Operating Instructions

Proline Prowirl 72

Vortex Flow Measuring System
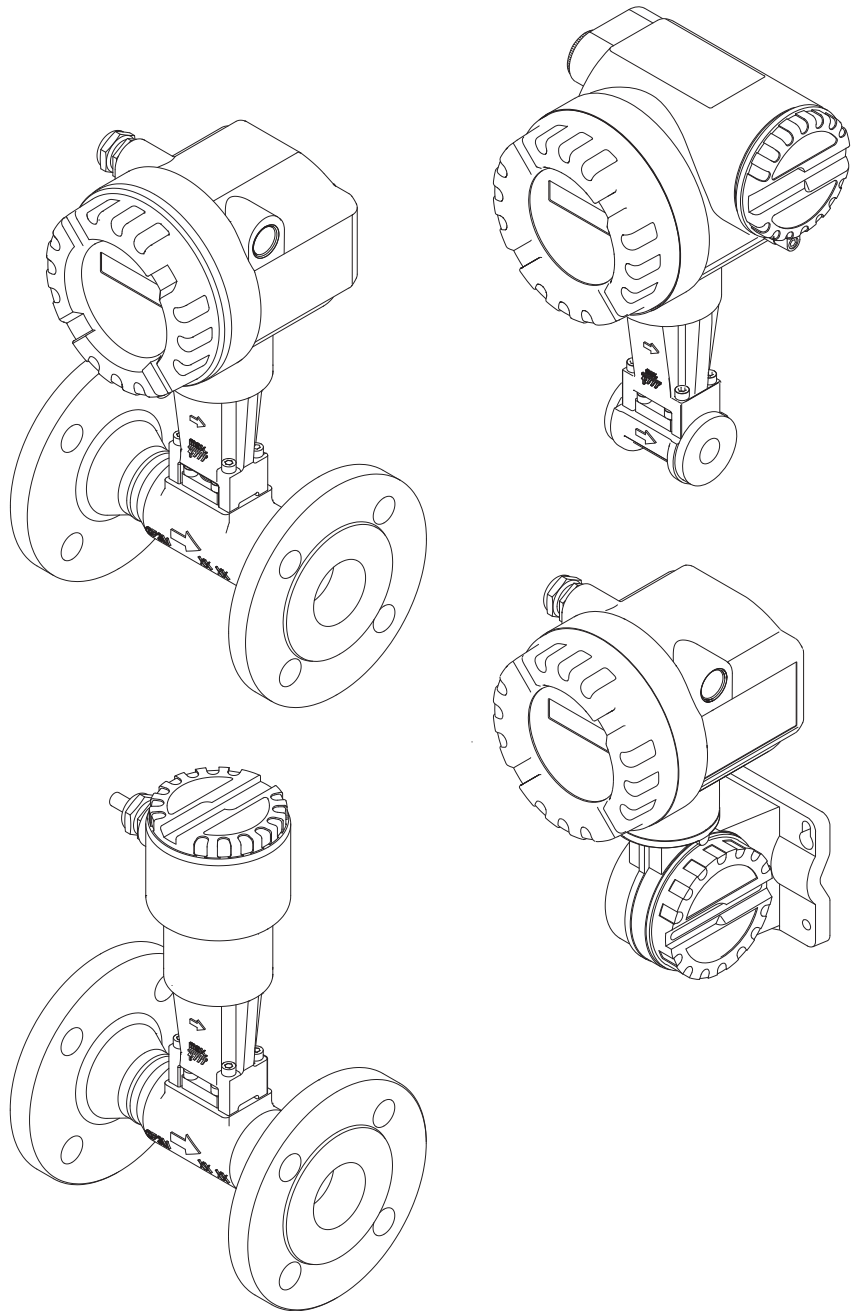
Fieldbus™
Foundation

Endress+Hauser

People for Process Automation

Contents

1 Safety instructions

1.1 Designated use

The measuring system is used to measure the volume flow of saturated steam, superheated steam, gases and liquids. If the process pressure and process temperature are constant, the measuring device can also output the flow as the calculated mass flow or corrected volume flow.

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 resulting from this.

1.2 Installation, commissioning and operation

Note the following points:
- Installation, electrical installation, 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 these Operating Instructions is mandatory.
- Endress+Hauser is willing to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However, small changes in temperature, concentration or the degree of contamination in the process can result in changes 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.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams.
- Invariably, local regulations governing the operation, maintenance and repair of electrical devices apply. Special instructions relating to the device can be found in the relevant sections of the documentation.

1.3 Operational safety

Note the following points:
- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an *integral part* of these Operating Instructions. Strict compliance with the installation instructions and ratings as listed in this supplementary documentation is mandatory. The symbol on the front of the Ex documentation indicates the approval and the certification center (ⓔ Europe, ⓕ USA, ⓖ Canada).
- The measuring system complies with the general safety requirements in accordance with EN 61010-1 and the EMC requirements of IEC/EN 61326 and NAMUR Recommendations NE 21, NE 43 and NE 53.
- 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

The following procedures must be carried out before a flowmeter requiring repair or calibration, for example, is returned to Endress+Hauser:

- Always enclose a fully completed "Declaration of Contamination" form with the device. 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 European Directive 1907/2006/EG.
- Remove all fluid residues. Pay special attention to the grooves for seals and crevices which could contain fluid residues.
  This is particularly important if the fluid is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
A *copy* of the "Declaration of Contamination" can be found at the end of these Operating Instructions.

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

1. 5   Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested and left the factory in a condition in which they are safe to operate.
The devices comply with the applicable standards and regulations in accordance with EN 61010-1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". They 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 symbols:

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

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

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

2   Identification

2. 1   Device designation

The "Proline Prowirl 72 FOUNDATION Fieldbus" flowmeter system consists of the following components:

- Transmitter Proline Prowirl 72 FOUNDATION Fieldbus
- Prowirl F or Prowirl W sensor

In the *compact version*, the transmitter and sensor form a mechanical unit; in the *remote version* they are mounted separate from one another.

2.1.1   Nameplate of the transmitter/sensor
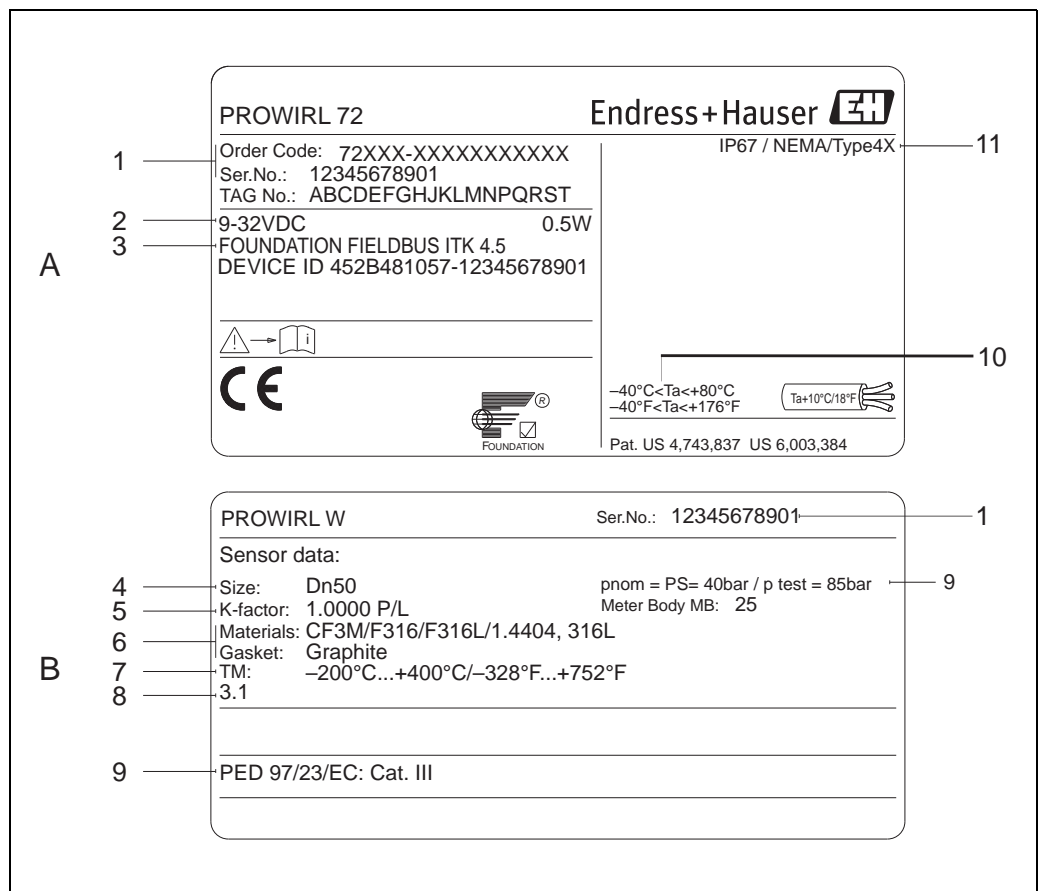
Fig. 1:   *Nameplate specifications for transmitter and sensor (example)*
                   A = Nameplate on transmitter, B = nameplate on sensor (only compact version)

