



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



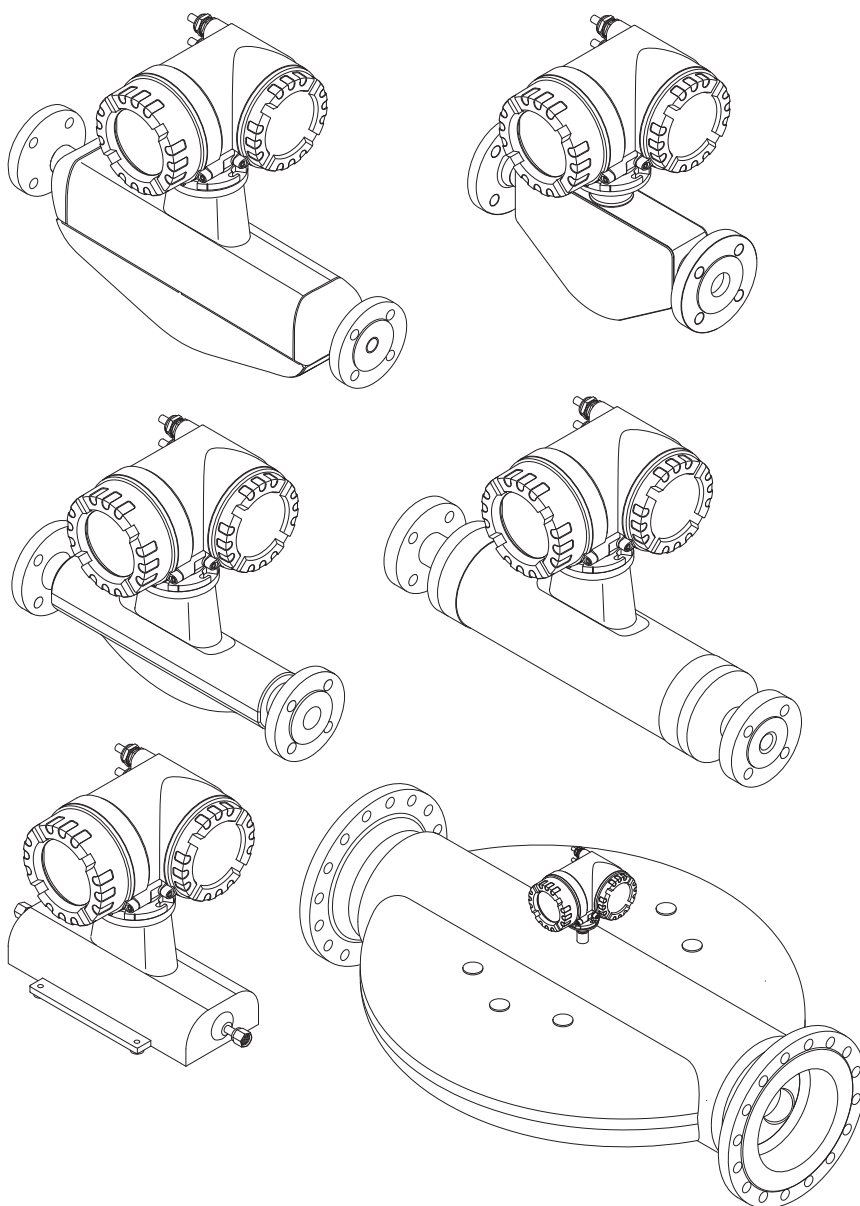
Solutions

Operating Instructions

Proline Promass 83

PROFIBUS DP/PA

Coriolis Mass Flow Measuring System



BA00063D/06/EN/14.12
71197484

Valid as of version
PROFIBUS DP
V 3.06.XX (device software)
PROFIBUS PA
V 3.06.XX (device software)

Endress+Hauser

People for Process Automation

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1 Safety instructions

1.1 Designated use

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

Examples:

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

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




1.2 Installation, commissioning and operation

Note the following points:


- Installation, connection to the electricity supply, commissioning and maintenance of the 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.
- Endress+Hauser is willing to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However small changes in temperature, concentration or the degree of contamination in the process can result in changes of the chemical resistance properties. Therefore, Endress+Hauser 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, unless the power supply is galvanically isolated, i.e. galvanically isolated power supply according to separated or safely extra-low voltage or protected extra-low voltage (SELV = Safe Extra Low Voltage; PELV = Protective Extra Low Voltage).
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:

- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body (e.g.  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.
- External surface temperature of the transmitter can increase by 10 K due to power consumption of internal electronic components. Hot process fluids passing through the measuring device will further increase the surface temperature of the measuring device. Especially the surface of the sensor can reach temperatures which are close to process temperature. Additionally safety precautions are required when increased process temperatures are present.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to these Operating Instructions.

1.4 Return

- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.
- Please note the measures on →  147

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

The following options are available for identification of the measuring device::

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

For an overview of the scope of the Technical Documentation provided, refer to the following:

- The chapters "Supplementary Documentation" →  196
- Der *W@M Device Viewer*: Enter the serial number from the nameplate (www.endress.com/deviceviewer)

Reorder

The measuring device is reordered using the order code.

Extended order code:

- The device type (product root) and basic specifications (mandatory features) are always listed.
- Of the optional specifications (optional features), only the safety and approval-related specifications are listed (e.g. LA). If other optional specifications are also ordered, these are indicated collectively using the # placeholder symbol (e.g. #LA#).
- If the ordered optional specifications do not include any safety and approval-related specifications, they are indicated by the + placeholder symbol (e.g. 8E2B50-ABCDE+).

2.1 Device designation

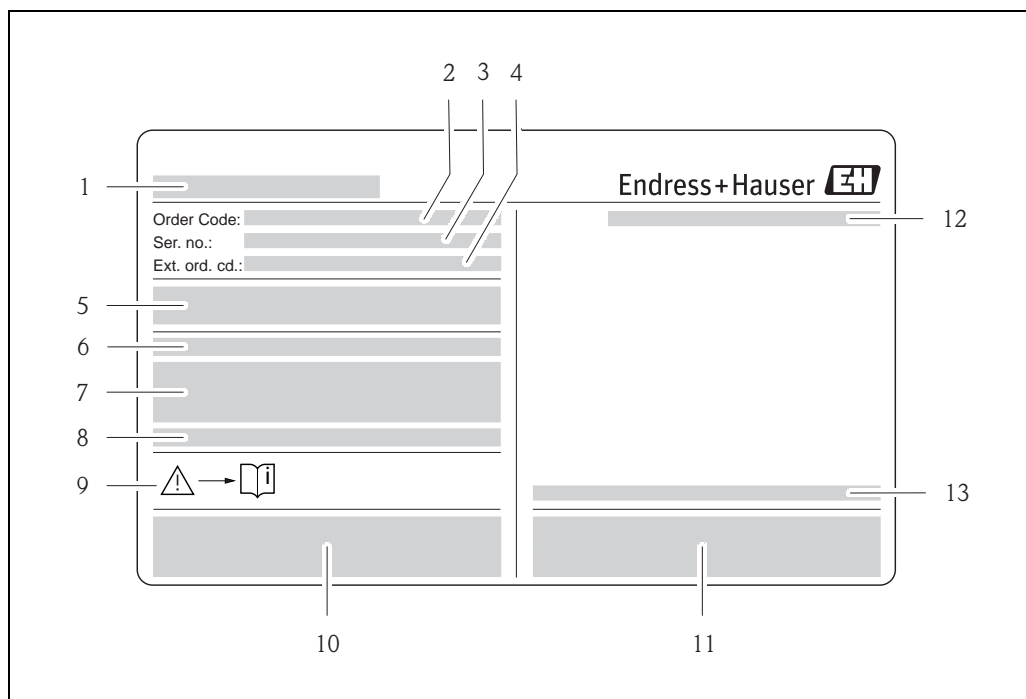
The "Promass 83" flow measuring system consists of the following components:

- Promass 83 transmitter.
- Promass F, Promass E, Promass A, Promass H, Promass I, Promass S, Promass P, Promass O or Promass X sensor.

Two versions are available:

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

2.1.1 Nameplate of the transmitter



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Fig. 1: Example of a transmitter nameplate

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

2.1.2 Nameplate of the sensor

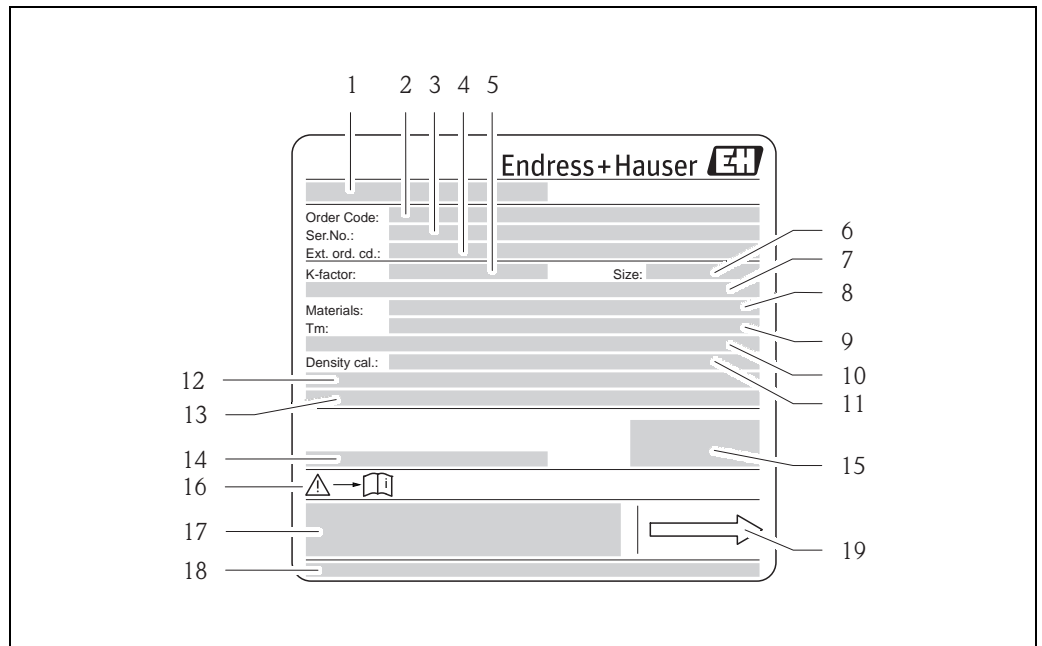


Fig. 2: Example of a sensor nameplate

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

2.1.3 Nameplate for connections

See operating manual
Betriebsanleitung beachten
Observer manuel d'instruction

A: active
P: passive
NO: normally open contact
NC: normally closed contact

1 Ser.No.: 1 2

Supply / Versorgung / Tension d'alimentation

L1/L+
N/L-
PE

20(+)/21(-)
22(+)/23(-)
24(+)/25(-)
26(+)/27(-)

2 3

ex works / ab Werk / réglages usine

Device SW:
Communication:
Drivers:
Date:

Update 1 Update 2

319475-00XX


8 9 10 11 12

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Fig. 3: Example of a connection nameplate

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

2.2 Certificates and approvals

The devices are designed in accordance with good engineering practice to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. See also "Certificates and approvals" →  195.

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

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

3 Installation

3.1 Incoming acceptance, transport and storage



3.1.1 Incoming acceptance

On receipt of the goods, check the following points:

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

3.1.2 Transport

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

- Transport the devices in the containers in which they are delivered.
- 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 $> \text{DN } 40$ ($> 1\frac{1}{2}"$) by the transmitter housing or the connection housing in the case of the remote version (→  4). - Use webbing slings slung round the two process connections. Do not use chains, as they could damage the housing.
- Promass X, Promass O sensor: see special instructions for transporting →  13



Warning!

Risk of injury if the measuring device slips. The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung.

At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.

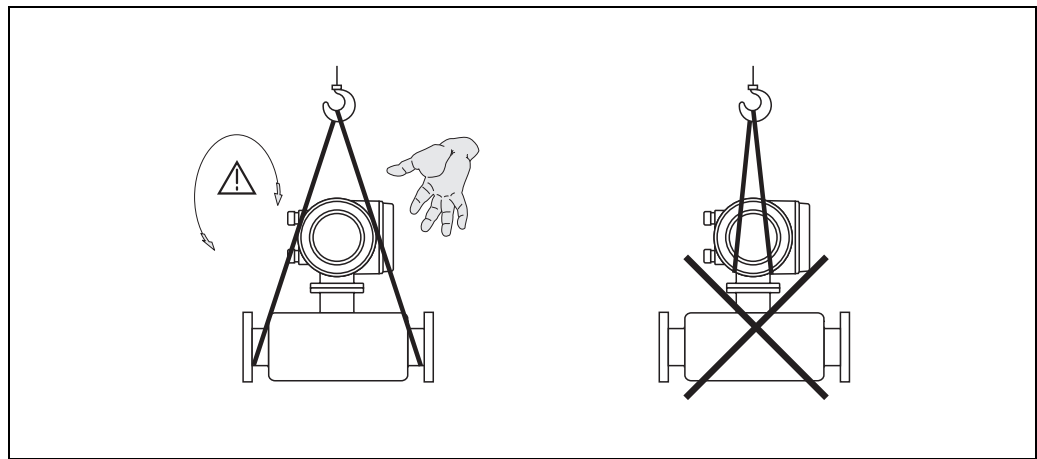


Fig. 4: Instructions for transporting sensors with $> \text{DN } 40$ ($> 1\frac{1}{2}"$)

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Special instructions for transporting Promass X and O

Warning!

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

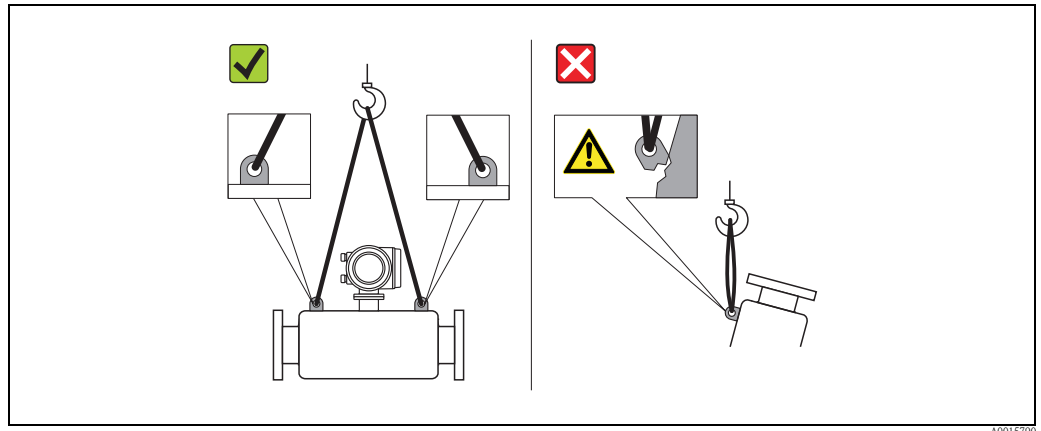


Fig. 5: Instructions for transporting Promass O

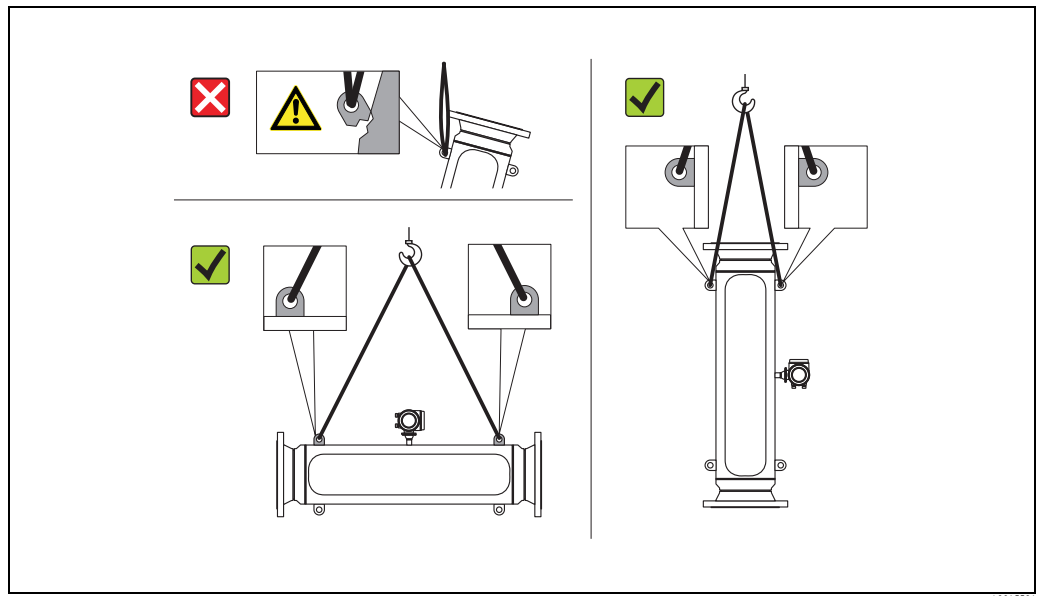


Fig. 6: Instructions for transporting Promass X

3.1.3 Storage

Note the following points:

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

3.2 Installation conditions

Note the following points:

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

3.2.1 Dimensions

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

3.2.2 Mounting location

Entrained air or gas bubbles forming in the measuring tube can result in an increase in measuring errors.

Avoid the following locations in the pipe installation:

- Highest point of a pipeline. Risk of air accumulating.
- Directly upstream of a free pipe outlet in a vertical pipeline.

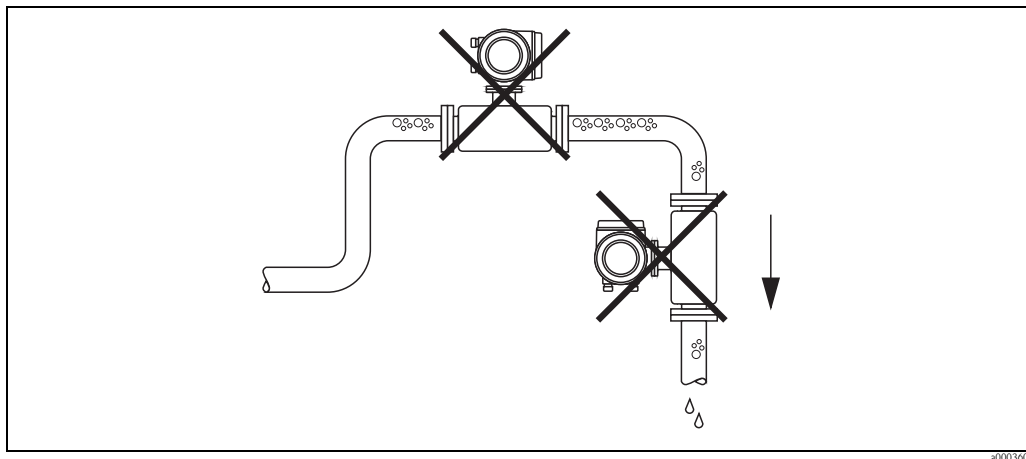


Fig. 7: Mounting location

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Installation in a vertical pipe

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

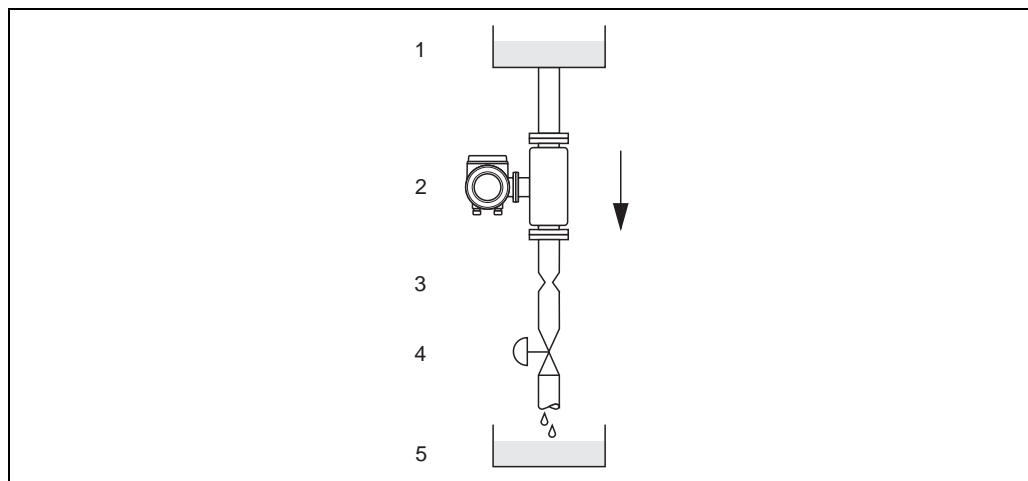


Fig. 8: Installation in a vertical pipe (e.g. for batching applications)

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

DN		Ø Orifice plate, pipe restrictor	
		mm	inch
1	1/24"	0.8	0.03
2	1/12"	1.5	0.06
4	1/8"	3.0	0.12
8	3/8"	6	0.24
15	1/2"	10	0.40
15 FB	1/2"	15	0.60
25	1"	14	0.55
25 FB	1"	24	0.95
40	1 1/2"	22	0.87

FB = Full bore versions of Promass I

DN		Ø Orifice plate, pipe restrictor	
		mm	inch
40 FB	1 1/2"	35	1.38
50	2"	28	1.10
50 FB	2"	54	2.00
80	3"	50	2.00
100	4"	65	2.60
150	6"	90	3.54
250	10"	150	5.91
350	14"	210	8.27

System pressure

It is important to ensure that cavitation does not occur, because it would influence the oscillation of the measuring tube. No special measures need to be taken for fluids which have properties similar to water under normal conditions.

In the case of liquids with a low boiling point (hydrocarbons, solvents, liquefied gases) or in suction lines, it is important to ensure that pressure does not drop below the vapor pressure and that the liquid does not start to boil. It is also important to ensure that the gases that occur naturally in many liquids do not outgas. Such effects can be prevented when system pressure is sufficiently high.

For this reason, the following installation locations are preferred:

- Downstream from pumps (no danger of vacuum)
- At the lowest point in a vertical pipe.

3.2.3 Orientation

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

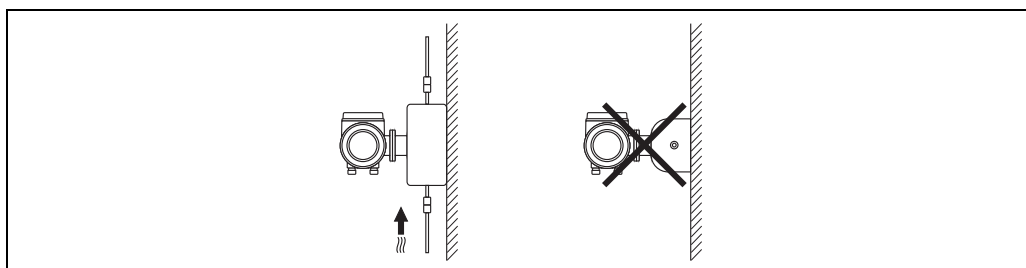
Orientation Promass A

Vertical

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

Horizontal

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



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Special installation instructions for Promass A



Caution!

Risk of measuring pipe fracture if sensor installed incorrectly!

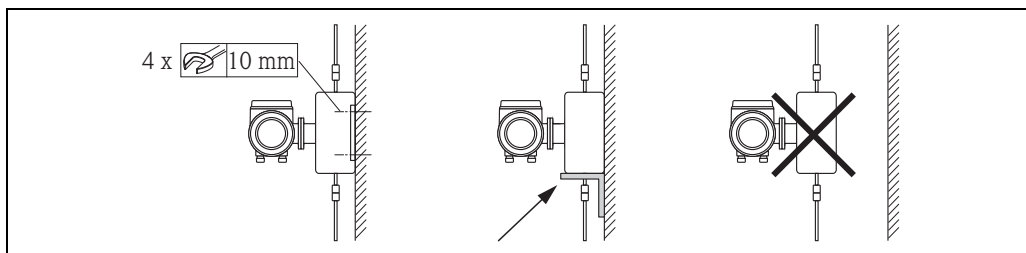
The sensor may not be installed in a pipe as a freely suspended sensor:

- Using the base plate, mount the sensor directly on the floor, the wall or the ceiling.
- Support the sensor on a firmly mounted support base (e.g. angle bracket).

Vertical

We recommend two installation versions when mounting vertically:

- Mounted directly on a wall using the base plate
- Measuring device supported on an angle bracket mounted on the wall

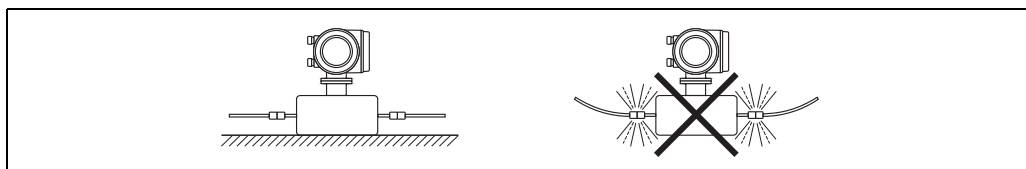


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Horizontal

We recommend the following installation version when mounting horizontally:

- Measuring device standing on a firm support base



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Orientation Promass F, E, H, I, S, P, O, X

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

Vertical:

Recommended orientation with upward direction of flow (Fig. V). When fluid is not flowing, entrained solids will sink down and gases will rise away from the measuring tube.

The measuring tubes can be completely drained and protected against solids buildup.

Horizontal (Promass F, E, O):

The measuring tubes of Promass F, E and O must be horizontal and beside each other.

When installation is correct the transmitter housing is above or below the pipe (Fig. H1/H2).

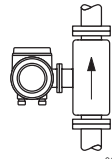
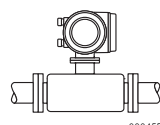
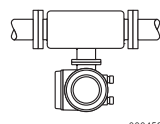
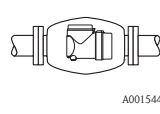
Always avoid having the transmitter housing in the same horizontal plane as the pipe.

See next chapter – special installation instructions.

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

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

Promass H, I, S, P: See next chapter – special installation instructions

	Promass F, E, O Standard, compact	Promass F, E Standard, remote	Promass F High-temperature, compact	Promass F High-temperature, remote	Promass H, I, S, P	Promass X
Abb. V: Vertical orientation  a0004572	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Abb. H1: Horizontal orientation Transmitter head up  a0004576	✓✓	✓✓	✗ TM > 200 °C (392 °F)	✓ TM > 200 °C (392 °F)	✓✓	✓✓
Abb. H2: Horizontal orientation Transmitter head down  a0004580	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Abb. H3: Horizontal orientation Transmitter head to the side  A0015445	✗	✗	✗	✗	✓✓	✓①
✓✓ = Recommended orientation; ✓ = Orientation recommended in certain situations; ✗ = Impermissible orientation ① The measuring tubes are curved. Therefore the unit is installed horizontally, adapt the sensor position to the fluid properties: ■ Suitable to a limited extent for fluids with entrained solids. Risk of solids accumulating ■ Suitable to a limited extent for outgassing fluids. Risk of air accumulating						

In order to ensure that the permissible ambient temperature range for the transmitter (→ 176) is not exceeded, we recommend the following orientations:

- For fluids with very high temperatures we recommend the horizontal orientation with the transmitter head pointing downwards (Fig. H2) or the vertical orientation (Fig. V).
- For fluids with very low temperatures, we recommend the horizontal orientation with the transmitter head pointing upwards (Fig. H1) or the vertical orientation (Fig. V).

3.2.4 Special installation instructions

Promass F, E, H, S, P and O



Caution!

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

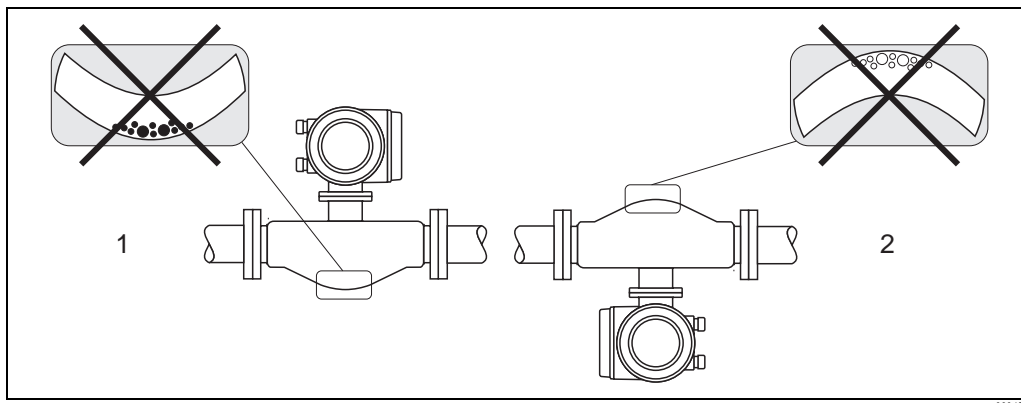


Fig. 9: Horizontal installation of sensors with curved measuring tube.

- 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.

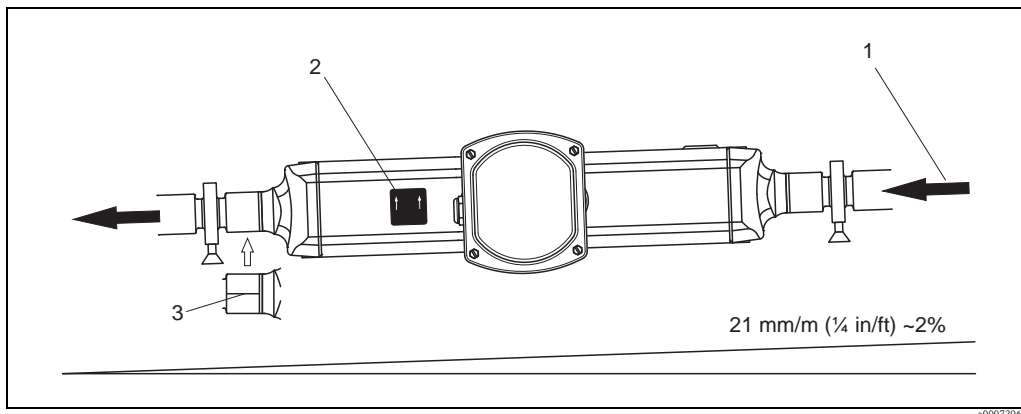


Fig. 10: Promass P: When lines are pitched in a specific direction and at a specific slope: as per hygienic guidelines (21 mm/m or approximately 2%). Gravity can be used to achieve complete drainability.

- 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.

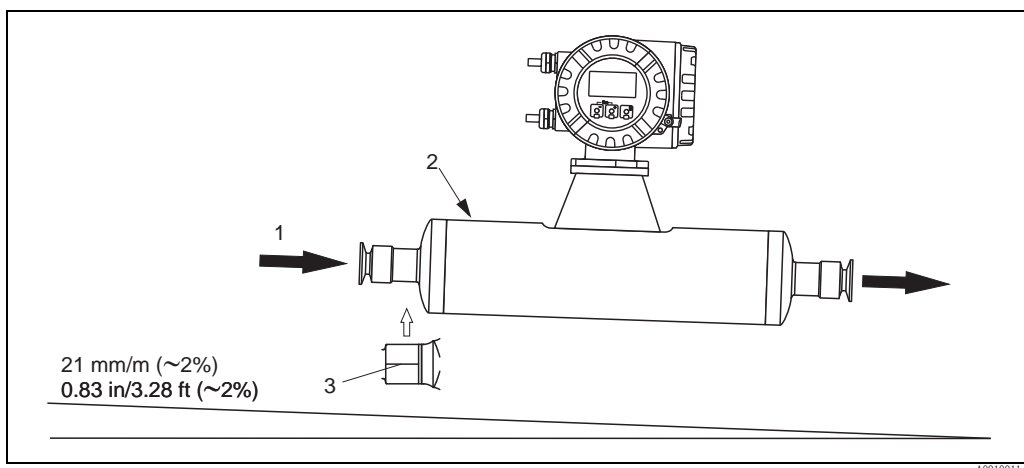


Fig. 11: Promass I: When lines are pitched in a specific direction and at a specific slope: as per hygienic guidelines (21 mm/m or approximately 2%). Gravity can be used to achieve complete drainability.

- 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.

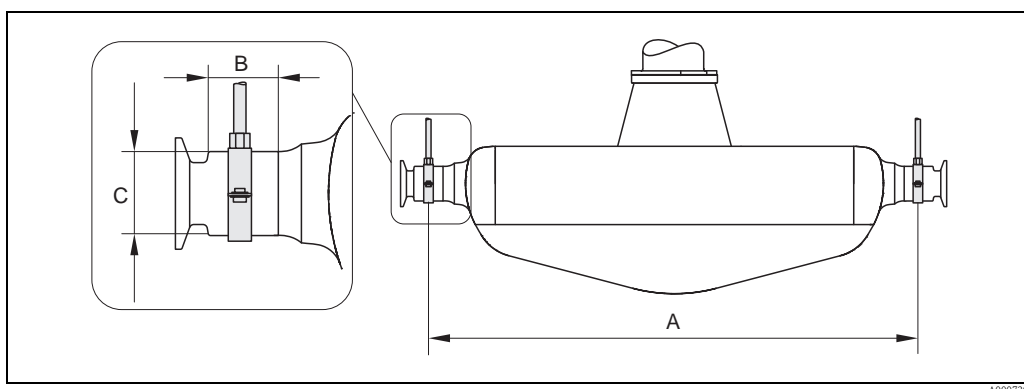


Fig. 12: Promass P, mounted with mounting clamp

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

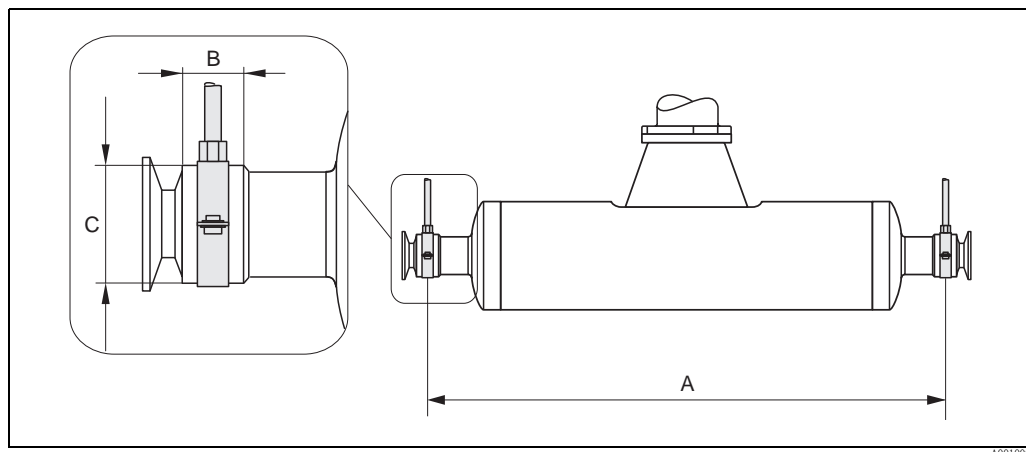


Fig. 13: Promass I, mounted with mounting clamp

DN	8	15	15FB	25	25FB	40	40FB	50	50FB	50FB	80	80
Tri-Clamp	½"	¾"	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. → 16. For fluid temperature of 150°C (302°F) or above the usage of the remote version with separate connection housing is recommended.
- With a fluid temperature between 200 °C to 350 °C (392 to 662 °F) the remote version of the high-temperature version is preferable.
- When using electrical heat tracing whose heat is regulated using phase control or by pulse packs, it cannot be ruled out that the measured values are influenced by magnetic fields which may occur, (i.e. at values greater than those permitted by the EC standard (Sinus 30 A/m)). In such cases, the sensor must be magnetically shielded.
The secondary containment can be shielded with tin plates or electric sheets without privileged direction (e.g. V330-35A) with the following properties:
 - Relative magnetic permeability $\mu_r \geq 300$
 - Plate thickness $d \geq 0.35 \text{ mm (0.014")}$
- Information on permissible temperature ranges → 177
- Promass X: Especially under critical climatic conditions it has to be ensured that the temperature difference between environment and measured medium does not exceed 100 K. Suitable measures, such as heating or thermal insulation, are to be taken.

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

3.2.6 Thermal insulation

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

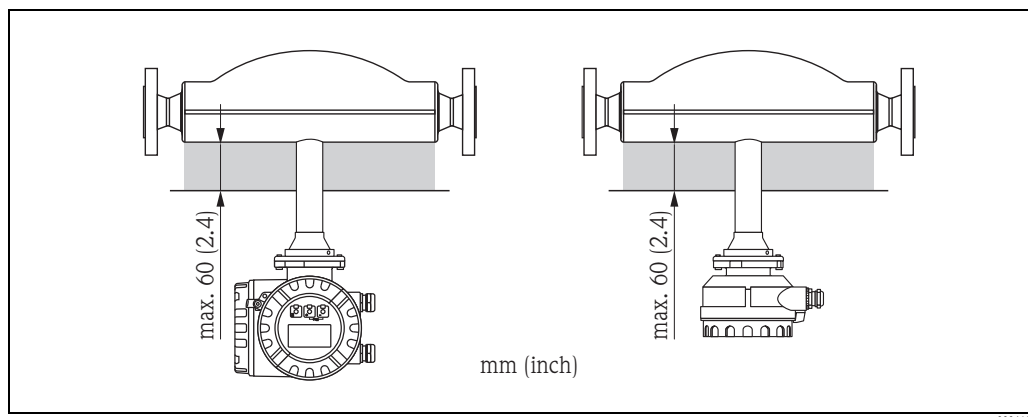


Fig. 14: In the case of the Promass F high-temperature version, a maximum insulation thickness of 60 mm (2.4") must be observed in the area of the electronics/neck.

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

3.2.7 Inlet and outlet runs

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

3.2.8 Vibrations

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

3.2.9 Limiting flow

Relevant information can be found in the "Technical Data" section under "Measuring range" → 150 or "Limiting flow" → 179.

3.3 Installation

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. $2 \times 90^\circ$ in either direction).
5. Lower the housing into position and reengage the bayonet catch.
6. Retighten the two securing screws.

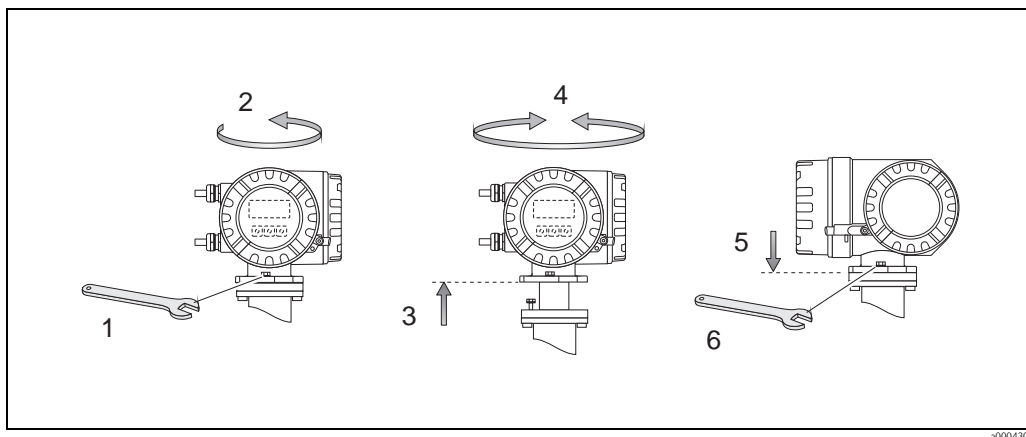


Fig. 15: Turning the transmitter housing (aluminum field housing)

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. $2 \times 90^\circ$ in either direction).
4. Lower the housing into position.
5. Retighten the two securing screws.

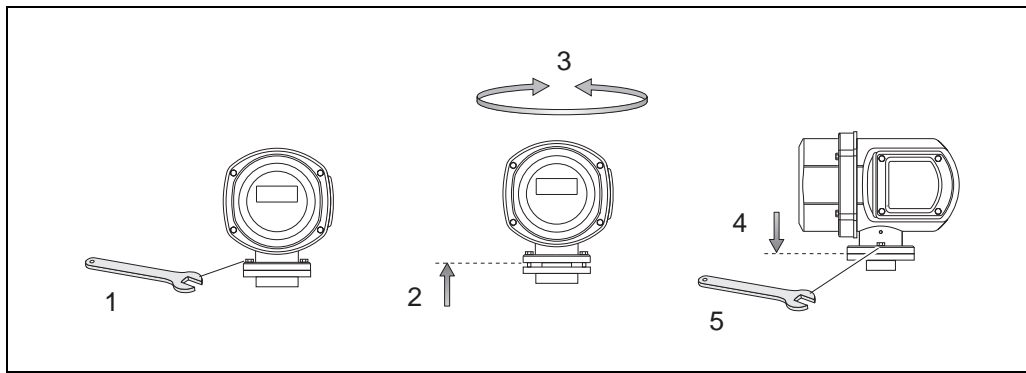


Fig. 16: Turning the transmitter housing (stainless steel field housing)

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



Caution!

