Storage

Note the following points:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permissible storage temperature is –40 to +80 °C (–40 °F to +176 °F), preferably +20 °C (+68 °F).
- Do not remove the protective covers or caps on the process connections until you are ready to install the device.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.

3.2 Installation conditions

Note the following points:
- No special measures such as supports are necessary. External forces are absorbed by the construction of the instrument, for example the secondary containment.
- The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by pipe vibrations.
- No special precautions need to be taken for fittings which create turbulence (valves, elbows, T-pieces, etc.), as long as no cavitation occurs.
- For mechanical reasons and in order to protect the pipe, it is advisable to support heavy sensors.

3.2.1 Dimensions

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

3.2.2 Mounting location

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

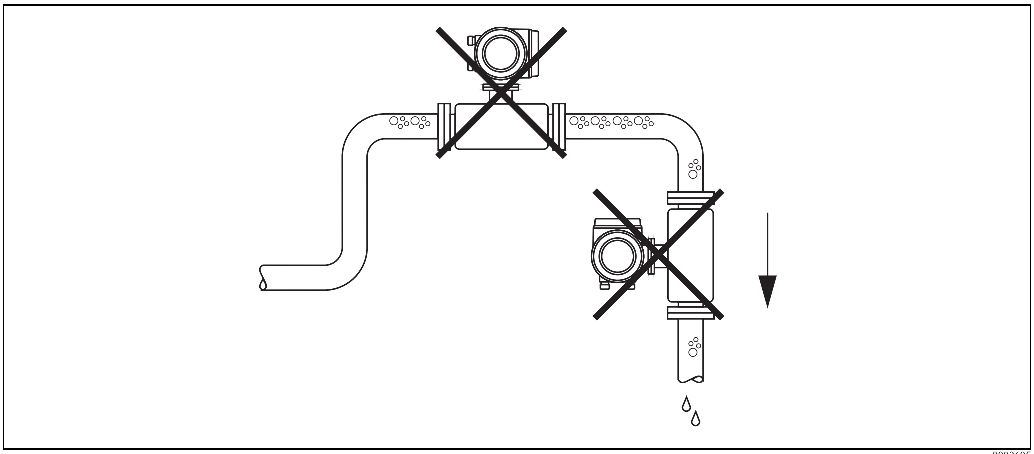

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Fig. 8: Mounting location

Installation in a vertical pipe

The proposed configuration in the following diagram, however, permits installation in a vertical pipeline. Pipe restrictors or the use of an orifice plate with a smaller cross-section than the nominal diameter prevent the sensor from running empty during measurement.

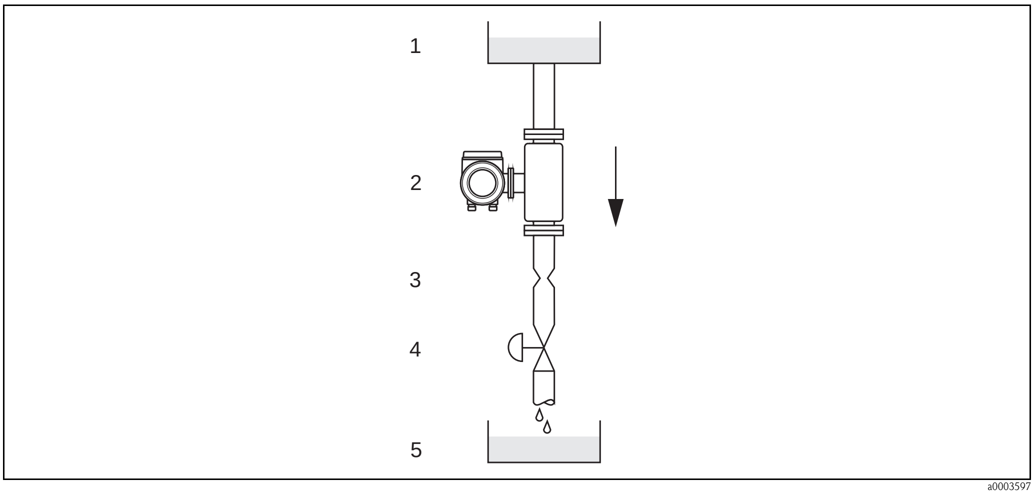


Fig. 9: Installation in a vertical pipe (e.g. for batching applications)

1 = Supply tank, 2 = Sensor, 3 = Orifice plate, pipe restrictions (see Table), 4 = Valve, 5 = Batching tank

DN		Ø Orifice plate, pipe restrictor	
		mm	inch
2	1/12"	1.5	0.06
4	1/8"	3.0	0.12
8	3/8"	6	0.24
15	1/2"	10	0.40
25	1"	14	0.55
40	1 ½"	22	0.87

DN		Ø Orifice plate, pipe restrictor	
		mm	inch
50	2"	28	1.10
80	3"	50	2.00
100	4"	65	2.60
150	6"	90	3.54
250	10"	150	5.91
350	14"	210	8.27

System pressure

It is important to ensure that cavitation does not occur, because it would influence the oscillation of the measuring tube. No special measures need to be taken for fluids which have properties similar to water under normal conditions.
In the case of liquids with a low boiling point (hydrocarbons, solvents, liquefied gases) or in suction lines, it is important to ensure that pressure does not drop below the vapor pressure and that the liquid does not start to boil. It is also important to ensure that the gases that occur naturally in many liquids do not outgas. Such effects can be prevented when system pressure is sufficiently high.

For this reason, the following installation locations are preferred:
- Downstream from pumps (no danger of vacuum)
- At the lowest point in a vertical pipe.

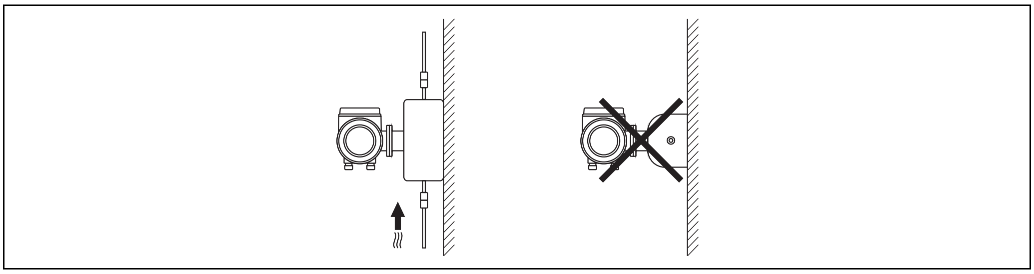
3.2.3 Orientation

Make sure that the direction of the arrow on the nameplate of the sensor matches the direction of flow direction in which the fluid flows through the pipe.

Orientation Promass A

Vertical
Recommended orientation with direction of flow upwards. When fluid is not flowing, entrained solids will sink down and gases will rise away from the measuring tube. The measuring tubes can be completely drained and protected against solids build-up.

Horizontal
When installation is correct the transmitter housing is above or below the pipe. This means that no gas bubbles or solids deposits can form in the bent measuring tube (single-tube system).



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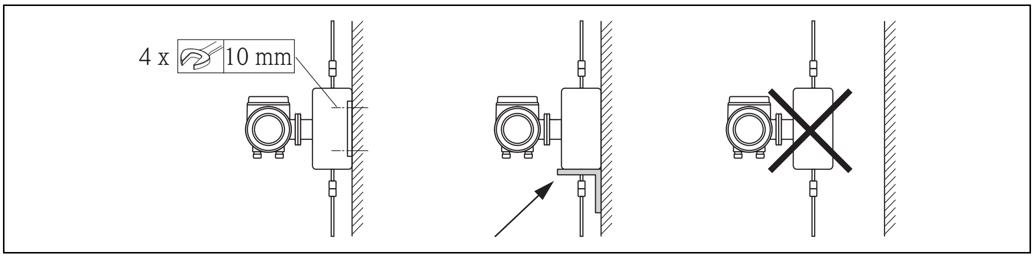
Special installation instructions for Promass A

Caution!
Risk of measuring pipe fracture if sensor installed incorrectly!
The sensor may not be installed in a pipe as a freely suspended sensor:
- Using the base plate, mount the sensor directly on the floor, the wall or the ceiling.
- Support the sensor on a firmly mounted support base (e.g. angle bracket).

Vertical
We recommend two installation versions when mounting vertically:
- Mounted directly on a wall using the base plate
- Measuring device supported on an angle bracket mounted on the wall



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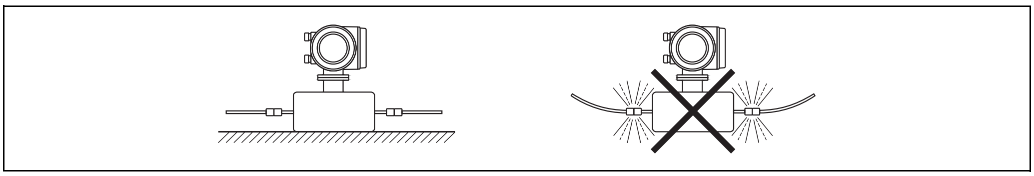
Horizontal
We recommend the following installation version when mounting horizontally:
- Measuring device standing on a firm support base



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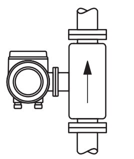
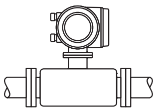
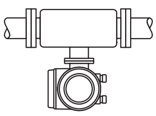
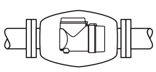
Orientation Promass F, O, X

Make sure that the direction of the arrow on the nameplate of the sensor matches the direction of flow (direction in which the fluid flows through the pipe).

Vertical:
Recommended orientation with upward direction of flow (Fig. V). When fluid is not flowing, entrained solids will sink down and gases will rise away from the measuring tube.
The measuring tubes can be completely drained and protected against solids buildup.

Horizontal (Promass F, O):
The measuring tubes of Promass F and O must be horizontal and beside each other.
When installation is correct the transmitter housing is above or below the pipe (Fig. H1/H2).
Always avoid having the transmitter housing in the same horizontal plane as the pipe.
See next chapter – special installation instructions.

Horizontal (Promass X):
Promass X can be installed in any orientation in a horizontal pipe run.

		Promass F, O Standard	**Promass F High-temperature, compact**	**Promass F High-temperature, remote**	**Promass X**
Fig. V: Vertical orientation	 a0004572	✔✔	✔✔	✔✔	✔✔
Fig. H1: Horizontal orientation Transmitter head up	 a0004576	✔✔	✘ TM > 200 °C (392 °F)	✔ TM > 200 °C (392 °F)	✔✔
Fig. H2: Horizontal orientation Transmitter head down	 a0004580	✔✔	✔✔	✔✔	✔✔
Fig. H3: Horizontal orientation Transmitter head to the side	 A0015445	✘	✘	✘	✔ ①

✔✔ = Recommended orientation; ✔ = Orientation recommended in certain situations; ✘ = Impermissible orientation

① The measuring tubes are curved. Therefore the unit is installed horizontally, adapt the sensor position to the fluid properties:
- Suitable to a limited extent for fluids with entrained solids. Risk of solids accumulating
- Suitable to a limited extent for outgassing fluids. Risk of air accumulating

In order to ensure that the permissible ambient temperature range for the transmitter (→ 🗎 105) is not exceeded, we recommend the following orientations:
- For fluids with very high temperatures we recommend the horizontal orientation with the transmitter head pointing downwards (Fig. H2) or the vertical orientation (Fig. V).
- For fluids with very low temperatures, we recommend the horizontal orientation with the transmitter head pointing upwards (Fig. H1) or the vertical orientation (Fig. V).

3.2.4 Special installation instructions

Promass F and O

Caution!
If the measuring tube is curved and the unit is installed horizontally, adapt the sensor position to the fluid properties.

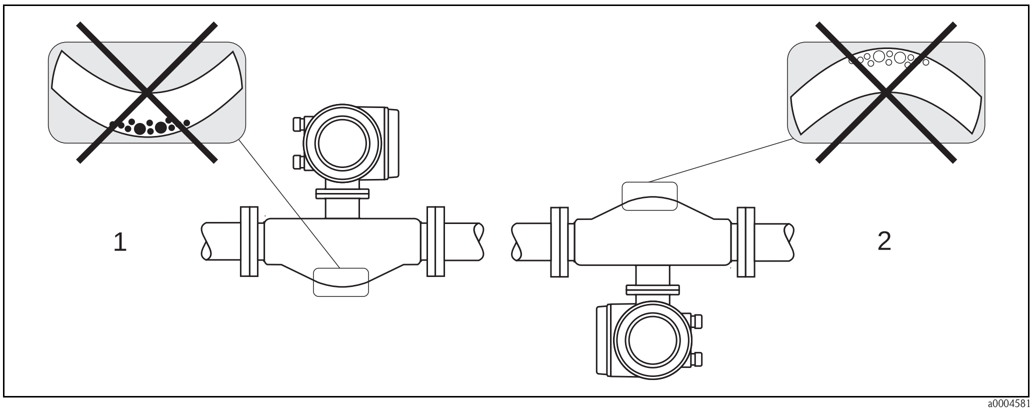


Fig. 10: Horizontal installation of sensors with curved measuring tube.

1 Not suitable for fluids with entrained solids. Risk of solids accumulating.
2 Not suitable for outgassing fluids. Risk of air accumulating.

3.2.5 Heating

Some fluids require suitable measures to avoid loss of heat at the sensor. Heating can be electric, e.g. with heated elements, or by means of hot water or steam pipes made of copper or heating jackets.

Caution!
- Risk of electronics overheating! Make sure that the maximum permissible ambient temperature for the transmitter is not exceeded. Consequently, make sure that the adapter between sensor and transmitter and the connection housing of the remote version always remain free of insulating material. Note that a certain orientation might be required, depending on the fluid temperature. → 16
- With a fluid temperature between 200 °C to 350 °C (392 to 662 °F) the remote version of the high-temperature version is preferable.
- When using electrical heat tracing whose heat is regulated using phase control or by pulse packs, it cannot be ruled out that the measured values are influenced by magnetic fields which may occur, (i.e. at values greater than those permitted by the EC standard (Sinus 30 A/m)). In such cases, the sensor must be magnetically shielded.
  The secondary containment can be shielded with tin plates or electric sheets without privileged direction (e.g. V330-35A) with the following properties:
  – Relative magnetic permeability $\mu_r \geq 300$
  – Plate thickness d ≥ 0.35 mm (0.014")
- Information on permissible temperature ranges → 106
- Promass X: Especially under critical climatic conditions it has to be ensured that the temperature difference between environment and measured medium does not exceed 100 K. Suitable measures, such as heating or thermal insulation, are to be taken.

Special heating jackets which can be ordered as accessories from Endress+Hauser are available for the sensors.

3.2.6 Thermal insulation

Some fluids require suitable measures to avoid loss of heat at the sensor. A wide range of materials can be used to provide the required thermal insulation.

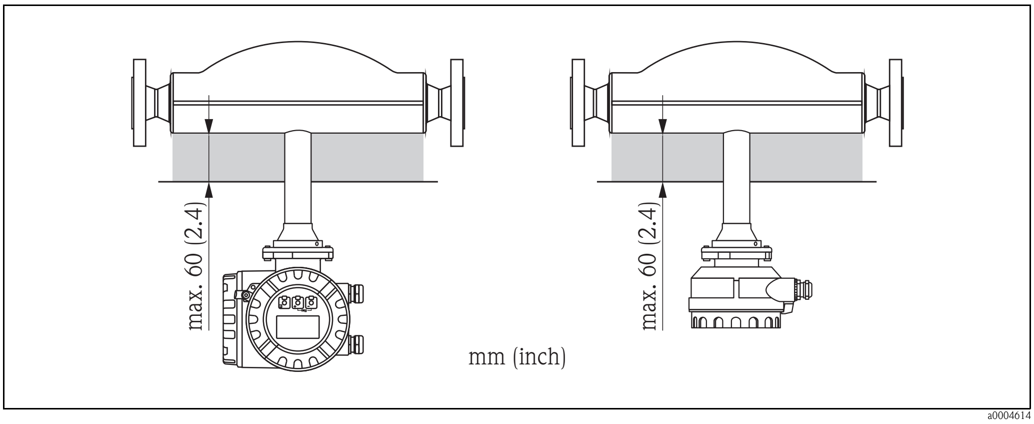


Fig. 11: In the case of the Promass F high-temperature version, a maximum insulation thickness of 60 mm (2.4") must be observed in the area of the electronics/neck.

If the Promass F high-temperature version is installed horizontally (with transmitter head pointing upwards), an insulation thickness of min. 10 mm (0.4") is recommended to reduce convection. The maximum insulation thickness of 60 mm (2.4") must be observed.

3.2.7 Inlet and outlet runs

There are no installation requirements regarding inlet and outlet runs. If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc.

3.2.8 Vibrations

The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by pipe vibrations. Consequently, the sensors require no special measures for attachment.

3.2.9 Limiting flow

Relevant information can be found in the "Technical Data" section under "Measuring range" → 🗎 89 or "Limiting flow" → 🗎 106.

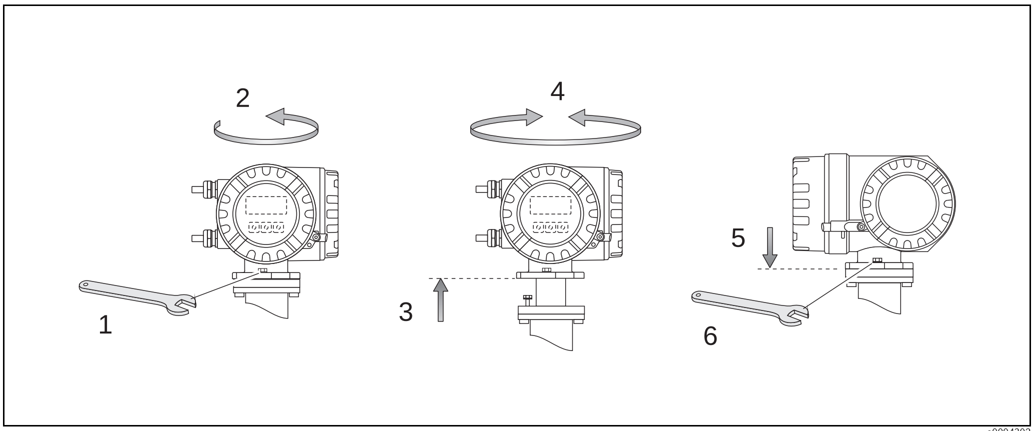
3.3 Installation

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

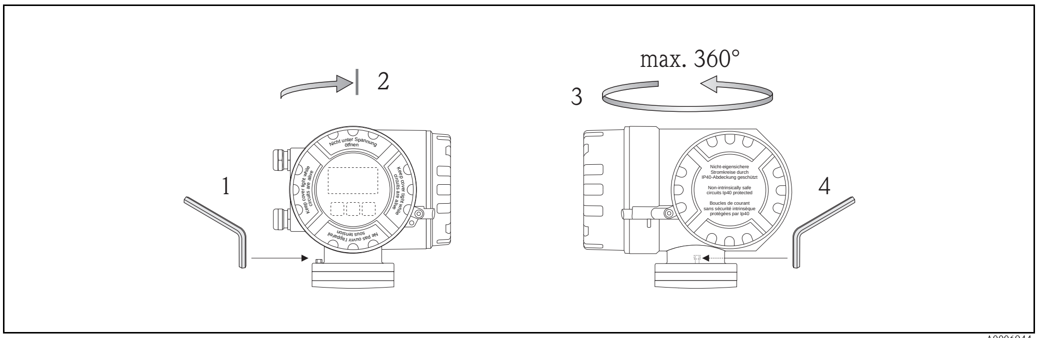


a0004302

Fig. 12: Turning the transmitter housing (aluminum field housing)

Turning the stainless steel field housing (Promass X and O)

1. Unscrew the grub screw.
2. Rotate the transmitter housing cautiously clockwise until the end stop (end of the thread).
3. Rotate the transmitter housing counter-clockwise (max. 360°) in the wanted position.
4. Tighten the grub screw again.



A0006944

Fig. 13: Turning the transmitter housing of Promass X and O

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.

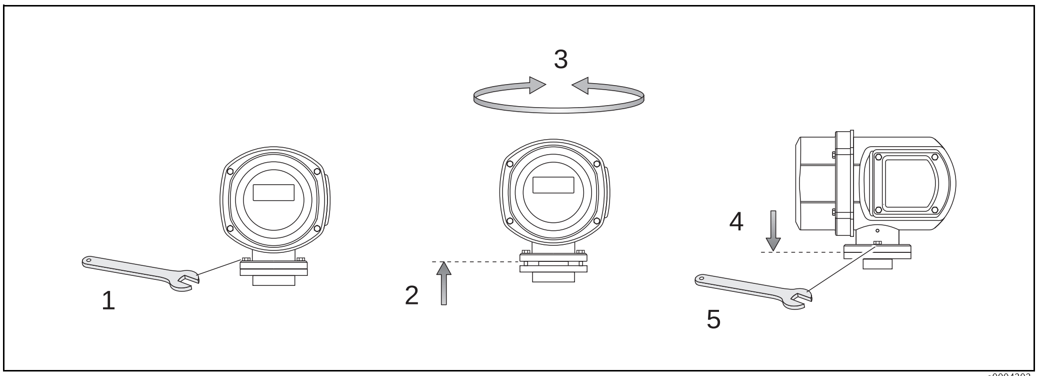


Fig. 14: Turning the transmitter housing (stainless steel field housing)

3.3.2 Installing the wall-mount housing

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

- Mounted directly on the wall
- Installation in control panel (separate mounting set, accessories) → 23
- Pipe mounting (separate mounting set, accessories) → 23

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

Mounted directly on the wall

1. Drill the holes as illustrated in the diagram.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm (0.26")
   – 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.

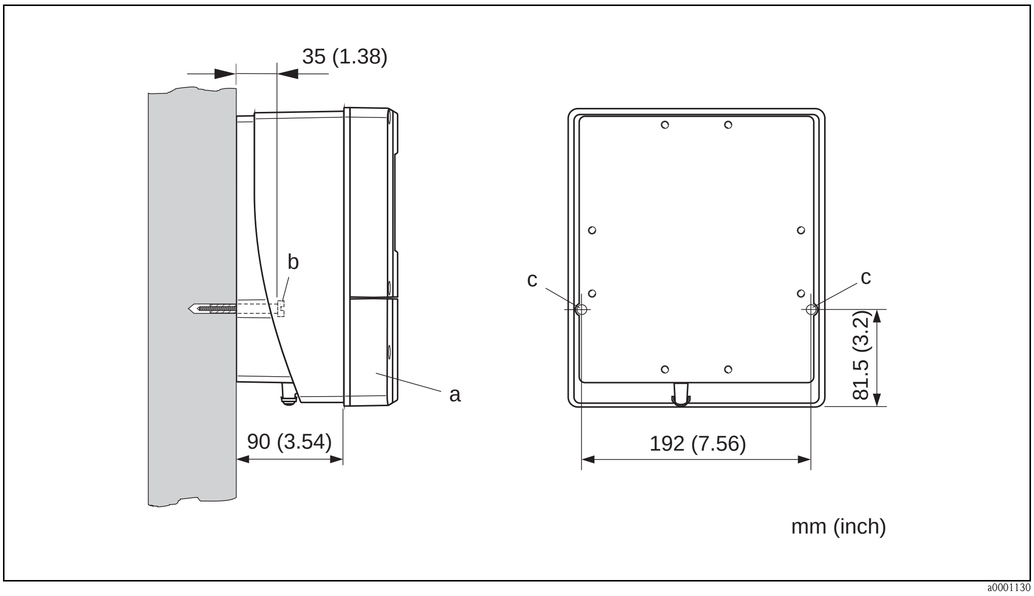


Fig. 15: Mounted directly on the wall

Installation in control panel

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

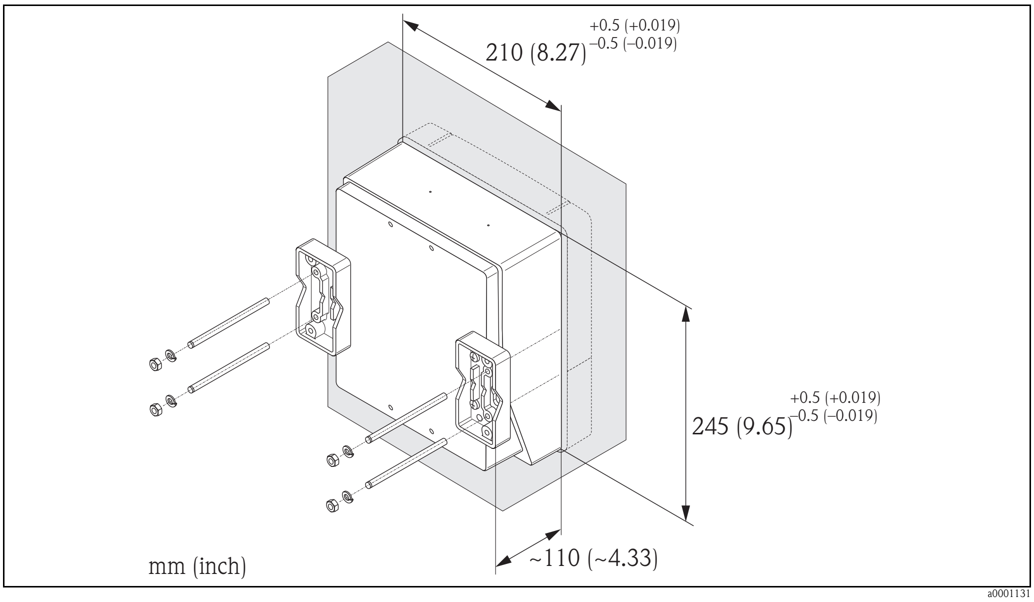


Fig. 16: Panel installation (wall-mount housing)

Pipe mounting

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

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

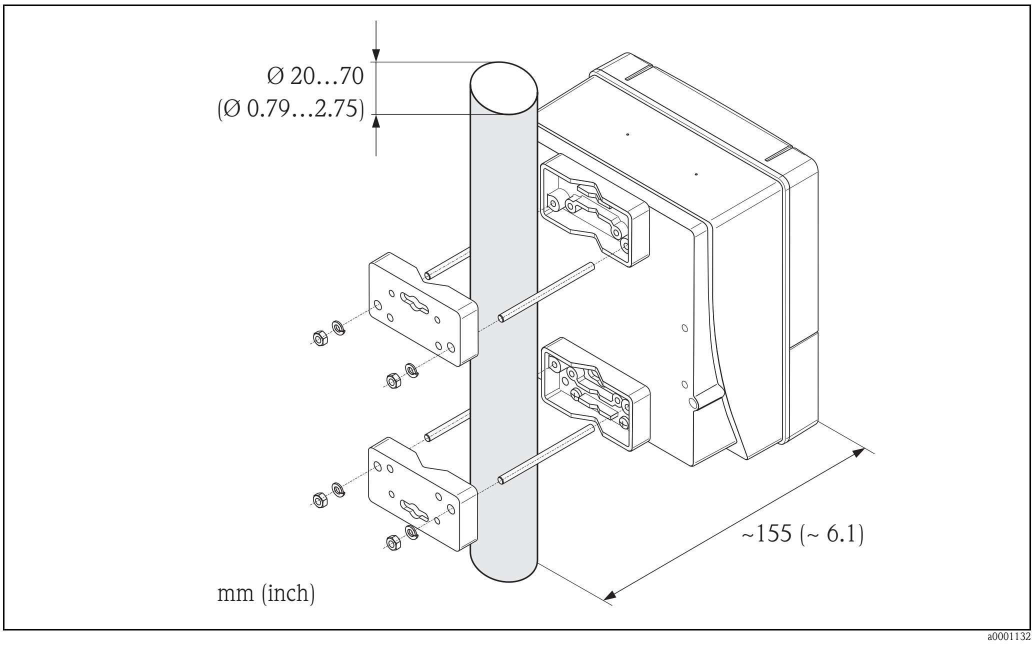


Fig. 17: Pipe mounting (wall-mount housing)

3.3.3 Turning the local display

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

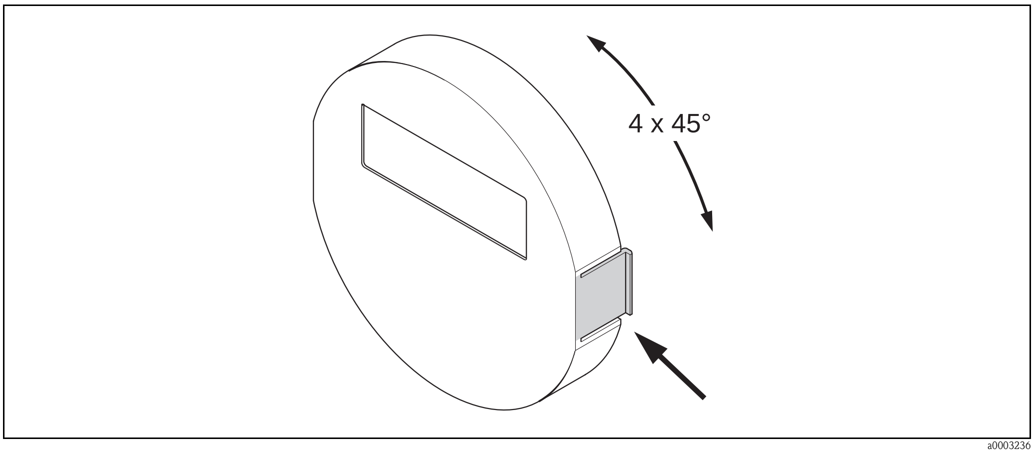


Fig. 18: Turning the local display (field housing)

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, measuring range, etc.?	→ 🗎 4
Installation instructions	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	-
Are the measuring point number and labeling correct (visual inspection)?	-
Is the orientation chosen for the sensor correct, in other words suitable for sensor type, fluid properties (outgassing, with entrained solids) and fluid temperature?	→ 🗎 14
Process environment / process conditions	Notes
Is the measuring device protected against moisture and direct sunlight?	-

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 sales office if you have any questions.