*1   Order code / serial number: see the specifications on the order confirmation for the meanings of the individual
        letters and digits.*
2   Power supply: 9 to 32 V DC, power consumption: 1.2 W
*3   FOUNDATION Fieldbus: equipped with FOUNDATION Fieldbus H1 interface
        ITK 4.5: certified by the Fieldbus Foundation; Interoperability Test Kit, revision status 4.5
        DEVICE ID: FOUNDATION Fieldbus device identifier*
4   Nominal diameter
5   Calibration factor
6   Material sensor and gasket
7   Fluid temperature range
8   Reserved for information on special products
9   Data regarding Pressure Equipment Directive (optional)
10   Permitted ambient temperature range
11   Degree of protection

2.1.2   Sensor nameplate, remote version
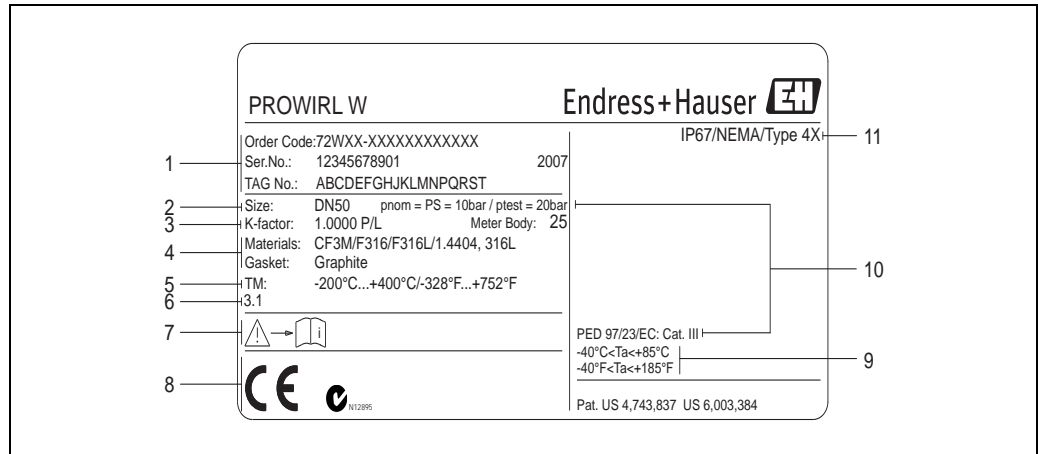
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Fig. 2:   Nameplate specifications for transmitter, remote version (example)

1   Order code / serial number: see the specifications on the order confirmation for the meanings of the individual letters and digits.
2   Nominal diameter
3   Calibration factor
4   Material sensor and gasket
5   Medium temperature range
6   Reserved for information on special products
7   Permitted ambient temperature range
8   Data regarding Pressure Equipment Directive (optional)
9   Degree of protection

2.1.3   Service nameplate
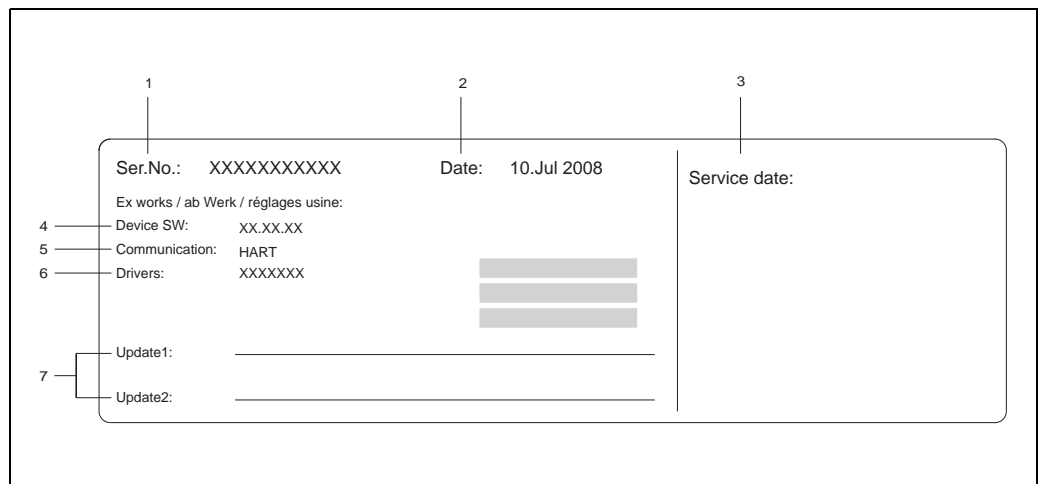
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Fig. 3:   Service nameplate specifications for Prowirl 72 transmitter (example)

1   Serial number
2   Date of manufacture
3   Date of servicing
4   Device software
5   Type of device communication (e.g. FOUNDATION Fieldbus)
6   Revision number
7   Space for update entries

2. 2   Certificates and approvals

The devices are designed to meet state–of–the–art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010–1"Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and the EMC requirements as per IEC/EN 61326.
The measuring system described in these Operating Instructions therefore complies with the legal requirements of the EU Directives. Endress+Hauser confirms this by affixing the CE mark to it and by issuing the CE declaration of conformity.
The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

2. 3   Registered trademarks

GYLON$^{®}$
Registered trademark of Garlock Sealing Technologies, Palmyar, NY, USA

FOUNDATION Fieldbus$^{®}$
Registered trademark of Fieldbus Foundation, Austin, USA

INCONEL$^{®}$
Registered trademark of Inco Alloys International Inc., Huntington, USA

KALREZ$^{®}$, VITON$^{®}$
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

Fieldcheck$^{®}$, Applicator$^{®}$, FieldCare$^{®}$
Registered or registration–pending trademarks of Endress+Hauser Flowtec AG, Reinach, Switzerland

3 Installation

3.1 Incoming acceptance, transport, 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

Please note the following when unpacking or transporting to the measuring point:

- The devices must be transported in the container supplied.
- Devices with nominal diameter DN 40 to 300 (1½ to 12") may not be lifted at the transmitter housing or at the connection housing of the remote version when transporting (see Fig. 4). Use carrier slings when transporting and put the slings around both process connections. Avoid chains as these could damage the housing.

⚠ Warning!
Risk of injury if the measuring device slips.
The center of gravity of the entire measuring device might be higher than the points around which the slings are slung. Therefore, when transporting, make sure that the device does not unintentionally turn or slip.
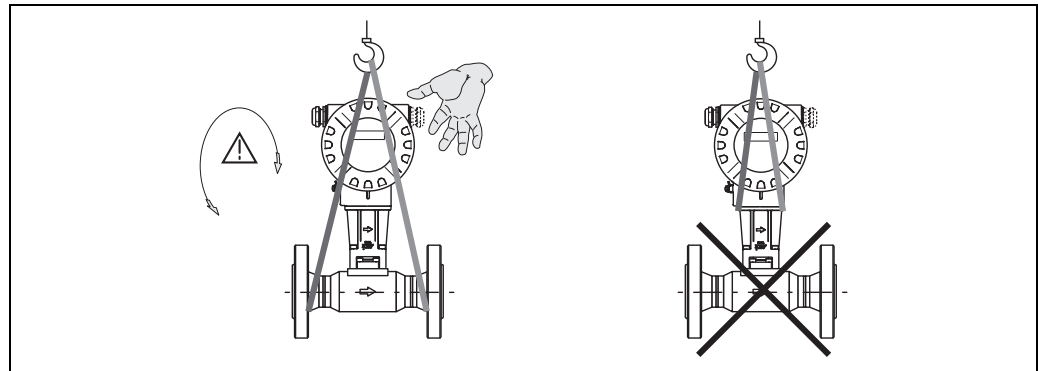
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Fig. 4:   Instructions for transporting sensors with DN 40 to 300 (1½ to 12")

3.1.3 Storage

Note the following points:

- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permissible storage temperature is:
  - Standard: –40 to +80 °C (–40 to +176 °F)
  - ATEX II 1/2 GD version/dust ignition-proof: –20 to +55 °C (–4 to +131 °F)
- When in storage, the device should not be exposed to direct sunlight in order to avoid impermissibly high surface temperatures.

3.2   Installation conditions

Note the following points:

- The measuring device requires a fully developed flow profile as a prerequisite for correct volume flow measurement. The inlet and outlet runs must be taken into account (see Page 14).
- The maximum permitted ambient temperatures (see Page 67) and fluid temperatures (see Page 68) must be observed.
- Pay particular attention to the notes on orientation and piping insulation (see Page 12).
- Verify that the correct nominal diameter and pipe standard (DIN/JIS/ANSI) were taken into account when ordering since the calibration of the device and the achievable accuracy depend on these factors. If the mating pipe and the device have different nominal diameters/pipe standards, an inlet correction can be made via the device software by entering the actual pipe diameter (see "Process Param. – Mating Pipe Diameter" parameter on Page 96).
- The correct operation of the measuring system is not influenced by plant vibrations up to 1 g, 10 to 500 Hz.
- For mechanical reasons, and in order to protect the piping, it is advisable to support heavy sensors. For weight information, please refer to Technical Information TI070D/06/en.

3.2.1   Dimensions

The dimensions and lengths of the sensor and transmitter can be found in the Technical Information TI070D/06/en.