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

Mounted directly on the wall

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

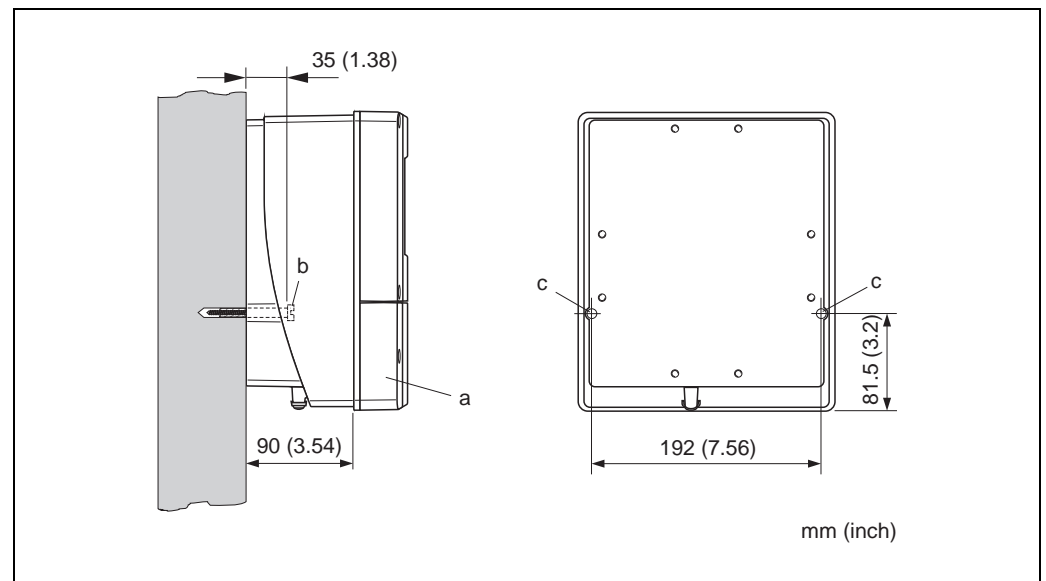


Fig. 17: Mounted directly on the wall

a0001130

Installation in control panel

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

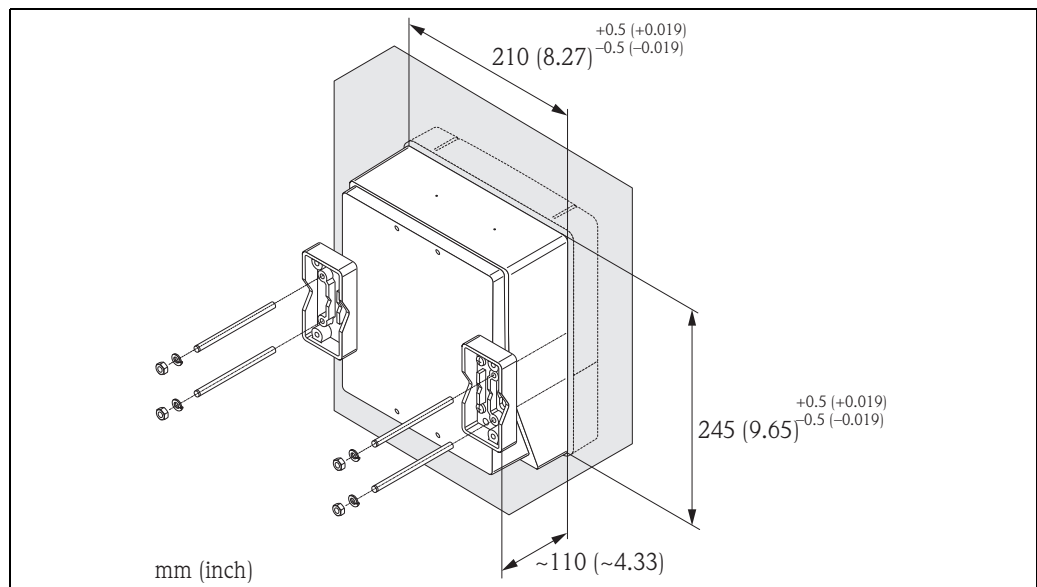


Fig. 18: Panel installation (wall-mount housing)

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).

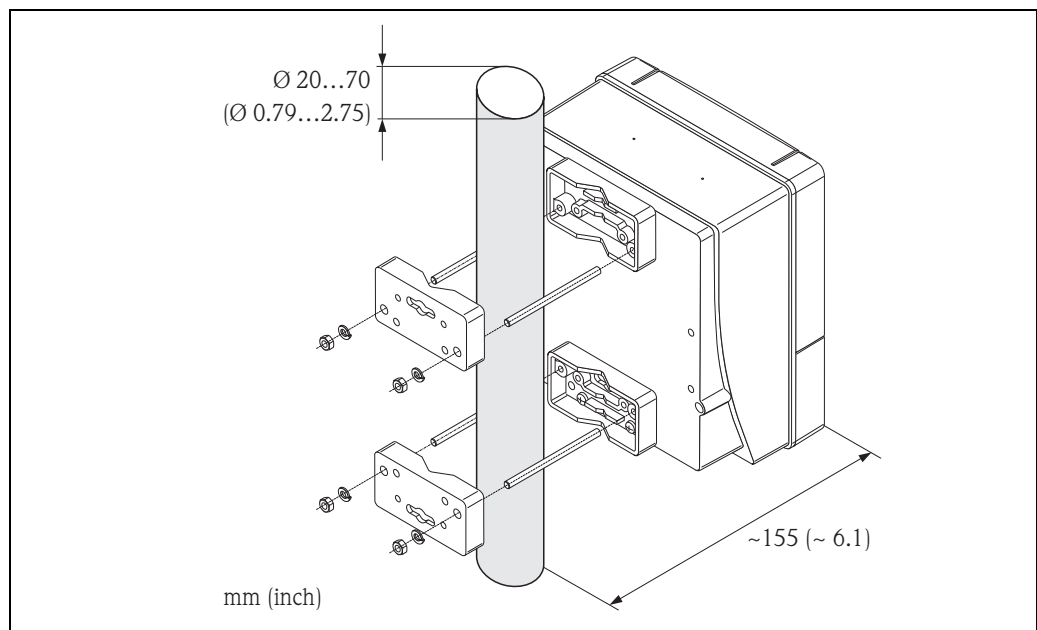


Fig. 19: Pipe mounting (wall-mount housing)

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. $4 \times 45^\circ$ in both directions), and reset it onto the electronics compartment cover plate.
4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.

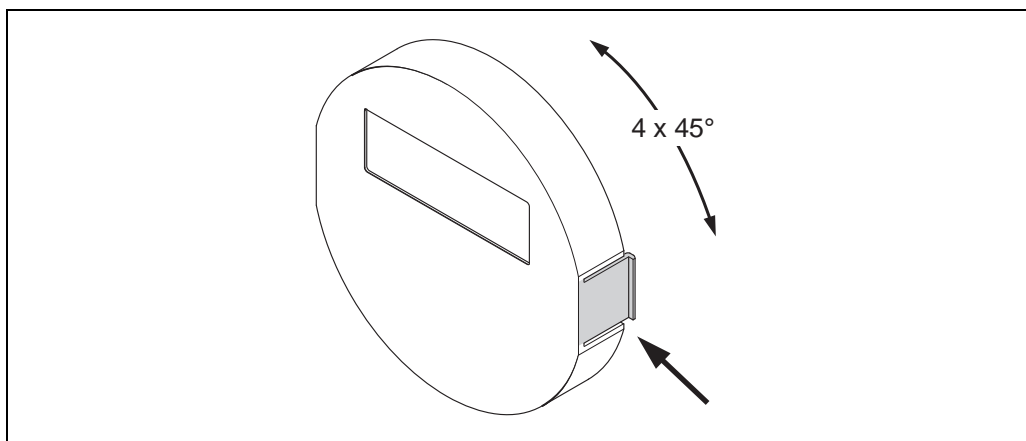


Fig. 20: Turning the local display (field housing)

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.?	→ 5
Installation instructions	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	-
Are the measuring point number and labeling correct (visual inspection)?	-
Is the orientation chosen for the sensor correct, in other words suitable for sensor type, fluid properties (outgassing, with entrained solids) and fluid temperature?	→ 16
Process environment / process conditions	Notes
Is the measuring device protected against moisture and direct sunlight?	-

4 Wiring



Warning!

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



Note!

The 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 cable specifications

4.1.1 PROFIBUS DP cable specifications

Cable type

Two versions of the bus line are specified in IEC 61158. Cable type A can be used for all transmission rates up to 12 Mbit/s. Please refer to the table for the cable parameters:

Cable type A	
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	< 30 pF/m
Core cross-section	>0.34 mm ² , corresponds to AWG 22
Cable type	Twisted in pairs, 1 × 2, 2 × 2 or 1 × 4 wire
Loop-resistance	110 Ω /km
Signal damping	Max. 9 dB over the entire length of the cable section
Shielding	Copper braided shielding or braided shielding and foil shielding

Bus structure

Note the following points:

- The maximum line length (segment length) depends on the transmission rate.
For cable type A, the maximum line length (segment length) is as follows:

Transmission rate [kBit/s]	Line length	
	[m]	[ft]
9.6 to 93.75	1200	4000
187.5	1000	3300
500	400	1300
1500	200	650
3000 to 12000	100	330

- A maximum of 32 users are permitted per segment.
- Each segment is terminated at either end with a terminating resistor.
- The bus length or the number of users can be increased by introducing a repeater.
- The first and last segment can comprise max. 31 devices.
The segments between the repeaters can comprise max. 30 stations.
- The maximum distance between two bus users can be calculated as follows:
(NO_REP + 1) × segment length

Note!

NO_REP = maximum number of repeaters that may be switched in series depending on the repeater in question.

Example

In accordance with manufacturer specifications, 9 repeaters can be switched in series when using a standard line. The maximum distance between two bus users at a transmission rate of 1.5 MBit/s can be calculated as follows: $(9 + 1) \times 200 \text{ m} (660 \text{ ft}) = 2000 \text{ m} (6600 \text{ ft})$.

Spurs

Note the following points:

- Length of spurs < 6.6 m (21.7 ft) (at max. 1.5 MBit/s)
- No spurs should be used for transmission rates > 1.5 MBit/s. The line between the connector and the bus driver is described as a spur. Experience has shown that you should proceed with caution when configuring spurs. For this reason, you cannot presume that the sum of all spurs at 1.5 MBit/s may be 6.6 m (21.7 ft). This is affected greatly by the arrangement of the field devices. Therefore, we recommend you do not use any spurs, if possible, at transmission rates > 1.5 MBit/s.
- If you cannot avoid using spurs, then they may not include any bus terminators.

Bus termination

It is important to terminate the RS485 line correctly at the start and end of the bus segment since impedance mismatch results in reflections on the line which can cause faulty communication transmission → 53.

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."

4.1.2 PROFIBUS PA cable specifications**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	*

	Type A	Type B
Shield coverage	90%	*
Max. cable length (incl. spurs >1 m)	1 900 m (6200 ft)	1 200 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

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 spurs >1 m (> 3.28 ft).

Note the following points:

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

Typ A	1 900 m	6200 ft
Typ B	1 200 m	4000 ft

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

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 (>3.28 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]	393	295	196	98	3.28

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 (3300 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.

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.

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."

4.1.3 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!

4.2 Connecting the remote version

4.2.1 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 (→ 21 or wiring diagram inside cover).
4. Seal the connection compartment or the transmitter housing again.

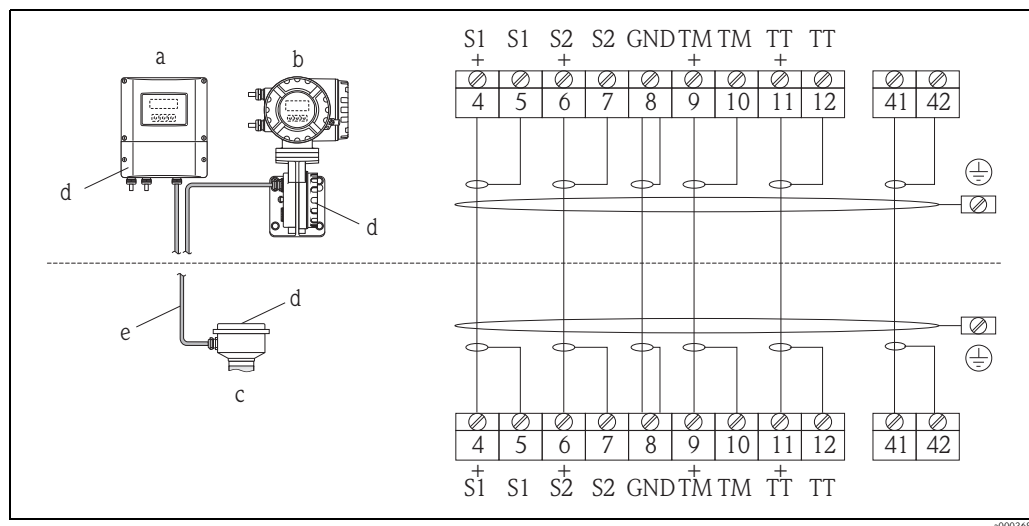


Fig. 21: Connecting the remote version

- 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

4.2.2 Cable specification for connecting cable

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

- $6 \times 0.38 \text{ mm}^2$ PVC cable with common shield and individually shielded cores
- Conductor resistance: $\leq 50 \text{ } \Omega/\text{km}$
- Capacitance core/shield: $\leq 420 \text{ pF/m}$
- Cable length: max. 20 m (65 ft)
- Permanent operating temperature: max. $+105 \text{ } ^\circ\text{C}$ ($+221 \text{ } ^\circ\text{F}$)



Note!

The cable must be installed securely, to prevent movement.

4.3 Connecting the measuring unit

4.3.1 Terminal assignment

Electrical values for:

- Inputs → 152
- Outputs → 153

PROFIBUS DP



Caution!

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

- Slot "INPUT / OUTPUT 3" = Terminals 22 / 23
- Slot "INPUT / OUTPUT 4" = Terminals 20 / 21

Order characteristic for "inputs/outputs"	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-) Submodule on slot No. 4	22 (+) / 23 (-) Submodule on slot No. 3	24 (+) / 25 (-) Fixed on I/O board	26 = B (RxD/TxD-P) 27 = A (RxD/TxD-N) Fixed on I/O board
J	–	–	+5V (power supply for ext. bus terminator)	PROFIBUS DP
V	Relay output 2	Relay output 1	Status input	PROFIBUS DP
P	Current output	Frequency output	Status input	PROFIBUS DP

PROFIBUS PA

Order characteristic for "inputs/outputs"	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 = PA + ¹⁾ 27 = PA – ¹⁾
F	–	–	–	PROFIBUS PA, Ex i
H	–	–	–	PROFIBUS PA
¹⁾ With integrated reverse polarity protection				

4.3.2 Transmitter connection




Warning!

- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to 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. Unscrew the connection compartment cover (a) from the transmitter housing.
2. Feed the power supply cable (b), the fieldbus cable (d) and the power supply cable for external bus terminator (optional) or signal cable (g) through the appropriate cable entries.
3. Perform wiring in accordance with the respective terminal assignment and the associated wiring diagram.



Caution!

- Risk of damaging the fieldbus cable!
Observe the information about shielding and grounding the fieldbus cable →  29.
 - We recommend that the fieldbus cable not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.
4. Screw the cover of the connection compartment (a) back onto the transmitter housing.

4.3.3 PROFIBUS DP connection diagram

Permanent assignment board (Order characteristic for "inputs/outputs: J)

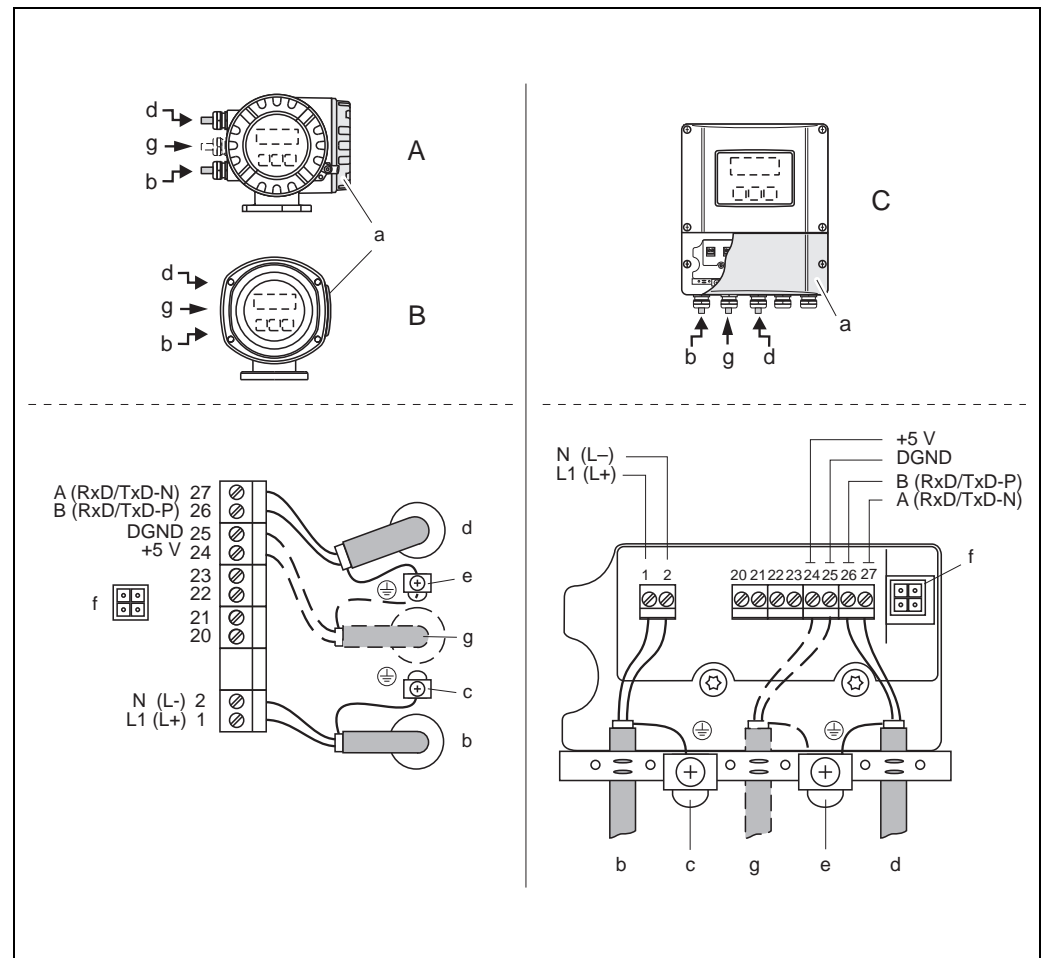


Fig. 22: Connecting the transmitter, cable cross-section: max. 2.5 mm² (AWG 14)

- 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: B (Rx/D/TxD-P)
Terminal No. 27: A (Rx/D/TxD-N)
- e Ground terminal for fieldbus cable shield
Observe the following:
 - the shielding and grounding of the fieldbus cable → 29
 - 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)
- g Power supply cable for external bus terminator (optional):
Terminal No. 24: +5 V
Terminal No. 25: DGND

Flexible assignment board (order characteristic for "inputs/outputs: V and P)

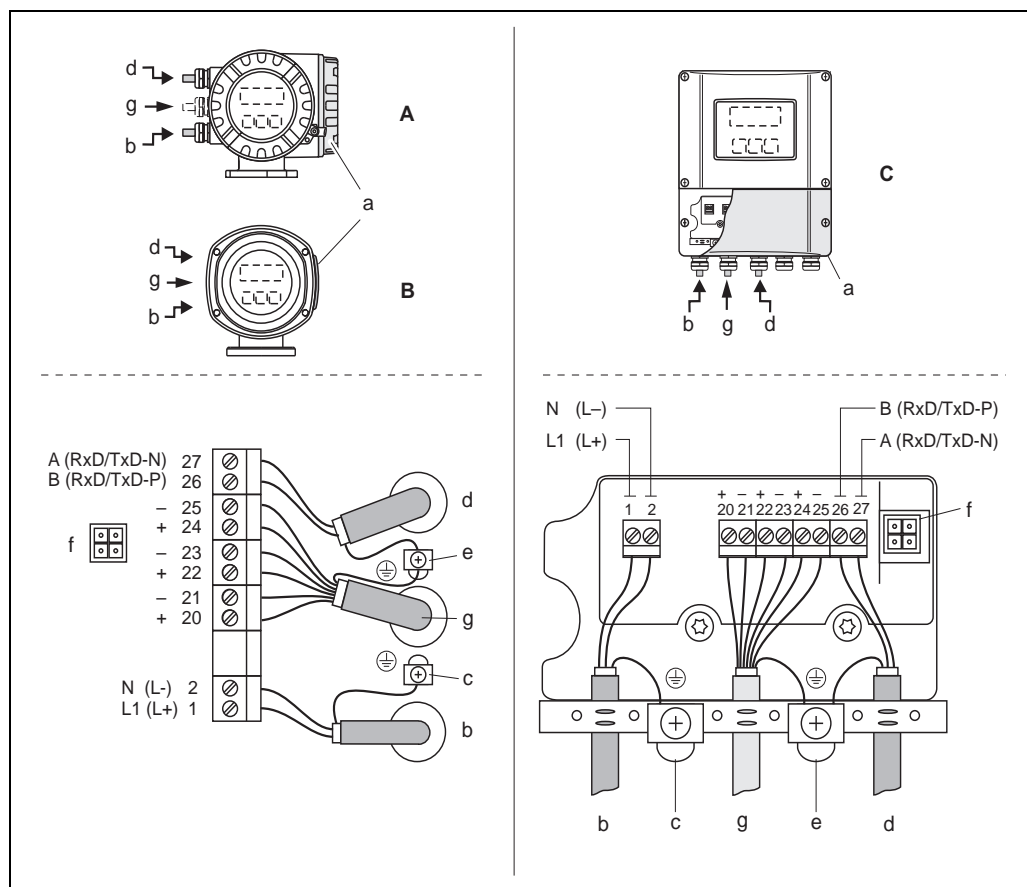


Fig. 23: Connecting the transmitter, cable cross-section: max. 2.5 mm² (AWG 14)

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: B (Rx/D/TxD-P)

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

e Ground terminal for signal cable shield/fieldbus cable shield

Observe the following:

- the shielding and grounding of the fieldbus cable → 29
- 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)

g Signal cable: see terminal assignment → 31

4.3.4 PROFIBUS PA connection diagram

Permanent assignment board (order characteristic for "inputs/outputs: F and H)

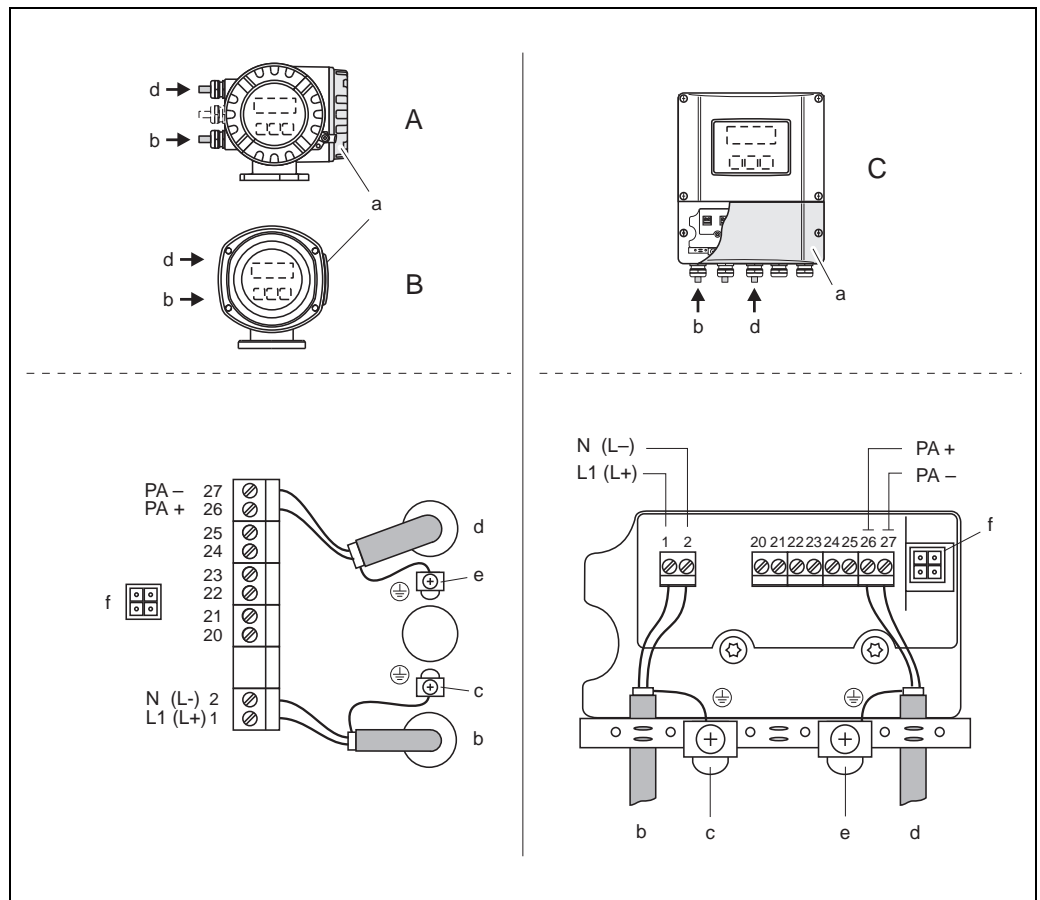


Fig. 24: Connecting the transmitter, cable cross-section: max. 2.5 mm² (AWG 14)

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 → 29

– 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)

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 → 141.

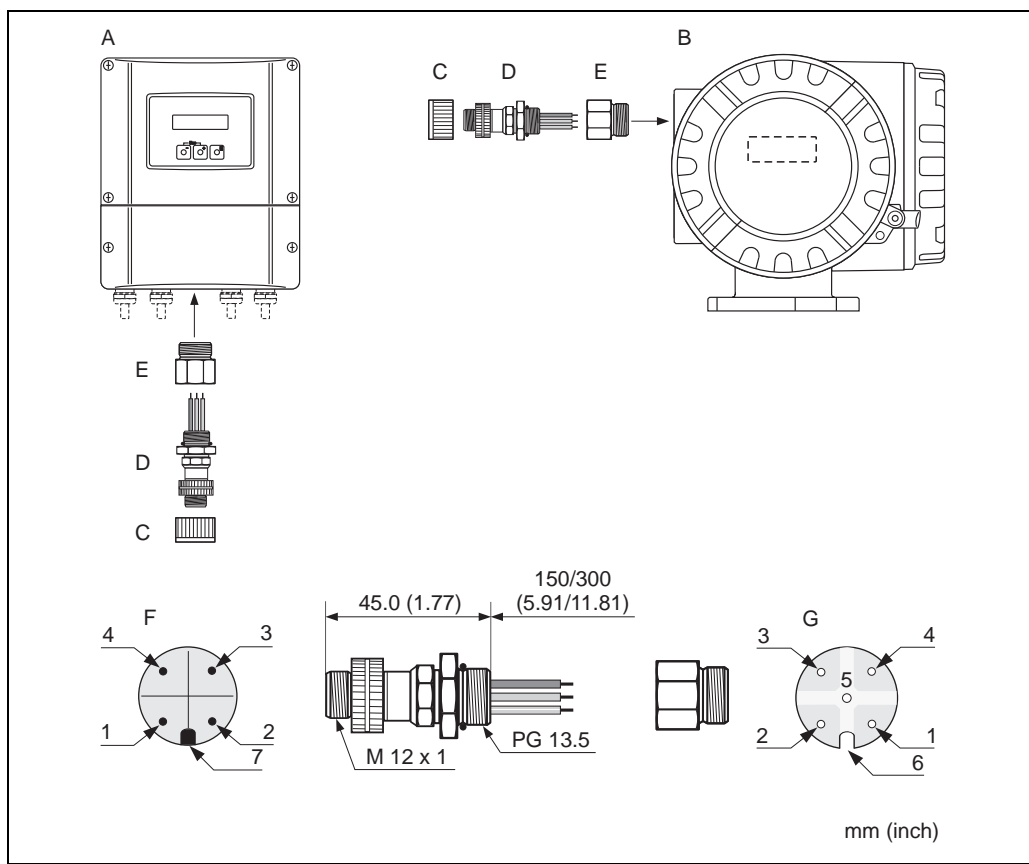


Fig. 25: Connectors for connecting to the PROFIBUS PA

- 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 DP → 33; PA → 35)
 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 to +150 °C (−40 to +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).

4.4 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 → 155, cable entries.
- Firmly tighten the cable entry (point **a** → 26).
- The cable must loop down in front of the cable entry ("water trap") (point **b** → 26). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point upwards.



Note!

The cable entries may not be point up.

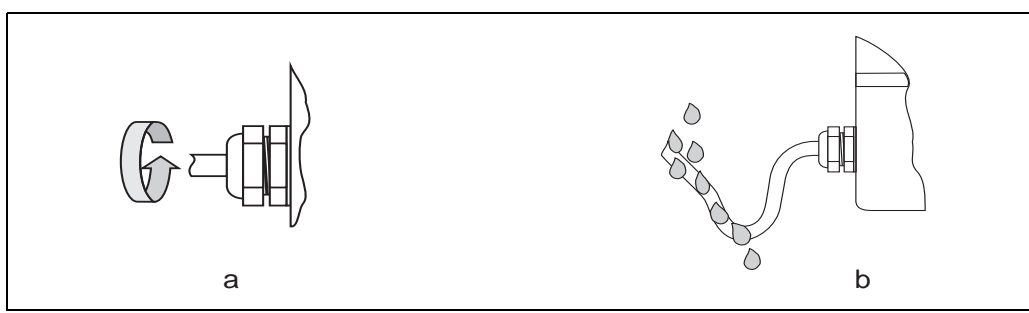


Fig. 26: Installation instructions, cable entries

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



Caution!

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

4.5 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	-
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85 to 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 DP → 26 PROFIBUS PA → 27 Sensor cable → 31
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"?	→ 38
Are all housing covers installed and firmly tightened?	-
Electrical connection of PROFIBUS DP/PA	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?	PROFIBUS DP → 53
Has the max. length of the fieldbus cable been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → 26 PROFIBUS PA → 28
Has the max. length of the spurs been observed in accordance with the PROFIBUS specifications?	PROFIBUS DP → 27 PROFIBUS PA → 28
Is the fieldbus cable fully shielded and correctly grounded?	→ 29

5 Operation

5.1 Quick operation guide

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

1. **Local display (option)** → 41
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** → 49
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**
 - PROFIBUS DP → 51
 - PROFIBUS PA → 56

You can make the following hardware settings using a jumper or miniature switches on the I/O board:

- Address mode configuration (select software or hardware addressing)
- Device bus address configuration (for hardware addressing)
- Hardware write protection enabling/disabling

 **Note!**

A description of the configuration of the current output (active/passive) and the relay output (NC contact/NO contact) can be found in the "Hardware settings" section → 54.

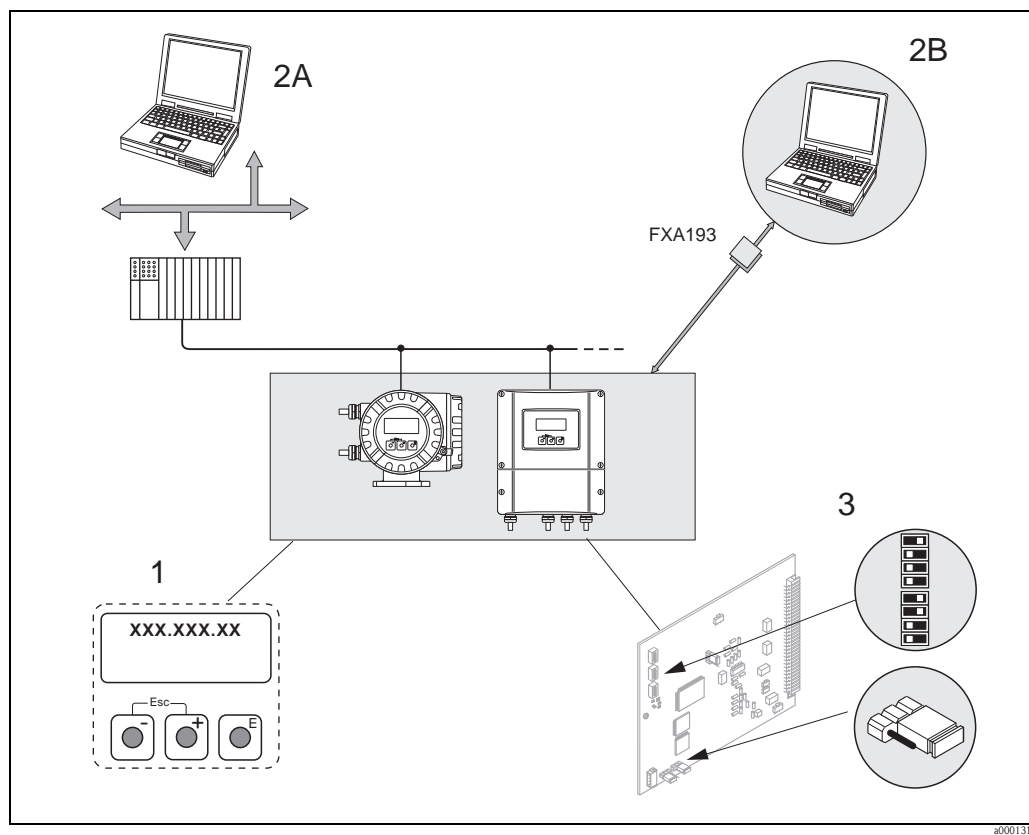


Fig. 27: Methods of operating PROFIBUS PA/DP

- 1 Local display for device operation in the field (option)
- 2A Configuration/operating programs (e.g. FieldCare) for operation via PROFIBUS DP/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, address mode)

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 (→ see the "Description of Device Functions" manual).

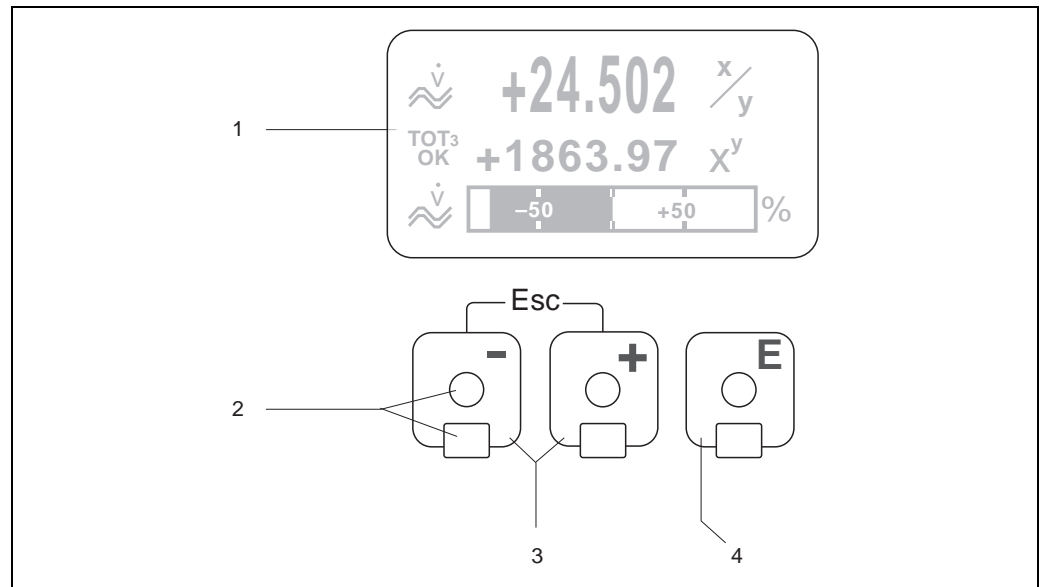


Fig. 28: Display and operating elements

1 Liquid crystal display

The backlit, four-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).

Display

2 Optical sensors for "Touch Control"

3 $\boxed{+}$ / $\boxed{-}$ keys

– HOME position → Direct access to totalizer values and actual values of inputs/outputs

– Enter numerical values, select parameters

– Select different blocks, groups and function groups within the function matrix

Press the $\boxed{+}$ / $\boxed{-}$ keys simultaneously to trigger the following functions:

– Exit the function matrix step by step → HOME position

– Press and hold down $\boxed{+}$ / $\boxed{-}$ keys for longer than 3 seconds → Return directly to HOME position

– Cancel data entry

4 Enter key

– HOME position → Entry into the function matrix

– Save the numerical values you input or settings you change

5.2.2 Display (operating mode)

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

Multiplex mode:

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

Error messages:

Display and presentation of system/process errors → 48

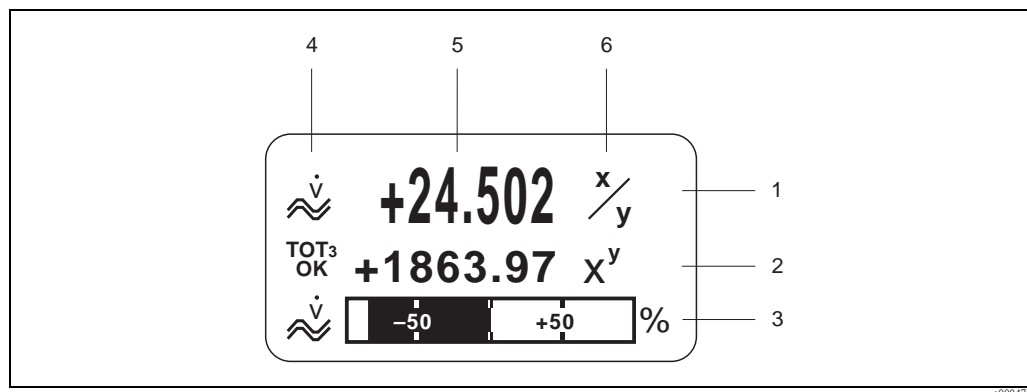


Fig. 29: Typical display for normal operating mode (HOME position)

- 1 Main line: shows the main measured values
- 2 Additional line: shows additional measured variables and status variables
- 3 Information line: shows additional information on the measured variables and status variables, e.g. bar graph display
- 4 "Info icons" field: icons representing additional information on the measured values are shown in this field → 43.
- 5 "Measured values" field: the current measured values appear in this field
- 6 "Unit of measure" field: the units of measure and time defined for the current measured values appear in this field

5.2.3 Additional display functions

Depending on the order option, the local display has different display functions (F-CHIP → 120).

Device without batching software:

From HOME position, use the keys to open an "Info Menu" containing the following information:

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

→ Scan of individual values within the Info Menu






















(Esc key) → Back to HOME position














Device with batching software:

On measuring devices with installed batching software and a suitably configured display line, you can carry out filling processes directly using the local display. Detailed description → 45.

5.2.4 Icons

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

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
I 1 to n	Current output 1 to n	P 1 to n	Pulse output 1 to n
F 1 to n	Frequency output	S 1 to n	Status output/relay output 1 to n
 a0001181	Measuring mode: PULSATING FLOW	 a0001187	Status input
 a0001188	Volume flow	 a0001189	Target volume flow
 a0001190	Target corrected volume flow	 a0001191	Carrier volume flow
 a0001192	Carrier corrected volume flow	 a0001193	% Target volume flow
 a0001194	% Carrier volume flow	 a0001195	Mass flow
 a0001196	Target mass flow	 a0001197	% Target mass flow
 a0001198	Carrier mass flow	 a0001199	% Carrier mass flow
 a0001200	Fluid density	 a0001208	Reference density
 a0001201	Batching quantity upwards	 a0001202	Batching quantity downwards
 a0001203	Batch quantity	 a0001204	Total batching quantity

Icon	Meaning	Icon	Meaning
 a0001205	Batch counter (x times)	 a0001207	Fluid temperature
 a0001206	Acyclic communication via PROFIBUS active (e.g. via the operating program "FieldCare")	 (scrolling display)	Cyclic communication via PROFIBUS active, for example via PLC (Class 1 master)
 a0002322	Display value (module DISPLAY_VALUE) with status GOOD	 a0002321	Display value (module DISPLAY_VALUE) with status UNC = uncertain
 a0002320	Display value (module DISPLAY_VALUE) with status BAD		
 a0002324	Output value OUT, Analog Input 1 to 6 (AI module) with status GOOD	 a0002325	Output value OUT, Totalizer 1 to 3 (TOTAL module) with status GOOD
 a0002326	Output value OUT, Analog Input 1 to 6 (AI module) with status UNC = uncertain	 a0002327	Output value OUT, Totalizer 1 to 3 (TOTAL module) with status UNC = uncertain
 a0002328	Output value OUT, Analog Input 1 to 6 (AI module) with status BAD	 a0002329	Output value OUT, Totalizer 1 to 3 (TOTAL module) with status BAD

5.2.5 Controlling the batching processes using the local display

Filling processes can be carried out directly by means of the local display with the aid of the optional "(Batching)" software package (F-CHIP, accessories → 122). Therefore, the device can be fully deployed in the field as a "batch controller".

Procedure:

1. Configure all the required batching functions and assign the lower display info line (= BATCHING KEYS) using the "Batch" Quick Setup menu (→ 64) or use the function matrix (→ 46).
The following "softkeys" then appear on the bottom line of the local display → 30:
 – START = left display key (□)
 – PRESET = middle display key (□+)
 – MATRIX = right display key (□E)
2. Press the "PRESET (□+)" key. Various batching process functions requiring configuration will now appear on the display:

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

3. After exiting the PRESET menu, you can now start the batching process by pressing "START (□)". New softkeys (STOP / HOLD or GO ON) now appear on the display. You can use these to interrupt, continue or stop the batching process at any time → 30.
STOP (□) → Stops batching process
HOLD (□+) → Interrupts batching process (softkey changes to "GO ON")
GO ON (□+) → Continues batching process (softkey changes to "HOLD")
 After the batch quantity is reached, the "START" or "PRESET" softkeys reappear on the display.

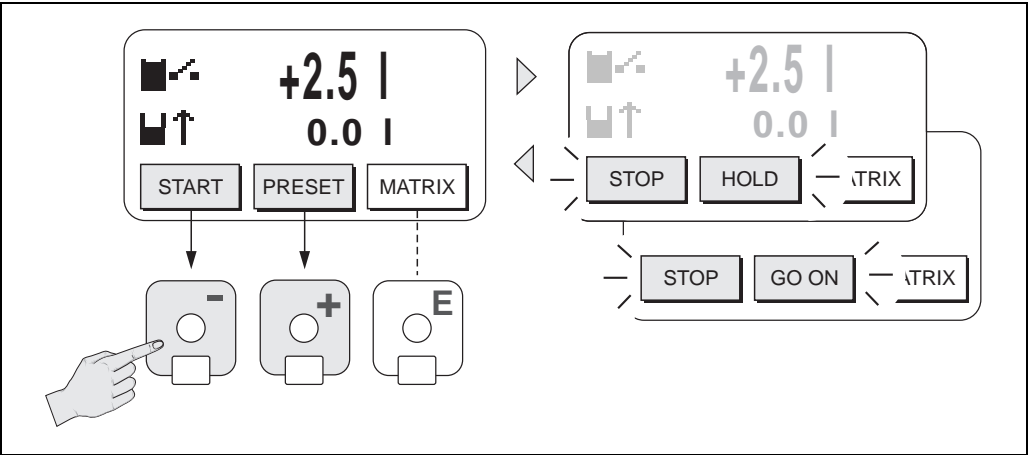


Fig. 30: Controlling batching processes using the local display (softkeys)

5.3 Brief operating instructions on the function matrix



Note!