Note!
The measuring instrument does not have an internal disconnecting device. Therefore, assign a switch or circuit breaker to the measuring instrument with which the voltage supply line can be disconnected from the power system.

4.1 Connecting the remote version

4.1.1 Connecting the sensor/transmitter

Warning!
- Risk of electric shock. Switch off the power supply before opening the device.
  Do not install or wire the device while it is connected to the power supply.
  Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective earth to the ground terminal on the housing before the power supply is applied.
- You may only connect the sensor to the transmitter with the same serial number. Communication errors can occur if this is not observed when connecting the devices.

1. Remove the connection compartment cover (d) of the transmitter and sensor housing.
2. Feed the connecting cable (e) through the appropriate cable runs.
3. Establish the connections between sensor and transmitter in accordance with the wiring diagram (→ 19 or wiring diagram in screw cap).
4. Screw the connection compartment cover (d) back onto the sensor and transmitter housing.

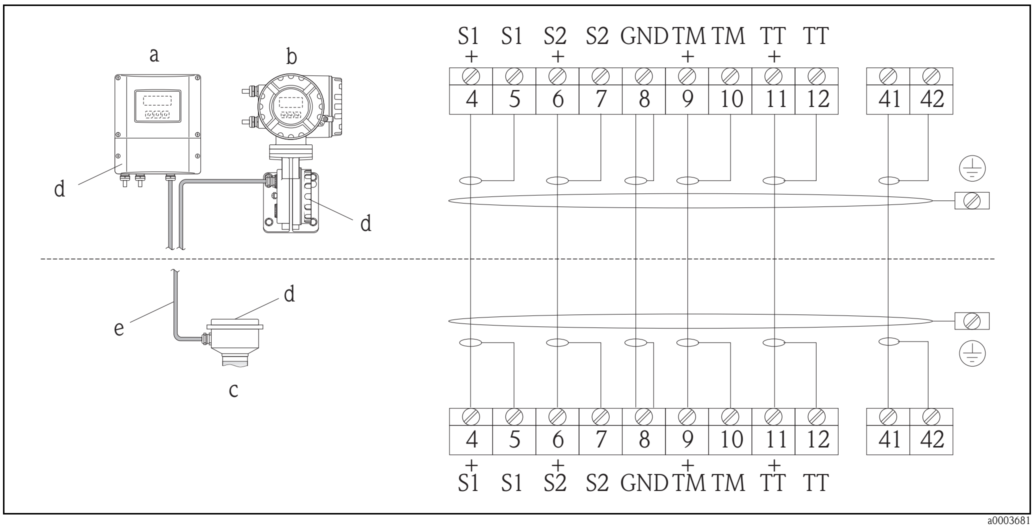


Fig. 19: Connecting the remote version

a Wall-mount housing: non-hazardous area and ATEX II3G / zone 2 → see separate "Ex documentation"
b Wall-mount housing: ATEX II2G / Zone 1 /FM/CSA → see separate "Ex documentation"
c Remote version, flanged version
d Cover of the connection compartment or connection housing
e Connecting cable

Terminal No.: 4/5 = gray; 6/7 = green; 8 = yellow; 9/10 = pink; 11/12 = white; 41/42 = brown

4.1.2 Cable specification, connecting cable

The specifications of the cable connecting the transmitter and the sensor of the remote version are as follows:

- 6 × 0.38 mm² PVC cable with common shield and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance core/shield: ≤ 420 pF/m
- Cable length: max. 20 m (65 ft)
- Permanent operating temperature: max. +105 °C (+221 °F)

Note!
The cable must be installed securely, to prevent movement.

4.2 Connecting the measuring unit

4.2.1 Transmitter connection

Warning!
- Risk of electric shock! Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock! Connect the protective ground to the ground terminal on the housing before the power supply is applied unless special protection measures have been taken (e. g. galvanically isolated power supply SELV or PELV).
- Compare the specifications on the nameplate with the local supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.

1. Unscrew the connection compartment cover (f) from the transmitter housing.
2. Feed the power supply cable (a) and the signal cable (b) through the appropriate cable entries.
3. Perform wiring:
   – Wiring diagram (aluminum housing) → 20
   – Wiring diagram (stainless steel housing → 21
   – Wiring diagram (wall-mount housing) → 22
   – Terminal assignment → 28
4. Screw the cover of the connection compartment (f) back onto the transmitter housing.

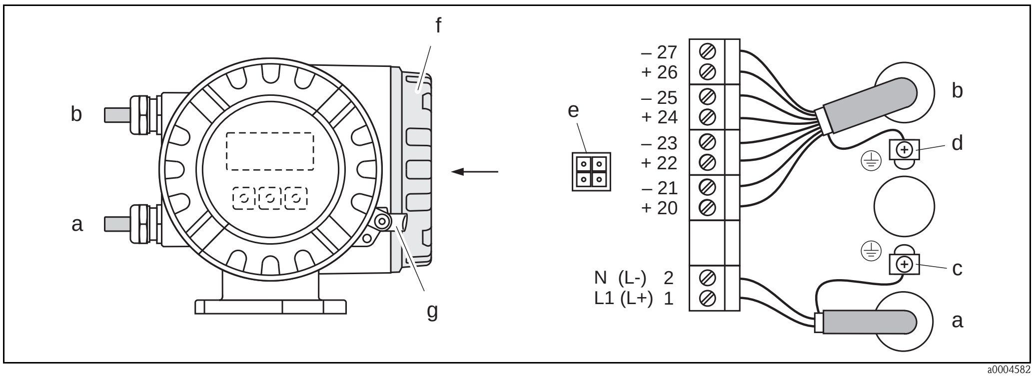


Fig. 20: Connecting the transmitter (aluminum field housing); Cable cross-section: max. 2.5 mm²

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 → 28*
c	*Ground terminal for protective ground*
d	*Ground terminal for signal cable shield*
e	*Service adapter for connecting service interface FXA193 (FieldCheck, FieldCare)*
f	*Cover of the connection compartment*
g	*Securing clamp*

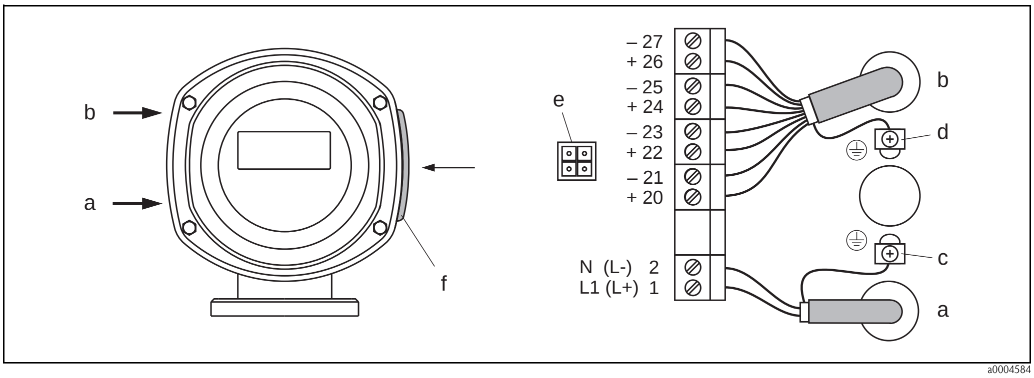


Fig. 21: Connecting the transmitter (stainless steel field housing); cable cross-section: max. 2.5 mm²

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** → 28*
c *Ground terminal for protective ground*
d *Ground terminal for signal cable shield*
e *Service adapter for connecting service interface FXA193 (FieldCheck, FieldCare)*
f *Cover of the connection compartment*

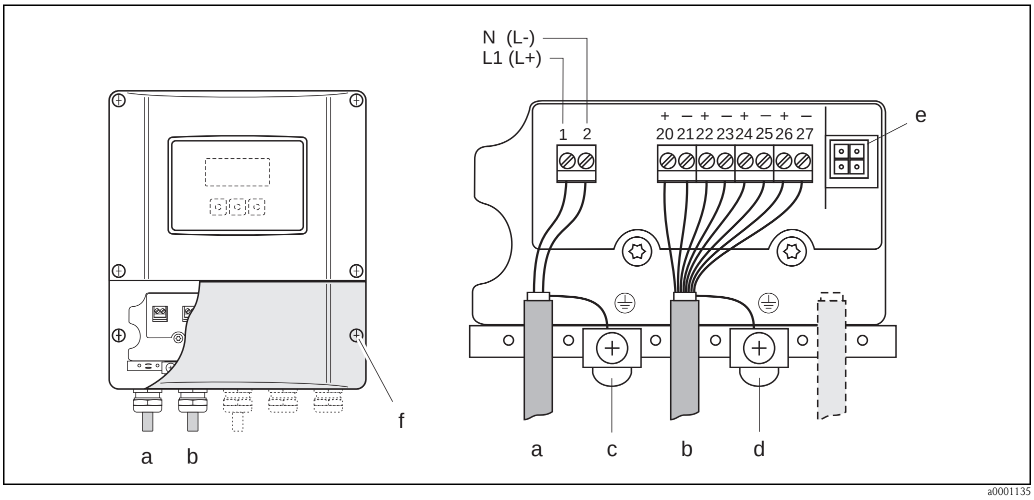


Fig. 22: Connecting the transmitter (wall-mount housing); cable cross-section: max. 2.5 mm²

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** → 28*
c *Ground terminal for protective ground*
d *Ground terminal for signal cable shield*
e *Service adapter for connecting service interface FXA193 (FieldCheck, FieldCare)*
f *Cover of the connection compartment*

4.2.2 Terminal assignment

Electrical values for:
- Inputs → 93
- Outputs → 94

Order characteristic for "inputs/outputs"	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (-)
Fixed communication boards (permanent assignment)				
S	–	–	Frequency output Ex i, passive	Current output HART, Ex i, active
T	–	–	Frequency output Ex i, passive	Current output HART, Ex i, passive
Flexible communication boards				
D	Status input	Relay output	Frequency output	Current output HART
M	Status input	Puls-/Frequency output 2	Puls-/Frequency output 1	Current output HART
1	Relay output	Frequency output 2	Frequency output 1	Current output HART
2	Relay output	Current output 2	Frequency output	Current output 1 HART

4.2.3 HART connection

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

Note!
- The measuring circuit's minimum load must be at least 250 Ω.
- The CURRENT SPAN function must be set to "4–20 mA" (individual options see separate "Description of Device Functions" manual).
- See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

Connection of the HART handheld communicator

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

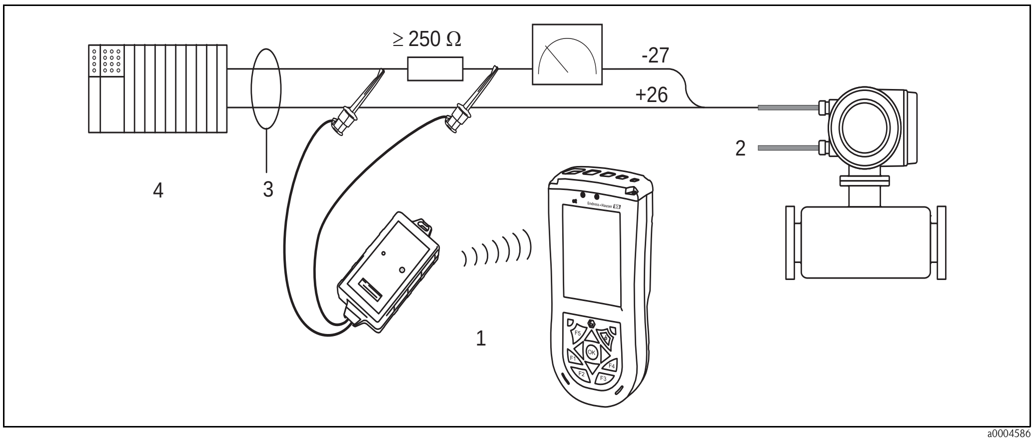


Fig. 23: Electrical connection of HART handheld terminal

1 HART handheld terminal
2 Auxiliary energy
3 Shielding
4 Other switching units 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.

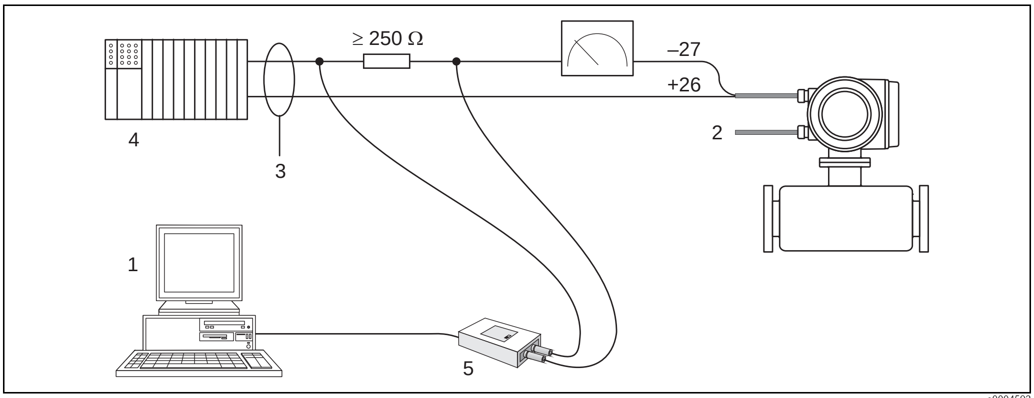


Fig. 24: Electrical connection of a PC with operating software

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

4.3 Degree of protection

The measuring device fulfill all the requirements for IP 67.

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

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- The threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → 95, cable entries.
- The cable entries must be firmly tighten (point **a** → 25).
- The cable must loop down in front of the cable entry ("water trap") (point **b** → 25). This arrangement prevents moisture penetrating the entry.

  Note!
  The cable entries may not be point up.

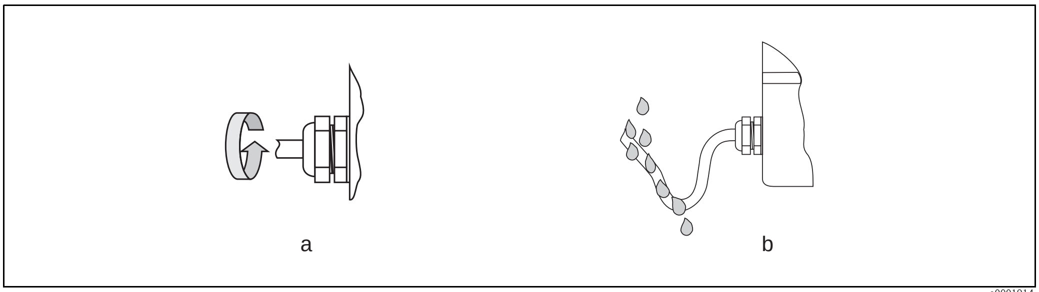


Fig. 25: Installation instructions, cable entries

- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.

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

4.4 Post-connection check

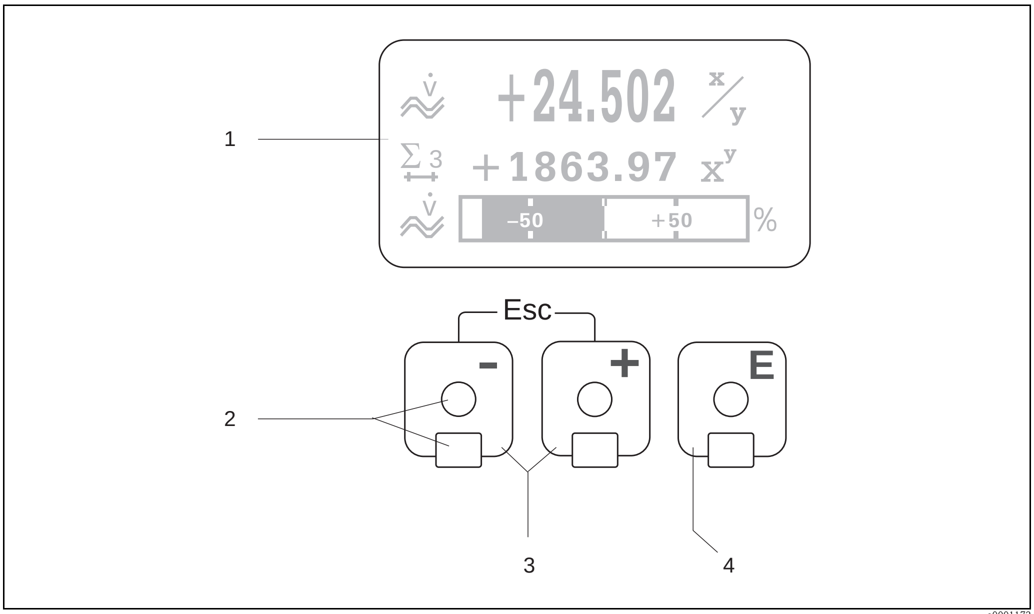
Perform the following checks after completing electrical installation of the measuring device:

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	-
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	85 to 260 V AC (45 to 65 Hz) 20 to 55 V AC (45 to 65 Hz) 16 to 62 V DC
Do the cables comply with the specifications?	→ 🗎 26
Do the cables have adequate strain relief?	-
Cables correctly segregated by type? Without loops and crossovers?	-
Are the power supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Are all screw terminals firmly tightened?	-
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 🗎 29
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 measuring instrument using the "Quick Setup" or the function matrix.
The display consists of four lines; this is where measured values and/or status variables (direction of flow, empty pipe, bar graph, etc.) are displayed. You can change the assignment of display lines to different variables to suit your needs and preferences (→ "Description of Device Functions" manual).



a0001172

Fig. 26: Display and operating elements

1 Liquid crystal display
The backlit, four-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. HOME position (operating mode) is the term given to the display during normal operation. Readings displayed
2 Optical sensors for "Touch Control"
3 Plus/minus keys
– HOME position → Direct access to totalizer values and actual values of inputs/outputs
– Enter numerical values, select parameters
– Select different blocks, groups and function groups within the function matrix
Press the +/- keys (-+) simultaneously to trigger the following functions:
– Exit the function matrix step by step → HOME position
– Press and hold the +- keys for longer than 3 seconds → Return directly to home position
– Cancel data entry
4 Enter key
– HOME position → Entry into the function matrix
– Save the numerical values you input or settings you change

5.1.1 Readings displayed (operation mode)

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

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

Error messages:
Display and presentation of system/process errors → 36

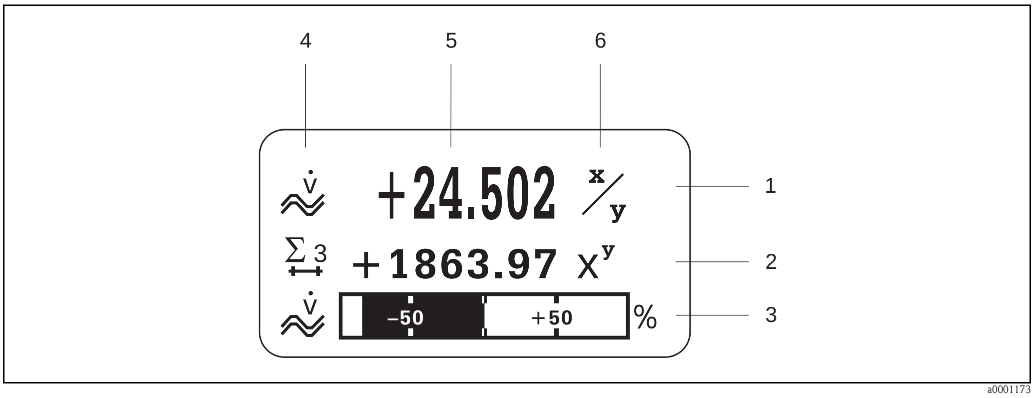


Fig. 27: Typical display for normal operating mode (HOME position)

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

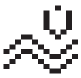
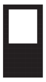
5.1.2 Additional display functions

From HOME position, use the keys to open an "Info Menu" containing the following information:
- Totalizer (including overflow)
- Actual values or states of the configured inputs/outputs
- Device TAG number (user-definable)

→ Scan of individual values within the Info Menu
(Esc key) → Back to HOME position

5.1.3 Icons

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

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
ϟ	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
I 1 to n	Current output 1 to n	P 1 to n	Pulse output 1 to n
F 1 to n	Frequency output	S 1 to n	Status/relay output 1 to n
Σ 1 to n	Totalizer 1 to n	 a0001187	Status input
 a0001181	Measuring mode; PULSATING FLOW	 a0001182	Measuring mode; SYMMETRY (bidirectional)
 a0001183	Measuring mode; STANDARD	 a0001184	Counting mode, totalizer; BALANCE (forward and reverse flow)
 a0001185	Counting mode, totalizer; forward	 a0001186	Counting mode, totalizer; reverse
 a0001188	Volume flow	 a0001200	Fluid density
 a0001208	Reference density	 a0001207	Medium temperature
 a0001206	Configuration via remote operation Active device operation via: ▪ HART, e.g. FieldCare, Field Xpert		

5.2 Brief operating instructions to the function matrix

Note!
- See the general notes → 35
- Function descriptions → see the "Description of Device Functions" manual

1. HOME position → E → Entry into the function matrix
2. Select a block (e.g. OUTPUTS)
3. Select a group (e.g. CURRENT OUTPUT 1)
4. Select a function group (e.g. SETTINGS)
5. Select a function (e.g. TIME CONSTANT)
   Change parameter / enter numerical values:
   +/− → Select or enter enable code, parameters, numerical values
   E → Save your entries
6. Exit the function matrix:
   – Press and hold down Esc key (−/+) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (−/+) → Return step by step to HOME position

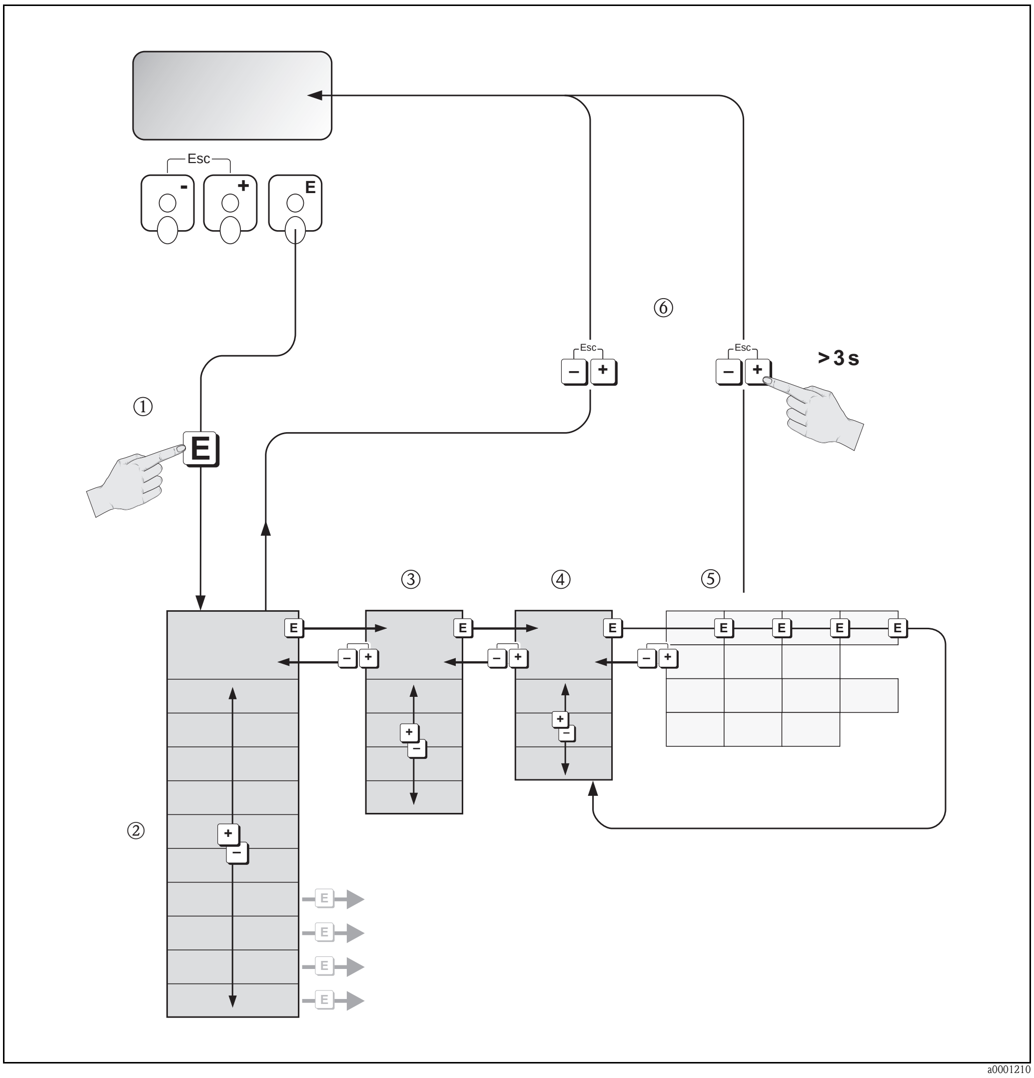


Fig. 28: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

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

Comply with the following instructions when configuring functions:
- You select functions as described already. → 34
  Each cell in the function matrix is identified by a numerical or letter code on the display.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries.
  Press +/- to select "SURE [YES]" and press E to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is disabled automatically if you do not press a key within 60 seconds following automatic return to the HOME position.

