FMC Technologies

Coriolis Mass Flowmeter
Proline Promass 80

Operating Instructions

PROFI
PROCESS FIELD BUS
BUS

Valid as of version
V 3.05.XX (device software)

The Most Trusted Name In Measurement

Brief operating instructions

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

Safety instructions	Page 7

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Switching on the measuring device	Page 46

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Display and operating elements	Page 37

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Basic configuration (device parameters, automation functions)	Page 46 ff.
Configuration programs from various manufacturers can be used to configure device-specific parameters and to specify automation functions for the PROFIBUS interface. ✎ Note! If the measuring device is equipped with a local display, device-specific parameters and functions can be configured easily and quickly using the "Commissioning" Quick Setup menu, e.g. language of the UI, measured variables, engineering units, signal type etc. → see next page	

▼

System integration and cyclic data transmission	→ Page 50 ff.
▪ Use of the device master files (GSD files) ▪ Cyclic data transmission, configuration examples	

▼

Application-specific commissioning	→ Page 39
Device functions, zero point adjustment, density adjustment	

▼

Customer-specific configuration	→ Page 39 ff.
Complex measuring operations necessitate additional functions that you can select and configure as necessary with the aid of the function matrix, and customize to suit your process parameters. ✎ Note! 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!
Always start troubleshooting with the checklist on Page 69 if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

QUICK SETUP "Commissioning"

✎ Note!
More detailed information on running Quick Setup menus, especially for devices without a local display, can be found in the "Commissioning" section. → Page 47 ff.
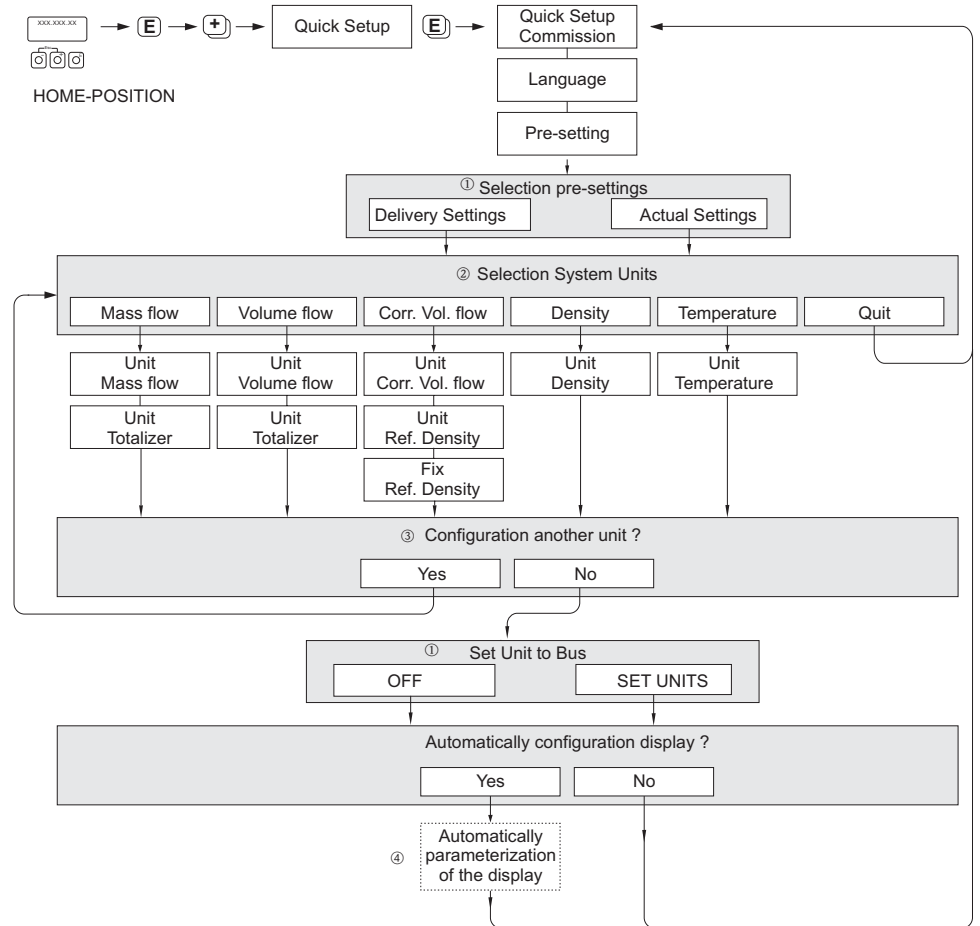

Fig. 1:   Quick Setup "Commissioning"

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

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

1.2   Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner–operator. The specialist must have read and understood these Operating Instructions and must follow the instructions 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 Instructions is mandatory.
- FMC Technologies is willing to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However small changes in temperature, concentration or the degree of contamination in the process can result in changes of the chemical resistance properties. Therefore, FMC Technologies can not guarantee or accept liability for the chemical resistance properties of the fluid wetted materials in a specific application. The user is responsible for the choice of fluid wetted materials in regards to their in–process resistance to corrosion.
- 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 grounded, except in cases where special protective measures have been taken (e.g. galvanically isolated power supply SELV or PELV).
- 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. ⬡ Europe, ◇ USA, ⬤ Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326, and NAMUR 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.
- Due to the performance rate in the electronic components, the maximum heating of the outer housing surfaces is 10 K. When hot media are passed through the measuring tube, the surface temperature of the housing increases. With regard to the sensor, in particular, you should expect temperatures that can be close to the temperature of the medium. If the temperature of the medium is high, ensure staff are protected against burns and scalds.
- The manufacturer reserves the right to modify technical data without prior notice. Your FMC Technologies distributor will supply you with current information and updates to this Operating Instructions.

1.4   Return

The following procedures must be carried out before a flowmeter requiring repair or calibration, for example, is returned to FMC Technologies:
- Always enclose a duly completed "Declaration of contamination" form. Only then can FMC Technologies transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per Regulation (EC) 1907/2006 REACH.
- 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.
  With Promass A and Promass M the threaded process connections must first be removed from the sensor and then cleaned.

Note!
You will find a preprinted "Declaration of contamination" form at the back of this manual.

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

1.5   Notes on safety conventions and icons

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

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

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

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

2   Identification

2.1   Device designation

The "Promass 80/83" flow measuring system consists of the following components:
- Promass 80 or 83 transmitter.
- Promass F, Promass M, Promass E, Promass A, Promass H, Promass I, Promass S or Promass P 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
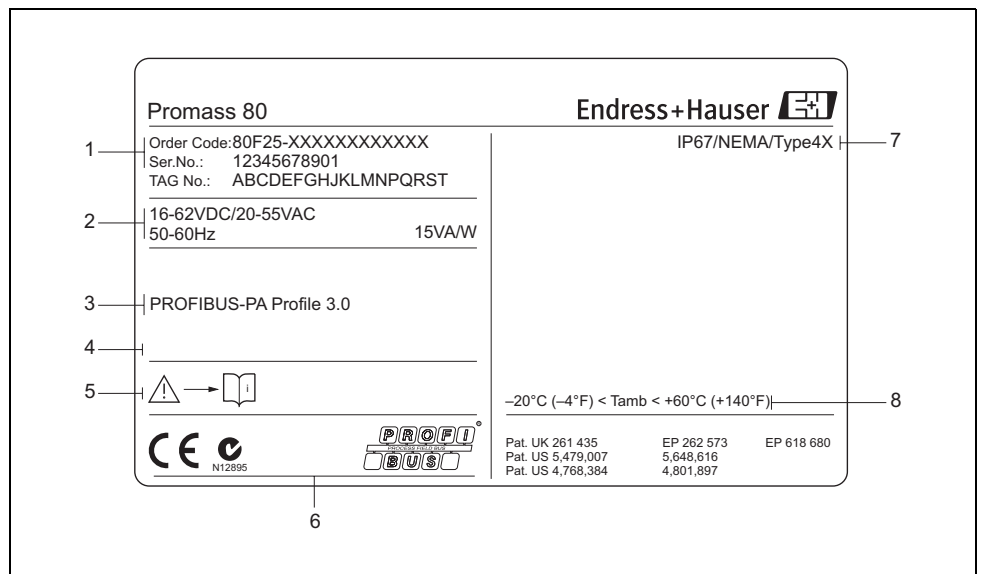
Fig. 2:   Nameplate specifications for the "Promass 80" transmitter (example)

1   Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
2   Power supply/frequency: 16 to 62 V DC / 20 to 55 V AC / 50 to 60 Hz
       Power consumption: 15 VA / W
3   Available inputs/outputs:
       PROFIBUS-PA
4   Reserved for information on special products
5   Please refer to operating instructions / documentation
6   Reserved for additional information on device version (approvals, certificates)
7   Degree of protection
8   Ambient temperature range

2.1.2   Nameplate of the sensor
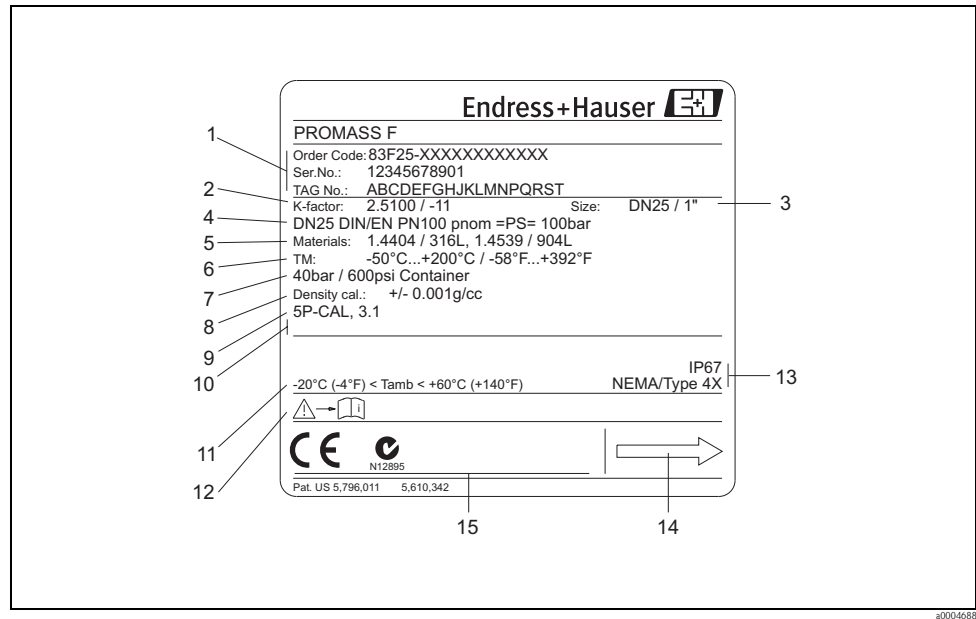
Fig. 3:   Nameplate specifications for the "Promass F" sensor (example)

1   Order code / Serial number: See the specifications on the order confirmation for the meanings of the individual
     letters and digits.
2   Calibration factor with zero point
3   Device nominal diameter/nominal pressure
4   Flange nominal diameter/nominal pressure
5   Measuring tube material
6   Max. fluid temperature
7   Secondary containment pressure range
8   Density accuracy
9   Additional information (examples):
     – 5P-CAL: with 5-point calibration
     – 3.1: with 3.1 certificate for wetted materials
10   Reserved for information on special products
11   Ambient temperature range
12   Please refer to operating instructions / documentation
13   Degree of protection
14   Flow direction
15   Reserved for additional information on device version (approvals, certificates)

2.1.3   Nameplate for connections
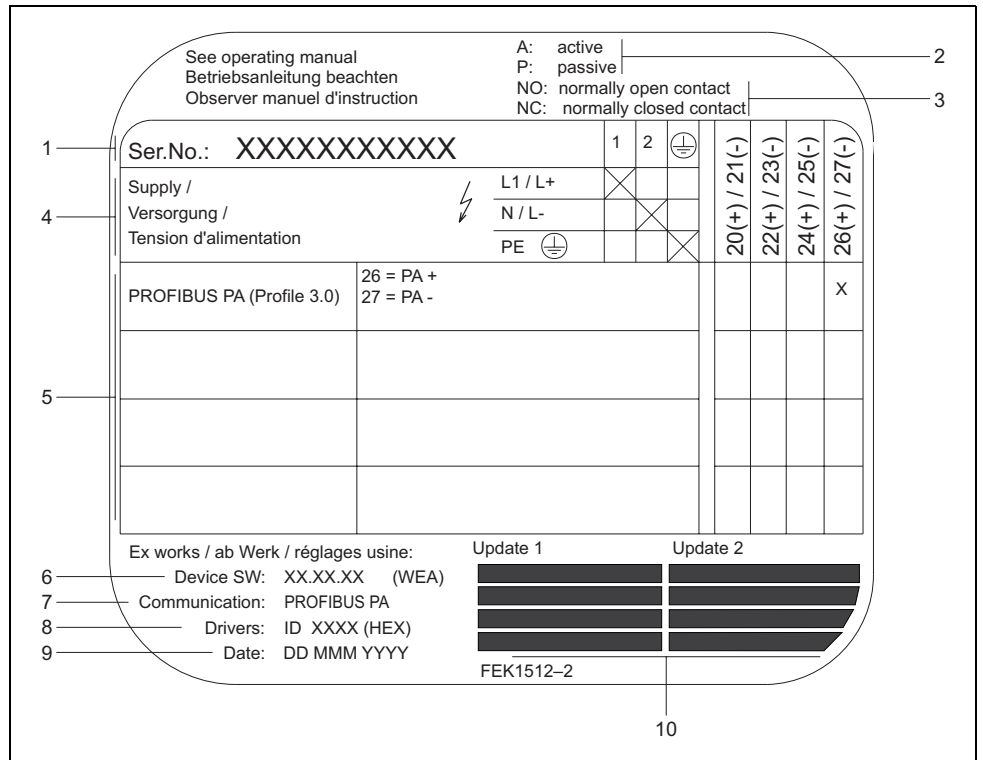
Fig. 4:   Nameplate specifications for Proline sensor (example)

1   Serial number
2   Possible configuration of current output
3   Possible configuration of relay contacts
4   Terminal assignment, cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
      Terminal **No. 1**: L1 for AC, L+ for DC
      Terminal **No. 2**: N for AC, L- for DC
5   Pending signals at the inputs and outputs → Page 91 ff.
      possible configuration and terminal assignment
6   Version of device software currently installed (inclusive language group)
7   Installed communication type
8   PROFIBUS ID No.
9   Date of installation
10   Language group
11   Current updates to data specified in points 6 to 9

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 devices comply with the applicable standards and regulations in accordance with EN 61010–1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" 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 complies with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organization).

The device thus meets all the requirements of the following specifications:
- Certified to PROFIBUS Specification Profile 3.0 version
  (Device certification number: provided upon request)
- The measuring device can also be operated with certified devices of other manufacturers
  (interoperability).

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

PROFIBUS®
Registered trademark of the PROFIBUS User Organization, Karlsruhe, D

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

3   Installation

3.1   Incoming acceptance, transport and storage

3.1.1   Incoming acceptance

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

3.1.2   Transport

The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- 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 (Fig. 5). – Use webbing slings slung round the two process connections. Do not use chains, as they could damage the housing.
- In the case of the Promass M / DN 80 sensor, use only the lifting eyes on the flanges to lift the assembly!

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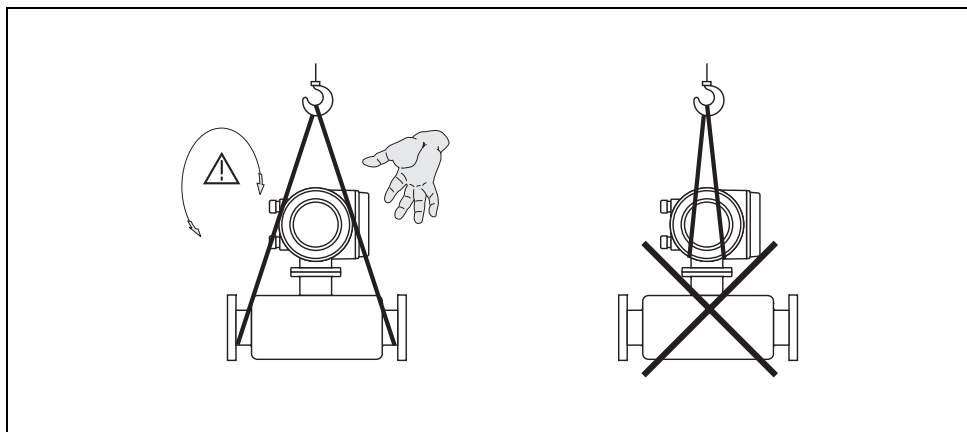
Fig. 5:   Instructions for transporting sensors with > DN 40 (> 1½")

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.

a0003605
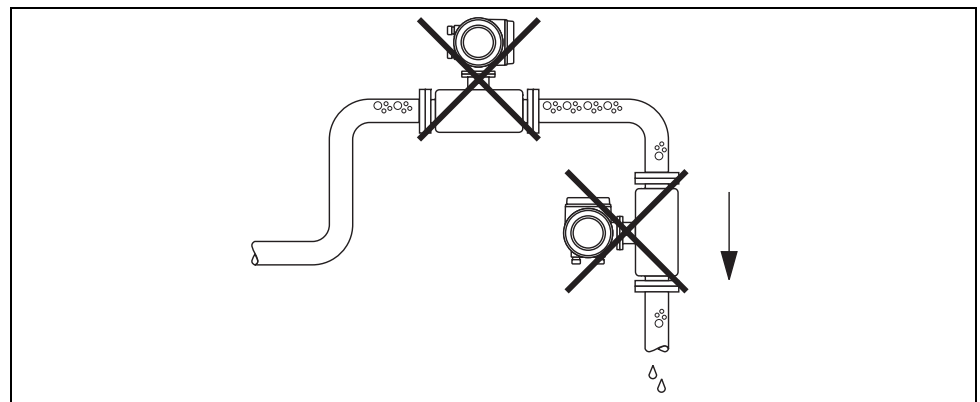
Fig. 6:   Mounting location

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.
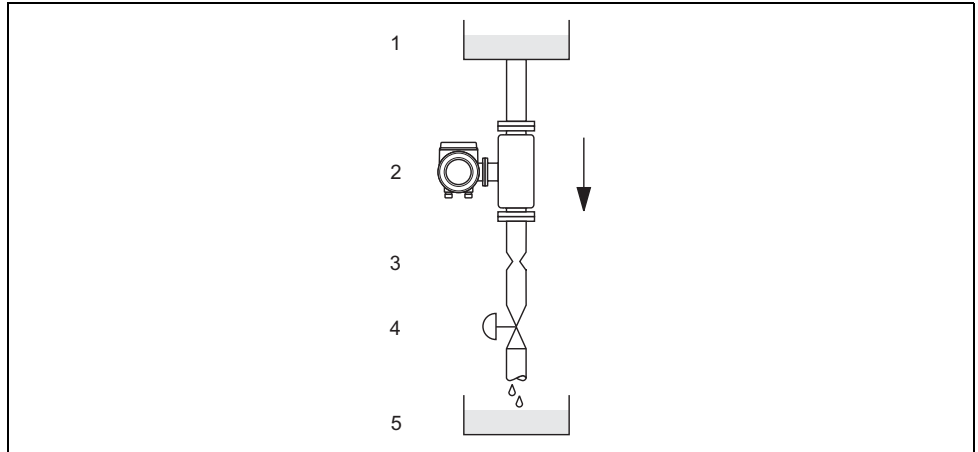
Fig. 7:   Installation in a vertical pipe (e.g. for batching applications)

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

DN		Ø Orifice plate, pipe restrictor		DN		Ø Orifice plate, pipe restrictor	
		mm	inch			mm	inch
1	1/24"	0.8	0.03	40	1½"	22	0.87
2	1/12"	1.5	0.06	40 FB	1½"	35	1.38
4	1/8"	3.0	0.12	50	2"	28	1.10
8	3/8"	6	0.24	50 FB	2"	54	2.00
15	½"	10	0.40	80	3"	50	2.00
15 FB	½"	15	0.60	100	4"	65	2.60
25	1"	14	0.55	150	6"	90	3.54
25 FB	1"	24	0.95	250	10"	150	5.91

FB = Full bore versions of Promass I

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 upward direction of flow. 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:

When installation is correct the transmitter housing is above or below the pipe. This arrangement means that no gas or solid deposits can accumulate in the curved measuring tube (single-tube system).
Do not install the sensor in such a way that it is suspended in the pipe, in other words without support or attachment. This is to avoid excessive strain at the process connection. The base plate of the sensor housing is designed for mounting on a tabletop, wall or post.
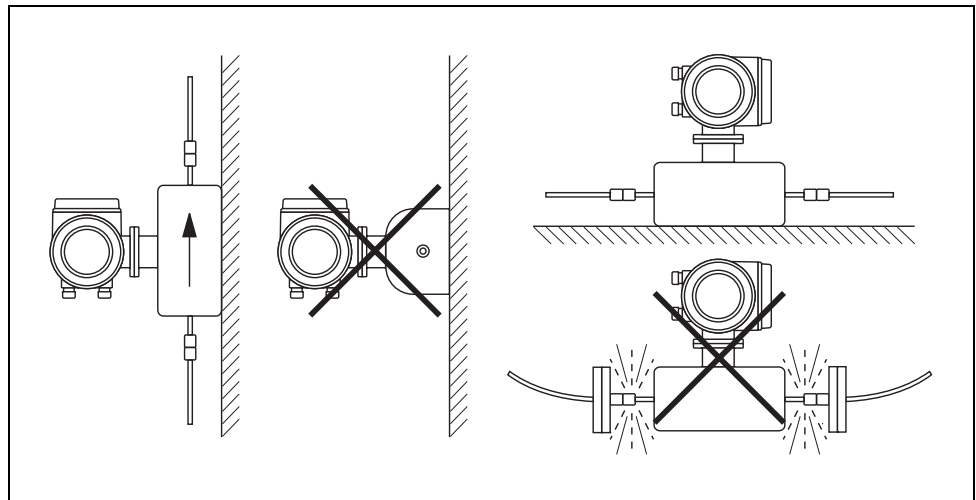
Fig. 8:   Vertical and horizontal orientation (Promass A)

Orientation Promass F, M, E, H, I, S, P

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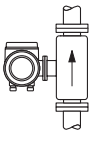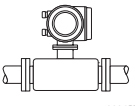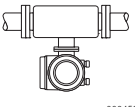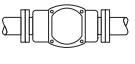
Recommended orientation with upward direction of flow (View V). When fluid is not flowing, entrained solids will sink down and gases will rise away from the measuring tube. The measuring tubes can be completely drained and protected against solids buildup.

Horizontal (Promass F, M, E):

The measuring tubes of Promass F, M and E must be horizontal and beside each other. When installation is correct the transmitter housing is above or below the pipe (View H1/H2). Always avoid having the transmitter housing in the same horizontal plane as the pipe.

Horizontal (Promass H, I, S, P):

Promass H, I, S and P can be installed in any orientation in a horizontal pipe run.

	Promass F, M, E Standard, compact	Promass F, M, E Standard, remote	Promass F High-temperature, compact	Promass F High-temperature, remote	Promass H, I, S, P Standard, compact	Promass H, I, S, P Standard, compact
Abb. V: Vertical orientation	▫▫	▫▫	▫▫	▫▫	▫▫	▫▫
Abb. H1: Horizontal orientation Transmitter head up	▫▫	▫▫	✘ TM > 200 °C (392 °F) ①	▫ TM > 200 °C (392 °F) ①	▫▫	▫▫
Abb. H2: Horizontal orientation Transmitter head down	▫▫ ②	▫▫ ②	▫▫ ②	▫▫ ②	▫▫ ②	▫▫ ②
Abb. H3: Horizontal orientation Transmitter head to the side	✘	✘	✘	✘	▫▫	▫▫

▫▫ = Recommended orientation
▫ = Orientation recommended in certain situations
✘ = Impermissible orientation

In order to ensure that the maximum permissible ambient temperature for the transmitter (−20 to +60 °C (−4 to +140° F), optional −40 to +60 °C (−40 to +140 °F)) is not exceeded, we recommend the following orientations:

① = For fluids with very high temperatures > 200 °C (392 °F), we recommend the horizontal orientation with the transmitter head pointing downwards (Fig. H2) or the vertical orientation (Fig. V).

② = For fluids with 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, E, H, S and P

Caution!
If the measuring tube is curved and the unit is installed horizontally, adapt the sensor position to
the fluid properties.
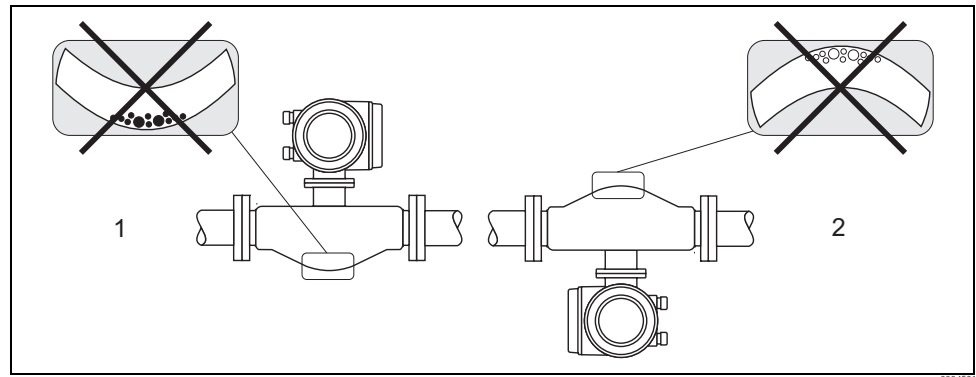
Fig. 9:   Horizontal installation of sensors with curved measuring tube.