3.2.2   Installation location

We recommend you observe the following dimensions to guarantee problem-free access to the device for service purposes:
- Minimum spacing (A) in all directions = 100 mm (3.94 inch)
- Necessary cable length (L): L + 150 mm (L + 5.91 inch).
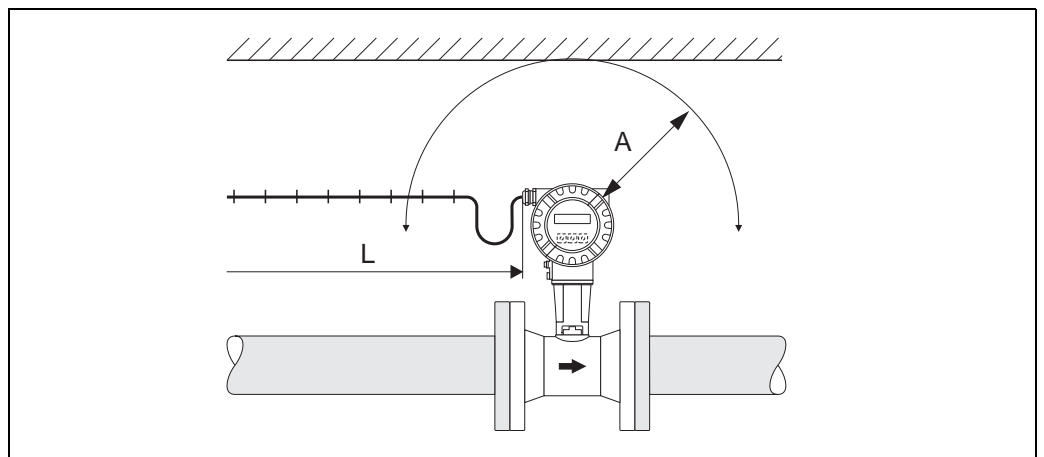
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Fig. 5:   A = Minimum spacing in all directions, L = cable length

3.2.3 Orientation

The device can be installed basically in any orientation. Please consider the following, however (Fig. 6):

- In the case of liquids, there should be upward flow in vertical pipes to avoid partial pipe filling (see orientation A).
- The arrow on the meter body has to point in flow direction.
- In order to make sure that the maximum ambient temperature (see Page 67) is not exceeded, we recommend the following orientations:
  - In the case of hot fluids (e.g. steam or fluid temperature ≥ 200 °C/≥ 392 °F), select orientation C or D.
  - Orientations B and D are recommended for very cold fluids (e.g. liquid nitrogen).

Caution!

- If fluid temperature is ≥ 200 °C (≥ 392 °F), orientation B is **not** permitted for the wafer version (Prowirl 72 W) with a nominal diameter of DN 100 (4") and DN 150 (6").
- In case of vertical orientation and downward flowing liquid, the piping has always to be completely filled.
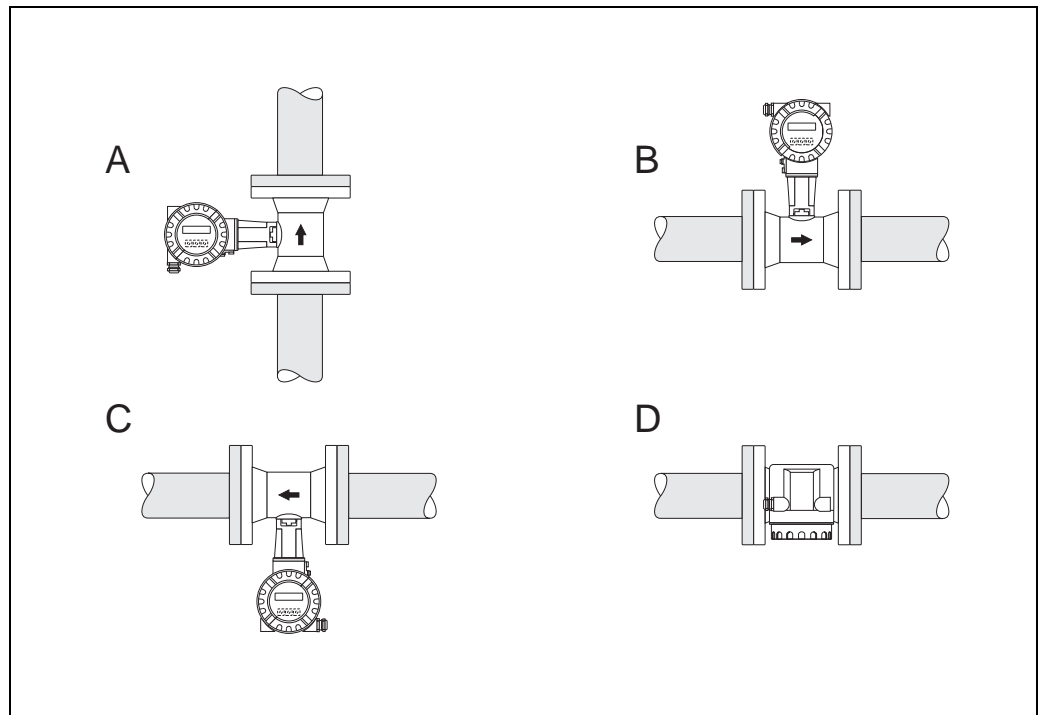
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Fig. 6:   Possible orientations of the device

High fluid temperature:
– horizontal piping: orientation C or D
– vertical piping: orientation A

Low fluid temperature:
– horizontal piping: orientation B or D
– vertical piping: orientation A

3.2.4   Heat insulation

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

When insulating, please ensure that a sufficiently large area of the housing support is exposed. The uncovered part serves as a radiator and protects the electronics from overheating (or undercooling). The maximum insulation height permitted is illustrated in the Fig. 7. These apply equally to both the compact version and the sensor in the remote version.
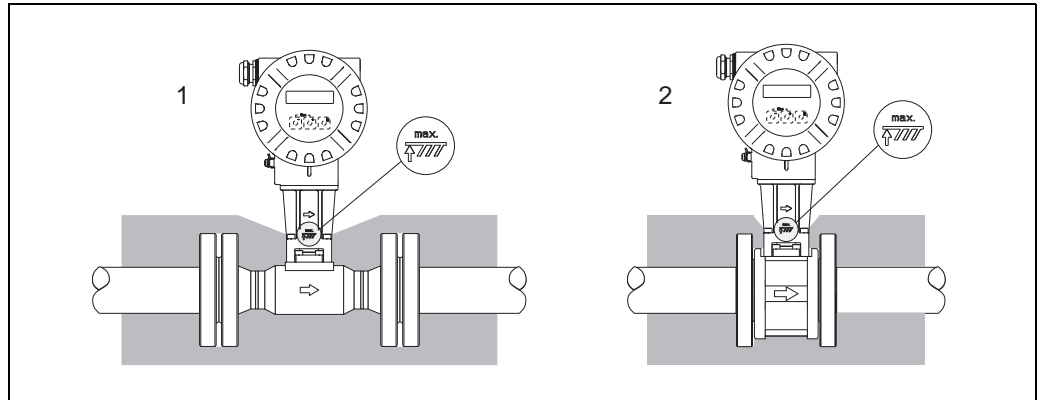
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Fig. 7:   1 = Flanged version, 2 = Wafer version

Caution!
Danger of electronics overheating!

- Therefore, make sure that the adapter between sensor and transmitter and the connection housing of the remote version is always exposed.
- Note that a certain orientation might be required, depending on the fluid temperature → Page 12.
- Information on permissible temperature ranges → Page 67.

3.2.5   Inlet and outlet run

As a minimum, the inlet and outlet runs shown below must be observed to achieve the specified accuracy of the device. The longest inlet run shown must be observed if two or more flow disturbances are present.
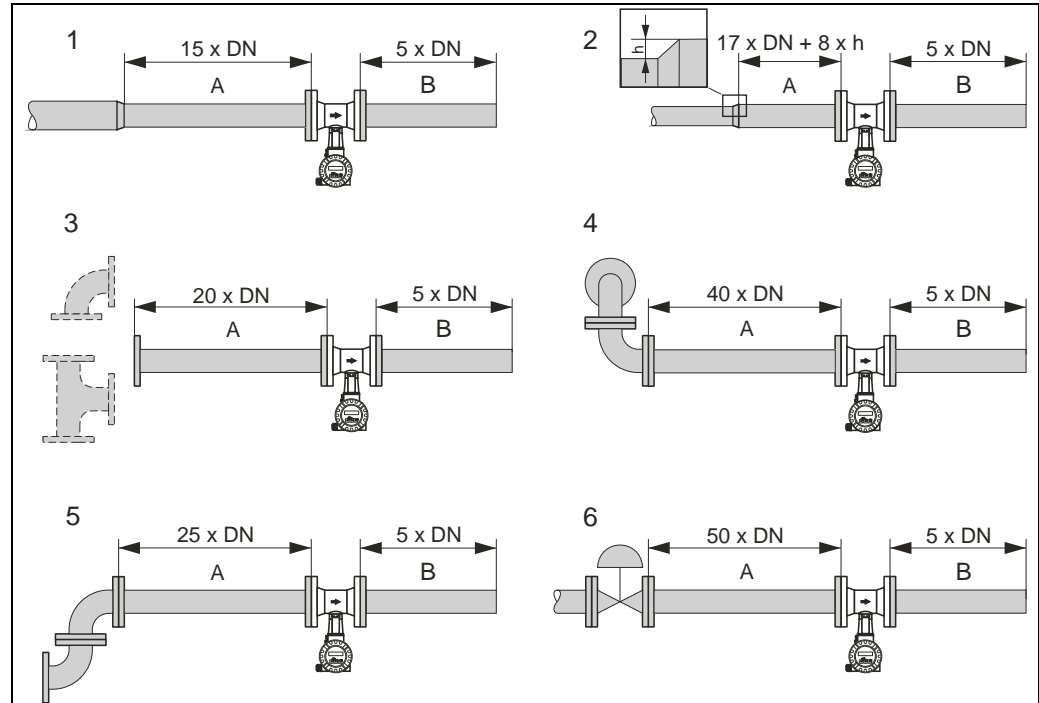
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Fig. 8:   Minimum inlet and outlet runs with various flow obstructions

A   Inlet run
B   Outlet run

1 = Reduction
2 = Expansion
3 = 90° elbow or T-piece
4 = 2 x 90° elbow, 3-dimensional
5 = 2 x 90° elbow
6 = Control valve

✎   Note!
A specially designed perforated plate flow conditioner can be installed if it is not possible to observe the inlet runs required (see Page 15).