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

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

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 84) 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 entered as the customer's code, programming is always enabled!
- Your Endress+Hauser representative can be of assistance if you mislay your personal code.

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

5.2.3 Disabling the programming mode

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

5.3 Error messages

5.3.1 Type of error

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

The measuring system distinguishes between two types of error:
- *System errors:*
  This group comprises all device errors, e.g. communication errors, hardware errors, etc. → 75
- *Process errors:*
  This group includes all application errors, e.g. fluid not homogeneous, etc. → 79

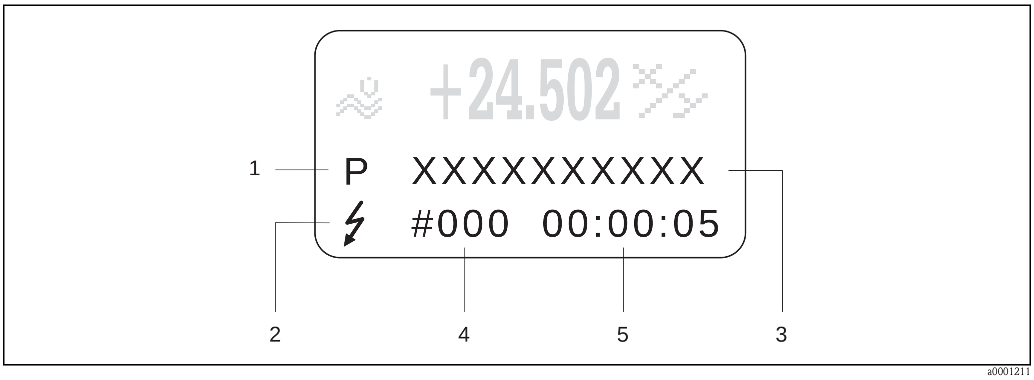


Fig. 29: Error messages on the display (example)

1 *Error type: P = process error, S = system error*
2 *Error message type: ϟ = Fault message, ! = Notice message*
3 *Error designation: e.g. FLUID INHOM. = fluid is not homogeneous*
4 *Error number: e.g. #702*
5 *Duration of most recent error occurrence (in hours, minutes and seconds)*

5.3.2 Error message type

Users have the option of weighting system and process errors differently, by defining them as **Fault messages** or **Notice messages.** You can define messages in this way with the aid of the function matrix (→ see the "Description of Device Functions" manual).
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)
- Displayed as → Exclamation mark (!), error designation (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 designation (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix. → 81

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

5.3.3 Confirming error messages

For the sake of plant and process safety, the measuring device can be configured in such a way that fault messages displayed (ϟ) always have to be rectified and acknowledged locally by pressing E. Only then do the error messages disappear from the display.
This option can be switched on or off by means of the "ACKNOWLEDGE FAULT MESSAGES" function (→ see the "Description of Device Functions" manual).

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

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART → 🗎 28.
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 groups:

There are three different command groups:
- *Universal Commands*
  These are associated with the following functionalities for example: Universal commands are supported and used by all HART devices.
  – Recognizing 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 cut off settings etc.

✎ Note!
The measuring device has access to all three command classes.
List of all "Universal Commands" and "Common Practice Commands": → 🗎 40

5.4.1 Operating options

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

Note!
- In the CURRENT RANGE function (current output 1), the HART protocol demands the setting "4-20 mA HART" or "4-20 mA (25 mA) HART".
- HART write protection can be disabled or enabled by means of a jumper on the I/O board → 48.

HART handheld terminal Field Xpert

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 flowmeters are accessed via a HART interface FXA195 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 software:	3.01.00	→ Function DEVICE SOFTWARE
Device data HART		
Manufacturer ID:	11 $_{hex}$ (ENDRESS+HAUSER)	→ Function MANUFACTURER ID
Device ID:	52_{hex}	→ Function DEVICE ID
HART version data:	Device Revision 9 / DD Revision 1	
Software release:	01.2010	

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

Tester/simulator:	Sources for obtaining device descriptions:
Fieldcheck	▪ Update by means of FieldCare via flow device FXA 193/291 DTM in Fieldflash Module

5.4.3 Device and process variables

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

Code (decimal)	Device variable	Code (decimal)	Device variable
0	OFF (unassigned)	8	Reference density
2	Mass flow	9	Temperature
5	Volume flow	250	Totalizer 1
6	Corrected volume flow	251	Totalizer 2
7	Density	252	Totalizer 3

Process variables:

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

- Primary process variable (PV) → Mass flow
- Secondary process variable (SV) → Totalizer 1
- Third process variable (TV) → Density
- Fourth process variable (FV) → Temperature

Note!
You can set or change the assignment of device variables to process variables using Command 51 → 44.

5.4.4 Universal / Common practice HART commands

The following table contains all the universal 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)
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 = Endress+Hauser – Byte 2: Device type ID, e.g. 82 = Promass 84 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-spec. commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Byte 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable *Factory setting:* Primary process variable = Mass flow Note! ■ You can set the assignment of device variables to process variables using Command "51". ■ Manufacturer-specific units are represented using the HART unit code "240".
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: Actual current of the primary process variable in mA – Bytes 4-7: Percentage of the set measuring range *Factory setting:* Primary process variable = Mass flow Note! You can set the assignment of device variables to process variables using Command "51".
3	Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: Primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* ■ Primary process variable = Mass flow ■ Second process variable = Totalizer 1 ■ Third process variable = Density ■ Fourth process variable = Temperature Note! ■ You can set the assignment of device variables to process variables using Command "51". ■ Manufacturer-specific units are represented using the HART unit code "240".

Command No.	HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
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
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 measuring instrument: – Byte 0: Fixed value 254 – Byte 1: Manufacturer ID, 17 = Endress+Hauser – Byte 2: Device type ID, 82 = Promass 84 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-spec. commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Byte 9-11: Device identification
12	Read user message Access type = read	none	Bytes 0-24: User message Note! You can write the user message using Command "17".
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: Descriptor – Byte 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! ▪ Die The data relate to the primary process variable (= Mass flow). ▪ Manufacturer-specific units are represented using the HART unit code "240".

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
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: Start of measuring range, value for 4 mA – Bytes 11-14: Attenuation constant in [s] – Byte 15: Write protection ID – Byte 16: OEM manufacturer ID, 17 = Endress+Hauser *Factory setting:* Primary process variable = Mass flow ✎ Note! ■ You can set the assignment of device variables to process variables using Command "51". ■ Manufacturer-specific units are represented using the HART unit code "240".
16	@Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: Descriptor – Byte 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: Descriptor – Byte 18-20: Date

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 in seconds *Factory setting:* Primary process variable = Mass flow	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: End of measuring range, value for 20 mA – Bytes 5-8: Start of measuring range, value for 4 mA *Factory setting:* Primary process variable = Mass flow Note! ▪ You can set the assignment of device variables to process variables using Command "51". ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: Upper range, value for 20 mA – Bytes 5-8: Start of measuring range, value for 4 mA Note! Manufacturer-specific units are represented using the HART unit code "240".
38	Device status reset (Configuration changed) Access = write	none	none
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Byte 0-3: Output current in mA *Factory setting:* Primary process variable = Mass flow Note! You can set the assignment of device variables to process variables with Command "51".	The momentary output current of the primary process variable is displayed as a response: Byte 0-3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Mass flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table → 🗎 45
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 mass flow ■ Second process variable: Code 250 for totalizer 1 ■ Third process variable: Code 7 for density ■ Fourth process variable: Code 9 for temperature ✎ Note! You can set the assignment of device variables to process variables with Command "51".
51	Write assignments of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Code of the supported device variables:* See data → 🗎 39 *Factory setting:* ■ Primary process variable = Mass flow ■ Second process variable = Totalizer 1 ■ Third process variable = Density ■ Fourth process variable = Temperature	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 data → 🗎 39 ✎ Note! ■ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ■ If you change the unit of the device variable, this has no impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: Device variable code – Byte 1: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (2 to 20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: Number of preambles

5.4.5 Device status / Error messages

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

✎ Note!
Detailed explanation of the measuring instrument status and error messages and their elimination → 🗎 75

Byte-bit	Error No.	Short error description → 🗎 74
0-0	001	Serious device error
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
1-1	031	S-DAT: Defective or missing
1-2	032	S-DAT: Error accessing saved values
1-3	041	T-DAT: Defective or missing
1-4	042	T-DAT: Error accessing saved values
1-5	051	I/O board and the amplifier board are not compatible.
3-3	111	Totalizer checksum error
3-4	121	I/O board and the amplifier board (software versions) are not compatible.
3-6	205	T-DAT: Data download not successful
3-7	206	T-DAT: Data upload not successful
4-3	251	Internal communication fault on the amplifier board.
4-4	261	No data reception between amplifier and I/O board
5-7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-0	340	
6-1	341	
6-2	342	
6-3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-4	344	
6-5	345	
6-6	346	
6-7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7-0	348	
7-1	349	
7-2	350	

Byte-bit	Error No.	Short error description → 74
7-3	351	Current output: The actual value for the flow lies outside the set limits.
7-4	352	
7-5	353	
7-6	354	
7-7	355	Frequency output: The actual value for the flow lies outside the set limits.
8-0	356	
8-1	357	
8-2	358	
8-3	359	Pulse output: Pulse output frequency is out of range.
8-4	360	
8-5	361	
8-6	362	
9-0	379	The measuring tube oscillation frequency is outside the permitted range.
9-1	380	
9-2	381	The temperature sensor on the measuring tube is likely defective.
9-3	382	
9-4	383	The temperature sensor on the carrier tube is likely defective.
9-5	384	
9-6	385	One of the measuring tube sensor coils (inlet or outlet) is likely defective.
9-7	386	
10-0	387	
10-1	388	Amplifier error
10-2	389	
10-3	390	
11-6	471	Max. permitted batching time has been exceeded.
11-7	472	Underbatching: the minimum quantity was not reached. Overbatching: the maximum permitted batching quantity was exceeded.
12-0	473	The predefined batch quantity point was exceeded. End of filling process approaching.
12-1	474	Maximum flow value entered is overshot.
12-7	501	New amplifier software version is loaded. Currently no other commands are possible.
13-0	502	Upload and download of device files. Currently no other commands are possible.
13-2	571	Batching process in progress (valves are open)
13-3	572	Batching process has been stopped (valves are closed)
13-5	586	The fluid properties do not allow normal measuring operation.
13-6	587	Extreme process conditions exist. The measuring system can therefore not be started.
13-7	588	Overdriving of the internal analog to digital converter. A continuation of the measurement is no longer possible!
14-3	601	Positive zero return active

Byte-bit	Error No.	Short error description → 🗎 74
14-7	611	Simulation current output active
15-0	612	
15-1	613	
15-2	614	
15-3	621	Simulation frequency output active
15-4	622	
15-5	623	
15-6	624	
15-7	631	Simulation pulse output active
16-0	632	
16-1	633	
16-2	634	
16-3	641	Simulation status output active
16-4	642	
16-5	643	
16-6	644	
16-7	651	Simulation relay output active
17-0	652	
17-1	653	
17-2	654	
17-3	661	Simulation current input active
17-4	662	
17-5	663	
17-6	664	
17-7	671	Simulation status input active
18-0	672	
18-1	673	
18-2	674	
18-3	691	Simulation of response to error (outputs) active
18-4	692	Simulation of volume flow active
19-0	700	The process fluid density is outside the upper or lower limit values set in the "EPD" function
19-1	701	The maximum current value for the measuring tube exciter coils has been reached, since certain process fluid characteristics are extreme.
19-2	702	Frequency control is not stable, due to inhomogeneous fluid.
19-3	703	NOISE LIM. CH0 Overdriving of the internal analog to digital converter. A continuation of the measurement is still possible!
19-4	704	NOISE LIM. CH1 Overdriving of the internal analog to digital converter. A continuation of the measurement is still possible!
19-5	705	The electronics' measuring range will be exceeded. The mass flow is too high.
20-5	731	The zero point adjustment is not possible or has been canceled.
22-4	61	F-Chip is faulty or not plugged into the I/O board.
24-5	363	Current input: The actual value for the current lies outside the set limits.

5.4.6 Switching HART write protection on and off

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

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 → 83 or → 85
3. Switch HART write protection on or off, as applicable, by means of the jumper (→ 30).
4. Installation of the I/O board is the reverse of the removal procedure.

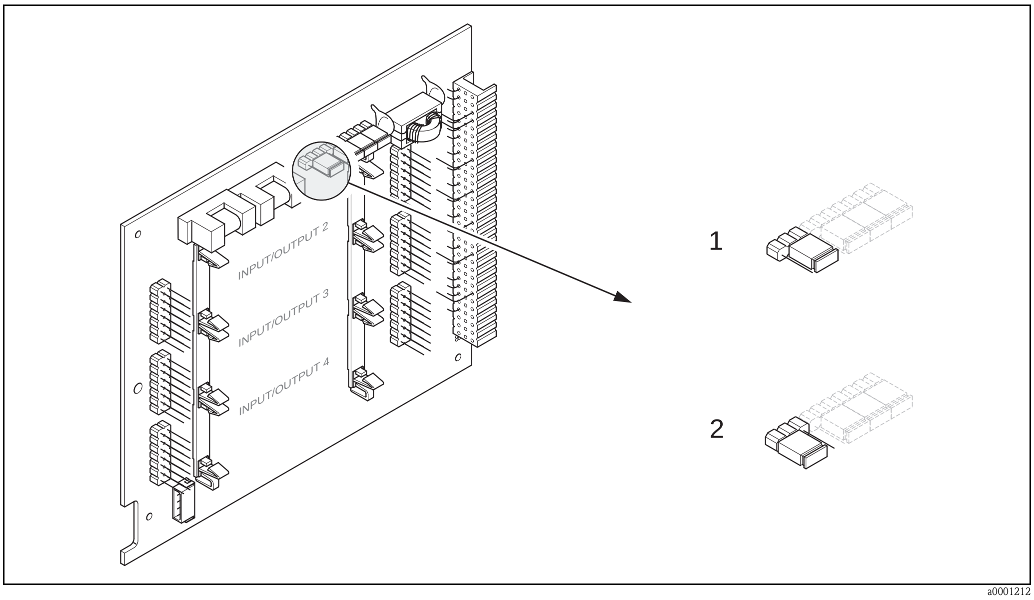


Fig. 30: Switching HART write protection on and off

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

6 Commissioning

6.1 Function check

Make sure that the following function checks have been performed successfully before switching on the supply voltage for the measuring device:

- Checklist for "Post-installation check" → 24
- Checklist for "Post-connection check" → 30

6.2 Switching on the measuring device

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

Display	
PROMASS 84 START-UP RUNNING	Startup message
▼	
PROMASS 84 DEVICE SOFTWARE V XX.XX.XX	Current software version
▼	
CURRENT OUTPUT FREQUENCY OUTPUT 1 FREQUENCY OUTPUT 2 STATUS INPUT	List of installed input/output modules
▼	
C.T. YES/NO	
▼	
SYSTEM OK → OPERATION	Beginning of normal measuring mode

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

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

6.3 Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the configuration program, e.g. FieldCare.
If the measuring device is equipped with a local display, all the important device parameters for standard operation, as well as additional functions, can be configured quickly and easily by means of the following Quick Setup menus.

6.3.1 Quick Setup "Commissioning"

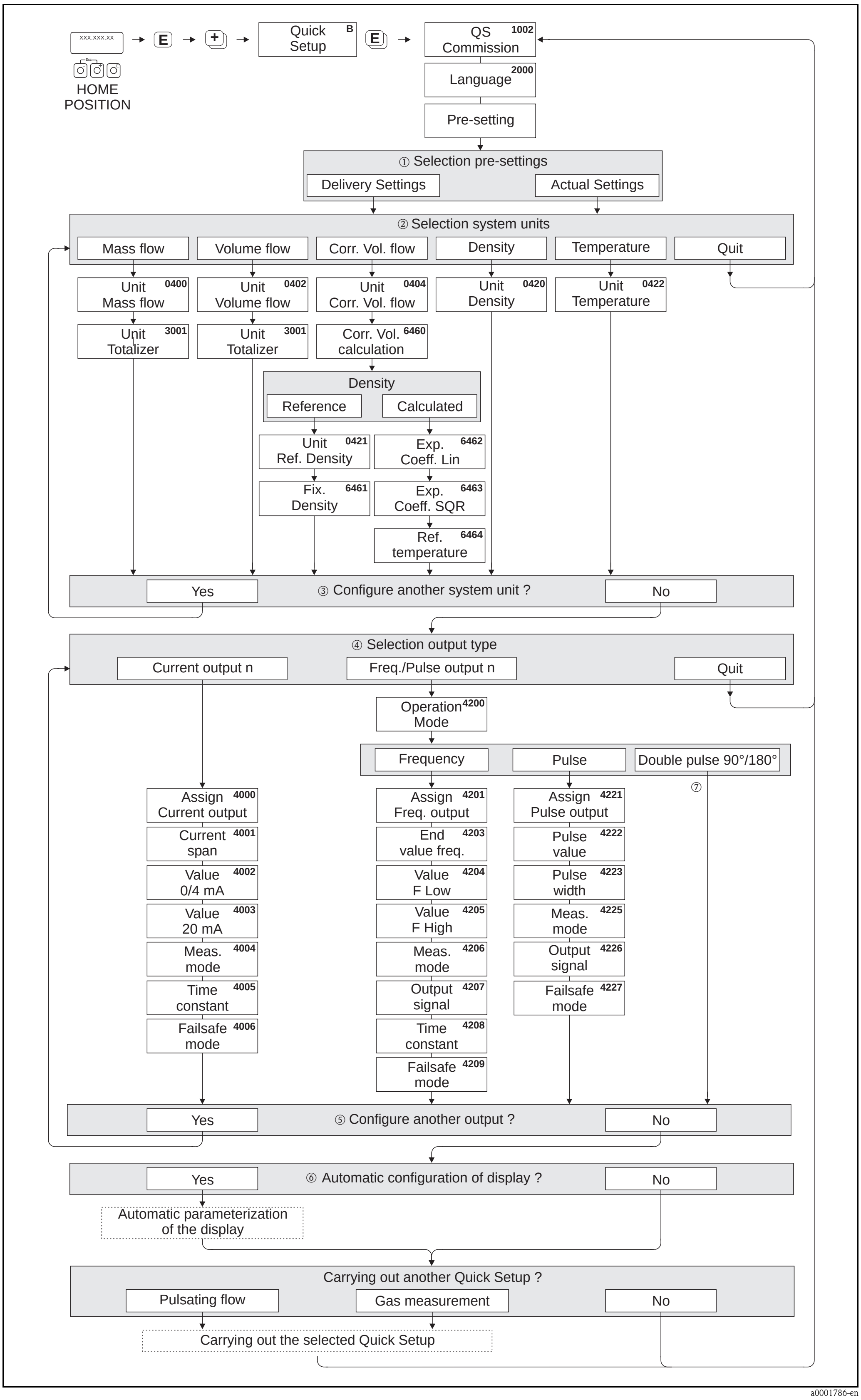


Fig. 31: "QUICK SETUP COMMISSIONING"- menu for straightforward configuration of the major device functions

✎ Note!

- The display returns to the cell SETUP COMMISSIONING (1002) if you press the key combination during parameter interrogation The stored parameters remain valid.
- The "Commissioning" Quick Setup must be carried out before one of the Quick Setups explained below is run.

① The "DELIVERY SETTINGS" option sets every selected unit to the factory setting.
The "ACTUAL SETTING" option accepts the units you previously configured.

② Only units not yet configured in the current Setup are offered for selection in each cycle. The unit for mass, volume and corrected volume is derived from the corresponding flow unit.

③ The "YES" option remains visible until all the units have been configured. "NO" is the only option displayed when no further units are available.

④ Only the outputs not yet configured in the current Setup are offered for selection in each cycle.

⑤ The "YES" option remains visible until all the outputs have been configured. "NO" is the only option displayed when no further outputs are available.

⑥ The "automatic parameterization of the display" option contains the following basic settings/factory settings:
YES: Main line = Mass flow; Additional line = Totalizer 1; Information line = Operating/system conditions
NO: The existing (selected) settings remain.

⑦ The DOUBLE PULS 90° or DOUBLE PULS 180° can only be selected for frequency/pulse output 2 and only if the PULSE operating mode was selected for frequency/pulse output 1.
The frequency/pulse output 2 then works with the parameters selected by frequency/pulse output 1, but phase-shifted by 90° or 180°.

6.3.2 Quick Setup "Pulsating Flow"

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

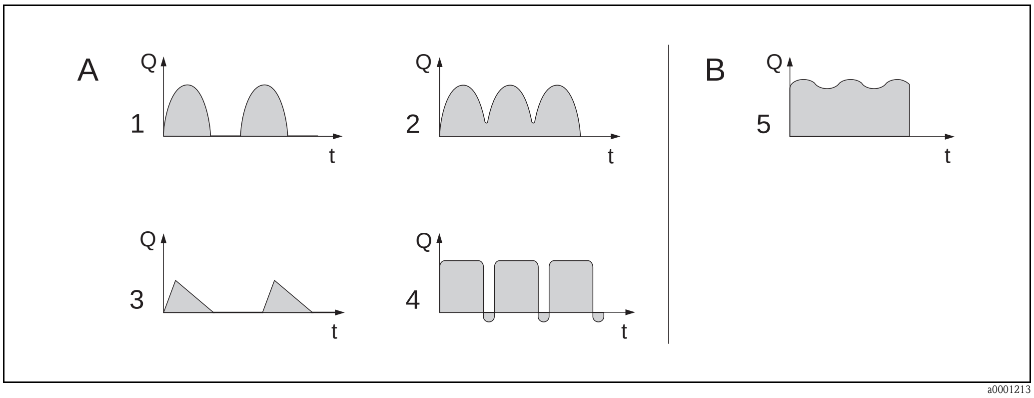


Fig. 32: Flow characteristics of various types of pump

A With severely pulsating flow
B With low pulsating flow
1 1-cylinder cam pump
2 2-cylinder cam pump
3 Magnetic pump
4 Peristaltic pump, flexible connecting hose
5 Multi-cylinder reciprocating pump

✎ Note!
Before carrying out the Quick Setup "Pulsating Flow", the Quick Setup "Commissioning" has to be executed → 📄 50.