- See the general notes → 47.
 - Function descriptions → see the "Description of Device Functions" manual"
1. HOME position → **E** → Entry into the function matrix
 2. Select a block (e.g. OUTPUTS)
 3. Select a group (e.g. CURRENT OUTPUT 1)
 4. Select a function group (e.g. CONFIGURATION)
 5. Select a function (e.g. TIME CONSTANT)
Change parameter / enter numerical values:
 ▢ → Select or enter enable code, parameters, numerical values
E → Save your entries
 6. Exit the function matrix:
 - Press and hold down Esc key (**Esc**) for longer than 3 seconds → HOME position
 - Repeatedly press Esc key (**Esc**) → Return step-by-step to HOME position

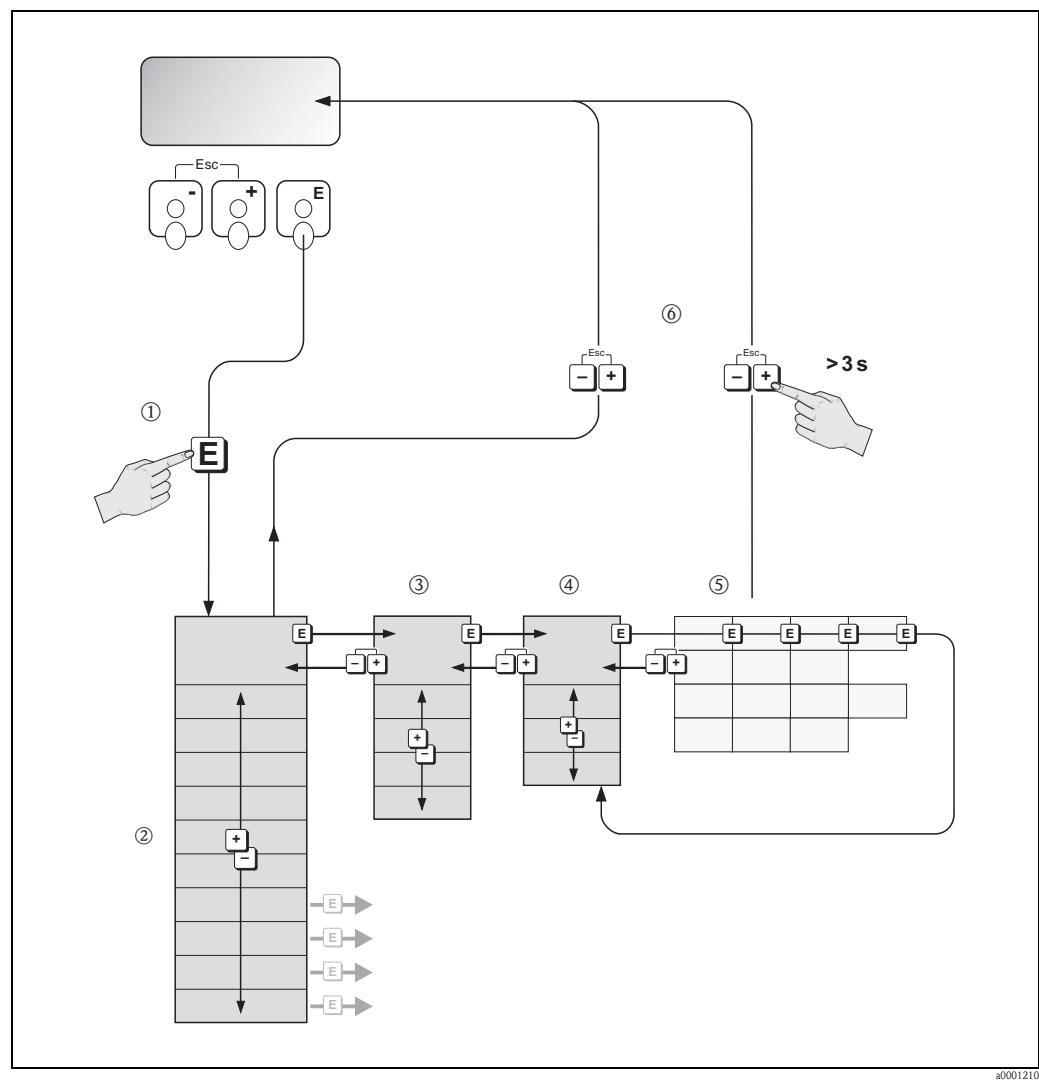





Fig. 31: Selecting functions and configuring parameters (function matrix)

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 on a number of menu levels (blocks, groups, and function groups).

Comply with the following instructions when configuring functions:

- You select functions as described →  46.
Each cell in the function matrix is identified by a numerical or letter code on the display.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press  to select "SURE [YES]" and press  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 or the fieldbus communication in the normal way.
- If the supply voltage fails all preset and parameterized values remain safely stored in the EEPROM.

5.3.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 83) 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 Endress+Hauser service organization. Please contact Endress+Hauser 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*: Includes all device errors, e.g. hardware errors, etc. → 126
- *Process error*: Includes all application errors, e.g. fluid not homogeneous, etc. → 135

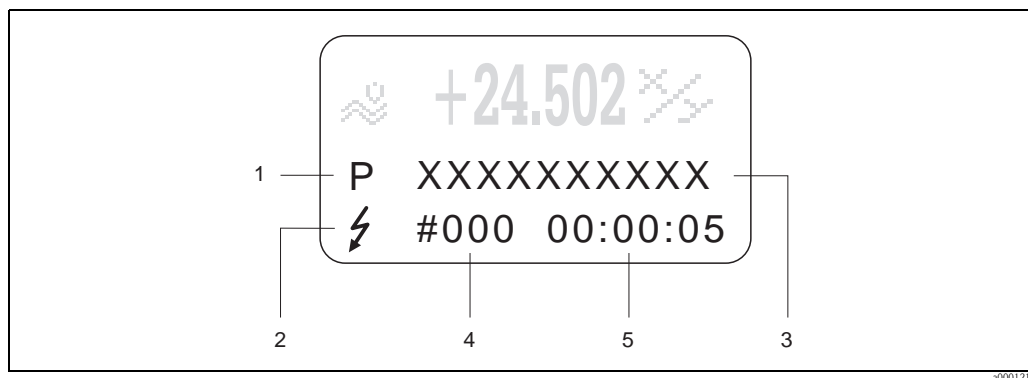


Fig. 32: Error messages on the display (example)

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

5.4.2 Error message type

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 → 124.

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 and the outputs of the measuring device.
- Displayed as → Exclamation mark (!), type of error (S: system error, P: process error)
- Displaying the device status on PROFIBUS DP/PA → 126

Fault message (⚡)

- The error in question interrupts or stops the current operation and has an immediate effect on the outputs. The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix → 124.
- Displayed as → Lightning flash (⚡), type of error (S: system error, P: process error)
- Displaying the device status on PROFIBUS DP/PA → 126



Note!

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

5.5 Operating options

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.

PROFIBUS DP

Valid for device software:	3.06.XX	→ DEVICE SOFTWARE function (8100)
Device data PROFIBUS DP:		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promass 83 ID No.:	1529 (Hex)	→ DEVICE ID function (6162)
Profile ID No.:	9742 (Hex)	
GSD file information:		
Promass 83GSD file:	Extended Format (recommended): eh3x1529.gsd Standard Format: eh3_1529.gsd	
	 Note! Before configuring the PROFIBUS network, read and follow the information for using the GSD file → 88.	
Profile GSD file:	PA039742.gsd	
Bitmaps:	EH_1529_d.bmp/.dib EH_1529_n.bmp/.dib EH_1529_s.bmp/.dib	
Software release:	06.2010	
Operating program/device description:	Sources for obtaining device descriptions/program updates:	
Promass 83 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:	
Device:	How to acquire:
Fieldcheck	■ Update by means of FieldCare via flow device FXA 193/291 DTM in the Fieldflash Module



Note!

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

PROFIBUS PA

Valid for device software:	3.06.XX	→ DEVICE SOFTWARE function (8100)
Device data PROFIBUS PA:		
Profile Version:	3.0	→ PROFILE VERSION function (6160)
Promass 83 ID No.:	152A (Hex)	→ DEVICE ID function (6162)
Profile ID No.:	9742 (Hex)	
GSD file information:		
Promass 83 GSD file:	Extended Format (recommended): eh3x152A.gsd Standard Format: eh3_152A.gsd	
	 Note! Before configuring the PROFIBUS network, read and follow the information for using the GSD file →  88	
Profile GSD file:	PA139742.gsd	
Bitmaps:	EH_152A_d.bmp/.dib EH_152A_n.bmp/.dib EH_152A_s.bmp/.dib	
Software release:	06.2010	
Operating program/device description:	Sources for obtaining device descriptions/program updates:	
Promass 83 GSD file	■ www.endress.com → Download	
Profile GSD file:	■ www.profibusb.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:	
Device:	How to acquire:
Fieldcheck	■ Update by means of FieldCare via flow device FXA 193/291 DTM in the Fieldflash Module

**Note!**

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

5.6 PROFIBUS DP hardware settings

5.6.1 Configuring the 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.
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

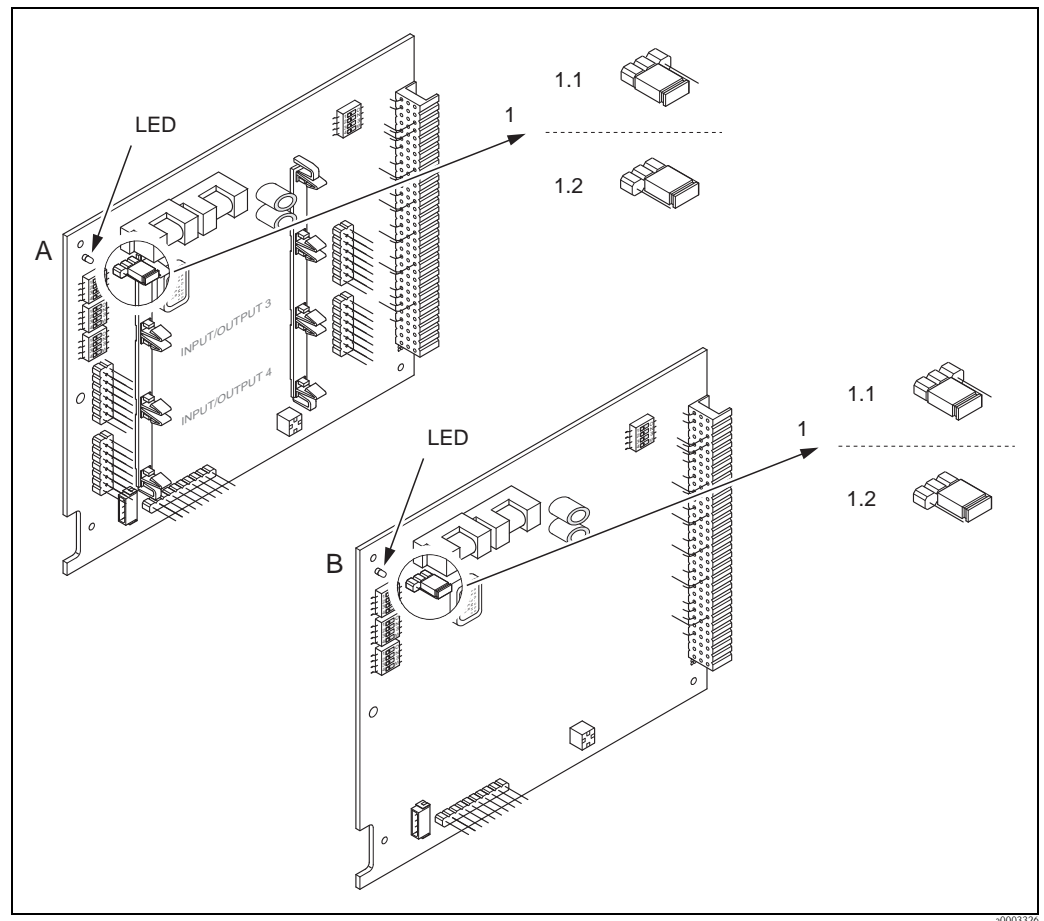


Fig. 33: Switching write protection on and off with the aid of a jumper on the I/O board

A Flexible assignment board

B Permanent assignment board

1 Jumper for switching write protection on and off

1.1 Write protection switched on = it is **not** possible to write to the device functions via PROFIBUS (acyclic data transmission, e.g. via the operating program "FieldCare")

1.2 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")

LED Overview of LED states:

- Lit continuously → Ready for operation
- Not lit → Not ready for operation
- Flashing → System or process error present → 124

5.6.2 Configuring the device address

The address must always be configured for a PROFIBUS DP/PA device. The valid device addresses are in the range from 1 to 126. In a PROFIBUS DP/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 takes place in the FIELDBUS ADDRESS function (6101) → see the "Description of Device Functions" manual.

Addressing via miniature switches



Warning!

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

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

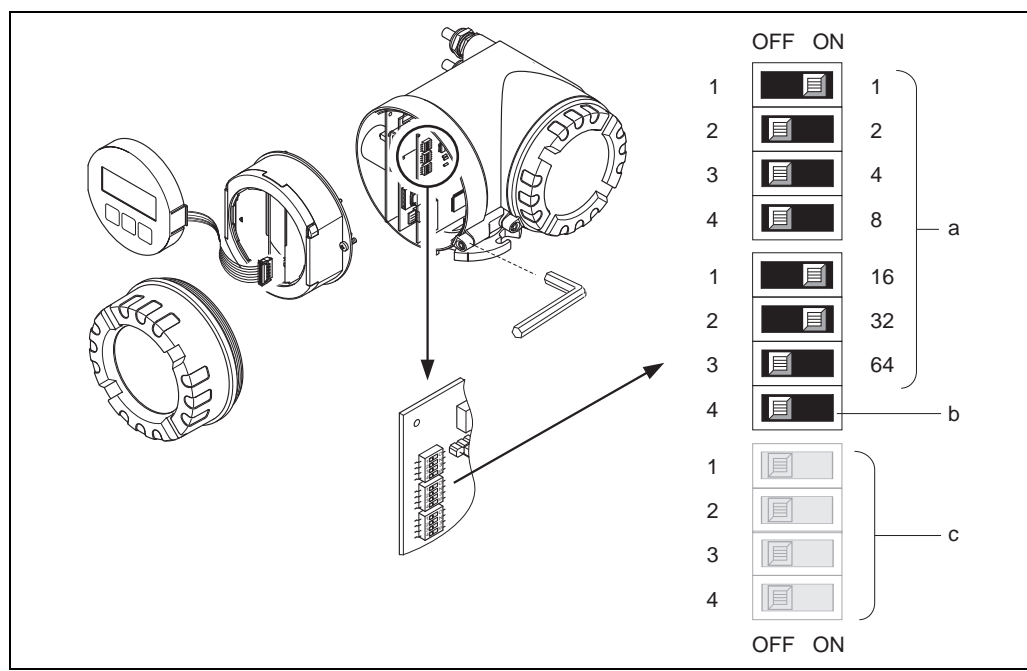


Fig. 34: Addressing with the aid of miniature switches on the I/O board

- 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

5.6.3 Configuring the terminating resistors



Note!

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



Warning!

Risk of electric shock. Exposed components carry dangerous voltages.

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

- For baudrates up to 1.5 MBaud, the termination is set via the terminating switch SW 1 for the last transmitter on the bus: ON – ON – ON – ON.
- Device is operated with a baud rate >1.5 MBaud: due to the capacitive load of the user and the resulting line reflection, make sure that an external bus terminator is used.
In addition, the signal lines have to be shielded and grounded for flexible assignment boards
→ 34.

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

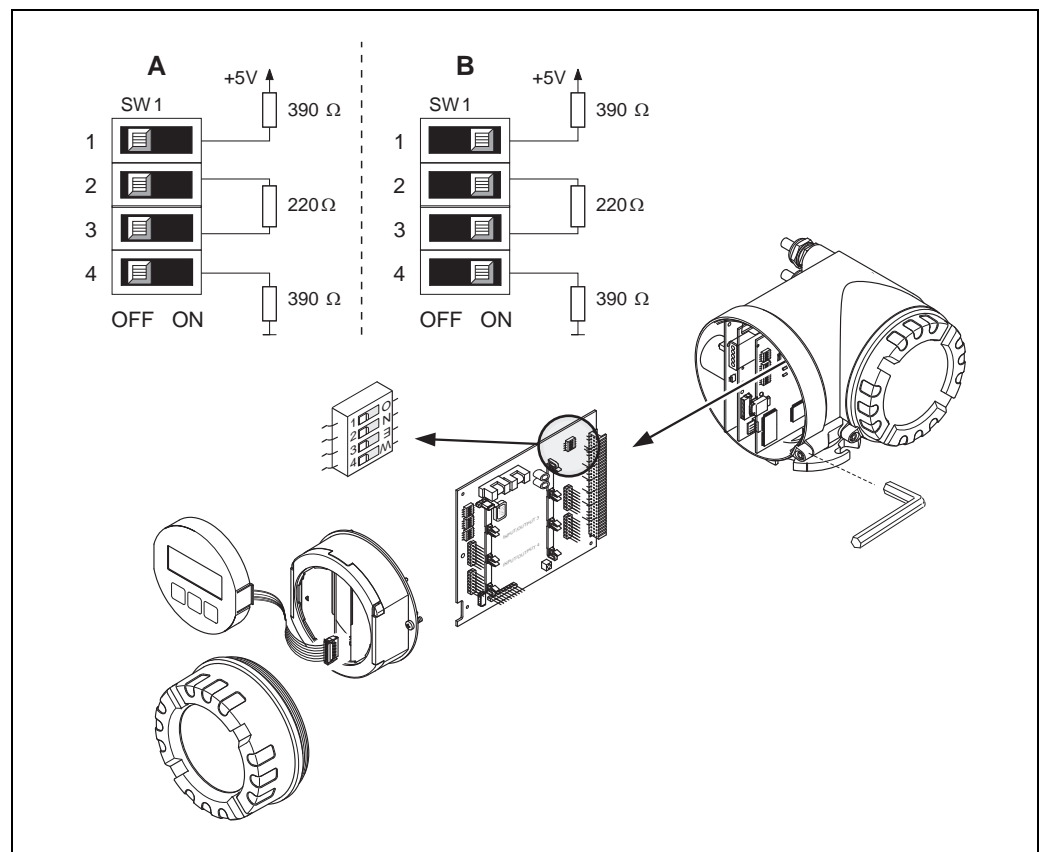


Fig. 35: Configuring the terminating resistors (for baud rates < 1.5 MBaud)

A = Factory setting

B = Setting at the last transmitter



Note!

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

5.6.4 Current output configuration

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



Warning!

Risk of electric shock. Exposed components carry dangerous voltages.

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

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



Caution!

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

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

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

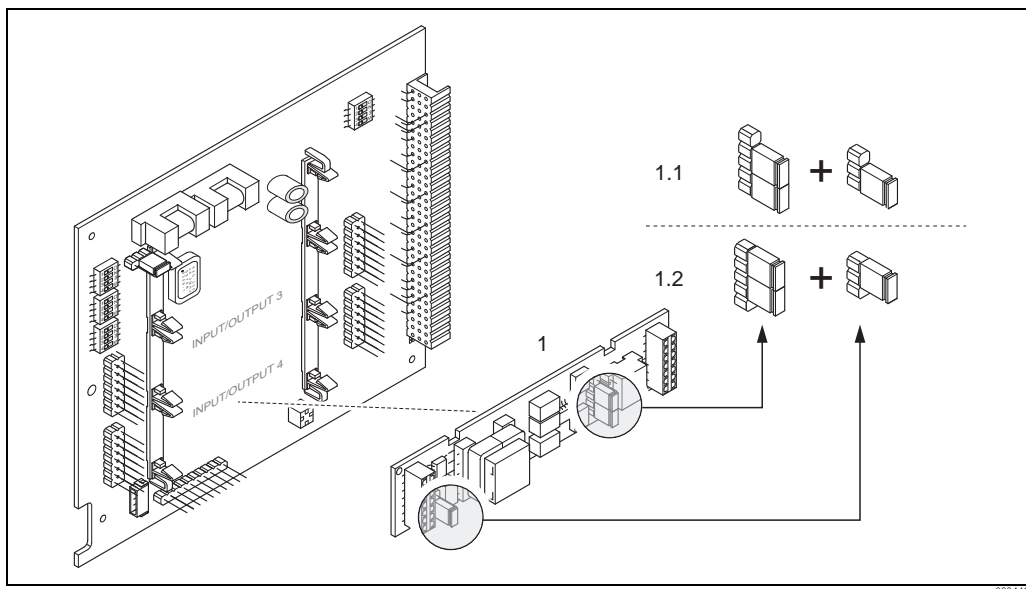


Fig. 36: Configuring the current input with the aid of jumpers (I/O board)

- 1 Current output
 1.1 Active current output (default)
 1.2 Passive current output

5.6.5 Relay output configuration

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



Warning!

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

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



Caution!

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

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

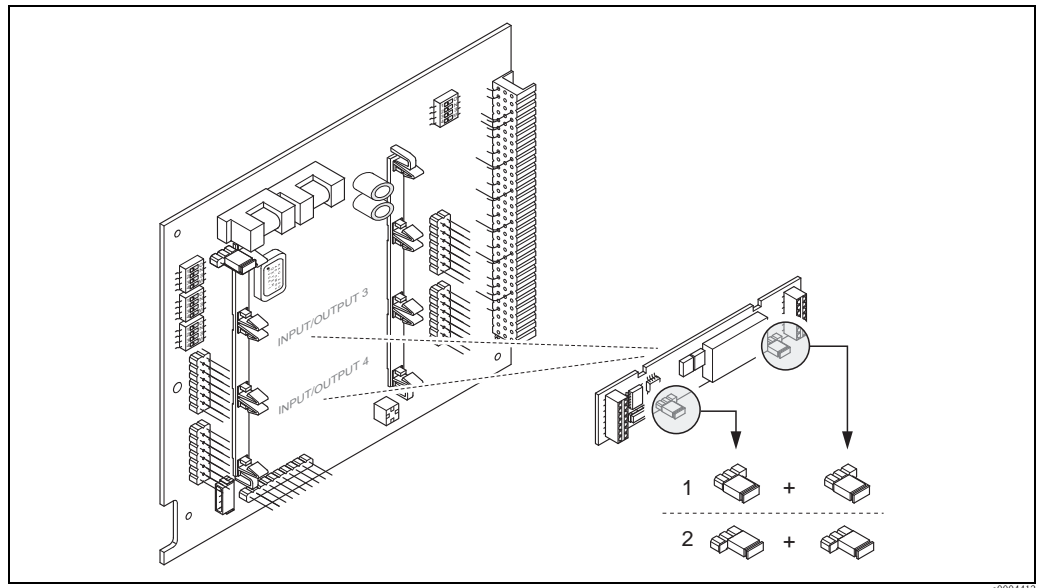


Fig. 37: Configuring relay contacts (NC/NO) on the convertible I/O board (submodule) with the help of jumpers.

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

5.7 PROFIBUS PA hardware settings

5.7.1 Configuring the 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.
3. Configure the hardware write protection accordingly with the aid of the jumpers (see Figure).
4. Installation is the reverse of the removal procedure.

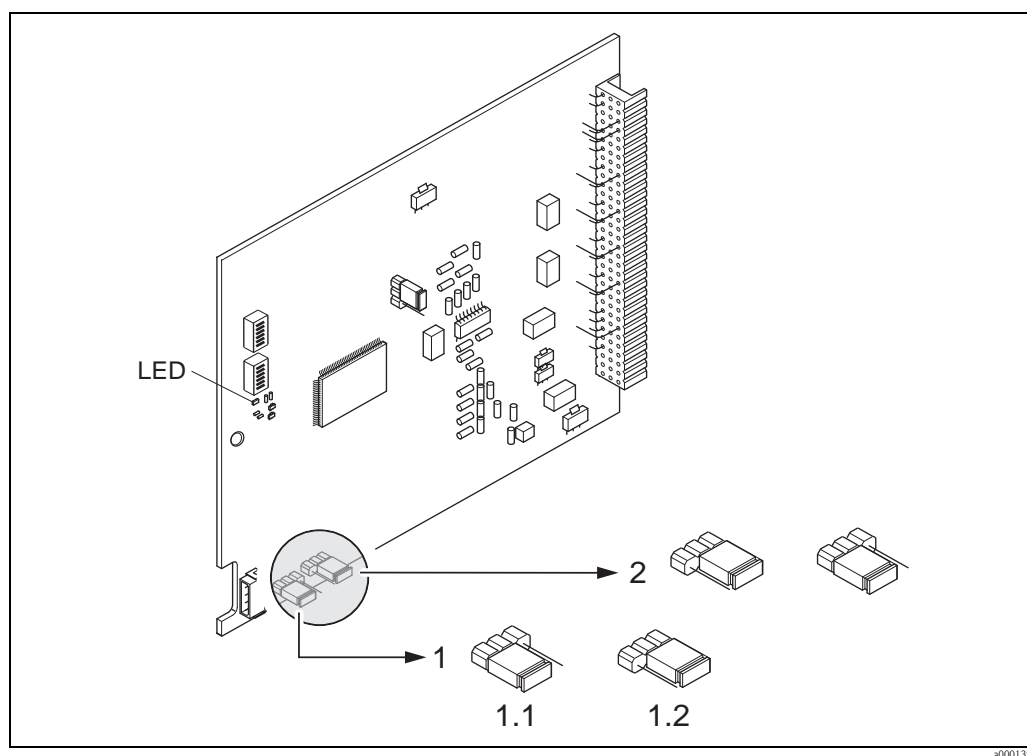


Fig. 38: Switching write protection on and off with the aid of a jumper on the I/O board

- 1 Jumper for switching write protection on and off
 - 1.1 Write protection switched on = it is **not** possible to write to the device functions via PROFIBUS (acyclic data transmission, e.g. via the operating program "FieldCare")
 - 1.2 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")
- 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 → 124

5.7.2 Configuring the device address

The address must always be configured for a PROFIBUS DP/PA device. The valid device addresses are in the range from 1 to 126. In a PROFIBUS DP/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 takes place in the FIELDBUS ADDRESS function (6101) → see the "Description of Device Functions" manual.

Addressing via miniature switches



Warning!

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

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

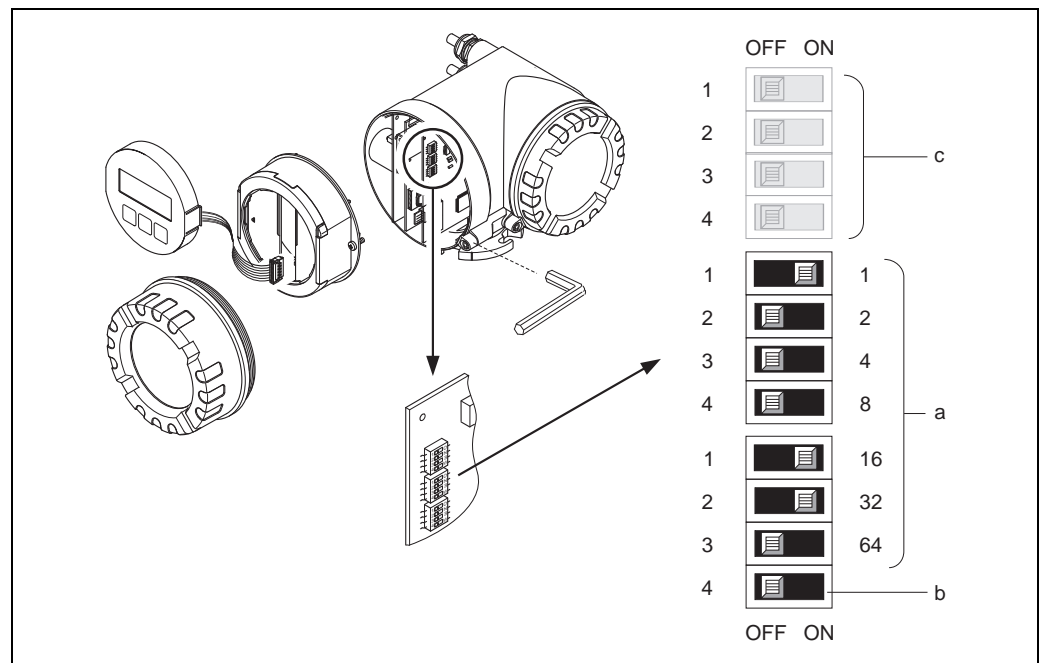


Fig. 39: Addressing with the aid of miniature switches on the I/O board

- a Miniature switches for setting the device address (illustrated: $1 + 16 + 32 = \text{device address } 49$)
 b Miniature switches for the address mode (method of addressing):
 OFF = software addressing via local operation/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" → 25
- Checklist for "Post-connection check" → 39



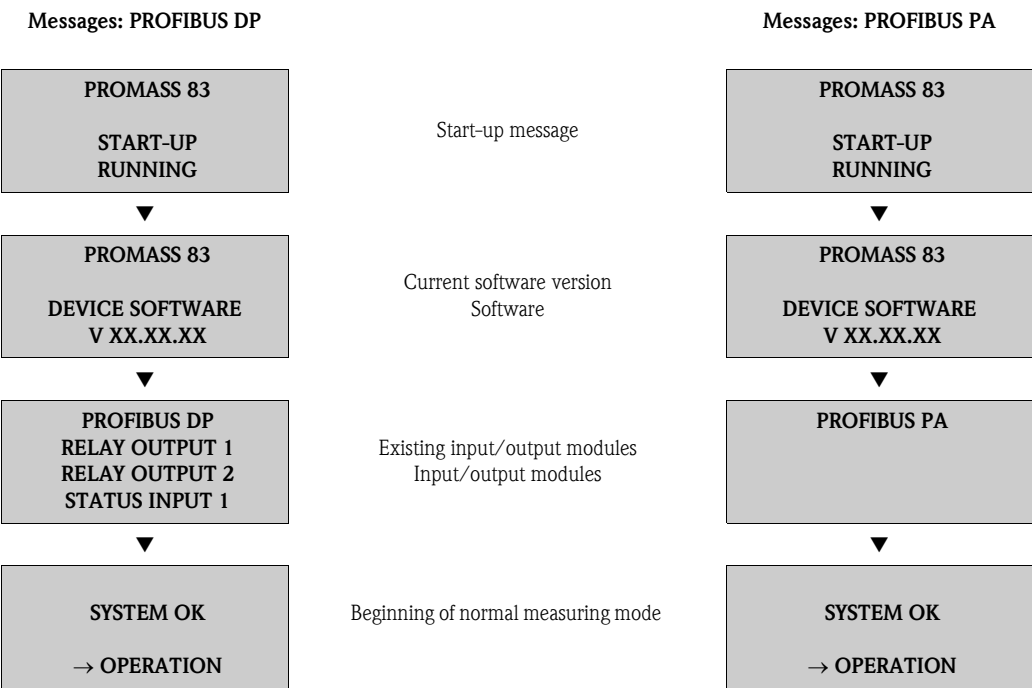
Note!

When using PROFIBUS PA, please note the following:

- The PROFIBUS interface's technical data must be maintained in accordance with IEC 61158-2 (MBP).
- A normal multimeter can be used to check the bus voltage of 9 to 32 V and the current consumption of 11 mA at the device.

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:



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"

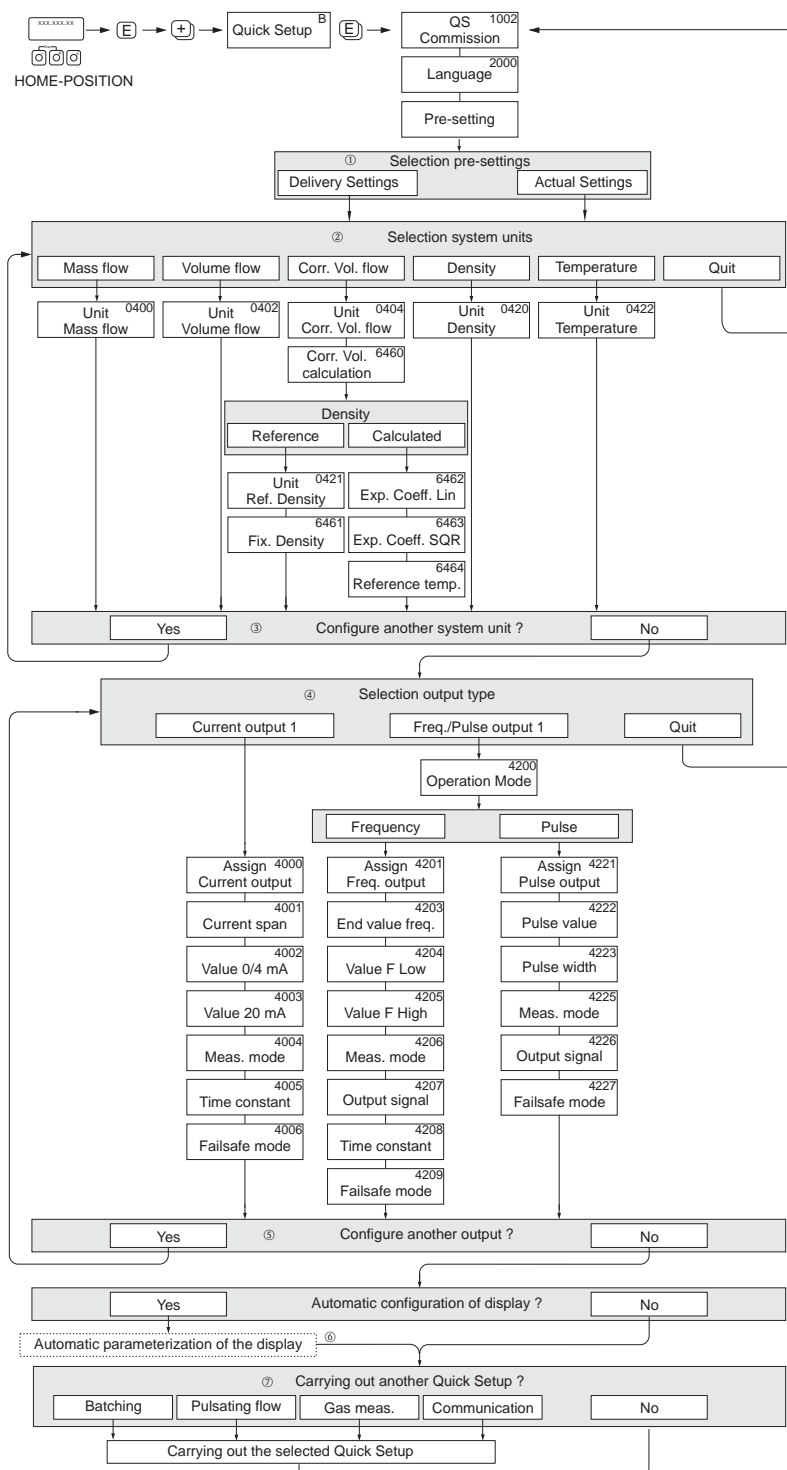


Fig. 40: Quick Setup "Commissioning"

**Note!**

- The display returns to the cell SETUP COMMISSIONING (1002) if you 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 This prompt only appears if a current output and/or pulse/frequency output is available. Only the outputs not yet configured in the current Setup are offered for selection in each cycle.
 - ⑤ The "YES" option remains visible until all the outputs have been configured.
"NO" is the only option displayed when no further outputs are available.
 - ⑥ The "automatic parameterization of the display" option contains the following basic settings/factory settings

YES	Main line = mass flow Additional line = totalizer 1 Information line = operating/system condition
NO	The existing (selected) settings remain.
 - ⑦ The execution of other Quick Setups is described in the following sections.

**Note!**

- The QUICK SETUP BATCHING is only available when the optional software package BATCHING is installed and PROFIBUS DP is present.
- The QUICK SETUP PULS. FLOW is only available if a current and/or pulse/frequency output is available.

6.3.2 Quick Setup "Pulsating Flow"



Note!

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

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



Note!

Before carrying out the Quick Setup "Pulsating flow" the Quick Setup "Commissioning" has to be executed → 59.

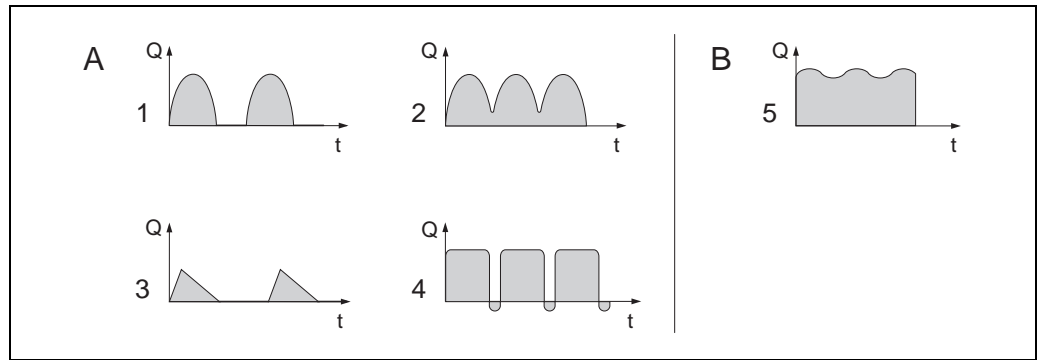


Fig. 41: Flow characteristics of various types of pump

A With severely pulsating flow
B With low pulsating flow

- 1 1-cylinder cam pump
- 2 2-cylinder cam pump
- 3 Magnetic pump
- 4 Peristaltic pump, flexible connecting hose
- 5 Multi-cylinder reciprocating pump

Severely pulsating flow

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



Note!

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

Slightly pulsating flow

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

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

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

Performing the "Pulsating flow" Quick Setup

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

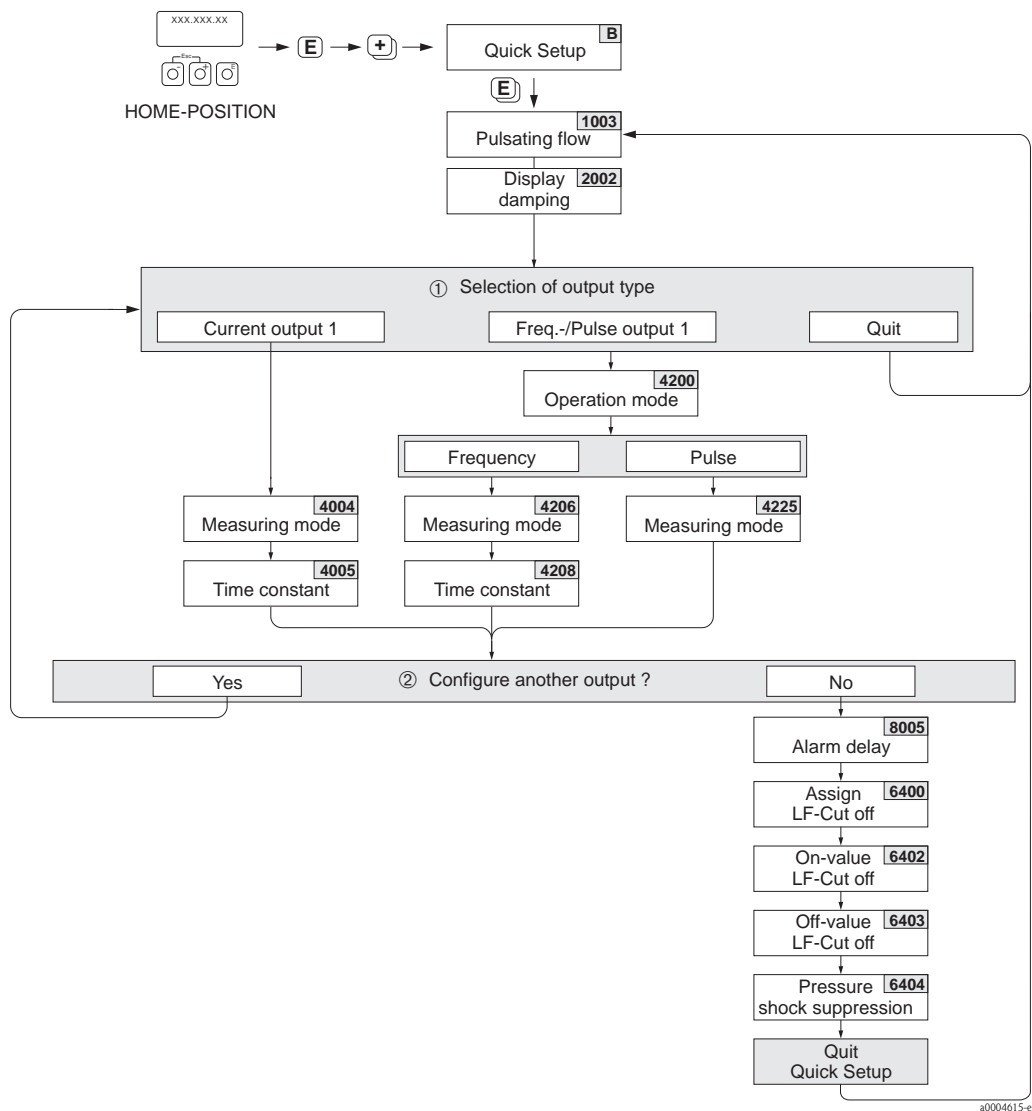


Fig. 42: Quick Setup for measuring severely pulsating flows.










Note!

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

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

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

Recommended settings

Quick Setup "Pulsating Flow"		
HOME position →  → MEASURED VARIABLE (A) MEASURED VARIABLE →  → QUICK SETUP (B) QUICK SETUP →  → QS PULS. FLOW (1003)		
Function No.	Function name	Selection with ()
1003	QS PULS. FLOW	YES After  is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
▼		
Basic configuration		
2002	DISPLAY DAMPING	1 s
Signal type for "CURRENT OUTPUT 1"		
4004	MEASURING MODE	PULS. FLOW
4005	TIME CONSTANT	1 s
Signal type for "FREQ./PULSE OUTPUT 1" (for FREQUENCY operating mode)		
4206	MEASURING MODE	PULS. FLOW
4208	TIME CONSTANT	0 s
Signal type for "FREQ./PULSE OUTPUT 1" (for PULSE operating mode)		
4225	MEASURING MODE	PULS. FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LOW FLOW CUTOFF	MASS FLOW
6402	ON-VALUE LOW FLOW CUT OFF	Setting depends on diameter: DN 1 = 0.02 [kg/h] or [l/h] DN 2 = 0.10 [kg/h] or [l/h] DN 4 = 0.45 [kg/h] or [l/h] DN 8 = 2.0 [kg/h] or [l/h] DN 15 = 6.5 [kg/h] or [l/h] DN 15 FB = 18 [kg/h] resp. [l/h] DN 25 = 18 [kg/h] resp. [l/h] DN 25 FB = 45 [kg/h] resp. [l/h] DN 40 = 45 [kg/h] resp. [l/h] DN 40 FB = 70 [kg/h] resp. [l/h] DN 50 = 70 [kg/h] resp. [l/h] DN 50 FB = 180 [kg/h] resp. [l/h] DN 80 = 180 [kg/h] or [l/h] DN 100 = 350 [kg/h] or [l/h] DN 150 = 650 [kg/h] or [l/h] DN 250 = 1800 [kg/h] or [l/h] DN 350 = 3250 [kg/h] or [l/h] FB = Full bore versions of Promass I
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s
▼		
Back to the HOME position: → Press and hold down Esc key  for longer than three seconds or → Repeatedly press and release Esc key  → Exit the function matrix step by step		

6.3.3 Quick Setup "Batching"



Note!