Outlet runs with pressure and temperature measuring points
If pressure and temperature measuring points are installed after the device, please ensure there is a large enough distance between the device and the measuring point so there are no negative effects on vortex formation in the sensor.
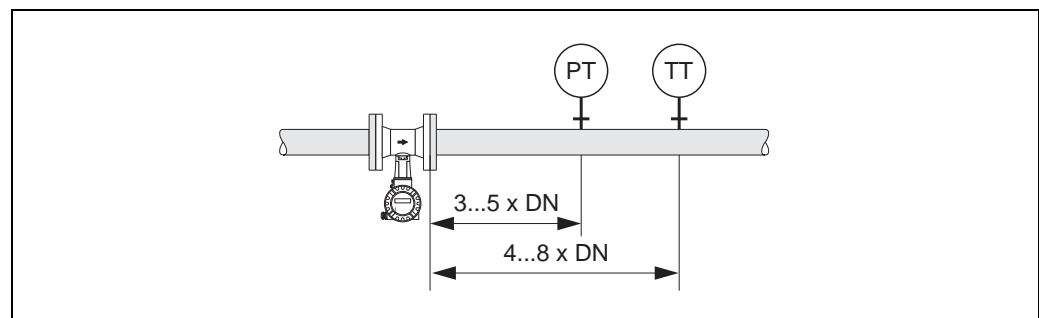
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Fig. 9:   Installation of pressure measuring point (PT) and temperature measuring point (TT)

Perforated plate flow conditioner
A specially designed perforated plate flow conditioner, available from Endress+Hauser, can be installed if it is not possible to observe the inlet runs required. The flow conditioner is fitted between two piping flanges and centered with mounting bolts. Generally, this reduces the inlet run required to $10 \times$ DN with complete accuracy.
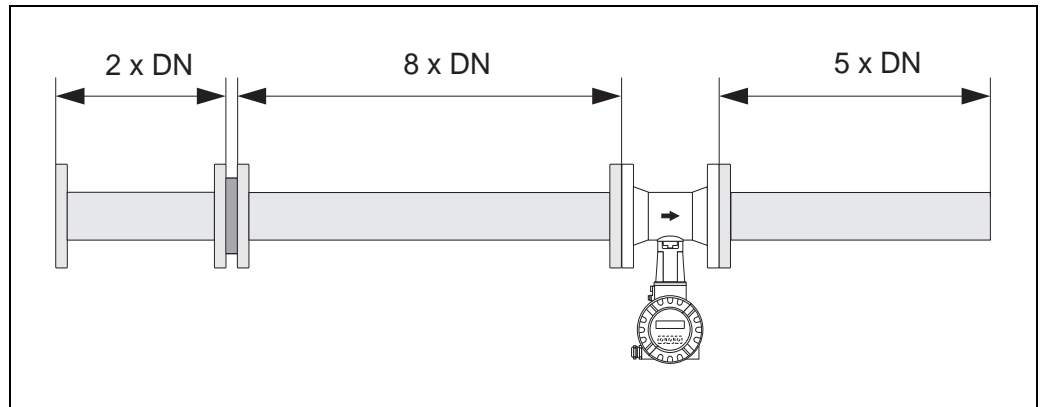
Fig. 10:   Perforated plate flow conditioner

Calculation examples (SI units) for the pressure loss of flow conditioners:
The pressure loss for flow conditioners is calculated as follows:
Δp [mbar] $= 0.0085 \cdot \rho$ [kg/m³] $\cdot v^2$ [m/s]

- Example with steam
  p = 10 bar abs
  t = 240 °C $\rightarrow \rho$ = 4.39 kg/m³
  v = 40 m/s
  $\Delta p = 0.0085 \cdot 4.39 \cdot 40^2$ = 59.7 mbar

- Example with H_2O condensate (80 °C)
  ρ = 965 kg/m³
  v = 2.5 m/s
  $\Delta p = 0.0085 \cdot 965 \cdot 2.5^2$ = 51.3 mbar

3.2.6   Vibrations

The correct operation of the measuring system is not influenced by plant vibrations up to 1 g, 10 to 500 Hz. Consequently, the sensors require no special measures for attachment.

3.2.7   Limiting flow

See the information on Page 62 and 70.0

3.3 Installation

3.3.1 Mounting sensor

Caution!
Please note the following prior to mounting:

- Prior to installing the measuring device in the piping, remove all traces of transport packaging and any protective covers from the sensor.
- Make sure that the internal diameters of seals are the same as, or greater than, those of the measuring pipe and piping. Seals projecting into the flow current have a negative effect on the vortex formation after the bluff body and cause inaccurate measurement. The gaskets provided by Endress+Hauser for the wafer version have therefore an inner diameter with a bigger inner diameter than the piping.
- Ensure that the arrow on the measuring pipe matches the direction of flow in the piping.
- Lengths:
  - Prowirl W (wafer version): 65 mm (2.56 inch)
  - Prowirl F (flanged version) → See Technical Information TI070D/06/en.

Mounting Prowirl W
The centering rings supplied are used to mount and center the wafer-style devices.
A mounting kit consisting of tie rods, seals, nuts and washers can be ordered separately.
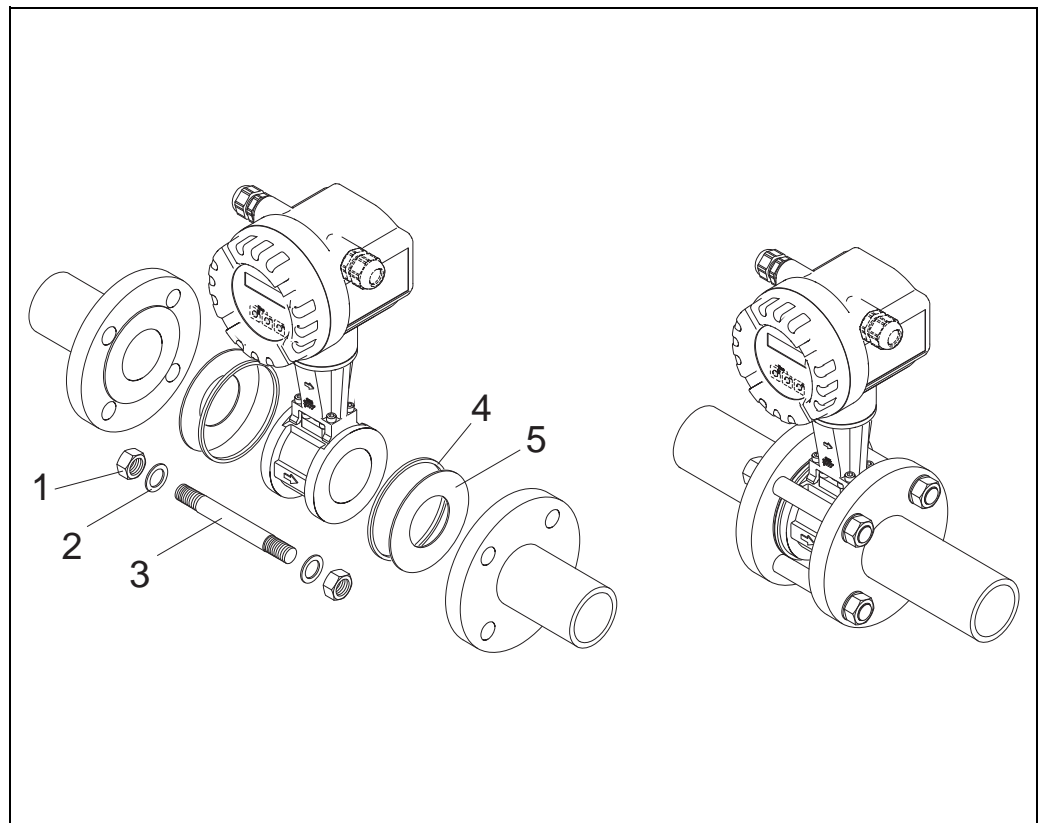
A0001888

Fig. 11:   Mounting the wafer version

1   Nut
2   Washer
3   Tie rod
4   Centering ring (is supplied with the device)
5   Seal

3.3.2 Rotating the transmitter housing

The electronics housing can be rotated continuously 360° on the housing support.

1. Loosen the safety screw.
2. Turn the transmitter housing to the desired position (max. 180° in each direction to the stop).

✎ Note!
There are recesses in the rotating groove at 90° stages (only compact version).
These help you align the transmitter easier.