Severely pulsating flow

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

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

Slightly pulsating flow

If flow fluctuations are no more than minor, as is the case, for example with gear-type, three-cylinder or multi-cylinder pumps, it is **not** absolutely necessary to work through the Quick Setup menu.
In cases of this nature, however, it is advisable to adapt the functions listed below in the function matrix (see the "Description of Device Functions" manual) to suit local process conditions in order to ensure a stable, unvarying output signal:

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

Performing the "Pulsating flow" Quick Setup

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

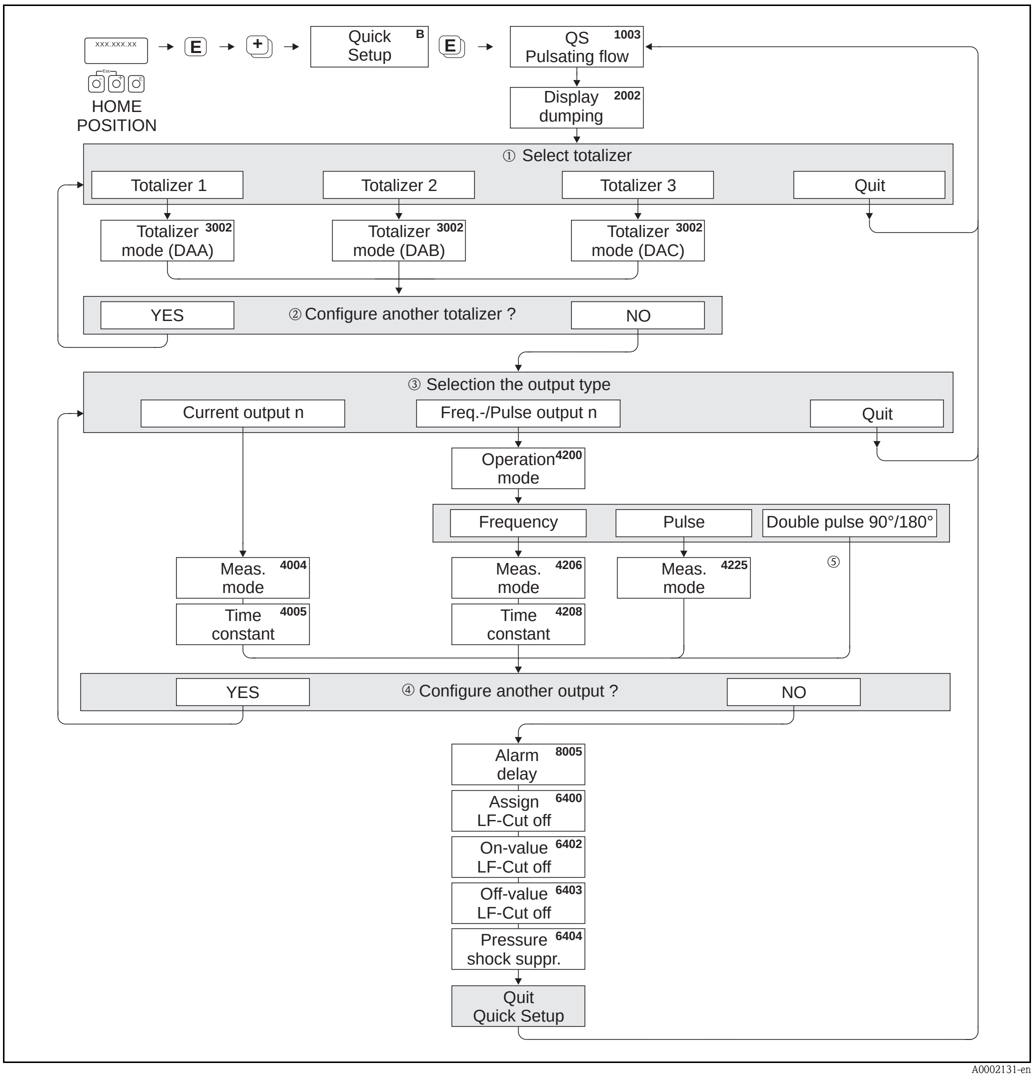


Fig. 33: Quick Setup for measuring severely pulsating flows

Note!

- The display returns to the function QUICK SETUP PULSATING FLOW (1003) if you press the [+/-] key combination. The stored parameters remain valid.
- You can call up this Setup menu either directly from the "COMMISSIONING" Setup menu or manually by means of the function QUICK SETUP PULSATING FLOW (1003).

① Only totalizers not yet configured in the current Setup are offered for selection in each cycle.

② The "YES" option remains visible until all the totalizers have been configured. "NO" is the only option displayed when no further totalizers are available.

③ Only the outputs not yet configured in the current Quick Setup are offered for selection in each cycle.

④ The "YES" option remains visible until all the outputs have been configured. "NO" is the only option displayed when no further outputs are available.

⑤ The DOUBLE PULS 90° or DOUBLE PULS 180° can only be selected for frequency/pulse output 2 and only if the PULSE operating mode was selected for frequency/pulse output 1.
The frequency/pulse output 2 then works with the parameters selected by frequency/pulse output 1, but phase-shifted by 90° or 180°.

Recommended settings

Quick Setup "Pulsating flow"		
HOME position → E → MEASURED VARIABLE (A) MEASURED VARIABLE → + → QUICK SETUP (B) QUICK SETUP → E → QS PULS. FLOW (1003)		
Function No.	Function name	Selection with (+/-)
1003	QS PULS. FLOW	YES After E is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
▼		
Basic configuration		
2002	DISPLAY DAMPING	1 s
3002	TOTALIZER MODE (DAA)	BALANCE (Totalizer 1)
3002	TOTALIZER MODE (DAB)	BALANCE (Totalizer 2)
3002	TOTALIZER MODE (DAC)	BALANCE (Totalizer 3)
Signal type for "CURRENT OUTPUT 1 to n"		
4004	MEASURING MODE	PULSATING FLOW
4005	TIME CONSTANT	1 s
Signal type for "FREQ./PULSE OUTPUT 1 to n" (for FREQUENCY mode of operation)		
4206	MEASURING MODE	PULSATING FLOW
4208	TIME CONSTANT	0 s
Signal type for "FREQ./PULSE OUTPUT 1 to n" (for PULSE mode of operation)		
4225	MEASURING MODE	PULSATING FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LOW FLOW CUTOFF	MASS FLOW
6402	ON-VALUE LOW FLOW CUT OFF	Setting depends on diameter: DN 2 = 0.10 [kg/h] or [l/h] DN 4 = 0.45 [kg/h] or [l/h] DN 8 = 2.0 [kg/h] or [l/h] DN 15 = 6.5 [kg/h] or [l/h] DN 25 = 18 [kg/h] or [l/h] DN 40 = 45 [kg/h] or [l/h] DN 50 = 70 [kg/h] or [l/h] DN 80 = 180 [kg/h] or [l/h] DN 100 = 350 [kg/h] or [l/h] DN 150 = 650 [kg/h] or [l/h] DN 250 = 1800 [kg/h] or [l/h] DN 350 = 3250 [kg/h] or [l/h]
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s
▼		
Back to the HOME position: → Press and hold down Esc key -+ for longer than three seconds or → Repeatedly press and release Esc key -+ → Exit the function matrix step by step		

6.3.3 Quick Setup "Gas measurement"

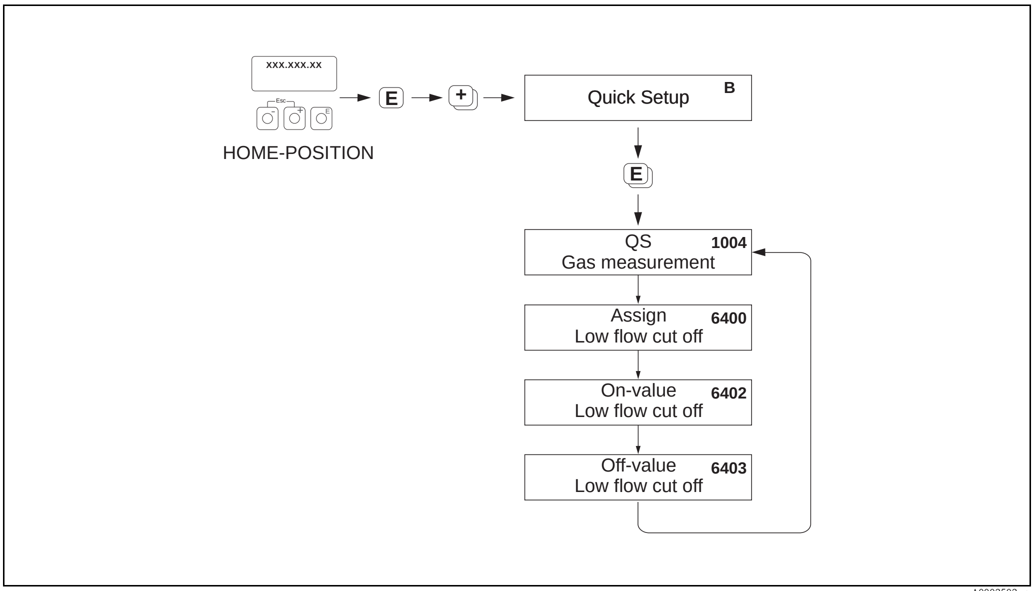
The measuring device is not only suitable for measuring liquid flow. Direct mass measurement based on the Coriolis principle is also possible for measuring the flow rate of gases.

Note!

- Before carrying out the Quick Setup "Gas measurement", the Quick Setup "Commissioning" has to be executed → 50.
- Only mass and Corrected volume flow can be measured and output with the gas measurement mode. Note that direct density and/or volume measurement is not possible!
- The flow ranges and measuring accuracy that apply to gas measurement are not the same as those for liquids.
- If corrected volume flow (e.g. in Nm^3/h) is to be measured and output instead of the mass flow (e.g. in kg/h), change the setting for the CORRECTED VOLUME CALCULATION function to "FIXED REFERENCE DENSITY" in the "Commissioning" Quick Setup menu.
  Corrected volume flow can be assigned as follows:
  – to a display line,
  – to the current output,
  – to the pulse/frequency output.

Performing the "Gas Measurement" Quick Setup

This Quick Setup menu guides you systematically through the setup procedure for all the device functions that have to be parameterized and configured for gas measurement.



A0002502-en

Fig. 34: Quick Setup "Gas measurement"

Recommended settings are found on the following page.

Quick Setup "Gas measurement"		
HOME position → E → MEASURED VARIABLE (A) MEASURED VARIABLE → + → QUICK SETUP (B) QUICK SETUP → E → QS-GAS MEASUREMENT (1004)		
Function No.	Function name	Setting to be selected (+/-) (to next function with E)
1004	QS GAS MEASUREMENT	YES After E is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
▼		
6400	ASSIGN LOW FLOW CUTOFF	On account of the low mass flow involved when gas flows are measured, it is advisable not use a low flow cut off. Setting: OFF
6402	ON-VALUE LOW FLOW CUT OFF	If the ASSIGNMENT LOW FLOW CUTOFF function was not set to "OFF", the following applies: Setting: 0.0000 [unit] User input: Flow rates for gas measurements are low, so the value for the switch-on point (= low flow cut off) must be correspondingly low.
6403	OFF-VALUE LOW FLOW CUTOFF	If the ASSIGNMENT LOW FLOW CUTOFF function was not set to "OFF", the following applies: Setting: 50% User input: Enter the switch-off point as a positive hysteresis in %, referenced to the switch-on point.
▼		
Back to the HOME position: → Press and hold down Esc key -+ for longer than three seconds or → Repeatedly press and release Esc key -+ → Exit the function matrix step by step		

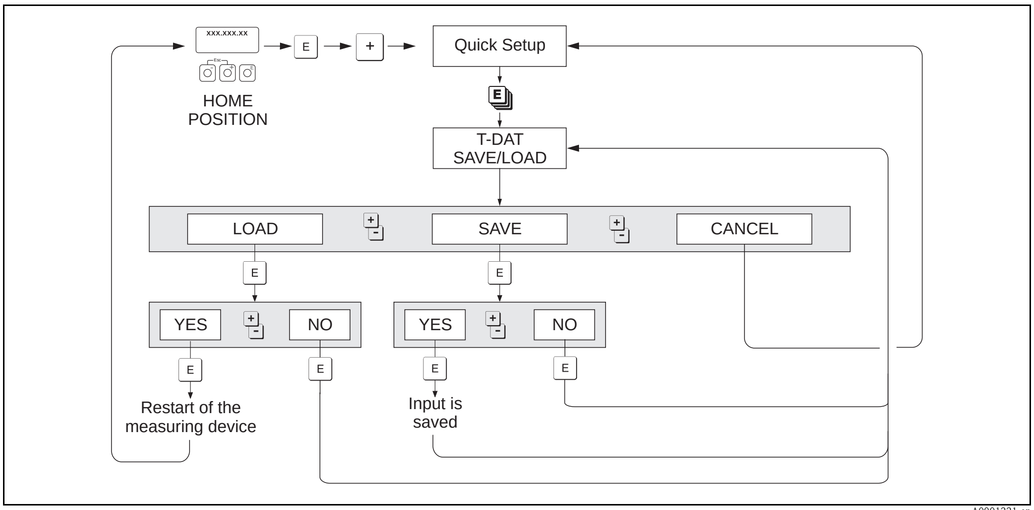
Note!
Quick Setup automatically deactivates the function EMPTY PIPE DETECTION (6420) so that the instrument can measure flow at low gas pressures.

6.3.4 Data back-up/transfer

You can use the T-DAT SAVE/LOAD function to transfer data (device parameters and settings) between the T-DAT (removable memory) and the EEPROM (device memory).

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

Note!
Installing and removing the T-DAT → 83



A0001221-en

Abb. 35: Data storage/transmission with T-DAT SAVE/LOAD

Information on the LOAD and SAVE options available:

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

Note!
- Any settings already saved on the EEPROM are deleted.
- This option is only available if the T-DAT contains valid data.
- This option can only be executed if the software version of the T-DAT is the same as, or more recent than, that of the EEPROM. If this is not the case, the error message "TRANSM. SW-DAT" appears after restarting and the LOAD function is then no longer available.

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

6.4 Configuration

Warning!
In the case of explosion-protected equipment, observe a cooling or discharge time of 10 minutes before opening the device.

6.4.1 Current output: active/passive

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

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

1. Switch off power supply
2. Remove the I/O board → 83 or → 85
3. Set the jumpers → 36

   Caution!
   Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagram. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.
4. Installation of the I/O board is the reverse of the removal procedure.

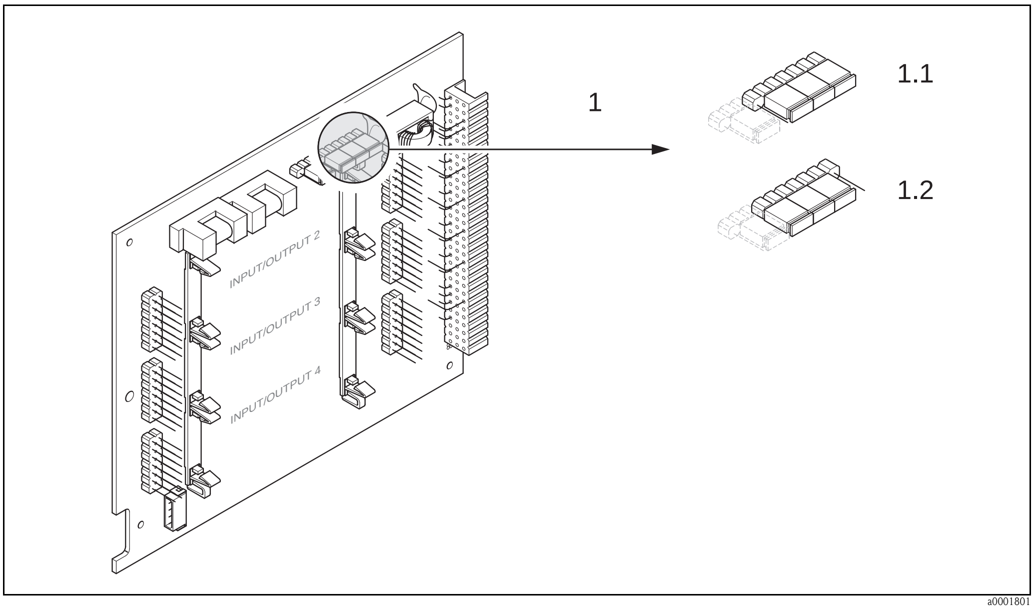


Fig. 36: Configuring current outputs with the aid of jumpers (I/O board)

1 Current output 1 with HART
1.1 Active current output (default)
1.2 Passive current output

6.4.2 Pulse/frequency outputs 1 and 2

The configuration of the pulse/frequency output with line monitoring "On" or "Off" takes place by means of various jumpers on the pulse/frequency output submodule.

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

1. Switch off power supply
2. Remove the I/O board → 🗎 83 or → 🗎 85
3. Set the jumpers → 🖻 37

   Caution!
   – Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagram. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.
4. Installation of the I/O board is the reverse of the removal procedure.

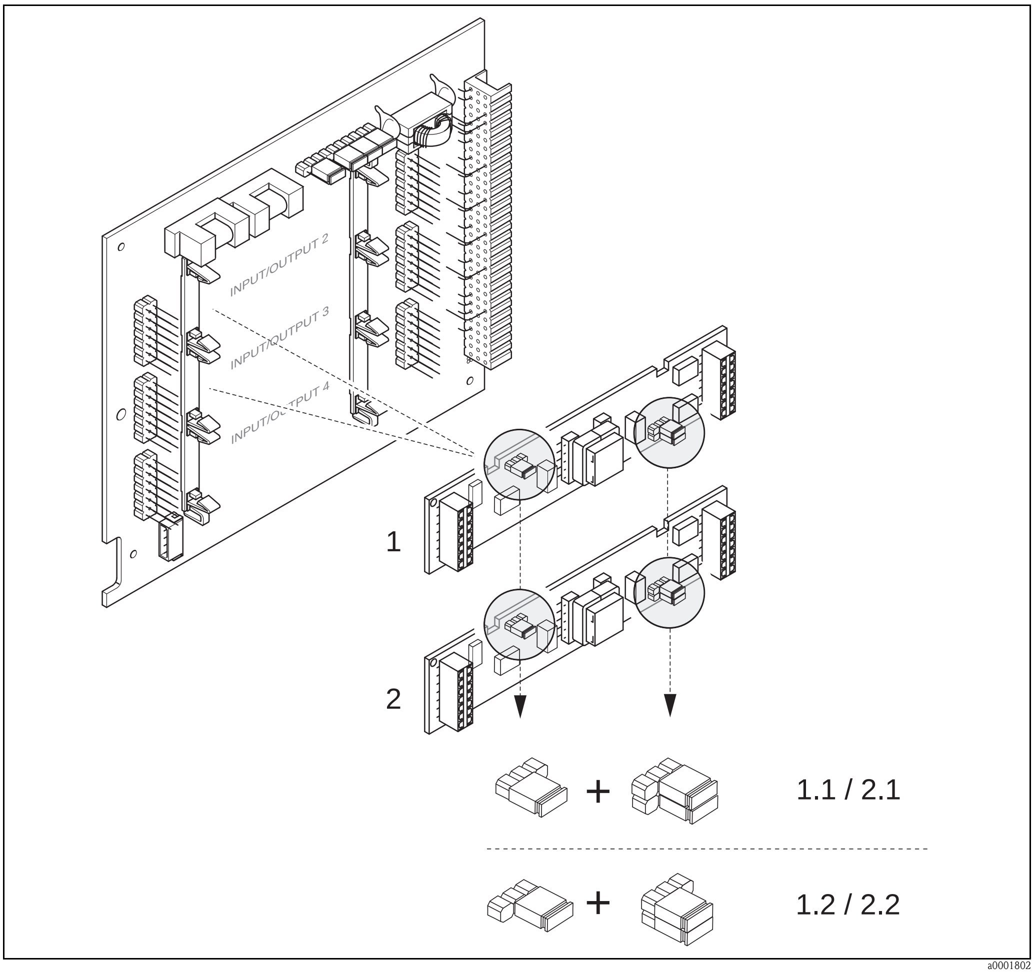


Fig. 37: Configuring pulse/frequency outputs with the aid of jumpers (I/O board)

1 Pulse/frequency output 1
1.1 Line monitoring ON (factory setting)
1.2 Line monitoring OFF

2 Pulse/frequency output 2
2.1 Line monitoring ON (factory setting)
2.2 Line monitoring OFF

6.4.3 Relay contacts: Normally closed/Normally open

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

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 → 83 or → 85
3. Set the jumpers → 38

   Caution!
   - If you change the setting you must always change the positions of **both** jumpers! Note precisely the specified positions of the jumpers.
   - Note that the position of the relay submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → 28.
4. Installation of the I/O board is the reverse of the removal procedure.

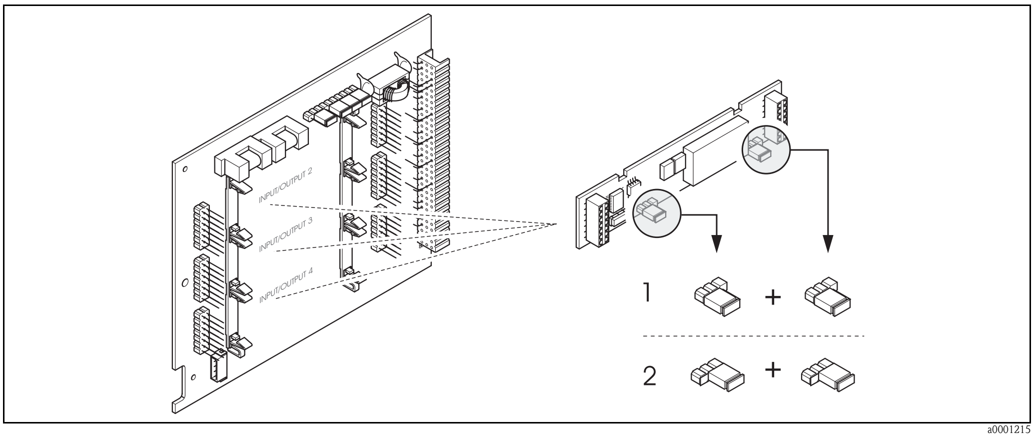


Fig. 38: Configuring relay contacts (NC / NO) on the convertible I/O board (submodule).

1 Configured as NO contact (default, relay 1)
2 Configured as NC contact (default, relay 2, if installed)

6.5 Adjustment

6.5.1 Zero point adjustment

All measuring devices are calibrated with state-of-the-art technology.
The zero point obtained in this way is printed on the nameplate.
Calibration takes place under reference operating conditions → 📄 96.
Consequently, the zero point adjustment is generally **not** necessary for Promass!

Experience shows that the zero point adjustment is advisable only in special cases:
- To achieve highest measuring accuracy at very small flow rates.
- Under extreme process or operating conditions (e.g. very high process temperatures or very high viscosity fluids).

Preconditions for a zero point adjustment

Note the following before you perform a zero point adjustment:
- A zero point adjustment can be performed only with fluids that contain no gas or solid contents.
- Zero point adjustment is performed with the measuring tubes completely filled and at zero flow (v = 0 m/s). This can be achieved, for example, with shutoff valves upstream and/or downstream of the sensor or by using existing valves and gates.
  - Normal operation → valves 1 and 2 open
  - Zero point adjustment *with* pump pressure → Valve 1 open / valve 2 closed
  - Zero point adjustment *without* pump pressure → Valve 1 closed / valve 2 open

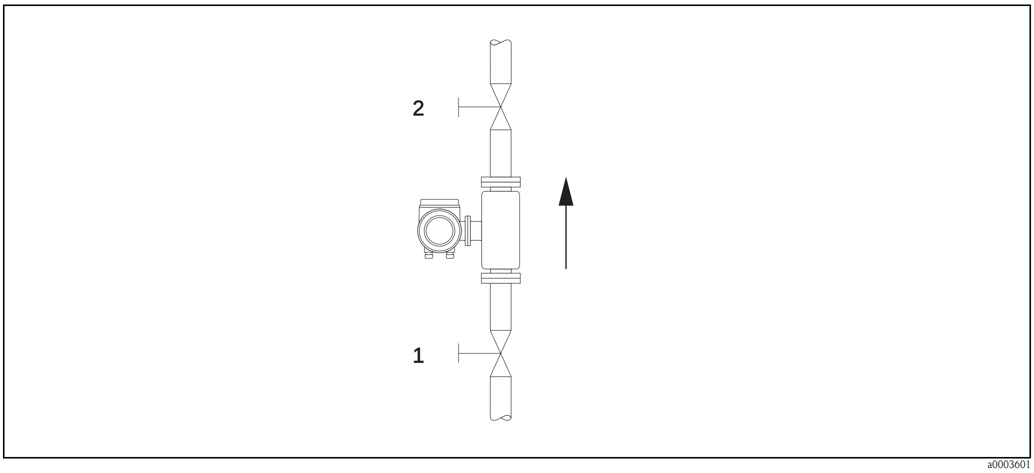


Fig. 39: Zero point adjustment and shutoff valves

Caution!
- If the fluid is very difficult to measure (e.g. containing entrained solids or gas) it may prove impossible to obtain a stable zero point despite repeated zero point adjustments. In instances of this nature, please contact your Endress+Hauser representative.
- You can view the currently valid zero point value using the "ZEROPOINT" function (see the "Description of Device Functions" manual).

Performing a zero point adjustment

1. Let the system run until operating conditions have been reached.
2. Stop the flow (v = 0 m/s).
3. Check the shutoff valves for leaks.
4. Check that operating pressure is correct.
5. Perform a zero point adjustment as follows:

Key	Procedure	Display text
E	HOME position → Enter the function matrix	> GROUP SELECTION< MEASURED VARIABLES
+/-	Select the BASIC FUNCTION block	> GROUP SELECTION< BASIC FUNCTION
+/-	Select the PROCESS PARAMETER group	> GROUP SELECTION< PROCESS PARAMETER
+/-	Select the ADJUSTMENT function group	> GROUP SELECTION< ADJUSTMENT
E	Select the ZERO ADJUST. function	ZERO ADJUST. CANCEL
+/-	After you press +/-, you are automatically prompted to enter the code if the function matrix is still disabled.	CODE ENTRY ***
+/-	Enter the code (84 = default)	CODE ENTRY 84
E	Confirm the code as entered. The ZERO ADJUST function reappears on the display.	PROGRAMMING ENABLED ZERO ADJUST. CANCEL
+/-	Select START	ZERO ADJUST. START
E	Confirm the entry by pressing the Enter key. The confirmation prompt appears on the display.	SURE? NO
+/-	Select YES.	SURE? YES
E	Confirm the entry by pressing the Enter key. Zero point adjustment now starts. While zero point adjustment is in progress, the display shown here is visible for 30 to 60 seconds. If the flow of fluid in the pipe exceeds 0.1 m/s, an error message appears on the display: ZERO ADJUST NOT POSSIBLE. When the zero point adjustment completes, the ZERO ADJUST. function reappears on the display.	ZERO ADJUST. RUNNING ZERO ADJUST. CANCEL
E	After actuating the Enter key, the new zero point value is displayed.	ZERO POINT
+/- (simultaneously)	Simultaneously pressing +/- → HOME position	

6.5.2 Density adjustment

It is advisable to perform a density adjustment when optimum measuring accuracy is required for calculating density dependent values. The application may require a 1-point or 2-point density adjustment.

1-point density adjustment (with one fluid):
This type of density adjustment is necessary under the following circumstances:
- The sensor does not measure exactly the density value that the user expects on the basis of laboratory analyses.
- The fluid properties are outside the measuring points set at the factory, or the reference operating conditions used to calibrate the measuring device.
- The system is used exclusively to measure a fluid's density which must be registered to a high degree of accuracy under constant conditions.
  Example: Brix density measurement for apple juice.