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

Promass I and P with Eccentric Tri-clamps

Eccentric Tri-Clamps can be used to ensure complete drainability when the sensor is installed in a
horizontal line. When lines are pitched in a specific direction and at a specific slope, gravity can be
used to achieve complete drainability. The sensor must be installed in the correct position with the
tube bend facing to the side, to ensure full drainability in the horizontal position. Markings on the
sensor show the correct mounting position to optimize drainability.
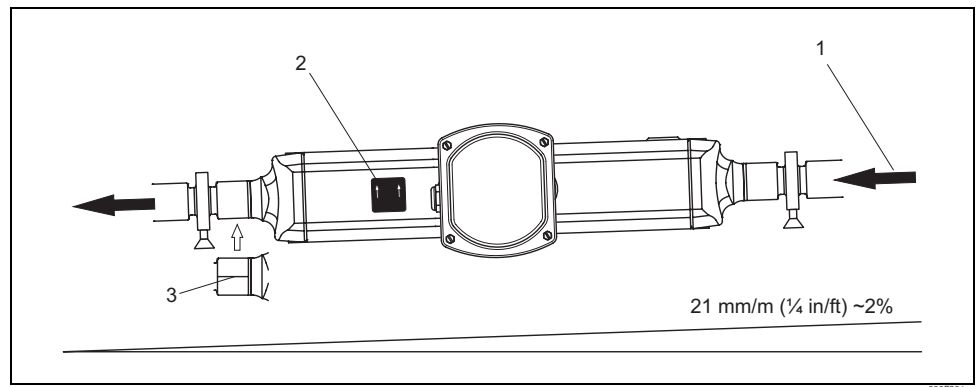
Fig. 10:   Promass P: When lines are pitched in a specific direction and at a specific slope: as per hygienic guidelines
             (21 mm/m or approximatley 2%). Gravity can be used to achieve complete drainability.

1   The arrow indicates the direction of flow (direction of fluid flow through the pipe).
2   The label shows the installation orientation for horizontal drainability.
3   The underside of the process connection is indicated by a scribed line. This line indicates the lowest point of the
        eccentric process connection.
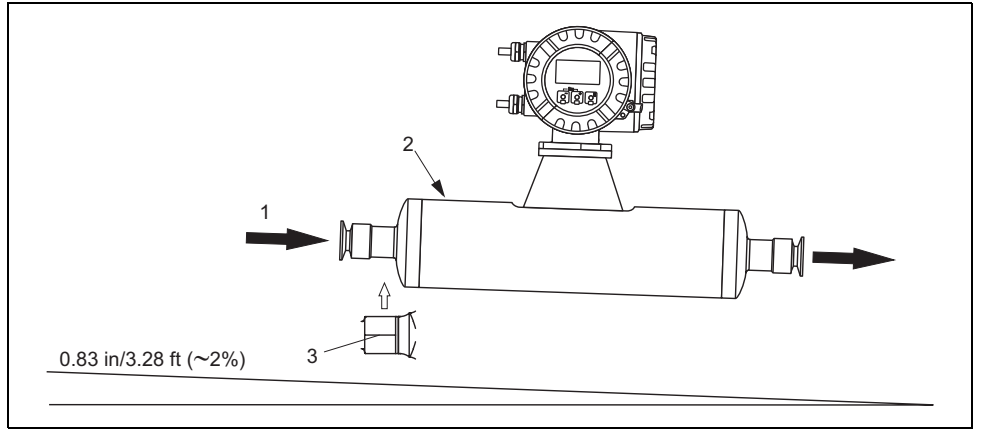
Fig. 11:   Promass I: When lines are pitched in a specific direction and at a specific slope: as per hygienic guidelines
             (21 mm/m or approximatley 2%). Gravity can be used to achieve complete drainability.

1   The arrow indicates the direction of flow (direction of fluid flow through the pipe).
2   The label shows the installation orientation for horizontal drainability.
3   The underside of the process connection is indicated by a scribed line. This line indicates the lowest point of the
        eccentric process connection.

Promass I and P with hygienic connections
(mounting clamp with lining between clamp and instrument)

It is not necessary to support the sensor under any circumstances for operational performance. If the requirement exists to support the sensor the following recommendation should be followed.
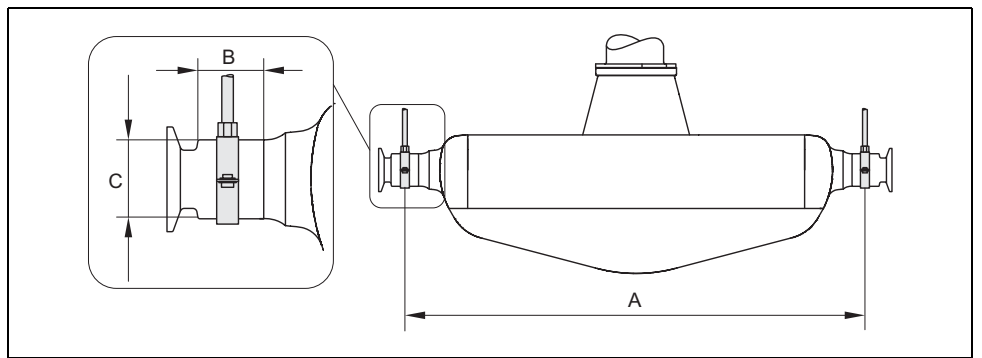
Fig. 12:   Promass P, mounted with mounting clamp

DN	8	15	25	40	50
A	298	402	542	750	1019
B	33	33	33	36.5	44.1
C	28	28	38	56	75

A0010008
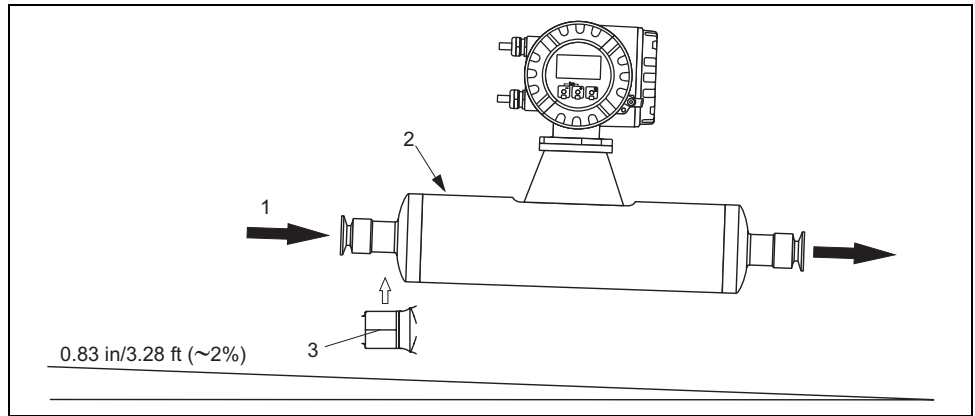
Fig. 13:   Promass I, mounted with mounting clamp

DN	8	15	15FB	25	25FB	40	40FB	50	50FB	50FB	80	80
Tri-Clamp	½"	3/4"	1"	1"	1 ½"	1 ½"	2"	2"	2 ½"	3"	2 ½"	3"
A	373	409	539	539	668	668	780	780	1152	1152	1152	1152
B	20	20	30	30	28	28	35	35	57	57	57	57
C	40	40	44.5	44.5	60	60	80	80	90	90	90	90

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. → Page 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 (except for Promass M).
  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 $d \geq 0.35$ mm (0.0011")
- Information on permissible temperature ranges → Page 99

Special heating jackets which can be ordered as accessories from FMC Technologies 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.
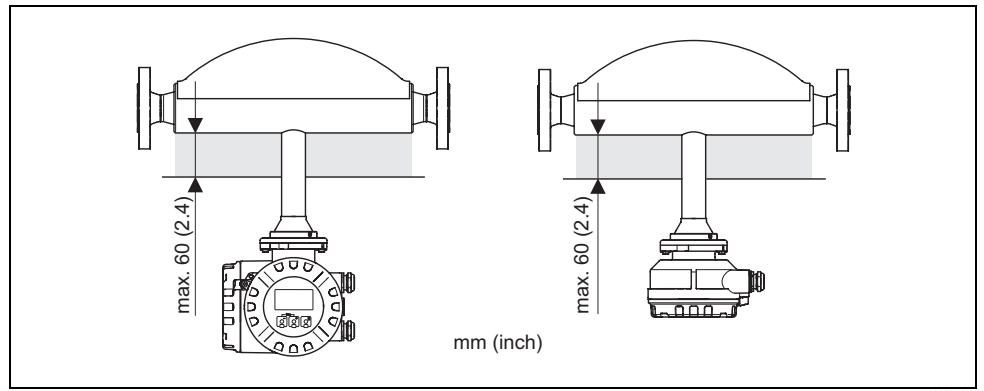
Fig. 14:   In the case of the Promass F high-temperature version, a maximum insulation thickness of 60 mm (2.4") must be observed in the area of the electronics/neck.

If the device 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
→ Seite 88

3.3 Installation instructions

3.3.1 Turning the transmitter housing

Turning the aluminum field housing

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

1. Loosen the two securing screws.

2. Turn the bayonet catch as far as it will go.

3. Carefully lift the transmitter housing as far as it will go.

4. Turn the transmitter housing to the desired position (max. 2 x 90° in either direction).

5. Lower the housing into position and reengage the bayonet catch.

6. Retighten the two securing screws.

a0004302
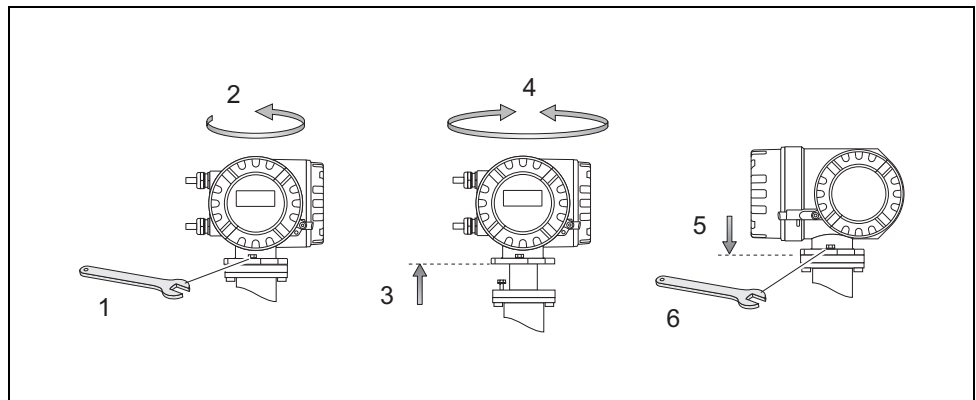
Fig. 15:   Turning the transmitter housing (aluminum field housing)

Turning the stainless steel field housing

1. Loosen the two securing screws.

2. Carefully lift the transmitter housing as far as it will go.

3. Turn the transmitter housing to the desired position (max. 2 x 90° in either direction).

4. Lower the housing into position.

5. Retighten the two securing screws.

a0004303
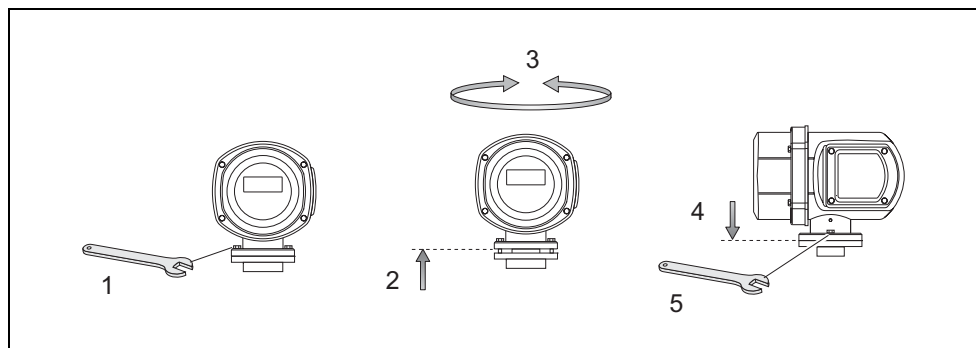
Fig. 16:   Turning the transmitter housing (stainless steel field housing)

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) → Page 24
- Pipe mounting (separate mounting set, accessories) → Page 24

Caution!
- At the mounting location, make sure that the 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.
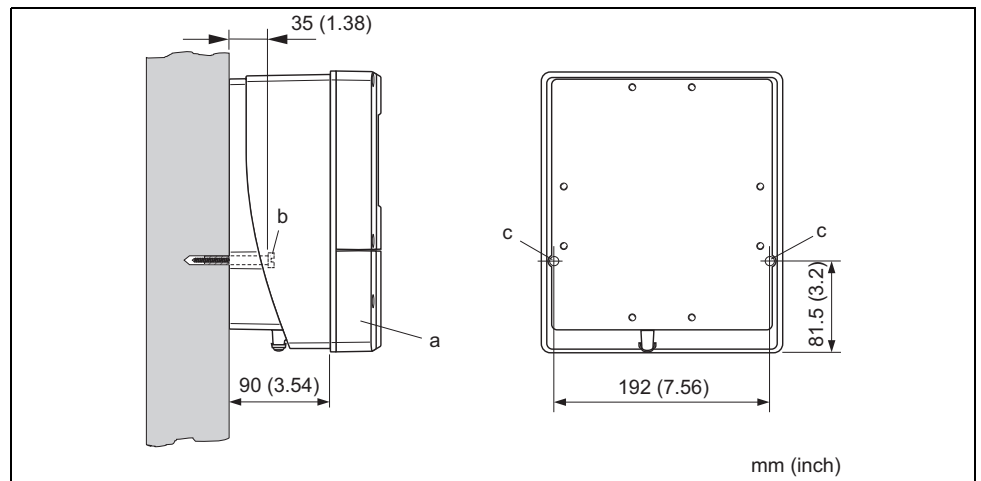
Fig. 17:   Mounted directly on the wall

Panel mounting

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.
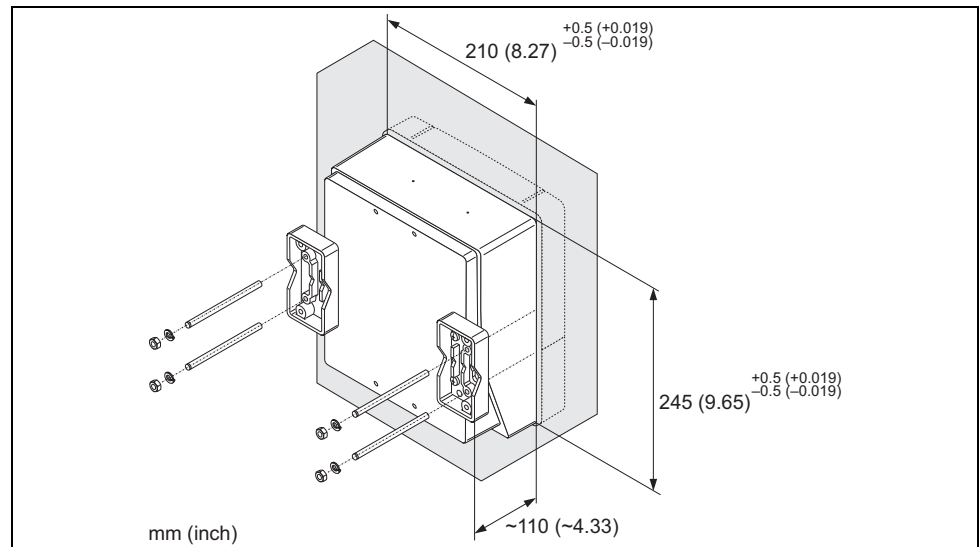
Fig. 18:   Panel installation (wall-mount housing)

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).
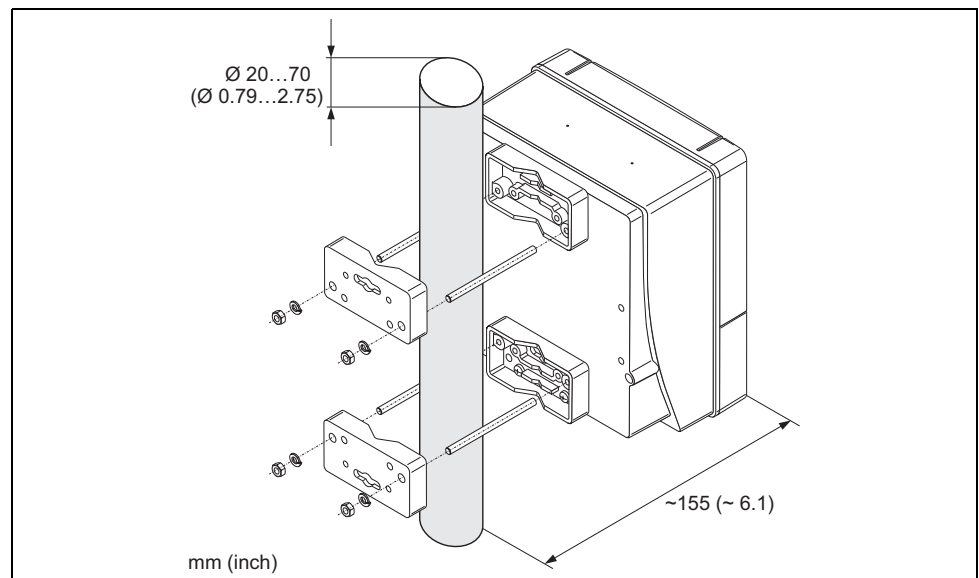
Fig. 19:   Pipe mounting (wall-mount housing)

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 x 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.

a0003236
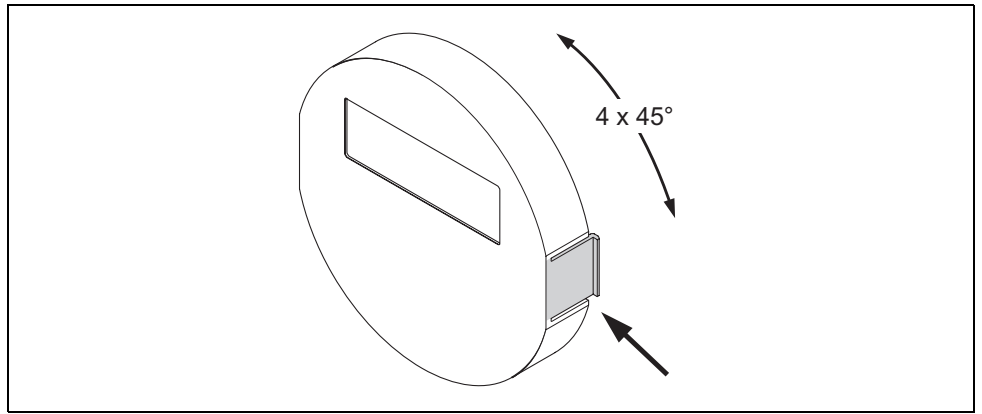
Fig. 20:   Turning the local display (field housing)

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.?	→ Page 7 ff.
Installation	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?	→ Page 14 ff.
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 FMC Technologies sales office if you have any questions.

✎ **Note!**
The device does not have an internal power switch. For this reason, assign the device a switch or power–circuit breaker which can be used to disconnect the power supply line from the power grid.

4.1 PROFIBUS PA cable specifications

4.1.1 Cable type

Twin–core cables are recommended for connecting the device to the fieldbus. Following IEC 61158–2 (MBP), four different cable types (A, B, C, D) can be used with the fieldbus, only two of which (cable types A and B) are shielded.

- Cable types A or B are particularly preferable for new installations. Only these types have cable shielding that guarantees adequate protection from electromagnetic interference and thus the most reliable data transfer. In the case of type B multi–pair cables, it is permissible to operate multiple fieldbuses with the same degree of protection on one cable. No other circuits are permissible in the same cable.
- Practical experience has shown that cable types C and D should not be used due to the lack of shielding, since the freedom from interference generally does not meet the requirements described in the standard.

The electrical data of the fieldbus cable have not been specified but determine important characteristics of the design of the fieldbus, such as distances bridged, number of users, electromagnetic compatibility, etc.

	Type A	Type B
Cable structure	Twisted pair, shielded	One or more twisted pairs, fully shielded
Wire cross–section	0.8 mm^2 (AWG 18)	0.32 mm^2 (AWG 22)
Loop–resistance (DC)	44 Ω/km	112 Ω/km
Characteristic impedance at 31.25 kHz	100 Ω ± 20%	100 Ω ± 30%
Attenuation constant at 39 kHz	3 dB/km	5 dB/km
Capacitive asymmetry	2 nF/km	2 nF/km
Envelope delay distortion (7.9 to 39 kHz)	1.7 μs/km	*
Shield coverage	90%	*
Max. cable length (incl. spurs >1 m)	1900 m (6200 ft)	1200 m (4000 ft)

* Not specified

Suitable fieldbus cables from various manufacturers for non–hazardous areas are listed below:
- Siemens: 6XV1 830–5BH10
- Belden: 3076F
- Kerpen: CeL–PE/OSCR/PVC/FRLA FB–02YS(ST)YFL

4.1.2 Maximum overall cable length

The maximum network expansion depends on the type of protection and the cable specifications. The overall cable length combines the length of the main cable and the length of all the spurs (>1 m (>3 ft)).

Note the following points:
- The maximum permissible overall cable length depends on the cable type used:

Type A	1 900 m	6 200 ft
Type B	1 200 m	4 000 ft

- If repeaters are used, the maximum permissible cable length is doubled.
  A maximum of three repeaters are permitted between user and master.

4.1.3 Maximum spur length

The line between the distribution box and field device is described as a spur.
In the case of non-Ex applications, the max. length of a spur depends on the number of spurs (>1 m) (>3 ft):

Number of spurs		1 to 12	13 to 14	15 to 18	19 to 24	25 to 32
Max. length per spur	[m]	120	90	60	30	1
	[ft]	400	300	200	100	3

4.1.4 Number of field devices

In systems that meet FISCO with EEx ia type of protection, the line length is limited to max. 1 000 m (3 280 ft). A maximum of 32 users per segment in non-Ex areas or a maximum of 10 users in an Ex-area (EEx ia IIC) is possible. The actual number of users must be determined during configuration.

4.1.5 Bus termination

The start and end of each fieldbus segment are always to be terminated with a bus terminator. With various junction boxes (non-Ex), the bus termination can be activated via a switch. If this is not the case, a separate bus terminator must be installed.

Note the following points:
- In the case of a branched bus segment, the device furthest from the segment coupler represents the end of the bus.
- If the fieldbus is extended with a repeater then the extension must also be terminated at both ends.

4.1.6 Further information

General information and further notes regarding the wiring are contained in BA034S/04: "Guidelines for planning and commissioning, PROFIBUS DP/PA, field communication."

4.2   Shielding and grounding

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

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

To ensure the optimum electromagnetic compatibility of systems, it is important that the system components and above all the cables, which connect the components, are shielded and that no portion of the system is unshielded. Ideally, the cable shields are connected to the normally metal housings of the connected field devices. Since these are generally connected to the protective earth, the shield of the bus cable is grounded many times. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.
This approach, which provides the best electromagnetic compatibility and personal safety, can be used without restriction in systems with good potential matching.
In the case of systems without potential matching, a power supply frequency (50 Hz) equalizing current can flow between two grounding points which, in unfavorable cases, e.g. when it exceeds the permissible shield current, may destroy the cable.
To suppress the low frequency equalizing currents on systems without potential equalization, it is therefore recommended to connect the cable shield directly to the building ground (or protective earth) at one end only and to use capacitive coupling to connect all other grounding points.

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

4.3 Connecting the remote version

4.3.1 Connecting connecting cable for 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 parts of the electronics.
- Risk of electric shock. Connect the protective ground 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 cover (d) from the connection compartment or the 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 (see Fig. 21 or wiring diagram inside cover).