3. Tighten the safety screw.
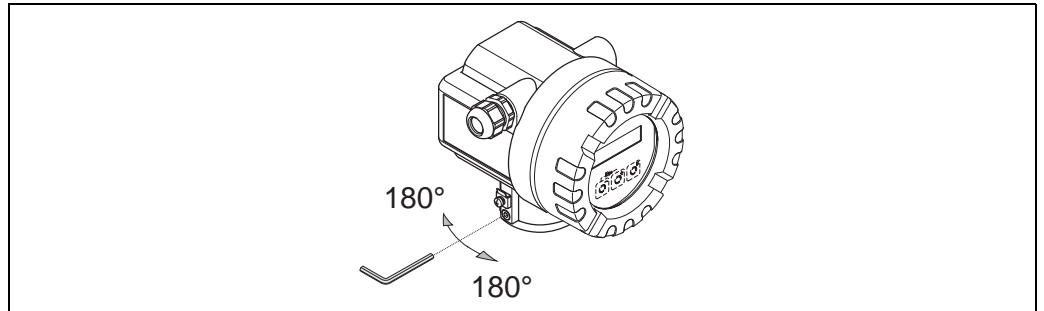
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Fig. 12:   Rotating the transmitter housing

3.3.3 Rotating the local display

1. Unscrew the cover of the electronics compartment from the transmitter housing.
2. Remove the display module from the transmitter retainer rails.
3. Turn the display to the desired position (max. 4 × 45° in each direction) and reset it onto the retaining rails.
4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.
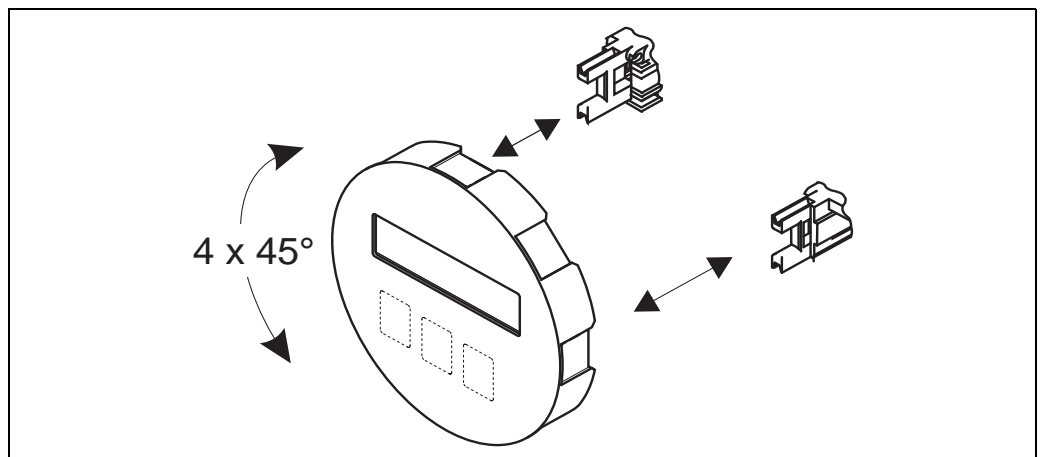
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Fig. 13:   Rotating the local display

3.3.4   Mounting transmitter (remote)

The transmitter can be mounted in the following ways:
- Wall mounting
- Pipe mounting (with separate mounting kit, accessories → Page 44)

The transmitter and the sensor must be mounted separate in the following circumstances:
- poor accessibility,
- lack of space,
- extreme ambient temperatures.

Caution!
If the device is mounted to warm piping, make certain that the housing temperature does not exceed the max. permissible temperature value.
– Standard: –40 to +80 °C (–40 to +176 °F)
– EEx d/XP version: –40 to +60 °C (–40 to +140 °F)
– ATEX II 1/2 GD version/dust ignition-proof: –20 to +55 °C (–4 to +131 °F)

Mount the transmitter as illustrated in the diagram.

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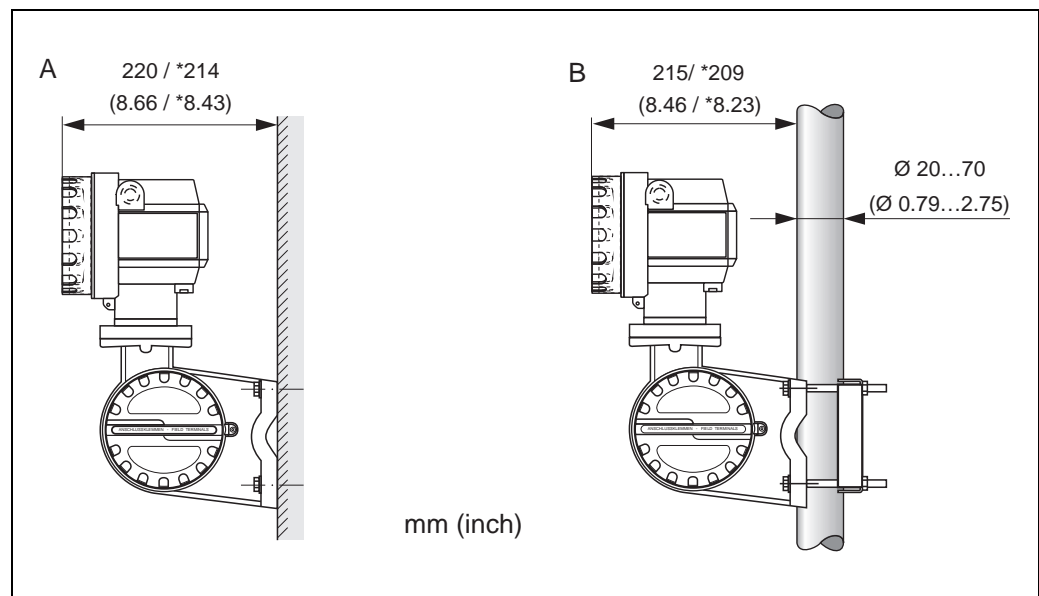
Fig. 14:   Mounting the transmitter (remote version)

A   Direct wall mounting
B   Pipe mounting
* Dimensions for version without local display

3.4   Post-installation check

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

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Do the process temperature/pressure, ambient temperature, measuring range etc. correspond to the specifications of the device?	see Page 62 ff.
Installation	Notes
Does the arrow on the pipe stand or on the sensor 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?	see Page 11 ff.
Process environment / process conditions	Notes
Is the measuring device protected against moisture and direct sunlight?	–

4   Wiring

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

4. 1   FOUNDATION Fieldbus cable specifications

4.1.1   Cable type

Twin–core cables are required for connecting the device to the FOUNDATION Fieldbus H1. Following IEC 61158–2 (MBP), four different cable types (A, B, C, D) can be used with the FOUNDATION 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 cable type B, several fieldbuses (same degree of protection) may be operated in 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 lack of shielding 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 size	0.8 mm² (AWG 18)	0.32 mm² (AWG 22)
Loop–resistance (direct current)	44 Ω/km	112 Ω/km
Characteristic impedance at 31.25 kHz	100 Ω ± 20%	100 Ω ± 30%
Attenuation constant at 39 kHz	3 dB/km	5 dB/km
Capacitive asymmetry	2 nF/km	2 nF/km
Envelope delay distortion (7.9 to 39 kHz)	1.7 μs/km	*
Shield coverage	90%	*
Max. cable length (inc. spurs >1 m)	1900 m (6233 ft)	1200 m (3937 ft)
* Not specified		

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

4.1.2   Maximum overall cable length

The maximum network expansion depends on the type of protection and the cable specifications.
The overall cable length combines the length of the main cable and the length of all spurs
(>1 m/3.28 ft). Note the following points:

- The maximum permissible overall cable length depends on the cable type used (→ Page 20).
- If repeaters are used, the maximum permissible cable length is doubled.
  A maximum of three repeaters are permitted between user and master.

4.1.3   Maximum spur length

The line between the distribution box and field device is described as a spur.
In the case of non-Ex applications, the max. length of a spur depends on the number of spurs
(>1 m/3.28 ft):

Number of spurs	1 to 12	13 to 14	15 to 18	19 to 24	25 to 32
Max. length per spur	120 m (393 ft)	90 m (295 ft)	60 m (196 ft	30 m (98 ft)	1 m (3.28 ft)

4.1.4   Number of field devices

In accordance with IEC 61158-2 (MBP), a maximum of 32 field devices can be connected per
fieldbus segment. However, this number is restricted under certain conditions (explosion
protection, bus feed, field device current consumption).
A maximum of four field devices can be connected to a spur.

4.1.5   Shielding and grounding

Optimum electromagnetic compatibility of the fieldbus system can only be guaranteed if the system
components and, in particular, the lines are shielded and the shield forms as complete a cover as
possible. A shield coverage of 90% is ideal.

To ensure an optimum shield effect, connect the shield as often as possible to the reference ground.
Where applicable, national installation regulations and guidelines must be observed!
If there are large potential differences between the individual grounding points, only one point of
the shielding is directly connected to the reference ground. In plants without potential matching,
therefore, cable shielding of fieldbus systems should only be grounded on one side, for example for
the fieldbus supply unit or safety barriers.

Caution!
If the shielding of the cable is grounded at more than one point in systems without potential
matching, mains frequency equalizing currents can occur that damage the bus cable or shielding or
have a serious effect on signal transmission.

Bus termination
The start and end of each fieldbus segment must always 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 pointers on wiring can be found on www.fieldbus.org, the website
of the Fieldbus Foundation.

4. 2   Connecting the remote version

4.2.1   Connecting the sensor

✎ Note!
- The remote version must be grounded. In doing so, the sensor and transmitter must be connected to the same potential matching.
- When using the remote version, always make sure that you connect the sensor only to the transmitter with the same serial number. Compatibility errors (e.g. the incorrect K-factor will be used) can occur if the devices are not connected in this way.