This function is only available when the additional "batching" software is installed in the measuring device (order option). You can order this software from Endress+Hauser as an accessory at a later date → [122](#).

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

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






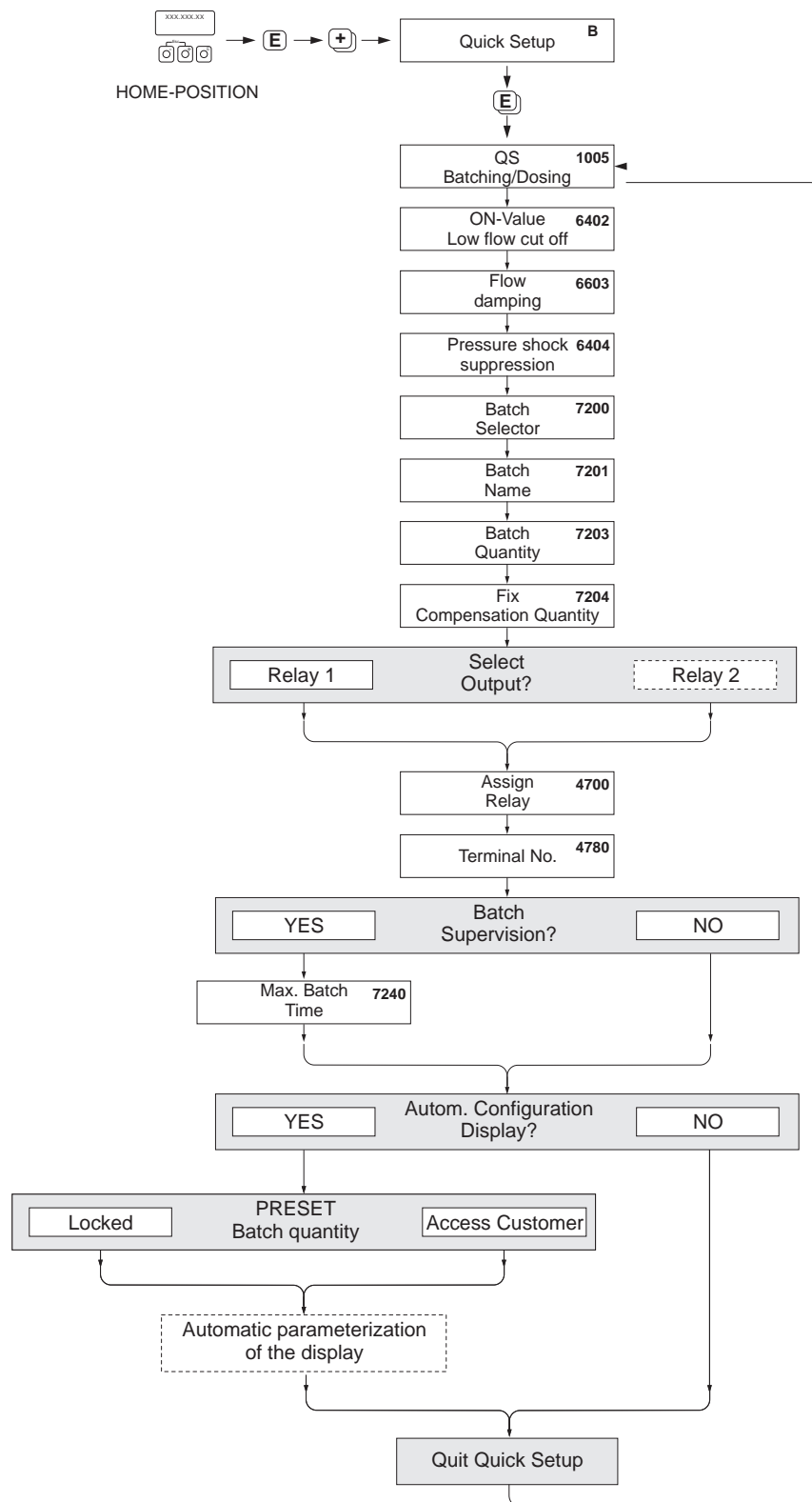
Caution!

The "Batching" Quick Setup sets certain device functions for discontinuous measurement operation. If the measuring device is used for continuous flow measurement at a later time, we recommend that you rerun the "Commissioning" and/or "Pulsating flow" Quick Setup.



Note!

- Before carrying out the Quick Setup "Batching" the Quick Setup "Commissioning" has to be executed → [59](#).
- You can find detailed information on the batching functions in the separate "Description of Device Functions" manual".
- You can also directly control filling process using the local display. During Quick Setup, an appropriate dialog appears concerning the automatic display configuration. Acknowledge this by clicking "YES".
This assigns special batching functions (START, PRESET, MATRIX) to the bottom line of the display. These can be directly executed onsite using the three operating keys ( /  / ).
Therefore, the measuring device can be fully deployed in the field as a "batch controller" → [45](#).
- You can also directly control the filling process using the fieldbus.
- The Quick Setup "Batching" is not available for Promass X.



a0004644-en

Fig. 43: Quick Setup "Batching"

Recommended settings are found on the following page.

Recommended settings

Quick Setup "Batching"		
HOME position → → MEASURED VARIABLE (A) MEASURED VARIABLE → → QUICK SETUP (B) QUICK SETUP → → QUICK SETUP BATCHING (1005)		
Function No.	Function name	Setting to be selected () (to next function with)
1005	QUICK SETUP BATCHING / DOSING	YES After is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
▼		
Note! Functions with a gray background are configured automatically (by the measuring system itself)		
6400	ASSIGN LOW FLOW CUTOFF	MASS FLOW
6402	ON-VALUE LOW FLOW CUT OFF	→ 63, Table
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6603	FLOW DAMPING	0 seconds
6404	PRESSURE SHOCK SUPPRESSION	0 seconds
7200	BATCH SELECTOR	BATCH #1
7201	BATCH NAME	BATCH #1
7202	ASSIGN BATCH VARIABLE	MASS
7203	BATCH QUANTITY	0
7204	FIXED CORRECTION QUANTITY	0
7205	CORRECTION MODE	OFF
7208	BATCH STAGES	1
7209	INPUT FORMAT	VALUE INPUT
4700	ASSIGN RELAY	BATCH VALVE 1
4780	TERMINAL NUMBER	Output (display only)
7220	OPEN VALVE 1	0% or 0 [unit]
7240	MAXIMUM BATCH TIME	0 seconds (= switched off)
7241	MINIMUM BATCH QUANTITY	0
7242	MAXIMUM BATCH QUANTITY	0
2200	ASSIGN (Main line)	BATCH NAME
2220	ASSIGN (Multiplex main line)	OFF
2400	ASSIGN (Additional line)	BATCH DOWNWARDS
2420	ASSIGN (Multiplex additional line)	OFF
2600	ASSIGN (Information line)	BATCHING KEYS
2620	ASSIGN (Multiplex information line)	OFF
▼		
Back to the HOME position: → Press and hold down Esc key for longer than three seconds or → Repeatedly press and release Esc key → Exit the function matrix step by step		

DN		Low flow cut off / factory settings (v ~ 0.04 m/s (0.13 ft/s))	
		SI units [kg/h]	US units [lb/min]
1	1/24"	0.08	0.003
2	1/12"	0.4	0.015
4	1/8"	1.8	0.066
8	3/8"	8	0.3
15	1/2"	26	1.0
15 FB	1/2"	72	2.6
25	1"	72	2.6
25 FB	1"	180	6.6
40	1 1/2"	180	6.6
40 FB	1 1/2"	300	11
50	2"	300	11
50 FB	2"	720	26
80	3"	720	26
100	4"	1200	44
150	6"	2600	95
250	10"	7200	260
FB = Full bore versions of Promass I			

6.3.4 Quick Setup "Gas Measurement"

The measuring device is not only suitable for measuring liquid flow. Direct mass measurement based on the Coriolis principle is also possible for measuring the flow rate of gases. For this purpose, the relevant device functions can be configured either by means of an operating program or the local display.



Note!

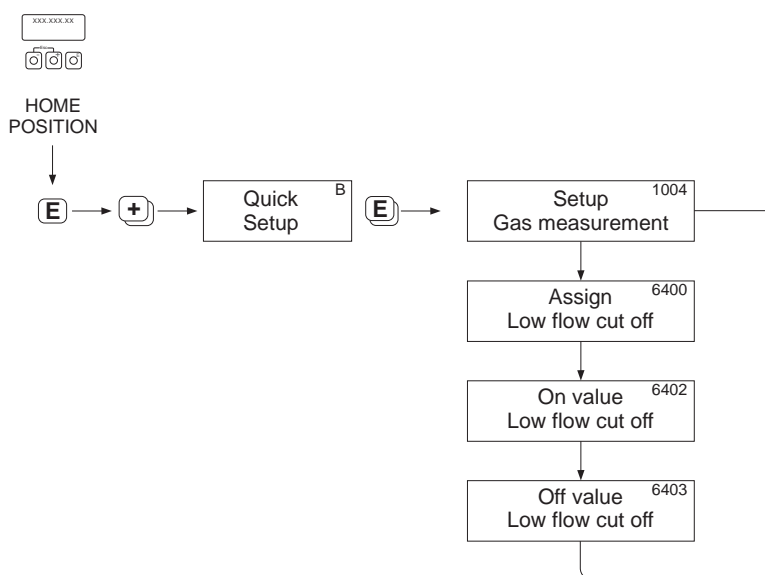
- Before carrying out the Quick Setup "Gas measurement" the Quick Setup "Commissioning" has to be executed → 59.
- Only mass and Corrected volume flow can be measured and output with the gas measurement mode. Note that direct density and/or volume measurement is not possible!
- The flow ranges and measuring accuracy that apply to gas measurement are not the same as those for liquids.
- If corrected volume flow (e.g. in Nm³/h) is to be measured and output instead of the mass flow (e.g. in kg/h), change the setting for the CORRECTED VOLUME CALCULATION function to FIXED REFERENCE DENSITY in the "Commissioning" Quick Setup menu.

Performing the "Gas Measurement" Quick Setup

The "Gas Measurement" Quick Setup menu guides you systematically through the setup procedure for all the device functions that have to be configured for operation with gas.

The "Gas Measurement" Quick Setup can be called up in the function matrix by means of two different functions:

- Via the OS GAS MEASUREMENT (1004) function → 44 or
- Via the OS COMMISSIONING (1002) function → 59



a0002618-en

Fig. 44: Quick Setup "Gas Measurement"

Recommended settings are found on the following page.

Recommended settings

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

**Note!**

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

Corrected volume measurement with gas:

Proceed as follows if the corrected volume flow (e.g. in Nm³/h) should be displayed and output instead of the mass flow (e.g. in kg/h):

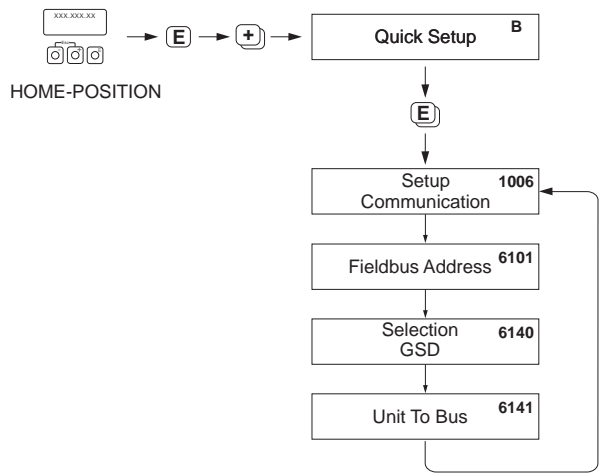
1. Select the "Commissioning" Quick Setup by means of the function matrix.
2. Under "Pre-setting", select the system unit "Corrected volume flow" and configure the functions as follows:

Function No.	Function name	Setting to be selected () (to next function with)
0404	UNIT CORRECTED VOLUME FLOW	Select desired engineering unit
6460	CORR. VOL. CALC	FIXED REFERENCE DENSITY
0421	UNIT REFERENCE DENSITY	Select desired engineering unit
6461	FIXED REFERENCE DENSITY	Enter the gas-dependent reference density (i.e. the density related to the reference temperature and reference pressure) Example for air: Reference density = 1.2928 kg/Nm ³ (in relation to 0 °C and 1.013 bar)

3. Exit the "Commissioning" Quick Setup menu and return to the HOME position.

6.3.5 Quick Setup "Communication"





To establish cyclic data transfer, various arrangements between the PROFIBUS master (Class 1) and the measuring device (slave) are required which have to be taken into consideration when configuring various functions. These functions can be configured quickly and easily by means of the "Communication" Quick Setup. The following table explains the parameter configuration options in more detail.



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Fig. 45: Quick Setup communication

Quick Setup "Communication"		
HOME position → → MEASURED VARIABLE (A) MEASURED VARIABLE → → QUICK SETUP (B) QUICK SETUP → → QUICK SETUP COMMUNICATION (1006)		
Function No.	Function name	Setting to be selected () (to next function with)
1006	QUICK SETUP COMMUNICATION	YES → After is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.
6101	FIELDBUS ADDRESS	Enter the device address (permitted address range: 1 to 126) Factory setting: 126
6140	SELECTION GSD	Select the operating mode (GSD file) which should be used for cyclic communication with the PROFIBUS master (Class 1). Options: MANUFACT. SPEC. → The measuring device is operated in the manufacturer-specific mode. MANUFACT V2.0 → The measuring device is used as the replacement for the previous Promass 63 model (compatibility mode). PROFILE-GSD → The measuring device is operated in the PROFIBUS Profile mode. Factory setting: MANUFACT. SPEC. 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. → 88

Quick Setup "Communication"		
6141	UNIT TO BUS	<p>If this function is executed, the measured variables are transmitted cyclically to the PROFIBUS master (Class 1) with the system units set in the measuring device.</p> <p>Options: OFF SET UNITS (Transmission is started by pressing the  key)</p> <p> Caution! Activating this function can cause a sudden change of the measured variables transmitted to the PROFIBUS master (Class 1); this, in turn, can affect subsequent control routines.</p>
▼		
<p>Back to the HOME position: → Press and hold down Esc key  for longer than three seconds or → Repeatedly press and release Esc key  → Exit the function matrix step by step</p>		

6.3.6 Data backup/transmission

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

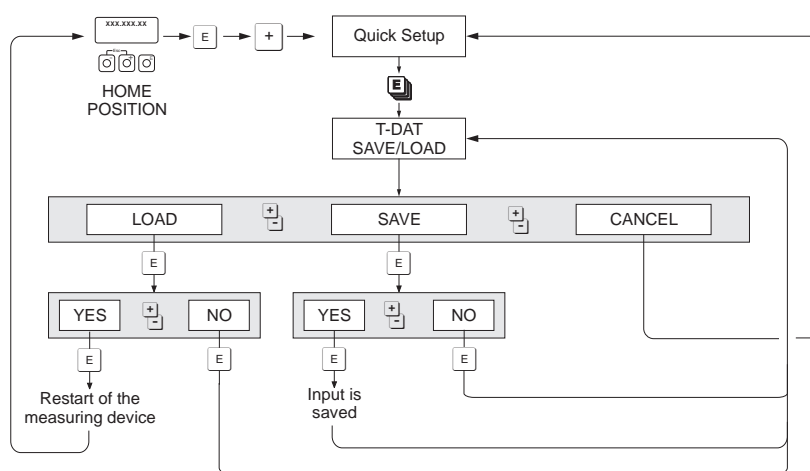
This is required in the following instances:

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



Hinweis!

For information on installing and removing the T-DAT → 140



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Fig. 46: Data backup/transmission with T-DAT SAVE/LOAD function

Information on the LOAD and SAVE options available:

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



Hinweis!

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

SAVE:

Data are transferred from the EEPROM to the T-DAT

6.4 Device configuration

6.4.1 Concentration measurement

The measuring device determines three primary variables simultaneously:

- Mass flow
- Fluid density
- Fluid temperature

As standard, these measured variables allow other process variables to be calculated, such as volume flow, reference density (density at reference temperature) and corrected volume flow.

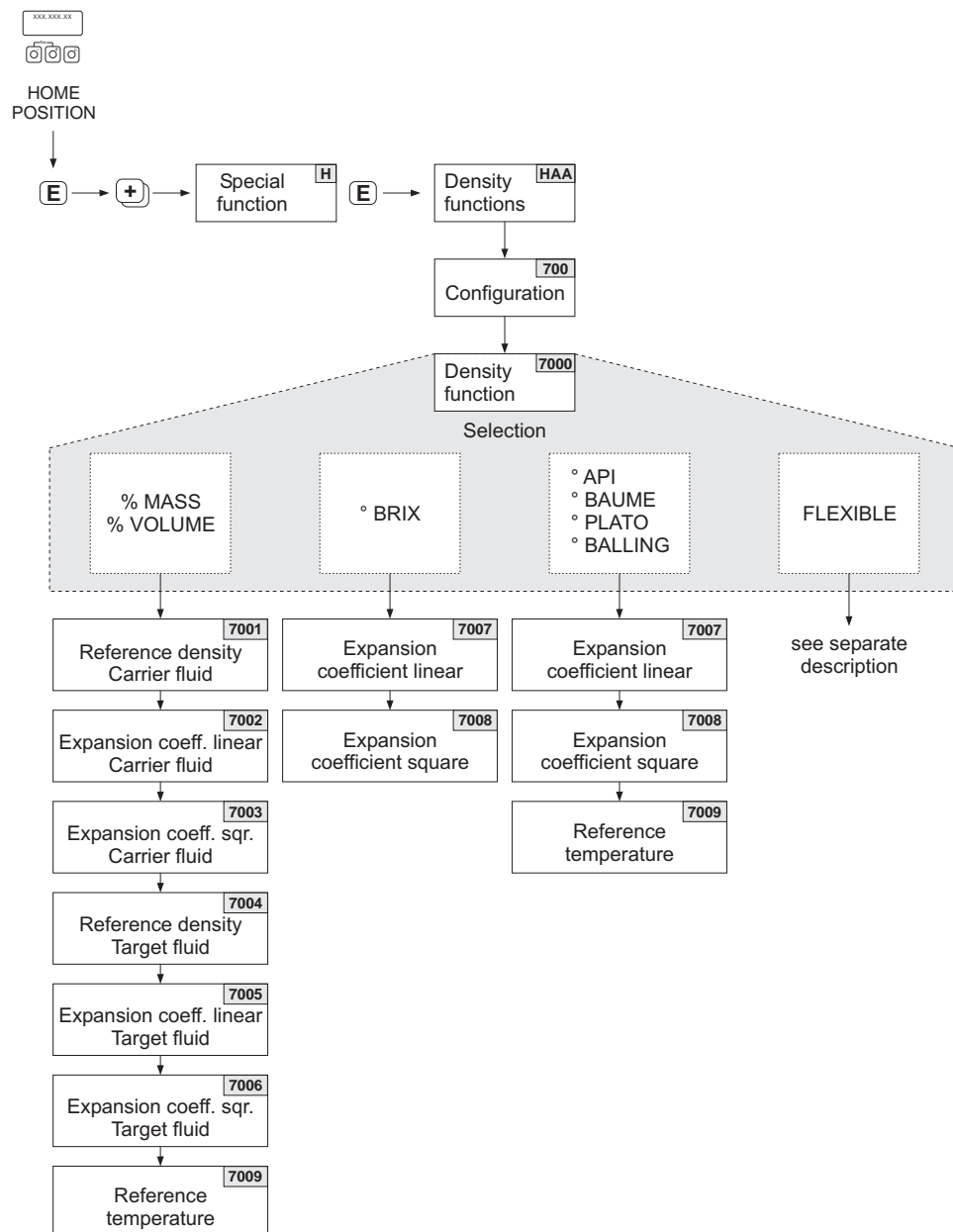
The optional software package "Concentration measurement" (F-CHIP, accessories) offers a multitude of additional density functions. Additional evaluation methods are available in this way, especially for special density calculations in all types of applications: → 122

- Calculating percentage contents, mass and volume flow in two-phase media (carrier fluid and target fluid),
- Converting density of the fluid into special density units (°Brix, °Baumé, °API, etc.).

Concentration measurement with fixed calculation function

By means of the DENSITY FUNCTION (7000) function, you can select various density functions which use a fixed specified calculation mode for calculating concentration:

Density function	Remarks
%-MASS %-VOLUME	<p>By using the functions for two-phase-media, it is possible to calculate the percentage mass or volume contents of the carrier fluid or the target fluid. The basic equations (without temperature compensation) are:</p> $\text{Mass [\%]} = \frac{D2 \cdot (\rho - D1)}{\rho \cdot (D2 - D1)} \cdot 100\%$ $\text{Volume [\%]} = \frac{(\rho - D1)}{(D2 - D1)} \cdot 100\%$ <p>D1 = density of carrier fluid (transporting liquid, e.g. water) D2 = density of target fluid (material transported, e.g. lime powder or a second liquefied material to be measured) ρ = measured overall density</p>
°BRIX	<p>Density unit used for the Food & Beverage industry which deals with the saccharose content of aqueous solutions, e.g. for measuring solutions containing sugar such as fruit juice, etc. The following ICUMSA table for Brix units is the basis for calculations within the device.</p>
°BAUME	<p>This density unit or scale is mainly used for acidic solutions, e.g. ferric chloride solutions. Two Baumé scales are used in practice:</p> <ul style="list-style-type: none"> – BAUME > 1 kg/l: for solutions heavier than water – BAUME < 1 kg/l: for solutions lighter than water
°BALLING °PLATO	<p>Both units are a commonly used basis for calculating the fluid density in the brewery industry. A liquid with a value of 1° BALLING (Plato) has the same density as a water/cane sugar solution consisting of 1 kg cane sugar dissolved in 99 kg of water. 1° Balling (Plato) is thus 1% of the liquid weight.</p>
%-BLACK LIQUOR	<p>The units of concentration used in the paper industry for black liquor in % by mass. The formula used for the calculation is the same as for %-MASS.</p>
°API	<p>°API (= American Petroleum Institute) Density units specifically used in North America for liquefied oil products.</p>



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Fig. 47: Selecting and configuring different density functions in the function matrix

Brixgrade (density of hydrous saccharose solution in kg/m ³)								
°Brix	10°C	20°C	30°C	40°C	50°C	60°C	70°C	80°C
0	999.70	998.20	995.64	992.21	988.03	983.19	977.76	971.78
5	1019.56	1017.79	1015.03	1011.44	1007.14	1002.20	996.70	989.65
10	1040.15	1038.10	1035.13	1031.38	1026.96	1021.93	1016.34	1010.23
15	1061.48	1059.15	1055.97	1052.08	1047.51	1042.39	1036.72	1030.55
20	1083.58	1080.97	1077.58	1073.50	1068.83	1063.60	1057.85	1051.63
25	1106.47	1103.59	1099.98	1095.74	1090.94	1085.61	1079.78	1073.50
30	1130.19	1127.03	1123.20	1118.80	1113.86	1108.44	1102.54	1096.21
35	1154.76	1151.33	1147.58	1142.71	1137.65	1132.13	1126.16	1119.79
40	1180.22	1176.51	1172.25	1167.52	1162.33	1156.71	1150.68	1144.27
45	1206.58	1202.61	1198.15	1193.25	1187.94	1182.23	1176.14	1169.70

Brixgrade (density of hydrous saccharose solution in kg/m ³)								
°Brix	10°C	20°C	30°C	40°C	50°C	60°C	70°C	80°C
50	1233.87	1229.64	1224.98	1219.93	1214.50	1208.70	1202.56	1196.11
55	1262.11	1257.64	1252.79	1247.59	1242.05	1236.18	1229.98	1223.53
60	1291.31	1286.61	1281.59	1276.25	1270.61	1264.67	1258.45	1251.88
65	1321.46	1316.56	1311.38	1305.93	1300.21	1294.21	1287.96	1281.52
70	1352.55	1347.49	1342.18	1336.63	1330.84	1324.80	1318.55	1312.13
75	1384.58	1379.38	1373.88	1368.36	1362.52	1356.46	1350.21	1343.83
80	1417.50	1412.20	1406.70	1401.10	1395.20	1389.20	1383.00	1376.60
85	1451.30	1445.90	1440.80	1434.80	1429.00	1422.90	1416.80	1410.50

Source: A. & L. Emmerich, Technical University of Brunswick; officially recommended by ICUMSA, 20th session 1990

Concentration measurement with flexible calculation function

Under certain application conditions, it may not be possible to use density functions with a fixed calculation function (% mass, °Brix, etc). However, user-specific or application-specific concentration calculations can be used with the "FLEXIBLE" setting in the function DENSITY FUNCTION (7000).

The following types of calculation can be selected in function MODE (7021):

- % MASS 3D
- % VOLUME 3D
- % MASS 2D
- % VOLUME 2D

Calculation type "% MASS 3D" or "% VOLUME 3D"

For this type of calculation, the relationship between the three variables – concentration, density and temperature must be known (3-dimensional), e.g. by a table. In this way, the concentration can be calculated from the measured density and temperature values by means of the following formula (the coefficients A0, A1, etc. have to be determined by the user):

$$K = A0 + A1 \cdot \rho + A2 \cdot \rho^2 + A3 \cdot \rho^3 + A4 \cdot \rho^4 + B1 \cdot T + B2 \cdot T^2 + B3 \cdot T^3$$

a0004620

<i>K</i>	<i>Concentration</i>
<i>ρ</i>	<i>Currently measured density</i>
<i>A0</i>	<i>Value from function (COEFFICIENT A0 (7032))</i>
<i>A1</i>	<i>Value from function (COEFFICIENT A1 (7033))</i>
<i>A2</i>	<i>Value from function (COEFFICIENT A2 (7034))</i>
<i>A3</i>	<i>Value from function (COEFFICIENT A3 (7035))</i>
<i>A4</i>	<i>Value from function (COEFFICIENT A4 (7036))</i>
<i>B1</i>	<i>Value from function (COEFFICIENT B1 (7037))</i>
<i>B2</i>	<i>Value from function (COEFFICIENT B2 (7038))</i>
<i>B3</i>	<i>Value from function (COEFFICIENT B3 (7039))</i>
<i>T</i>	<i>Currently measured temperature in °C</i>

Example:

The following is a concentration table from a reference source.

Temperature	10°C	15°C	20°C	25°C	30°C
Density					
825 kg/m ³	93.6%	92.5%	91.2%	90.0%	88.7%
840 kg/m ³	89.3%	88.0%	86.6%	85.2%	83.8%
855 kg/m ³	84.4%	83.0%	81.5%	80.0%	78.5%
870 kg/m ³	79.1%	77.6%	76.1%	74.5%	72.9%
885 kg/m ³	73.4%	71.8%	70.2%	68.6%	66.9%
900 kg/m ³	67.3%	65.7%	64.0%	62.3%	60.5%
915 kg/m ³	60.8%	59.1%	57.3%	55.5%	53.7%

**Note!**

The coefficients for the Promass 83 concentration algorithm should be determined with the density in units of kg/liter, temperature in °C and concentration in decimal form (0.50, not 50%). B1, B2 and B3 need to be entered into the matrix positions 7037, 7038 and 7039 in scientific notation as 10^{-3} , 10^{-6} or 10^{-9} .

Assume:

Density (ρ): 870 kg/m³ → 0.870 kg/l

Temperature (T): 20°C

Coefficients determined for table above:

$$A0 = -2.6057$$

$$A1 = 11.642$$

$$A2 = -8.8571$$

$$A3 = 0$$

$$A4 = 0$$

$$B1 = -2.7747 \cdot 10^{-3}$$

$$B2 = -7.3469 \cdot 10^{-6}$$

$$B3 = 0$$

Calculation:

$$K = A0 + A1 \cdot \rho + A2 \cdot \rho^2 + A3 \cdot \rho^3 + A4 \cdot \rho^4 + B1 \cdot T + B2 \cdot T^2 + B3 \cdot T^3$$

$$= -2.6057 + 11.642 \cdot 0.870 + (-8.8571) \cdot 0.870^2 + 0 \cdot 0.870^3 + 0 \cdot 0.870^4 + (-2.7747) \cdot 10^{-3} \cdot 20 + (-7.3469) \cdot 10^{-6} \cdot 20^2 + 0 \cdot 20^3$$

$$= 0.7604$$

$$= \mathbf{76.04\%}$$

#0004620

Calculation type "% MASS 2D" or "% VOLUME 2D"

For this type of calculation, the relationship between the two variables concentration and reference density must be known (2-dimensional), e.g. by a table. In this way, the concentration can be calculated from the measured density and temperature values by means of the following formula (the coefficients A0, A1, etc. have to be determined by the user):

$$K = A0 + A1 \cdot \rho_{\text{ref}} + A2 \cdot \rho_{\text{ref}}^2 + A3 \cdot \rho_{\text{ref}}^3 + A4 \cdot \rho_{\text{ref}}^4$$

a0004621

<i>K</i>	<i>Concentration</i>
<i>ρ_{ref}</i>	<i>Currently measured reference density</i>
<i>A0</i>	<i>Value from function (COEFFICIENT A0 (7032))</i>
<i>A1</i>	<i>Value from function (COEFFICIENT A1 (7033))</i>
<i>A2</i>	<i>Value from function (COEFFICIENT A2 (7034))</i>
<i>A3</i>	<i>Value from function (COEFFICIENT A3 (7035))</i>
<i>A4</i>	<i>Value from function (COEFFICIENT A4 (7036))</i>

**Note!**

Promass determines the reference density by means of the density and temperature currently measured. To do so, both the reference temperature (function REFERENCE TEMPERATURE) and the expansion coefficients (function EXPANSION COEFF) must be entered in the measuring system.

The parameters important for measuring the reference density can also be configured directly via the "Commissioning" Quick Setup menu.

6.4.2 Advanced diagnostic functions

Changes to the measuring system, e.g. coating buildup or corrosion and abrasion on the measuring tubes can be detected at an early stage by means of the optional software package "Advanced Diagnostics" (F-Chip, accessories → 122). Normally, these influences reduce the measuring accuracy of the system or may lead to serious system errors.

By means of the diagnostic functions it is now possible to record various process and device parameters during operation, e.g. mass flow, density/reference density, temperature values, measuring tube damping etc.

By analyzing the trend of these measured values, deviations of the measuring system from a "reference status" can be detected in good time and corrective measures can be taken.

Reference values as the basis for trend analysis

Reference values of the parameters in question must always be recorded for trend analysis. These reference values are determined under reproducible, constant conditions. Such reference values are initially recorded during calibration at the factory and saved in the measuring device.

Reference data can also be ascertained under customer-specific process conditions, e.g. during commissioning or at certain process stages (cleaning cycles, etc.).

Reference values are recorded and saved in the measuring system always by means of the device function REFERENCE CONDITION USER (7401).



Caution!

It is not possible to analyze the trend of process/device parameters without reference values! Reference values can only be determined under constant, non-changing process conditions.

Methods of ascertaining data

Process and device parameters can be recorded in two different ways which you can define in the function ACQUISITION MODE (7410):

- PERIODICAL option: Measuring device acquires data periodically. Enter the desired time interval by means of the function ACQUISITION PERIOD (7411).
- SINGLE SHOT option: The user himself acquires the data manually at different, free selectable periods.

Ensure that the process conditions always correspond to the reference status when data is being recorded. It is only in this way that deviations from the reference status can be clearly determined.



Note!

The last ten entries are retained in chronological order in the measuring system. The "history" of such values can be called up via various functions:

Diagnosis parameters	Data saved (per parameter)
Mass flow Density Reference density Temperature Measuring tube damping Sensor symmetry Operating frequency fluctuation Tube damping fluctuation	Reference value → REFERENCE VALUE function Lowest measured value → MINIMUM VALUE function Highest measured value → MAXIMUM VALUE function List of the last ten measured values → HISTORY function Deviation measured/reference value → ACTUAL DEVIATION function
More detailed information can be found in the "Description of Device Functions" Manual.	

Triggering warning messages

If required, a limit value can be assigned to all the process/device parameters relevant to the diagnostic functions. A warning message is triggered if this limit value is exceeded → function WARNING MODE (7403).

The limit value is entered into the measuring system as an absolute (+/–) or relative deviation from the reference value → function WARNING LEVEL (74...).

Deviations arising and recorded by the measuring system can also be output via the current or relay outputs or by means of the fieldbus.

Data interpretation

The way the data recorded by the measuring system is interpreted depends largely on the application in question. This means that users must have a very good knowledge of their specific process conditions and the related deviation tolerances in the process, which have to be determined by the users themselves in each individual case.

For example, when using the limit function it is especially important to know the minimum and maximum deviation tolerances allowed. Otherwise there is the danger that a warning message is triggered inadvertently during "normal" process fluctuations.

There can be various reasons for deviating from the reference status. The following table provides examples and pointers for each of the six diagnosis parameters recorded:

Diagnosis parameters	Possible reasons for deviation
Mass flow	A deviation from the reference status indicates possible zero point shift.
Density	A deviation from the reference status can be caused by a change in the measuring tube resonance frequency, e.g. from deposits in the measuring tube, corrosion or abrasion.
Reference density	The reference density values can be interpreted in the same way as the density values. If the fluid temperature cannot be kept completely constant, you can analyze the reference density (density at a constant temperature, e.g. at 20 °C) instead of the density. Ensure that the parameters required for calculating the reference density have been correctly configured (functions REFERENCE TEMPERATURE and EXPANSION COEFF.).
Temperature	Use this diagnosis parameter to check the functionality of the PT 1000 temperature sensor.
Measuring tube damping	A deviation from the reference status can be caused by a change in measuring tube damping, e.g. from mechanical changes (coating buildup, corrosion, abrasion).
Sensor symmetry	Use this diagnosis parameter to determine whether the sensor signals are symmetrical.
Operating frequency fluctuation	A deviation in the operating frequency fluctuation indicates possible gas content in the medium.
Tube damping fluctuation	A deviation in the tube damping fluctuation indicates possible gas content in the medium.

6.5 Commissioning the PROFIBUS 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: 83) must be entered to change device functions, numerical values or factory settings → 47.

PROFIBUS PA commissioning → 84.

6.5.1 PROFIBUS DP commissioning

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

1. **Check the hardware write protection:**

The WRITE PROTECT (6102) parameter indicates whether it is possible to write to the device functions via PROFIBUS (acyclic data transmission, e.g. via the operating program "FieldCare").



Note!

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

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → CONFIGURATION (610) → WRITE PROTECT (6102) → Display of one of the following options:

- OFF (factory setting) = write access via PROFIBUS possible
- ON = write access via PROFIBUS not possible

Deactivate the write protection if necessary → 51.

2. **Enter the tag name (optional):**

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → CONFIGURATION (610) → TAG NAME (6100)

3. **Configuring the fieldbus address:**

Software addressing using the local display or an operating program:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → CONFIGURATION (610) → FIELDBUS ADDRESS (6101)

Hardware addressing via miniature switches → 52

4. **Select the system unit:**

- a. Determine the units by means of the system units group:

MEASURED VARIABLES (A) → SYSTEM UNITS (ACA) → CONFIGURATION (040) → UNIT MASS FLOW (0400) / UNIT MASS (0401) / UNIT VOLUME FLOW (0402) / ...

- b. In the function UNIT TO BUS (6141), select the option SET UNITS, so that the measured variables transmitted cyclically to the PROFIBUS master (Class 1) are transmitted with the system units set in the measuring device:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → OPERATION (614) → UNIT TO BUS (6141)



Note!

- The configuration of the system units for the totalizer is described separately → see step 7
- If the system unit of a measured variable is changed by means of the local operation or an operating program, this initially does not have any effect on the unit that is used to transmit the measured variable to the PROFIBUS master (Class 1). Changed system units of the measured variables are not transmitted to the PROFIBUS master (Class 1) until the SET UNITS option is activated in the function BASIC FUNCTION (G) → PROFIBUS DP (GBA) → OPERATION (614) → UNIT TO BUS (6141).

5. Configuration of the Analog Input function blocks 1 to 6:


The measuring device has six Analog Input function blocks (AI modules), through which the various measured variables can be cyclically transmitted to the PROFIBUS master (Class 1). The assignment of a measured variable to the Analog Input function block is shown below using the example of Analog Input function block 1 (AI module, slot 1).

Using the CHANNEL function (6123), you can determine the measured variable (e.g. mass flow) to be cyclically transmitted to the PROFIBUS master (Class 1):

- a. Select BASIC FUNCTION (G) → PROFIBUS DP (GBA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120).
- b. Select the option ANALOG INPUT 1.
- c. Select the function CHANNEL (6123).
- d. Select the option MASS FLOW.

Possible settings

Measured variable	ID for CHANNEL function
MASS FLOW (factory setting AI function block 1)	277
VOLUME FLOW (factory setting AI function block 2)	273
CORRECTED VOLUME FLOW (factory setting AI function block 3)	398
DENSITY (factory setting AI function block 4)	281
REFERENCE DENSITY (factory setting AI function block 5)	402
TEMPERATURE (factory setting AI function block 6)	285
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
CARRIER CORRECTED VOLUME FLOW	1174
% BLACK LIQUOR	1166
°BAUME	1175
°API	
°PLATO	
°BALLING	
°BRIX	
FLEXIBLE	
The following measured variables are available when the additional "viscosity" software is installed (order option)	
DYN. VISCOSITY	1177
KIN. VISCOSITY	1178
T. COMP. DYN. VISCOSITY	1179
T. COMP. KIN. VISCOSITY	1180

Measured variable	ID for CHANNEL function
The following measured variables are available when the additional "batching" software is installed (order option)	
BATCH UPWARDS	1346
BATCH DOWNWARDS	1347
BATCH COUNTER	1348
BATCH SUM	1349
BATCHING TIME	1354
The following measured variables are available when the additional "advanced diagnostics" software is installed (order option)	
MASS FLOW DEVIATION	1603
DENSITY DEVIATION	1620
REFERENCE DENSITY DEVIATION	1637
TEMPERATURE DEVIATION	1654
TUBE DAMPING DEVIATION	1671
ACTUAL DEVIATION ELECTR. DYN. SENSORS	1688
TUBE DAMPING FLUCTUATION DEVIATION	2055
TUBE DAMPING FLUCTUATION DEVIATION	2072
 Note! If, when performing the PROFIBUS network configuration, the AI module was integrated in slot 1 to 6, the measured variable selected in the CHANNEL function for the respective Analog Input function block 1 to 6 is transmitted cyclically to the PROFIBUS master (Class 1). → 93	

6. Setting the measuring mode:

In the function MEASURING MODE (6601), select the flow portions to be measured by the measuring device.

BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601) → Selection of one of the following options:

- UNIDIRECTIONAL (factory setting) = only the positive flow portions
- BIDIRECTIONAL = the positive and negative flow components

7. Configuration of totalizers 1 to 3:

The measuring device has three totalizers. The following example describes the configuration of the totalizer using totalizer 1 as an example.

- Using the CHANNEL function (6133), you can determine the measured variable (e.g. mass flow) to be transmitted to the PROFIBUS master (Class 1) as a totalizer value:
 - a. Select BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → SELECT TOTALIZER (6130).
 - b. Select the option TOTALIZER 1.
 - c. Go to the function CHANNEL (6133).
 - d. Select the option MASS FLOW.

Possible settings → see following table.

- Enter the desired unit for the totalizer:
BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → UNIT TOTALIZER (6134)
- Configure totalizer status (e.g. totalize):
BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → SET TOTALIZER (6135) → Select the option TOTALIZE

■ Set the totalizer mode:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) →

TOTALIZER MODE (6137) → Selection of one of the following options:

- BALANCE (factory setting): calculates the positive and negative flow portions
- POSITIVE: calculates the positive flow portions
- NEGATIVE: calculates the negative flow portions
- HOLD VALUE: The totalizer remains at the last value



Note!

For the calculation of the positive and negative flow portions (BALANCE) or the negative flow portions (NEGATIVE) to be carried out correctly, the selection BIDIRECTIONAL must be active in the function BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601).

Possible settings

Totalizer value/measured variable	ID for CHANNEL function
MASS FLOW (factory setting totalizers 1 to 3)	277
VOLUME FLOW	273
CORRECTED VOLUME FLOW	398
OFF	0
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
TARGET VOLUME FLOW	1167
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
CARRIER VOLUME FLOW	1172
CARRIER CORRECTED VOLUME FLOW	1174
Note! If, when performing the PROFIBUS network configuration, the module or the function TOTAL was integrated in slot 7, 8 or 9, the measured variable selected in the CHANNEL function for the totalizers 1 to 3 is transmitted cyclically to the PROFIBUS master (Class 1) → 95.	

8. Select the operating mode:

Select the operating mode (GSD file) which should be used for cyclic communication with the PROFIBUS master (Class 1).

BASIC FUNCTION (G) → PROFIBUS DP (GBA/GCA) → OPERATION (614) → SELECTION GSD (6140) → Options:

- MANUFACT. SPEC. (factory setting): the complete device functionality is available.
- MANUFACT V2.0: The device is used as the replacement for the previous Promass 63 model (compatibility mode).
- PROFILE-GSD: Promass 83 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 → 88.

9. Configuration of cyclic data transmission in the PROFIBUS master

A detailed description of the system integration can be found on → 92.

6.5.2 PROFIBUS PA commissioning

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

1. **Check the hardware write protection:**

The WRITE PROTECT (6102) parameter indicates whether it is possible to write to the device functions via PROFIBUS (acyclic data transmission, e.g. via the operating program "FieldCare").



Note!

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

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) →

WRITE PROTECT (6102) → Display of one of the following options:

- OFF (factory setting) = write access via PROFIBUS possible
- ON = write access via PROFIBUS not possible

Deactivate the write protection if necessary → 51.

2. **Enter the tag name (optional):**

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → TAG NAME (6100)

3. **Configuring the fieldbus address:**

Software addressing using the local display or an operating program:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → CONFIGURATION (610) → FIELDBUS ADDRESS (6101)

Hardware addressing via miniature switches → 52

4. **Select the system unit:**

- a. Determine the units by means of the system units group:

MEASURED VARIABLES (A) → SYSTEM UNITS (ACA) → CONFIGURATION (040) → UNIT MASS FLOW (0400) / UNIT MASS (0401) / UNIT VOLUME FLOW (0402) / ...