4. Seal the connection compartment or the transmitter housing again.
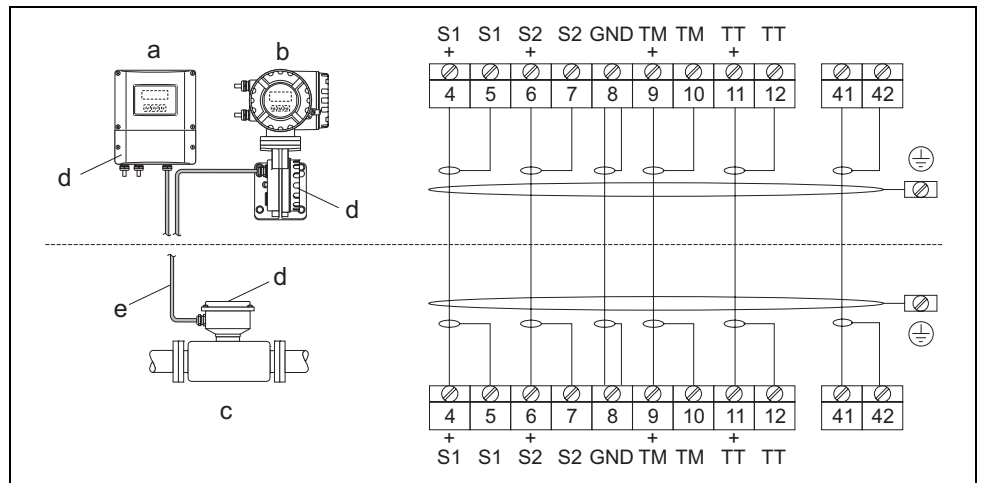
Fig. 21:   Connecting the remote version

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, flange 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

4.3.2 Cable specification for connecting cable

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

- 6 x 0.38 mm^2 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 (3.28 ft)
- Permanent operating temperature: max. +105 °C (+221 °F)

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

4.4 Connecting the measuring unit

4.4.1 Terminal assignment

Electrical values of the inputs → Page 91

Electrical values of the outputs → Page 91

Order version	Terminal No. (outputs/inputs) 26: PA + / 27: PA – (with integrated reverse polarity protection)
80***-***********H	PROFIBUS-PA
PROFIBUS-PA connection data	
U_i = 30 V AC; I_i = 500 mA; P_i = 5.5 W; L_i = 10.0 µH; C_i = 5.0 nF	

4.4.2 Transmitter connection

⚠

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

1. Remove the cover (a) from the connection compartment.

2. Route the power supply cable (b) and fieldbus cable (d) through the appropriate cable entries.

   ✎ Note!
   The measuring devices can also be supplied with the option of a ready-mounted fieldbus connector. Further information: → Page 32

3. Perform wiring: wiring diagram (aluminum housing, stainless steel housing or wall-mount housing) → Fig. 17.

   ☝ Caution!
   – Risk of damaging the fieldbus cable!
     If the shielding of the cable is grounded at more than one point in systems without additional potential equalization, power supply frequency equalization currents can occur that damage the cable or the shielding.
     In such cases the shielding of the cable is to be grounded on only one side, i.e. it must not be connected to the ground terminal of the housing. The shield that is not connected should be insulated!
   – We recommend that the fieldbus cable not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.

   ✎ Note!
   – The terminals for the PROFIBUS PA connection (26/27) have integrated reverse polarity protection. This ensures correct signal transmission via the fieldbus even if lines are mixed up.
   – Conductor cross-section: max. 2.5 mm^2
   – Observe the grounding concept of the plant.
   – Connection values → Chap. 4.4.1

4. Seal the connection compartment again.
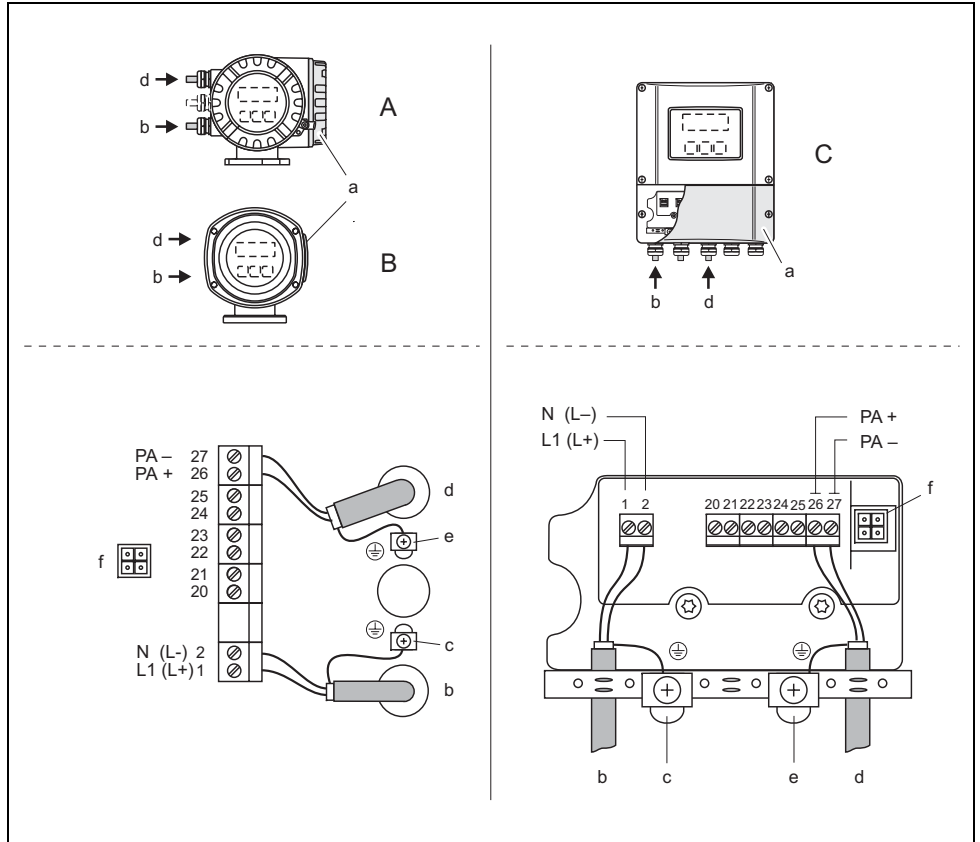
Fig. 22:   Connecting the transmitter, cable cross-section: max. 2.5 mm² (AWG 14)

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

a   Connection compartment cover
b   Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
         Terminal No. 1: L1 for AC, L+ for DC
         Terminal No. 2: N for AC, L− for DC
c   Ground terminal for protective earth
d   Fieldbus cable:
         Terminal No. 26: PA + (with reverse polarity protection)
         Terminal No. 27: PA − (with reverse polarity protection)
e   Ground terminal for fieldbus cable shield
         Observe the following:
         – the shielding and grounding of the fieldbus cable → Page 28
         – that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible
f   Service adapter for connecting service interface FXA193 (Fieldcheck, FieldCare)

4.4.3   Fieldbus connector

Note!
The connector can only be used for PROFIBUS PA devices.

The connection technology of PROFIBUS PA allows measuring devices to be connected to the fieldbus via uniform mechanical connections such as T-boxes, distribution modules etc.

This connection technology using prefabricated distribution modules and plug-in connectors offers substantial advantages over conventional wiring:
- Field devices can be removed, replaced or added at any time during normal operation. Communication is not interrupted.
- Installation and maintenance are significantly easier.
- Existing cable infrastructures can be used and expanded instantly, e.g. when constructing new star distributors using 4-channel or 8-channel distribution modules.

The device can therefore be supplied with the option of a ready-mounted fieldbus connector. Fieldbus connectors for retrofitting can be ordered from Endress+Hauser as a spare part. → Page 67
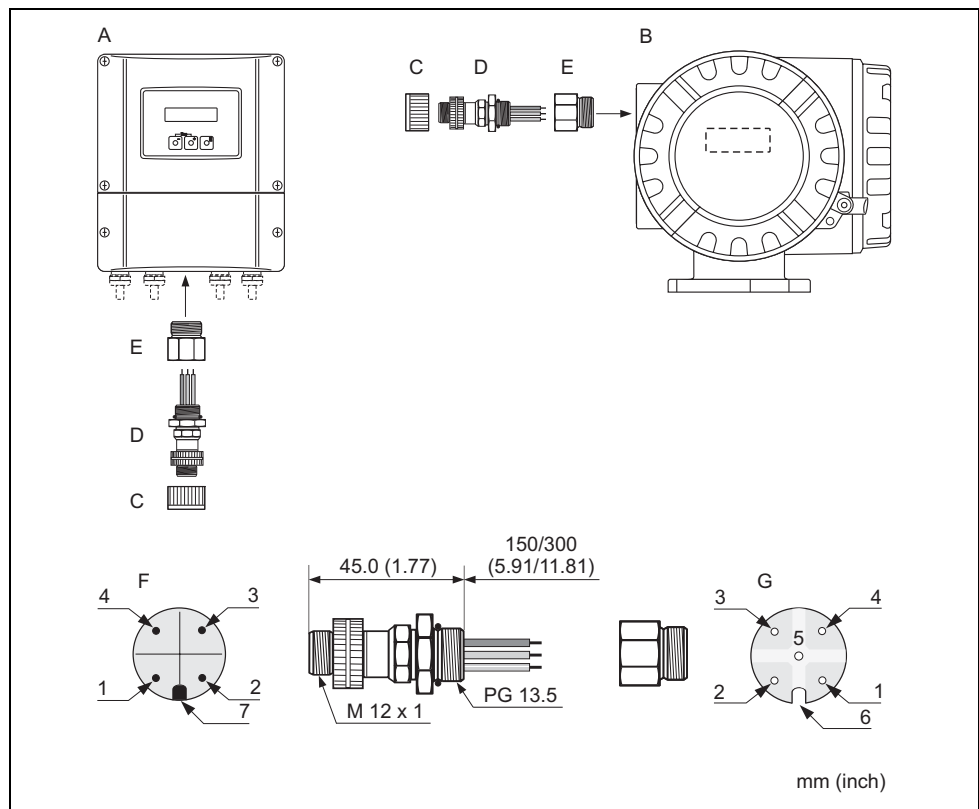
Fig. 23:   Connectors for connecting to the PROFIBUS PA

A   Aluminum field housing
B   Stainless steel field housing
C   Protection cap for connector
D   Fieldbus connector
E   Adapter PG 13.5 / M 20.5
F   Connector at housing (male)
G   Female connector

Pin assignment / color codes:
1   Brown wire: PA + (terminal 26)
2   Not connected
3   Blue wire: PA – (terminal 27)
4   Black wire: ground (instructions for connection → Seite 31 ff.)
5   Middle female connector not assigned
6   Positioning groove
7   Positioning key

Technical data (fieldbus connector):

Connection cross section	0.75 mm^2
Connector thread	PG 13.5
Degree of protection	IP 67 in accordance with DIN 40 050 IEC 529
Contact surface	CuZnAu
Housing material	Cu Zn, surface Ni
Flammability	V – 2 in accordance with UL – 94
Operating temperature	−40 to +85 °C (−40 to +185 °F)
Ambient temperature	−40...+150 °C, (−40... +302 °F)
Nominal current per contact	3 A
Nominal voltage	125 to 150 V DC in accordance with the VDE Standard 01 10/ISO Group 10
Resistance to tracking	KC 600
Volume resistance	≤ 8 mΩ in accordance with IEC 512 Part 2
Insulation resistance	≤ 10^{12} Ω in accordance with IEC 512 Part 2

Shielding of the cable connection/T-box

Use cable glands with good EMC properties, with surrounding contact of the cable gland (iris spring). This requires small differences in potential, and possibly potential matching.
- Do not interrupt the shielding of the PA cable.
- Always keep the connection of the shielding as short as possible.

Ideally, cable glands with iris springs should be used for the connection of the shielding. The shield is placed on the T-box via the iris spring that is inside the cable gland. The shielding mesh is located under the iris spring. When the PG thread is screwed closed, the iris spring is pressed onto the shield, making a conductive connection between the shielding and the metal housing.

A junction box or connection is to be considered part of the shielding (Faraday cage). This is particularly true for offset boxes when these are connected to a PROFIBUS PA measuring device using a plug-in cable. In such a case, use a metallic plug in which the cable shielding is attached to the plug housing (such as prefabricated cables).

4.5   Degree of protection

The devices fulfill all the requirements for IP 67.

Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection is maintained:
- The housing seals must be clean and undamaged when inserted into the sealing groove. The seals must be dried, cleaned or replaced if necessary.
- All the housing screws and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outer diameter. → Page 29
- Firmly tighten the cable entry.
- The cable must loop down in front of the cable entry ("water trap"). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point upwards.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.
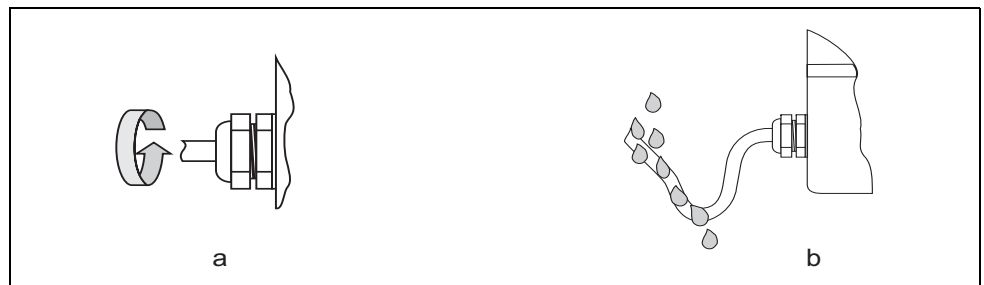
Fig. 24:   Installation instructions, cable entries

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

4.6   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?	PROFIBUS PA → Page 26 Sensor cable → Page 29
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"?	→ Page 34
Are all housing covers installed and firmly tightened?	–
Electrical connection of PROFIBUS	**Notes**
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected with each other correctly?	–
Has each fieldbus segment been terminated at both ends with a bus terminator?	–
Has the max. length of the fieldbus cable been observed in accordance with the PROFIBUS specifications?	→ Page 27
Has the max. length of the spurs been observed in accordance with the PROFIBUS specifications?	→ Page 27
Is the fieldbus cable fully shielded and correctly grounded?	→ Page 33

5   Operation

5.1   Quick operation guide

The user has a number of options for configuring and commissioning the device:

1. **Local display (option)** → Page 37
    The local display enables you to read all important variables directly at the measuring point, configure device-specific parameters in the field and perform commissioning.

2. **Operating programs** → Page 42
    The configuration of profile and device-specific parameters is primarily done via the PROFIBUS interface. You can obtain special configuration and operating programs from various manufacturers for these purposes.

3. **Jumpers/miniature switches for hardware settings**
    – Configuring the device address → Page 45
    – Hardware write protection → Page 44
    You can make the following hardware settings using a jumper or miniature switches on the I/O board:
    ▪ Device bus address configuration (for hardware addressing)
    ▪ Hardware write protection enabling/disabling
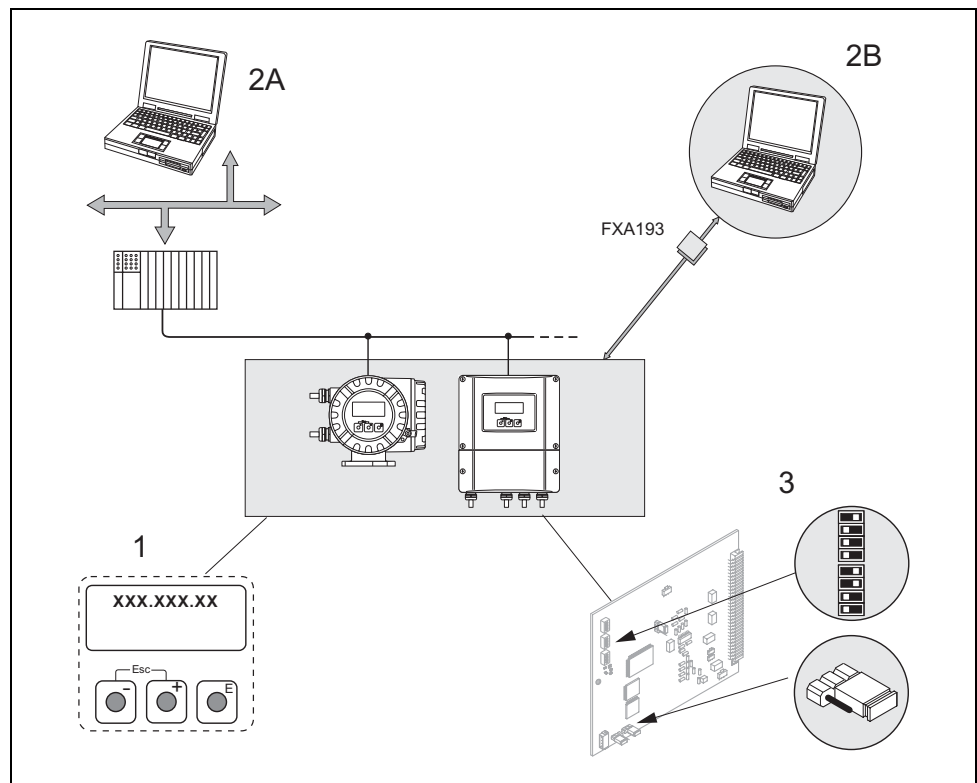
Fig. 25:   Methods of operating PROFIBUS PA

1   Local display for device operation in the field (option)
2A   Configuration/operating programs (e.g. FieldCare) for operation via PROFIBUS PA
2B   Configuration/operating program for operating by means of the FXA193 service interface (e.g. FieldCare)
3   Jumper/miniature switches for hardware settings (write protection, device address)

5.2 Local display

5.2.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device using the "Quick Setup" or the function matrix.
The display 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 ($\rightarrow$ "Description of Device Functions" manual).
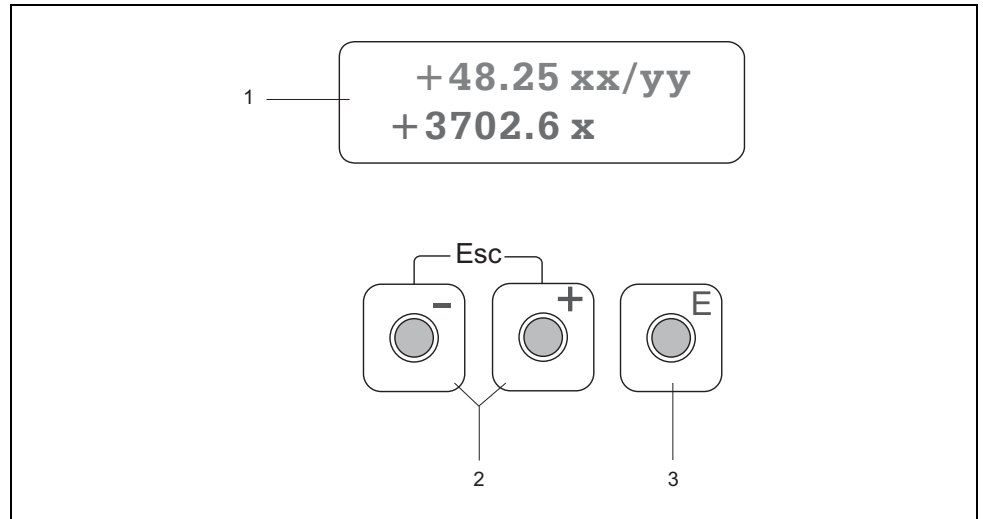
Fig. 26:   Display and operating elements

1   Liquid crystal display
      The two-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).
       – Top line: shows main measured values, e.g. volume flow, [e.g. in ml/min]
       – Bottom line: shows the totalizer reading [e.g. in m^3]
       – Bargraph display, tag name
2    $+$/ $-$ keys
       – HOME position $\rightarrow$ Direct access to totalizer values and actual values of inputs/outputs
       – Enter numerical values, select parameters
       – Select different function groups within the function matrix
      Press the +/- keys ($\boxed{+}\boxed{-}$) simultaneously to trigger the following functions:
       – Exit the function matrix step by step $\rightarrow$ HOME position
       – Press and hold down +/– keys for longer than 3 seconds $\rightarrow$ Return directly to HOME position
       – Cancel data entry
3    $\boxed{E}$ key (Enter key)
       – HOME position $\rightarrow$ Entry into the function matrix
       – Save the numerical values you input or settings you changed

5.2.2   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.

Icons	Meaning
S	System error
!	Notice message
P	Process error
⚡	Fault message
← → (scrolling display)	Cyclic communication via PROFIBUS active, for example via PLC (Class 1 master)
▮ a0001206	Acyclic communication via PROFIBUS active, e.g. via FieldCare

5.3   Brief operating instructions on the function matrix

✎ Note!
- See the general notes → Page 40
- Function descriptions → see the "Description of Device Functions" manual"

1.   HOME position → Ⓔ → Entry into the function matrix

2.   Select a function group (e.g. CURRENT OUTPUT 1)

3.   Select a function (e.g. TIME CONSTANT)
      Change parameter ⁄ enter numerical values:
      ⊞ ⊟ → Select or enter release code, parameters, numerical values
      Ⓔ → Save your entries

4.   Exit the function matrix:
      – Press and hold down Esc key (⊟⊞) for longer than 3 seconds → HOME position
      – Repeatedly press Esc key (⊟⊞) → Return step-by-step to HOME position
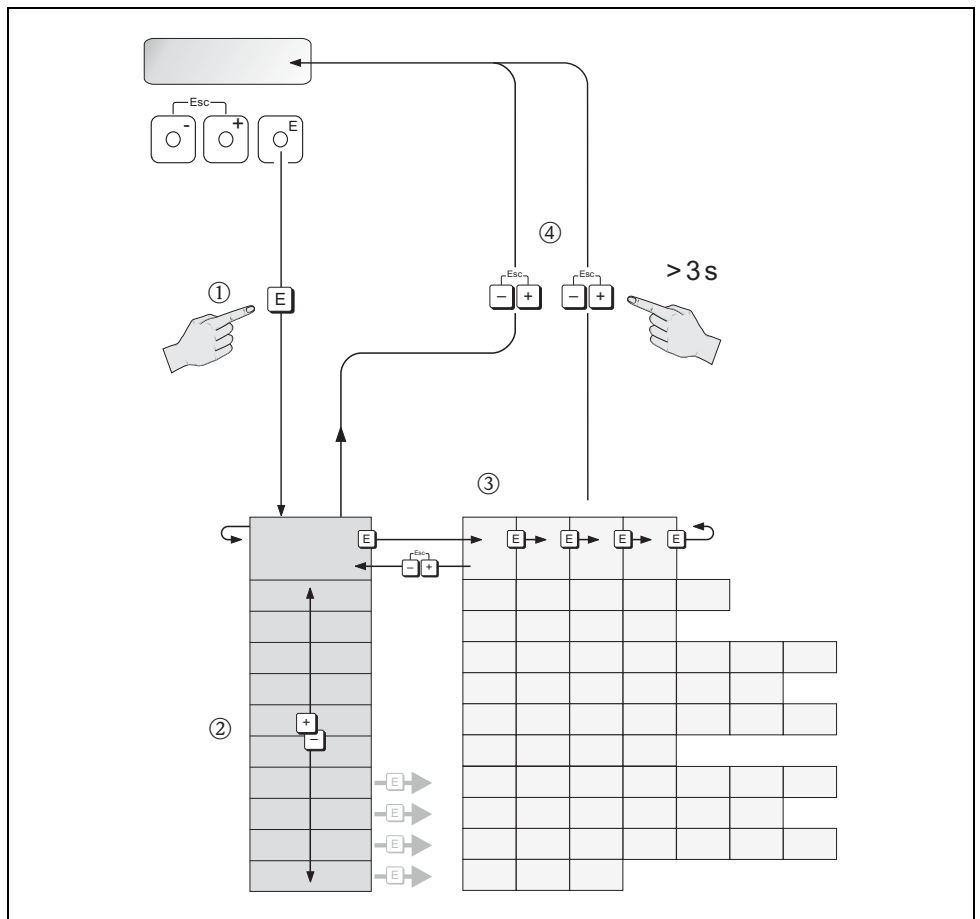
Fig. 27:   Selecting functions and configuring parameters (function matrix)

5.3.1   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 in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described earlier. → Page 39
- 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 ⌑ 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 power supply fails all preset and configured values remain safely stored in the EEPROM.

5.3.2   Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 80) 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!
- The Endress+Hauser service organization can be of assistance if you mislay your personal code.

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

5.3.3   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).

5.4   Error messages

5.4.1   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 error**: This group includes all device errors, e.g. hardware errors, etc. → Page 71
- **Process error**: This group includes all application errors, e.g. fluid not homogeneous, etc.
  → Page 77


```
    ┌──────────────────────┐
1 ──│  P   XXXXXXXXX        │
    │  ⚡  #000  00:00:05   │
    └──────────────────────┘
      2         4      5     3
```
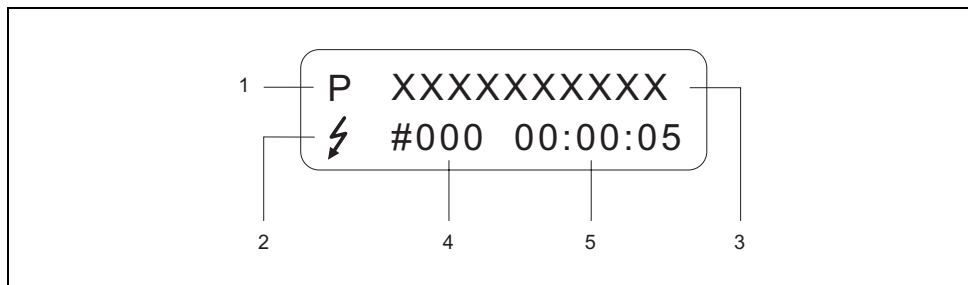
Fig. 28:   Error messages on the display (example)

1   Error type: P = process error, S = system error
2   Error message type: ⚡ = fault message, ! = notice message, definition
3   Error designation: e.g. MEDIUM INHOM. = fluid is not homogeneous
4   Error number: e.g. #702
5   Duration of last error to occur (in hours, minutes and seconds)

5.4.2   Error message type

The measuring device always assigns system and process errors which occur to two types of error messages (fault or notice messages), resulting in different weightings → Page 69.
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)
- The error in question has no effect on the current operation
- Displayed as → Exclamation mark (!), type of error (S: system error, P: process error)
- PROFIBUS device status display, error display → Page 71

Fault message (⚡)
- The error in question interrupts or stops the current operation
- Displayed as → Lightning flash (⚡), type of error (S: system error, P: process error)
- PROFIBUS device status display, error display → Page 71

5.5 Operating options

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

5.5.1 FieldCare

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

5.5.2 Operating program "SIMATIC PDM" (Siemens)

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

5.5.3   Device description files for operating programs

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

Valid for device software:	3.05.XX	→ DEVICE SOFTWARE function
Device data PROFIBUS PA:		
Profile Version:	3.0	→ PROFILE VERSION function
Promass 80 ID No.:	1528hex	→ DEVICE ID function
Profile ID No.:	9742 (Hex)	
GSD file information:		
Promass 80 GSD file:	Extended Format (recommended): Standard Format:	eh3x1528.gsd eh3_1528.gsd
	✎ Note! Before configuring the PROFIBUS network, read and follow the information for using the GSD file → Page 50 ff.	
Bitmaps:	EH_1528_d.bmp/.dib EH_1528_n.bmp/.dib EH_1528_s.bmp/.dib	
Profile GSD file:	PA139742.gsd	
Software release:	12.2007	

Operating program/device description:	Sources for obtaining device descriptions/program updates:
Promass 80 GSD file	▪ www.endress.com → Download
Profile GSD file	▪ www.profibus.com
FieldCare/DTM	▪ www.endress.com → Download ▪ CD–ROM (Endress+Hauser order number: 56004088) ▪ DVD (Endress+Hauser order number: 70100690)
SIMATIC PDM	▪ www.endress.com → Download

Tester/simulator:	How to acquire:
Fieldcheck	▪ Update by means of FieldCare with the Flow Device FXA193/291 DTM in the Fieldflash Module

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

5.6 PROFIBUS PA hardware settings

5.6.1 Hardware write protection

A jumper on the I/O board provides the means of switching hardware write protection on or off. When hardware write protection is switched on, it is **not** possible to write to the device functions via PROFIBUS (acyclic data transmission, e.g. via the operating program "FieldCare").