1. Remove the cover of the connection compartment of the transmitter (a).
2. Remove the cover of the connection compartment of the sensor (b).
3. Feed the connecting cable (c) through the appropriate cable entries.
4. Wire the connecting cable between the sensor and transmitter in accordance with the electrical wiring diagram: → Fig. 15
   → The wiring diagram in the connection compartment covers (a/b).
5. Tighten the glands of the cable entries on the sensor housing and transmitter housing.
6. Screw the cover of the connection compartment (a/b) back onto the sensor housing or transmitter housing.
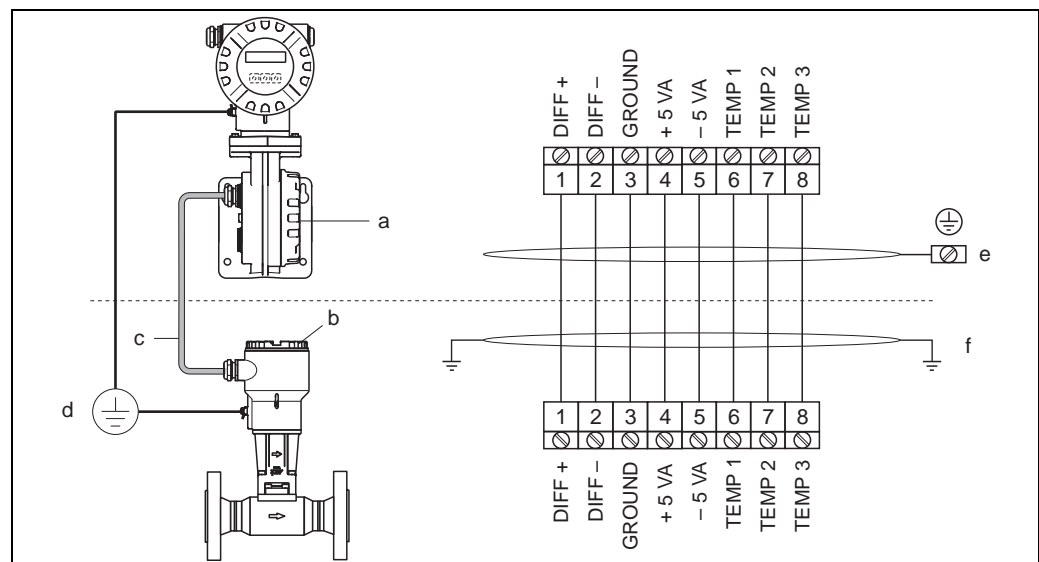
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Fig. 15:   Connecting the remote version

a   Connection compartment cover (transmitter)
b   Connection compartment cover (sensor)
c   Connecting cable (signal cable)
d   Identical potential matching for sensor and transmitter
e   Connect shielding to ground terminal in transmitter housing and keep as short as possible
f   Connect shielding to cable strain relief clamp in connection housing

Wire color (colour code according to DIN 47100):
Terminal number: 1 = white; 2 = brown; 3 = green; 4 = yellow, 5 = gray; 6 = pink; 7 = blue; 8 = red

4.2.2 Cable specifications, connecting cable

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

- $4 \times 2 \times 0.5$ mm² (AWG 20) PVC cable with common shield (4 pairs, pair-stranded)

✎ Note!
If the cross-section of a cable deviates from the specification, the value for the cable length has to be calculated. → See "Calculating and entering the cable length".
- Conductor resistance to DIN VDE 0295 Class 5 or IEC 60228 Class 55: $39\Omega/km$

✎ Note!
The conductor resistance specified by the standard is compensated for.

- Capacity core/screen: < 400 pF/m (122 pF/ft)
- Cable length: max. 30 m (98 ft)
- Operating temperature: –40 to +105 °C (–40 to +221 °F)

4.2.3 Cable specifications, armored connecting cable

The optionally available armored connecting cable between transmitter and sensor possesses the following specifications:

- $4 \times 2 \times 0.5$ mm² (AWG 20) PVC cable with common shield (4 pairs, pair-stranded)

✎ Note!
If the cross-section of a cable deviates from the specification, the value for the cable length has to be calculated. → See "Calculating and entering the cable length".
- Conductor resistance to DIN VDE 0295 Class 5 or IEC 60228 Class 5: $39\Omega/km$

✎ Note!
The conductor resistance specified by the standard is compensated for.

- Extensively resistant against acids, bases and specific oils
- A galvanized braided steel wire forms the total shield
- Outer sheath version: smooth, uniform, round
- Cable length: max. 30 m (98 ft)
- Operating temperature: –30 to +70 °C (–22 to +158 °F)

4.2.4 Calculating and entering the cable length

1. Calculate the cable length as follows if the cross-section of the connecting cable deviates from the specification:

$$\frac{\text{Conductor resistance of the cable used } [\Omega/km]}{\text{Conductor resistance as per specification } [\Omega/km]} \times \text{Actual cable length [m]} = \text{cable length to be entered (m)}$$

Example:

$$\frac{26\ \Omega/km}{39\ \Omega/km} \cdot 15\ m = 10\ m$$

2. Enter the value for the cable length in the CABLE LENGTH function in accordance with the unit that was selected in the UNIT LENGTH function.

4. 3   Connecting the measuring unit

Field instruments can be connected to the FOUNDATION Fieldbus in two ways:

- Connection via conventional cable gland   → Kap. 4.2.1
- Connection via prefabricated fieldbus connector (option)   → Kap. 4.3.2

4.3.1   Connecting the transmitter

✎ Note!
- When connecting Ex-certified devices, please refer to the notes and diagrams in the Ex-specific supplement to these Operating Instructions.
- The remote version must be grounded. In doing so, the sensor and transmitter must be connected to the same potential matching.
- The national regulations governing the installation of electrical equipment must be observed.
- When connecting the transmitter, use a connecting cable with a continuous service temperature of at least –40 °C (–40 °F) to permitted max. ambient temperature plus 10 °C (plus 18 °F).
- A shielded cable must be used for the connection.
- The terminals for the FOUNDATION Fieldbus connection (terminal 1 = FF+ , terminal 2 = FF –) have integrated reverse polarity protection.
  This ensures correct signal transmission via the fieldbus even if lines are confused.
- Cable cross-section: max. 2.5 mm²
- Observe the grounding concept of the plant.

☝ Caution!
- Risk of damaging the fieldbus cable!
  If the shielding of the cable is grounded at more than one point in systems without additional potential matching, mains frequency equalizing currents can occur that damage the cable or the shielding. In such cases, the shielding of the cable is to be grounded on only one side, i.e. it must not be connected to the ground terminal of the housing. The shield that is not connected should be insulated!
- We recommend that the fieldbus not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.
- Please pay particular attention to company-internal grounding concepts and national installation regulations and guidelines.

Procedure for connecting the transmitter, Non-Ex, Ex i/IS and Ex n version (→ Fig. 16)

1. Unscrew the cover (a) of the electronics compartment from the transmitter housing.
2. Remove the display module (b) from the retaining rails (c) and refit onto right retaining rail with the left side (this secures the display module).
3. Loosen the fixing screw (d) of the cover of the connection compartment and fold down the cover.
4. Push the cable for the power supply/fieldbus through the cable gland (e).
5. Tighten the cable glands (e) (see also Page 28).
6. Pull the terminal connector (f) out of the transmitter housing and connect the cable for the power supply/fieldbus (→ Fig. 18).

    ✎ Note!
    The terminal connector (f) is pluggable, i.e. it can be plugged out of the transmitter housing to connect the cable.

7. Plug the terminal connector (f) into the transmitter housing.
8. Secure the ground cable to the ground terminal (g).

    ✎ Note!
    Between the stripped fieldbus cable and the ground terminal, the cable shielding should not exceed a length of 5 mm (0.20 in).

9. Only remote version:
    Secure ground cable to the ground terminal (→ Fig. 18, B).
10. Fold up the cover of the connection compartment and tighten the fixing screw (d).
11. Remove the display module (b) and fit on the retaining rails (c).
12. Screw the cover of the electronics compartment (a) onto the transmitter housing.
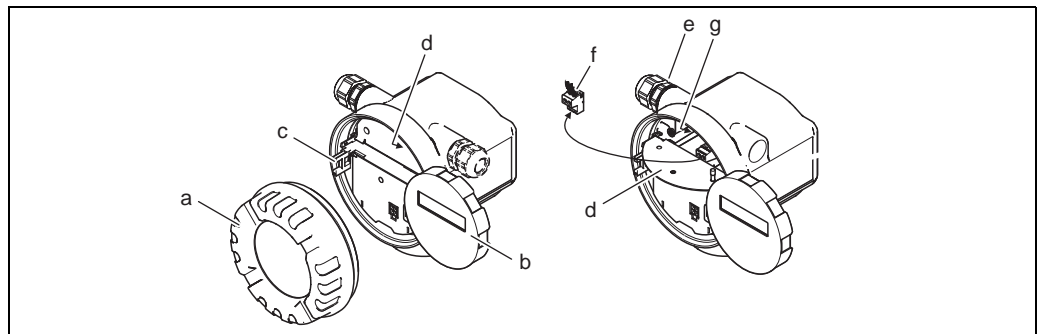
A0003782

Fig. 16:   Procedure for connecting the transmitter Non-Ex / Ex i/IS and Ex n version

a   Cover of electronics compartment
b   Display module
c   Retaining rail for display module
d   Fixing screw for cover of connection compartment
e   Cable gland
f   Terminal connector
g   Ground terminal

Procedure for connecting the transmitter, Ex d/XP version (→ Fig. 17)

1. Release the securing clamp (a) of the connection compartment cover.
2. Screw the connection compartment cover (b) off the transmitter housing.
3. Push the power supply/fieldbus cable through the cable gland (c).
4. Tighten the cable glands (c) (see also Page 28).
5. Pull the terminal connector (d) out of the transmitter housing and connect the power supply/fieldbus cable (→ Fig. 18).