- b. In the function UNIT TO BUS (6141), select the option SET UNITS, so that the measured variables transmitted cyclically to the PROFIBUS master (Class 1) are transmitted with the system units set in the measuring device:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → UNIT TO BUS (6141)



Note!

- The configuration of the system units for the totalizer is described separately → see step 7
- If the system unit of a measured variable is changed by means of the local operation or an operating program, this initially does not have any effect on the unit that is used to transmit the measured variable to the PROFIBUS master (Class 1). Changed system units of the measured variables are not transmitted to the PROFIBUS master (Class 1) until the SET UNITS option is activated in the function BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → UNIT TO BUS (6141).

5. Configuration of the Analog Input function blocks 1 to 6:


The measuring device has six Analog Input function blocks (AI modules), through which the various measured variables can be cyclically transmitted to the PROFIBUS master (Class 1). The assignment of a measured variable to the Analog Input function block is shown below using the example of Analog Input function block 1 (AI module, slot 1).

Using the CHANNEL function (6123), you can determine the measured variable (e.g. mass flow) to be cyclically transmitted to the PROFIBUS master (Class 1):

- a. Select BASIC FUNCTION (G) → PROFIBUS PA (GCA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120).
- b. Select the option ANALOG INPUT 1.
- c. Select the function CHANNEL (6123).
- d. Select the option MASS FLOW.

Possible settings

Measured variable	ID for CHANNEL function
MASS FLOW (factory setting AI function block 1)	277
VOLUME FLOW (factory setting AI function block 2)	273
CORRECTED VOLUME FLOW (factory setting AI function block 3)	398
DENSITY (factory setting AI function block 4)	281
REFERENCE DENSITY (factory setting AI function block 5)	402
TEMPERATURE (factory setting AI function block 6)	285
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
CARRIER CORRECTED VOLUME FLOW	1174
% BLACK LIQUOR	1166
°BAUME	1175
°API	
°PLATO	
°BALLING	
°BRIX	
FLEXIBLE	
The following measured variables are available when the additional "viscosity" software is installed (order option)	
DYN. VISCOSITY	1177
KIN. VISCOSITY	1178
T. COMP. DYN. VISCOSITY	1179
T. COMP. KIN. VISCOSITY	1180

Measured variable	ID for CHANNEL function
The following measured variables are available when the additional "advanced diagnostics" software is installed (order option)	
MASS FLOW DEVIATION	1603
DENSITY DEVIATION	1620
REFERENCE DENSITY DEVIATION	1637
TEMPERATURE DEVIATION	1654
TUBE DAMPING DEVIATION	1671
ACTUAL DEVIATION ELECTR. DYN. SENSORS	1688
TUBE DAMPING FLUCTUATION DEVIATION	2055
TUBE DAMPING FLUCTUATION DEVIATION	2072
 Note! If, when performing the PROFIBUS network configuration, the AI module was integrated in slot 1 to 6, the measured variable selected in the CHANNEL function for the respective Analog Input function block 1 to 6 is transmitted cyclically to the PROFIBUS master (Class 1) → 93.	

6. Setting the measuring mode:

In the function MEASURING MODE (6601), select the flow portions to be measured by the measuring device.

BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601) → Selection of one of the following options:

- UNIDIRECTIONAL (factory setting) = only the positive flow portions
- BIDIRECTIONAL = the positive and negative flow components

7. Configuration of totalizers 1 to 3:

The measuring device has three totalizers. The following example describes the configuration of the totalizer using totalizer 1 as an example.

- Using the CHANNEL function (6133), you can determine the measured variable (e.g. mass flow) to be transmitted to the PROFIBUS master (Class 1) as a totalizer value:
 - a. Select BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → SELECT TOTALIZER (6130).
 - b. Select the option TOTALIZER 1.
 - c. Go to the function CHANNEL (6133).
 - d. Select the option MASS FLOW.


Possible settings → see following table.

- Enter the desired unit for the totalizer:
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → UNIT TOTALIZER (6134)
- Configure totalizer status (e.g. totalize):
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → SET TOTALIZER (6135) → Select the option TOTALIZE
- Set the totalizer mode:
BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → TOTALIZER MODE (6137) → Selection of one of the following options:
 - BALANCE (factory setting): calculates the positive and negative flow portions
 - POSITIVE: calculates the positive flow portions
 - NEGATIVE: calculates the negative flow portions
 - HOLD VALUE: The totalizer remains at the last value

**Note!**

For the calculation of the positive and negative flow portions (BALANCE) or the negative flow portions (NEGATIVE) to be carried out correctly, the selection BIDIRECTIONAL must be active in the function BASIC FUNCTION (G) → SYSTEM PARAMETER (GLA) → CONFIGURATION (660) → MEASURING MODE (6601).

Possible settings

Totalizer value/measured variable	ID for CHANNEL function
MASS FLOW (factory setting totalizers 1 to 3)	277
VOLUME FLOW	273
CORRECTED VOLUME FLOW	398
OFF	0
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
TARGET VOLUME FLOW	1167
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
CARRIER VOLUME FLOW	1172
CARRIER CORRECTED VOLUME FLOW	1174
 Note! If, when performing the PROFIBUS network configuration, the module or the function TOTAL was integrated in slot 7, 8 or 9, the measured variable selected in the CHANNEL function for the totalizers 1 to 3 is transmitted cyclically to the PROFIBUS master (Class 1) → 95.	

8. Select the operating mode:

Select the operating mode (GSD file) which should be used for cyclic communication with the PROFIBUS master (Class 1).

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → SELECTION GSD (6140) → Options:

- MANUFACT. SPEC. (factory setting): the complete device functionality is available.
- MANUFACT V2.0: The device is used as the replacement for the previous Promass 63 model (compatibility mode).
- PROFILE-GSD: Promass 83 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 → 88.

9. Configuration of cyclic data transmission in the PROFIBUS master

A detailed description of the system integration can be found on → 104.

6.6 PROFIBUS DP/PA system integration

6.6.1 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 83 GSD file (manufacturer-specific GSD file, complete device functionality)
- PROFIBUS Profile GSD file
- Promass 63 GSD file (compatibility with previous model Promass 63)

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

Promass 83 GSD file (manufacturer-specific 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 DP → 92

PROFIBUS PA → 104

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 (EH3x15xx.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 83 GSD file

	ID No.	GSD file	Type file	Bitmaps
PROFIBUS DP	1529 (Hex)	Extended Format (recommended): EH3x1529.gsd Standard Format: EH3_1529.gsd	EH_1529.200	EH_1529_d.bmp/.dib EH_1529_n.bmp/.dib EH_1529_s.bmp/.dib
PROFIBUS PA	152A (Hex)	Extended Format (recommended): EH3x152A.gsd Standard Format: EH3_152A.gsd	EH_152A.200	EH_152A_d.bmp/.dib EH_152A_n.bmp/.dib EH_152A_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).

The following modules are supported with the Profile GSD file:

"AI Flow" module	→	Analog Input function block 1 / output variable: mass flow
"AI Density" module	→	Analog Input function block 2 / output variable: density
"AI Temperature" module	→	Analog Input function block 3 / output variable: temperature
"Totalizer" module	→	Totalizer function block / output variable: totalized mass flow

Name of the PROFIBUS Profile GSD file

	ID No.	Profile GSD file
PROFIBUS DP	9742 (Hex)	PA039742.gsd
PROFIBUS PA	9742 (Hex)	PA139742.gsd

Source

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

Promass 63 GSD file

Promass 63 with Profile Version 2.0 is the precursor to the Promass 83.

If Promass 63 is already being operated in the system and if the measuring device has to be replaced, Promass 83 can be used as a replacement device without having to reconfigure the PROFIBUS DP network.

Further information →  91.

6.6.2 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.

BASIC FUNCTION (G) → PROFIBUS DP/PA (GBA/GCA) → OPERATION (614) → SELECTION GSD (6140)

Promass 83 GSD file	→	Select: MANUFACT. SPEC. (factory setting)
Profile GSD file	→	Select: PROFILE-GSD
Promass 83 GSD file	→	Select: MANUFACT V2.0

Example

Before configuration takes place, a decision should be made as to which GSD file should be used to configure measuring device 83 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.

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → OPERATION (614) → SELECTION GSD (6140) → 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 (EH3x152A.gsd). However, if the installation or the configuration of the device fails with this format, then use the standard GSD (EH3_152A.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 (EH3x152A.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. A detailed description of the modules supported by the measuring device as follows:

PROFIBUS DP → 92

PROFIBUS PA → 104

6.6.3 Compatibility with previous Promass 63 model (Profile Version 2.0)

Promass 63 with Profile Version 2.0 is the precursor to Promass 83. If Promass 63 is already being operated in the system and if the measuring device has to be replaced, Promass 83 can be used as a replacement device without having to reconfigure the PROFIBUS network. In the event of a device being replaced, Promass 83 completely supports the compatibility of the cyclic data with the previous Promass 63 model.

The measuring devices can be exchanged as follows:

Existing device:	GSD file used:	→	To be replaced with:
Promass 63 PROFIBUS DP ID No.: 1512 (Hex)	Extended Format: EH3x1512.gsd or Standard Format: EH3_1512.gsd	→	Promass 83 PROFIBUS DP
Promass 63 PROFIBUS PA ID No.: 1506 (Hex)	Extended Format: EH3x1506.gsd or Standard Format: EH3_1506.gsd	→	Promass 83 PROFIBUS PA

Promass 83 is accepted as the replacement device if the MANUFACT V2.0 option is activated in the SELECTION GSD (6140) function. The measuring device automatically detects that a Promass 63 device was configured in the automation system and makes both suitable input and output data and measured value status information available even though the devices differ in name and ID number. You do not have to adjust the configuration of the PROFIBUS network in the automation system.

Procedure after replacing the measuring devices:

1. Set the same (old) device address → FIELDBUS ADDRESS (6101) function
2. In the SELECTION GSD (6140) function → Select MANUFACT V2.0
3. Restart the measuring device → SYSTEM RESET (8046) function



Note!

If necessary, the following settings have to be configured via an operating program:

- Configuration of the application-specific parameters
- Configuration of the system units for the measured values and totalizers.

6.6.4 Maximum 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.

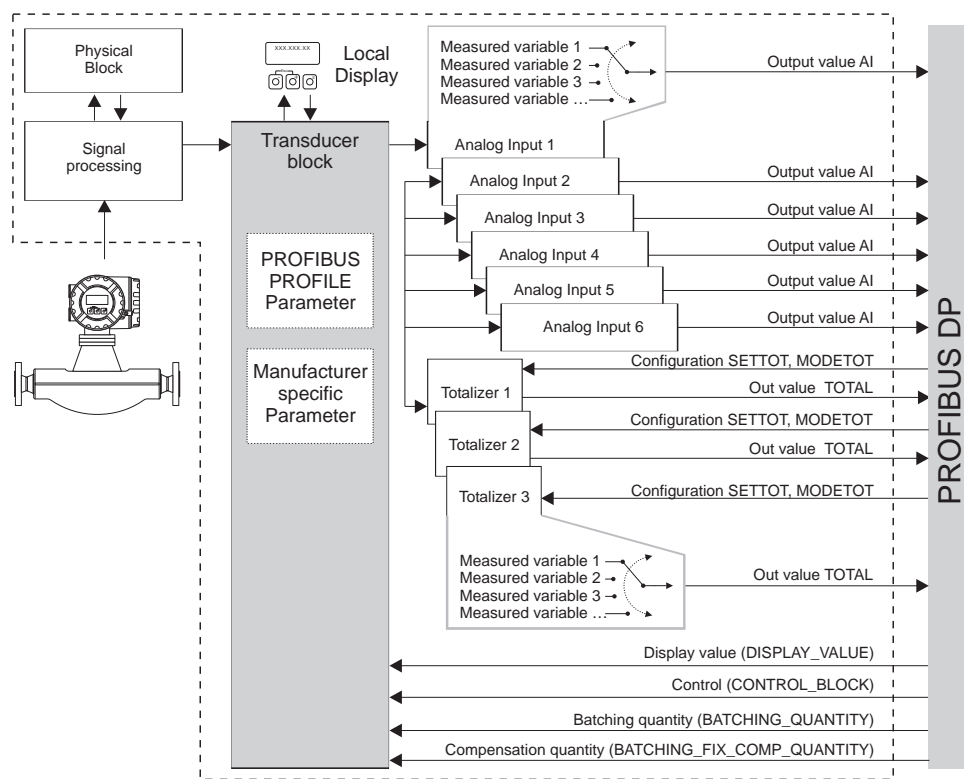
The number of writes to the EEPROM is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss and measuring device failure. For this reason, avoid constantly writing nonvolatile device parameters via the PROFIBUS!

6.7 PROFIBUS DP cyclic data exchange

Below is a description of the cyclic data transmission when using the Promass 83 GSD file (complete device functionality).

6.7.1 Block model

The block model illustrated shows which input and output data Promass 83 provides for cyclic data exchange via PROFIBUS DP.



a0002612-en

Fig. 48: Block model for Promass 83 PROFIBUS DP Profile 3.0

6.7.2 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	AI	Analog Input function block 5 Output variable → reference density (factory setting)
6	AI	Analog Input function block 6 Output variable → temperature (factory setting)
7	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
8		Totalizer function block 2 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
9		Totalizer function block 3 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
10	DISPLAY_VALUE	Default value for local display
11	CONTROL_BLOCK	Control of device functions
12	BATCHING_QUANTITY	Batching quantity
13	BATCHING_FIX_COMP_QUANTITY	Fixed correction quantity



Note!

- The assignment of the measured variables for the Analog Input function blocks (1 to 6) and the Totalizer function blocks (1 to 3) 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.

6.7.3 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 6). 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 →  126

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 6 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the CHANNEL function:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120): Selection of an Analog Input function block → CHANNEL (6123): Selection of 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
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
CARRIER CORRECTED VOLUME FLOW	1174
% BLACK LIQUOR	1166
°BAUME	1175
°API	
°PLATO	
°BALLING	
°BRIX	
FLEXIBLE	
The following measured variables are available when the additional "viscosity" software is installed (order option)	
DYN. VISCOSITY	1177
KIN. VISCOSITY	1178
T. COMP. DYN. VISCOSITY	1179
T. COMP. KIN. VISCOSITY	1180

Measured variable	ID for CHANNEL function
The following measured variables are available when the additional "batching" software is installed (order option)	
BATCH UPWARDS	1346
BATCH DOWNWARDS	1347
BATCH COUNTER	1348
BATCH SUM	1349
BATCHING TIME	1354
The following measured variables are available when the additional "advanced diagnostics" software is installed (order option)	
MASS FLOW DEVIATION	1603
DENSITY DEVIATION	1620
REFERENCE DENSITY DEVIATION	1637
TEMPERATURE DEVIATION	1654
TUBE DAMPING DEVIATION	1671
ACTUAL DEVIATION ELECTR. DYN. SENSORS	1688
FREQU. FLUCTUATION DEVIATION	2055
TUBE DAMPING FLUCTUATION DEVIATION	2072
 Note! The measured variables for the software options (concentration measurement, viscosity, batching, adv. diagnosis) are only available if the appropriate additional software is installed in the device. If the measured variable is selected even if the additional software is not installed, the value "0" is transmitted to the PROFIBUS master (Class 1) for the measured variable.	

Factory setting


Module	Analog Input function block	Measured variable	Unit	CHANNEL function factory setting
AI (slot 1)	1	MASS FLOW	kg/s	277
AI (slot 2)	2	VOLUME FLOW	m ³ /h	273
AI (slot 3)	3	CORRECTED VOLUME FLOW	Nm ³ /h	398
AI (slot 4)	4	DENSITY	kg/l	281
AI (slot 5)	5	REFERENCE DENSITY	kg/Nl	402
AI (slot 6)	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. BASIC FUNCTION (G) → PROFIBUS DP (GBA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120): Select ANALOG INPUT 1, then select CHANNEL (6123) = MASSFLOW
2. BASIC FUNCTION (G) → PROFIBUS DP (GBA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120): Select ANALOG INPUT 2, then select CHANNEL (6123) = TEMPERATURE

TOTAL module

The measuring device has three Totalizer function blocks. The totalizer values can be cyclically transmitted to the PROFIBUS master (Class 1) via the TOTAL module (slots 7 to 9). 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 →  126.

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 blocks 1 to 3 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the "CHANNEL" function:

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) → SELECT TOTALIZER (6130): Selection of a totalizer → CHANNEL (6133): Selection of measured variable

Possible settings

Totalizer value/measured variable	ID for CHANNEL function
MASS FLOW	277
VOLUME FLOW	273
CORRECTED VOLUME FLOW	398
OFF	0
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
TARGET VOLUME FLOW	1167
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
CARRIER VOLUME FLOW	1172
CARRIER CORRECTED VOLUME FLOW	1174
 Note! The measured variables for the software option "concentration measurement" are only available if the appropriate additional software is installed in the device. If the measured variable is selected even if the additional software is not installed, the value "0" is transmitted to the PROFIBUS master (Class 1) for the measured variable.	

Factory setting

Module	Totalizer function block	Totalizer value/Measured variable	Unit	ID for CHANNEL function
TOTAL (slot 7)	1	MASS FLOW	kg	277
TOTAL (slot 8)	2	MASS FLOW	kg	277
TOTAL (slot 9)	3	MASS FLOW	kg	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 7):

BASIC FUNCTION (G) → PROFIBUS DP (GBA) → TOTALIZER (613) →
select TOTALIZER (6130): Select TOTALIZER 1, then select CHANNEL (6133) = VOLUME FLOW

SETTOT_TOTAL module

The module combination SETTOT_TOTAL (slots 7 to 9) 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 → 98.

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 96

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 (slots 7 to 9) 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 SETTOT_TOTAL module → 97.

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 portions (control variable 0) or the negative flow portions only (control variable 2) to be carried out correctly, the option BIDIRECTIONAL must be active in the MEASURING MODE (6601) function.

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 96.

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 10). 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 → 43.

CONTROL_BLOCK module

By means of the CONTROL_BLOCK module (slot 11), 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 → x:

Module	Control variables
CONTROL_BLOCK	0 → 2: Positive zero return ON 0 → 3: Positive zero return OFF 0 → 4: Run zero point adjustment 0 → 8: UNIDIRECTIONAL measuring mode 0 → 9: BIDIRECTIONAL measuring mode 0 → 24: Run UNIT TO BUS function
	The following control variables are only executed if the measuring device has a relay output.
	0 → 50: Relay output 1 OFF 0 → 51: Relay output 1 ON 0 → 55: Relay output 2 OFF 0 → 56: Relay output 2 ON
	Control variables that are executed only if the "Batching" software is installed in the measuring device.
	0 → 30: Select batching specification 1 0 → 31: Select batching specification 2 0 → 32: Select batching specification 3 0 → 33: Select batching specification 4 0 → 34: Select batching specification 5 0 → 35: Select batching specification 6 0 → 40: Stop batching 0 → 41: Start batching 0 → 42: Interrupt batching 0 → 43: Continue batching 0 → 44: Reset the fault message (affects the following batching fault messages: # 471, 472, 473, 474) 0 → 46: Reset batching quantity counter and total batching quantity to 0
	Control variables that are executed only if additional "Advanced diagnostics" software is installed in the measuring device.
	0 → 25: Warning mode "Advanced Diagnostics" OFF 0 → 26: Warning mode "Advanced Diagnosis" ON 0 → 70: Start determining the user reference status 0 → 74: Acquisition mode OFF 0 → 75: Acquisition mode, PERIODICAL 0 → 76: Acquisition mode, MANUAL (SINGLE SHOT) 0 → 78: Start manual determination of the advanced diagnostics parameters
	 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	→	To	Result
0	→	2	Positive zero return is switched on.
2	→	0	No effect
0	→	3	Positive zero return is switched off.
3	→	2	No effect

Output data

Byte 1
Control

BATCHING_QUANTITY module

The value of the quantity to be batched (IEEE 754 floating point number), including status, can be cyclically transmitted by the PROFIBUS master (Class 1) to the measuring device using the BATCH QUANTITY module (slot 12). If the batch quantity specified here is achieved, the closing contact for valve 1 is activated. The unit selected in the measuring device is used as the unit.



Caution!
The batching quantity is a nonvolatile device parameter. For this reason, avoid constantly writing this device parameter via PROFIBUS! → 91



Note!

- This module is only evaluated by the measuring device if the additional "batching" software is installed in the measuring device (order option).
- Further explanation of the parameter BATCH QUANTITY (7203) is contained in the "Description of Device Functions" manual, which is a separate part of these Operating Instructions.

Output data

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Batch quantity (IEEE 754 floating point number)				Status



Note!
The status is not evaluated by the device.

BATCHING_FIX_COMP_QUANTITY module

A positive or negative correction value (IEEE 754 floating point number), including status, can be cyclically transmitted by the PROFIBUS master (Class 1) to the measuring device using the BATCHING_FIX_COMP_QUANTITY module (slot 13). The correction quantity balances out a constant, system-related incorrect quantity. This can be caused, for example, by a pump overrunning or by the closing time of a valve. The correction quantity is determined by the system operator. A negative compensation quantity must be specified for overbatching and a positive correction quantity for underbatching. The permitted input range is ± 10% of the batch quantity. The unit selected in the measuring device is used as the unit.



Caution!
The batching quantity is a nonvolatile device parameter. For this reason, avoid constantly writing this device parameter via PROFIBUS! → 91



Note!

- This module is only evaluated by the measuring device if the additional "batching" software is installed in the measuring device (order option).
- If the input range is not sufficient for the correction quantity, the batching quantity may have to be adjusted.
- Further explanation of the parameter FIXED CORRECTION (7204) is contained in the "Description of Device Functions" manual, which is a separate part of these Operating Instructions.

Output data


Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Fixed correction quantity (IEEE 754 floating point number)				Status



Note!
The status is not evaluated by the device.

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 →  93.

6.7.4 Configuration examples with Simatic S7 HW-Konfig

Example 1:

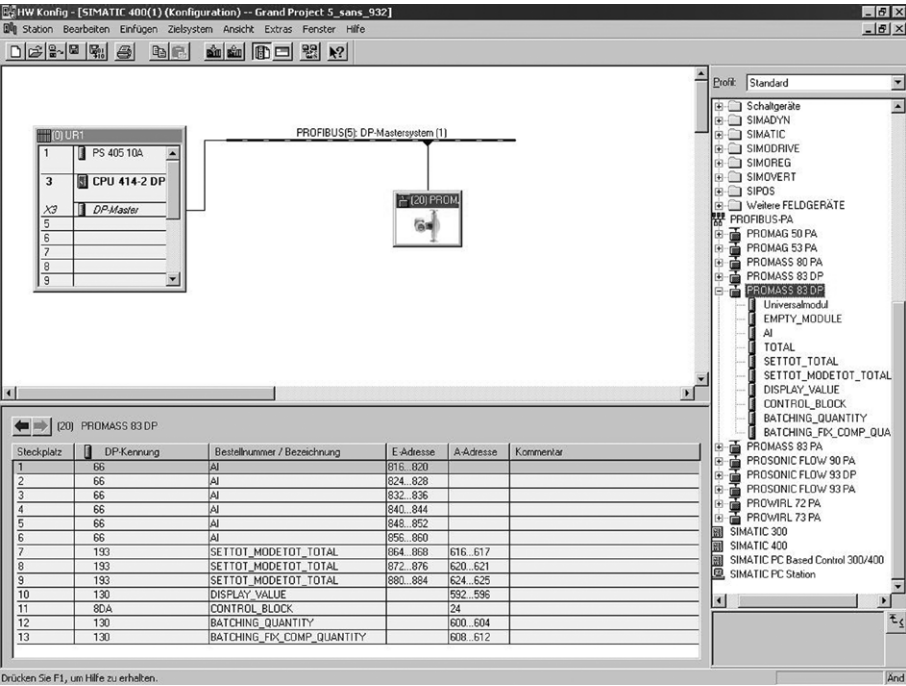


Fig. 49: Complete configuration using the Promass 83 GSD file.

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	AI	5	–	Analog Input function block 5 Output variable → reference density (factory setting)
6	AI	5	–	Analog Input function block 6 Output variable → temperature (factory setting)
7	SETTOT_MODETOT_TOTAL	5	2	Totalizer function block 1 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
8	SETTOT_MODETOT_TOTAL	5	2	Totalizer function block 2 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
9	SETTOT_MODETOT_TOTAL	5	2	Totalizer function block 3 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
10	DISPLAY_VALUE	–	5	Default value for local display
11	CONTROL_BLOCK	–	1	Control of device functions
12	BATCHING_QUANTITY	–	5	Batching quantity
13	BATCHING_FIX_COMP_QUANTITY	–	5	Fixed correction quantity

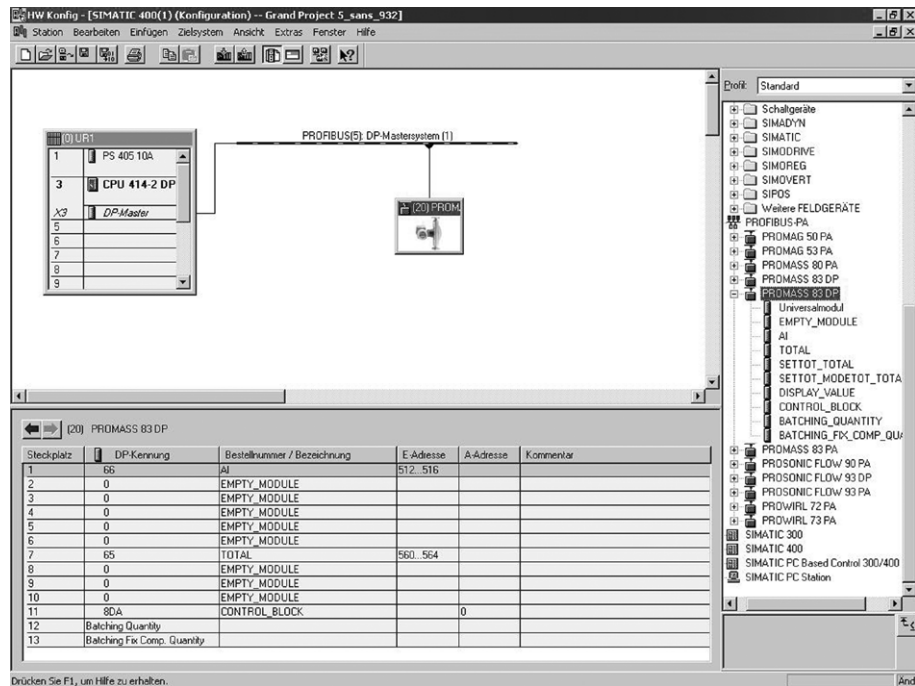
Example 2:

Fig. 50: In this configuration example, modules that are not needed are replaced by the module `EMPTY_MODULE`. The Promass 83 GSD file is used.

With this configuration, the Analog Input function block 1 (slot 1), the totalizer value TOTAL (slot 7) and the cyclic control of device functions CONTROL_BLOCK (slot 11) 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).

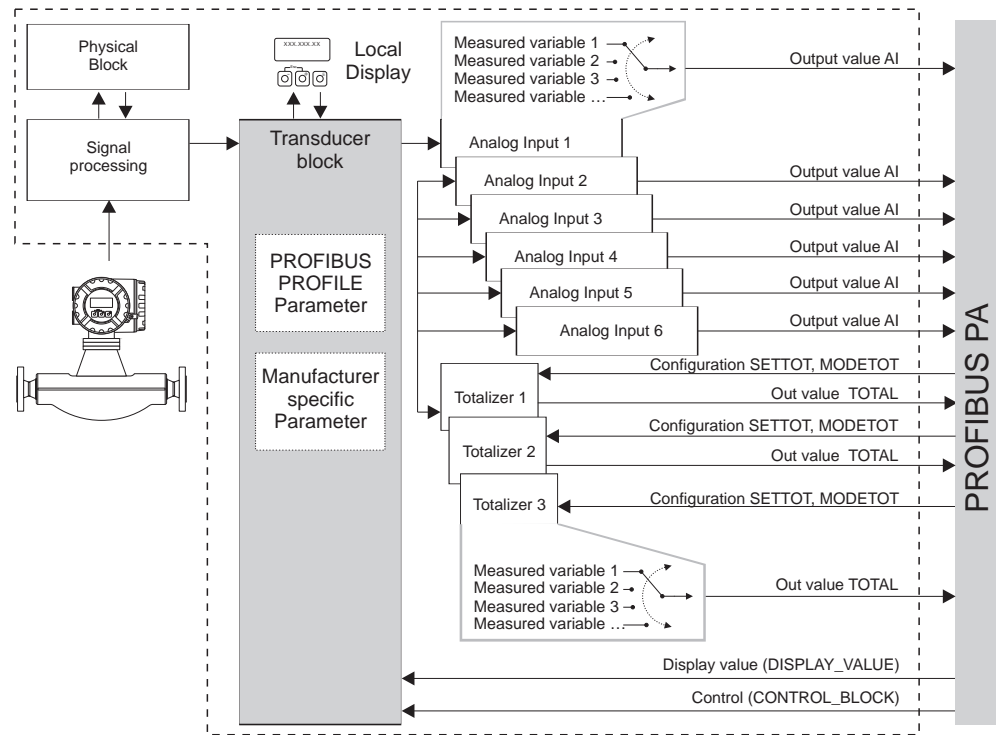
Slot sequence	Module	Byte length input data	Byte length output data	Description
1	AI	5	–	Analog Input function block 1 Output variable → Mass flow (factory setting)
2	EMPTY_MODULE	–	–	Empty
3	EMPTY_MODULE	–	–	Empty
4	EMPTY_MODULE	–	–	Empty
5	EMPTY_MODULE	–	–	Empty
6	EMPTY_MODULE	–	–	Empty
7	TOTAL	5	–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

6.8 PROFIBUS PA cyclic data exchange

Below is a description of the cyclic data transmission when using the Promass 83 GSD file (complete device functionality).

6.8.1 Block model

The block model illustrated shows which input and output data Promass 83 provides for cyclic data exchange via PROFIBUS PA.



a0002613-en

Fig. 51: Block model for Promass 83 PROFIBUS PA Profile 3.0

6.8.2 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	AI	Analog Input function block 5 Output variable → reference density (factory setting)
6	AI	Analog Input function block 6 Output variable → temperature (factory setting)
7	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
8		Totalizer function block 2 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
9		Totalizer function block 3 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
10	DISPLAY_VALUE	Default value for local display
11	CONTROL_BLOCK	Control of device functions



Note!

- The assignment of the measured variables for the Analog Input function blocks (1 to 6) and the Totalizer function blocks (1 to 3) 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.

6.8.3 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 6). 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 →  126.

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 6 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the CHANNEL function:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120): Selection of an Analog Input function block → CHANNEL (6123): Selection of 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
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
% TARGET MASS FLOW	1165
TARGET VOLUME FLOW	1167
% TARGET VOLUME FLOW	1168
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
% CARRIER MASS FLOW	1171
CARRIER VOLUME FLOW	1172
% CARRIER VOLUME FLOW	1173
CARRIER CORRECTED VOLUME FLOW	1174
% BLACK LIQUOR	1166

Measured variable	ID for CHANNEL function
°BAUME	1175
°API	
°PLATO	
°BALLING	
°BRIX	
FLEXIBLE	
The following measured variables are available when the additional "viscosity" software is installed (order option)	
DYN. VISCOSITY	1177
KIN. VISCOSITY	1178
T. COMP. DYN. VISCOSITY	1179
T. COMP. KIN. VISCOSITY	1180
The following measured variables are available when the additional "advanced diagnostics" software is installed (order opt.)	
MASS FLOW DEVIATION	1603
DENSITY DEVIATION	1620
REFERENCE DENSITY DEVIATION	1637
TEMPERATURE DEVIATION	1654
TUBE DAMPING DEVIATION	1671
ACTUAL DEVIATION ELECTR. DYN. SENSORS	1688
FREQU. FLUCTUATION DEVIATION	2055
TUBE DAMPING FLUCTUATION DEVIATION	2072
 Note! The measured variables for the software options (concentration measurement, viscosity, batching, adv. diagnosis) are only available if the appropriate additional software is installed in the device. If the measured variable is selected even if the additional software is not installed, the value "0" is transmitted to the PROFIBUS master (Class 1) for the measured variable.	

Factory setting


Module	Analog Input function block	Measured variable	Unit	CHANNEL function factory setting
AI (slot 1)	1	MASS FLOW	kg/s	277
AI (slot 2)	2	VOLUME FLOW	m ³ /h	273
AI (slot 3)	3	CORRECTED VOLUME FLOW	Nm ³ /h	398
AI (slot 4)	4	DENSITY	kg/l	281
AI (slot 5)	5	REFERENCE DENSITY	kg/Nl	402
AI (slot 6)	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. BASIC FUNCTION (G) → PROFIBUS PA (GCA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION(6120): Select ANALOG INPUT 1, then select CHANNEL (6123) = MASSFLOW
2. BASIC FUNCTION (G) → PROFIBUS PA (GCA) → FUNCTIONBLOCKS (612) → BLOCK SELECTION (6120): Select ANALOG INPUT 2, then select CHANNEL (6123) = TEMPERATURE

TOTAL module

The measuring device has three Totalizer function blocks. The totalizer values can be cyclically transmitted to the PROFIBUS master (Class 1) via the TOTAL module (slots 7 to 9). 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 →  126.

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 blocks 1 to 3 by means of the local display or with the aid of an operating program (e.g. FieldCare) in the "CHANNEL" function:

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) → SELECT TOTALIZER (6130): Selection of a totalizer → CHANNEL (6133): Selection of measured variable

Possible settings

Totalizer value/measured variable	ID for CHANNEL function
MASS FLOW	277
VOLUME FLOW	273
CORRECTED VOLUME FLOW	398
OFF	0
The following measured variables are available when the additional "concentration measurement" software is installed (order option)	
TARGET MASS FLOW	1164
TARGET VOLUME FLOW	1167
TARGET CORRECTED VOLUME FLOW	1169
CARRIER MASS FLOW	1170
CARRIER VOLUME FLOW	1172
CARRIER CORRECTED VOLUME FLOW	1174
 Note! The measured variables for the software option "concentration measurement" are only available if the appropriate additional software is installed in the device. If the measured variable is selected even if the additional software is not installed, the value "0" is transmitted to the PROFIBUS master (Class 1) for the measured variable.	

Factory setting

Module	Totalizer function block	Totalizer value/Measured variable	Unit	ID for CHANNEL function
TOTAL (slot 7)	1	MASS FLOW	kg	277
TOTAL (slot 8)	2	MASS FLOW	kg	277
TOTAL (slot 9)	3	MASS FLOW	kg	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 7):

BASIC FUNCTION (G) → PROFIBUS PA (GCA) → TOTALIZER (613) →
select TOTALIZER (6130): Select TOTALIZER 1, then select CHANNEL (6133) = VOLUME FLOW

SETTOT_TOTAL module

The module combination SETTOT_TOTAL (slots 7 to 9) 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 → 98.

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 96.

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 (slots 7 to 9) 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 SETTOT_TOTAL module → 97.

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 portions (control variable 0) or the negative flow portions only (control variable 2) to be carried out correctly, the option BIDIRECTIONAL must be active in the MEASURING MODE (6601) function.

TOTAL function

For a description of the TOTAL function, refer to TOTAL module → 96.

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 10). 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 → 43.

CONTROL_BLOCK module

By means of the CONTROL_BLOCK module (slot 11), 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 → x:

Module	Control variables
CONTROL_BLOCK	0 → 2: Positive zero return ON 0 → 3: Positive zero return OFF 0 → 4: Run zero point adjustment 0 → 8: UNIDIRECTIONAL measuring mode 0 → 9: BIDIRECTIONAL measuring mode 0 → 24: Run UNIT TO BUS function
	Control variables that are executed only if additional "Advanced diagnostics" software is installed in the measuring device.
	0 → 25: Warning mode "Advanced Diagnostics" OFF 0 → 26: Warning mode "Advanced Diagnosis" ON 0 → 70: Start determining the user reference status 0 → 74: Acquisition mode OFF 0 → 75: Acquisition mode, PERIODICAL 0 → 76: Acquisition mode, MANUAL (SINGLE SHOT) 0 → 78: Start manual determination of the advanced diagnostics parameters
 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	→	To	Result
0	→	2	Positive zero return is switched on.
2	→	0	No effect
0	→	3	Positive zero return is switched off.
3	→	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 →  93.

6.8.4 Configuration examples with Simatic S7 HW-Konfig

Example 1:

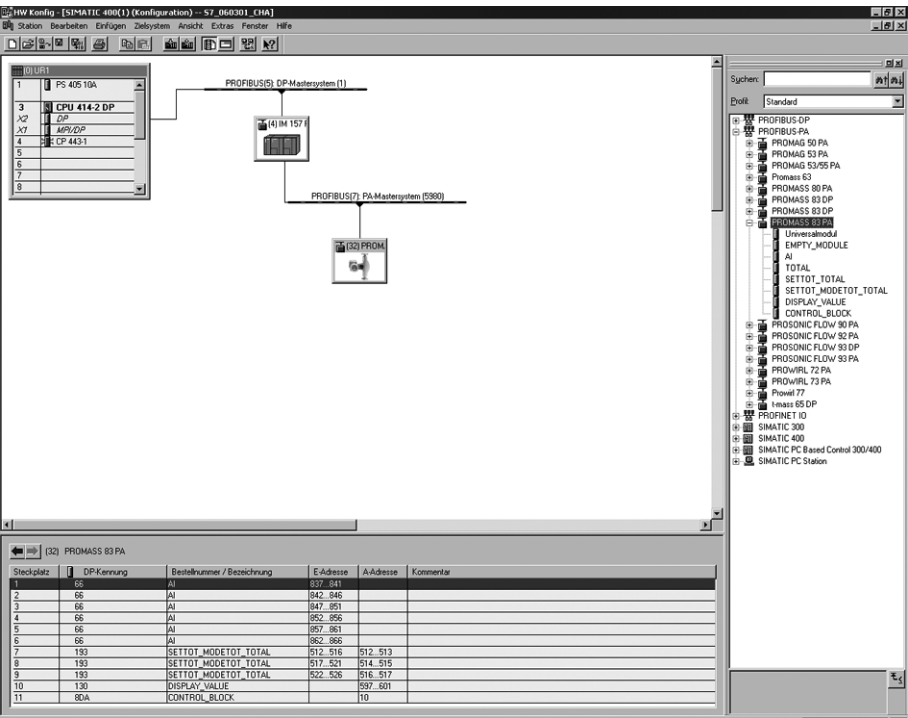


Fig. 52: Complete configuration using the Promass 83 GSD file.

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	AI	5	–	Analog Input function block 5 Output variable → reference density (factory setting)
6	AI	5	–	Analog Input function block 6 Output variable → temperature (factory setting)
7	SETTOT_MODETOT_TOTAL	5	2	Totalizer function block 1 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
8	SETTOT_MODETOT_TOTAL	5	2	Totalizer function block 2 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
9	SETTOT_MODETOT_TOTAL	5	2	Totalizer function block 3 TOTAL → output variable = totalized mass flow (factory setting) SETTOT → totalizer control MODETOT → totalizer configuration
10	DISPLAY_VALUE	–	5	Default value for local display
11	CONTROL_BLOCK	–	1	Control of device functions

Example 2:

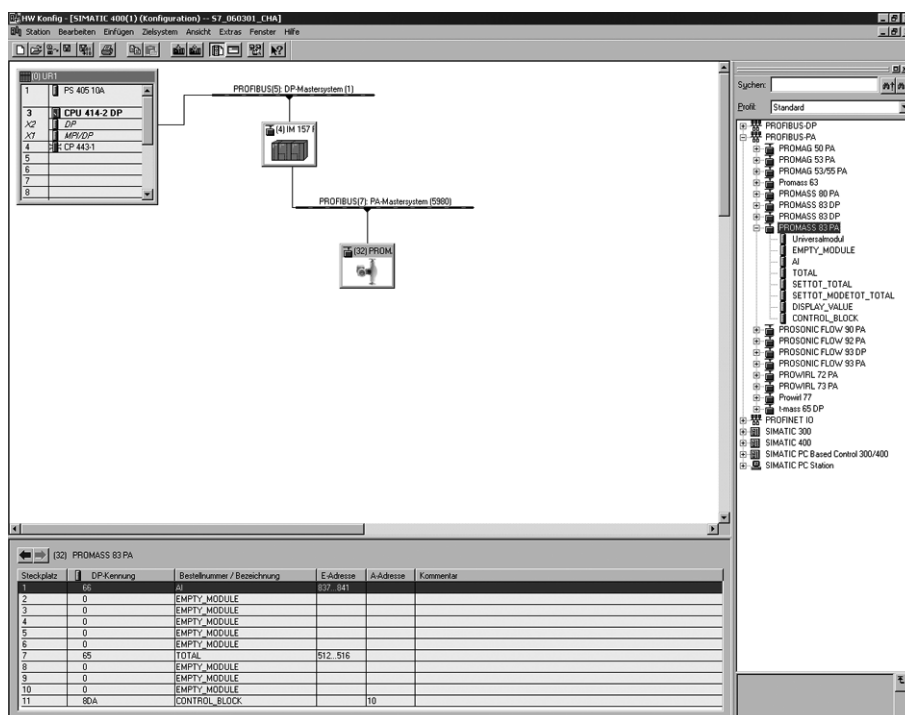


Fig. 53: In this configuration example, modules that are not needed are replaced by the module `EMPTY_MODULE`. The Promass 83 GSD file is used.

With this configuration, the Analog Input function block 1 (slot 1), the totalizer value TOTAL (slot 7) and the cyclic control of device functions CONTROL_BLOCK (slot 11) 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	EMPTY_MODULE	–	–	Empty
6	EMPTY_MODULE	–	–	Empty
7	TOTAL	5	–	Totalizer function block 1 TOTAL → output variable = totalized mass flow (factory setting)
8	EMPTY_MODULE	–	–	Empty
9	EMPTY_MODULE	–	–	Empty
10	EMPTY_MODULE	–	–	Empty
11	CONTROL_BLOCK	–	1	Control of device functions

6.9 Acyclic data transmission PROFIBUS DP/PA

Acyclic data transmission is used to transmit parameters during commissioning or maintenance, or to display additional measured variables that are not included in cyclic data traffic. Thus parameters for identification, control or adjustment in the various blocks (Physical Block, Transducer Block, function block) can be changed while the device is in the process of cyclic data transmission with a PLC.

The measuring device supports the two basic types of acyclic data transmission:

- MS2AC communication with 2 available SAPs
- MS1AC communication

6.9.1 Master class 2 acyclic (MS2AC)

MS2AC is acyclic data transmission between a field device and a Class 2 master (e.g. FieldCare, Siemens PDM etc.). During this process, the master opens a communication channel via an SAP (Service Access Point) to access the device.