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

1. Switch off power supply.

2. Remove the I/O board. → Page 81 ff.

3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).

4. Installation is the reverse of the removal procedure.

a0001359
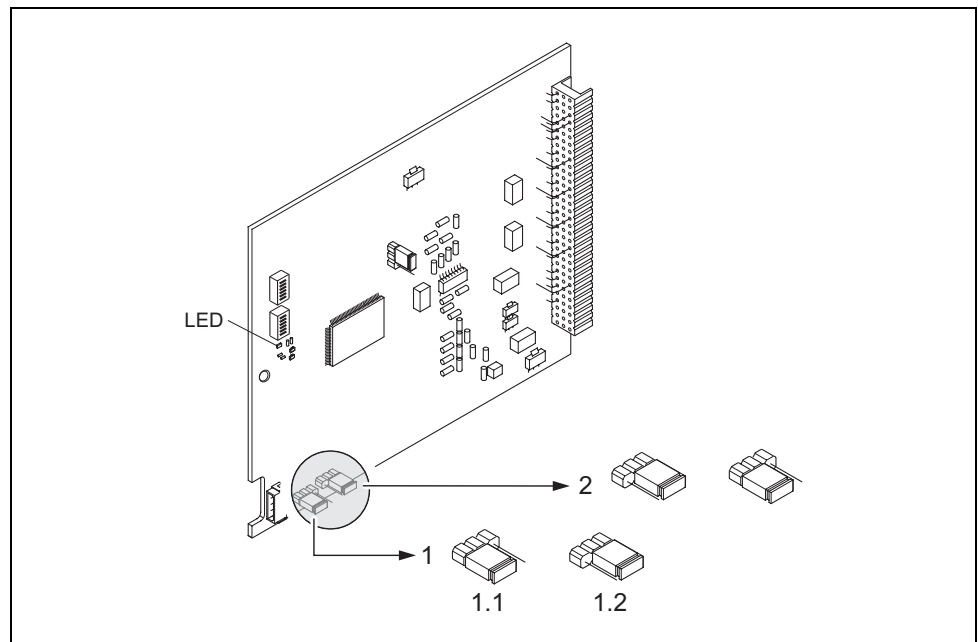
Fig. 29:   Switching write protection on and off with the aid of a jumper on the I/O board

1   Jumper for switching write protection on and off
1.1   Write protection switched off (factory setting) = it is possible to write to the device functions via PROFIBUS (acyclic data transmission, e.g. via the operating program "FieldCare")
1.2   Write protection switched on = it is **not** possible to write to the device functions via PROFIBUS (acyclic data transmission, e.g. via the operating program "FieldCare")

2   Jumper without function

LED   Overview of LED states:
– Lit continuously → Ready for operation
– Not lit → Not ready for operation
– Flashing → System or process error present → Page 69 ff.

5.6.2   Configuring the device address

The address must always be configured for a PROFIBUS PA device. The valid device addresses are in the range from 1 to 126. In a PROFIBUS PA network, each address can only be assigned once. If an address is not configured correctly, the device is not recognized by the master. All measuring devices are delivered from the factory with the address 126 and with software addressing.

Addressing via local operation/operating program

Addressing via miniature switches

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

1.   Loosen the Allen screw (3 mm) of the securing clamp.

2.   Unscrew cover of the electronics compartment from the transmitter housing.

3.   Remove the local display (if present) by loosening the set screws of the display module.

4.   Set the position of the miniature switches on the I/O board using a sharp pointed object.

5.   Installation is the reverse of the removal procedure.

a0002590
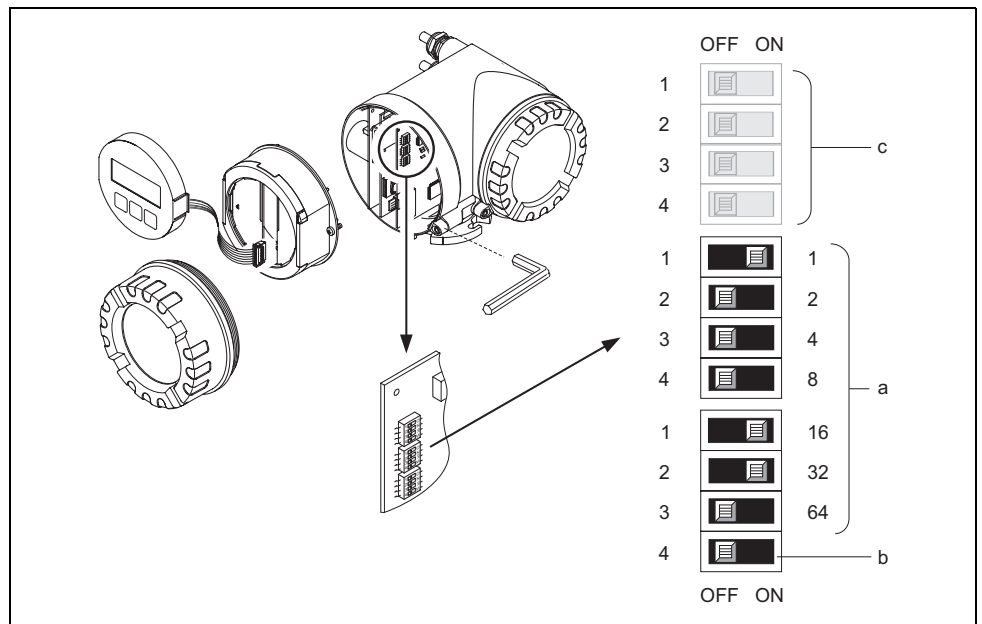
Fig. 30:   Addressing with the aid of miniature switches on the I/O board

a   Miniature switches for setting the device address (illustrated: 1 + 16 + 32 = device address 49)
b   Miniature switches for the address mode (method of addressing):
       OFF = software addressing via local operation/operating program (factory setting)
       ON = hardware addressing via miniature switches
c   Miniature switches not assigned

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" → Page 25
- Checklist for "Post-connection check" → Page 91 → Page 35

6.2   Switching on the measuring device

Once the function check has been performed successfully, the device is operational and can be
switched on via the supply voltage. The device then performs internal test functions and the
following messages are shown on the local display:

PROMASS 80 **START UP…**	Start-up message
▼	
DEVICE SOFTWARE **V XX.XX.XX**	Current software version
▼	
SYSTEM OK **→ OPERATION**	Beginning of normal measuring mode
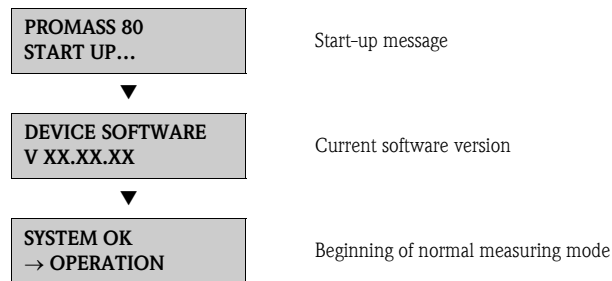
Normal measuring mode commences as soon as startup completes.
Various measured value and/or status variables appear on the display (HOME position).

✎   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 operating program, e.g. FieldCare.

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

6.3.1   Quick Setup "Commissioning"
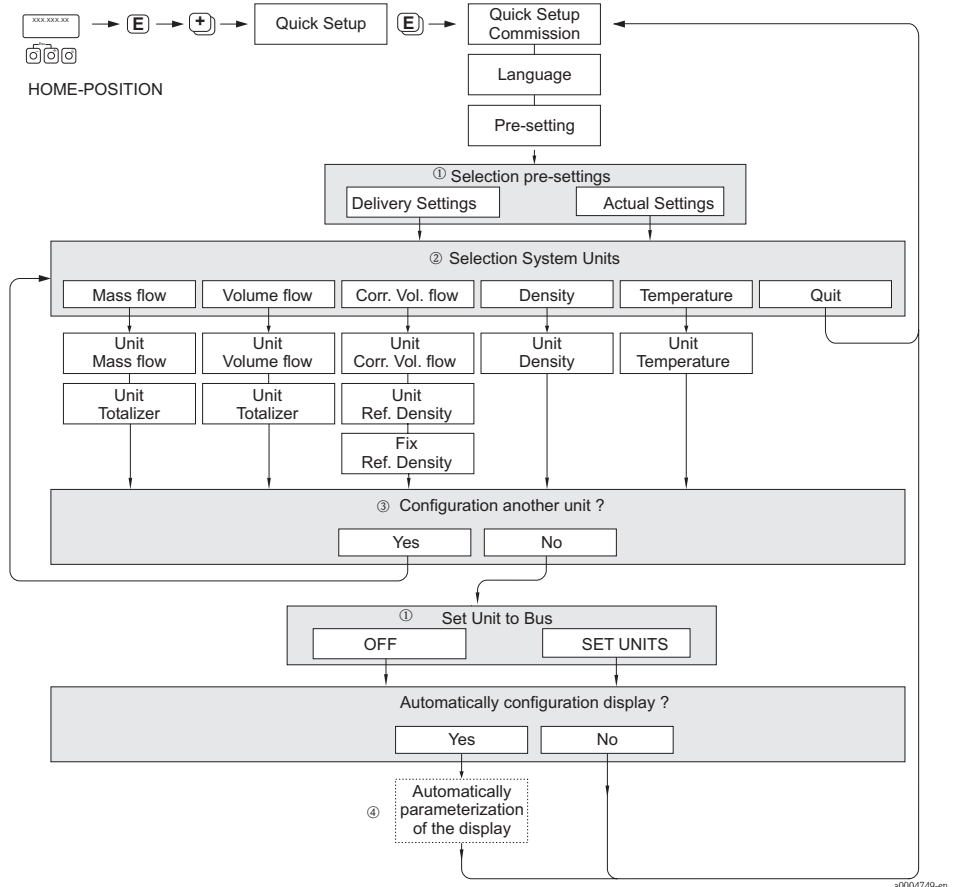
Fig. 31:   Quick Setup "Commissioning"

✎   Note!
- The display returns to the cell SETUP COMMISSIONING (1002) if you the press ⌨ 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 SETTINGS" accepts the units you configured beforehand.

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 The "automatic parameterization of the display" option contains the following basic settings/factory settings:
YES: line 1= mass flow; line 2 = totalizer 1
NO: The existing (selected) settings remain.

6.4 Commissioning the PROFIBUS PA interface

✎ Note!
- All functions required for commissioning are described in detail in the "Description of Device Functions" manual which is a separate part of these Operating Instructions.
- A code (factory setting: 80) must be entered to change device functions, numerical values or factory settings.

The following steps must be carried out in the sequence specified:

1. **Check the hardware write protection:**
   The WRITE PROTECT parameter indicates whether it is possible to write to the device via PROFIBUS communication (e.g. via FieldCare).

   ✎ Note!
   This check is not needed if operating via the local display.

   COMMUNICATION → WRITE PROTECT…
   … → OFF displayed (factory setting): write access via PROFIBUS possible
   … → ON displayed: write access via PROFIBUS **not** possible

   Deactivate the write protection if necessary → Page 44

2. **Enter the tag name (optional):**
   COMMUNICATION → TAG NAME

3. **Configuring the fieldbus address:**
   Set the bus address:
   – Software addressing using the local display:
      COMMUNICATION → BUS ADDRESS
   – Hardware addressing via miniature switches → Page 45

4. **Select the system units:**
   - Via the system units group:
      SYSTEM UNITS → UNIT VOL. FLOW → UNIT VOLUME → UNIT…
   - In the SET UNIT TO BUS function, select the SET UNITS function to transfer the cyclically transmitted volume flow to the PROFIBUS master (Class 1) with the system unit set in the measuring device.
      COMMUNICATION → SET UNIT TO BUS

   ✎ Note!
   – The configuration of the engineering units for the totalizers is described separately → see Point 6
   – If a system unit is altered via local operation, this initially does not affect the unit that is used to transfer the volume flow to the automation system.
      The SET UNIT TO BUS function has to be activated in the COMMUNICATION block before the altered system unit of the measured value is transmitted to the automation system.

5. **Setting the measuring mode:**
   SYSTEM PARAMETER → MEASURING MODE
   Select the flow components that should be recorded by the measuring device:
   – UNIDIRECTIONAL (factory setting) = only the positive flow portions
   – BIDIRECTIONAL = the positive and negative flow components

6. **Configuration of the totalizer:**
   The measuring device has one totalizer.

   - You can assign a measured variable to the totalizer via the CHANNEL parameter:
      TOTALIZER → CHANNEL …
      … → VOLUME FLOW option (CHANNEL = 273), factory setting: the volume flow is totalized as the measured variable
      … → OFF option (CHANNEL = 0): no totalizing, the value 0 is displayed as the totalizer value

✎ Note!
If the module or the TOTAL function was integrated when configuring the PROFIBUS network, the measured variable selected in the CHANNEL parameter is cyclically transmitted to the PROFIBUS master (Class 1) (for further information, see Page 53).

■ Enter the desired totalizer units:
TOTALIZER → UNIT TOTALIZER (factory setting: m³)

■ Configure totalizer status (e.g. totalize):
TOTALIZER → SET TOTALIZER...
... → Select: TOTALIZE

■ Configure the totalizer mode:
TOTALIZER → TOTALIZER MODE...
... → BALANCE option (factory setting): calculates the positive and negative flow components
... → POSITIVE option: calculates the positive flow components only
... → NEGATIVE option: calculates the negative flow components only
... → HOLD VALUE option: the totalizer remains at the last value

✎ Note!
For the calculation of the positive and negative flow components (BALANCE) or the negative flow components only (NEGATIVE) to be carried out correctly, the option BIDIRECTIONAL must be active in the SYSTEM PARAMETER → MEASURING MODE function.

7. **Select the operating mode:**
Select the operating mode (GSD file) which should be used for cyclic data transmission to the PROFIBUS master.

COMMUNICATION → SELECTION GSD...
... → MANUFACT. SPEC. option (factory setting): the complete device functionality is available
... → PROFILE-GSD option: the device is operated in the PROFIBUS Profile mode

✎ Note!
For PROFIBUS network configuration, make sure that the right device master file (GSD file) of the measuring device is used for the selected operating mode → Page 50.

8. **Configuration of cyclic data transmission in the PROFIBUS master**
A detailed description of the system integration can be found on → Page 50.

6.5   PROFIBUS PA system integration

6.5.1   Device master file (GSD file)

For PROFIBUS network configuration, the device master file (GSD file) is needed for every bus user (PROFIBUS slave). The GSD file contains a description of the properties of a PROFIBUS device, such as supported data transmission rate and number of input and output data.
Before configuration takes place, a decision should be made as to which GSD file should be used to operate the measuring device in the PROFIBUS DP master system.

The measuring device supports the following GSD files:
- Promass 80 GSD file (manufacturer-specific GSD file, complete device functionality)
- PROFIBUS Profile GSD file.

Below you will find a detailed description of the GSD files supported.

Promass 80 GSD file (manufacturer-specific GSD file, complete device functionality)

Use this GSD file to access the complete functionality of the measuring device. In this way, device-specific measured variables and functionalities are thus completely available in the PROFIBUS master system. An overview of the modules available (input and output data) is contained on the following pages:
PROFIBUS PA → Page 53 ff.

GSD file with standard or extended format

The GSD file with either the standard or the extended format must be used depending on the configuration software used. When installing the GSD file, the GSD file with the extended format (EH3**x**15xx.gsd) should always be used first.
However, if the installation or the configuration of the measuring device fails with this format, then use the standard GSD (EH3_15xx.gsd). This differentiation is the result of different implementation of the GSD formats in the master systems. Note the specifications of the configuration software.

Name of the Promass 80 GSD file

	ID No.	GSD file		Type file	Bitmaps
PROFIBUS PA	1528 (Hex)	Extended Format (recommended): Standard Format:	EH3x1528.gsd EH3_1528.gsd	EH_1528.200	EH_1528_d.bmp/.dib EH_1528_n.bmp/.dib EH_1528_s.bmp/.dib

How to acquire

- Internet (Endress+Hauser) → www.endress.com (→ Download → Software → Device Driver)
- CD-ROM with all GSD files for Endress+Hauser devices → Order No.: 56003894

Contents of the download file from the Internet and the CD-ROM:

- All Endress+Hauser GSD files (standard and extended format)
- Endress+Hauser type files
- Endress+Hauser bitmap files
- Information on the devices

PROFIBUS Profile GSD file:

The function scope of the profile GSD file is defined by the PROFIBUS Profile Specification 3.0. The function scope is restricted compared to the manufacturer-specific GSD file (complete device functionality). However, similar devices from different manufacturers can be interchanged with the profile GSD file without the need to reconfigure (interchangeability).

Profile GSD (multivariable) with the ID number 9760 (Hex): This GSD contains all the function blocks such as AI, DO, DI etc. This GSD is not supported by Promass.

Note!
- Before configuration takes place, a decision should be made as to which GSD should be used to operate the system.
- The setting can be changed via the local display or using a Class 2 master. Setting via the local display. Page 48

GSD files supported: → Page 43

Each device receives an identification number (ID No.) from the Profibus User Organization (PNO). The name of the device master file (GSD) is derived from this.
For Endress+Hauser, this ID No. starts with the manufacturer ID 15xx.
In order to ensure clarity and make assignment easier, the GSD names (with the exception of type files) at Endress+Hauser are as follows:

EH3_15xx	EH = Endress + Hauser 3 = Profile 3.0 _ = Standard ID 15xx = ID No.
EH3x15xx	EH = Endress + Hauser 3 = Profile 3.0 x = Extended ID 15xx = ID No.

Name of the PROFIBUS Profile GSD file

	ID No.	Profile GSD file
PROFIBUS PA	9742 (Hex)	PA139742.gsd

Source

Internet (GSD library of the PROFIBUS User Organization) → www.PROFIBUS.com

6.5.2   Selecting the GSD file in the measuring device

Depending on which GSD file is used in the PROFIBUS master system, the corresponding GSD file has to be configured in the device by means of the SELECTION GSD function.

COMMUNICATION → SELECTION GSD

Promass 80 GSD file	→	Select: MANUFACT. SPEC. (factory setting)
Profile GSD file	→	Select: PROFILE-GSD

Example

Before configuration takes place, a decision should be made as to which GSD file should be used to configure the measuring device in the PROFIBUS master system. Below, the use of the manufacturer-specific GSD file (complete device functionality) is shown using **PROFIBUS PA** as an example:

Select the manufacturer-specific GSD file in the measuring device by means of the SELECTION GSD function.

COMMUNICATION → SELECTION GSD → Select: MANUFACT. SPEC. (factory setting)

1. Before configuring the network, load the corresponding GSD file into the configuration system/master system.

    ✎   Note!
    When installing the GSD file, always first use the GSD file with the extended format (EH3x1528.gsd). However, if the installation or the configuration of the device fails with this format, then use the standard GSD (EH3_1528.gsd).

    Example for the configuration software Siemens STEP 7 of the Siemens PLC family S7-300/400:
    Use the GSD file with the extended format (EH3x1528.gsd). Copy the file to the subdirectory "…\siemens\step7\s7data\gsd". The GSD files also include bitmap files. These bitmap files are used to display the measuring points in image form. The bitmap files must be saved to the directory "…\siemens\step7\s7data\nsbmp".

    If you are using configuration software other than that referred to above, ask your PROFIBUS master system manufacturer which directory you should use.

2. The measuring device is a modular PROFIBUS slave, i.e. the desired module configuration (input and output data) must be performed in the next step. This can be done directly by means of the configuration software.

6.5.3   imum number of writes

If a nonvolatile device parameter is modified via the cyclic or acyclic data transmission, this change is saved in the EEPROM of the measuring device.
The number of writes to the EEPROM is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss and measuring device failure. For this reason, avoid constantly writing nonvolatile device parameters via the PROFIBUS!

6.6 Cyclic data transmission PROFIBUS PA

Below is a description of the cyclic data transmission when using the Promass 80 GSD file (complete device functionality).

6.6.1 Block model

The block model illustrated shows which input and output data Promass 80 provides for cyclic data exchange via PROFIBUS PA.
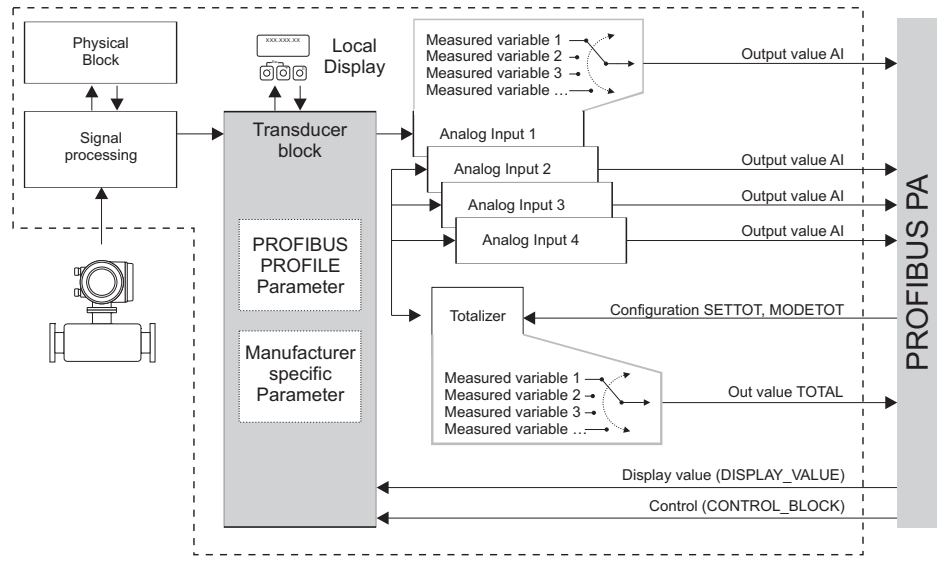
Fig. 32:   Block model for Promass 80 PROFIBUS PA Profile 3.0

6.6.2 Modules for cyclic data transmission

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable – it consists of several individual modules. In the GSD file, the individual modules (input and output data) are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules (see following table). Gaps between configured modules have to be assigned the EMPTY_MODULE module.
To optimize the data throughput rate of the PROFIBUS network, it is recommended to only configure modules that are processed in the PROFIBUS master system.

It is essential to adhere to the following sequence/assignment when configuring the modules in the PROFIBUS master system:

Slot sequence	Module	Description
1	AI	**Analog Input function block 1** Output variable → mass flow (factory setting)
2	AI	**Analog Input function block 2** Output variable → volume flow (factory setting)
3	AI	**Analog Input function block 3** Output variable → corrected volume flow (factory setting)
4	AI	**Analog Input function block 4** Output variable → density (factory setting)
5	TOTAL or SETTOT_TOTAL or SETTOT_MODETOT_TOTAL	**Totalizer function block 1** TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
6	DISPLAY_VALUE	Default value for local display
7	CONTROL_BLOCK	Control of device functions

✎ Note!
- The assignment of the measured variables for the Analog Input function blocks 1 to 4 and the Totalizer function block 1 can be changed by means of the CHANNEL function. A detailed description of the individual modules is contained in the following section.
- The device has to be reset once a new configuration has been loaded to the automation system. This can be effected as follows:
  – By means of the local display
  – By means of an operating program (e.g. FieldCare)
  – By switching the supply voltage off and on again.