2-point density adjustment (with two fluids):
This type of adjustment is always to be carried out if the measuring tubes have been mechanically altered by, e.g. material buildup, abrasion or corrosion. In such cases, the resonant frequency of the measuring tubes has been affected by these factors and is no longer compatible with the calibration data set at the factory. The 2-point density adjustment takes these mechanically-based changes into account and calculates new, adjusted calibration data.

Performing a 1-point or 2-point density adjustment

Caution!
- Onsite density adjustment can be performed only if the user has detailed knowledge of the fluid density, obtained for example from detailed laboratory analyses.
- The target density value specified in this way must not deviate from the measured fluid density by more than ±10%.
- An error in defining the target density affects all calculated density and volume functions.
- The 2-point density adjustment is only possible if both target density values are different from each other by at least 0.2 kg/l. Otherwise the error message #731 (adjustment is not possible) appears on the display.
- Density adjustment changes the factory density calibration values or the calibration values set by the service technician.
- The functions outlined in the following instructions are described in detail in the "Description of Device Functions" manual.

1. Fill the sensor with fluid. Make sure that the measuring tubes are completely filled and that liquids are free of gas bubbles.
2. Wait until the temperature difference between fluid and measuring tube has equalized. The time you have to wait for equalization depends on the fluid and the temperature level.
3. Using the local display, select the SETPOINT DENSITY function in the function matrix and perform density adjustment as follows:

Function No.	Function name	Setting to be selected (− or +) (to next function with E)
6482	DENSITY ADJUST MODE	Use +/− to select a 1- or 2-point adjustment. Note! When you press +/− you are automatically prompted to enter the access code if the function matrix is still disabled. Enter the code.
6483	DENSITY SET VALUE 1	Use +/− to enter the target density of the first fluid and press E to save this value (input range = actual density value ±10%).

Function No.	Function name	Setting to be selected (− or +) (to next function with E)
6484	MEASURE FLUID 1	Use +/− to select START and press E. The message "DENSITY MEASUREMENT RUNNING" appears on the display for approximately 10 seconds. During this time Promass measures the current density of the first fluid (measured density value).

▼

For 2-point density adjustment only:

6485	DENSITY SET VALUE 2	Use +/− to enter the target density of the second fluid and press E to save this value (input range = actual density value ±10%).
6486	MEASURE FLUID 2	Use +/− to select START and press E. The message "DENSITY MEASUREMENT RUNNING" appears on the display for approximately 10 seconds. During this time Promass measures the current density of the second fluid (measured density value).

▼

6487	DENSITY ADJUSTMENT	Use +/− to select DENSITY ADJUSTMENT and press E. The measuring device compares the measured density value and the target density value and calculates the new density coefficient.
6488	RESTORE ORIGINAL	If the density adjustment does not complete correctly, you can select the RESTORE ORIGINAL function to reactivate the default density coefficient.

▼

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

6.6 Rupture disk

Sensor housings with integrated rupture disks are optionally available.

Warning!
- Make sure that the function and operation of the rupture disk is not impeded through the installation. Triggering overpressure in the housing as stated on the indication label. Take adequate precautions to ensure that no damage occurs, and risk to human life is ruled out, if the rupture disk is triggered.
  Rupture disk: Burst pressure 10 to 15 bar (145 to 218 psi)
  (Promass X: 5,5 to 6,5 bar (80 to 94 psi))
- Please note that the housing can no longer assume a secondary containment function if a rupture disk is used.
- It is not permitted to open the connections or remove the rupture disk.

Caution!
- Rupture disks can not be combined with separately available heating jacket (except Promass A).
- The existing connection nozzles are not designed for a rinse or pressure monitoring function.

Note!
- Before commissioning, please remove the transport protection of the rupture disk.
- Please note the indication labels.

6.7 Purge and pressure monitoring connections

The sensor housing protects the inner electronics and mechanics and is filled with dry nitrogen. Beyond that, up to a specified measuring pressure it additionally serves as secondary containment.

⚠ Warning!
For a process pressure above the specified containment pressure, the housing does not serve as an additional secondary containment. In case a danger of measuring tube failure exists due to process characteristics, e.g. with corrosive process fluids, we recommend the use of sensors whose housing is equipped with special pressure monitoring connections (ordering option). With the help of these connections, fluid collected in the housing in the event of tube failure can be drained off. This diminishes the danger of mechanical overload of the housing, which could lead to a housing failure and accordingly is connected with an increased danger potential. These connections can also be used for gas purging (gas detection).

The following instructions apply to handling sensors with purge or pressure monitoring connections:
- Do not open the purge connections unless the containment can be filled immediately with a dry inert gas.
- Use only low gauge pressure to purge. Maximum pressure 5 bar (72.51 psi).

6.8 Memory (HistoROM)

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

6.8.1 HistoROM/S-DAT (sensor-DAT)

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

6.8.2 HistoROM/T-DAT (transmitter-DAT)

The T-DAT is an exchangeable data storage device in which all transmitter parameters and settings are stored. Storing of specific parameter settings from the EEPROM to the T-DAT and vice versa has to be carried out by the user (= manual save function). Detailed instructions regarding this can be found in the manual "Description of Device Functions", BA110D (function "T-DAT SAVE/LOAD", No. 1009).

7 Custody transfer measurement

Promass 84 is a flowmeter suitable for custody transfer measurement for liquids (other than water) and for gases.

7.1 Suitability for custody transfer, metrological control, obligation to subsequent verification

All Promass 84 flowmeters are verified on site using reference measurements.
Only once it has been verified on site by the Verification Authority for legal metrology controls may the measuring device be regarded as verified and used for applications subject to legal metrology controls. The associated seal (stamp) on the measuring device ensures this status.

Caution!
Only flowmeters verified by the Verification Authorities may be used for invoicing in applications subject to legal metrology controls. For all verification processes, both the corresponding approvals and the country-specific requirements resp. regulations (e.g. such as the German Verification Act) must be observed. The owner / user of the instrument is obliged to subsequent verification.

7.1.1 Approval for custody transfer

The following guidelines for the custody transfer process were developed in accordance with the following authorities for legal metrology controls:

- **PTB**, Germany
- **NMi**, The Netherlands
- **METAS**, Switzerland
- **BEV**, Austria
- **NTEP**, USA
- **MC**, Canada

7.1.2 Special features of working in the custody transfer mode

Switching on the power supply in custody transfer mode

If the measuring instrument is started in custody transfer mode, for example after a power outage, system error No. 271 "POWER BRK. DOWN" flashes on the local display.
The fault message can be acknowledged or reset using the "Enter" key or by means of the status input configured accordingly.

Note!
It is not mandatory to reset the fault message for correct operation.

7.2 Definition of terms

Terms used in the subject area "suitability for custody transfer measurement for liquids other than water.

Verify	Inspection of a measuring system to determine the measured error from the "true" value with subsequent system sealing. Verification can only be carried out on site by the authority for legal metrology controls responsible.
Suitable for custody transfer measurement	A measuring system or a part of the system, for example counters or accessory equipment, has the (type) "approval for national verification" of a (national) approval center.
Verified	The measuring system has been inspected and sealed on site by a representative of the authority for legal metrology controls. This must be arranged by the facility's owner-operator.
Repair	Upon request, the authority responsible can give companies that repair verified measuring devices (repairers) the authority to mark repaired devices (repairer mark) if they have the equipment necessary for repair and adjustment and have properly trained specialist staff. Endress+Hauser is authorized to carry out repair work on verified measuring devices.
Adjust	Adjustment on site (zero point, density) under operating conditions. Is performed by the facility's owner-operator.
Calibrate	Determine and save correction values for the individual measuring instrument to get as close as possible to the "real" value with the measured value.
Quantity convertor	Unit for automatically converting the measured value determined to another variable (pressure, temperature, density, etc.) or nonvolatile saved conversion values for the fluid.
Measured error	(Also known as limit of permissible error, error limit or inaccuracy). Relative measurement error, derived from the quotient (measured value – "true" measured value) / "true" measured value in percent.
Measuring system	Measuring device that includes the counter and all the ancillary equipment and additional devices.
Reapproval	Verified measuring devices can be reapproved if they observe the applicable limits of error in legal metrology and meet any other requirements which applied when they were initially verified. The authority responsible provides you with information as to how long the verification is valid.
Q_{min}	Minimum flow as of which the counter must observe the error limits.
Q_{max}	Maximum flow of the counter while observing the error limits.
Stamp points	To be provided on all parts of the measuring system which cannot otherwise be protected against any alteration (=falsification) to measured value determination and processing. Lead stamping is preferably used, but adhesive seals are also permitted. They may only be affixed by an authorized party, namely authority for legal metrology controls or service team with field service mark.
Counter	Device for measuring, saving and displaying the variables subject to mandatory verification (mass, volume, density, etc.)
Additional devices	Equipment that does not have a direct effect on the measurement but which is needed to ensure correct measuring or make it easier (e.g. gas display units, filters, pumps, etc.)
Ancillary equipment	Equipment used for direct further processing of the measurement result (e.g. printers, quantity convertors, price calculators, preset devices, etc.)

7.3 Verification process

For all verification processes, both the corresponding approvals and the country-specific regulations must be observed.

For installation and commioning of the metrological gas meter read the document "Commissioning Instructions for PTB gas approval" (SD00128). The document can be obtained from your Endress+Hauser representative.

Please do not hesitate to contact your Endress+Hauser representative if you have any questions.

7.3.1 Setting up custody transfer mode

The measuring instrument has to be operational and not set to custody transfer mode.

1. Configure the functions important for custody transfer measurement, such as the output configuration, custody transfer variable and the measuring mode.
   In the "CUSTODY TRANSFER" block (function block Z; functions Z001 to Z008), the outputs relevant for custody transfer measurement can be set to custody transfer and the current custody transfer status can be displayed.

   In the "OUTPUTS" block (function block E), the custody transfer variables can be assigned to the existing outputs.

   In the "INPUTS" block (function block F), a switching behavior is assigned to the input.
   For NTEP and MC only: The "CUSTODY TRANSFER" block is hidden. All relevant outputs are set to custody transfer.

   ✎ Note!
   Please refer to the separate Device Functions manual for a detailed description of the functions.

2. Once all the functions relevant to custody transfer have been configured, the custody transfer code is entered in the "ACCESS CODE (2020)" cell.
   Custody transfer code: 8400
   The functions are locked once you enter the custody transfer code. These functions are marked with a keyhole symbol in the separate Device Functions manual (⚿).

3. The lead stamping of the measuring instrument (see illustration below)

4. The device is suitable for custody transfer measurement. The flow measurement may now be used in applications subject to legal metrology controls.

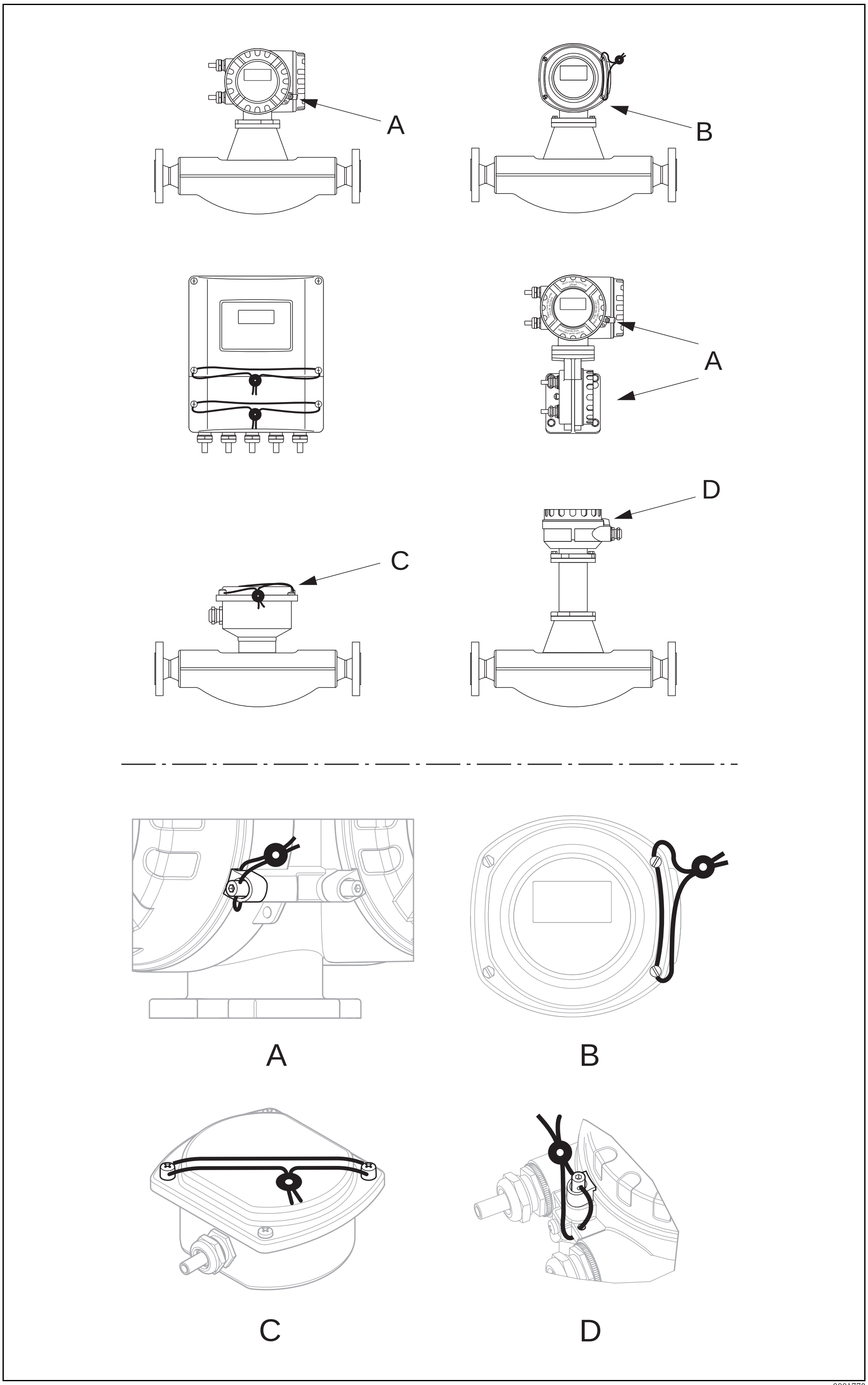


Fig. 40: Examples of how to seal the various device versions.

7.3.2 Disabling custody transfer mode

The measuring instrument has to be operational and already set to custody transfer mode.

1. Disconnect the device from the operating voltage.
2. Remove the custody transfer seals.

Warning!
In the case of explosion-protected equipment, observe a cooling or discharge time of 10 minutes before opening the device.

3. Open the cover of the transmitter housing electronics compartment.
   Detailed procedure for the compact version/wall-mount housing → 83
4. Remove the S-DAT
5. Reconnect the device to the power supply.
6. The device runs through the startup cycle.
   After startup, the error message "#031 SENSOR HW-DAT" is displayed.

   Note!
   This error message appears because the S-DAT has been removed.
   This does not have any effect on the subsequent steps.
7. Disconnect the device from the power supply again.
8. Reinsert the S-DAT.
9. Screw the covers of the electronics compartment and the display module back on.
10. Reconnect the device to the power supply.
11. The device runs through the startup cycle.
    During startup, the message "CUSTODY TRANSFER NO" appears on the display.
12. The device is now operational and is not in custody transfer mode.

Note!
To set the device back to custody transfer mode, proceed as described on → 68.

8 Maintenance

No special maintenance work is required.

8.1 External cleaning

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

8.2 Replacing seals

Under normal circumstances, fluid wetted seals of the Promass A sensors do not require replacement. Replacement is necessary only in special circumstances, for example if aggressive or corrosive fluids are incompatible with the seal material.

✎ Note!
- The period between changes depends on the fluid properties and on the frequency of cleaning cycles in the case of CIP/SIP cleaning
- Replacement seals (accessories)

9 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Detailed information on the order code in question can be obtained from your Endress+Hauser representative.

9.1 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for transmitter	Mounting set for wall-mount housing (remote version). Suitable for: – Wall mounting – Pipe mounting – Installation in control panel Mounting set for aluminum field housing: Suitable for pipe mounting (3/4" to 3")	DK8WM - *
Post mounting set for the Promass A sensor	Post mounting set for the Promass A	DK8AS - * *
Mounting set for the Promass A sensor	Mounting set for Promass A, comprising: – 2 process connections – Seals	DK8MS - * * * * * *
Set of seals for sensor	For regular replacement of the seals of the Promass A sensors. Set consists of two seals.	DKS - * * *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick. Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.	RSG40 - ************

9.2 Communication-specific accessories

Accessory	Description	Order code
HART Communicator Field Xpert handheld terminal	Handheld terminal for remote parameterization and for obtaining measured values via the current output HART (4 to 20 mA). Contact your Endress +Hauser representative for more information.	SFX100 - *******

Accessory	Description	Order code
FXA195	The Commubox FXA195 connects intrinsically safe smart transmitters with the HART protocol with the USB port of a personal computer. This enables remote operation of the transmitter with operating software (e.g. FieldCare). Power is supplied to the Commubox via the USB port.	FXA195 - *

9.3 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.	DXA80 – *
W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.	
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant asset management tool 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 flowmeters are accessed via a service interface or via the service interface FXA193.	→ Product page on the Endress+Hauser website: www.endress.com
FXA193	Service interface from the measuring device to the PC for operation via FieldCare.	FXA193 – *

10 Troubleshooting

10.1 Troubleshooting instructions

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

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → Terminal 1, 2 2. Check device fuse → 🗎 87 85 to 260 V AC: 0.8 A slow-blow / 250 V 20 to 55 V AC and 16 to 62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 🗎 82
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 → 🗎 82 2. Display module defective → order spare parts → 🗎 82 3. Measuring electronics defective → order spare parts → 🗎 82
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ± keys and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective → order spare parts → 🗎 82
▼	
Error messages on display	
Errors that occur during commissioning or measuring are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Type of error: **S** = System error, **P** = Process error – Error message type: ϟ = Fault message, **!** = Notice message – **FLUID INHOM.** = Error designation (e.g. fluid is not homogeneous) – **03:00:05** = Duration of error occurrence (in hours, minutes and seconds) – **#702** = Error number Caution! See the information → 🗎 36	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → 🗎 75
Error number: No. 400 – 499 No. 700 – 799	Process error (application error) has occurred → 🗎 79
▼	
Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → 🗎 80

10.2 System error messages

Serious system errors are **always** recognized by the instrument as "Fault message", and are shown as a lightning flash (ϟ) on the display!

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

Note!
- The listed error message types below correspond to the factory setting.
- Also observe the information on the following pages: → 🗎 36

No.	Error message / Type	Cause	Remedy / spare part
S = System error ϟ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE ϟ: # 001	Serious device error	Replace the amplifier board. Spare part → 🗎 82
011	S: AMP HW EEPROM ϟ: # 011	Amplifier: Defective EEPROM	Replace the amplifier board. Spare parts → 🗎 82
012	S: AMP SW EEPROM ϟ: # 012	Measuring amplifier: Error when accessing data of the EEPROM	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 erroneous parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see also error No. 111 / CHECKSUM TOTAL.).
031	S: SENSOR HW DAT ϟ: # 031	Sensor DAT: 1. S-DAT is defective 2. S-DAT is not plugged into the amplifier board or is missing.	1. Replace the S-DAT. Spare parts → 🗎 82 Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the S-DAT into the amplifier board. → 🗎 83 or → 🗎 85
032	S: SENSOR SW DAT ϟ: # 032	Sensor DAT: Error accessing the calibration values stored in the S-DAT.	1. Check whether the S-DAT is correctly plugged into the amplifier board. → 🗎 83 or → 🗎 85 2. Replace the S-DAT if it is defective. Spare parts → 🗎 82 Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → 🗎 82
041	S: TRANSM. HW DAT ϟ: # 041	Sensor DAT: 1. T-DAT is defective 2. T-DAT is not plugged into the amplifier board or is missing.	1. Replace the T-DAT. Spare parts → 🗎 82 Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the T-DAT into the amplifier board. → 🗎 83 or → 🗎 85

No.	Error message / Type	Cause	Remedy / spare part
042	S: TRANSM. SW DAT ϟ: # 042	Sensor DAT: Error accessing the calibration values stored in the S-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → 📄 83 bzw. → 📄 85 2. Replace the T-DAT if it is defective. Spare parts → 📄 82 Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → 📄 82
No. # 1xx → Software error			
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 displayed on the display.	Module with lower software version has either to be actualized by FieldCare with the required software version or the module has to be replaced. Spare parts → 📄 82
No. # 2xx → Error in DAT / no communication			
205	S: LOAD T-DAT !: # 205	Transmitter DAT: Data backup (downloading) to T-DAT failed, or error when accessing (uploading) the calibration values stored in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → 📄 83 or → 📄 85 2. Replace the T-DAT if it is defective. Spare parts → 📄 82 Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → 📄 82
206	S: SAVE T-DAT !: # 206		
251	S: COMMUNIC I/O ϟ: # 251	Internal communication fault on the amplifier board.	Remove the amplifier board. Spare parts → 📄 82
261	S: COMMUNIC I/O ϟ: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts
271	S: POWER BRK. DOWN ϟ: # 271	Power supply interrupted. Error message appears during device startup in custody transfer mode after a power failure.	Confirm with the ENTER key or reset via the auxiliary input (status input).
No. # 3xx → System limits exceeded			
339 to 342	S: STACK CUR OUT n ϟ: # 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 (ϟ): – Configure the fault response of the output to "ACTUAL VALUE", so that the temporary buffer can be cleared. → 📄 82 – Clear the temporary buffer by the measures described under Item 1.
343 to 346	S: STACK FREQ. OUT n ϟ: # 343 to 346		
347 to 350	S: STACK PULSE OUT n !: # 347 to 350	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse weighting 2. Increase the max. pulse frequency if the totalizer can handle a higher number of pulses. 3. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (ϟ): – Configure the fault response of the output to "ACTUAL VALUE", so that the temporary buffer can be cleared. → 📄 82 – Clear the temporary buffer by the measures described under Item 1.

No.	Error message / Type	Cause	Remedy / spare part
351 to 354	S: CURRENT RANGE n ϟ: # 351 to 354	Current output: The actual value for the flow lies outside the set limits.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 to 358	S: FREQ. RANGE n !: # 355 to 358	Frequency output: The actual value for the flow lies outside the set limits.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 to 362	S: PULSE RANGE ϟ: # 359 to 362	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Version 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Version 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
379 to 380	S: FREQ. LIM ϟ: # 379 to 380	The measuring tube oscillation frequency is outside the permitted range. Causes: – Change the upper or lower limit setting, as applicable. – Increase or reduce flow, as applicable.	Contact your Endress+Hauser representative.
381	S: FLUIDTEMP.MIN. ϟ: # 381	The temperature sensor on the measuring tube is likely defective.	Check the following electrical connections before you contact your Endress+Hauser representative: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board. → 🗎 83 or → 🗎 85 – Remote version: Check sensor and transmitter terminal connections No. 9 and 10→ 🗎 25.
382	S: FLUIDTEMP.MAX. ϟ: # 382		
383	S: CARR.TEMP.MIN ϟ: # 383	The temperature sensor on the carrier tube is likely defective.	Check the following electrical connections before you contact your Endress+Hauser representative: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board → 🗎 83 or → 🗎 85 – Remote version: Check sensor and transmitter terminal connections No. 11 and 12 → 🗎 25.
384	S: CARR.TEMP.MAX ϟ: # 384		
385	S: INL.SENS.DEF. ϟ: # 385	One of the measuring tube sensor coils (inlet) is likely defective.	Check the following electrical connections before you contact your Endress+Hauser representative: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board. → 🗎 83 or → 🗎 85 – Remote version: Check sensor and transmitter terminal connections No. 4, 5, 6 and 7 → 🗎 25.
386	S: OUTL.SENS.DEF. ϟ: # 386	One of the measuring tube sensor coils (outlet) is likely defective.	
387	S: SEN.ASY.EXCEED ϟ: # 387	One of the Measuring tube sensor coils is probably faulty.	
388 to 390	S: AMP. FAULT ϟ: # 388 to 390	Amplifier error	Contact your Endress+Hauser representative.

No.	Error message / Type	Cause	Remedy / spare part
No. # 5xx → Application error			
501	S: SW.-UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until process is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT. !: # 502	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until process is finished.
586	S: OSC. AMP. LIMIT ϟ: # 586	The fluid properties do not allow a continuation of the measurement. Causes: – Extremely high viscosity – Process fluid is very inhomogeneous (gas or solid content)	Change or improve process conditions.
587	S: TUBE OSC. NOT ϟ: # 587	Extreme process conditions exist. The measuring system can therefore not be started.	Change or improve process conditions.
588	S: GAIN RED.IMPOS ϟ: # 588	Overdriving of the internal analog to digital converter. Causes: – Cavitation – Extreme pressure pulses – High gas flow velocity A continuation of the measurement is no longer possible!	Change or improve process conditions, e.g. by reducing the flow velocity.
No. # 6xx → Simulation mode active			
601	S: POSITIVE 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
671 to 674	S: SIM. STAT. 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 measuring variables (e.g. mass flow)	Switch off simulation
698	S: DEV. TEST AKT. !: # 698	The measuring device is being checked on site via the test and simulation device.	–

10.3 Process error messages

Process errors can be defined as either "Fault" or "Notice" messages and can thereby be weighted differently. This is specified via the function matrix
(→ "Description of Device Functions" manual).