All parameters to be exchanged with a device via PROFIBUS must be made known to a Class 2 master. This assignment to each individual parameter takes place either in a device description (DD), a DTM (Device Type Manager), or inside a software component in the master via slot and index addressing.

When using MS2AC communication, note the following:

- As described above, a Class 2 master accesses a device via special SAPs.
Therefore, the number of Class 2 masters that can communicate with a device simultaneously is limited to the number of SAPs available for this data transmission.
- The use of a Class 2 master increases the cycle time of the bus system. This must be taken into account when programming the control system used.

6.9.2 Master class 1 acyclic (MS1AC)

In MS1AC, a cyclic master, that is already reading the cyclic data from the device or writing to the device opens the communication channel via the SAP 0x33 (special Service Access Point for MS1AC) and can then read or write a parameter acyclically like a Class 2 master via the slot and the index (if supported).

When using MS1AC communication, note the following:

- Currently, few PROFIBUS masters on the market support this data transmission.
- MS1AC is not supported by all PROFIBUS devices.
- In the user program, note that constant writing of parameters (for example, at every cycle of the program) can drastically reduce the service life of a device. Acyclically written parameters are written to voltage-resistant memory modules (EEPROM, Flash etc.). These memory modules are designed for a limited number of write operations. In normal operation without MS1AC (during parameter configuration), the number of write operations does not even come close to this number. If programming is incorrect, this maximum number can be reached quickly, drastically reducing a device's service life.

 **Note!**

The memory module of the measuring device is designed for one million writes.

6.10 Adjustment

6.10.1 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 → 156.

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 at very small flow rates.
- Under extreme process or operating conditions (e.g. very high process temperatures or very high viscosity fluids).

Preconditions for a zero point adjustment

Note the following before you perform a zero point adjustment:

- A zero point adjustment can be performed only with fluids that have no gas or solid contents.
- Zero point adjustment is performed with the measuring tubes completely filled and at zero flow ($v = 0 \text{ m/s}$). 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

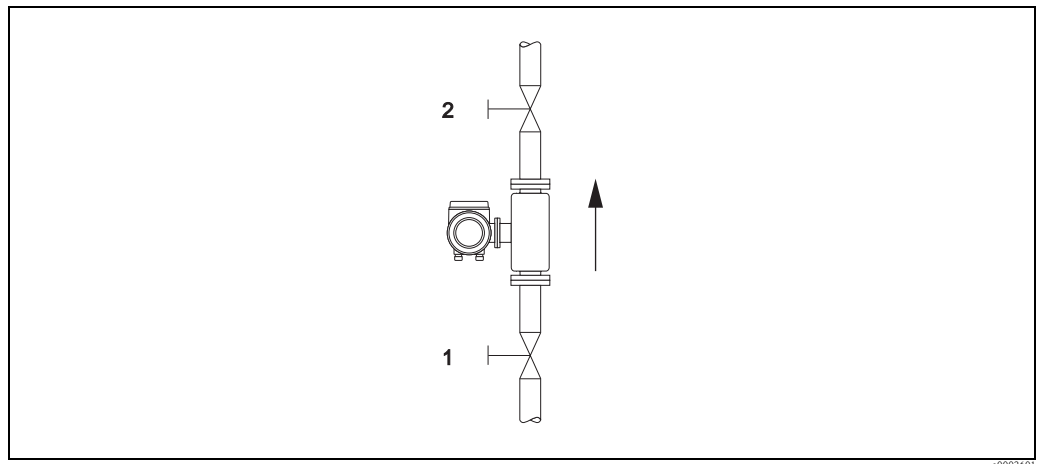


Fig. 54: Zero point adjustment and shutoff valves



















Caution!

- If the fluid is very difficult to measure (e.g. containing entrained solids or gas) it may prove impossible to obtain a stable zero point despite repeated zero point adjustments. In instances of this nature, please contact your Endress+Hauser 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. Let the system run until operating conditions have been reached.
2. Stop the flow ($v = 0$ m/s).
3. Check the shutoff valves for leaks.
4. Check that operating pressure is correct.
5. Perform a zero point adjustment as follows:

Key	Procedure	Display text
	HOME position → Enter the function matrix	> GROUP SELECTION< MEASURED VARIABLES
	Select the BASIC FUNCTION block	> GROUP SELECTION< BASIC FUNCTION
	Select the PROCESS PARAMETER group	> GROUP SELECTION< PROCESS PARAMETER
	Select the ADJUSTMENT function group	> GROUP SELECTION< ADJUSTMENT
	Select the ZERO ADJUST. function	ZERO ADJUST. CANCEL
	After you press  , you are automatically prompted to enter the code if the function matrix is still disabled.	CODE ENTRY ***
	Enter the code (83 = default)	CODE ENTRY 83
	Confirm the code as entered. The ZERO ADJUST function reappears on the display.	PROGRAMMING ENABLED ZERO ADJUST. CANCEL
	Select START	ZERO ADJUST. START
	Confirm the entry by pressing the Enter key. The confirmation prompt appears on the display.	SURE? NO
	Select YES.	SURE? YES
	Confirm the entry by pressing the Enter key. Zero point adjustment now starts. While zero point adjustment is in progress, the display shown here is visible for 30 to 60 seconds. If the flow of fluid in the pipe exceeds 0.1 m/s, an error message appears on the display: ZERO ADJUST NOT POSSIBLE. When the zero point adjustment completes, the ZERO ADJUST. function reappears on the display.	ZERO ADJUST. RUNNING ZERO ADJUST. CANCEL
	After actuating the Enter key, the new zero point value is displayed.	ZERO POINT
	Simultaneously pressing  → HOME position	

6.10.2 Density adjustment

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

1-point density adjustment (with one fluid):

This type of density adjustment is necessary under the following circumstances:

- The sensor does not measure exactly the density value that the user expects on the basis of laboratory analyses.
- The fluid properties are outside the measuring points set at the factory, or the reference operating conditions used to calibrate the measuring device.
- The system is used exclusively to measure a fluid's density which must be registered to a high degree of accuracy under constant conditions.

Example: Brix density measurement for apple juice.

2-point density adjustment (with two fluids):

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

Performing a 1-point or 2-point density adjustment






Caution!





- Onsite density adjustment can be performed only if the user has detailed knowledge of the fluid density, obtained for example from detailed laboratory analyses.
 - The target density value specified in this way must not deviate from the measured fluid density by more than $\pm 10\%$.
 - An error in defining the target density affects all calculated density and volume functions.
 - The 2-point density adjustment is only possible if both target density values are different from each other by at least 0.2 kg/l. Otherwise the error message #731 (adjustment is not possible) appears in the "Diag. - Act. Sys. Condition" parameter.
 - Density adjustment changes the factory density calibration values or the calibration values set by the service technician.
 - The functions outlined in the following instructions are described in detail in the "Description of Device Functions" manual.
1. Fill the sensor with fluid. Make sure that the measuring tubes are completely filled and that liquids are free of gas bubbles.
 2. Wait until the temperature difference between fluid and measuring tube has equalized. The time you have to wait for equalization depends on the fluid and the temperature level.
 3. Using the local display, select the SETPOINT DENSITY function in the function matrix and perform density adjustment as follows:

Function No.	Function name	Setting to be selected (or) (to next function with)
6482	SETPOINT DENSITY	Use to select a 1- or 2-point adjustment. Note! When you press you are automatically prompted to enter the access code if the function matrix is still disabled. Enter the code.
6483	DENSITY SET VALUE 1	Use to enter the target density of the first fluid and press to save this value (input range = actual density value $\pm 10\%$).
6484	MEASURE FLUID 1	Use to select START and press . The message "DENSITY MEASUREMENT RUNNING" appears on the display for approximately 10 seconds. During this time Promass measures the current density of the first fluid (measured density value).





Function No.	Function name	Setting to be selected ( or ) (to next function with )
--------------	---------------	---

For 2-point density adjustment only:



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



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



Back to the HOME position:

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

6.11 Rupture disk

Sensor housings with integrated rupture disks are optionally available.



Warning!

- Make sure that the function and operation of the rupture disk is not impeded through the installation. Triggering overpressure in the housing as stated on the indication label. Take adequate precautions to ensure that no damage occurs, and risk to human life is ruled out, if the rupture disk is triggered.

Rupture disk: Burst pressure 10 to 15 bar (145 to 218 psi)
(Promass X: 5,5 to 6,5 bar (80 to 94 psi))

- Please note that the housing can no longer assume a secondary containment function if a rupture disk is used.
- It is not permitted to open the connections or remove the rupture disk.



Caution!

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



Note!

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

6.12 Purge and pressure monitoring connections

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



Warning!

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

The following instructions apply to handling sensors with purge or pressure monitoring connections:

- Do not open the purge connections unless the containment can be filled immediately with a dry inert gas.
- Use only low gauge pressure to purge. Maximum pressure 5 bar (72.5 psi).

6.13 Data storage device (HistoROM), F-CHIP


At Endress+Hauser, 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.

6.13.1 HistoROM/S-DAT (sensor-DAT)

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

6.13.2 HistoROM/T-DAT (transmitter-DAT)



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

Storing of specific parameter settings from the EEPROM to the T-DAT and vice versa has to be carried out by the user (= manual save function). Detailed instructions regarding this can be found on →  72.

6.13.3 F-CHIP (Function-Chip)

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

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

- Accessories →  122
- Plugging on to the I/O board →  140



Caution!

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


7 Maintenance

No special maintenance work is required.

7.1 Exterior cleaning

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

7.2 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, Technical Information →  150.

7.3 Replacing seals

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



Note!

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

8 Accessories

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

8.1 Device-specific accessories

Accessory	Description	Order code
Transmitter Proline Promass 83	Transmitter for replacement or for stock. Use the order code to define the following specifications: <ul style="list-style-type: none"> – Approvals – Degree of protection / version – Cable entries – Display / power supply / operation – Software – Outputs / inputs. 	83XXX – XXXX * * * * *
Conversion kit Inputs/outputs (PROFIBUS DP only)	Conversion kit with appropriate slot modules for converting the present input/output configuration to a new version.	DK8UI- * * * *
Software packages for Proline Promass 83 (PROFIBUS DP only)	Software add-ons on F-Chip, can be ordered individually: <ul style="list-style-type: none"> – Advanced diagnostics – Batching – Concentration measurement 	DK8SO – *

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for transmitter	Mounting kit for wall-mount housing (remote version). Suitable for: <ul style="list-style-type: none"> – 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: <ul style="list-style-type: none"> – 2 process connections – Seals 	DK8MS – * * * * *
Set of seals for sensor	For regular replacement of the seals of the Promass A sensors. Set consists of two seals.	DKS – * * *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick. Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.	RSG40 – * * * * * * * *





8.3 Service-specific accessories

Accessory	Description	Order code
Applicator	<p>Software for selecting and sizing Endress+Hauser measuring devices:</p> <ul style="list-style-type: none"> ■ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections ■ Graphic illustration of the calculation results <p>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.</p> <p>Applicator is available:</p> <ul style="list-style-type: none"> ■ Via the Internet: https://wapps.endress.com/applicator ■ On CD-ROM for local PC installation. 	DXA80 – *
W@M	<p>Life cycle management for your plant</p> <p>W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle.</p> <p>The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.</p> <p>W@M is available:</p> <ul style="list-style-type: none"> ■ Via the Internet: www.endress.com/lifecyclemanagement ■ On CD-ROM for local PC installation. 	
Fieldcheck	<p>Tester/simulator for testing flowmeters in the field.</p> <p>When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification.</p> <p>Contact your Endress+Hauser representative for more information.</p>	50098801
FieldCare	<p>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.</p>	See the product page on the Endress+Hauser website: www.endress.com
FXA193	<p>The FXA193 service interface connects the device to the PC for configuration via FieldCare.</p>	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.	<ol style="list-style-type: none"> 1. Check the supply voltage → Terminals 1, 2 2. Check device fuse → 146 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 → 140
No display visible, but output signals are present.	<ol style="list-style-type: none"> 1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → 140 2. Display module defective → order spare parts → 140 3. Measuring electronics defective → order spare parts → 140
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 → 140
▼	
Error messages on display	
<p>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):</p> <ul style="list-style-type: none"> – 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 <p> Caution! Also refer to the information → 48</p>	
System error (device error) has occurred → 126	
Process error (application error) has occurred → 135	
▼	
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 → 146 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	<p>PROFIBUS PA: Check data line Terminal 26 = PA + Terminal 27 = PA –</p> <p>PROFIBUS DP: Check data line Terminal 26 = B (RxD/TxD-P) Terminal 27 = A (RxD/TxD-N)</p>
▼	

▼	
Fieldbus connector (only for PROFIBUS PA)	<ul style="list-style-type: none"> ■ Check pin assignment/wiring → 26 ■ Check connection between connector/fieldbus port. Is the coupling ring tightened correctly?
Fieldbus voltage (only for PROFIBUS PA)	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 → 26.
Basic current (only for PROFIBUS PA)	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.
Power consumption, permitted feed current (only for PROFIBUS PA)	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 → 138

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.



Caution!

In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. Important procedures must be carried out before you return a flowmeter to Endress+Hauser → 147.

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!

Further information → 48.

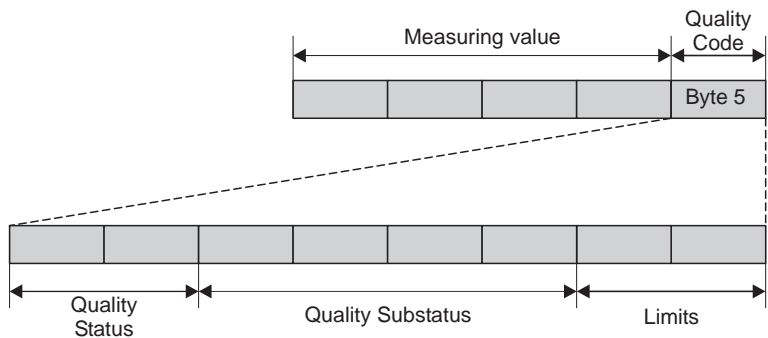
9.2.1 Displaying the device status on PROFIBUS DP/PA

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. 55: 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)	Quality code (HEX) Measured value status	PROFIBUS measured value status			Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part→ 📄 140)
			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	<i>Cause:</i> ROM/RAM error. Error when accessing the program memory (ROM) or random access memory (RAM) of the processor. <i>Remedy:</i> Replace the amplifier board.
011	S: AMP HW EEPROM ⚡: # 011	0x0F	BAD	Device Failure	Constant	Amplifier EEPROM failure	<i>Cause:</i> Amplifier with faulty EEPROM <i>Remedy:</i> Replace the amplifier board.
012	S: AMP SW EEPROM ⚡: # 012	0x0F	BAD	Device Failure	Constant	Amplifier EEPROM data inconsistent	<i>Cause:</i> Error when accessing data of the measuring amplifier EEPROM <i>Remedy:</i> Perform a "warm start" (= start the measuring system without disconnecting main power). <i>Access:</i> 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→ 140)
		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	<p><i>Cause:</i></p> <ol style="list-style-type: none"> 1. S-DAT is not plugged into the amplifier board correctly (or is missing). 2. S-DAT is defective. <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 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	<p>Check that the new, replacement DAT is compatible with the measuring electronics. Check the:</p> <ul style="list-style-type: none"> - Spare part set number - Hardware revision code <ol style="list-style-type: none"> 3. Replace measuring electronics boards if necessary. 4. Plug the S-DAT into the amplifier board.
041	S: TRANSM. HW-DAT #: # 041	0x0F	BAD	Device Failure	Constant	T-DAT failure	<p><i>Cause:</i></p> <ol style="list-style-type: none"> 1. T-DAT is not plugged into the amplifier board correctly (or is missing). 2. T-DAT is defective. <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Check whether the T-DAT is correctly plugged into the amplifier board. 2. Replace the T-DAT if it is defective.
042	S: TRANSM. SW-DAT #: # 042	0x0F	BAD	Device Failure	Constant	T-DAT data inconsistent	<p>Check that the new, replacement DAT is compatible with the measuring electronics. Check the:</p> <ul style="list-style-type: none"> - Spare part set number - Hardware revision code <ol style="list-style-type: none"> 3. Replace measuring electronics boards if necessary. 4. Plug the T-DAT into the amplifier board.
061	S: HW F-CHIP #: # 061	0x0F	BAD	Device Failure	Constant	F-CHIP failure	<p><i>Cause:</i></p> <ul style="list-style-type: none"> - F-Chip is not plugged into the I/O board correctly (or is missing). - F-Chip is defective <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Check whether the F-Chip is plugged into the I/O board correctly. 2. Replace the F-Chip if it is defective. 3. Plug the F-Chip into the I/O board.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part→ 140)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
121	S: A/C COMPATIB. !: # 121	0x0F	BAD	Device Failure	Constant	Amplifier and I/O board only partially compatible	<p><i>Cause:</i> Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality).</p> <p> Note! ■ This message is only listed in the error history. ■ Nothing is displayed on the display.</p> <p><i>Remedy:</i> Module with lower software version has either to be actualized by FieldCare with the required software version or the module has to be replaced.</p>
205	S: LOAD T-DAT !: # 205	0x0F	BAD	Device Failure	Constant	Save to T-DAT failed	<p><i>Cause:</i> Data backup (download) to T-DAT failed, or error when accessing (uploading) the calibration values stored in the T-DAT.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Check whether the T-DAT is correctly plugged into the amplifier board.
206	S: SAVE T-DAT !: # 206	0x0F	BAD	Device Failure	Constant	Restore from T-DAT failed	<ol style="list-style-type: none"> 2. Replace the T-DAT if it is defective. Check that the new, replacement DAT is compatible with the measuring electronics. Check the: - Spare part set number - Hardware revision code 3. Replace measuring electronics boards if necessary. 4. Plug the T-DAT into the amplifier board.
251	S: COMMUN. SENS. I/O !: # 251	0x0F	BAD	Device Failure	Constant	Communication sensor failure	<p><i>Cause:</i> Internal communication fault on the amplifier board.</p> <p><i>Remedy:</i> Replace the amplifier board.</p>
261	S: COMMUNICAT. I/O !: # 261	0x18 0x19 0x1A	BAD	No Commu- nication	O.K. Low High	Communication failure	<p><i>Cause:</i> Communication error. No data reception between amplifier and I/O board or faulty internal data transfer.</p> <p><i>Remedy:</i> Check whether the electronics boards are correctly inserted in their holders</p>

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part→ 140)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
339 to 342	S: STACK CUR OUT n f: # 339 to 342	0x0F	BAD	Device Failure	Constant	Temp. buf. not cleared	<p><i>Cause:</i> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. <p><i>Recommendation:</i></p> <ul style="list-style-type: none"> – Configure the fault response of the output to ACTUAL VALUE, so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
343 to 346	S: STACK FREQ. OUT n f: # 343 to 346	0x0F	BAD	Device Failure	Constant	Temp. buf. not cleared	<p><i>Cause:</i> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Increase the setting for pulse weighting. 2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses. 3. Increase or reduce flow, as applicable. <p><i>Recommendation:</i></p> <ul style="list-style-type: none"> – Configure the fault response of the output to ACTUAL VALUE, so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
347 to 350	S: STACK PULSE OUT n f: # 347 to 350	0x0F	BAD	Device Failure	Constant	Temp. buf. not cleared	<p><i>Cause:</i> The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Increase the setting for pulse weighting. 2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses. 3. Increase or reduce flow, as applicable. <p><i>Recommendation:</i></p> <ul style="list-style-type: none"> – Configure the fault response of the output to ACTUAL VALUE, so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
351 to 354	S: CURRENT RANGE n f: # 351 to 354	0x54 0x55 0x56	UNCERTAIN	Engineering Unit Range Violation (im- permissible overranging)	O.K. Low High	Flow is Out of Range	<p><i>Cause:</i> Current output: The actual value for the flow lies outside the set limits.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 to 358	S: FREQ. RANGE n f: # 355 to 358	0x54 0x55 0x56	UNCERTAIN	Engineering Unit Range Violation (im- permissible overranging)	O.K. Low High	Flow is Out of Range	<p><i>Cause:</i> Frequency output: The actual value for the flow lies outside the set limits.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part→ 140)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
359 to 362	S: PULSE RANGE !: # 359 to 362	0x54 0x55 0x56	UNCERTAIN	Engineering Unit Range Violation (im- permissible overranging)	O.K. Low High	Flow is Out of Range	<p>Cause: Pulse output: The pulse output frequency is out of range.</p> <p>Remedy:</p> <ol style="list-style-type: none"> 1. Increase the setting for pulse weighting. 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC, etc.). <p>Determine the pulse width:</p> <ul style="list-style-type: none"> – Version 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Version 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. <p>Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is:</p> $\frac{1}{2 \cdot 10 \text{ Hz}} = 50 \text{ ms}$ <p>3. Reduce flow</p>
379	S: LOW FREQ. LIM #: # 379	0x0F	BAD	Device Failure	Constant	Frequency limit 1	<p>Cause: The measuring tube oscillation frequency is outside the permitted range.</p> <p>Causes: Measuring tube damaged Sensor defective or damaged</p> <p>Remedy: Contact your Endress+Hauser service organization.</p>
380	S: UPPER FREQ. LIM #: # 380	0x0F	BAD	Device Failure	Constant	Frequency limit 2	<p>Cause: The measuring tube oscillation frequency is outside the permitted range.</p> <p>Causes: Measuring tube damaged Sensor defective or damaged</p> <p>Remedy: Contact your Endress+Hauser service organization.</p>

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No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part→ 140)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
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: <ul style="list-style-type: none"> ■ 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 → 30
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: <ul style="list-style-type: none"> ■ 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 → 30
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: <ul style="list-style-type: none"> ■ 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	
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.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part→ 140)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
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	<i>Cause:</i> Up- or downloading the device data via operating program. Currently no other functions are possible. <i>Remedy:</i> Wait until process is finished.
586	P: OSC. AMP. LIMIT f: # 586	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Oscillation amplitude too low	<i>Cause:</i> The fluid properties do not allow a continuation of the measurement. <i>Causes:</i> Extremely high viscosity Fluid is very inhomogeneous (gas or solid content) <i>Remedy:</i> Change or improve process conditions.
587	P: TUBE NOT OSC f: # 587	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	No oscillation possible	<i>Cause:</i> Extreme process conditions exist. The measuring system can therefore not be started. <i>Remedy:</i> Change or improve process conditions.
588	P: GAIN RED.IMPOS f: # 588	0x10 0x11 0x12	BAD	Sensor Failure	O.K. Low High	Gain reduction impossible	<i>Cause:</i> Overdriving of the internal analog to digital converter. A continuation of the measurement is no longer possible! <i>Causes:</i> Cavitation Extreme pressure shock High gas flow velocity <i>Remedy:</i> 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	<i>Cause:</i> Positive zero return is active <i>Remedy:</i> Switch off positive zero return: <i>Access:</i> BASIC FUNCTIONS → SYSTEM PARAMETER → CONFIGURATION → POS. ZERO RETURN (→ OFF)
611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	0x80	GOOD (good)	O.K.	O.K.	Simulation IO active	<i>Advanced diagnostics:</i> The mass flow is outside the limit value, set in the corresponding diagnosis functions.
621 to 624	S: SIM. FREQ. OUT. n !: # 621 to 624	0x80	GOOD (good)	O.K.	O.K.	Simulation IO active	<i>Advanced diagnostics:</i> The density is outside the limit value, set in the corresponding diagnosis functions.
631 to 634	S: SIM. PULSE n !: # 631 to 634	0x80	GOOD (good)	O.K.	O.K.	Simulation IO active	<i>Advanced diagnostics:</i> The reference density is outside the limit value, set in the corresponding diagnosis functions.
641 to 644	S: SIM. STAT. OUT n !: # 641 to 644	0x80	GOOD (good)	O.K.	O.K.	Simulation IO active	<i>Advanced diagnostics:</i> The temperature is outside the limit value, set in the corresponding diagnosis functions.

No.	Device status message (local display)	PROFIBUS measured value status				Extended diagnostic message in the PROFIBUS master	Cause/remedy (spare part→ 140)
		Quality code (HEX) Measured value status	Quality status	Quality substatus	Limits		
651 to 654	S: SIM. RELAY n !: # 651 to 654	0x80	GOOD (good)	O.K.	O.K.	Simulation IO active	<i>Advanced diagnostics:</i> The pipe damping is outside the limit value, set in the corresponding diagnosis functions.
671 to 674	S: SIM. STATUS IN n !: # 671 to 674	0x80	GOOD (good)	O.K.	O.K.	Simulation IO active	<i>Advanced diagnostics:</i> The electrodynamic sensor is outside the limit value, set in the corresponding diagnosis functions.
691	S: SIM. FAILSAFE !: # 691	0x48 0x49 0x4A	UNCERTAIN	Substitute set (Substitute set of failsafe status)	O.K. Low High	Simulation failsafe active	<i>Cause:</i> Simulation of response to error is active. <i>Remedy:</i> Switch off simulation: <i>Access:</i> SUPERVISION → SYSTEM → OPERATION → SIM. FAILSAFE MODE (→ OFF)
692	S: SIM. MEASURAND !: # 692	0x60 0x61 0x62	UNCERTAIN	Simulated Value (manually specified value)	O.K. Low High	Simulation measured value active	<i>Cause:</i> Simulation is active <i>Remedy:</i> Switch off simulation: <i>Access:</i> 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	<i>Cause:</i> The measuring device is being checked on site via the test and simulation device.
No. # 8xx → Other error messages with software options (Coriolis flowmeters)							
800	S: M. FL. DEV. LIMIT !: # 800	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Mass flow outside the limit	–
801	S: DENS. DEV. LIMIT !: # 801	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Density outside the limit	–
802	S: REF. D. DEV. LIM. !: # 802	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Ref.dens. outside the limit	–
803	S: TEMP. DEV. LIMIT !: # 803	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Temperature out. the limit	–
804	S: T. DAMP. DEV. LIM !: # 804	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Tube damping out. the limit	–
805	S: E. D. SEN. DEV. LI !: # 805	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Elec.-mag.sens.out the limit	–
806	S: F. FLUCT. DEV. LIM !: # 806	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Op.freq. fluct. out. the limit	–
807	S: TD FLUCT. DEV. LIM !: # 807	0x40 0x41 0x42	UNCERTAIN	Non specific (uncertain status)	O.K. Low High	Tube damping fluct. out. the limit	–

9.3 Process error messages






Note!



Further Information → 48.

9.3.1 Displaying the device status on PROFIBUS DP/PA

Further information → 126.

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 (<i>with</i> an effect on the outputs) ! = Notice message (<i>without</i> any effect on the outputs)							
471	P: > BATCH TIME ⚡: # 471	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Batch Time	<p><i>Cause:</i> The maximum permitted batching time was exceeded.</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none">1. Increase flow rate.2. Check valve (opening).3. Adjust time setting to changed batch quantity. <p> Note! If the errors listed above occur, these are displayed in the Home position flashing continuously.</p> <ul style="list-style-type: none">■ General: These error messages can be reset by configuring any batching parameter. It is sufficient to confirm with the  key and then the  key.■ Batching via status input: The error message can be reset by means of a pulse. Another pulse then restarts the batching.■ Batching via operating keys (softkeys) The error message is reset by pressing the START key. Pressing the START key a second time starts the batching process.■ Batching via the BATCHING PROCESS function (7260): The error message can be reset by pressing the STOP, START, HOLD or GO ON keys. Pressing the START key a second time starts the batching process.

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		
472	P: >< BATCH QUANTITY !/: # 472	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Batch Quantity	<p><i>Cause:</i></p> <ul style="list-style-type: none"> – Underbatching: The minimum quantity was not reached. – Overbatching: The maximum permitted batching quantity was exceeded. <p><i>Remedy:</i></p> <p>Underbatching:</p> <ol style="list-style-type: none"> 1. Increase fixed correction quantity. 2. Valve closes too quickly with active after run correction. Enter smaller after run as mean value. 3. If the batching quantity changes, the minimum batching quantity must be adjusted. <p><i>Overbatching:</i></p> <ol style="list-style-type: none"> 1. Reduce fixed correction quantity. 2. Valve closes too slowly with active after run correction. Enter larger after run as mean value. 3. If the batching quantity changes, the maximum batching quantity must be adjusted. <p> Note! Please observe Note in error message No. 471</p>
473	P: PROGRESS NOTE !/: # 473	0x80	GOOD (good)	O.K.	O.K.	Progress Note	<p><i>Cause:</i></p> <p>End of filling process approaching. The running filling process has exceeded the predefined batch quantity point for the display warning message.</p> <p><i>Remedy:</i></p> <p>No measures required (if necessary prepare to replace container).</p>
474	P: MAX. FLOW RATE !/: # 474	0x00 0x01 0x02	BAD	Non specific (uncertain status)	O.K. Low High	Flow Rate	<p><i>Cause:</i></p> <p>Maximum flow value entered is exceeded.</p> <p><i>Remedy:</i></p> <p>Reduce the flow value.</p> <p> Note! Please observe Note in error message No. 471</p>
571	P: RUN BATCHING !/: #571	0x80	GOOD (good)	O.K.	O.K.	Batch running	Batching process is active
572	P: HOLD BATCHING !/: #572	0x80	GOOD (good)	O.K.	O.K.	Batch hold	Batching process is stopped

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		
700	P: EMPTY PIPE !: # 700	0x53	UNCER- TAIN	Sensor conversion not accurate (measured value from sensor not accurate)	Constant	Empty pipe detected	<p><i>Cause:</i> The process fluid density is outside the upper or lower limit values set for empty pipe detection.</p> <p><i>Causes:</i> Air in the measuring tube Partly filled measuring tube</p> <p><i>Remedy:</i></p> <ol style="list-style-type: none"> 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. <p><i>Access:</i> BASIC FUNCTIONS → PROCESS PARAMETER → EPD PARAMETER → EPD VALUE LOW or EPD VALUE HIGH</p>
701	P: EXC. CURR. LIM. !: # 701	0x40 0x41 0x42	UNCER- TAIN	Non specific (uncertain status)	O.K. Low High	Excitation too high	<p><i>Cause:</i> The maximum current value for the measuring tube exciter coils has been reached, since certain process fluid characteristics are extreme, e.g. high gas or solid content. The instrument continues to work correctly.</p> <p><i>Remedy:</i> In particular with outgassing fluids and/or increased gas content, the following measures are recommended to increase system pressure:</p> <ul style="list-style-type: none"> – 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.
702	P: MEDIUM INHOM. !: # 702	0x43	UNCER- TAIN	Non specific (uncertain status)	Constant	Fluid inhomogeneous	<p><i>Cause:</i> Frequency control is not stable, due to inhomogeneous process fluid, e.g. gas or solid content.</p> <p><i>Remedy:</i> In particular with outgassing fluids and/or increased gas content, the following measures are recommended to increase system pressure:</p> <ul style="list-style-type: none"> – 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		
703	P: NOISE LIM. CH0 !: # 703	0x40 0x41 0x42	UNCER- TAIN	Non specific (uncertain status)	O.K. Low High	Noise Limit Channel 0	<i>Cause:</i> Overdriving of the internal analog to digital converter. <i>Causes:</i> Cavitation Extreme pressure pulses High gas flow velocity
704	P: NOISE LIM. CH1 !: # 704	0x40 0x41 0x42	UNCER- TAIN	Non specific (uncertain status)	O.K. Low High	Noise Limit Channel 1	A continuation of the measurement is still possible! <i>Remedy:</i> Change or improve process conditions, e.g. by reducing the flow velocity.
705	P: FLOW LIMIT !: # 705	0x42	UNCER- TAIN	Non specific (uncertain status)	High Limited	Flow limit	<i>Cause:</i> The mass flow is too high. The electronics' measuring range will be exceeded. <i>Remedy:</i> Reduce flow
731	P: ADJ. ZERO FAIL !: # 731	0x43	UNCER- TAIN	Non specific (uncertain status)	Constant	Zero Point adjustment failure	<i>Cause:</i> The zero point adjustment is not possible or has been canceled. <i>Remedy:</i> Make sure that zero point adjustment is carried out at "zero flow" only (v = 0 m/s) → 115.

9.4 Process errors without messages

Symptoms	Rectification
<p> 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.</p>	
Measured value reading fluctuates even though flow is steady.	<ol style="list-style-type: none"> 1. Check the fluid for presence of gas bubbles. 2. Increase the following values: <ul style="list-style-type: none"> – 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.	<ol style="list-style-type: none"> 1. Check the fluid for presence of gas bubbles. 2. Enter a value for the low flow cut off 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.	<p>The following options are available for tackling problems of this nature:</p> <p>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:</p> <ul style="list-style-type: none"> ■ Brief description of the fault ■ Nameplate specifications: order code and serial number → 7 <p>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.</p> <p>Replace transmitter electronics Parts of the measuring electronics defective → Order spare parts → 140.</p>

9.5 Response of outputs to errors



Note!

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

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

Failsafe mode of outputs		
	Process/system error is present	Positive zero return is activated
Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the outputs. See the information on → 48.		
Current output	MIN. CURRENT The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). MAX. CURRENT The current output will be set to the higher value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). HOLD VALUE Measured value display on the basis of the last saved value preceding occurrence of the fault. ACTUAL VALUE Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	FALLBACK VALUE Signal output → 0 Hz FAILSAFE VALUE Output of the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Relay output	In the event of a fault or power supply failure: Relay → deenergized The "Description of Device Functions" manual contains detailed information on relay switching response for various configurations such as error message, flow direction, limit value, etc.	No effect on relay output
PROFIBUS	→ 126	–

9.6 Spare parts

The previous sections contain a detailed troubleshooting guide → 124.

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

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



Note!

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

Spare parts are shipped as sets comprising the following parts:

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

9.6.1 PROFIBUS DP

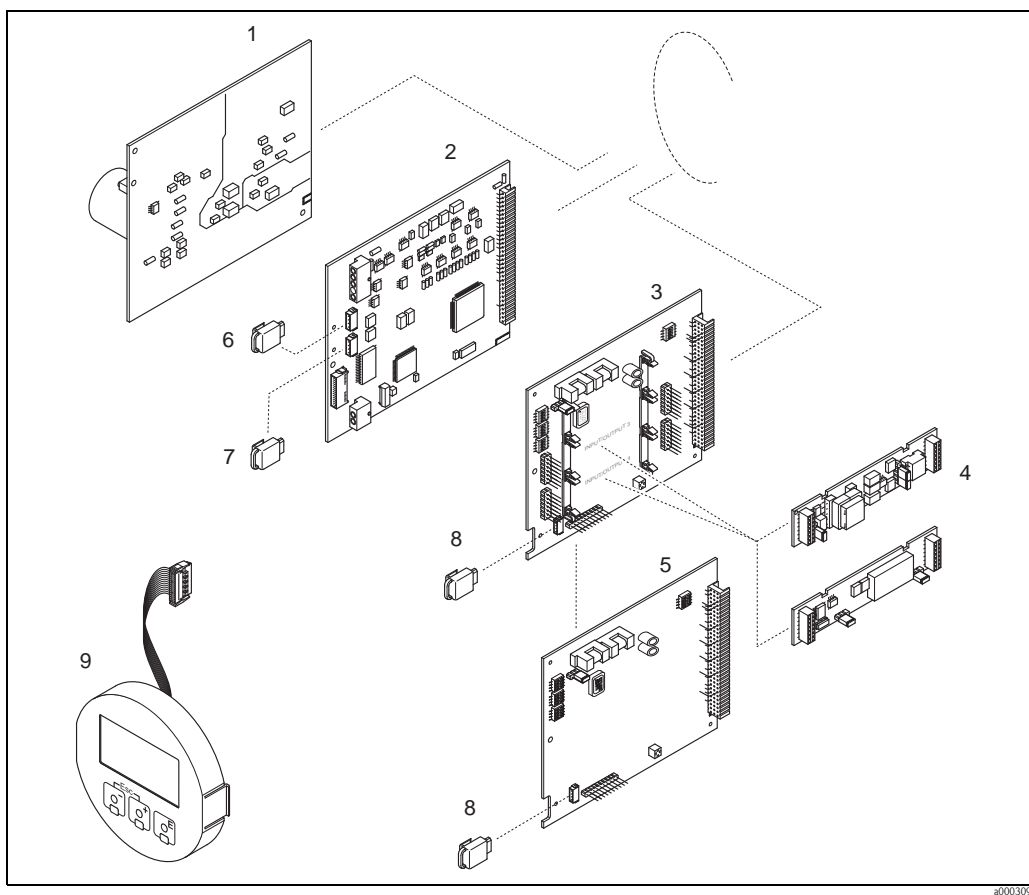


Fig. 56: Spare parts for PROFIBUS DP transmitters (field and wall-mount housing)

- 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), flexible
- 4 Pluggable output submodules; ordering structure
- 5 I/O board (COM module), permanent assignment
- 6 S-DAT (sensor data storage device)
- 7 T-DAT (transmitter data storage device)
- 8 F-CHIP (function chip for optional software)
- 9 Display module

9.6.2 PROFIBUS PA

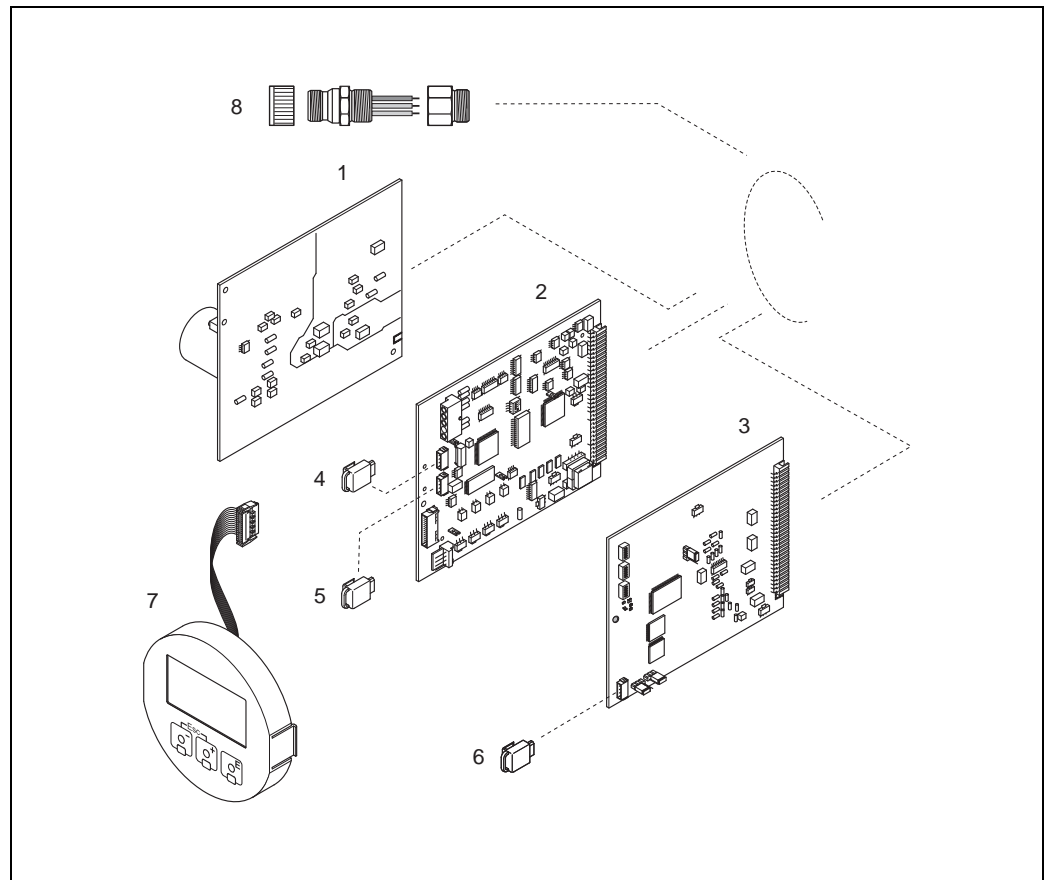


Fig. 57: Spare parts for PROFIBUS PA transmitters (field and wall-mount housing)

- 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), permanent assignment
- 4 S-DAT (sensor data storage device)
- 5 T-DAT (transmitter data storage device)
- 6 F-CHIP (function chip for optional software)
- 7 Display module
- 8 Fieldbus connector consisting of protection cap, connector, adapter PG 13.5/M20.5 (only for PROFIBUS PA, order No. 50098037)

9.6.3 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 Endress+Hauser parts.

Installing and removing printed circuit boards →  58:

1. Unscrew cover of the electronics compartment from the transmitter housing.
 2. Remove the local display (1) as follows:
 - Press in the latches (1.1) at the side and remove the display module.
 - Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
 3. Remove the screws and remove the cover (2) from the electronics compartment.
 4. Remove power unit board (4) and I/O board (6):
 - Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
 5. Remove submodules (6.2) (optional):
 - No tools are required for removing the submodules (outputs) from the I/O board. Installation is also a no-tools operation.
-  **Caution!**
Only certain combinations of submodules on the I/O board are permissible →  31.
The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:
- "INPUT / OUTPUT 3" slot = terminals 22/23
 - "INPUT / OUTPUT 4" slot = terminals 20/21
6. Remove amplifier board (5):
 - Disconnect the plug of the sensor signal cable (5.1) including S-DAT (5.3) from the board.
 - Gently disconnect the plug of the excitation current cable (5.2) from the board, i.e. without moving it back and forward.
 - Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
 7. Installation is the reverse of the removal procedure.