6.6.3   Description of the modules

AI module (Analog Input)

The corresponding measured variable, including the status, is cyclically transmitted to the PROFIBUS master (Class 1) by means of the AI module (slots 1 to 4). The measured variable is represented in the first four bytes in the form of floating point numbers in accordance with the IEEE 754 standard. The fifth byte contains standardized status information corresponding to the measured variable.
Further information on the device status → Page 71

Input data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Measured variable (IEEE 754 floating point number)				Status

Assignment of the measured variables to the AI module

The AI module can transmit different measured variables to the PROFIBUS master (Class 1). The measured variables are assigned to the Analog Input function blocks 1 to 4 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the CHANNEL function:

COMMUNICATION → BLOCK SELECTION: select an Analog Input function block → CHANNEL: select a measured variable

Possible settings

Measured variable	ID for CHANNEL function
MASS FLOW	277
VOLUME FLOW	273
CORRECTED VOLUME FLOW	398
DENSITY	281
REFERENCE DENSITY	402
TEMPERATURE	285

Factory setting:

Module	Analog Input function block	Measured variable	Unit	ID for CHANNEL function
AI (slot 1)	1	MASS FLOW	kg/s	277
AI (slot 2)	2	VOLUME FLOW	m/h	273
AI (slot 3)	4	DENSITY	kg/l	281
AI (slot 4)	6	TEMPERATURE	K	285

Example:

You want to cyclically transmit the mass flow to the PROFIBUS master (Class 1) by means of the Analog Input function block 1 (module AI, slot 1) and the temperature by means of the Analog Input function block 2 (module AI, slot 2).

1.   COMMUNICATION → BLOCK SELECTION: select ANALOG INPUT 1, then select CHANNEL = MASS FLOW

2.   COMMUNICATION → BLOCK SELECTION: select ANALOG INPUT 2, then select CHANNEL = TEMPERATURE

TOTAL module

The measuring device has one totalizer function block. The totalizer values can be cyclically transmitted to the PROFIBUS master (Class 1) via the TOTAL module (slot 5). The totalizer value is represented in the first four bytes in the form of a floating point number in accordance with the IEEE 754 standard. The fifth byte contains standardized status information corresponding to the totalizer value.
Further information on the device status → Page 71

Input data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Totalizer value (IEEE 754 floating point number)				Status

Assignment of the measured variables to the TOTAL module

The TOTAL module can transmit different totalizer variables to the PROFIBUS master (Class 1). The measured variables are assigned to the Totalizer function block by means of the local display or with the aid of an operating program (e.g. FieldCare) in the "CHANNEL" function:

TOTALIZER → TOTALIZER option: select a totalizer →
CHANNEL: select a measured variable

Possible settings

Totalizer value/measured variable	ID for CHANNEL function
MASS FLOW	277
VOLUME FLOW	273
CORRECTED VOLUME FLOW	398
OFF	0

Factory setting

Module	Totalizer function block	Totalizer value/ Measured variable	Unit	ID for CHANNEL function
TOTAL (slot 5)	1	MASS FLOW	kg/s	277

Example:

You want to cyclically transmit the totalized volume flow as totalizer value 1 to the PROFIBUS master (Class 1) by means of the TOTAL module (slot 5):

TOTALIZER → TOTALIZER option: select TOTALIZER 1, then select CHANNEL = VOLUME FLOW

SETTOT_TOTAL module

The module combination SETTOT_TOTAL (slot 5) consists of the functions SETTOT and TOTAL.
With this module combination:
- The totalizer can be controlled via the automation system (SETTOT).
- The totalizer value is transmitted including the status (TOTAL)

SETTOT function

In the SETTOT function, the totalizer can be controlled via control variables.
The following control variables are supported:
- 0 = Totalize (factory setting)
- 1 = Reset totalizer (the totalizer value is reset to 0)
- 2 = Accept totalizer preset

✎ Note!
After the totalizer value has been reset to 0 or set to the preset value, the totalizing continues
automatically. The control variable does not have to be changed to 0 again to restart totalizing.
Stopping totalizing is controlled in the SETTOT_MODETOT_TOTAL module via the MODETOT
function. → Page 57

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → Page 56

Data structure of the SETTOT_TOTAL module combination

Output data		Input data				
SETTOT		**TOTAL**				
Byte 1		Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Control		Totalizer value (IEEE 754 floating point number)				Status

SETTOT_MODETOT_TOTAL module

The module combination SETTOT_MODETOT_TOTAL (slot 5) consists of the functions SETTOT,
MODETOT and TOTAL.
With this module combination:
- The totalizer can be controlled via the automation system (SETTOT).
- The totalizer can be configured via the automation system (MODETOT).
- The totalizer value is transmitted including the status (TOTAL)

SETTOT function

For a description of the SETTOT function, refer to SETOT_TOTAL module. → Page 57

MODETOT function

In the MODETOT function, the totalizer can be configured via control variables.
The following settings are possible:
- 0 = Balance (factory setting), calculates the positive and negative flow portions
- 1 = calculates the positive flow portions
- 2 = calculates the negative flow portions
- 3 = Totalizing is stopped

✎ Note!
For the calculation of the positive and negative flow components (control variable 0) or the negative
flow components only (control variable 2) to be carried out correctly, the option BIDIRECTIONAL
must be active in the MEASURING MODE function.

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → Page 56

Data structure of the SETTOT_MODETOT_TOTAL module combination

Output data		Input data				
SETTOT	**MODETOT**	**TOTAL**				
Byte 1	Byte 2	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Control	Configuration	Totalizer value (IEEE 754 floating point number)				Status

Example of using the SETTOT_MODETOT_TOTAL module

If the SETTOT function is set to 1 (= reset the totalizer), the value for the aggregated total is reset to 0.
If the aggregated total of the totalizer should constantly retain the value 0, the MODETOT function must first be set to 3 (= totalizing is stopped) and then the SETTOT function must be set to 1 (= reset the totalizer).

DISPLAY_VALUE module

Any value (IEEE 754 floating point number), including status, can be cyclically transmitted via the PROFIBUS master (Class 1) directly to the local display using the DISPLAY_VALUE module (slot 6). Display value assignment to the main line, additional line or info line can be configured via the local display itself or an operating program (e.g. FieldCare).

Output data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Displayed value (IEEE 754 floating point number)				Status

Status

The measuring device interprets the status in accordance with PROFIBUS Profile Specification Version 3.0. The statuses OK, BAD and UNCERTAIN are indicated on the local display by a corresponding symbol. → Page 38

CONTROL_BLOCK module

By means of the CONTROL_BLOCK module (slot 7), the measuring device is able to process device-specific control variables from the PROFIBUS master (Class 1) in cyclic data transmission (e.g. switching on positive zero return).

Supported control variables of the CONTROL_BLOCK module

The following device-specific control variables can be activated by changing the output byte from $0 \rightarrow x$:

Module	Control variables
CONTROL_BLOCK	$0 \rightarrow 2$: Positive zero return ON $0 \rightarrow 3$: Positive zero return OFF $0 \rightarrow 4$: Run zero point adjustment $0 \rightarrow 8$: UNIDIRECTIONAL measuring mode $0 \rightarrow 9$: BIDIRECTIONAL measuring mode $0 \rightarrow 24$: Run UNIT TO BUS function

✎ Note!
The control (e.g. switching on positive zero return) is executed by cyclic data transmission if the output byte switches from "0" to the bit pattern in question. The output byte must always switch from "0". A switchback to "0" does not have any effect.

Example (change the output byte)

From	$\rightarrow$	To	Result
0	$\rightarrow$	2	Positive zero return is switched on.
2	$\rightarrow$	0	No effect
0	$\rightarrow$	3	Positive zero return is switched off.
3	$\rightarrow$	2	No effect

Output data

Byte 1
Control

EMPTY_MODULE module

The measuring device is a so-called modular PROFIBUS slave. In contrast to a compact slave, the structure of a modular slave is variable – it consists of several individual modules. In the GSD file, the individual modules are described with their individual properties. The modules are permanently assigned to the slots, i.e. the sequence or arrangement of the modules must be observed when configuring the modules. Gaps between configured modules have to be assigned the EMPTY_MODULE module.
For a more detailed description, see $\rightarrow$ Page 54

6.6.4   Configuration examples with Simatic S7 HW-Konfig

Example 1:

a0004775
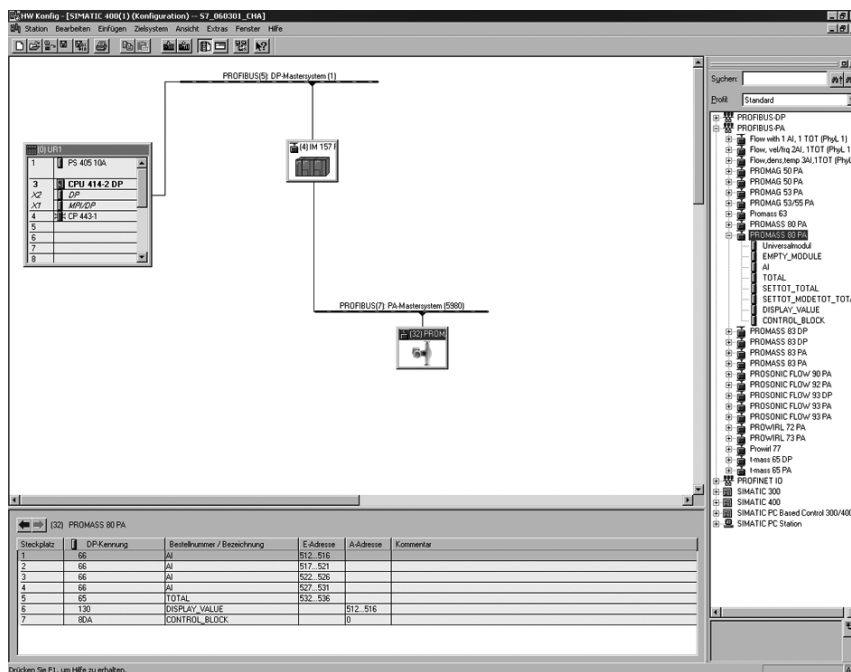
Fig. 33:   Complete configuration using the Promass 80 GSD file.

It is essential to adhere to the following sequence when configuring the modules in the PROFIBUS master (Class 1):

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	–	**Analog Input function block 1** Output variable → mass flow (factory setting)
2	AI	5	–	**Analog Input function block 2** Output variable → volume flow (factory setting)
3	AI	5	–	**Analog Input function block 3** Output variable → corrected volume flow (factory setting)
4	AI	5	–	**Analog Input function block 4** Output variable → density (factory setting)
5	SETTOT_MODETOT_TOTAL	5	2	**Totalizer function block 1** TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
6	DISPLAY_VALUE	–	5	Default value for local display
7	CONTROL_BLOCK	–	1	Control of device functions

Example 2:

a0004791
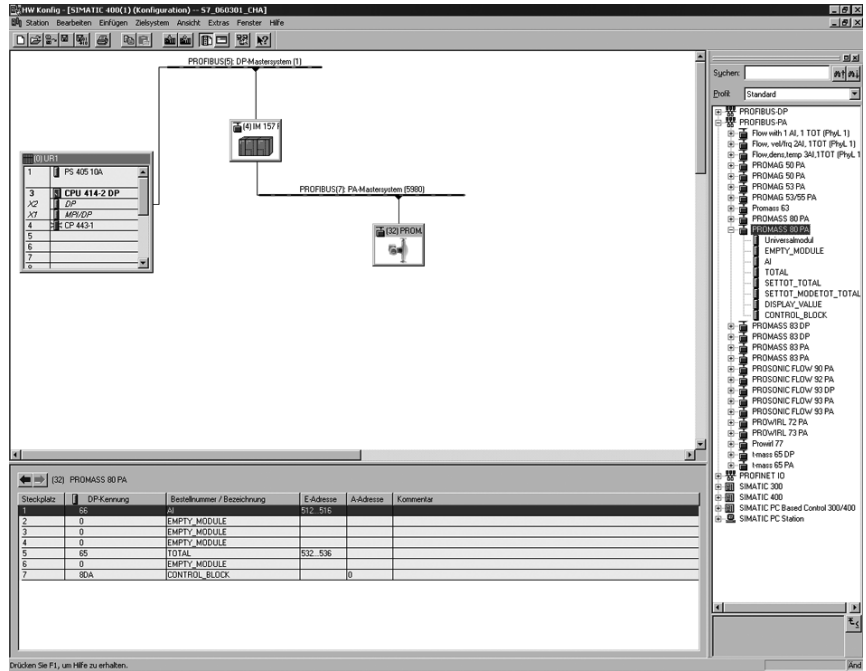
Fig. 34:   In this configuration example, modules that are not needed are replaced by the module EMPTY_MODULE.
            The Promass 80 GSD file is used.

With this configuration, the Analog Input function block 1 (slot 1), the totalizer value TOTAL
(slot 5) and the cyclic control of device functions CONTROL_BLOCK (slot 8) are activated. The
mass flow (factory setting) is read out cyclically by the measuring device by means of the Analog
Input function block 1. The totalizer is configured "without configuration". In other words, in this
example it only returns the totalizer value for the mass flow (factory setting) by means of the TOTAL
module and cannot be controlled by the PROFIBUS master (Class 1).

Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	–	**Analog Input function block 1** Output variable → mass flow (factory setting)
2	EMPTY_MODULE	–	–	Empty
3	EMPTY_MODULE	–	–	Empty
4	EMPTY_MODULE	–	–	Empty
5	TOTAL	5	–	**Totalizer function block 1** TOTAL → output variable = totalized mass flow (factory setting)
6	EMPTY_MODULE	–	–	Empty
7	CONTROL_BLOCK	–	1	Control of device functions

6.7   Adjustment

6.7.1   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. → Page 92 ff.
Consequently, the zero point adjustment is generally **not** necessary!

Experience shows that the zero point adjustment is advisable only in special cases:
- To achieve highest measuring accuracy also with 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 have 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
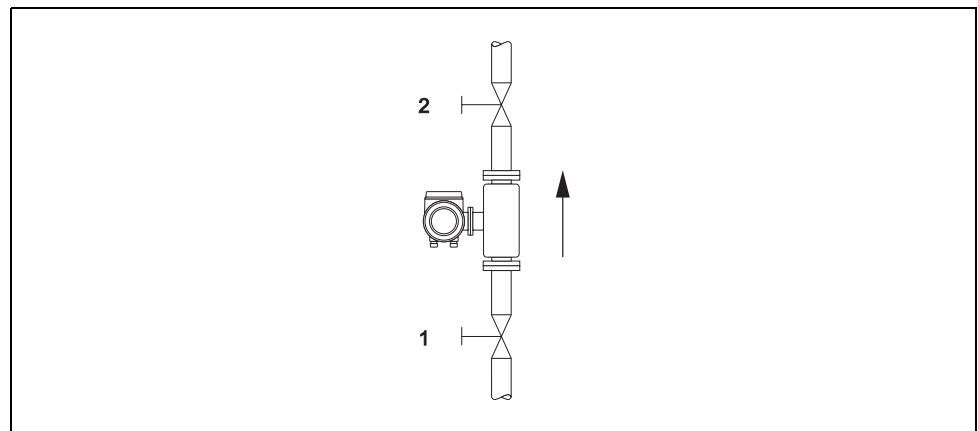
Fig. 35:   Zero point adjustment and shutoff valves

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 E+H service center.
- You can view the currently valid zero point value using the ZERO POINT function (see the "Description of Device Functions" manual).

Performing a zero point adjustment

1. Operate the system until operating conditions have settled.

2. Stop the flow (v = 0 m/s).

3. Check the shutoff valves for leaks.

4. Check that operating pressure is correct.

5. Now perform the adjustment as follows:

Key	Procedure	Display text
E	HOME position → enter the operating matrix	> GROUP SELECTION < MEASURED VALUES
	Select the "PROCESS PARAMETER" function group	> GROUP SELECTION < PROCESS PARAMETER
	Select the desired function "ZERO ADJUST".	ZERO ADJUST CANCEL
	When you press you are automatically prompted to enter the access code if the function matrix is still disabled.	CODE ENTRY ***
	Enter code (80 = factory setting)	CODE ENTRY 80
E	Confirm code entry. The "ZERO ADJUST" function then appears again on the display.	PROGRAMMING ENABLED ZERO ADJUST. CANCEL
	Select "START"	ZERO ADJUST. START
E	Confirm entry with the E-key. A security query appears on the display.	SURE? NO
	Select "YES"	SURE? YES
E	Confirm entry with the E-key. Zero point adjustment is now started. The message on the right appears on the display for 30 to 60 seconds while zero point adjustment is in progress. If the flow in the pipe exceeds 0.1 m/s, the following error message appears on the display: "ZERO ADJUST NOT POSSIBLE". When the zero point adjustment is completed, the "ZERO ADJUST." function reappears on the display.	ZERO ADJUST. RUNNING ZERO ADJUST. CANCEL
E	The new zero point value is displayed when the Enter key is pressed.	ZERO POINT
	Press simultaneously → HOME position	

6.7.2 Density adjustment

Accuracy when determining the density has a direct effect on volume flow calculation. Density adjustment is thus necessary under the following conditions:

- 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.

Performing a 1-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.
- 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. Select the density adjustment function:
   HOME → ⒠ → ⊞ → PROCESS PARAMETERS → ⒠ → DENSITY SET POINT
   – When you press ⒣ you are automatically prompted to enter the access code if the function matrix is still disabled. Enter the code.
   – Now use ⒣ to enter the target density of your fluid and press ⒠ to save this value (input range = actual density value ±10%).

4. Press ⒠ to select the "MEASURE FLUID" function.
   With ⒣, select the "START" setting and press ⒠. The message "DENSITY ADJUST RUNNING" then appears on the display for approx. 10 seconds. During this time Promass measures the current density of the fluid (actual density value).

5. Press ⒠ to select the "DENSITY ADJUST" function.
   With ⒣, now select the "DENSITY ADJUST" setting and press ⒠. Promass now compares the target and actual density values and uses this information to calculate the new density coefficients.

   Caution!
   If the density adjustment does not complete correctly, you can select the RESTORE ORIGINAL function to reactivate the default density coefficients.

6. Back to HOME position with ⊞ (press ⒣ simultaneously).

6.8   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.
- 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.

6.9   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 (73 psi).

6.10   Data storage device (HistoROM)

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

6.10.1   HistoROM/S–DAT (sensor–DAT)

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

7   Maintenance

No special maintenance work is required.

7.1   Exterior cleaning

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

7.2   Cleaning with pigs (Promass H, I, S, P)

If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube and process connection into account. See also Technical Information. → Page 116

7.3   Replacing seals

Under normal circumstances, fluid wetted seals of the Promass A and Promass M 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)

8   Accessories

Various accessories , which can be ordered separately from FMC Technologies, are available for the transmitter and the sensor. The FMC Technologies service organization can provide detailed information on the order code of your choice.

8.1   Device-specific accessories:

Accessory	Description	Order code
Proline Promass 80 transmitter	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable entries – Display / power supply / operation – Software – Outputs / inputs.	80XXX – XXXXX * * * * * *

8.2   Measuring principle-specific accessories:

Accessory	Description	Order code
Mounting set for transmitter	Mounting kit for wall-mount housing (remote version). Suitable for: – Wall mounting – Pipe mounting – Panel mounting Mounting set for aluminum field housing: Suitable for pipe mounting (¾" 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 M and Promass A sensors. Set consists of two seals.	DKS – * * *

8.3 Service-specific accessories:

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 – *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant asset management tool. It can configure all intelligent field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.	See the product page on the Endress+Hauser Web site: www.endress.com
FXA193	The FXA193 service interface connects the device to the PC for configuration via FieldCare.	FXA193 – *

9   Troubleshooting

9.1   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 → Terminals 1, 2 2. Check device fuse → Page 85 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 → Page 80
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 80 ff. 2. Display module defective → order spare parts → Page 80 3. Measuring electronics defective → order spare parts → Page 80
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 → Page 80

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): – Error type: **S** = system error, **P** = process error – Error message type: ⚡ = fault message, **!** = notice message – **MEDIUM 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! Also refer to the information on → Page 40
System error (device error) has occurred → Page 71
Process error (application error) has occurred → Page 77

Faulty connection to control system	
No connection can be made between the control system and the device. Check the following points:	
Supply voltage Transmitter	Check the supply voltage → Terminals 1/2
Device fuse	Check device fuse → Page 85 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
Fieldbus connection	Check the data cable Terminal 26 = PA + Terminal 27 = PA –
Fieldbus connector	■ Check pin assignment/wiring → Page 25 ■ Check connection between connector/fieldbus port. Is the coupling ring tightened correctly?
Fieldbus voltage	Check that a min. bus voltage of 9 V DC is present at terminals 26/27. Permissible range: 9 to 32 V DC

Network structure	Check permissible fieldbus length and number of spurs. → Page 26
Basic current	Is there a basic current of min. 11 mA?
Bus address	Check bus address: make sure there are no double assignments
Bus termination (Termination)	Has the PROFIBUS network been terminated correctly? Each bus segment must always be terminated with a bus terminator at both ends (start and finish). Otherwise there may be interference in communication.
Current consumption, permissible feed current	Check the current consumption of the bus segment: The current consumption of the bus segment in question (= total of basic currents of all bus users) must not exceed the max. permissible feed current of the bus power supply.

System or process error messages
System or process errors which occur during commissioning or operation can be displayed via the local display or an operating program (e.g. FieldCare) in the ACTUAL SYSTEM CONDITION function.

Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → Seite 79

9.2 System error messages

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

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. Important procedures must be carried out before you return a flowmeter to FMC Technologies. → Page 8
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!
See the information on → Page 40

9.2.1 Displaying the device status on PROFIBUS PA

Display in the operating program (acyclic data transmission)

The device status can be queried using an operating program (e.g. FieldCare):
Function block SUPERVISION → SYSTEM → OPERATION → ACTUAL SYSTEM CONDITION

Display in the PROFIBUS master system (cyclic data transmission)

If the AI or TOTAL modules are configured for cyclic data transmission, the device status is coded in accordance with PROFIBUS Profile Specification 3.0 and transmitted with the measured value to the PROFIBUS master (Class 1) by means of the quality byte (byte 5). The quality byte is split into the "quality status", "quality substatus" and "limits" segments.
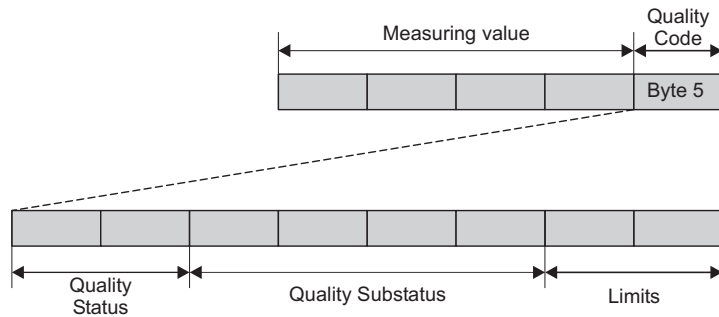
a0002707-en

Fig. 36:   Structure of the quality byte

The content of the quality byte depends on the failsafe mode error behavior configured in the corresponding Analog Input function block. Depending on which failsafe mode has been set in the FAILSAFE_TYPE function, the following status information is transmitted to the PROFIBUS master (Class 1) via the quality byte:

- For FAILSAFE_TYPE → FSAFE VALUE:

Quality code (HEX)	Quality status	Quality substatus	Limits
0x48 0x49 0x4A	UNCERTAIN	Substitute set	OK Low High

■ For FAILSAFE_TYPE → LAST GOOD (factory setting):

If a valid output value was available before the failure:

Quality code (HEX)	Quality status	Quality substatus	Limits
0x44 0x45 0x46	UNCERTAIN	Last usable value	OK Low High

If no valid output value was available before the failure:

Quality code (HEX)	Quality status	Quality substatus	Limits
0x4C 0x4D 0x4E	UNCERTAIN	Initial Value	OK Low High

■ For FAILSAFE_TYPE → WRONG VALUE:
  For status information, see the table in the following section.

✎ Note!
The FAILSAFE_TYPE function can be configured in the corresponding Analog Input function block
1 to 6 or Totalizer function block 1 to 3 by means of an operating program (e.g. FieldCare).