    ✎ Note!
    The terminal connector (d) is pluggable, i.e. it can be plugged out of the transmitter housing to connect the cable.

6. Plug the terminal connector (d) into the transmitter housing.
7. Secure the ground cable to the ground terminal (e).

    ✎ Note!
    Between the stripped fieldbus cable and the ground terminal, the cable shielding should not exceed a length of 5 mm (0.20 in).

8. Only remote version:
    Secure ground cable to the ground terminal (→ Fig. 18, B).
9. Screw the connection compartment cover (b) onto the transmitter housing.
10. Tighten the securing clamp (a) of the connection compartment cover.
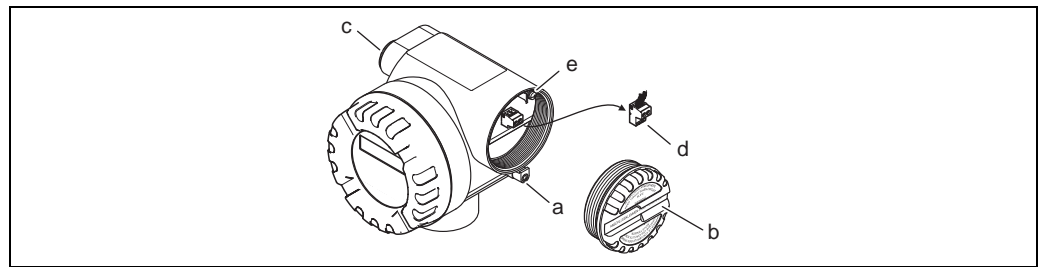
A0003783

Fig. 17:   Procedure for connecting the transmitter Ex d/XP version

a   Clamp securing the cover of the connection compartment
b   Cover of connection compartment
c   Cable gland
d   Terminal connector
e   Ground terminal

Wiring diagram
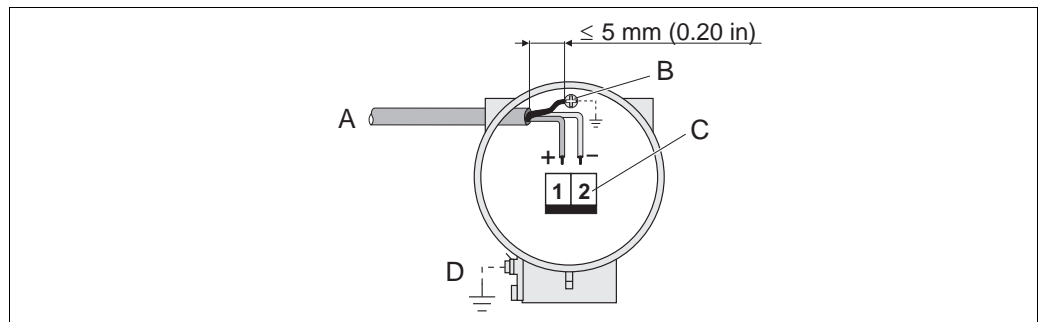
A0003784

Fig. 18:   Connecting the transmitter

A   Fieldbus cable (FOUNDATION Fieldbus)
B   Ground terminal (between the stripped fieldbus cable and the ground terminal, the cable shielding should not exceed a length of 5 mm (0.20 in).
C   Terminal connector (1 = FF+; 2 = FF–)
D   Ground terminal (external, only relevant for remote version)

4.3.2   Fieldbus connector

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

This connection technology using prefabricated distribution modules and plug-in connectors offers substantial advantages over conventional wiring:

- Field devices can be removed, replaced or added at any time during normal operation. Communication is not interrupted.
- Installation and maintenance are significantly easier.
- Existing cable infrastructures can be used and expanded instantly, e.g. when constructing new star distributors using 4-channel or 8-channel distribution modules.

The device can therefore be supplied with the option of a ready-mounted fieldbus connector. Fieldbus connectors for retrofitting can be ordered from Endress+Hauser as a spare part
(→ Page 56).

Supply line/T-box shielding
Use cable glands with good EMC properties, if possible with all-round contact of the cable shielding (Iris spring). This requires small differences in potential, poss. potential matching.

- The fieldbus cable shielding must be intact.
- The shielding connection must always be kept as short as possible.

Ideally, cable glands with Iris springs should be used for the shielding connection. The shielding is positioned on the T-box housing by means of the Iris spring located inside the gland. The shielding braid is located beneath the Iris spring. When the armored thread is tightened, the Iris spring is pressed against the shielding, thereby creating a conductive connection between the shielding and the metal housing.

A connection box or a plug-in connection is to be seen as part of the shielding (Faraday shield). This applies, in particular, to remote boxes if these are connected to a FOUNDATION Fieldbus measuring device by means of a pluggable cable. In such instances, a metallic connector must be used where the cable shielding is positioned at the plug housing (e.g. prefabricated cables).

A0007346
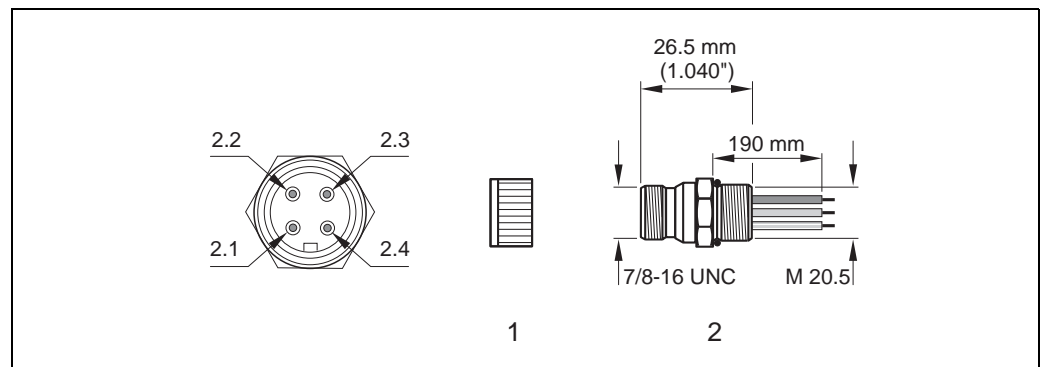
Fig. 19:   *Connectors for connecting to the FOUNDATION Fieldbus*

1   Protection cap for connector
2   Fieldbus connector (pin assignment/color codes)
2.1   Brown wire: FF+ (terminal 1)
2.2   Blue wire: FF– (terminal 2)
2.3   Not assigned
2.4   Green/yellow: earth (notes on connection → Page 21, 24)

Connector technical data:
– Degree of protection IP 67
– Ambient temperature: –40 to +150 °C (–40 to +302 °F)

4.3.3   Terminal assignment

| | Terminal no. (inputs/outputs) | |
Order variant	1	2
72***-***********K	FF +	FF –

4. 4   Degree of protection

The measuring device meets all the requirements for IP 67 (NEMA 4X).
Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP 67 (NEMA 4X) protection is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- The housing screws and screw caps must be firmly tightened.
- The cables used for connection must be of the specified outside diameter→ Seite 66, cable entries.
- The cable entries must be firmly tightened (point **a** → Fig. 20).
- The cable must loop down before it enters the cable entry ("water trap") (point **b** → Fig. 20). This arrangement prevents moisture penetrating the entry.

✎ Note!
The cable entries should not point upwards.
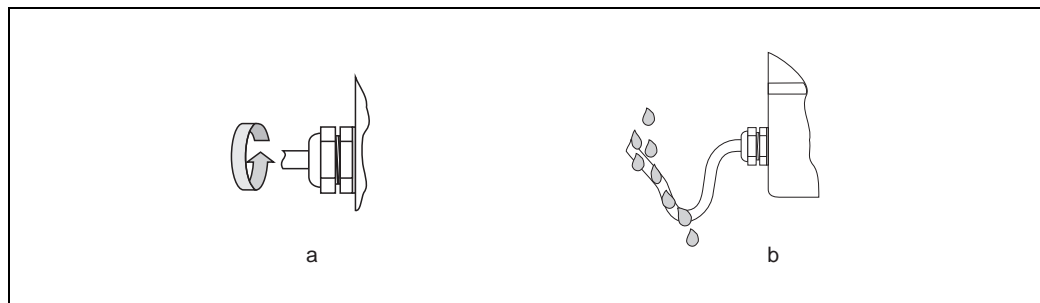
Fig. 20:   Installation instructions for cable entries

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

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?	9 to 32 V DC
Do the cables used comply with the specifications?	■ Fieldbus cable → Page 20 ■ Signal cable → Page 23
Do the cables have adequate strain relief?	–
Are the power supply and fieldbus cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Are all terminals firmly tightened?	–
Are all the cable entries installed, tightened and sealed? Cable run with "water trap"?	→ Page 28
Are all the housing covers installed and tightened?	–
Electrical connection of FOUNDATION Fieldbus	Notes
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected with each other correctly?	–
Has each fieldbus segment been terminated at both ends with a bus terminator?	–
Has the max. length of the fieldbus cable been observed in accordance with the FOUNDATION Fieldbus specifications?	→ Page 21
Has the max. length of the spurs been observed in accordance with the FOUNDATION Fieldbus specifications?	→ Page 21
Is the fieldbus cable fully shielded and correctly grounded?	→ Page 21

5   Operation

5. 1   Quick operation guide

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

1. Operating programs → Page 33
The configuration of FOUNDATION Fieldbus functions and device-specific parameters is primarily done via the fieldbus interface. You can obtain special configuration and operating programs from various manufacturers for these purposes.