Note!
- The listed error message types below correspond to the factory setting.
- Also observe the information on the following pages: → 🗎 36

<table>
<tr><th>No.</th><th>Error message / Type</th><th>Cause</th><th>Remedy / spare part</th></tr>
<tr><td colspan="4">P = Process error
ϟ = Fault message (with an effect on the inputs and outputs)
! = Notice message (without any effect on the inputs and outputs)</td></tr>
<tr><td>700</td><td>P: EMPTY PIPE
ϟ: # 700</td><td>The process fluid density is outside the upper or lower limit values set in the "EPD" function.
Causes:
– Air in the measuring tube
– Partly filled measuring tube</td><td>1. Ensure that there is no gas content in the process liquid.
2. Adapt the values in the "EPD" function to the current process conditions.</td></tr>
<tr><td>701</td><td>P: EXC. CURR. LIM
ϟ: # 701</td><td>The maximum current value for the measuring tube exciter coils has been reached, since certain process fluid characteristics are extreme, e.g. high gas or solid content.
The instrument continues to work correctly.</td><td rowspan="2">In particular with outgassing fluids and/or increased gas content, the following measures are recommended to increase system pressure:
1. Install the instrument at the outlet side of a pump.
2. Install the instrument at the lowest point of an ascending pipeline.
3. Install a flow restriction, e.g. reducer or orifice plate, downstream from the instrument.</td></tr>
<tr><td>702</td><td>P: FLUID INHOM.
ϟ: # 702</td><td>Frequency control is not stable, due to inhomogeneous process fluid, e.g. gas or solid content.</td></tr>
<tr><td>703</td><td>P: NOISE LIM. CH0
ϟ: # 703</td><td rowspan="2">Overdriving of the internal analog to digital converter.
Causes:
– Cavitation
– Extreme pressure pulses
– High gas flow velocity
A continuation of the measurement is still possible!</td><td rowspan="2">Change or improve process conditions, e.g. by reducing the flow velocity.</td></tr>
<tr><td>704</td><td>P: NOISE LIM. CH1
ϟ: # 704</td></tr>
<tr><td>705</td><td>P: FLOW LIMIT
ϟ: # 705</td><td>The mass flow is too high. The electronics' measuring range will be exceeded.</td><td>Reduce flow</td></tr>
<tr><td>731</td><td>P: ADJ. ZERO FAIL
!: # 731</td><td>The zero point adjustment is not possible or has been canceled.</td><td>Make sure that zero point adjustment is carried out at "zero flow" only (v = 0 m/s). → 🗎 61</td></tr>
</table>

10.4 Process errors without messages

Symptoms	Rectification
Comment: You may have to change or correct certain settings of the function matrix in order to rectify faults. The functions outlined below, such as DISPLAY DAMPING, are described in detail in the "Description of Device Functions" manual.	
Measured value reading fluctuates even though flow is steady.	1. Check the fluid for presence of gas bubbles. 2. "TIME CONSTANT" function → increase value (→ OUTPUTS / CURRENT OUTPUT / CONFIGURATION) 3. "DISPLAY DAMPING" function → increase value (→ USER INTERFACE / CONTROL / BASIC CONFIG.)
Flow values are negative, even though the fluid is flowing forwards through the pipe.	Change the "INSTALLATION DIRECTION SENSOR" function accordingly.
Measured-value reading or measured-value output pulsates or fluctuates, e.g. because of reciprocating pump, peristaltic pump, diaphragm pump or pump with similar delivery characteristic.	Run the "Pulsating Flow" Quick Setup → 🗎 52. If the problem persists despite these measures, a pulsation damper will have to be installed between pump and measuring device.
There are differences between the flowmeter's internal totalizer and the external metering device.	This symptom is due primarily to backflow in the piping, because the pulse output cannot subtract in the "STANDARD" or "SYMMETRY" measuring modes. The problem can be solved as follows: Allow for flow in both directions. Set the "MEASURING MODE" function to "PULSATING FLOW" for the pulse output in question.
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check the fluid for presence of gas bubbles. 2. Activate the "ON-VAL. LF-CUTOFF" function, i.e. enter or increase the value for the low flow cut off (→ BASIC FUNCTION / PROCESSPARAMETER / CONFIGURATION).
The error cannot be eliminated or another error pattern is present. In these instances, please contact your Endress+Hauser representative.	The following solutions are possible: **Request the services of an Endress+Hauser service technician** If you request the services of a service technician, please be ready with the following information: – Brief error description – Nameplate specifications: order code and serial number → 🗎 6 **Return the devices to Endress+Hauser** Procedures must be carried out before you return a flowmeter to Endress+Hauser for repair or calibration → 🗎 5. Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a master copy of the Dangerous Goods Sheet at the back of these Operating Instructions. **Replace the transmitter electronics** Parts of the measuring electronics defective → order spare part → 🗎 82

10.5 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 present	Positive zero return is activated
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on → 36		
Current output	MIN. CURRENT The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the separate "Description of Device Functions" manual). MAX. CURRENT The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the separate "Description of Device Functions" manual). 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"
Pulse output	FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	FALLBACK VALUE Signal output → 0 Hz FAILSAFE VALUE Output of the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Relay output	In event of fault or power supply failure: relay → de-energized The "Description of Device Functions" manual contains detailed information on relay switching response for various configurations such as error message, flow direction, EPD, full scale value, etc.	No effect on the relay output
Totalizer	STOP The totalizers are paused until the fault is rectified. ACTUAL VALUE The fault is ignored. The totalizer continues to count in accordance with the current flow value. HOLD VALUE The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops

10.6 Spare parts

The previous sections contain detailed troubleshooting instructions → 🗎 74
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 representative 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

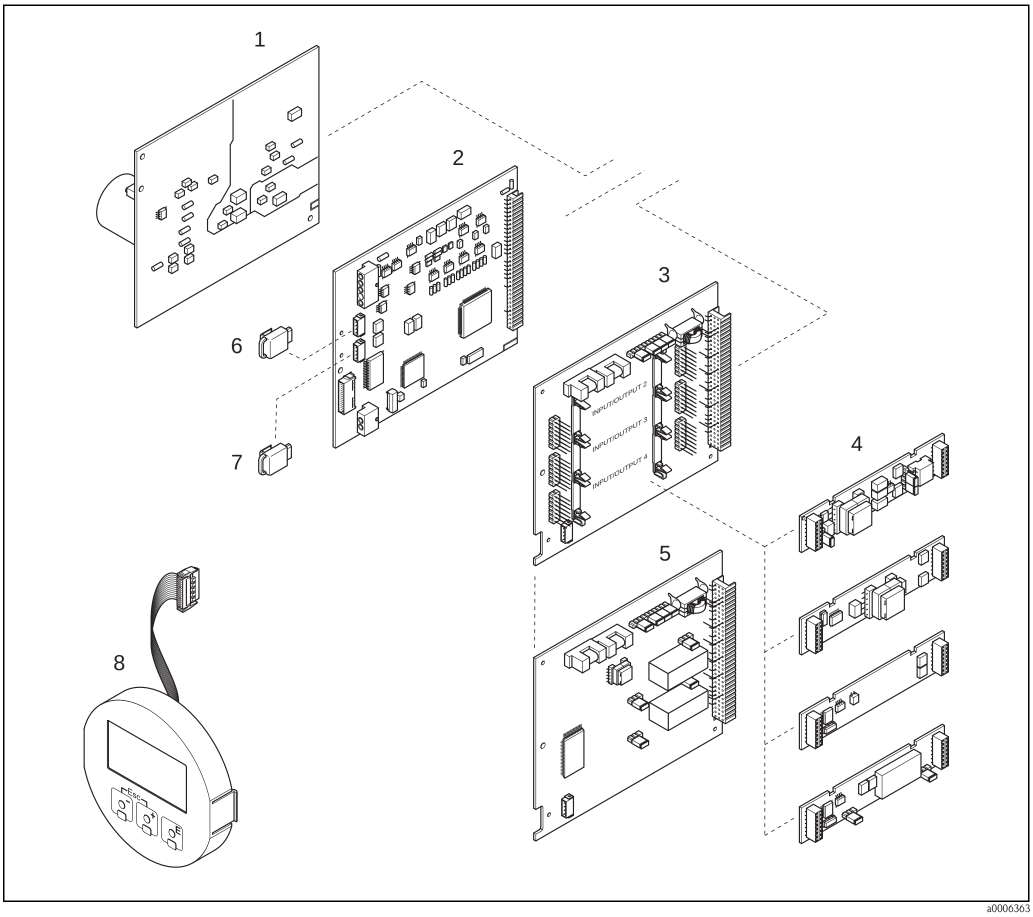


Fig. 41: Spare parts for transmitter 84 (field and wall-mount housings)

1 power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
2 Amplifier board
3 I/O board (COM module), flexible assignment
4 Pluggable input/output submodules; product structure → 🗎 72
5 I/O board (COM module), permanent assignment
6 S-DAT (sensor data memory)
7 T-DAT (transmitter data memory)
8 Display module

10.6.1 Removing and installing printed circuit boards

Field housing

Warning!
- Risk of electric shock.
  Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection).
  Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purposely built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the measuring instrument is maintained in the followinProline Adapter Cableg steps, then an appropriate inspection must be carried out in accordance with the manufacturer’s specifications.

Caution!
Use only original Endress+Hauser parts.

→ 42, installation and removal:

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the local display (1) as follows:
   – Press in the latches (1.1) at the side and remove the display module.
   – Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
3. Remove the screws and remove the cover (2) from the electronics compartment.
4. Remove power unit board (4) and I/O board (6, 7):
   Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
5. Remove submodules (6.1):
   No tools are required for removing the submodules (inputs/outputs) from the I/O board. Installation is also a no-tools operation.

   Caution!
   Only certain combinations of submodules on the I/O board are permissible → 28.
   The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

   Slot "INPUT / OUTPUT 2" = Terminals 24 / 25
   Slot "INPUT / OUTPUT 3" = Terminals 22 / 23
   Slot "INPUT / OUTPUT 4" = Terminals 20 / 21
6. Remove amplifier board (5):
   – Disconnect the plug of the sensor signal cable (5.1) including S-DAT (5.3) from the board.
   – Gently disconnect the plug of the excitation current cable (5.2) from the board, i.e. without moving it back and forward.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

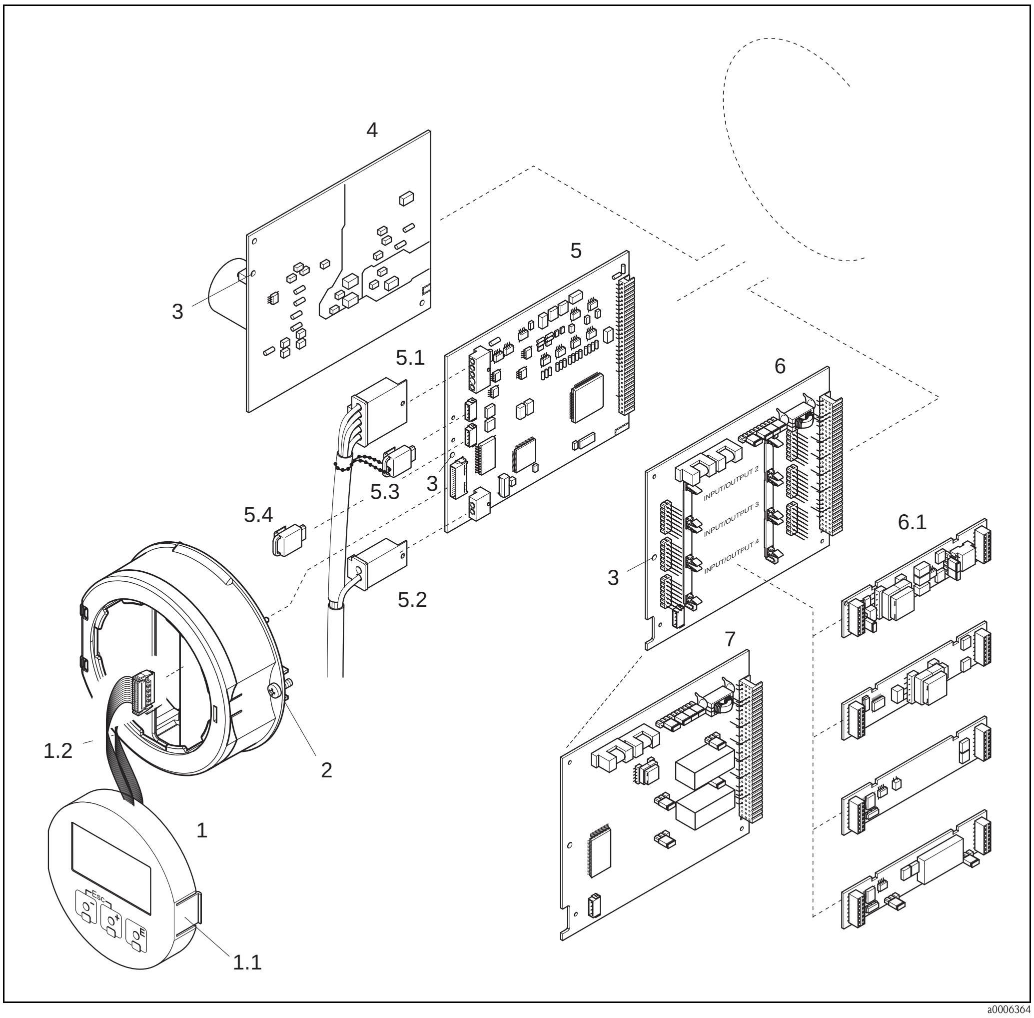


Fig. 42: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws of electronics compartment cover
3 Aperture for installing/removing boards
4 Power unit board
5 Amplifier board
5.1 Signal cable (sensor)
5.2 Excitation current cable (sensor)
5.3 S-DAT (sensor data memory)
5.4 T-DAT (transmitter data memory)
6 I/O board (flexible assignment)
6.1 Pluggable submodules (status input and current input, current output, frequency output and relay output)
7 I/O board (permanent assignment)

Wall-mount housing

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

Caution!
Use only original Endress+Hauser parts.

→ 43, installation and removal:

1. Loosen the screws and open the hinged cover (1) of the housing.
2. Remove the screws securing the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mount housing.
3. Disconnect the following cable plugs from amplifier board (7):
   – Sensor signal cable plug (7.1) including S-DAT (7.3)
   – Unplug excitation current cable (7.2). Gently disconnect the plug, i.e. without moving it back and forward.
   – Ribbon cable plug (3) of the display module.
4. Remove the cover (4) from the electronics compartment by loosening the screws.
5. Remove the boards (6, 7, 8, 9):
   Insert a thin pin into the hole (5) provided for the purpose and pull the board clear of its holder.
6. Remove submodules (8.1):
   No tools are required for removing the submodules (inputs/outputs) from the I/O board. Installation is also a no-tools operation.

   Caution!
   Only certain combinations of submodules on the I/O board are permissible → 28.
   The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

   Slot "INPUT / OUTPUT 2" = Terminals 24 / 25
   Slot "INPUT / OUTPUT 3" = Terminals 22 / 23
   Slot "INPUT / OUTPUT 4" = Terminals 20 / 21
7. Installation is the reverse of the removal procedure.

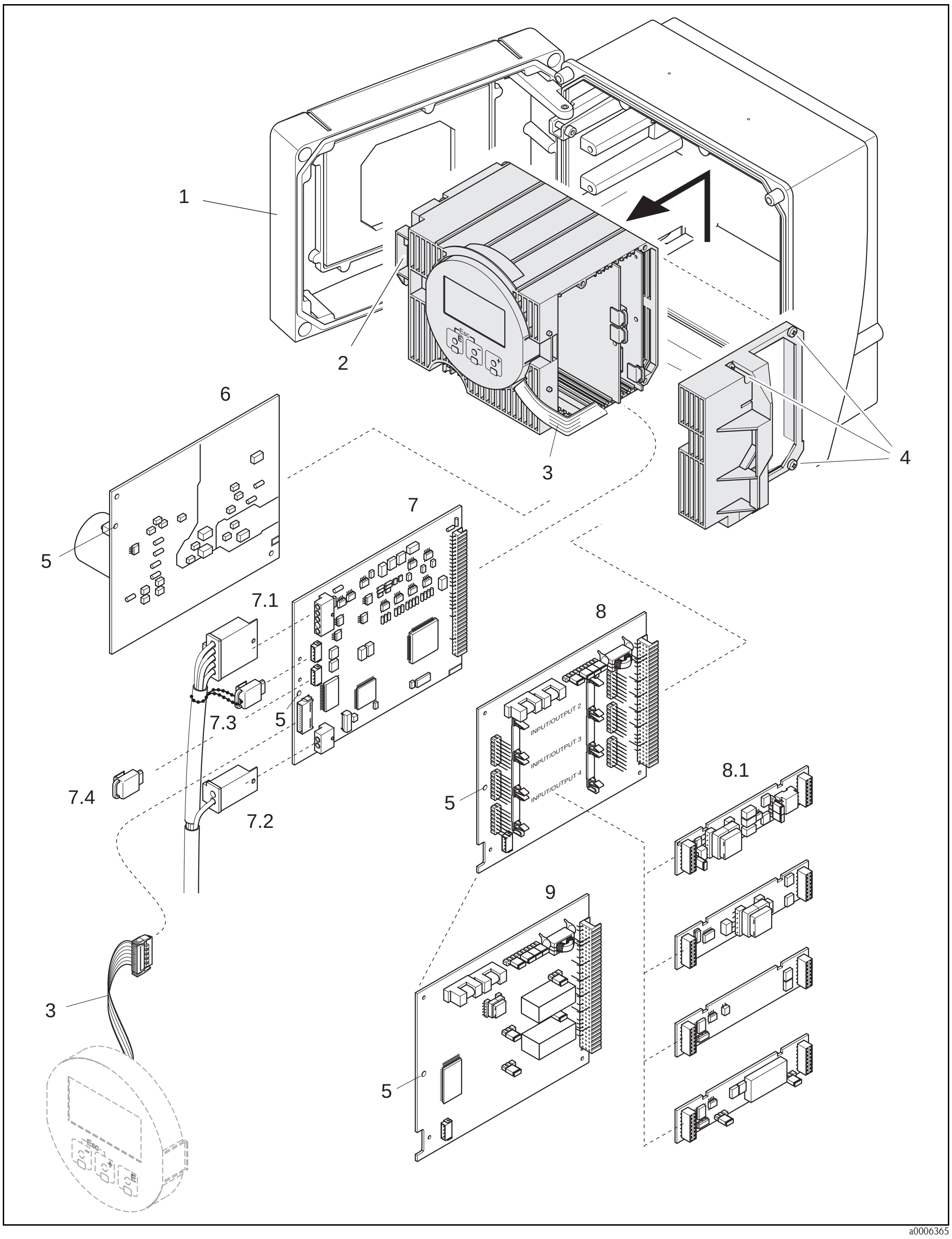


Fig. 43: Wall-mount housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Screws of electronics compartment cover
5 Aperture for installing/removing boards
6 Power unit board
7 Amplifier board
7.1 Signal cable (sensor)
7.2 Excitation current cable (sensor)
7.3 S-DAT (sensor data memory)
7.4 T-DAT (transmitter data memory)
8 I/O board (flexible assignment)
8.1 Pluggable submodules (status input and current input, current output, frequency output and relay output)
9 I/O board (permanent assignment)

10.6.2 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 unit board → 44.
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power unit board → 83 or → 85
3. Remove the protection cap (1) and replace the device fuse (2).
   Only use the following fuse type:
   – 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.

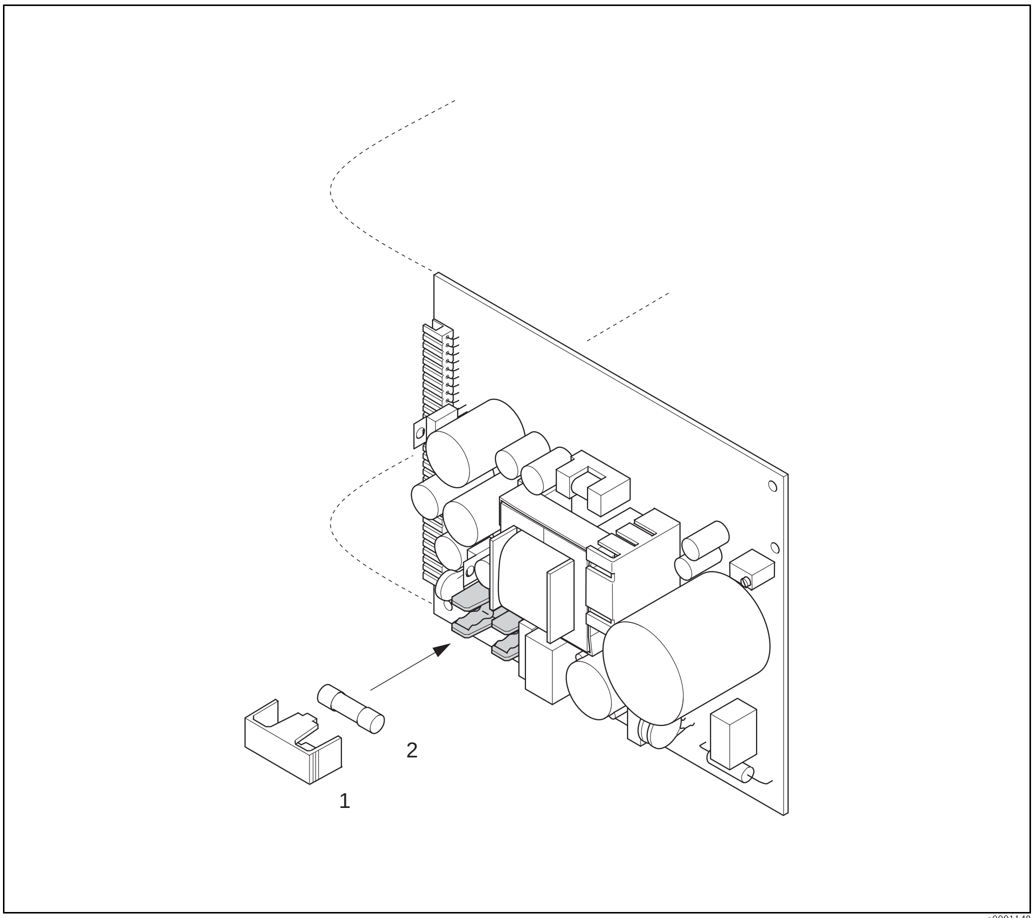


Fig. 44: Replacing the device fuse on the power unit board

1 Protective cap
2 Device fuse

10.7 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.

10.8 Disposal

Observe the regulations applicable in your country!

10.9 Software history

Date	Software version	Changes to software	Documentation
10.2012	3.01.XX	–	71197492/14.12
03.2012		New Sensor: Promass O, Promass X	71157207/13.11
01.2010		New functionalities: ▪ Calibration history ▪ Life zero	71111276/03.10
09.2008	3.00.XX	▪ New amplifier hardware. ▪ Enhanced gas measuring range. ▪ New SIL	71082989/09.08
10.2006	2.02.XX	▪ Selectable phase shift ▪ Global (USA) and selective (Europe) locking in custody transfer mode ▪ Instrument functions in general	71035269/12.06
11.2004	2.00.XX	Original software Compatible with: - Fieldtool - HART Communicator DXR 375 Rev. 06, DD 1	50108928/09.08

11 Technical data

11.1 Technical data at a glance

11.1.1 Applications

→ 📄 4

11.1.2 Function and system design

Measuring principle

Mass flow measurement by the Coriolis principle

Measuring system

→ 📄 6

11.1.3 Input

Measured variable

- Mass flow (proportional to the phase difference between two sensors mounted on the measuring tube to register a phase shift in the oscillation)
- Fluid density (proportional to resonance frequency of the measuring tube)
- Fluid temperature (via temperature sensors)/(not suitable for custody transfer measurement)

Measuring range in non-custody transfer mode

Measuring ranges for liquids

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
2	1/12	0 to 100 kg/h	0 to 3.7 lb/min
4	1/8	0 to 450 kg/h	0 to 16.5 lb/min
8	3/8	0 to 2000 kg/h	0 to 73.5 lb/min
15	½	0 to 6500 kg/h	0 to 238 lb/min
25	1	0 to 18000 kg/h	0 to 660 lb/min
40	1 ½	0 to 45000 kg/h	0 to 1650 lb/min
50	2	0 to 70000 kg/h	0 to 2570 lb/min
80	3	0 to 180000 kg/h	0 to 6600 lb/min
100	4	0 to 350000 kg/h	0 to 12860 lb/min
150	6	0 to 800000 kg/h	0 to 29400 lb/min
250	10	0 to 2200000 kg/h	0 to 80860 lb/min
350	14	0 to 4100 t/h	0 to 4520 tn. sh./h

Measuring ranges for gases, general

The full scale values depend on the density of the gas.
Use the formula below to calculate the full scale values:

$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} : x$ [kg/m³ (lb/ft³)]

$\dot{m}_{max(G)}$ = Max. full scale value for gas [kg/h (lb/min)]
$\dot{m}_{max(F)}$ = Max. full scale value for liquid [kg/h (lb/min)]
$\rho_{(G)}$ = Gas density in [kg/m³ (lb/ft³)] for process conditions

Here, $\dot{m}_{max(G)}$ can never be greater than $\dot{m}_{max(F)}$

Measuring ranges for gases (Promass F, O):

DN		x
[mm]	[inch]	
8	3/8	60
15	½	80
25	1	90
40	1½	90
50	2	90
80	3	110
100	4	130
150	6	200
250	10	200

Measuring ranges for gases (Promass A)

DN		x
[mm]	[inch]	
2	1/12"	32
4	1/8"	32

Measuring ranges for gases (Promass X)

DN		x
[mm]	[inch]	
350	14	200

Calculation example for gas:

- Sensor type: Promass F, DN 50
- Gas: air with a density of 60.3 kg/m³ (at 20 °C and 50 bar)
- Measuring range (liquid): 70000 kg/h
- x = 90 (for Promass F DN 50)

Max. possible full scale value:
$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} \div x$ [kg/m³] = 70000 kg/h · 60.3 kg/m³ ÷ 90 kg/m³ = 46900 kg/h

Recommended full scale values

See information on → 🗎 106 ("Limiting flow")

Measuring range in custody transfer mode PTP approval

The following are example data for German PTB approval (liquids other than water)

Measuring ranges for liquids in mass flow (Promass F)

DN		Mass flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[kg/min]	[lbs/min]	[kg]	[lbs]
8	3/8	1.5 to 30	3.3075 to 66.15	0.5	1.10
15	1/2	5 to 100	11.025 to 220.5	2	4.41
25	1	15 to 300	33.075 to 661.5	5	11.0
40	1 1/2	35 to 700	77.175 to 1543.5	20	44.1
50	2	50 to 1000	110.25 to 2205.0	50	110.25
80	3	150 to 3000	330.75 to 6615.0	100	220.50
100	4	200 to 4500	441.00 to 9922.5	200	441.00
150	6	350 to 12000	771.75 to 26460	500	1102.5
250	10	1500 to 35000	3307.5 to 77175	1000	2205.0

Measuring ranges for liquids in mass flow (Promass A):

DN		Mass flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[kg/min]	[lbs/min]	[kg]	[lbs]
2	1/12	0.1 to 2	0.2205 to 4.410	0.05	0.110
4	1/8	0.4 to 8	0.8820 to 17.64	0.20	0.0528

Measuring ranges for liquids in volume flow (also LPG) (Promass F):

DN		Volume flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[l/min]	[gal/hr]	[l]	[gal]
8	3/8	1.5 to 30	23.76 to 475.20	0.5	0.132
15	1/2	5 to 100	79.20 to 1584.0	2.0	0.528
25	1	15 to 300	237.6 to 4752.0	5.0	1.320
40	1 1/2	35 to 700	554.4 to 11088	20	5.280
50	2	50 to 1000	792.0 to 15840	50	13.20
80	3	150 to 3000	2376 to 47520	100	26.40
100	4	200 to 4500	3168 to 71280	200	52.80
150	6	350 to 12000	5544 to 190080	500	132.0
250	10	1500 to 35000	23760 to 554400	1000	264.0

Measuring ranges for liquids in volume flow (also LPG) (Promass A):

DN		Volume flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[l/min]	[gal/hr]	[l]	[gal]
2	1/12	0.1 to 2	1.52 to 31.680	0.05	0.0132
4	1/8	0.4 to 8	6.34 to 126.72	0.20	0.0528

✎ Note!
For information about the other approvals → see corresponding certificate.