9.2.2   List of system error messages

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part → Page 80 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
Depicted on the local display: S = System error ⚡ = Fault message (with an effect on the outputs) ! = Notice message (without any effect on the outputs)							
001	S: CRITICAL FAILURE ⚡: # 001	0x0F	BAD	Device Failure	Constant	ROM / RAM failure	**Cause:** ROM/RAM error. Error when accessing the program memory (ROM) or random access memory (RAM) of the processor. **Remedy:** Replace the amplifier board.
011	S: AMP HW EEPROM ⚡: # 011	0x0F	BAD	Device Failure	Constant	Amplifier EEPROM failure	**Cause:** Amplifier with faulty EEPROM **Remedy:** Replace the amplifier board.
012	S: AMP SW EEPROM ⚡: # 012	0x0F	BAD	Device Failure	Constant	Amplifier EEPROM data inconsistent	**Cause:** Error when accessing data of the measuring amplifier EEPROM **Remedy:** Perform a "warm start" (= start the measuring system without disconnecting main power). **Access:** SUPERVISION → SYSTEM → OPERATION → SYSTEM RESET (→ RESTART)

| No. | Device status message (local display) | PROFIBUS measured value status | | | | Extended diagnostic message in the PROFIBUS master | Cause/remedy (spare part → Page 80 ff.) |
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
031	S: SENSOR HW DAT ↯: # 031	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	S–DAT failure / S–DAT not inserted	Cause: 1. S–DAT is not plugged into the amplifier board correctly (or is missing). 2. S–DAT is defective. Remedy: 1. Check whether the S–DAT is correctly plugged into the amplifier board. 2. Replace the S–DAT if it is defective.
032	S: SENSOR SW DAT ↯: # 032	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	S–DAT data inconsistent	Check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. 4. Plug the S–DAT into the amplifier board.
121	S: A/C COMPATIB. !: # 121	0x0F	BAD	Device Failure	Constant	Amplifier and I/O board only partially compatible	Cause: 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. Remedy: Module with lower software version has either to be actualized by FieldCare with the required software version or the module has to be replaced.
261	S: COMMUNICAT. I/O ↯: # 261	0x18 0x19 0x1A	BAD	No Communication	O.K. Low High	Communication failure	Cause: Communication error. No data reception between amplifier and I/O board or faulty internal data transfer. Remedy: Check whether the electronics boards are correctly inserted in their holders
379	S: LOW FREQ. LIM ↯: # 379	0x0F	BAD	Device Failure	Constant	Frequence limit 1	Cause: The measuring tube oscillation frequency is outside the permitted range. Causes: Measuring tube damaged Sensor defective or damaged Remedy: Contact your Endress+Hauser service organization.

| No. | Device status message (local display) | Quality code (HEX) Measured value status | PROFIBUS measured value status | | | Extended diagnostic message in the PROFIBUS master | Cause/remedy (spare part → Page 80 ff.) |
			Quality status	Quality substatus	Limits		
380	S: UPPER FREQ. LIM ⚡: # 380	0x0F	BAD	Device Failure	Constant	Frequence limit 2	**Cause:** The measuring tube oscillation frequency is outside the permitted range. **Causes:** Measuring tube damaged Sensor defective or damaged **Remedy:** Contact your Endress+Hauser service organization.
381	S: FLUIDTEMP.MIN. ⚡: # 381	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Fluid Temperature Min.	**Cause:** The temperature sensor on the measuring tube is likely defective. **Remedy:** Check the following electrical connections before you contact your Endress+Hauser service organization: ■ Verify that the sensor signal cable connector is correctly plugged into the amplifier board ■ Remote version: Check sensor and transmitter terminal connections No. 9 and 10 → Page 29 ff.
382	S: FLUIDTEMP.MAX. ⚡: # 382	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Fluid Temperature Max.	
383	S: CARR.TEMP.MIN ⚡: # 383	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Carrier Temperature Min.	**Cause:** The temperature sensor on the carrier tube is likely defective. **Remedy:** Check the following electrical connections before you contact your Endress+Hauser service organization: ■ Verify that the sensor signal cable connector is correctly plugged into the amplifier board ■ Remote version: Check sensor and transmitter terminal connections No. 11 and 12 → Page 29 ff.
384	S: CARR.TEMP.MAX ⚡: # 384	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Carrier Temperature Max.	
385	S: INL.SENS.DEF. ⚡: # 385	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Inlet Sensor Defect	**Cause:** One of the measuring tube sensor coils (inlet or outlet) is likely defective. **Remedy:** Check the following electrical connections before you contact your Endress+Hauser service organization: ■ Verify that the sensor signal cable connector is correctly plugged into the amplifier board ■ Remote version: Check sensor and transmitter terminal connections No. 4, 5, 6, 7.
386	S: OUTL.SENS.DEF. ⚡: # 386	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Outlet Sensor Defect	
387	S: SEN.ASY.EXCEED ⚡: # 387	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Sensor Asymmetry Exceeded	
388	S: AMP. FAULT ⚡: # 388	0x0F	BAD	Device Failure	Constant	Amplifier failure	**Cause:** Amplifier error **Remedy:** Contact your Endress+Hauser service organization.
389	S: AMP. FAULT ⚡: # 389	0x0F	BAD	Device Failure	Constant	Amplifier failure	
390	S: AMP. FAULT ⚡: # 390	0x0F	BAD	Device Failure	Constant	Amplifier failure	

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part → Page 80 ff.)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
501	S: SW.-UPDATE ACT. !: # 501	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	New amplifier software loaded	Cause: New amplifier or communication software version is loaded. Currently no other functions are possible. Remedy: Wait until process is finished. The device will restart automatically.
502	S: UP-/DOWNLO. ACT. !: # 502	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	Upload/download of device data active	Cause: Up- or downloading the device data via operating program. Currently no other functions are possible. Remedy: Wait until process is finished.
586	P: OSC. AMP. LIMIT ↯: # 586	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Oscillation amplitude too low	Cause: The fluid properties do not allow a continuation of the measurement. Causes: Extremely high viscosity Fluid is very inhomogeneous (gas or solid content) Remedy: Change or improve process conditions.
587	P: TUBE NOT OSC ↯: # 587	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	No oscillation possible	Cause: Extreme process conditions exist. The measuring system can therefore not be started. Remedy: Change or improve process conditions.
588	P: GAIN RED.IMPOS ↯: # 588	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Gain reduction impossible	Cause: Overdriving of the internal analog to digital converter. A continuation of the measurement is no longer possible! Causes: Cavitation Extreme pressure shock High gas flow velocity Remedy: Change or improve process conditions, e.g. by reducing the flow velocity.
601	S: POS. ZERO-RETURN !: # 601	0x53	UNCERTAIN	Sensor conversion not accurate (measured value from sensor not accurate)	Constant	Positive zero return active	Cause: Positive zero return is active Remedy: Switch off positive zero return: Access: BASIC FUNCTIONS → SYSTEM PARAMETER → CONFIGURATION → POS. ZERO RETURN (→ OFF)
691	S: SIM. FAILSAFE !: # 691	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	Simulation failsafe active	Cause: Simulation of response to error is active. Remedy: Switch off simulation: Access: SUPERVISION → SYSTEM → OPERATION → SIM. FAILSAFE MODE (→ OFF)

| No. | Device status message (local display) | PROFIBUS measured value status | | | | Extended diagnostic message in the PROFIBUS master | Cause/remedy (spare part → Page 80 ff.) |
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
692	S: SIM. MEASURAND !: # 692	0x60 0x61 0x62	UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Simulation measured value active	Cause: Simulation is active Remedy: Switch off simulation: Access: SUPERVISION → SYSTEM → OPERATION → SIM. MEASURAND (→ OFF)
698	S: DEV. TEST ACT. !: # 698	0x60 0x61 0x62	UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Device test via Fieldcheck active	Cause: The measuring device is being checked on site via the test and simulation device.

9.3 Process error messages

✎ Note!
See the information on → Page 40

9.3.1 Displaying the device status on PROFIBUS PA

Further information → Page 71

9.3.2 List of process error messages

| No. | Device status message (local display) | PROFIBUS measured value status | | | | Extended diagnostic message in the PROFIBUS master | Cause/remedy |
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
P = Process error ↯ = Fault message (with an effect on the outputs) ! = Notice message (without any effect on the outputs)							
700	P: EMPTY PIPE !: # 700	0x53	UNCERTAIN	Sensor conversion not accurate (measured value from sensor not accurate)	Constant	Empty pipe detected	Cause: The process fluid density is outside the upper or lower limit values set for empty pipe detection. Causes: Air in the measuring tube Partly filled measuring tube Remedy: 1. Ensure that there is no gas content in the process liquid. 2. Adjust the upper or lower limit value for empty pipe detection to the current process conditions. Access: BASIC FUNCTIONS → PROCESS PARAMETER → EPD PARAMETER → EPD VALUE LOW or EPD VALUE HIGH
701	P: EXC. CURR. LIM !: # 701	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Excitation too high	Cause: The maximum current value for the sensor coils has been reached, since certain process fluid characteristics are extreme, e.g. high gas or solid content. The instrument continues to work correctly. Remedy: In particular with outgassing fluids and/or increased gas content, the following measures are recommended to increase system pressure: – Install the instrument at the outlet side of a pump. – Install the instrument at the lowest point of an ascending pipeline. – Install a flow restriction, e.g. reducer or orifice plate, downstream from the instrument.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
702	P: MEDIUM INHOM. !: # 702	0x43	UNCERTAIN	Non specific (uncertain status)	Constant	Fluid inhomogeneous	**Cause:** Frequency control is not stable, due to inhomogeneous process fluid, e.g. gas or solid content. **Remedy:** In particular with outgassing fluids and/or increased gas content, the following measures are recommended to increase system pressure: − Install the instrument at the outlet side of a pump. − Install the instrument at the lowest point of an ascending pipeline. − Install a flow restriction, e.g. reducer or orifice plate, downstream from the instrument.
703	P: NOISE LIM. CH0 !: # 703	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Noise Limit Channel 0	**Cause:** 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! **Remedy:** Change or improve process conditions, e.g. by reducing the flow velocity.
704	P: NOISE LIM. CH1 !: # 704	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Noise Limit Channel 1	
705	P: FLOW LIMIT ↯: # 705	0x42	UNCERTAIN	Non specific (uncertain status)	High Limited	Flow limit	**Cause:** The mass flow is too high. The electronics' measuring range will be exceeded. **Remedy:** Reduce flow
731	P: ADJ. ZERO FAIL !: # 731	0x43	UNCERTAIN	Non specific (uncertain status)	Constant	Zero point adjustment failure	**Cause:** The zero point adjustment is not possible or has been canceled. **Remedy:** Make sure that zero point adjustment is carried out at "zero flow" only (v = 0 m/s). → Page 62

9.4   Process errors without messages

Symptoms	Rectification
✎ Note! You may have to change or correct certain settings of the function matrix in order to rectify faults. The functions outlined below 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. Increase the following values:
	      – Analog Input function block → RISING TIME
	      – BASIC FUNCTIONS → SYSTEM PARAMETER → CONFIGURATION → FLOW DAMPING
	
	3. Increase the value for display damping:
	      HOME → USER INTERFACE → CONTROL → BASIC CONFIG. → DISPLAY DAMPING

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. Enter a value for the low flow cutoff or increase this value: BASIC FUNCTION → PROCESS PARAMETER → CONFIGURATION → ON-VALUE LF CUTOFF
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: **Request the services of an Endress+Hauser service technician** If you contact our service organization to have a service technician sent out, please be ready with the following information: ■ Brief description of the fault ■ Nameplate specifications: order code and serial number → Page 9 **Return devices to Endress+Hauser** You can return a measuring device to Endress+Hauser for repair or calibration. Always enclose the duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted blank of this form at the back of this manual. **Replace transmitter electronics** Parts of the measuring electronics defective → Order spare parts → Page 80 ff.

9.5 Spare parts

The previous sections contain a detailed troubleshooting guide. → Page 69 ff.
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 FMC Technologies service organization by providing the serial number printed on the transmitter's nameplate.

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

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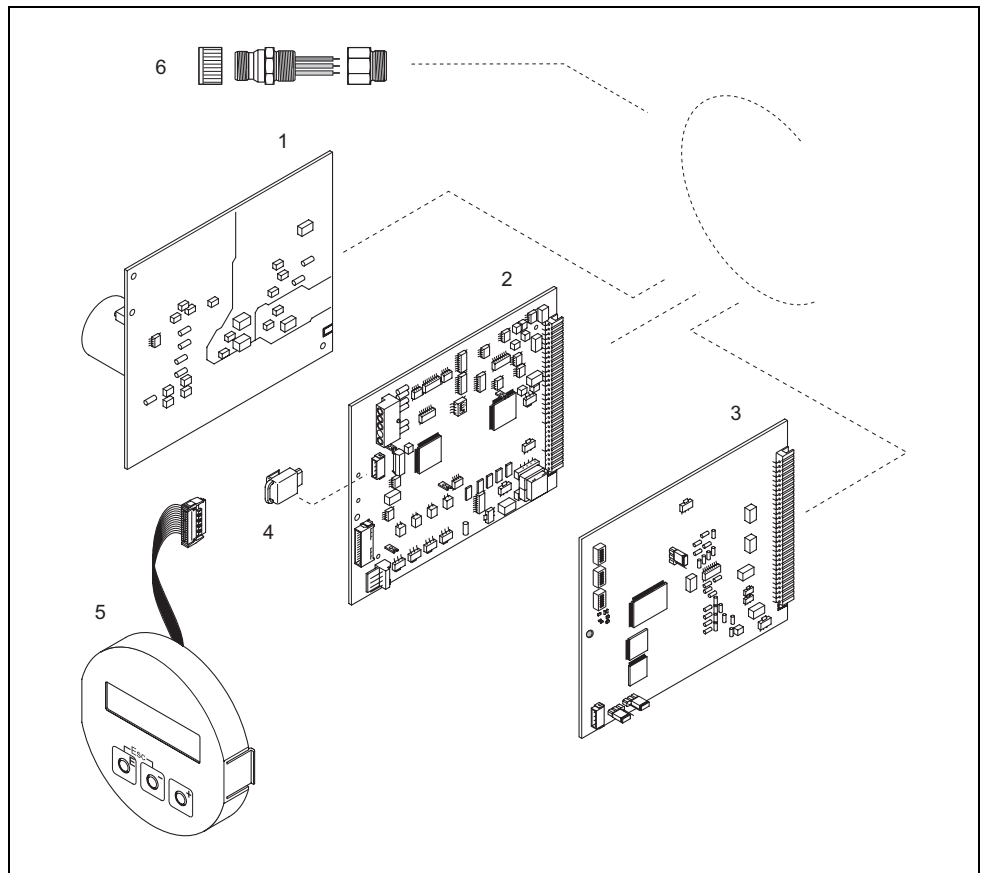Fig. 37:   Spare parts for PROFIBUS PA transmitters (field and wall-mount housing)

1   Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
2   Amplifier board
3   I/O board (COM module)
4   S-DAT (sensor data storage device)
5   Display module
6   Fieldbus connector consisting of protection cap, connector, adapter PG 13.5/M20.5
    (order No. 50098037)

9.5.1 Removing and installing printed circuit boards

Field housing

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

☞ Caution!
Use only original FMC Technologies parts.

Fig. 38, 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):
   Insert a thin pin into the hole provided (3) for the purpose and pull the board clear of its holder.
5. 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 forth.
   – Insert a thin pin into the hole provided (3) for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.
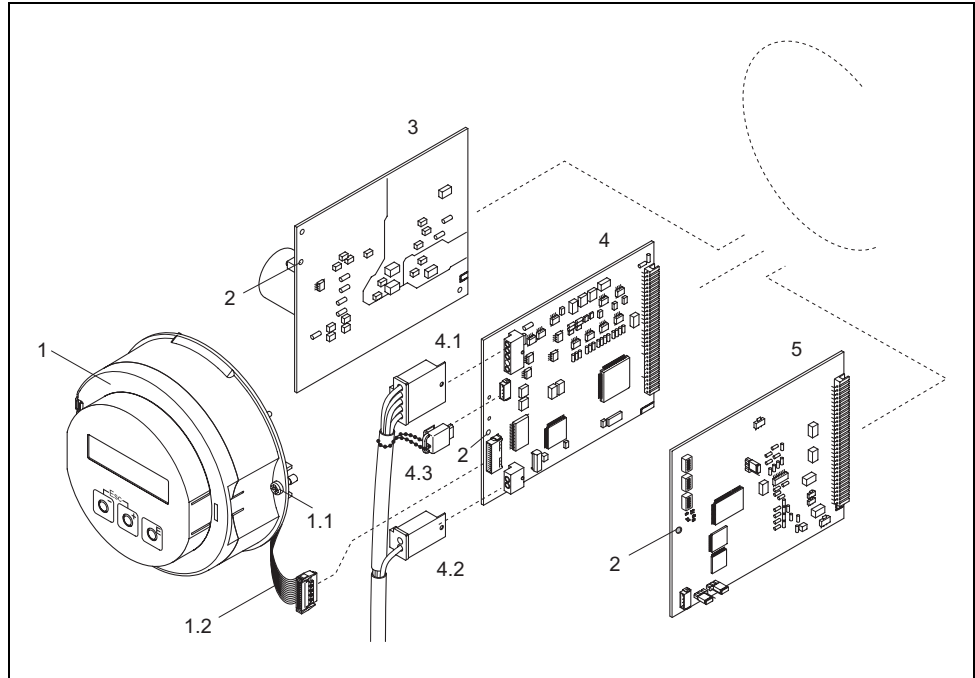
Fig. 38:   Field housing: removing and installing printed circuit boards

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 storage device)
6   I/O board

Wall-mount housing

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

Caution!
Use only original FMC Technologies parts.

Fig. 39, installation and removal:

1. Loosen the screws and open the hinged cover (1) of the housing.

2. Loosen 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)
    – Plug of excitation current cable (7.2). Gently disconnect the plug, i.e. without moving it back and forth.
    – 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):
    Insert a thin pin into the hole provided (5) for the purpose and pull the board clear of its holder.

6. Installation is the reverse of the removal procedure.

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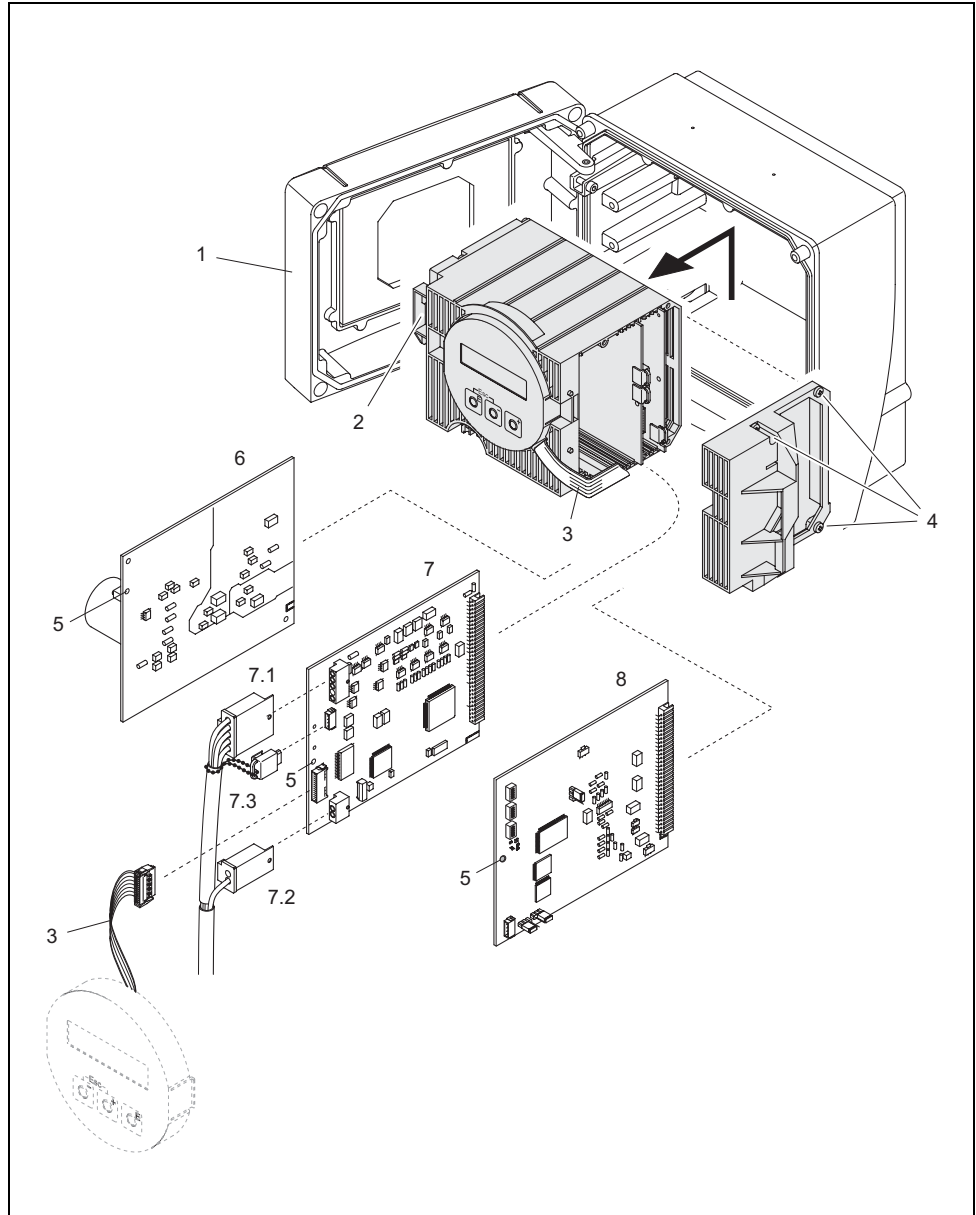
Fig. 39:   Field housing: removing and installing printed circuit boards

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 storage device)
8   I/O board

9.5.2   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. → Fig. 38
The procedure for replacing the fuse is as follows:

1.   Switch off power supply.

2.   Remove the power unit board. → Page 81 → Page 83

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 x 20 mm
      – Power supply 85 to 260 V AC → 0.8 A slow–blow / 250 V; 5.2 x 20 mm
      – Ex-rated devices → see the Ex documentation

4.   Installation is the reverse of the removal procedure.

Caution!
Use only original FMC Technologies parts.

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Fig. 40:   Replacing the device fuse on the power unit board

1   Protective cap
2   Device fuse

9.6   Return

→ Page 8

9.7   Disposal

Observe the regulations applicable in your country!

9.8   Software history

✎ Note!
Uploading/downloading between different software versions is normally only possible with special service software.
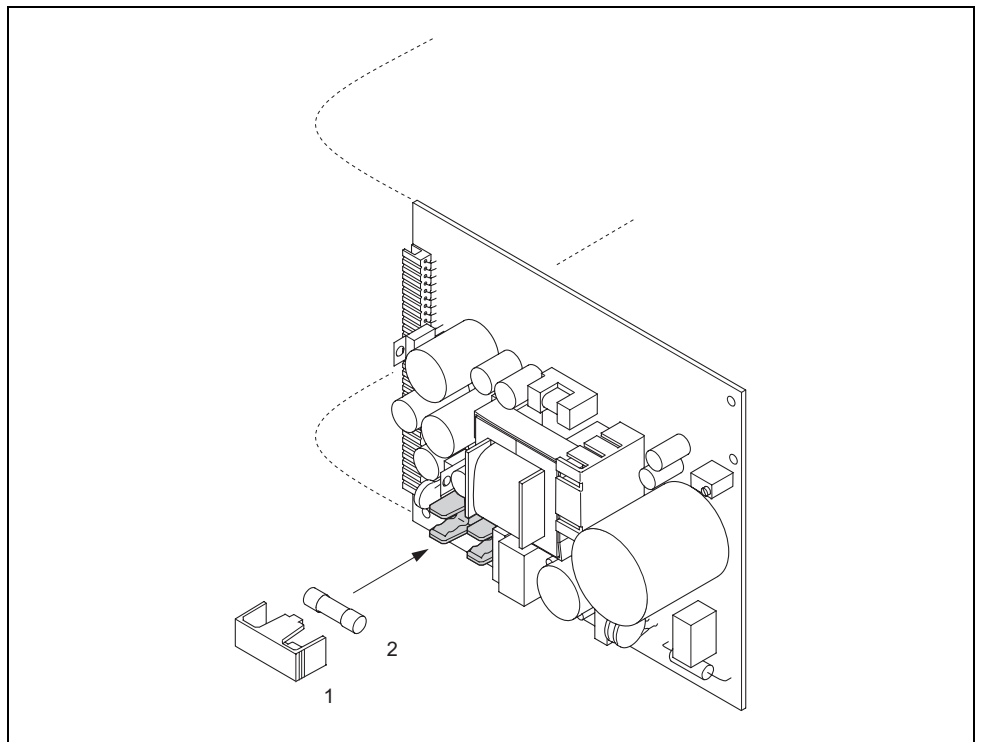
Date	Software version	Changes to software	Operating Instructions
12.2007	3.05.XX	Introduction of a new PROFIBUS PA I/O board	BA072D/06/en/12.07 71066150
12.2006	2.03.XX	New Sensor: – Promass S – Promass P	BA072D/06/en/12.06 71036013
12.2005		Software expansion: – Promass I DN80, DN50FB – General device functions	BA072D/06/en/12.05 71008415
11.2004		Software expansion: – New sensor DN 250 New functionalities: – Empty pipe detection via excitation current (EPD EXC.CURR. (6426)) – DEVICE SOFTWARE (8100) → Device software displayed (NAMUR recommendation 53)	BA072D/06/en/11.04 50100101
10.2003	Amplifier: 1.06.XX Communication module: 2.03.XX	Software expansion: – Language groups – Corrected volume measurement – Adjustments to Fieldcheck and Simubox – New error messages – SIL2 support – The totalizer values are also updated without integration in cyclic data exchange – Support for corrected volume flow and standard density process variables New functionalities: – Operation hours counter – Intensity of background illumination adjustable – Pulse output simulation – Counter for access code – Upload/download via ToF Tool – Fieldtool package Compatible with service protocol: – ToF Tool – Fieldtool Package (the latest SW version can be downloaded under: www.tof-fieldtool.endress.com) PROFIBUS operation via: – Commuwin II version 2.08-1 (update C) and higher	BA072D/06/en/10.03 50100101
12.2002	Amplifier: 2.02.00	Software expansion: Extended functions of Promass E	BA072D/06/en/09.02 50100101
04.2002	Amplifier: 1.02.01	Software adjustment:	BA072D/06/en/04.02 50100101

03.2002	Communication module:
	2.00.01
		Software expansion:
		– New error messages:
		  061, 121, 501
		– Extension of control systems in cyclic data exchange Control variables (measuring mode):
		  – 0 → 8: Unidirectional
		  – 0 → 9: Bidirectional
		– Communication software update possible via service protocol	

11.2001	Amplifier: 1.02.01	Software adjustment	

Date	Software version	Changes to software	Operating Instructions
07.2001	Amplifier: 1.02.00 Communication module: 1.01.00	Original software Compatible with: – Fieldtool – Commuwin II (version 2.07.02 and higher) – PROFIBUS DP/PA Profile Version 3.0	BA072D/06/en/06.01 50100101

10   Technical data

10.1   Technical data at a glance

10.1.1   Applications

→ Page 7

10.1.2   Function and system design

Measuring principle	Mass flow measurement by the Coriolis principle

Measuring system	→ Page 9

10.1.3   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 (measured with temperature sensors)

Measuring range

Measuring ranges for liquids (Promass F, M):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
8	3/8"	0 to 2000 kg/h	0 to 73.5 lb/min
15	1/2"	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
*) only Promass F			

Measuring ranges for liquids (Promass E, H, S, P):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
8	3/8"	0 to 2000 kg/h	0 to 73.5 lb/min
15	1/2"	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

Measuring ranges for liquids (Promass A):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
1	1/24"	0 to 20 kg/h	0 to 0.7 lb/min
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

Measuring ranges for liquids (Promass I):

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]		
8	3/8"	0 to 2000 kg/h	0 to 73.5 lb/min
15	1/2"	0 to 6500 kg/h	0 to 238 lb/min
15 FB	1/2" FB	0 to 18000 kg/h	0 to 660 lb/min
25	1"	0 to 18000 kg/h	0 to 660 lb/min
25 FB	1" FB	0 to 45000 kg/h	0 to 1650 lb/min
40	1 ½"	0 to 45000 kg/h	0 to 1650 lb/min
40 FB	1 ½" FB	0 to 70000 kg/h	0 to 2570 lb/min
50	2"	0 to 70000 kg/h	0 to 2570 lb/min
50 FB	2" FB	0 to 180000 kg/h	0 to 6600 lb/min
80	3"	0 to 180000 kg/h	0 to 6600 lb/min
FB = Full bore versions of Promass I			

Measuring ranges for gases, generell, (except Promass H)

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

$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} : x \ [kg/m^3 \ (lb/ft^3)]$

$\dot{m}_{max(G)}$ = 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, M):

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 E)

DN		x
[mm]	[inch]	
8	3/8"	85
15	½"	110
25	1"	125
40	1½"	125
50	2"	125

Measuring ranges for gases (Promass P, S)

DN		x
[mm]	[inch]	
8	3/8"	60
15	½"	80
25	1"	90
40	1½"	90
50	2"	90

Measuring ranges for gases (Promass A)

DN		x
[mm]	[inch]	
1	1/24"	32
2	1/12"	32
4	1/8"	32

Measuring ranges for gases (Promass I)

DN		x
[mm]	[inch]	
8	3/8"	60
15	1/2"	80
15 FB	1/2" FB	90
25	1"	90
25 FB	1" FB	90
40	1 ½"	90
40 FB	1 ½" FB	90
50	2"	90
50 FB	2" FB	110
80	3"	110
FB = Full bore versions of Promass I		

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:
$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} \div x \, [kg/m^3] = 70000 \, kg/h \cdot 60.3 \, kg/m^3 \div 90 \, kg/m^3 = 46900 \, kg/h$

Recommended full scale values

See information on → Page 101 ff. ("Limiting flow")

Operable flow range	Greater than 1000 : 1. Flows above the preset full scale value do not overload the amplifier, i.e. totalizer values are registered correctly.