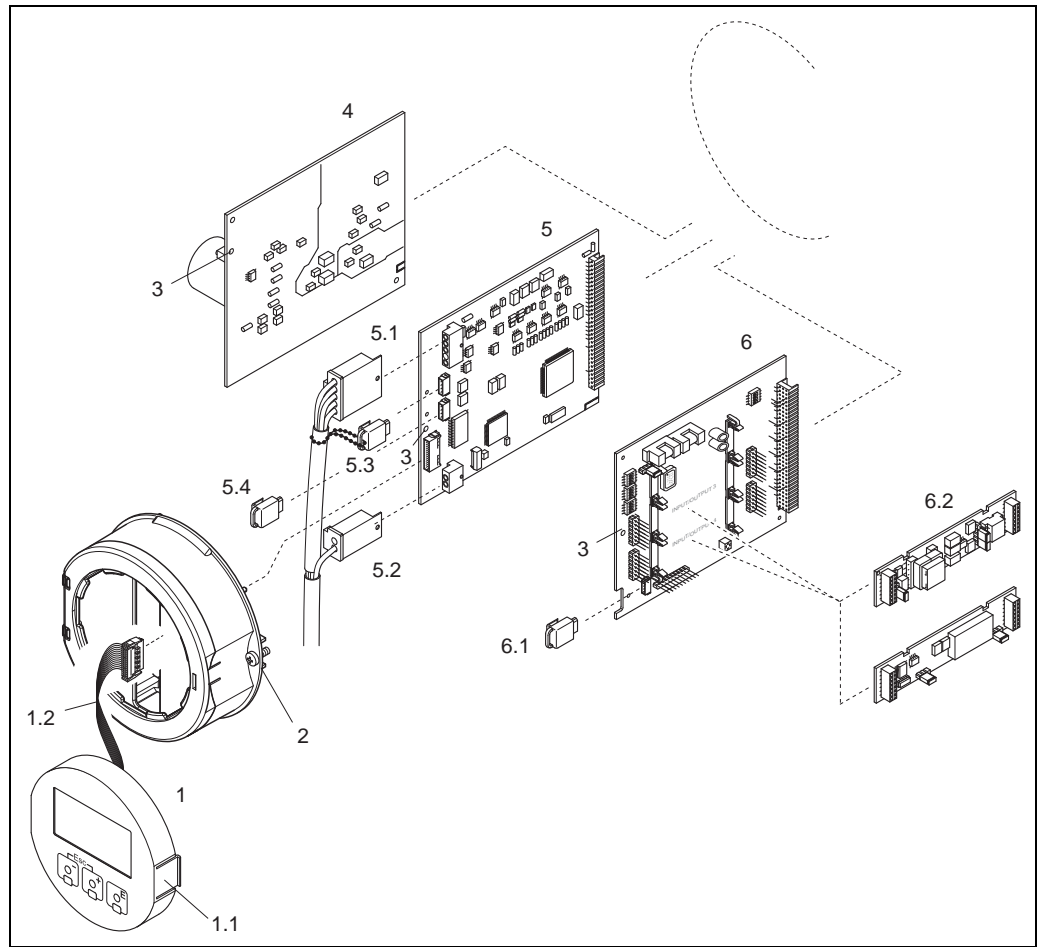


Fig. 58: Field housing: removing and installing printed circuit boards

- 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)
- 5.4 T-DAT (transmitter data storage device)
- 6 I/O board (flexible assignment)
- 6.1 F-CHIP (function chip for optional software)
- 6.2 Optional: Pluggable submodules (current output, pulse/frequency output and relay output)

Wall-mount housing**Warning!**

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


**Caution!**

Use only original Endress+Hauser parts.

Installing and removing printed circuit boards →  59:

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 exciting current cable (7.2):
Gently disconnect the plug, i.e. without moving it back and forward.
 - Ribbon cable plug (3) of the display module
4. Remove the cover (4) from the electronics compartment by loosening the screws.
5. Remove the boards (6, 7, 8):
Insert a thin pin into the hole provided (5) for the purpose and pull the board clear of its holder.
6. Remove submodules (8.2) (optional):
No tools are required for removing the submodules (outputs) from the I/O board. Installation is also a no-tools operation.

**Caution!**

Only certain combinations of submodules on the I/O board are permissible →  31.
The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

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

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

7. Installation is the reverse of the removal procedure.

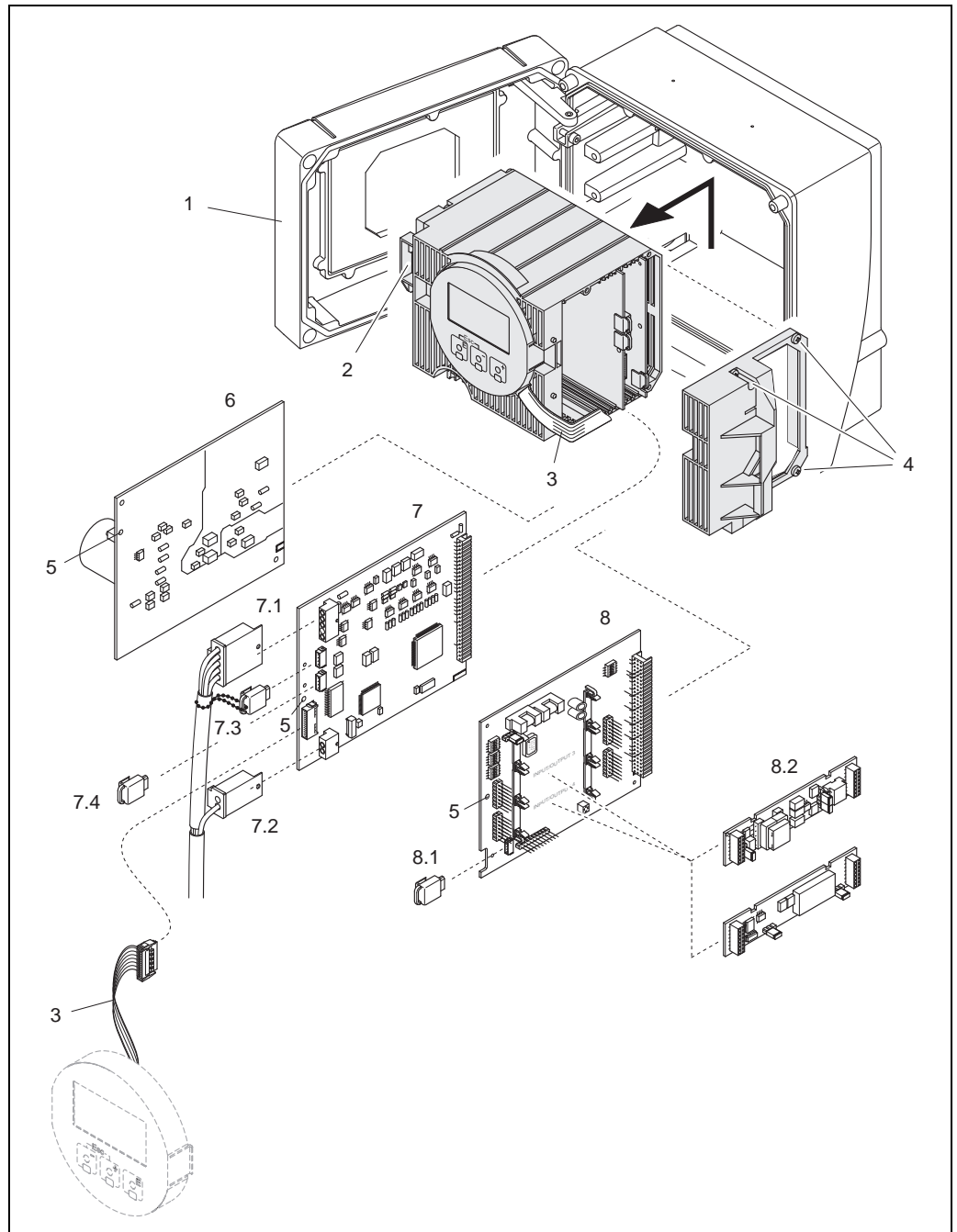


Fig. 59: Wall-mount housing: removing and installing printed circuit boards

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

9.6.4 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 →  60.

The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power unit board →  140.
3. Remove the protection cap (1) and replace the device fuse (2).
Only use the following fuse type:
– 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 × 20 mm
– Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 × 20 mm
– Ex-rated devices → see the Ex documentation
4. Installation is the reverse of the removal procedure.



Caution!

Use only original Endress+Hauser parts.

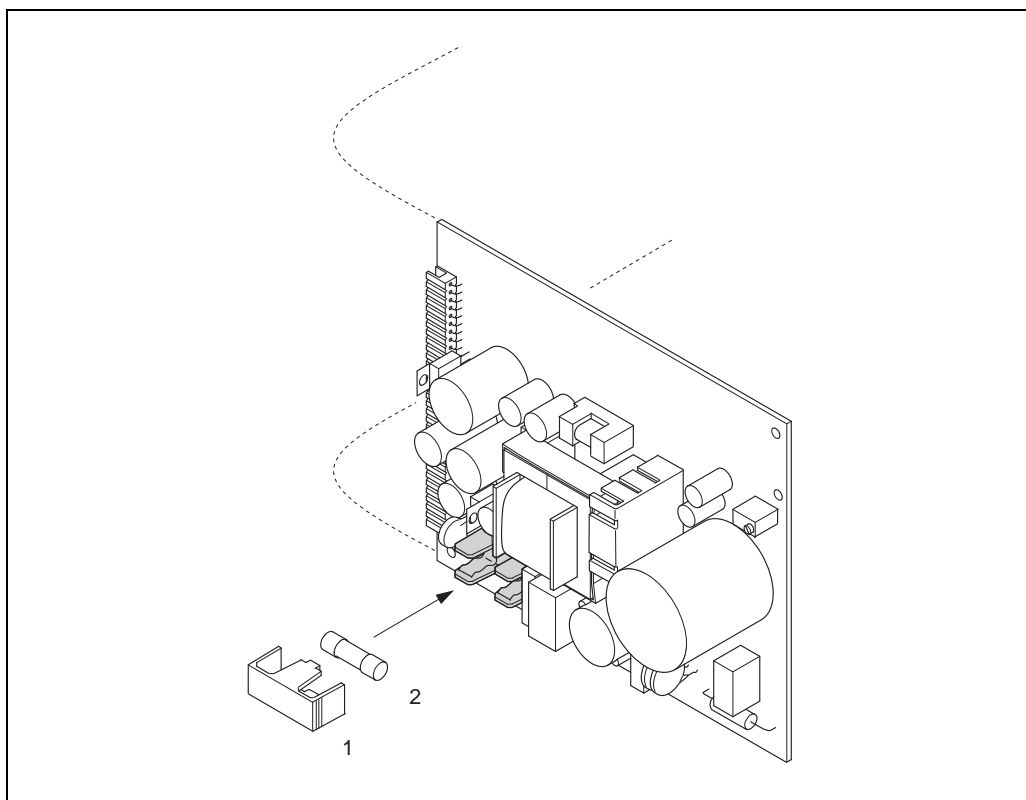


Fig. 60: Replacing the device fuse on the power unit board

- 1 Protective cap
2 Device fuse

9.7 Return



Caution!

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

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

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

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



Note!


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

9.8 Disposal

Observe the regulations applicable in your country!

9.9 Software history

Date	Software version	Changes to software	Operating Instructions
10.2012	PROFIBUS PA 3.06.XX		71197484/14.12
09.2011		New Sensor: Promass O, Promass X	71141443/13.11
06.2010		Software adjustment	71116475/06.10
08.2007	PROFIBUS PA 3.05.XX	Introduction of a new PROFIBUS PA I/O board	71060112/08.07
07.2007	PROFIBUS DP 3.04.XX	Software adjustment	
12.2006	PROFIBUS DP 3.02.XX	New Sensor: Promass S, Promass P	71036019/12.06
12.2005		Software expansion: – Promass I DN80, DN50FB – Additional functionalities for software option "Advanced Diagnostics" – Additional functionalities for software option "Batching" – General device functions – Support t-mass 65 PROFIBUS DP/ Modbus RS485	71009725/01.06
10.2005	PROFIBUS DP 3.01.XX	Software expansion: – Support Promag 53 PROFIBUS DP/ Modbus RS485 – Support Promag 50 PROFIBUS DP – No functional changes for Promass 83 PROFIBUS DP	
02.2005	PROFIBUS DP 3.00.XX	Introduction of a new PROFIBUS DP I/O board: – Support of additional output signals (current, frequency etc.) Software expansion: – Advanced diagnostics – Concentration measurement – Viscosity measurement – Batching	50100078/03.05
02.2005	PROFIBUS PA 2.03.XX	No functional changes	
10.2003	Amplifier: 1.06.XX Communication module: 2.03.XX	Software expansion: – Language groups – Adjustments to Fieldcheck and Simubox – New error messages – Support of compatibility with previous PROFIBUS model Promass 63 with Profile Version 2.0 – SIL 2 – The totalizer values are also updated without integration in cyclic data exchange New functionalities: – Operation hours counter – Intensity of background illumination adjustable – Counter for access code – Upload/download via ToF Tool - Fieldtool Package PROFIBUS operation via: – Commuwin II version 2.08-1 (update C) and higher	50100078/10.03
03.2003	Amplifier: 1.05.XX	Software adjustment	
12.2002	Communication module: 2.02.XX	Software adjustment	

Date	Software version	Changes to software	Operating Instructions
09.2002	Amplifier: 1.04.XX Communication module: 2.01.XX	Software expansion: – Support for 2-point density adjustment – "Measuring mode" function can be operated via local display – Data length of advanced diagnosis adjusted in cyclic data exchange  Note! As of this software version, a new device master file (GSD) must be used when replacing the device	50100078/10.03
08.2002	Amplifier: 1.04.XX	Software expansion: – Promass E	50100078/12.02
04.2002	Amplifier: 1.02.02	Software expansion: – Promass H	
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	50100078/04.02
11.2001	Amplifier: 1.02.01	Software adjustment	
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	50100078/06.01

10 Technical data

10.1 Technical data at a glance

10.1.1 Applications

→ 5

10.1.2 Function and system design

Measuring principle	Mass flow measurement by the Coriolis principle
Measuring system	→ 7

10.1.3 Input

Measured variable	<ul style="list-style-type: none">■ 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

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
8	3/8	0 to 2000 kg/h	0 to 73.5 lb/min
15	½	0 to 6500 kg/h	0 to 238 lb/min
15 FB	½ 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 1 650 lb/min
40	1 ½	0 to 45000 kg/h	0 to 1 650 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 6 600 lb/min
80	3	0 to 180000 kg/h	0 to 6 600 lb/min
100	4	0 to 350000 kg/h	0 to 12 860 lb/min
150	6	0 to 800000 kg/h	0 to 29 400 lb/min
250	10	0 to 2 200 000 kg/h	0 to 80 860 lb/min
350	14	0 to 4100 t/h	0 to 4520 tn. sh./h
FB = Full bore versions of Promass I			

Measuring ranges for gases, general, (except Promass H (Zr))

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

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

$\dot{m}_{\max(G)}$ = Max. full scale value for gas [kg/h (lb/min)]

$\dot{m}_{\max(F)}$ = Max. full scale value for liquid [kg/h (lb/min)]

$\rho_{(G)}$ = Gas density in [kg/m³ (lb/ft³)] for process conditions

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

Measuring ranges for gases (Promass F, O):

DN		x
[mm]	[inch]	
8	3/8	60
15	1/2	80
25	1	90
40	1 1/2	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	1/2	110
25	1	125
40	1 1/2	125
50	2	125
80	3	155

Measuring ranges for gases (Promass P, S, H (Ta))

DN		x
[mm]	[inch]	
8	3/8	60
15	1/2	80
25	1	90
40 ¹⁾	1 1/2 ¹⁾	90
50 ¹⁾	2 ¹⁾	90
¹⁾ only Promass P, S		

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 1/2	90
40 FB	1 1/2 FB	90
50	2	90
50 FB	2 FB	110
80	3	110

FB = Full bore versions of Promass I

Measuring ranges for gases (Promass X)

DN		x
[mm]	[inch]	
350	14	200

Calculation example for gas:

- Sensor type: Promass F, DN 50
- Gas: air with a density of 60.3 kg/m³ (at 20 °C and 50 bar)
- Measuring range (liquid): 70 000 kg/h
- x = 90 (for Promass F DN 50)

Max. possible full scale value:

$$\dot{m}_{\max(G)} = \dot{m}_{\max(F)} \cdot \rho_{(G)} \div x \text{ [kg/m}^3\text{]} = 70\,000 \text{ kg/h} \cdot 60.3 \text{ kg/m}^3 \div 90 \text{ kg/m}^3 = 46\,900 \text{ kg/h}$$

Recommended full scale values

See → Page 127 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 = 3 kΩ, galvanically isolated.
Switch level: ±3 to ±30 VDC, independent of polarity

10.1.4 Output variables

Output signal

Current output

Active/passive selectable, galvanically isolated, time constant selectable (0.05 to 100 s), Full scale value adjustable, temperature coefficient: typically 0.005% o.f.s./°C, resolution: 0.5 μ A


- Active: 0/4 to 20 mA, $R_L < 700 \Omega$
- Passive: 4 to 20 mA; supply voltage U_S 18 to 30 V DC; $R_i \geq 150 \Omega$

Pulse / frequency output:


Active/passive selectable, galvanically isolated

- Active: 24 V DC, 25 mA (max. 250 mA during 20 ms), $R_L > 100 \Omega$
- Passive: open collector, 30 V DC, 250 mA
- Frequency output: full scale frequency 2 to 10000 Hz ($f_{\max} = 12500$ Hz), on/off ratio 1:1, pulse width max. 2 s
- Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.05 to 2000 ms)

PROFIBUS DP interface:

- PROFIBUS DP in accordance with EN 50170 Volume 2
- Profile Version 3.0
- Data transmission rate: 9.6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Signal encoding: NRZ Code
- Function blocks: 6 \times Analog Input, 3 \times Totalizer
- Output data: Mass flow, Volume flow, Corrected volume flow, Density, Reference density, Temperature, Totalizers 1 to 3
- Input data: Positive zero return (ON/OFF), Zero point adjustment, Measuring mode, Totalizer control
- Bus address can be configured via miniature switches or via the local display (optional)
- Available output combination \rightarrow  31

PROFIBUS PA interface:

- PROFIBUS PA in accordance with EN 50170 Volume 2, IEC 61158-2 (MBP), galvanically isolated
- 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
- Function blocks: 6 × Analog Input, 3 × Totalizer
- Output data: Mass flow, Volume flow, Corrected volume flow, Density, Reference density, Temperature, Totalizer 1 to 3
- Input data: Positive zero return (ON/OFF), Zero point adjustment, Measuring mode, Totalizer control
- Bus address can be configured via miniature switches, via the local display (optional) or operating program
- Available output combination →  31

Signal on alarm

Current output

Failsafe mode selectable (for example NAMUR recommendation NE 43)

Pulse/frequency output

Failsafe mode selectable

Relay output

De-energized by fault or power supply failure

PROFIBUS DP/PA

Status and alarm messages in accordance with PROFIBUS Profile Version 3.0

Load

See "Output signal"

Relay output:

Normally closed (NC or break) or normally open (NO or make) contacts available (default: relay 1 = NO, relay 2 = NC), max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.



Low flow cut off

Switch points for low flow cut off are selectable.

Galvanic isolation

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

10.1.5 Power supply

Electrical connections	→  26
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	<p><i>Power supply and signal cables (inputs/outputs):</i></p> <ul style="list-style-type: none"> ■ Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47) ■ Threads for cable entries, 1/2" NPT, G 1/2" <p><i>Connecting cable for remote version:</i></p> <ul style="list-style-type: none"> ■ Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47) ■ Threads for cable entries, 1/2" NPT, G 1/2"
Cable specifications (remote version)	→  31
Power consumption	<p>AC: <15 VA (including sensor) DC: <15 W (including sensor)</p> <p><i>Switch-on current:</i></p> <ul style="list-style-type: none"> ■ max. 13.5 A (< 50 ms) at 24 V DC ■ max. 3 A (< 5 ms) at 260 V AC
Power supply failure	<p>Lasting min. 1 power cycle:</p> <ul style="list-style-type: none"> ■ EEPROM and T-DAT save 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/DIN 11631
- Water, typically +15 to +45 °C (+59 to +113 °F); 2 to 6 bar (29 to 87 psi)
- Data according to calibration protocol ± 5 °C (± 9 °F) and ± 2 bar (± 29 psi)
- Accuracy based on accredited calibration rigs according to ISO 17025

Performance characteristic Promass A

o.r. = of reading; $1 \text{ g/cm}^3 = 1 \text{ kg/l}$; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.

The additional measured error at the current output is typically $\pm 5 \mu\text{A}$.

Design fundamentals → 157.

- Mass flow and volume flow (liquids): $\pm 0.10\%$ o.r.
- Mass flow (gases): $\pm 0.50\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005 \text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005 \text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.02 \text{ g/cm}^3$
(valid over the entire temperature range and density range → 177)
 - Special density calibration: $\pm 0.002 \text{ g/cm}^3$
(optional, valid range: +5 to +80 °C (+41 to +176 °F) and 0.0 to 2.0 g/cm^3)
- Temperature: $\pm 0.5 \text{ °C} \pm 0.005 \cdot T \text{ °C}$; $\pm 1 \text{ °F} \pm 0.003 \cdot (T - 32) \text{ °F}$

Zero point stability

DN		Max. full scale value		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]	[kg/h] or [l/h]	[lb/min]
1	1/24	20	0.73	0.0010	0.000036
2	1/12	100	3.70	0.0050	0.00018
4	1/8	450	16.5	0.0225	0.0008

Example for max. measured error

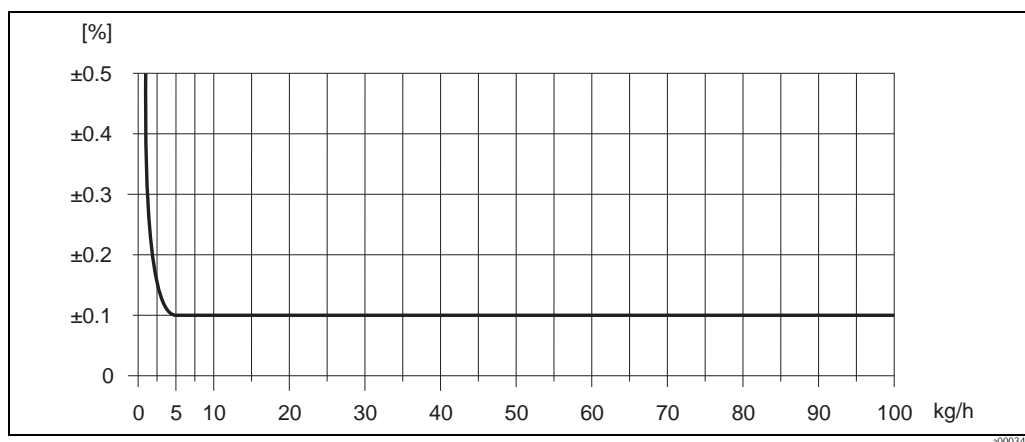


Fig. 61: Max. measured error in % o.r. (example: Promass A, DN 2)

Flow values (example)

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

Design fundamentals → 157

Repeatability

Design fundamentals → 157

- Mass flow and volume flow (liquids): $\pm 0.05\%$ o.r.
- Mass flow (gases): $\pm 0.25\%$ o.r.
- Density (liquids): ± 0.00025 g/cm³
- Temperature: ± 0.25 °C $\pm 0.0025 \cdot T$ °C; ± 0.5 °F $\pm 0.0015 \cdot (T - 32)$ °F

Influence of medium temperature

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

Influence of medium pressure

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

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ Base accuracy in % o.r.
- Flow $<$ Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

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

Performance characteristic
Promass E

o.r. = of reading; $1\text{ g/cm}^3 = 1\text{ kg/l}$; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically $\pm 5\text{ }\mu\text{A}$.
Design fundamentals → 160.

- Mass flow and volume flow (liquids): $\pm 0.25\%$ o.r.
- Mass flow (gases): $\pm 0.75\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005\text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005\text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.02\text{ g/cm}^3$
(valid over the entire temperature range and density range → 177)
- Temperature: $\pm 0.5\text{ }^\circ\text{C} \pm 0.005 \cdot T\text{ }^\circ\text{C}$; $\pm 1\text{ }^\circ\text{F} \pm 0.003 \cdot (T - 32)\text{ }^\circ\text{F}$

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8	0.20	0.0074
15	1/2	0.65	0.0239
25	1	1.80	0.0662
40	1 1/2	4.50	0.1654
50	2	7.00	0.2573
80	3	18.00	0.6615

Example for max. measured error

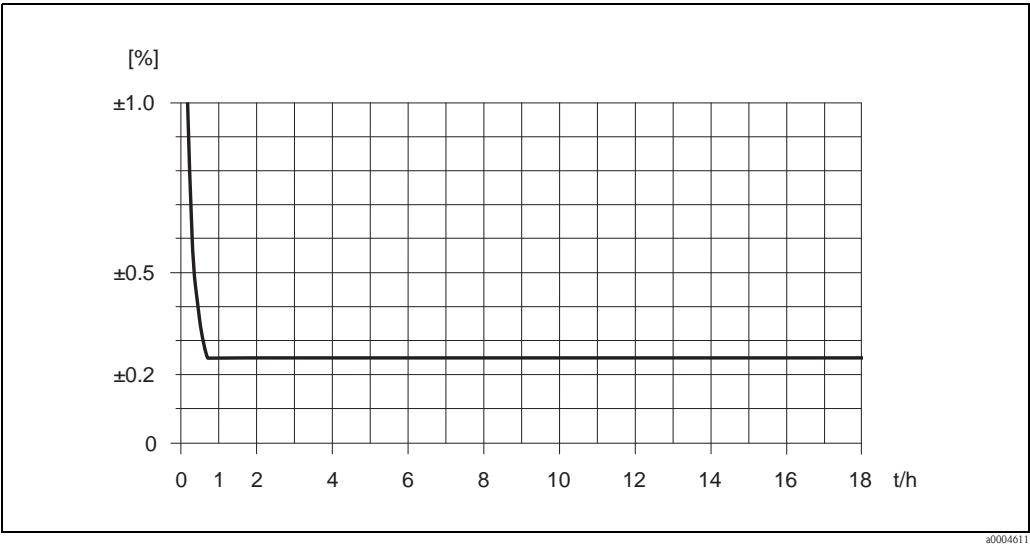


Fig. 62: Max. measured error in % o.r. (example: Promass E, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error [% o.r.]
	[kg/h]	[lb/min]	
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.25
2 : 1	9000	330.75	0.25

Design fundamentals → 160

Repeatability

Design fundamentals → 160

- Mass flow and volume flow (liquids): $\pm 0.10\%$ o.r.
- Mass flow (gases): $\pm 0.35\%$ o.r.
- Density (liquids): ± 0.00025 g/cm³
- Temperature: ± 0.25 °C $\pm 0.0025 \cdot T$ °C; ± 0.5 °F $\pm 0.0015 \cdot (T - 32)$ °F

Influence of medium temperature

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

Influence of medium pressure

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

DN		[% o.r./bar]
[mm]	[inch]	
8	3/8	no influence
15	1/2	no influence
25	1	no influence
40	1 1/2	no influence
50	2	-0.009
80	3	-0.020

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ Base accuracy in % o.r.
- Flow $<$ Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

Base accuracy for	
Mass flow liquids	0.25
Volume flow liquids	0.25
Mass flow gases	0.75

Performance characteristic
Promass F

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

Maximum measured error

The following values refer to the pulse/frequency output.

The additional measured error at the current output is typically $\pm 5 \mu\text{A}$.

Design fundamentals → 162.

- Mass flow and volume flow (liquids):
 - $\pm 0.05\%$ o.r. (PremiumCal, for mass flow)
 - $\pm 0.10\%$ o.r.
- Mass flow (gases): $\pm 0.35\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005 \text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005 \text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.01 \text{ g/cm}^3$
(valid over the entire temperature range and density range → 177)
 - Special density calibration: $\pm 0.001 \text{ g/cm}^3$
(optional, valid range: +5 to +80 °C (+41 to +176 °F) and 0.0 to 2.0 g/cm³)
- Temperature: $\pm 0.5 \text{ °C} \pm 0.005 \cdot T \text{ °C}$; $\pm 1 \text{ °F} \pm 0.003 \cdot (T - 32) \text{ °F}$

Zero point stability Promass F (standard)

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

Zero point stability Promass F (high-temperature version)

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

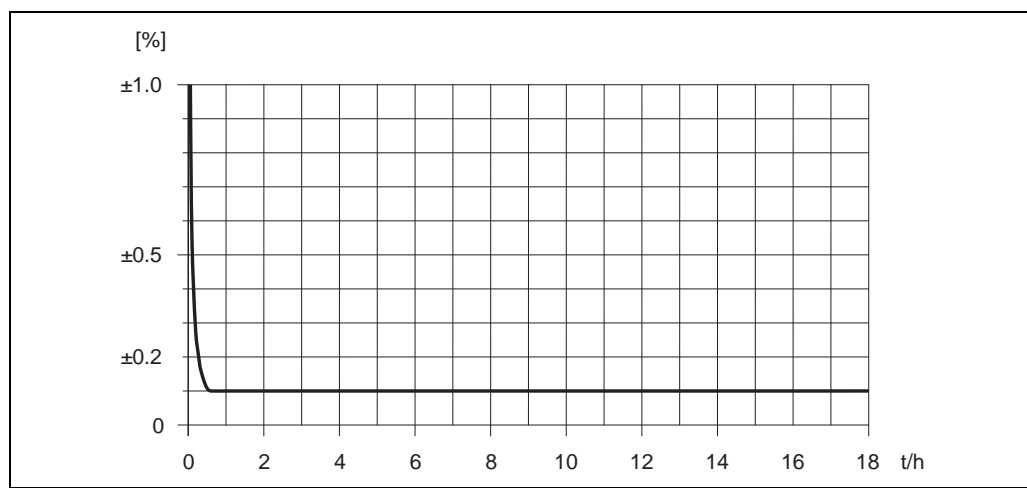
Example for max. measured error

Fig. 63: Max. measured error in % o.r. (example: Promass F, DN 25)

Flow values (example)

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

Design fundamentals → 162

Repeatability

Design fundamentals → 162.

- Mass flow and volume flow (liquids):
 $\pm 0.025\%$ o.r. (PremiumCal, for mass flow)
 $\pm 0.05\%$ o.r.
- Mass flow (gases): $\pm 0.25\%$ o.r.
- Density (liquids): ± 0.00025 g/cm³
- Temperature: ± 0.25 °C $\pm 0.0025 \cdot T$ °C; ± 0.5 °F $\pm 0.0015 \cdot (T - 32)$ °F

Influence of medium temperature

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

Influence of medium pressure

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

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

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm 1/2 \cdot$ Base accuracy in % o.r.
- Flow < Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm 1/2 \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

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

Performance characteristic
Promass H

o.r. = of reading; $1 \text{ g/cm}^3 = 1 \text{ kg/l}$; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.

The additional measured error at the current output is typically $\pm 5 \mu\text{A}$.

Design fundamentals → 165.

- Mass flow and volume flow (liquids)
Zirconium 702/R 60702 and Tantalum 2.5W: $\pm 0.10\%$ o.r.
- Mass flow (gases)
Tantalum 2.5W: $\pm 0.50\%$ o.r.
- Density (liquids)
Zirconium 702/R 60702 and Tantalum 2.5W
 - Reference conditions: $\pm 0.0005 \text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005 \text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.02 \text{ g/cm}^3$
(valid over the entire temperature range and density range → 177)
 - Special density calibration: $\pm 0.002 \text{ g/cm}^3$
(optional, valid range: $+10$ to $+80 \text{ }^\circ\text{C}$ ($+50$ to $+176 \text{ }^\circ\text{F}$) and 0.0 to 2.0 g/cm^3)
- Temperature: $\pm 0.5 \text{ }^\circ\text{C} \pm 0.005 \cdot T \text{ }^\circ\text{C}$; $\pm 1 \text{ }^\circ\text{F} \pm 0.003 \cdot (T - 32) \text{ }^\circ\text{F}$

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8	0.20	0.007
15	1/2	0.65	0.024
25	1	1.80	0.066
40	1 1/2	4.50	0.165
50	2	7.00	0.257

Example for max. measured error

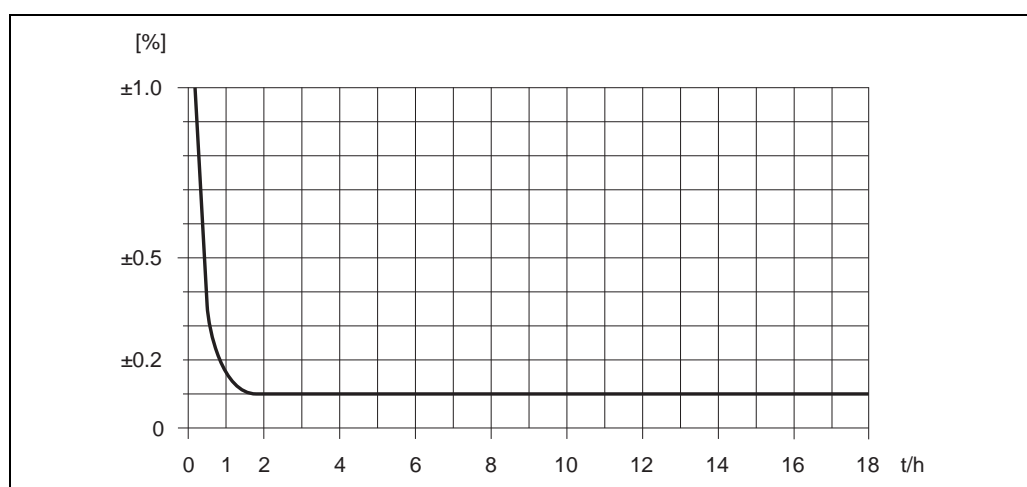


Fig. 64: Max. measured error in % o.r. (example: Promass H, DN 25)

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Flow values (example)

Turn down	Flow		Maximum measured error [% o.r.]
	[kg/h]	[lb/min]	
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.10
2 : 1	9000	330.75	0.10

Design fundamentals → 165

Repeatability

Design fundamentals → 165.

Material measuring tube: Zirconium 702/R 60702

- Mass flow and volume flow (liquids): $\pm 0.05\%$ o.r.
- Density (liquids): $\pm 0.00025 \text{ g/cm}^3$
- Temperature: $\pm 0.25 \text{ }^\circ\text{C} \pm 0.0025 \cdot T \text{ }^\circ\text{C}$; $\pm 0.5 \text{ }^\circ\text{F} \pm 0.0015 \cdot (T - 32) \text{ }^\circ\text{F}$

Material measuring tube: Tantalum 2.5W

- Mass flow and volume flow (liquids): $\pm 0.05\%$ o.r.
- Mass flow (gases): $\pm 0.25\%$ o.r.
- Density (liquids): $\pm 0.0005 \text{ g/cm}^3$
- Temperature: $\pm 0.25 \text{ }^\circ\text{C} \pm 0.0025 \cdot T \text{ }^\circ\text{C}$; $\pm 0.5 \text{ }^\circ\text{F} \pm 0.0015 \cdot (T - 32) \text{ }^\circ\text{F}$

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is $\pm 0.0002\%$ of the full scale value / $^\circ\text{C}$ ($\pm 0.0001\%$ of the full scale value/ $^\circ\text{F}$).

Influence of medium pressure

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

DN		Promass H Zirconium 702/R 60702	Promass H Tantalum 2.5W
[mm]	[inch]	[% o.r./bar]	[% o.r./bar]
8	3/8	-0.017	-0.010
15	1/2	-0.021	-0.010
25	1	-0.013	-0.012
40	1 1/2	-0.018	–
50	2	-0.020	–

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ Base accuracy in % o.r.
- Flow $<$ Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

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

Performance characteristic
Promass Io.r. = of reading; 1 g/cm³ = 1 kg/l; T = medium temperature*Maximum measured error*

The following values refer to the pulse/frequency output.

The additional measured error at the current output is typically $\pm 5 \mu\text{A}$.Design fundamentals \rightarrow 167.

- Mass flow and volume flow (liquids): $\pm 0.10\%$ o.r.
- Mass flow (gases): $\pm 0.50\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005 \text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005 \text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.02 \text{ g/cm}^3$
(valid over the entire temperature range and density range \rightarrow 177)
 - Special density calibration: $\pm 0.004 \text{ g/cm}^3$
(optional, valid range: +10 to +80 °C (+50 to +176 °F) and 0.0 to 2.0 g/cm³)
- Temperature: $\pm 0.5 \text{ °C} \pm 0.005 \cdot T \text{ °C}$; $\pm 1 \text{ °F} \pm 0.003 \cdot (T - 32) \text{ °F}$

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8	0.150	0.0055
15	1/2	0.488	0.0179
15 FB	1/2 FB	1.350	0.0496
25	1	1.350	0.0496
25 FB	1 FB	3.375	0.124
40	1 1/2	3.375	0.124
40 FB	1 1/2 FB	5.250	0.193
50	2	5.250	0.193
50 FB	2 FB	13.50	0.496
80	3	13.50	0.496

FB = Full bore

Example for max. measured error

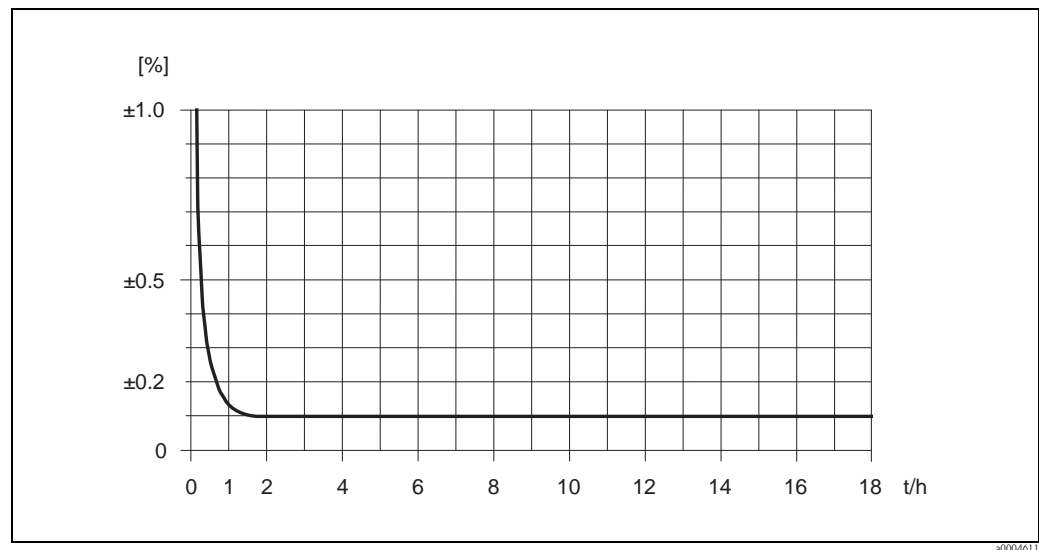


Fig. 65: Max. measured error in % o.r. (example: Promass I, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error
	[kg/h]	[lb/min]	[% o.r.]
250 : 1	72	2.646	1.875
100 : 1	180	6.615	0.750
25 : 1	720	26.46	0.188
10 : 1	1800	66.15	0.100
2 : 1	9000	330.75	0.100

Design fundamentals → 167

Repeatability

Design fundamentals → 167

- Mass flow and volume flow (liquids): $\pm 0.05\%$ o.r.
- Mass flow (gases): $\pm 0.25\%$ o.r.
- Density (liquids): $\pm 0.00025 \text{ g/cm}^3$
- Temperature: $\pm 0.25 \text{ }^\circ\text{C} \pm 0.0025 \cdot T \text{ }^\circ\text{C}$; $\pm 0.5 \text{ }^\circ\text{F} \pm 0.0015 \cdot (T - 32) \text{ }^\circ\text{F}$

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is $\pm 0.0002\%$ of the full scale value / $^\circ\text{C}$ ($\pm 0.0001\%$ of the full scale value / $^\circ\text{F}$).

Influence of medium pressure

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

DN		[% o.r./bar]
[mm]	[inch]	
8	3/8	0.006
15	1/2	0.004
15 FB	1/2 FB	0.006
25	1	0.006
25 FB	1 FB	no influence
40	1 1/2	no influence
40 FB	1 1/2 FB	-0.003
50	2	-0.003
50 FB	2 FB	0.003
80	3	0.003

FB = Full bore

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm 1/2 \cdot$ Base accuracy in % o.r.
- Flow < Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm 1/2 \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

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

Performance characteristic
Promass O

o.r. = of reading; $1 \text{ g/cm}^3 = 1 \text{ kg/l}$; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.

The additional measured error at the current output is typically $\pm 5 \mu\text{A}$.

Design fundamentals \rightarrow 169.

- Mass flow and volume flow (liquids):
 - $\pm 0.05\%$ o.r. (PremiumCal, for mass flow)
 - $\pm 0.10\%$ o.r.
- Mass flow (gases): $\pm 0.35\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005 \text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005 \text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.01 \text{ g/cm}^3$
(valid over the entire temperature range and density range \rightarrow 177)

- Special density calibration: $\pm 0.001 \text{ g/cm}^3$
(optional, valid range: +5 to +80 °C (+41 to +176 °F) and 0.0 to 2.0 g/cm³)
- Temperature: $\pm 0.5 \text{ °C} \pm 0.005 \cdot T \text{ °C}$; $\pm 1 \text{ °F} \pm 0.003 \cdot (T - 32) \text{ °F}$

Zero point stability

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

Example for max. measured error

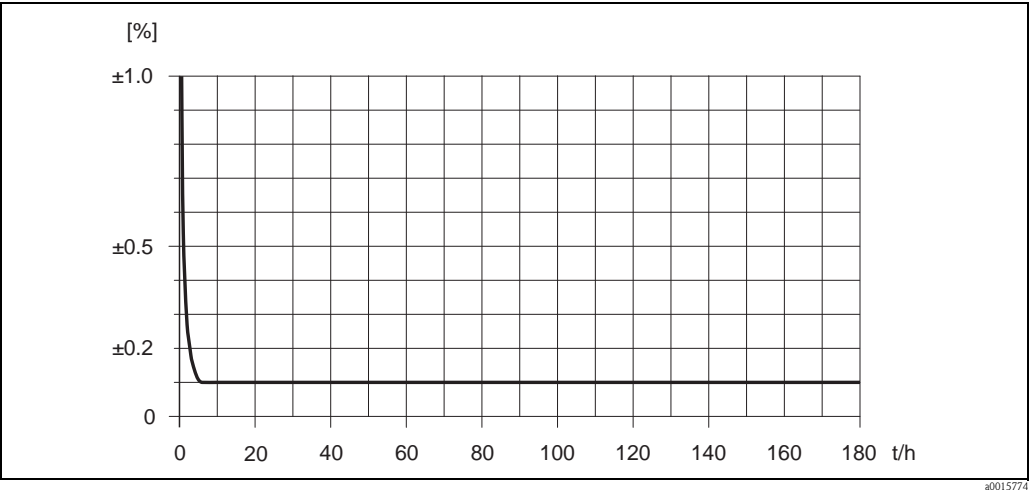


Fig. 66: Max. measured error in % o.r. (example DN 80)

Flow values (example DN 80)

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

Design fundamentals → 169

Repeatability

Design fundamentals → 169.