Measuring range in custody transfer mode
MI-005 Evaluation Certificate

The following are example data for MI-005 Evaluation Certificate (liquids other than water)

Measuring ranges for liquids in mass flow (Promass F)

DN		Mass flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[kg/min]	[lbs/min]	[kg]	[lbs]
8	3/8	1.5 to 30	3.3075 to 66.15	2	4.41
15	1/2	5 to 100	11.025 to 220.5	2	4.41
25	1	15 to 300	33.075 to 661.5	5	11.0
40	1 1/2	35 to 700	77.175 to 1543.5	20	44.1
50	2	50 to 1000	110.25 to 2205.0	50	110.25
80	3	150 to 3000	330.75 to 6615.0	100	220.50
100	4	200 to 4500	441.00 to 9922.5	200	441.00
150	6	350 to 12000	771.75 to 26460	500	1102.5
250	10	1500 to 35000	3307.5 to 77175	1000	2205.0

Measuring ranges for liquids in mass flow (Promass A):

DN		Mass flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[kg/min]	[lbs/min]	[kg]	[lbs]
2	1/12	0.1 to 2	0.2205 to 4.410	0.05	0.110
4	1/8	0.4 to 8	0.8820 to 17.64	0.20	0.0528

Measuring ranges for liquids in mass flow (Promass X)

DN		Mass flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[t/h]	[tn. sh./h]	[kg]	[lbs]
350	14	90 to 3500	100 to 3850	1000	2210

Measuring ranges for liquids in mass flow (Promass O)

DN		Mass flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[kg/min]	[lbs/min]	[kg]	[lbs]
80	3	150 to 3000	330.75 to 6615.0	100	220.50
100	4	200 to 4500	441.00 to 9922.5	200	441.00
150	6	350 to 12000	771.75 to 26460	500	1102.5

Measuring ranges for liquids in volume flow (Promass F):

DN		Volume flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[l/min]	[gal/hr]	[l]	[gal]
8	3/8	1.5 to 30	23.76 to 475.20	2.0	0.528
15	1/2	5 to 100	79.20 to 1584.0	2.0	0.528
25	1	15 to 300	237.6 to 4752.0	5.0	1.320
40	1 1/2	35 to 700	554.4 to 11088	20	5.280
50	2	50 to 1000	792.0 to 15840	50	13.20
80	3	150 to 3000	2376 to 47520	100	26.40
100	4	200 to 4500	3168 to 71280	200	52.80
150	6	350 to 12000	5544 to 190080	500	132.0
250	10	1500 to 35000	23760 to 554400	1000	264.0

Measuring ranges for liquids in mass flow (Promass A):

DN		Mass flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[kg/min]	[lbs/min]	[kg]	[lbs]
2	1/12	0.1 to 2	0.2205 to 4.410	0.05	0.110
4	1/8	0.4 to 8	0.8820 to 17.64	0.20	0.0528

Measuring ranges for liquids in volume flow (Promass X)

DN		Volume flow Q_{min} to Q_{max}		Kleinste Messmenge	
[mm]	[inch]	[m^3/h]	[gal/h]	[l]	[gal]
350	14	90 to 3500	23760 to 924600	1000	264

Measuring ranges for liquids in volume flow (Promass O):

DN		Volume flow (liquids) Q_{min} to Q_{max}		Smallest measured quantity	
[mm]	[inch]	[l/min]	[gal/hr]	[l]	[gal]
80	3	150 to 3000	2376 to 47520	100	26.40
100	4	200 to 4500	3168 to 71280	200	52.80
150	6	350 to 12000	5544 to 190080	500	132.0

✎ Note!
For information about the other approvals → see corresponding certificate.

Operable flow range

Over 20 : 1 for verified device

Input signal

Status input (auxiliary input):

U = 3 to 30 V DC, R_i = 5 kΩ, galvanically isolated.
Configurable for: totalizer reset, positive zero return, error message reset, start zero point adjustment

11.1.4 Output

Output signal

Current output

Active/passive selectable, galvanically isolated, time constant selectable (0.05 to 100 s), full scale value selectable, temperature coefficient: typically 0.005% o.f.s. / °C, resolution: 0.5 µA
- Active: 0/4 to 20 mA, R_L < 700 Ω (for HART: R_L ≥ 250 Ω)
- Passive: 4 to 20 mA; supply voltage V_S 18 to 30 V DC; R_i ≥ 150 Ω

o.f.s. = full scale value

Pulse/Frequency output

For custody transfer measurement, two pulse outputs can be operated, phase-shifted.
Passive, galvanically isolated, open collector, 30 V DC, 250 mA

- Frequency output:
  End frequency 2 to 10000 Hz (f_{max} = 12500 Hz), on/off ratio 1:1, pulse width max. 2 s.
  In "Phase-shifted pulse outputs" operating mode, the end frequency is limited to a maximum of 5000 Hz.
- Pulse output:
  Pulse value and pulse polarity selectable, pulse width configurable (0.05 to 2000 ms)

Signal on alarm

Current output
Failsafe mode selectable (for example, according to NAMUR Recommendation NE 43)

Pulse/frequency output
Failsafe mode selectable

Relay output
De-energized in the event of fault or power supply failure

Switching output

Relay output
Normally closed (NC or break) or normally open (NO or make) contacts available (factory setting: normally open),
max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.

Load

See "Output signal"

Low flow cut off

Switch points for low flow cut off are selectable.

DN		Low flow cut off / factory settings (v ~ 0.04 m/s)	
[mm]	[inch]	[kg/h]	[lb/min]
2	1/12	0.40	0.015
4	1/8	1.80	0.066
8	3/8	8.00	0.300
15	1/2	26.0	1.000
25	1	72.0	2.600
40	1 1/2	180	6.600
50	2	300	11.00
80	3	720	26.00
100	4	1200	44.00
150	6	2600	95.00
250	10	7200	260.0
350	14	13000	478.0

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

11.1.5 Power supply

Electrical connections	→ 📄 25
Supply voltage	85 to 260 V AC, 45 to 65 Hz 20 to 55 V AC, 45 to 65 Hz 16 to 62 V DC
Cable entries	Power supply and signal cables (inputs/outputs): ▪ Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 inch) ▪ Threads for cable entries, 1/2" NPT, G 1/2" Connecting cable for remote version: ▪ Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47 inch) ▪ Threads for cable entries, 1/2" NPT, G 1/2"
Cable specifications	Remote version → 📄 26
Power consumption	AC: <15 VA (including sensor) DC: <15 W (including sensor) Switch-on current ▪ max. 13.5 A (< 50 ms) at 24 V DC ▪ max. 3 A (< 5 ms) at 260 V AC
Power supply failure	Lasting min. 1 power cycle: ▪ EEPROM or HistoROM T-DAT saves measuring system data if power supply fails. ▪ HistoROM/S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point, etc.)
Potential equalization	No measures necessary. For explosion-protected equipment → see separate Ex-documentation supplied

11.1.6 Performance characteristics

Reference operating conditions

- Error limits following ISO/DIN 11631
- Water, typically +15 to +45 °C (+59 to +113 °F); 2 to 6 bar (29 to 87 psi)
- Data according to calibration protocol ±5 °C (±9 °F) and ±2 bar (±29 psi)
- Accuracy based on accredited calibration rigs according to ISO 17025

Performance characteristic Promass A

o.r. = of reading; 1 g/cm^3 = 1 kg/l; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 97.

- Mass flow and volume flow (liquids): ±0.10% o.r.
- Mass flow (gases): ±0.50% o.r.
- Density (liquids)
  - Reference conditions: ±0.0005 g/cm³
  - Field density calibration: ±0.0005 g/cm³ (valid after field density calibration under process conditions)
  - Standard density calibration: ±0.02 g/cm³ (valid over the entire temperature range and density range → 106)
  - Special density calibration: ±0.002 g/cm³ (optional, valid range: +5 to +80 °C (+41 to +176 °F) and 0.0 to 2.0 g/cm³)
- Temperature: ±0.5 °C ± 0.005 · T °C; ±1 °F ± 0.003 · (T – 32) °F

Zero point stability

DN		Max. full scale value		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]	[kg/h] or [l/h]	[lb/min]
2	1/12	100	3.70	0.0050	0.00018
4	1/8	450	16.5	0.0225	0.0008

Example for max. measured error

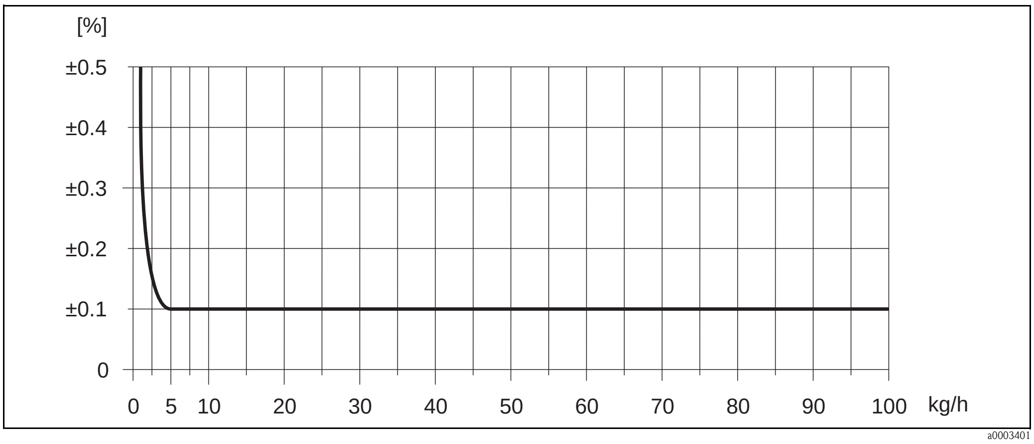


Fig. 45: Max. measured error in % o.r. (example: Promass A, DN 2)

Flow values (example)

Turn down	Flow		Max. measured error
	[kg/h]	[lb/min.]	[% o.r.]
250:1	0.4	0.0147	1.250
100:1	1.0	0.0368	0.500
25:1	4.0	0.1470	0.125
10:1	10	0.3675	0.100
2:1	50	1.8375	0.100

Design fundamentals → 97

Repeatability

Design fundamentals → 97

- Mass flow and volume flow (liquids): ±0.05% o.r.
- Mass flow (gases): ±0.25% o.r.
- Density (liquids): ±0.00025 g/cm^3
- Temperature: ±0.25 °C ± 0.0025 · T °C; ±0.5 °F ± 0.0015 · (T – 32) °F

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

A difference in pressure between the calibration pressure and the process pressure does not have any effect on the accuracy.

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ±Base accuracy in % o.r.
  – Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  – Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

Base accuracy for	
Mass flow liquids	0.10
Volume flow liquids	0.10
Mass flow gases	0.50

Performance characteristic Promass F

o.r. = of reading; 1 g/cm³ = 1 kg/l; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 100.

- Mass flow and volume flow (liquids):
  ±0.05% o.r. (PremiumCal, for mass flow)
  ±0.10% o.r.
- Mass flow (gases): ±0.35% o.r.
- Density (liquids)
  - Reference conditions: ±0.0005 g/cm³
  - Field density calibration: ±0.0005 g/cm³
    (valid after field density calibration under process conditions)
  - Standard density calibration: ±0.01 g/cm³
    (valid over the entire temperature range and density range → 106)
  - Special density calibration: ±0.001 g/cm³
    (optional, valid range: +5 to +80 °C (+41 to +176 °F) and 0.0 to 2.0 g/cm³)
- Temperature: ±0.5 °C ± 0.005 · T °C; ±1 °F ± 0.003 · (T - 32) °F

Zero point stability Promass F (standard)

DN		Zero point stability Promass F (Standard)	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8	0.030	0.001
15	½	0.200	0.007
25	1	0.540	0.019
40	1½	2.25	0.083
50	2	3.50	0.129
80	3	9.00	0.330
100	4	14.00	0.514
150	6	32.00	1.17
250	10	88.00	3.23

Zero point stability Promass F (high-temperature version)

DN		Zero point stability Promass F (high-temperature version)	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
25	1	1.80	0.0661
50	2	7.00	0.2572
80	3	18.0	0.6610

Example for max. measured error

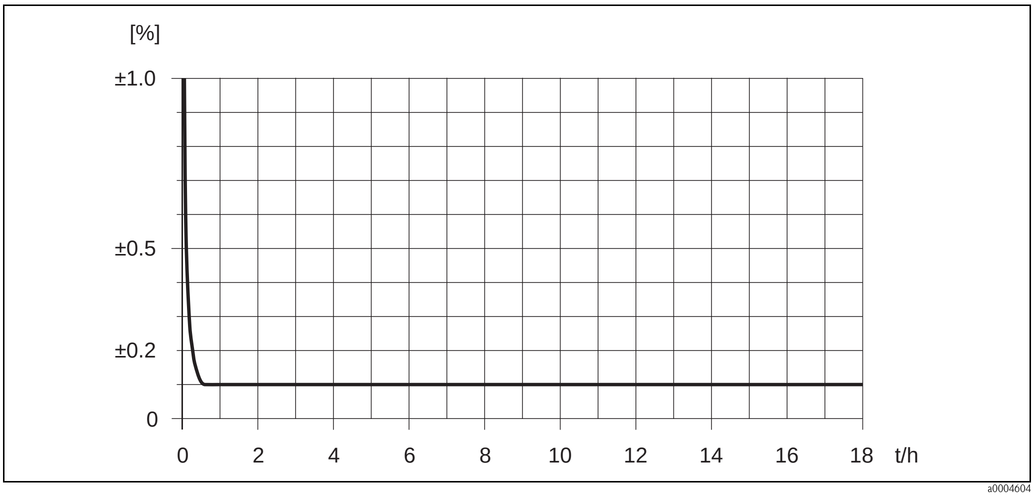


Fig. 46: Max. measured error in % o.r. (example: Promass F, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h]	[lb/min]	[% o.r.]
500 : 1	36	1.323	1.5
100 : 1	180	6.615	0.3
25 : 1	720	26.46	0.1
10 : 1	1800	66.15	0.1
2 : 1	9000	330.75	0.1

Design fundamentals → 🗎 100

Repeatability

Design fundamentals → 🗎 100.

- Mass flow and volume flow (liquids):
  ±0.025% o.r. (PremiumCal, for mass flow)
  ±0.05% o.r.
- Mass flow (gases): ±0.25% o.r.
- Density (liquids): ±0.00025 g/cm^3
- Temperature: ±0.25 °C ± 0.0025 · T °C; ±0.5 °F ± 0.0015 · (T – 32) °F

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		Promass F (standard)	Promass F (high-temperature version)
[mm]	[inch]	[% o.r./bar]	[% o.r./bar]
8	3/8	no influence	–
15	½	no influence	–
25	1	no influence	no influence
40	1½	–0.003	–
50	2	–0.008	–0.008
80	3	–0.009	–0.009
100	4	–0.007	–
150	6	–0.009	–
250	10	–0.009	–

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ±Base accuracy in % o.r.
  - Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  - Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  - Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

Base accuracy for	
Mass flow liquids, PremiumCal	0.05
Mass flow liquids	0.10
Volume flow liquids	0.10
Mass flow gases	0.35

Performance characteristic Promass O

o.r. = of reading; 1 g/cm^3 = 1 kg/l; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 102.

- Mass flow and volume flow (liquids):
  ±0.05% o.r. (PremiumCal, for mass flow)
  ±0.10% o.r.
- Mass flow (gases): ±0.35% o.r.
- Density (liquids)
  – Reference conditions: ±0.0005 g/cm³
  – Field density calibration: ±0.0005 g/cm³
    (valid after field density calibration under process conditions)
  – Standard density calibration: ±0.01 g/cm³
    (valid over the entire temperature range and density range → 106)
  – Special density calibration: ±0.001 g/cm³
    (optional, valid range: +5 to +80 °C (+41 to +176 °F) and 0.0 to 2.0 g/cm³)
- Temperature: ±0.5 °C ± 0.005 · T °C; ±1 °F ± 0.003 · (T – 32) °F

Zero point stability

DN		Zero point stability Promass F (Standard)	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
80	3	9.00	0.330
100	4	14.00	0.514
150	6	32.00	1.17

Example for max. measured error

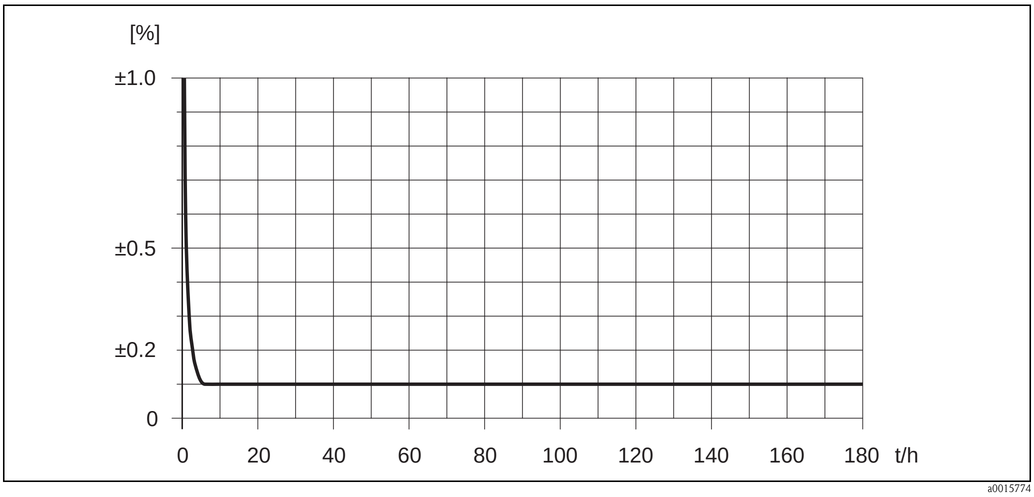


Fig. 47: Max. measured error in % o.r. (example DN 80)

Flow values (example DN 80)

Turn down	Flow		Maximum measured error
	[kg/h]	[lb/min]	[% o.r.]
500 : 1	360	13.23	1.5
100 : 1	1800	66.15	0.3
25 : 1	7200	264.6	0.1
10 : 1	18000	661.5	0.1
2 : 1	90000	3307.5	0.1

Design fundamentals → 🗎 102

Repeatability

Design fundamentals → 🗎 102.

- Mass flow and volume flow (liquids):
  ±0.025% o.r. (PremiumCal, for mass flow)
  ±0.05% o.r.
- Mass flow (gases): ±0.25% o.r.
- Density (liquids): ±0.00025 g/cm^3
- Temperature: ±0.25 °C ± 0.0025 · T °C; ±0.5 °F ± 0.0015 · (T – 32) °F

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		Promass F (standard)
[mm]	[inch]	[% o.r./bar]
80	3	–0.0055
100	4	–0.0035
150	6	–0.002

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ±Base accuracy in % o.r.
  – Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  – Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

Base accuracy for	
Mass flow liquids, PremiumCal	0.05
Mass flow liquids	0.10
Volume flow liquids	0.10
Mass flow gases	0.35

Performance characteristic Promass X

o.r. = of reading; 1 g/cm^3 = 1 kg/l; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.
Design fundamentals → 104.

- Mass flow and volume flow (liquids):
  ±0.05% o.r. (PremiumCal, for mass flow)
  ±0.10% o.r.
- Mass flow (gases):
  ±0.35% o.r.
- Density (liquids)
  – Reference conditions: ±0.0005 g/cm^3
  – Field density calibration: ±0.0005 g/cm^3
    (valid after field density calibration under process conditions)
  – Standard density calibration: ±0.01 g/cm^3
    (valid over the entire temperature range and density range → 106)
  – Special density calibration: ±0.001 g/cm^3
    (optional, valid range: +5 to +80 °C (+41 to +176 °F) and 0.0 to 2.0 g/cm^3)
- Temperature: ±0.5 °C ± 0.005 · T °C; ±1 °F ± 0.003 · (T - 32) °F

Zero point stability

DN		Zero point stability Promass F (Standard)	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
350	14	175	6.42

Example for max. measured error

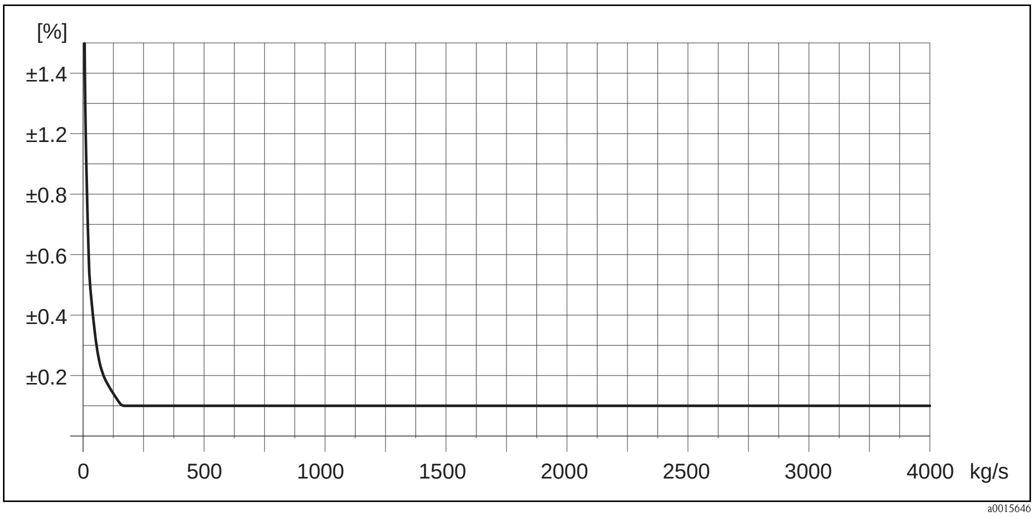


Fig. 48: Max. measured error in % o.r. (example: Promass 83X, DN 350)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h]	[lb/min]	[% o.r.]
500 : 1	8200	1.323	2.1
100 : 1	41 000	6.615	0.4
23 : 1	175000	28.23	0.1
10 : 1	410 000	66.15	0.1
2 : 1	2 050 000	330.75	0.1

Design fundamentals → 🗎 104

Repeatability

Design fundamentals → 🗎 104.

- Mass flow and volume flow (liquids):
  ±0.025% o.r. (PremiumCal, for mass flow)
  ±0.05% o.r.
- Mass flow (gaes):
  ±0.25% o.r.
- Density (liquids): ±0.00025 g/cm^3
- Temperature: ±0.25 °C ± 0.0025 · T °C; ±0.5 °F ± 0.0015 · (T – 32) °F

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002% of the full scale value / °C (±0.0001% of the full scale value/°F).

Influence of medium pressure

The table below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		Promass F (standard)
[mm]	[inch]	[% o.r./bar]
350	14	–0.009

Design fundamentals

Dependent on the flow:

- Flow ≥ Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ±Base accuracy in % o.r.
  – Repeatability: ± ½ · Base accuracy in % o.r.
- Flow < Zero point stability ÷ (Base accuracy ÷ 100)
  – Max. measured error: ± (Zero point stability ÷ measured value) · 100% o.r.
  – Repeatability: ± ½ · (Zero point stability ÷ measured value) · 100% o.r.

Base accuracy for	
Mass flow liquids, PremiumCal	0.05
Mass flow liquids	0.10
Volume flow liquids	0.10
Mass flow gases	0.35

11.1.7 Operating conditions: Installation

Installation instructions	→ 🗎 14
Inlet and outlet runs	There are no installation requirements regarding inlet and outlet runs.
Connection cable length, remote version	max. 20 meters (max. 65 feet)
System pressure	→ 🗎 15

11.1.8 Operating conditions: Environment

Ambient temperature range	Sensor and transmitter: ■ Standard: –20 to +60 °C (-4 to +140°F) ■ Optional: –40 to +60 °C (-40 to +140°F) Note! ■ Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. ■ At ambient temperatures below –20 °C (–4 °F) the readability of the display may be impaired.
Storage temperature	–40 to +80 °C (–40 to +175 °F), preferably at +20 °C (+68 °F)
Ambient class	B, C, I
Degree of protection	Standard: IP 67 (NEMA 4X) for transmitter and sensor
Shock resistance	According to IEC 68-2-31
Vibration resistance	Acceleration up to 2 g, 10 to 150 Hz, following IEC 68-2-6
CIP cleaning	yes
SIP cleaning	yes
Electromagnetic compatibility (EMC)	To IEC/EN 61326 and NAMUR recommendation NE 21

11.1.9 Operating conditions: Process

Medium temperature range

Sensor

- Promass F, A: –50 to +200 °C (–58 to +392 °F)
- Promass F (high temperature version): –50 to +350 °C (–58 to +662 °F)
- Promass O: –40 to +200 °C (–40 to +392 °F)
- Promass X: –50 to +180 °C (–40 to +356 °F)

Seals

- Promass F, O, X: No internal seals
- Promass A (only for mounting sets with threaded connections):
  - Viton: –15 to 200 °C (–5 to +392 °F)
  - EPDM: –40 to +160 °C (–40 to +320 °F)
  - Silikon: –60 to +200 °C (–76 to +392 °F)
  - Kalrez: –20 to +275 °C (–4 to +527 °F)

Fluid density range

0 to 5000 kg/m^3 (0 to 312 lb/cf)

Limiting medium pressure range (rated pressure)

The material load diagrams (pressure-temperature diagrams) for the process connections are provided in the separate "Technical Information" document on the measuring instrument in question. This can be downloaded as a PDF file from www.endress.com.
A list of the "Technical Information" documents available is provided on → 117.