Input signal

Status input (auxiliary input):

$U = 3$ to 30 V DC, $R_i = 5 \, k\Omega$, galvanically isolated.
Configurable for: positive zero return, error message reset, zero point adjustment start, batching start/stop (optional), totalizer reset for batching (optional).

10.1.4 Output

Output signal

- PROFIBUS PA in accordance with IEC 61158 (MBP), galvanically isolated
- Profile Version 3.0
- Data transmission rate: 31.25 kBaud
- Current consumption: 11 mA
- Permitted supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Signal coding: Manchester II
- Bus address can be configured via miniature switches, via the local display (optional) or operating program

Signal on alarm

PROFIBUS PA interface:

Status and alarm messages in accordance with PROFIBUS Profile Version 3.0

10.1.5 Power supply

Electrical connections

→ Page 26 ff.

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 x 1.5 (8 to 12 mm)
- Threads for cable entries, ½" NPT, G ½"

Connecting cable for remote version:
- Cable entry M20 x 1.5 (8 to 12 mm)
- Threads for cable entries, ½" NPT, G ½"

Cable specifications	Remote version → Page 29 → Page 26 ff. PROFIBUS see Page 29
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 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.

10.1.6 Performance characteristics

Reference operating conditions	Error limits following ISO/DIS 11631: ▪ 20 to 30 °C (68 to 86 °F); 2 to 4 bar (30 to 60 psi) ▪ Accuracy based on accredited calibration rigs according to ISO 17025 ▪ Zero point calibrated under operating conditions ▪ Field density calibrated (or special density calibration)
Maximum measured error	The following values refer to the pulse/frequency output. The measured error at the current output is typically also ±5 µA. o.r. = of reading **Mass flow (liquid)** Promass F, Premium Cal: ±0.10% ± [(zero point stability ÷ measured value) · 100]% o.r. Promass F, M, A, I, S, P: ±0.15% ± [(zero point stability ÷ measured value) · 100]% o.r. Promass E: ±0.30% ± [(zero point stability ÷ measured value) · 100]% o.r. Promass H: ±0.175% ± [(zero point stability ÷ measured value) · 100]% o.r. **Mass flow (gas)** Promass F: ±0.35% ± [(zero point stability ÷ measured value) · 100]% o.r. Promass M, A, I, S, P: ±0.50% ± [(zero point stability ÷ measured value) · 100]% o.r.

Promass E:

±0.75% ± [(zero point stability ÷ measured value) · 100]% o.r.

Volume flow (liquid)

Promass F:

±0.20% ± [(zero point stability ÷ measured value) · 100]% o.r.

Promass M, A:

±0.25% ± [(zero point stability ÷ measured value) · 100]% o.r.

Promass E:

±0.45% ± [(zero point stability ÷ measured value) · 100]% o.r.

Promass H, I:

±0.50% ± [(zero point stability ÷ measured value) · 100]% o.r.

Promass S, P:

±0.30% ± [(zero point stability ÷ measured value) · 100]% o.r.

Zero point stability (Promass A):

DN		Max. full scale value		Zero point stability	
		[kg/h]	[lb/min]	[kg/h]	[lb/min]
1	1/24"	0 to 20	0 to 0.7	0.0010	0.00004
2	1/12"	0 to 100	0 to 3.7	0.0050	0.0002
4	1/8"	0 to 450	0 to 16.5	0.0225	0.0008

Zero point stability (Promass F, M):

DN		Max. full scale value		Zero point stability					
				Promass F		Promass F (high-temperature)		Promass M	
		[kg/h]	[lb/min]	[kg/h]	[lb/min]	[kg/h]	[lb/min]	[kg/h]	[lb/min]
8	3/8"	2000	73.5	0.030	0.001	–	–	0.100	0.004
15	½"	6500	238	0.200	0.007	–	–	0.325	0.012
25	1"	18000	660	0.540	0.019	1.80	0.066	0.90	0.033
40	1½"	45000	1650	2.25	0.083	–	–	2.25	0.083
50	2"	70000	2570	3.50	0.129	7.00	0.257	3.50	0.129
80	3"	180000	6600	9.00	0.330	18.00	0.661	9.00	0.330
100	4"	350000	12860	14.00	0.514	–	–	–	–
150	6"	800000	29400	32.00	1.17	–	–	–	–
250	10"	2200000	80860	88.00	3.23	–	–	–	–

Zero point stability (Promass E, H, S, P):

DN		Max. full scale value		Zero point stability	
		[kg/h]	[lb/min]	[kg/h]	[lb/min]
8	3/8"	2000	73.5	0.200	0.007
15	½"	6500	238	0.650	0.024
25	1"	18000	660	1.80	0.066
40	1½"	45000	1650	4.50	0.165
50	2"	70000	2570	7.00	0.257

Zero point stability (Promass I):

| DN		Max. full scale value		Zero point stability	
		[kg/h]	[lb/min]	[kg/h]	[lb/min]
8	3/8"	2000	73.5	0.150	0.006
15	1/2"	6500	238	0.488	0.018
15 FB	1/2" FB	18000	660	1.350	0.050
25	1"	18000	660	1.350	0.050
25 FB	1" FB	45000	1650	3.375	0.124
40	1 ½"	45000	1650	3.375	0.124
40 FB	1 ½" FB	70000	2570	5.250	0.193
50	2"	70000	2570	5.250	0.193
50 FB	2" FB	180000	6600	13.500	0.495
80	3"	180000	6600	13.500	0.495
FB = Full bore versions of Promass I					

Sample calculation
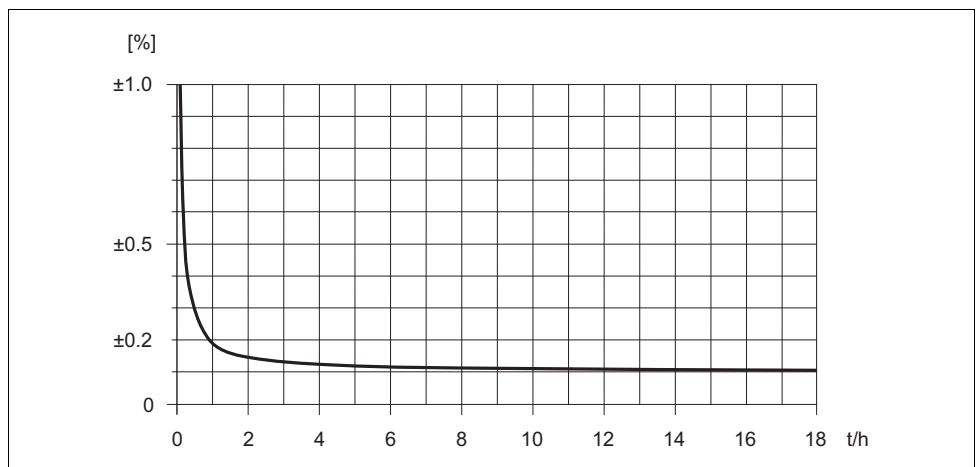
Fig. 41:   Maximum measured error in % of reading (example: Promass 80 F, M / DN 25)

Calculation example (mass flow, liquid):
Given: Promass 80 F / DN 25, flow = 8000 kg/h
Max. measured error: ±0.10% ± [(zero point stability ÷ measured value) · 100]% o.r.
Max. measured error → ±0.10% ±0.54 kg/h ÷ 8000 kg/h · 100% = ±0.107%

Density (liquid)

1 g/cc = 1 kg/l

After field density calibration or under reference conditions:

Promass F, S, P:
±0.0005 g/cc

Promass M, E, A, H:
±0.0010 g/cc

Promass I:
±0.0020 g/cc

Special density calibration (optional), not for high-temperature version
(calibration range = 0.8 to 1.8 g/cc, 5 to 80 °C (41 to 176 °F)):

Promass F:
±0.001 g/cc

Promass M, A, H, S, P:
±0.002 g/cc

Promass I:
±0.004 g/cc

Standard calibration:

Promass F, S, P:
±0.01 g/cc

Promass M, E, A, H, I:
±0.02 g/cc

Temperature

±0.5 °C ±0.005 · T (T = fluid temperature in °C)
±1 °F ±0.003 · (T–32) (T = fluid temperature in °F)

Repeatability	**Mass flow (liquid):**

Promass F, A, H, I, S, P
±0.05% ± [½ · (zero point stability ÷ measured value) · 100]% o.r.

Promass E:
±0.10% ± [½ · (zero point stability ÷ measured value) · 100]% o.r.

Mass flow (gas):

Promass F, M, A, I, S, P:

$\pm 0.25\% \pm [\frac{1}{2} \cdot$ (zero point stability $\div$ measured value) $\cdot 100]\%$ o.r.

Promass E:

$\pm 0.35\% \pm [\frac{1}{2} \cdot$ (zero point stability $\div$ measured value) $\cdot 100]\%$ o.r.

Volume flow (liquid):

Promass F:

$\pm 0.05\% \pm [\frac{1}{2} \cdot$ (zero point stability $\div$ measured value) $\cdot 100]\%$ o.r.

Promass M, A:

$\pm 0.10\% \pm [\frac{1}{2} \cdot$ (zero point stability $\div$ measured value) $\cdot 100]\%$ o.r.

Promass E, H, I, S, P:

$\pm 0.20\% \pm [\frac{1}{2} \cdot$ (zero point stability $\div$ measured value) $\cdot 100]\%$ o.r.

o.r. = of reading
Zero point stability: see "Max. measured error" $\rightarrow$ Page 92 ff.

Calculation example (mass flow, liquid):
Given: Promass 80 F / DN 25, flow = 8000 kg/h
Repeatability: $\pm 0.05\% \pm [\frac{1}{2} \cdot$ (zero point stability $\div$ measured value) $\cdot 100]\%$ o.r.
Repeatability $\rightarrow \pm 0.05\% \pm \frac{1}{2} \cdot 0.54$ kg/h $\div 8000$ kg/h $\cdot 100\% = \pm 0.053\%$

Density measurement (liquid)

1 g/cc = 1 kg/l

Promass F:
± 0.00025 g/cc

Promass M, H, E, A, S, P:
± 0.0005 g/cc

Promass I:
± 0.001 g/cc

Temperature measurement

± 0.25 °C $\pm 0.0025 \cdot T$ (T = fluid temperature in °C)
(± 0.5 °F $\pm 0.0015 \cdot (T - 32)$, T = fluid temperature in °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 Promass sensor is $\pm 0.0002\%$ of the full scale value / °C ($\pm 0.0001\%$ of the full scale value / °F). The typical measured error of the Promass E sensor is $\pm 0.0003\%$ of the full scale value / °C ($\pm 0.0002\%$ of the full scale value / °F).

Influence of medium pressure
The following section shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

Promass F, M:

DN		Promass F, Promass F high-temperature		Promass M		Promass M, high pressure	
		[% o.r./bar]	[% o.r./psi]	[% o.r./bar]	[% o.r./psi]	[% o.r./bar]	[% o.r./psi]
8	3/8"	No influence		0.009	−0.0006	0.006	0.0004
15	½"	No influence		0.008	−0.0005	0.005	0.0003
25	1"	No influence		0.009	−0.0006	0.003	0.0002
40	1½"	−0.003	−0.0002	0.005	−0.0003	–	–
50	2"	−0.008	−0.0005	No influence		–	–
80	3"	−0.009	−0.0006	No influence		–	–
100	4"	−0.012	−0.0008	–	–	–	–
150	6"	−0.009	−0.0006	–	–	–	–
250	10"	−0.009	−0.0006	–	–	–	–
o.r. = of reading							

Promass E:

With nominal diameters DN 8 to 40 (3/8" to 1½"), the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure is negligible.
At DN 50 (2"), the effect is −0.009% o.r. / bar (−0.006% v.M. / psi) (o.r. = of reading).

Promass A:

A difference between calibration pressure and process pressure has no effect on measuring accuracy.

Promass H:

DN		[% o.r./bar]	[% o.r./psi]
8	3/8"	−0.017	−0.0012
15	½"	−0.021	−0.0014
25	1"	−0.013	−0.0019
40	1½"	−0.018	−0.0012
50	2"	−0.020	−0.0014

Promass I:

DN		Promass I	
		[% o.r./bar]	[% o.r./psi]
8	3/8"	0.006	0.0004
15	½"	0.004	0.0003
15 FB	½" FB	0.006	0.0004
25	1"	0.006	0.0004
25 FB	1" FB	No influence	
40	1½"	No influence	
40 FB	1½" FB	−0.0002	−0.0003
50	2"	−0.0002	−0.0003
50 FB	2" FB	0.003	0.0002
80	3"	0.003	0.0002
FB = Full bore versions of Promass I			

Promass S, P:

DN		Promass S	
		[% o.r./bar]	[% o.r./psi]
8	3/8"	−0.002	−0.0001
15	½"	−0.006	−0.0004
25	1"	−0.005	−0.0003
40	1½"	−0.005	−0.0003
50	2"	−0.005	−0.0003

10.1.7 Operating conditions: Installation

Installation instructions	→ Page 14 ff.
Inlet and outlet runs	There are no installation requirements regarding inlet and outlet runs.
Length of connecting cable	Max. 20 meters (66 feet) (remote version)
System pressure	→ Page 15

10.1.8   Operating conditions: Environment

Ambient temperature range	Standard: –20 to +60 °C (-4 to +140°F) (sensor, transmitter) Optional: –40 to +60 °C (-40 to +140°F) (sensor, transmitter)

✎ 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 +20 °C (+68 °F))
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 1 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

10.1.9   Operating conditions: Process

Medium temperature range	**Sensor:** Promass F, A, H, P: –50 to +200 °C (–58 to +392 °F) Promass F (high-temperature version): –50 to +350 °C (–58 to +662 °F) Promass M, I, S: –50 to +150 °C (–58 to +302 °F) Promass E: –40 to +140 °C (–40 to +284 °F)

Seals:

Promass F, E, H, I, S, P:

No internal seals

Promass M:

Viton: −15 to +200 °C (−5 to +392 °F)
EPDM: −40 to +160 °C (−40 to +320 °F)
Silicon: −60 to +200 °C (−76 to +392 °F)
Kalrez: −20 to +275 °C (−4 to +527 °F);
FEP sheathed (not for gas applications): −60 to +200 °C (−76 to +392 °F)

Promass A

No inside seals.
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)
Silicon: −60 to +200 °C (−76 to +392 °F)
Kalrez: −20 to +275 °C (−4 to +527 °F)

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 device 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 → Page 116

Pressure ranges of secondary containment:

Promass F:

DN 8 to 50: 40 bar (580 psi)
DN 80: 25 bar (362 psi)
DN 100 to 150: 16 bar (232 psi)
DN 250: 10 bar (145 psi)

Promass M:

100 bar (1450) psi

Promass E:

No secondary containment

Promass A:

25 bar (362) psi

Promass H, P:

DN 8 to 15: 25 bar (362 psi)
DN 25 to 50: 16 bar (232 psi)

Promass I:

40 bar (580 psi)

Promass S:

DN 8 to 40: 16 bar (232 psi)
DN 50: 10 bar (145 psi)

Limiting flow	See the "Measuring range" section → Page 88 ff.

	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 91

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, M, E

Reynolds number	$Re = \dfrac{2 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$
	a0004623
Re ≥ 2300 *	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$
	a0004626
Re < 2300	$\Delta p = K1 \cdot \nu \cdot \dot{m} + \dfrac{K2 \cdot \nu^{0.25} \cdot \dot{m}^2}{\rho}$
	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)
* To compute the pressure loss for gases, always use the formula for Re ≥ 2300.	

Pressure loss formulas for Promass H, I, S, P

Reynolds number	$Re = \dfrac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$
	a0003381
Re ≥ 2300 *	$\Delta p = K \cdot n^{0.25} \cdot \dot{m}^{1.75} \cdot r^{-0.75} + \dfrac{K3 \cdot \dot{m}^2}{\rho}$
	a0004631
Re < 2300	$\Delta p = K1 \cdot \nu \cdot \dot{m} + \dfrac{K3 \cdot \dot{m}^2}{\rho}$
	a0004633
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 K3 = constants (depending on nominal diameter)
* To compute the pressure loss for gases, always use the formula for Re ≥ 2300.	

Pressure loss formulas for Promass A

Reynolds number	$Re = \dfrac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$
	a0003381
Re ≥ 2300 *	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75}$
	a0003380
Re < 2300	$\Delta p = K1 \cdot \nu \cdot \dot{m}$
	a0003379

Δp = pressure loss [mbar] ρ = density [kg/m³]
ν = kinematic viscosity [m2/s]   d = inside diameter of measuring tubes [m]
$\dot{m}$ = mass flow [kg/s]   K to K1 = constants (depending on nominal diameter)

* To compute the pressure loss for gases, always use the formula for Re ≥ 2300.

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	$102.26 \cdot 10^{-3}$	$3.00 \cdot 10^{2}$	$6.10 \cdot 10^{3}$	$1.33 \cdot 10^{2}$
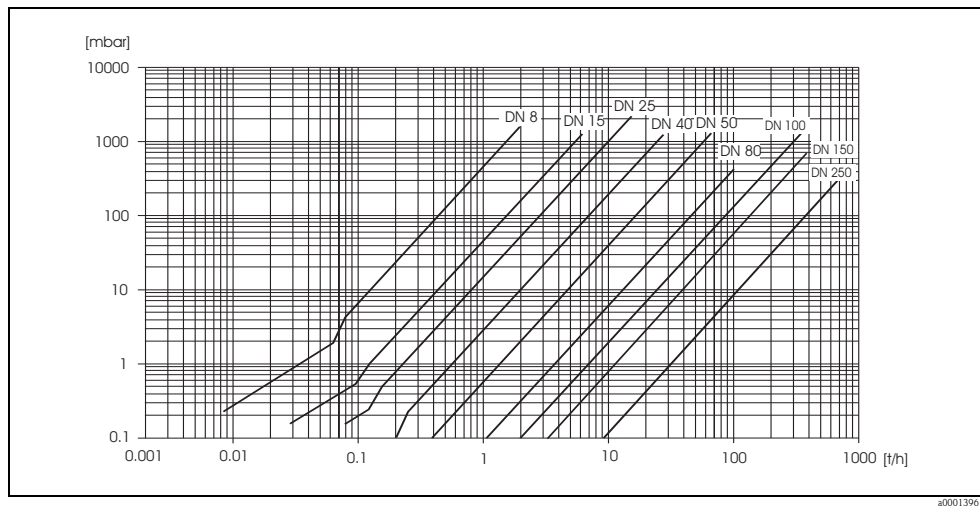
Fig. 42:   Pressure loss diagram for water

Pressure loss coefficient for Promass M

DN	d[m]	K	K1	K2
8	$5.53 \cdot 10^{-3}$	$5.2 \cdot 10^7$	$8.6 \cdot 10^7$	$1.7 \cdot 10^7$
15	$8.55 \cdot 10^{-3}$	$5.3 \cdot 10^6$	$1.7 \cdot 10^7$	$9.7 \cdot 10^5$
25	$11.38 \cdot 10^{-3}$	$1.7 \cdot 10^6$	$5.8 \cdot 10^6$	$4.1 \cdot 10^5$
40	$17.07 \cdot 10^{-3}$	$3.2 \cdot 10^5$	$1.2 \cdot 10^6$	$1.2 \cdot 10^5$
50	$25.60 \cdot 10^{-3}$	$6.4 \cdot 10^4$	$4.5 \cdot 10^5$	$1.3 \cdot 10^4$
80	$38.46 \cdot 10^{-3}$	$1.4 \cdot 10^4$	$8.2 \cdot 10^4$	$3.7 \cdot 10^4$
High pressure version				
8	$4.93 \cdot 10^{-3}$	$6.0 \cdot 10^7$	$1.4 \cdot 10^8$	$2.8 \cdot 10^7$
15	$7.75 \cdot 10^{-3}$	$8.0 \cdot 10^6$	$2.5 \cdot 10^7$	$1.4 \cdot 10^6$
25	$10.20 \cdot 10^{-3}$	$2.7 \cdot 10^6$	$8.9 \cdot 10^6$	$6.3 \cdot 10^5$
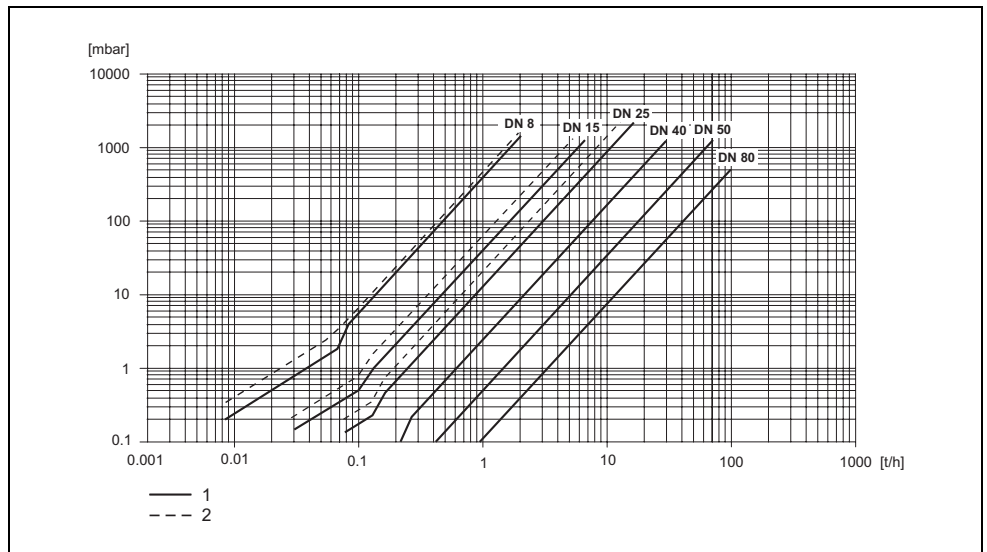
Fig. 43:   Pressure loss diagram for water