- Mass flow and volume flow (liquids):
 $\pm 0.025\%$ o.r. (PremiumCal, for mass flow)
 $\pm 0.05\%$ o.r.
- Mass flow (gases): $\pm 0.25\%$ o.r.
- Density (liquids): $\pm 0.00025 \text{ g/cm}^3$
- Temperature: $\pm 0.25 \text{ }^\circ\text{C} \pm 0.0025 \cdot T \text{ }^\circ\text{C}$; $\pm 0.5 \text{ }^\circ\text{F} \pm 0.0015 \cdot (T - 32) \text{ }^\circ\text{F}$

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is $\pm 0.0002\%$ of the full scale value / $^\circ\text{C}$ ($\pm 0.0001\%$ of the full scale value/ $^\circ\text{F}$).

Influence of medium pressure

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

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

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ Base accuracy in % o.r.
- Flow $<$ Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

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

Performance characteristic Promass P

o.r. = of reading; $1 \text{ g/cm}^3 = 1 \text{ kg/l}$; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.

The additional measured error at the current output is typically $\pm 5 \mu\text{A}$.

Design fundamentals → 171.

- Mass flow and volume flow (liquids): $\pm 0.10\%$ o.r.
- Mass flow (gases): $\pm 0.50\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005 \text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005 \text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.01 \text{ g/cm}^3$
(valid over the entire temperature range and density range → 177)
 - Special density calibration: $\pm 0.002 \text{ g/cm}^3$
(optional, valid range: $+5$ to $+80 \text{ }^\circ\text{C}$ ($+41$ to $+176 \text{ }^\circ\text{F}$) and 0.0 to 2.0 g/cm^3)
- Temperature: $\pm 0.5 \text{ }^\circ\text{C} \pm 0.005 \cdot T \text{ }^\circ\text{C}$; $\pm 1 \text{ }^\circ\text{F} \pm 0.003 \cdot (T - 32) \text{ }^\circ\text{F}$

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8	0.20	0.007
15	1/2	0.65	0.024
25	1	1.80	0.066
40	1 1/2	4.50	0.165
50	2	7.00	0.257

Example for max. measured error

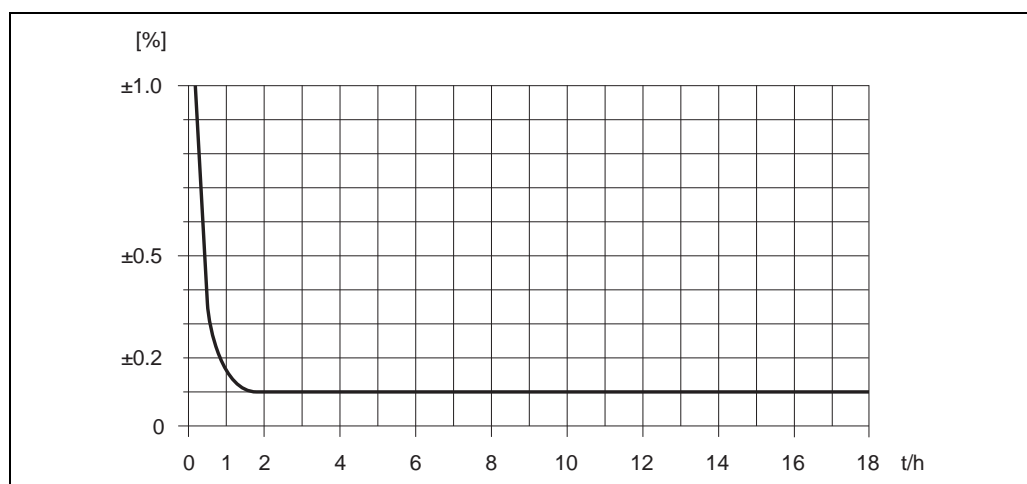


Fig. 67: Max. measured error in % o.r. (example: Promass P, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error [% o.r.]
	[kg/h]	[lb/min]	
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.10
2 : 1	9000	330.75	0.10

Design fundamentals → 171

Repeatability

Design fundamentals → 171.

- Mass flow and volume flow (liquids): $\pm 0.05\%$ o.r.
- Mass flow (gases): $\pm 0.25\%$ o.r.
- Density (liquids): $\pm 0.00025 \text{ g/cm}^3$
- Temperature: $\pm 0.25 \text{ }^\circ\text{C} \pm 0.0025 \cdot T \text{ }^\circ\text{C}$; $\pm 0.5 \text{ }^\circ\text{F} \pm 0.0015 \cdot (T - 32) \text{ }^\circ\text{F}$

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is $\pm 0.0002\%$ of the full scale value / $^\circ\text{C}$ ($\pm 0.0001\%$ of the full scale value / $^\circ\text{F}$).

Influence of medium pressure

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

DN		[% o.r./bar]
[mm]	[inch]	
8	3/8	-0.002
15	1/2	-0.006
25	1	-0.005
40	1 1/2	-0.005
50	2	-0.005

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ Base accuracy in % o.r.
- Flow $<$ Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

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

Performance characteristic Promass S

o.r. = of reading; $1 \text{ g/cm}^3 = 1 \text{ kg/l}$; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.

The additional measured error at the current output is typically $\pm 5 \mu\text{A}$.

Design fundamentals → 173.

- Mass flow and volume flow (liquids): $\pm 0.10\%$ o.r.
- Mass flow (gases): $\pm 0.50\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005 \text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005 \text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.01 \text{ g/cm}^3$
(valid over the entire temperature range and density range → 177)
 - Special density calibration: $\pm 0.002 \text{ g/cm}^3$
(optional, valid range: $+5$ to $+80 \text{ }^\circ\text{C}$ ($+41$ to $+176 \text{ }^\circ\text{F}$) and 0.0 to 2.0 g/cm^3)
- Temperature: $\pm 0.5 \text{ }^\circ\text{C} \pm 0.005 \cdot T \text{ }^\circ\text{C}$; $\pm 1 \text{ }^\circ\text{F} \pm 0.003 \cdot (T - 32) \text{ }^\circ\text{F}$

Zero point stability

DN		Zero point stability	
[mm]	[inch]	[kg/h] or [l/h]	[lb/min]
8	3/8	0.20	0.007
15	1/2	0.65	0.024
25	1	1.80	0.066
40	1 1/2	4.50	0.165
50	2	7.00	0.257

Example for max. measured error

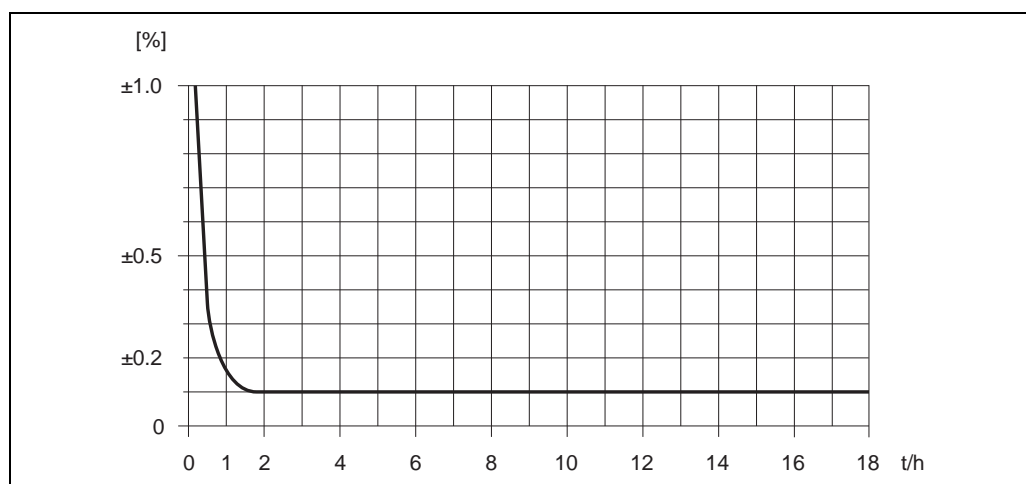


Fig. 68: Max. measured error in % o.r. (example: Promass S, DN 25)

Flow values (example)

Turn down	Flow		Maximum measured error [% o.r.]
	[kg/h]	[lb/min]	
250 : 1	72	2.646	2.50
100 : 1	180	6.615	1.00
25 : 1	720	26.46	0.25
10 : 1	1800	66.15	0.10
2 : 1	9000	330.75	0.10

Design fundamentals → 173

Repeatability

Design fundamentals → 173.

- Mass flow and volume flow (liquids): $\pm 0.05\%$ o.r.
- Mass flow (gases): $\pm 0.25\%$ o.r.
- Density (liquids): $\pm 0.00025 \text{ g/cm}^3$
- Temperature: $\pm 0.25 \text{ °C} \pm 0.0025 \cdot T \text{ °C}$; $\pm 0.5 \text{ °F} \pm 0.0015 \cdot (T - 32) \text{ °F}$

Influence of medium temperature

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

Influence of medium pressure

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

DN		[% o.r./bar]
[mm]	[inch]	
8	3/8	-0.002
15	1/2	-0.006
25	1	-0.005
40	1 1/2	-0.005
50	2	-0.005

Design fundamentals

Dependent on the flow:

- Flow \geq Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm Base accuracy in % o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ Base accuracy in % o.r.
- Flow $<$ Zero point stability \div (Base accuracy \div 100)
 - Max. measured error: \pm (Zero point stability \div measured value) \cdot 100% o.r.
 - Repeatability: $\pm \frac{1}{2} \cdot$ (Zero point stability \div measured value) \cdot 100% o.r.

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

Performance characteristic
Promass X

o.r. = of reading; $1\text{ g/cm}^3 = 1\text{ kg/l}$; T = medium temperature

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically $\pm 5\text{ }\mu\text{A}$.
Design fundamentals → 175.

- Mass flow and volume flow (liquids):
 - $\pm 0.05\%$ o.r. (PremiumCal, for mass flow)
 - $\pm 0.10\%$ o.r.
- Density (liquids)
 - Reference conditions: $\pm 0.0005\text{ g/cm}^3$
 - Field density calibration: $\pm 0.0005\text{ g/cm}^3$
(valid after field density calibration under process conditions)
 - Standard density calibration: $\pm 0.01\text{ g/cm}^3$
(valid over the entire temperature range and density range → 177)
 - Special density calibration: $\pm 0.001\text{ g/cm}^3$
(optional, valid range: $+5\text{ to }+80\text{ }^\circ\text{C}$ ($+41\text{ to }+176\text{ }^\circ\text{F}$) and $0.0\text{ to }2.0\text{ g/cm}^3$)
- Temperature: $\pm 0.5\text{ }^\circ\text{C} \pm 0.005 \cdot T\text{ }^\circ\text{C}$; $\pm 1\text{ }^\circ\text{F} \pm 0.003 \cdot (T - 32)\text{ }^\circ\text{F}$

Zero point stability

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

Example for max. measured error

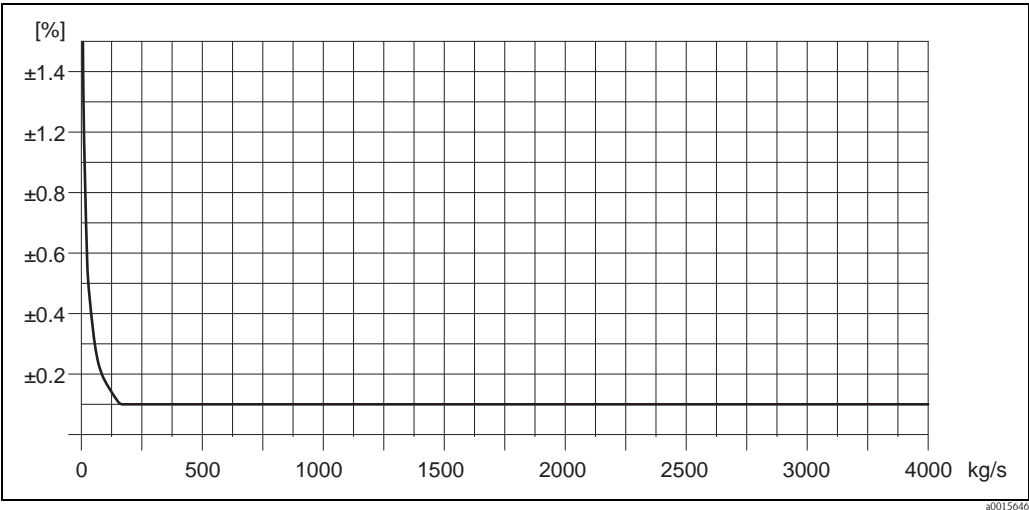


Fig. 69: Max. measured error in % o.r. (example: Promass 83X, DN 350)

Flow values (example)

Turn down	Flow		Maximum measured error [% o.r.]
	[kg/h]	[lb/min]	
500 : 1	8200	1.323	2.1
100 : 1	41 000	6.615	0.4
25 : 1	164 000	26.46	0.1
10 : 1	410 000	66.15	0.1
2 : 1	2 050 000	330.75	0.1

Design fundamentals → 175

Repeatability

Design fundamentals → 175.

- Mass flow and volume flow (liquids):
±0.025% o.r. (PremiumCal, for mass flow)
±0.05% o.r.
- Density (liquids): ±0.00025 g/cm³
- Temperature: ±0.25 °C ± 0.0025 · T °C; ±0.5 °F ± 0.0015 · (T - 32) °F

Influence of medium temperature

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

Influence of medium pressure

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

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

Design fundamentals

Dependent on the flow:

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

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

10.1.7 Operating conditions: Installation

Installation instructions →  14

Inlet and outlet runs There are no installation requirements regarding inlet and outlet runs.

Length of connecting cable max. 20 m (65 ft)

System pressure →  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 60068-2-31

Vibration resistance Acceleration up to 1 g, 10 to 150 Hz, following IEC 60068-2-6

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, P:

–50 to +200 °C (–58 to +392 °F)

Promass F (high-temperature version):

–50 to +350 °C (–58 to +662 °F)

Promass H:

■ Zirconium 702/R 60702: –50 to +200 °C (–58 to +392 °F)

■ Tantalum 2.5W: –50 to +150 °C (–58 to +302 °F)

Promass I, S:

–50 to +150 °C (–58 to +302 °F)

Promass E:

–40 to +140 °C (–40 to +284 °F)

Promass O

–40 to +200 °C (–40 to +392 °F)

Promass X

–50 to +180 °C (–40 to +356 °F)

Seals:

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

No internal seals

Promass A

No seals inlying.

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);

Fluid density range

0 to 5000 kg/m³ (0 to 312 lb/cf)

Limiting medium pressure
range (rated pressure)

The material load diagrams (pressure-temperature diagrams) for the process connections are provided in the separate "Technical Information" document on the 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 in the "Documentation" section →  196.

Pressure ranges of secondary containment:

Promass A:

25 bar (362) psi

Promass E:

No secondary containment

Promass F:

DN 8 to 50 (3/8" to 2"): 40 bar (580 psi)

DN 80 (3"): 25 bar (362 psi)

DN 100 to 150 (4" to 6"): 16 bar (232 psi)

DN 250(10"): 10 bar (145 psi)

Promass H:

■ Zirconium 702/R 60702:

DN 8 to 15 (3/8" to 1/2"): 25 bar (362 psi)

DN 25 to 50 (1" to 2"): 16 bar (232 psi)

■ Tantalum 2.5W:

DN 8 to 25 (3/8" to 1"): 25 bar (362 psi)

DN 40 to 50 (1 1/2" to 2"): 16 bar (232 psi)

Promass I:

40 bar (580 psi)

Promass P:

DN 8 to 25 (3/8" to 1"): 25 bar (362 psi)

DN 40 (1 1/2"): 16 bar (232 psi)

DN 50 (2"): 10 bar (145 psi)

Promass S:

DN 8 to 40 (3/8" to 1 1/2"): 16 bar (232 psi)

DN 50 (2"): 10 bar (145 psi)

Promass O:

16 bar (232 psi)

Promass X:

Type approved, maximum allowable pressure according to ASME BPVC: 6 bar (87 psi)

Limiting flow

See the "Measuring range" section → Page 101 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 → 151

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, E

Reynolds number	$Re = \frac{2 \cdot \dot{m}}{\pi \cdot d \cdot v \cdot \rho}$ a0004623
Re ≥ 2300 ¹⁾	$\Delta p = K \cdot v^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$ a0004626
	Promass F DN 250 $\Delta p = K \cdot \left[1 - a + \frac{a}{e^{b \cdot (v - 10^{-6})}} \right] \cdot v^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$ a0012135
Re < 2300	$\Delta p = K1 \cdot v \cdot \dot{m} + \frac{K2 \cdot v^{0.25} \cdot \dot{m}^2}{\rho}$ a0004628
Δp = pressure loss [mbar] v = kinematic viscosity [m ² /s] \dot{m} = mass flow [kg/s] ρ = fluid density [kg/m ³] d = inside diameter of measuring tubes [m] K to $K2$ = constants (depending on nominal diameter) $a = 0.3$ $b = 91000$	
¹⁾ To compute the pressure loss for gases, always use the formula for Re ≥ 2300.	

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

Reynolds number	$Re = \frac{4 \cdot \dot{m}}{\pi \cdot d \cdot v \cdot \rho}$ a0003381
Re ≥ 2300 ¹⁾	$\Delta p = K \cdot v^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75} + \frac{K3 \cdot \dot{m}^2}{\rho}$ a0004631
Re < 2300	$\Delta p = K1 \cdot v \cdot \dot{m} + \frac{K3 \cdot \dot{m}^2}{\rho}$ a0004633
Δp = pressure loss [mbar] v = kinematic viscosity [m ² /s] \dot{m} = mass flow [kg/s] ρ = fluid density [kg/m ³] d = inside diameter of measuring tubes [m] K to $K3$ = constants (depending on nominal diameter)	
¹⁾ To compute the pressure loss for gases, always use the formula for Re ≥ 2300.	

Pressure loss formulas for Promass A

Reynolds number	$\text{Re} = \frac{4 \cdot \dot{m}}{\pi \cdot d \cdot v \cdot \rho}$ a0003381
$\text{Re} \geq 2300^{1)}$	$\Delta p = K \cdot v^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75}$ a0003380
$\text{Re} < 2300$	$\Delta p = K1 \cdot v \cdot \dot{m}$ a0003379
Δp = pressure loss [mbar] v = kinematic viscosity [m ² /s] \dot{m} = mass flow [kg/s] ρ = density [kg/m ³] d = inside diameter of measuring tubes [m] K to $K1$ = constants (depending on nominal diameter) ¹⁾ To compute the pressure loss for gases, always use the formula for $\text{Re} \geq 2300$.	

Pressure loss formulas for Promass O, X

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

Pressure loss coefficient for Promass F

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

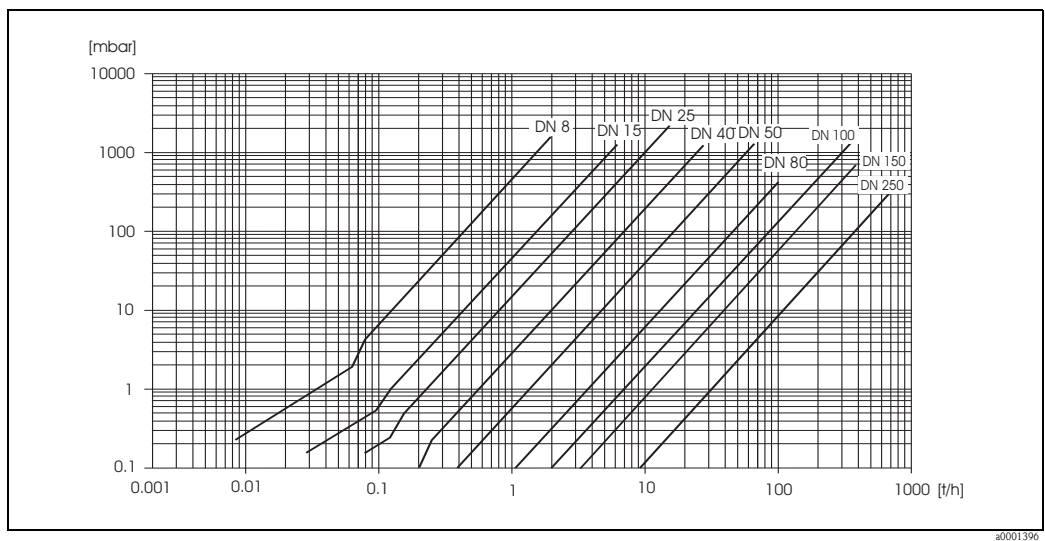


Fig. 70: Pressure loss diagram for water

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	$26.00 \cdot 10^{-3}$	$8.54 \cdot 10^4$	$4.02 \cdot 10^5$	$2.31 \cdot 10^4$
80	$40.50 \cdot 10^{-3}$	$1.44 \cdot 10^4$	$5.00 \cdot 10^4$	$2.30 \cdot 10^4$

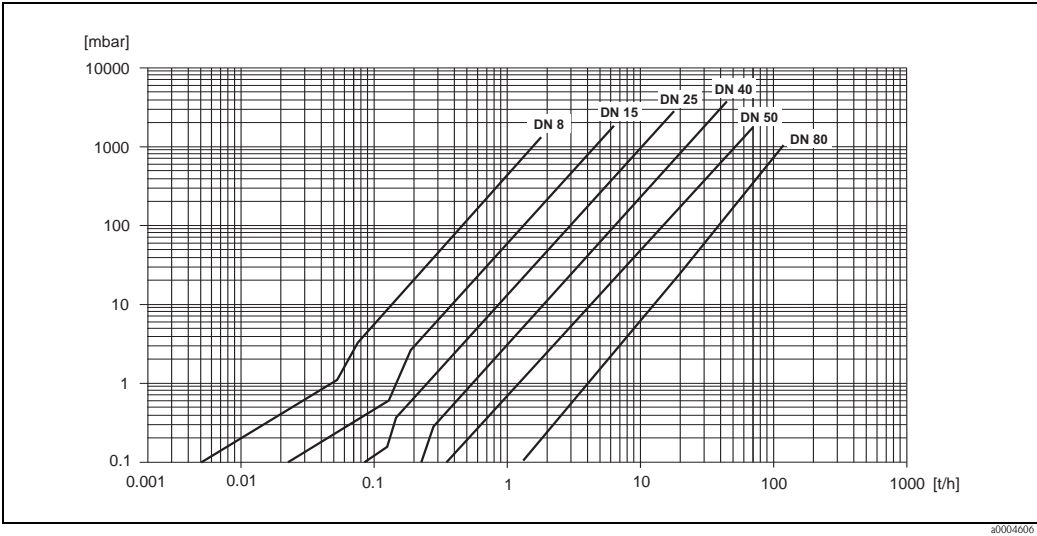


Fig. 71: Pressure loss diagram for water

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	$3.0 \cdot 10^{-3}$	$2.0 \cdot 10^9$	$4.3 \cdot 10^9$

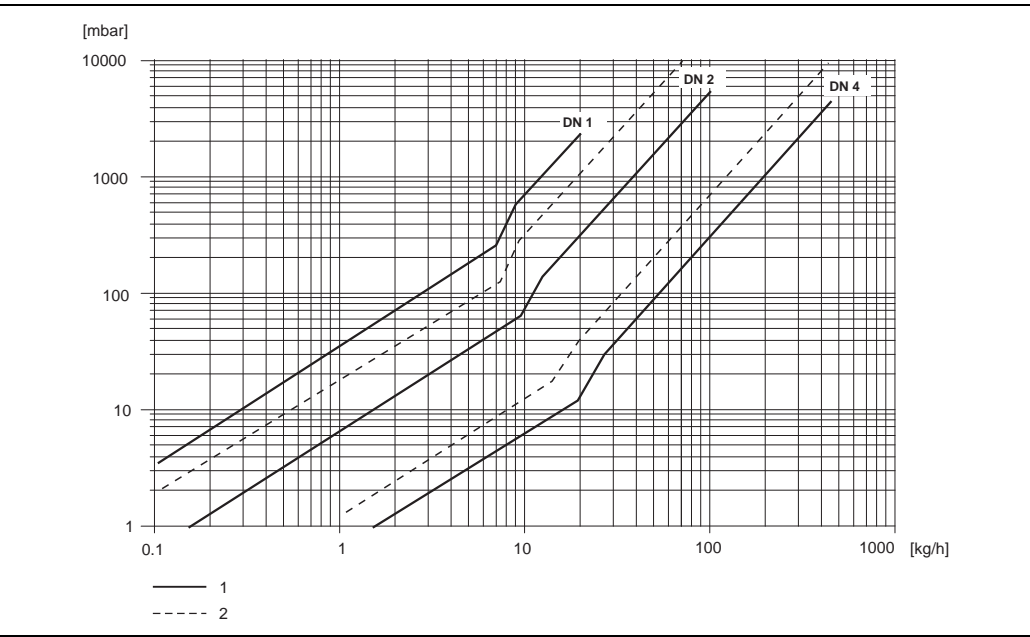


Fig. 72: Pressure loss diagram for water

- 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	$40.5 \cdot 10^{-3}$	$1.35 \cdot 10^4$	$1.72 \cdot 10^5$	$1.20 \cdot 10^3$
Pressure loss data includes interface between measuring tube and piping				

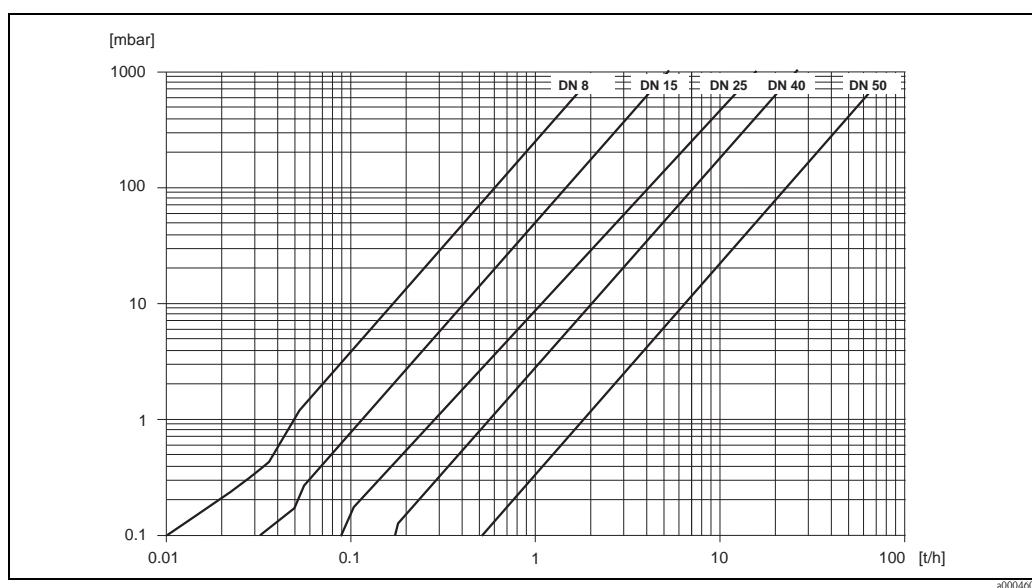


Fig. 73: Pressure loss diagram for water

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 ¹⁾	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^5$	$3.3 \cdot 10^6$	$0.01 \cdot 10^4$
25	$17.07 \cdot 10^{-3}$	$4.1 \cdot 10^5$	$3.3 \cdot 10^6$	$5.89 \cdot 10^4$
25 ¹⁾	$26.4 \cdot 10^{-3}$	$7.8 \cdot 10^4$	$8.5 \cdot 10^5$	$0.11 \cdot 10^4$
40	$26.4 \cdot 10^{-3}$	$7.8 \cdot 10^4$	$8.5 \cdot 10^5$	$1.19 \cdot 10^4$
40 ¹⁾	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^4$	$2.0 \cdot 10^5$	$0.08 \cdot 10^4$
50	$35.62 \cdot 10^{-3}$	$1.3 \cdot 10^4$	$2.0 \cdot 10^5$	$0.25 \cdot 10^4$
50 ¹⁾	$54.8 \cdot 10^{-3}$	$2.3 \cdot 10^3$	$5.5 \cdot 10^4$	$1.0 \cdot 10^2$
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

¹⁾ DN 15, 25, 40, 50 "FB" = Full bore versions of Promass I

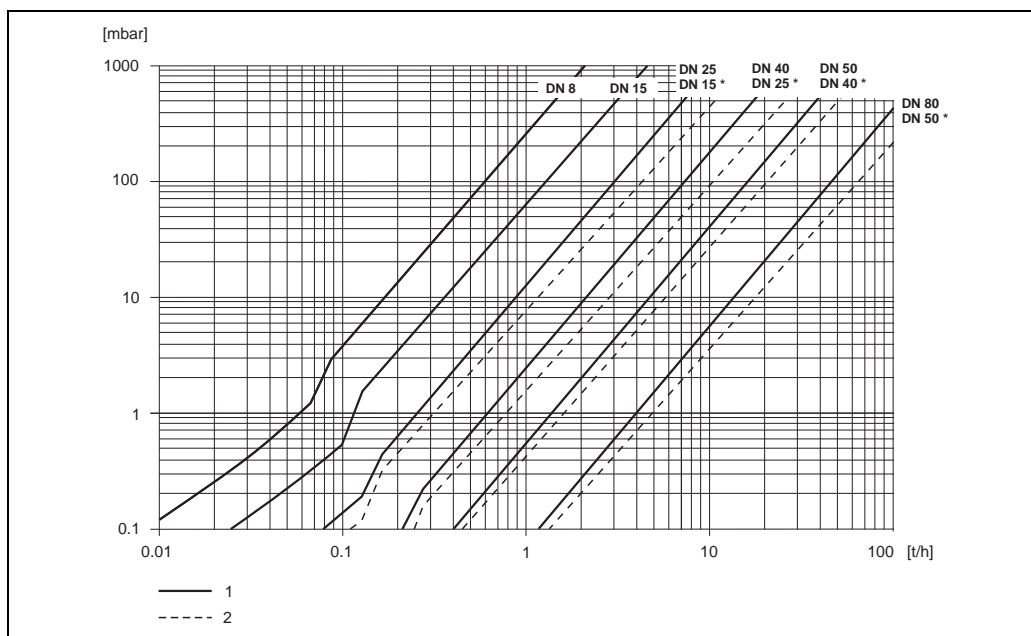


Fig. 74: Pressure loss diagram for water

- 1 Standard versions
- 2 Full bore versions (*)

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				

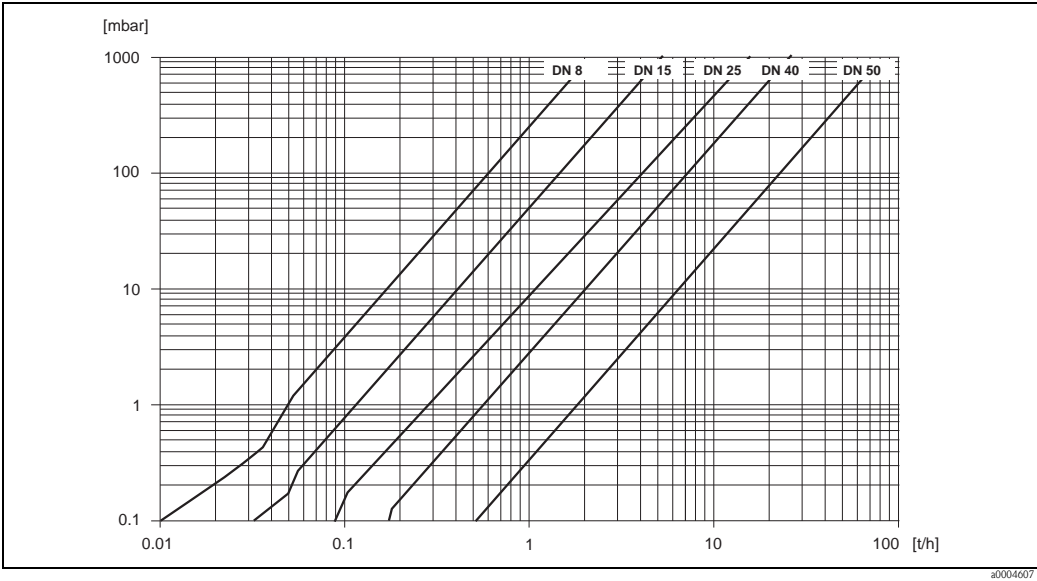


Fig. 75: Pressure loss diagram for water

Pressure loss coefficient for Promass O

DN		d[mm]	A ₀	A ₁	A ₂	A ₃
[mm]	[inch]					
80	3"	38.5	0.72	4.28	− 0.36	0.24
100	4"	49.0	0.70	3.75	− 0.35	0.22
150	6"	66.1	0.75	2.81	− 0.33	0.19

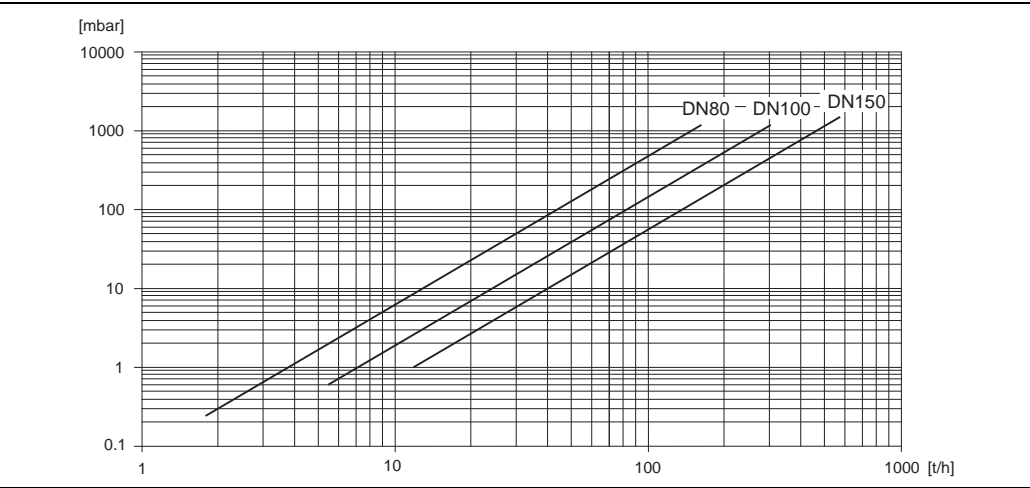


Fig. 76: Pressure loss diagram for water

Pressure loss coefficient for Promass X

DN		d[mm]	A ₀	A ₁	A ₂	A ₃
[mm]	[inch]					
350	14"	102.3	0.76	3.80	− 0.33	0.23

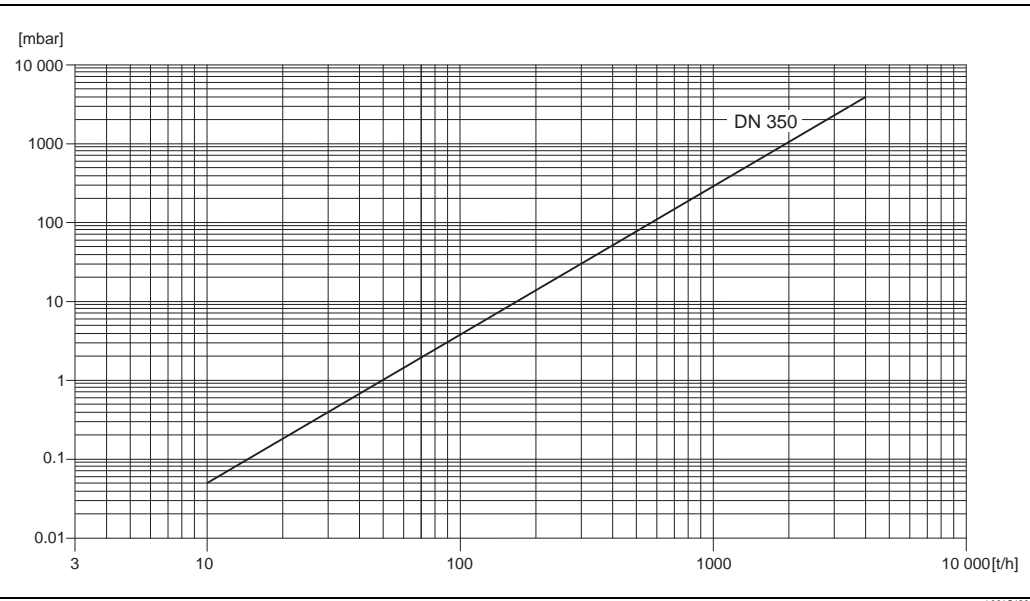


Fig. 77: Pressure loss diagram for water


Pressure loss (US units)

Pressure loss is dependent on fluid properties nominal diameter. Consult Endress+Hauser for Applicator PC software to determine pressure loss in US units. All important instrument data is contained in the Applicator software program in order to optimize the design of 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 in the "Documentation" section →  196.

Weight

- Compact version: see table below
- Remote version
 - Sensor: see table below
 - Wall-mount housing: 5 kg (11 lb)

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

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 E / DN	8	15	25	40	50	80
Compact version	8	8	10	15	22	31
Remote version	6	6	8	13	20	29

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	38	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

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

¹⁾ with Cl 900 flanges according to ASME

Promass X / DN ¹⁾	350
Compact version	555
Remote version	553

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

Weight (US units)

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

Promass F / DN	3/8"	1/2"	1"	1 1/2"	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 E / DN	3/8"	1/2"	1	1 1/2"	2"	3"
Compact version	18	18	22	33	49	69
Remote version	13	13	18	29	44	64

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

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

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

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

¹⁾ with Cl 900 flanges according to ASME

Promass X / DN ¹⁾	350
Compact version	1224
Remote version	1219

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

Material

Transmitter housing:

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

Sensor housing / containment:

Promass F:

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

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

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

Promass X, O:

- Acid- and alkali-resistant outer surface
- Stainless steel 1.4404/316L

Connection housing, sensor (remote version):

- Stainless steel 1.4301/304 (standard, not Promass X)
- 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 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 EN 1092-1 (DIN 2501) / ASME B16.5 / JIS B2220
→ stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022.
Loose flanges → stainless steel 1.4404/316L
- VCO coupling → stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022
- Tri-Clamp (OD-tubes) (1/2") → stainless steel 1.4539/904L
- 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, 1.4539/904L, Alloy C-22 2.4602/N 06022

Promass H:

- Flanges EN 1092-1 (DIN 2501) / according to ASME B16.5 / JIS B2220
→ stainless steel 1.4301/304, parts in contact with medium: zirconium 702/R 60702 or tantalum 2.5W

Promass I:

- Flanges 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 connection DIN 11851 / SMS 1145 → titanium grade 2
- Threaded hygienic connection ISO 2853 / DIN 11864-1 → titanium grade 2
- Tri-Clamp (OD-tubes) → titanium grade 2

Promass S:

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

Promass O:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 → stainless steel 25Cr duplex F53/EN 1.4410 (superduplex)

Promass X:

- Flanges according to EN 1092-1 (DIN 2501) / according to ASME B16.5 → stainless steel 1.4404/316/316L

Measuring tube(s):*Promass F:*

- DN 8 to 100 (3/8" to 4"): stainless steel 1.4539/904L; manifold: 1.4404/316L
- DN 150 (6"): stainless steel 1.4404/316L/1.4432
- DN 250 (10"): stainless steel 1.4404/316L/1.4432; 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 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
- Tantalum 2.5W

Promass I:

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

Promass P:

Stainless steel 1.4435/316L

Promass O:

- Stainless steel 25Cr Duplex EN 1.4410/UNS S32750 (superduplex)

Promass X:

- Stainless steel 1.4404/316/316L; manifold: 1.4404/316/316L

Seals:


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

Welded process connections without internal seals

Promass A:

Welded process connections without internal seals.




Only for mounting sets with threaded connections: Viton, EPDM, Silikon, 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 in the "Documentation" section →  196.
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Process connections	→ Page 138 ff.
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10.1.11 Operability

Display elements	<ul style="list-style-type: none"> ■ Liquid crystal display: illuminated, four lines with 16 characters per line ■ Selectable display of different measured values and status variables ■ At ambient temperatures below -20 °C (-4 °F) the readability of the display may be impaired.
------------------	---

Operating elements	<ul style="list-style-type: none"> ■ Local operation with three optical sensors (//) ■ Application-specific Quick Setup menus for straightforward commissioning
--------------------	--

Language groups	<p>Language groups available for operation in different countries:</p> <ul style="list-style-type: none"> ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech. ■ South and East Asia (SEA): English, Japanese, Indonesian ■ China (CN): English, Chinese
-----------------	--



Note!

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

10.1.12 Certificates and approvals

CE mark	The measuring system 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	<ul style="list-style-type: none"> ■ 3A authorization (all measuring systems, except Promass H, O and X) ■ EHEDG-tested (all measuring systems, except Promass E, H, O and X)
PROFIBUS DP/PA certification	<p>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:</p> <ul style="list-style-type: none"> ■ Certified in accordance with PROFIBUS Profile Version 3.0 (device certification number: available on request) ■ The measuring device can also be operated with certified devices of other manufacturers (interoperability).
Pressure measuring device approval	<p>The measuring devices can be ordered with or without PED (Pressure Equipment Directive). If a device with PED is required, this must be ordered explicitly. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary.</p> <ul style="list-style-type: none"> ■ With the identification PED/G1/III on the sensor nameplate, Endress+Hauser confirms conformity with the "Basic safety requirements" of Appendix I of the Pressure Equipment Directive 97/23/EC. ■ Devices with this identification (with PED) are suitable for the following types of fluid: <ul style="list-style-type: none"> – Fluids of Group 1 and 2 with a steam pressure of greater or less than 0.5 bar (7.3 psi) – Unstable gases ■ Devices without this identification (without PED) are designed and manufactured according to good engineering practice. They correspond to the requirements of Art. 3, Section 3 of the Pressure Equipment Directive 97/23/EC. Their application is illustrated in Diagrams 6 to 9 in Appendix II of the Pressure Equipment Directive 97/23/EC.
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 Endress+Hauser 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 Endress+Hauser, are available for the transmitter and the sensor →  122.

10.1.15 Supplementary Documentation

- Flow measuring technology (FA00005D)
- Description of Device Functions Promass 83 (BA00073D)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, IECEx NEPSI
- Technical Information
 - Promass 80A, 83A (TI00054D)
 - Promass 80E, 83E (TI00061D)
 - Promass 80F, 83F (TI00101D)
 - Promass 80H, 83H (TI00074D)
 - Promass 80I, 83I (TI00075D)
 - Promass 80P, 83P (TI00078D)
 - Promass 80S, 83S (TI00076D)
 - Promass 83O (TI00112D)
 - Promass 83X (TI00110D)

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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] _____ [mm²/s]**Medium and warnings**

Warnhinweise zum Medium



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

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

* explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv

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

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

Description of failure / Fehlerbeschreibung**Company data / Angaben zum Absender**

Company / Firma _____	Phone number of contact person / Telefon-Nr. Ansprechpartner: _____
Address / Adresse _____	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

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