Pressure ranges of secondary containment:

- Promass F
  - DN 8 to 50 (3/8" to 2"): 40 bar (600 psi)
  - DN 80 (3"): 25 bar (375 psi)
  - DN 100 to 150 (4" to 6"): 16 bar (250 psi)
  - DN 250 (10"): 10 bar (150 psi)
- Promass A
  - 25 bar (375 psi)
- Promass O
  - 16 bar (232 psi)
- Promass X
  - Type approved, maximum allowable pressure according to ASME BPVC: 6 bar (87 psi)

Limiting flow

See the "Measuring range" section → 89

Select nominal diameter by optimizing between required flow range and permissible pressure loss. See the "Measuring range" section for a list of max. possible full scale values.

- The minimum recommended full scale value is approx. 1/20 of the max. full scale value.
- In most applications, 20 to 50% of the maximum full scale value can be considered ideal.
- Select a lower full scale value for abrasive substances such as liquids with entrained solids (flow velocity <1 m/s (<3 ft/s)).
- For gas measurement the following rules apply:
  - Flow velocity in the measuring tubes should not be more than half the sonic velocity (0.5 Mach).
  - The maximum mass flow depends on the density of the gas: Formula → Page 90

Pressure loss (SI units)

Pressure loss depends on the properties of the fluid and on its flow. The following formulas can be used to approximately calculate the pressure loss:

Pressure loss formulas for Promass F

Reynolds number	$Re = \frac{2 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$ a0004623
Re ≥ 2300[1]	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$ a0004626
	Promass F DN 250 $\Delta p = K \cdot \left\{ 1 - a + \frac{a}{e^{b \cdot (\nu - 10^{-6})}} \right\} \cdot \nu^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$ a0012135
Re < 2300	$\Delta p = K1 \cdot \nu \cdot \dot{m} + \frac{K2 \cdot \nu^{0.25} \cdot \dot{m}^2}{\rho}$ a0004628
Δp = pressure loss [mbar] ν = kinematic viscosity [m2/s] $\dot{m}$ = mass flow [kg/s] ρ = fluid density [kg/m3]	d = inside diameter of measuring tubes [m] K to K2 = constants (depending on nominal diameter) a = 0.3 b = 91000

[1] To compute the pressure loss for gases, always use the formula for Re ≥ 2300.

Pressure loss formulas for Promass A

Reynolds number	$Re = \frac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$ a0003381
Re ≥ 2300[1]	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75}$ a0003380
Re < 2300	$\Delta p = K1 \cdot \nu \cdot \dot{m}$ a0003379
Δp = pressure loss [mbar] ν = kinematic viscosity [m^2/s] $\dot{m}$ = mass flow [kg/s]	ρ = density [kg/m^3] d = inside diameter of measuring tubes [m] K to K1 = constants (depending on nominal diameter)

[1] To compute the pressure loss for gases, always use the formula for Re ≥ 2300.

Pressure loss formulas for Promass O, X

Reynolds number	$Re = \frac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho \cdot n}$ A0015582
Pressure loss	$\Delta p = (A_0 + A_1 \cdot Re^{A_2})^{1/A_3} \cdot \frac{1}{\rho} \cdot \left(\frac{2 \cdot \dot{m}}{5 \cdot \pi \cdot n \cdot d^2} \right)^2$ A0015583
Δp = pressure loss [mbar] ν = kinematic viscosity [m^2/s] $\dot{m}$ = mass flow [kg/s] ρ = density [kg/m^3]	d = inside diameter of measuring tubes [m] A_0 to A_3= constants (depending on nominal diameter) n = number of tubes

Pressure loss coefficient for Promass F

DN	d[m]	K	K1	K2
8	$5.35 \cdot 10^{-3}$	$5.70 \cdot 10^{7}$	$9.60 \cdot 10^{7}$	$1.90 \cdot 10^{7}$
15	$8.30 \cdot 10^{-3}$	$5.80 \cdot 10^{6}$	$1.90 \cdot 10^{7}$	$10.60 \cdot 10^{5}$
25	$12.00 \cdot 10^{-3}$	$1.90 \cdot 10^{6}$	$6.40 \cdot 10^{6}$	$4.50 \cdot 10^{5}$
40	$17.60 \cdot 10^{-3}$	$3.50 \cdot 10^{5}$	$1.30 \cdot 10^{6}$	$1.30 \cdot 10^{5}$
50	$26.00 \cdot 10^{-3}$	$7.00 \cdot 10^{4}$	$5.00 \cdot 10^{5}$	$1.40 \cdot 10^{4}$
80	$40.50 \cdot 10^{-3}$	$1.10 \cdot 10^{4}$	$7.71 \cdot 10^{4}$	$1.42 \cdot 10^{4}$
100	$51.20 \cdot 10^{-3}$	$3.54 \cdot 10^{3}$	$3.54 \cdot 10^{4}$	$5.40 \cdot 10^{3}$
150	$68.90 \cdot 10^{-3}$	$1.36 \cdot 10^{3}$	$2.04 \cdot 10^{4}$	$6.46 \cdot 10^{2}$
250	$102.26 \cdot 10^{-3}$	$3.00 \cdot 10^{2}$	$6.10 \cdot 10^{3}$	$1.33 \cdot 10^{2}$

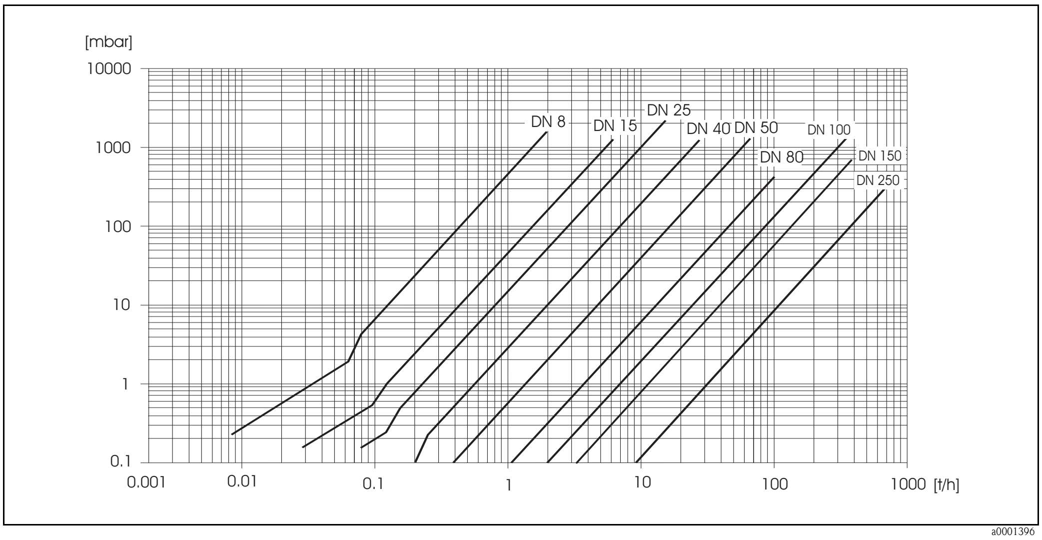


Fig. 49: Pressure loss diagram for water

Pressure loss coefficient for Promass A

DN	d[m]	K	K1
2	$1.8 \cdot 10^{-3}$	$1.6 \cdot 10^{10}$	$2.4 \cdot 10^{10}$
4	$3.5 \cdot 10^{-3}$	$9.4 \cdot 10^{8}$	$2.3 \cdot 10^{9}$
High pressure version			
2	$1.4 \cdot 10^{-3}$	$5.4 \cdot 10^{10}$	$6.6 \cdot 10^{10}$
4	$3.0 \cdot 10^{-3}$	$2.0 \cdot 10^{9}$	$4.3 \cdot 10^{9}$

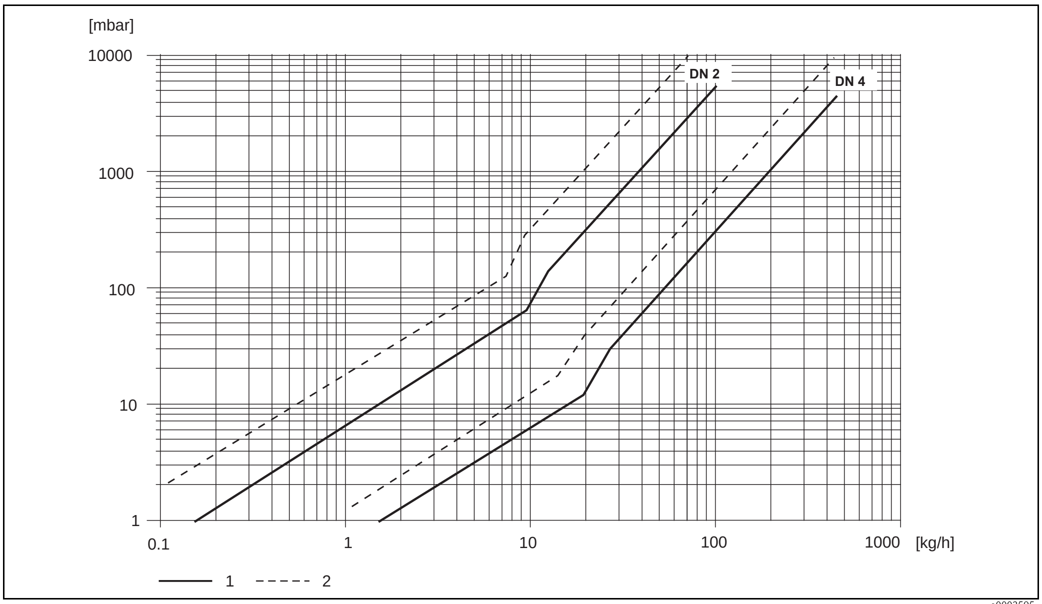


Fig. 50: Pressure loss diagram for water (1 = Standard version, 2 = High pressure version)

Pressure loss coefficient for Promass O

DN	d[mm]	A_0	A_1	A_2	A_3
80	38.5	0.72	4.28	– 0.36	0.24
100	49.0	0.70	3.75	– 0.35	0.22
150	66.1	0.75	2.81	– 0.33	0.19

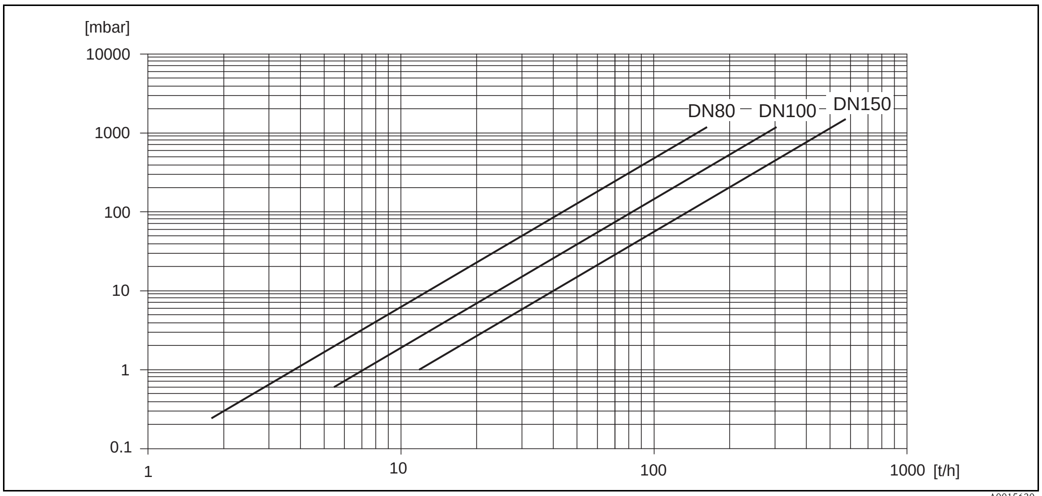


Fig. 51: Pressure loss diagram for water

Pressure loss coefficient for Promass X

DN	d[mm]	A_0	A_1	A_2	A_3
350	102.3	0.76	3.80	– 0.33	0.23

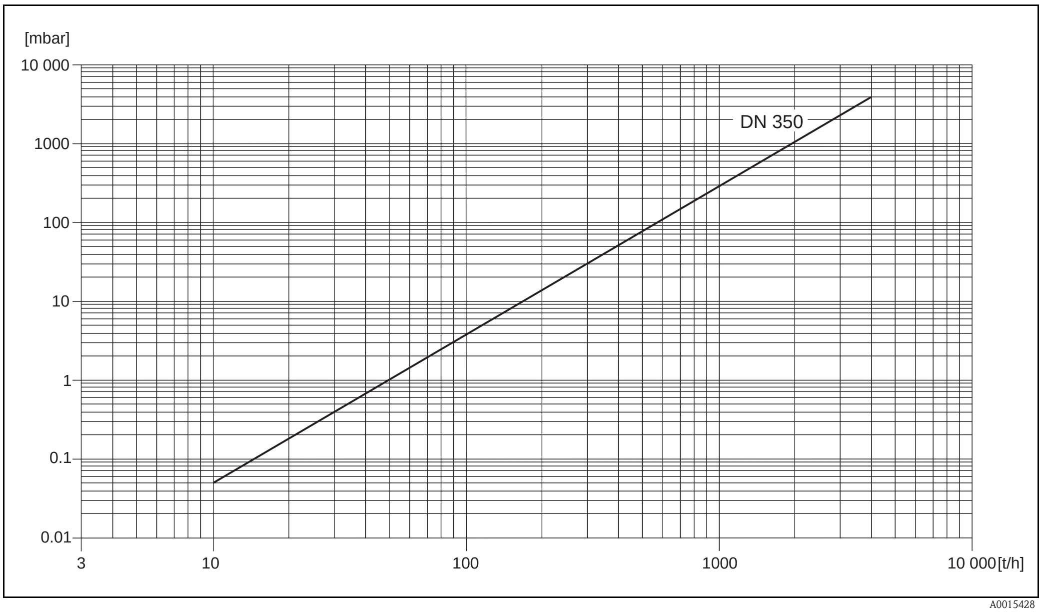


Fig. 52: Pressure loss diagram for water

Pressure loss (US units)

Pressure loss is dependent on the fluid properties and nominal diameter. Consult Endress+Hauser for Applicator PC software to determine pressure loss in US units. All important instrument data is contained in the Applicator software program in order to optimize the design of the measuring system.

The software is used for the following calculations:
- Nominal diameter of the sensor with fluid characteristics such as viscosity, density, etc.
- Pressure loss downstream of the measuring point.
- Converting mass flow to volume flow, etc.
- Simultaneous display of various meter sizes.
- Determining measuring ranges.

The Applicator runs on any IBM-compatible PC with Windows.

11.1.10 Mechanical construction

Design / dimensions

The dimensions and lengths of the sensor and transmitter are provided in the separate "Technical Information" document on the measuring instrument in question. This 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 → 117.

Weight

- Measuring device in compact and remote version: see tables below
- Wall-mount housing: 5 kg (11 lb)

Weight (SI units) in [kg]

All values (weight) refer to devices with EN/DIN PN 40 flanges. Weights in [kg].

Promass F / DN	8	15	25	40	50	80	100	150	250 [1]
Compact version	11	12	14	19	30	55	96	154	400
Compact version, high-temperature	–	–	14.7	–	30.7	55.7	–	–	–
Remote version	9	10	12	17	28	53	94	152	398
Remote version, high-temperature	–	–	13.5	–	29.5	54.5	–	–	–

[1] with 10" ASME Cl 300 flanges

Promass A / DN	2	4
Compact version	11	15
Remote version	9	13

Promass O / DN [1]	80	100	150
Compact version	75	141	246
Remote version	73	139	244

[1] with Cl 900 flanges according to ASME B16.5

Promass X / DN [1]	350
Compact version	555
Remote version	553

[1] with 12" according to ASME B16.5 Cl 150 flanges

Weight (US units) in [lb]

All values (weight) refer to devices with EN/DIN PN 40 flanges. Weights in [lb].

Promass F / DN	3/8"	1/2"	1"	1 1/2"	2"	3"	4"	6"	10" [1]
Compact version	24	26	31	42	66	121	212	340	882
Compact version, high-temperature	–	–	32	–	68	123	–	–	–
Remote version	20	22	26	37	62	117	207	335	878
Remote version, high-temperature	–	–	30	–	65	120	–	–	–

[1] with 10" ASME Cl 300 flanges

Promass A / DN	1/12"	1/8"
Compact version	24	33
Remote version	20	29

Promass O / DN [1]	3"	4"	6"
Compact version	165	311	542
Remote version	161	306	538

[1] with Cl 900 flanges according to ASME B16.5

Promass X / DN [1]	14"
Compact version	1224
Remote version	1219

[1] with 12" according to ASME B16.5 Cl 150 flanges

Material

Transmitter housing:

- Compact version
  - Compact version: powder coated die-cast aluminium
  - Stainless steel housing: stainless steel 1.4301/304
  - Stainless steel housing Ex d: stainless steel 1.4404/CF3M
  - Window material: glass or polycarbonate
- Remote version
  - Remote field housing: powder coated die-cast aluminium
  - Wall-mount housing: powder coated die-cast aluminium
  - Window material: glass

Connection housing, sensor (remote version):

- Standard: stainless steel 1.4301/304 (standard, not Promass X)
- High-temperature version and version for heating: powder coated die-cast aluminum

Sensor housing / secondary containment:

- Promass F: acid- and alkali-resistant outer surface
  - Stainless steel 1.4301/1.4307 /304L
- Promass A: acid- and alkali-resistant outer surface
  - Stainless steel 1.4301/304
- Promass X, O: acid- and alkali-resistant outer surface
  - Stainless steel 1.4404/316L

Process connections

Process connections, Promass F	Material
Flanges according to EN 1092-1 (DIN 2501)/ according to ASME B16.5/JIS 2220	Alloy C-22 2.4602/N 06022, stainless steel 1.4404/316L
DIN 11864–2 Form A (flat flange with groove)	Stainless steel 1.4404/316L
Threaded hygienic connections DIN 11851 / SMS 1145 / ISO 2853 / DIN 11864-1	Stainless steel 1.4404/316L
Tri-Clamp (OD-tubes)	Stainless steel 1.4404/316L

Process connections, Promass A	Material
Mounting set for flanges EN 1092-1 (DIN 2501)/ ASME B16.5/JIS B2220	Stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022
Loose flanges	Stainless steel 1.4404/316L
VCO coupling	Stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022
Tri-Clamp (OD-tubes) (1/2")	Stainless steel 1.4404/316L
Mounting set for SWAGELOK (1/4", 1/8")	Stainless steel 1.4404/316L
Mounting set for NPT-F (1/4")	Stainless steel 1.4404/316L

Process connections, Promass O	Material
Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5	Stainless steel 25Cr duplex EN 1.4410/F53 (superduplex)

Process connections, Promass X	Material
Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5	Stainless steel 1.4404/316/316L

Measuring tube(s)

- Promass F
  - DN 8 to 100: stainless steel SS 1.4539/904L; manifold: 1.4404/316L
  - DN 150: stainless steel 1.4404/316L/1.4432
  - DN 250: stainless steel .4404/316L/1.4432; manifold: CF3M
  - DN 8 to 150: Alloy C-22 2.4602/N 06022
- Promass F (high-pressure version)
  - DN 25, 50, 80: Alloy C-22 2.4602/N 06022
- Promass A
  - Stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022
- Promass O
  - Stainless steel 25Cr Duplex EN 1.4410/F53/UNS S32750 (superduplex)
- Promass X
  - Stainless steel 1.4404/316/316L; manifold: 1.4404/316/316L

Seals

- Promass F, O, X: Welded process connections without internal seals
- Promass A
  - Viton
  - EPDM
  - Silicone
  - Kalrez

Material load diagram	The material load diagrams (pressure–temperature diagrams) for the process connections are provided in the separate "Technical Information" document on the measuring instrument in question. This 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 → 117.
Process connections	→ 112

11.1.11 Operability

Display elements	▪ Liquid crystal display: illuminated, four lines with 16 characters per line ▪ Selectable display of different measured values and status variables ▪ At ambient temperatures below –20 °C (–4 °F), the readability of the display may be impaired.
Operating elements	▪ Local operation with three optical sensors (-/+/E) ▪ Application specific Quick Setup menus for straightforward commissioning
Language groups	Language groups available for operation in different countries: ▪ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ▪ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech ▪ South and east Asia (SEA): English, Japanese, Indonesian ▪ China (CIN): English, Chinese Note! You can change the language group via the operating program "FieldCare".
Remote operation	Operation by means of HART protocol

11.1.12 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 is in conformity with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, IECEx, NEPSI) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is also available upon request.

Suitability for custody transfer measurement

MID approval, Annex MI-002 (gas meter)

The device is qualified to OIML R137/D11.

Promass	DN		OIML R137/MID Evaluation Certificate (Europe)		
			Gas		
	[mm]	[inch]	Mass	Volume	Density
F	8 to 250	3/8 to 10	YES	YES*	NO
A	2 to 4	1/12 to 1/8	YES	YES*	NO
X	350	14	YES	YES*	NO
O	80 to 150	3 to 6	YES	YES*	NO

* at pure gases only (invariable gas density)

MID approval, Annex MI-005 (for liquids other than water)

The device is qualified to OIML R117-1.

Promass	DN		OIML R117-1/MID Evaluation Certificate (Europe)		
			For liquids other than water		
	[mm]	[inch]	Mass	Volume	Density
F	8 to 250	3/8 to 10	YES	YES	YES
A	2 to 4	1/12 to 1/8	YES	YES	YES
X	350	14	YES	YES	YES
O	80 to 150	3 to 6	YES	YES	YES

PTB / METAS / BEV approval

PTB / METAS / BEV approval for determining the mass and volume of liquids, other than water, and of fuel gases. The device is qualified to OIML R117-1.

Promass	DN		PTB-/METAS-/BEV approval for			
			For liquids other than water			High-pressure gas
	[mm]	[inch]	Mass	Volume	Density	(CNG) Mass
F	8 to 250	3/8 to 10	YES	YES	YES	NO
A	2 to 4	1/12 to 1/8	YES	YES	YES	NO

NTEP approval

The measuring instrument is qualified in accordance with the National Type Evaluation Program (NTEP) Handbook 44 ("Specifications and Tolerances and other Technical Requirements for Weighing and Measuring Devices").

Promass	DN		NTEP approval for		
			For liquids other than water		High-pressure gas
	[mm]	[inch]	Mass	Volume	(CNG) Mass
F	15 to 150	½ to 6	YES	YES	NO

MC approval

The measuring instrument is qualified in accordance with "The Draft Ministerial Specifications – Mass Flow Meters" (1993-09-21).

Promass	DN		MC approval for	
			For liquids other than water	
	[mm]	[inch]	Mass	Volume
F	8 to 150	3/8 to 6	YES	YES

Sanitary compatibility	▪ 3A authorization (all measuring systems, except Promass O and X) ▪ EHEDG-tested (all measuring systems, except Promass O and X)
Pressure measuring device approval	The measuring devices can be ordered with or without PED (Pressure Equipment Directive). If a device with PED is required, this must be ordered explicitly. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary. ▪ With the identification PED/G1/III on the sensor nameplate, Endress+Hauser confirms conformity with the "Basic safety requirements" of Appendix I of the Pressure Equipment Directive 97/23/EC. ▪ Devices with this identification (with PED) are suitable for the following types of fluid: – Fluids of Group 1 and 2 with a steam pressure of greater or less than 0.5 bar (7.3 psi) – Unstable gases ▪ Devices without this identification (without PED) are designed and manufactured according to good engineering practice. They correspond to the requirements of Art. 3, Section 3 of the Pressure Equipment Directive 97/23/EC. Their application is illustrated in Diagrams 6 to 9 in Appendix II of the Pressure Equipment Directive 97/23/EC.
Measuring instrument approval	The flowmeter is a suitable component for quantity measurement in legal metrology controlled measuring systems in accordance with Annex MI-005 of the European Measuring Instruments Directive 2004/22/EC (MID). It is qualified to OIML R117-1 and has an MID Evaluation Certificate [1] which confirms compliance with the essential requirements of the Measuring Instruments Directive. Note! According to the Measuring Instruments Directive, however, only the complete measuring system (e.g. gasoline pump) is licensable, covered by an EC-type examination certificate and bears the conformity marking.
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: "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

1) The Evaluation Certificate results from the WELMEC approach (cooperation between the legal metrology services of the member states of the European Union and EFTA) towards modular component certification for measuring systems in accordance with Annex MI-005 (measuring systems for the continuous and dynamic measurement of quantities of liquids other than water) of the Measuring Instruments Directive 2004/22/EC.

11.1.13 Ordering information

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

11.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor → 📄 72.

✎ Note!
Your Endress+Hauser representative can provide detailed information on the order codes of your choice.

11.1.15 Supplementary documentation

- Flow measuring technology (FA00005D)
- Technical Information
  - Promass 84A (TI00067D)
  - Promass 84F (TI00103D)
  - Promass 84O (TI00113D)
  - Promass 84X (TI00111D)
- Description of Device Functions Promass 84 (BA00110D)
- Document "Commissioning Instructions for PTB gas approval" (SD00128D)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, IECEx, NEPSI

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Endress+Hauser
People for Process Automation

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

RA No. ☐☐☐☐☐☐☐☐

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

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp ____

Serial number
Seriennummer ________________________

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

Process data/ *Prozessdaten*

Temperature / *Temperatur* _____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* ________ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium

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

* explosive; oxidizing; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* ____
____
____

Company data / *Angaben zum Absender*

Company / *Firma* ______________________________
____
Address / *Adresse*
____
____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*
____
Fax / E-Mail ______________________________
Your order No. / *Ihre Auftragsnr.* ______________________

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."
"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

______________________ (place, date / *Ort, Datum*)

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