1   Promass M
2   Promass M (high pressure version)

Pressure loss coefficient for Promass E

DN	d[m]	K	K1	K2
8	$5.35 \cdot 10^{-3}$	$5.70 \cdot 10^{7}$	$7.91 \cdot 10^{7}$	$2.10 \cdot 10^{7}$
15	$8.30 \cdot 10^{-3}$	$7.62 \cdot 10^{6}$	$1.73 \cdot 10^{7}$	$2.13 \cdot 10^{6}$
25	$12.00 \cdot 10^{-3}$	$1.89 \cdot 10^{6}$	$4.66 \cdot 10^{6}$	$6.11 \cdot 10^{5}$
40	$17.60 \cdot 10^{-3}$	$4.42 \cdot 10^{5}$	$1.35 \cdot 10^{6}$	$1.38 \cdot 10^{5}$
50	$26.00 \cdot 10^{-3}$	$8.54 \cdot 10^{4}$	$4.02 \cdot 10^{5}$	$2.31 \cdot 10^{4}$
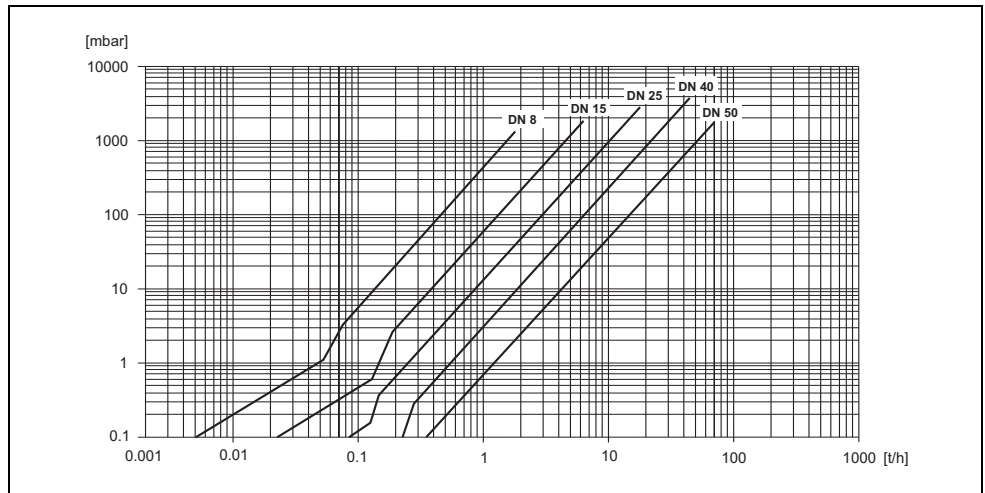
Fig. 44:   Pressure loss diagram for water

Pressure loss coefficient for Promass A

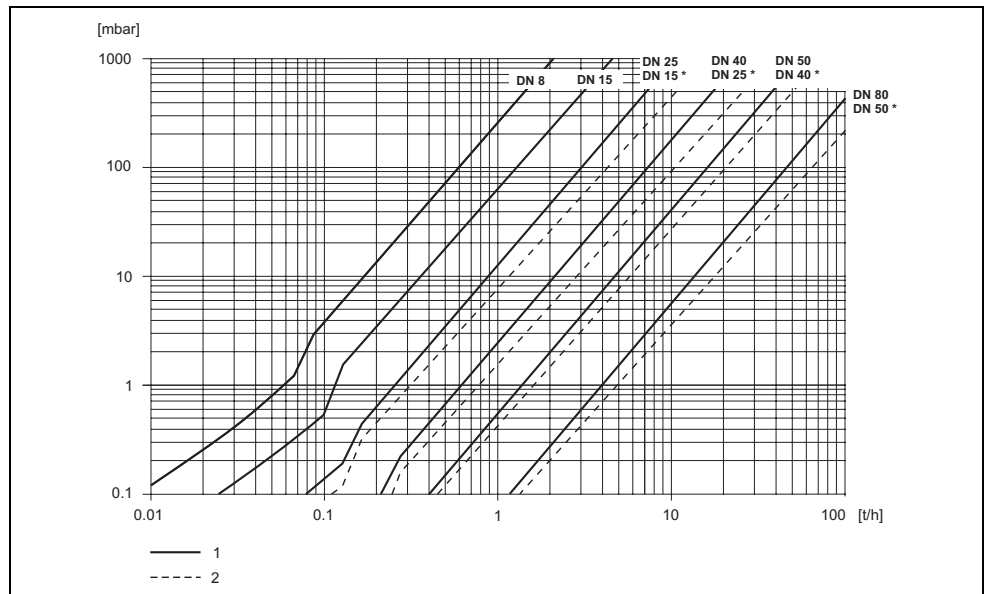| DN	d[m]	K	K1
1	$1.1 \cdot 10^{-3}$	$1.2 \cdot 10^{11}$	$1.3 \cdot 10^{11}$
2	$1.8 \cdot 10^{-3}$	$1.6 \cdot 10^{10}$	$2.4 \cdot 10^{10}$
4	$3.5 \cdot 10^{-3}$	$9.4 \cdot 10^{8}$	$2.3 \cdot 10^{9}$
High pressure version			
2	$1.4 \cdot 10^{-3}$	$5.4 \cdot 10^{10}$	$6.6 \cdot 10^{10}$
4	$3.0 \cdot 10^{-3}$	$2.0 \cdot 10^{9}$	$4.3 \cdot 10^{9}$
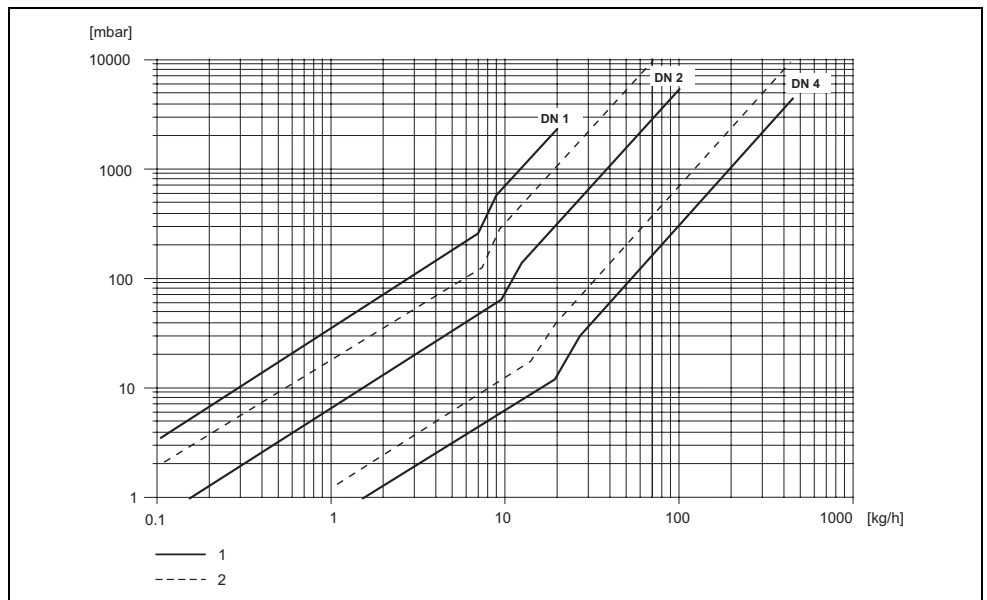
Fig. 45:   Pressure loss diagram for water

1   Standard version
2   High pressure version

Pressure loss coefficient for Promass H

| DN	d[m]	K	K1	K3
8	$8.51 \cdot 10^{-3}$	$8.04 \cdot 10^{6}$	$3.28 \cdot 10^{7}$	$1.15 \cdot 10^{6}$
15	$12.00 \cdot 10^{-3}$	$1.81 \cdot 10^{6}$	$9.99 \cdot 10^{6}$	$1.87 \cdot 10^{5}$
25	$17.60 \cdot 10^{-3}$	$3.67 \cdot 10^{5}$	$2.76 \cdot 10^{6}$	$4.99 \cdot 10^{4}$
40	$25.50 \cdot 10^{-3}$	$8.75 \cdot 10^{4}$	$8.67 \cdot 10^{5}$	$1.22 \cdot 10^{4}$
50	$40.50 \cdot 10^{-3}$	$1.35 \cdot 10^{4}$	$1.72 \cdot 10^{5}$	$1.20 \cdot 10^{3}$
Pressure loss data includes interface between measuring tube and piping				
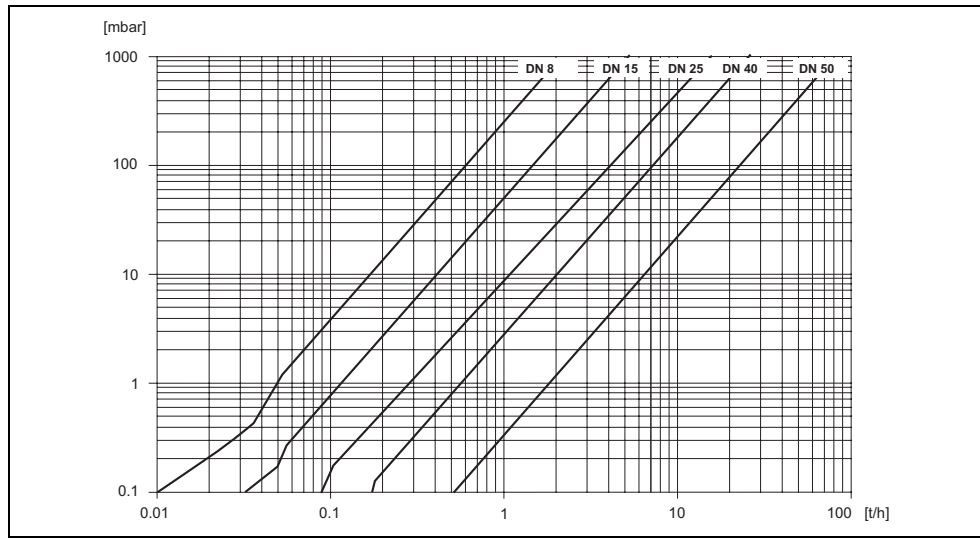
Fig. 46:   Pressure loss diagram for water

Pressure loss coefficient for Promass I

DN	d[m]	K	K1	K3
8	$8.55 \cdot 10^{-3}$	$8.1 \cdot 10^6$	$3.9 \cdot 10^7$	$129.95 \cdot 10^4$
15	$11.38 \cdot 10^{-3}$	$2.3 \cdot 10^6$	$1.3 \cdot 10^7$	$23.33 \cdot 10^4$
15 FB	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^5$	$3.3 \cdot 10^6$	$0.01 \cdot 10^4$
25	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^5$	$3.3 \cdot 10^6$	$5.89 \cdot 10^4$
25 FB	$26.40 \cdot 10^{-3}$	$7.8 \cdot 10^4$	$8.5 \cdot 10^5$	$0.11 \cdot 10^4$
40	$26.40 \cdot 10^{-3}$	$7.8 \cdot 10^4$	$8.5 \cdot 10^5$	$1.19 \cdot 10^4$
40 FB	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^4$	$2.0 \cdot 10^5$	$0.08 \cdot 10^4$
50	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^4$	$2.0 \cdot 10^5$	$0.25 \cdot 10^4$
50 FB	$54.8 \cdot 10^{-3}$	$2.3 \cdot 10^3$	$5.5 \cdot 10^4$	$1.0 \cdot 10^2$
80	$54.8 \cdot 10^{-3}$	$2.3 \cdot 10^3$	$5.5 \cdot 10^4$	$3.5 \cdot 10^2$
Pressure loss data includes interface between measuring tube and piping FB = Full bore versions of Promass I				

Fig. 47:   Pressure loss diagram for water

1   Standard versions
2   Full bore versions (*)

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Pressure loss coefficient for Promass S, P

DN	d[m]	K	K1	K3
8	$8.31 \cdot 10^{-3}$	$8.78 \cdot 10^{6}$	$3.53 \cdot 10^{7}$	$1.30 \cdot 10^{6}$
15	$12.00 \cdot 10^{-3}$	$1.81 \cdot 10^{6}$	$9.99 \cdot 10^{6}$	$1.87 \cdot 10^{5}$
25	$17.60 \cdot 10^{-3}$	$3.67 \cdot 10^{5}$	$2.76 \cdot 10^{6}$	$4.99 \cdot 10^{4}$
40	$26.00 \cdot 10^{-3}$	$8.00 \cdot 10^{4}$	$7.96 \cdot 10^{5}$	$1.09 \cdot 10^{4}$
50	$40.50 \cdot 10^{-3}$	$1.41 \cdot 10^{4}$	$1.85 \cdot 10^{5}$	$1.20 \cdot 10^{3}$
Pressure loss data includes interface between measuring tube and piping				
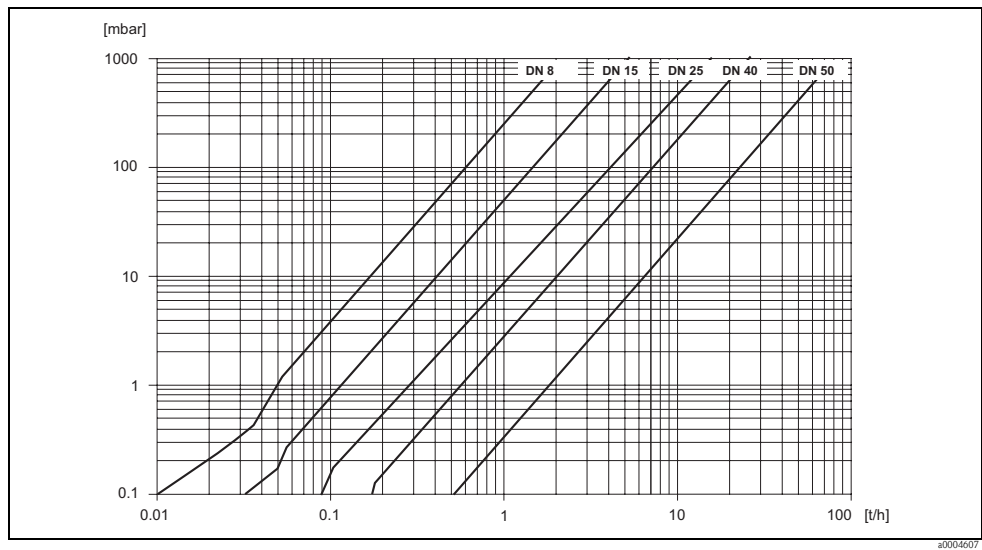
Fig. 48: Pressure loss diagram for water

Pressure loss (US units)

Pressure loss is dependent on fluid properties nominal diameter. Consult FMC Technologies 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 measuring system. The software is used for 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 size.
- Determining measuring ranges.

The Applicator runs on any IBM compatible PC with windows.

10.1.10 Mechanical construction

| Design / dimensions | The dimensions and lengths of the sensor and transmitter are provided in the separate "Technical Information" document on the device 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 → Page 116

Weight (SI units)

- Compact version: see table below

- Remote version
  - Sensor: see table below
  - Wall-mount housing: 5 kg

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

Promass F / DN	8	15	25	40	50	80	100	150	250*
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	–	–	–
* With 10" according to ASME B16.5 Cl 300 flanges									

Promass M / DN	8	15	25	40	50	80
Compact version	11	12	15	24	41	67
Remote version	9	10	13	22	39	65

Promass E / DN	8	15	25	40	50
Compact version	8	8	10	15	22
Remote version	6	6	8	13	20

Promass A / DN	1	2	4
Compact version	10	11	15
Remote version	8	9	13

Promass H / DN	8	15	25	40	50
Compact version	12	13	19	36	69
Remote version	10	11	17	34	67

Promass I / DN	8	15	15FB	25	25FB	40	40FB	50	50FB	80
Compact version	13	15	21	22	41	42	67	69	120	124
Remote version	11	13	19	20	39	40	65	67	118	122
"FB" = Full bore versions of Promass I										

Promass S / DN	8	15	25	40	50
Compact version	13	15	21	43	80
Remote version	11	13	19	41	78

Promass P / DN	8	15	25	40	50
Compact version	13	15	21	43	80
Remote version	11	13	19	41	78

Weight (US units)

- Compact version: see table below

- Remote version
  – Sensor: see table below
  – Wall-mount housing: 11 lb

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

Promass F / DN	3/8"	½"	1"	1½"	2"	3"	4"	6"	10"*
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	–	–	–
* With 10" according to ASME B16.5 Cl 300 flanges									

Promass M / DN	3/8"	½"	1	1½"	2"	3"
Compact version	24	26	33	53	90	148
Remote version	20	22	29	49	86	143

Promass E / DN	3/8"	½"	1	1½"	2"
Compact version	18	18	22	33	49
Remote version	13	13	18	29	44

Promass A / DN	1/24"	1/12"	1/8"
Compact version	22	24	33
Remote version	18	20	29

Promass H / DN	3/8"	½"	1	1½"	2"
Compact version	26	29	42	79	152
Remote version	22	24	37	75	148

Promass I / DN	3/8"	1/2"	1/2"FB	1 ½"	1 ½"FB	3/8"	3/8"FB	1	1FB	2"
Compact version	29	33	46	49	90	93	148	152	265	273
Remote version	24	29	42	44	86	88	143	148	260	269
"FB" = Full bore versions of Promass I										

Promass S / DN	3/8"	½"	1	1½"	2"
Compact version	29	33	46	95	176
Remote version	24	29	42	90	172

Promass P / DN	3/8"	½"	1	1½"	2"
Compact version	29	33	46	95	176
Remote version	24	29	42	90	172

Material

Transmitter housing:

- Compact housing: stainless steel 1.4301/304
- Compact housing: powder coated die-cast aluminum
- Wall-mount housing: powder coated die-cast aluminum
- Remote field housing: powder-coated die-cast aluminum

Sensor housing / containment:

Promass F:

- Acid- and alkali-resistant outer surface
- Stainless steel 1.4301/1.4307/304L

Promass M:

- Acid- and alkali-resistant outer surface
- DN 8 to 50 (3/8" to 2"): steel, chemically nickel-plated
- DN 80 (3"): stainless steel

Promass E, A, H, I, S, P:

- Acid- and alkali-resistant outer surface
- Stainless steel 1.4301/304

Connection housing, sensor (remote version):

- Stainless steel 1.4301/304 (standard)
- Powder coated die-cast aluminum (high-temperature version and version for heating)

Process connections

Promass F:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316L
- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → Alloy C-22 2.4602/N 06022
- DIN 11864-2 Form A (flat flange with groove) → stainless steel 1.4404/316L
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145
  → stainless steel 1.4404/316L
- Tri-Clamp (OD-tubes)→ stainless steel 1.4404/316L
- VCO connection → stainless steel 1.4404/316L

Promass F (high-temperature version):

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316L
- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → Alloy C-22 2.4602 (N 06022)

Promass M:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316L, titanium grade 2
- DIN 11864-2 Form A (flat flange with groove) → stainless steel 1.4404/316L
- PVDF connection to DIN / ASME / JIS
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145
  → stainless steel 1.4404/316L
- Tri-Clamp (OD-tubes) → stainless steel 1.4404/316L

Promass M (high pressure version):

- Connector → stainless steel 1.4404/316L
- Couplings → stainless steel 1.4401/316

Promass E:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316L
- DIN 11864-2 Form A (flat flange with groove) → stainless steel 1.4404/316L
- VCO connection → stainless steel 1.4404/316L
- Threaded hygienic connections DIN 11851/ DIN 11864-1, Form A / ISO 2853 / SMS 1145
  → stainless steel 1.4404/316L
- Tri-Clamp (OD-tubes) → stainless steel 1.4404/316L

Promass A:

- Mounting set for flanges to 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 connection → stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022
- Tri-Clamp (OD-tubes) (1/2") → stainless steel 1.4539/904L
- Mounting set for SWAGELOK (1/4", 1/8") → stainless steel 1.4401/316
- Mounting set for NPT-F (1/4") → stainless steel 1.4539/904L,
  Alloy C-22 2.4602/N 06022

Promass H:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4301/304, parts in contact with medium: zirconium 702

Promass I:

- Flanges according to EN 1092–1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4301/304
- DIN 11864–2 Form A (flat flange with groove) → titanium grade 2
- Threaded hygienic connections DIN 11851/ DIN 11864–1, Form A / ISO 2853 / SMS 1145
  → titanium grade 2
- Tri–Clamp (OD–tubes) → titanium grade 2

Promass S

- Flanges according to EN 1092–1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316/316L
- DIN 11864–2 Form A (flat flange with groove) → stainless steel 1.4435/316L
- Threaded hygienic connections DIN 11851/ DIN 11864–1, Form A / ISO 2853 / SMS 1145
  → stainless steel 1.4435/316L
- Tri–Clamp (OD–Tubes)→ stainless steel 1.4435/316L
- Clamp aseptic connection DIN 11864–3, Form A → stainless steel 1.4435/316L
- Clamp pipe connection DIN 32676 / ISO 2852 → stainless steel 1.4435/316L

Promass P

- Flanges according to EN 1092–1 (DIN 2501) / according to ASME B16.5 / JIS B2220
  → stainless steel 1.4404/316/316L
- DIN 11864–2 Form A (flat flange with groove), BioConnect® → stainless steel 1.4435/316L
- Threaded hygienic connections DIN 11851/ DIN 11864–1, Form A / ISO 2853 / SMS 1145
  → stainless steel 1.4435/316L
- Tri–Clamp (OD–Tubes)→ stainless steel 1.4435/316L
- Clamp aseptic connection DIN 11864–3, Form A → stainless steel 1.4435/316L
- Clamp pipe connection DIN 32676/ISO 2852, BioConnect® → stainless steel 1.4435/316L

Measuring tube(s):

Promass F:

- DN 8 to 100 (3/8" to 4"): stainless steel 1.4539/904L
- DN 150 (6"): stainless steel 1.4404/316L
- DN 250 (10"): stainless steel 1.4404/316L; manifold: CF3M
- DN 8 to 150 (3/8" to 6"): Alloy C–22 2.4602/N 06022

Promass F (high-temperature version):

- DN 25, 50, 80 (1", 2", 3"): Alloy C–22 2.4602/N 06022

Promass M:

- DN 8 to 50 (3/8" to 2"): titanium grade 9
- DN 80 (3"): titanium grade 2

Promass M (high pressure version):

- Titanium grade 9

Promass E, S:

- Stainless steel 1.4539/904L

Promass A:

- Stainless steel 1.4539/904L, Alloy C–22 2.4602/N 06022

Promass H:

- Zirconium 702/R 60702

Promass I:

- Titanium grade 9
- Titanium grade 2 (flange disks)

Promass P:

Stainless steel 1.4435/316L

Seals:

Promass F, E, H, I, S, P:

Welded process connections without internal seals

Promass M:

Viton, EPDM, silicon, Kalrez 6375, FEP sheathing (not for gas applications)

Promass A:

Welded process connections without internal seals.
Only for mounting sets with threaded connections: Viton, EPDM, silicon, 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 device 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 → Page 116
Process connections	see Page 112 ff.

10.1.11 Human interface

Display elements	- Liquid crystal display: illuminated, two 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 keys (–, +, E) - 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
	
	Note!
	You can change the language group via the operating program "FieldCare".

Remote operation	Operation via PROFIBUS

10.1.12 Certificates and approvals

CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
C–tick mark	The measuring system 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 information relevant to explosion protection is available in separate Ex documents that you can order as necessary.
Sanitary compatibility	■ 3A authorization (all measuring systems, except Promass H) ■ EHEDG–tested (all measuring systems, except Promass H and E)
Pressure device approval	Flowmeters with a nominal diameter smaller or equal DN 25 are covered by Art. 3(3) of the European directive 97/23/EC (Pressure Equipment Directive) and are designed according to sound engineer practice. For larger nominal diameters, optional approvals according to Cat. II/III are available when required (depends on fluid and process pressure). Optionally flowmeters in accordance to the guidelines AD 2000 are available on request (Promass F and M only).
Functional safety	SIL –2: In accordance with IEC 61508/IEC 61511–1 (FDIS)
Other standards and guidelines	■ EN 60529 Degrees of protection by housing (IP code) ■ EN 61010–1 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures ■ IEC/EN 61326 "Emission in accordance with requirements for Class A". Electromagnetic compatibility (EMC requirements). ■ NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment. ■ NAMUR NE 43 Standardization of the signal level for the breakdown information of digital transmitters with analog output signal. ■ NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics

10.1.13 Ordering information

The FMC Technologies service organization can provide detailed ordering information and information on the order codes on request.

10.1.14 Accessories

Various accessories, which can be ordered separately from FMC Technologies, are available for the transmitter and the sensor. → Page 67

10.1.15 Documentation

- Flow measuring technology (FA005D/06/en)
- Technical Information Promass 80F, 80M, 83F, 83M (TI053D/06/en)
- Technical Information Promass 80E, 83E (TI061D/06/en)
- Technical Information Promass 80A, 83A (TI 054D/06/en)
- Technical Information Promass 80H, 83H (TI074D/06/en)
- Technical Information Promass 80I, 83I (TI075D/06/en)
- Technical Information Promass 80S, 83S (TI076D/06/en)
- Technical Information Promass 80P, 83P (TI078D/06/en)
- Description of Device Functions Promass 80 PROFIBUS PA (BA073D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, IECEx, NEPSI
- Functional Safety Manual Promass 80, 83 (SD077D/06/en)

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

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

Description of failure / *Fehlerbeschreibung* _____
_____
_____

Company data / *Angaben zum Absender*

Company / *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)*

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

_____
Signature / *Unterschrift*

P/SF/Konta XIV

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacturer that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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United Arab Emirates, Dubai +971 (4) 331-3646

Liquid Measurement Products:
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Visit our website at www.fmctechnologies.com/measurementsolutions