2. Miniature switches (DIP switches) for diverse hardware settings → Page 35 ff.
You can make the following hardware settings for the FOUNDATION Fieldbus interface using miniature switches (DIP switches) on the I/O board or the amplifier board:
- Enabling/disabling the simulation mode in the AI and DO function block
- Switching the hardware write protection on/off
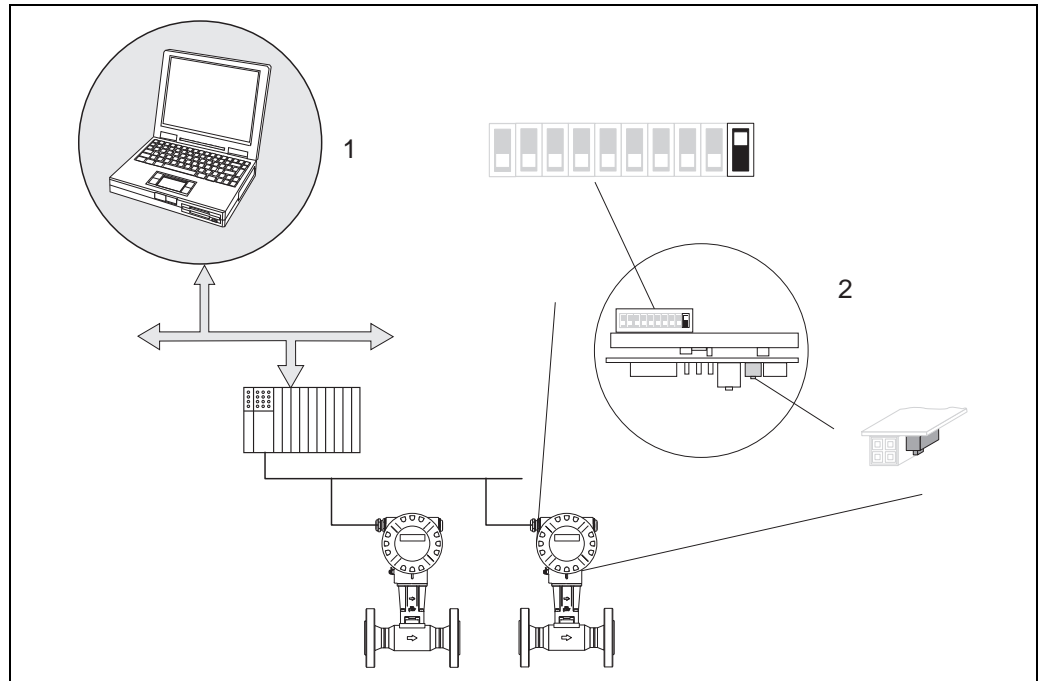
Fig. 21:   Device operating options via the FOUNDATION Fieldbus interface

1   Configuration/operating programs for operation via FOUNDATION Fieldbus (FOUNDATION Fieldbus functions, device parameters)
2   Miniature switches for hardware settings (write protection, simulation mode)

5. 2   Display elements

5.2.1   Display

Local display
The local display enables you to read important parameters directly at the measuring point. The display consists of two lines; this is where measured values and/or status variables (e.g. bar graph) are displayed.

You can change the assignment of the display lines to suit your needs and preferences (→ Page 107 ff.).

$$+48.25 \ m^3/h$$
$$+3702.6 \ m^3$$
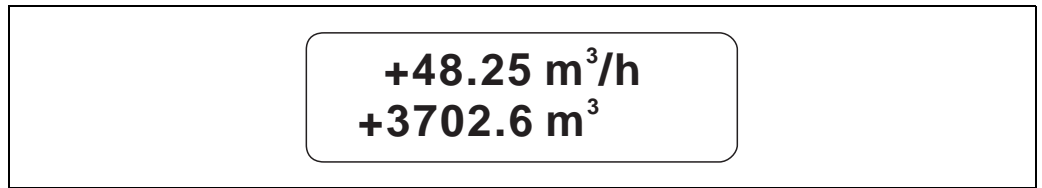
A0003802

Fig. 22:   Liquid crystal display

The two-line liquid-crystal display shows measured values, fault messages and notice messages.
– Top line: shows main measured values, e.g. calculated volume flow in [m³/h] or in [%].
– Bottom line: shows additional measured variables and status variables, e.g. totalizer reading in [m³], bar graph, tag name

5.2.2   Display symbols

Display symbol	Meaning
S	System error
P	Process error
⚡	Fault message
!	Notice message
▮	FF communication active

5.2.3   Error message display

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

The measuring system distinguishes between two types of error:
- *System error:* this group includes all device errors, for example communication errors, hardware errors, etc.
- *Process error:* this group includes all application errors, for example "empty pipe", etc.

A0000991
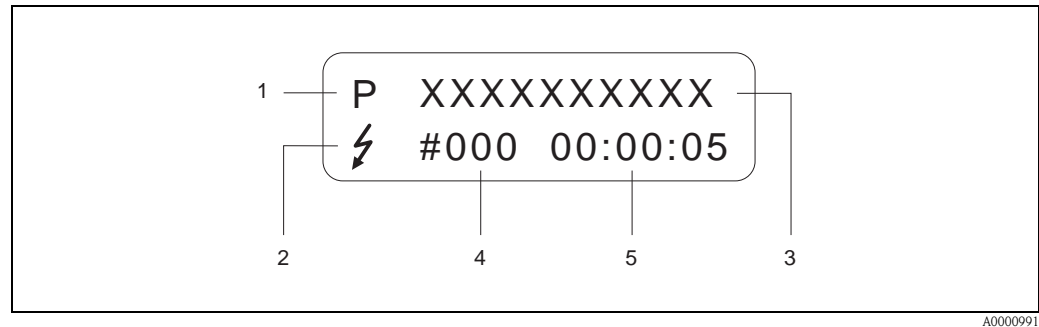
Fig. 23:   Error messages on the display (example)

1   Type of error: P = Process error, S = System error
2   Error message type:⚡ = fault message, ! = notice message
3   Error designation: e.g. DSC SENS LIMIT = Device being operated near application limits
4   Error number: e.g. #395
5   Duration of most recent error occurrence (in hours, minutes and seconds)

Types of error message
The measuring device always assigns system and process errors which occur to two types of error messages (fault or notice messages), resulting in different weightings. → Page 49 ff.
Serious system errors, e.g. electronic module defects, are always identified and displayed as "Fault messages" by the measuring device.

Notice message (!)
- The error in question does not have any effect on the current measuring operation.
- Displayed as → Exclamation mark (!), type of error (S: system error, P: process error)
- FOUNDATION Fieldbus → Notice messages are relayed to downstream function blocks or higher-level process control systems with the status "UNCERTAIN" of the output value OUT (AI Block).

Fault message (⚡)
- The error in question interrupts or stops the measuring operation running.
- Displayed as → Lightning flash (⚡), type of error (S: system error, P: process error)
- FOUNDATION Fieldbus → Fault messages are relayed to downstream function blocks or higher-level process control systems with the status "BAD" of the output value OUT (AI Block).

5. 3   FOUNDATION Fieldbus technology

For configuration information, please refer to Operating Instructions "FOUNDATION Fieldbus Overview" (BA013S). Available at: → www.endress.com → Download.

5. 4   Operating programs

5.4.1   Operating program "FieldCare"

Modular software package consisting of the "FieldCare" service program for the configuration and diagnosis of ToF level measuring devices (time–of–flight measurement) and pressure measuring instruments (Evolution series) as well as the "FieldCare" service program for the configuration and diagnosis of Proline flowmeters. The Proline flowmeters are accessed via a service interface or the FXA 193 service interface.

Contents of the "FieldCare":
- Commissioning, maintenance analysis
- Measuring device configuration
- Service functions
- Visualization of process data
- Troubleshooting
- Reading out the verification data and updating the software of the "Fieldcheck" flow simulator

5.4.2   Operation via FOUNDATION Fieldbus configuration programs

You can obtain special configuration and operating programs from various manufacturers for the configuration. These can be used for configuring both the FOUNDATION Fieldbus functions and all of the device-specific parameters. The predefined function blocks allow uniform access to all the network and fieldbus device data.

A detailed step–by–step description of the procedure for commissioning the FOUNDATION Fieldbus functions is given on Page 36 ff. together with information on configuring device–specific parameters. For general information on the FOUNDATION Fieldbus, please refer to Operating Instructions "FOUNDATION Fieldbus Overview" (BA013S). Available at: → www.endress.com → Download.

System files
You require the following files for commissioning and configuring the network:
- Commissioning → DD (Device Description: *.sym, *.ffo)
- Network configuration → CFF file (Common File Format: *.cff)

These files can be acquired as follows:
- Free of charge via the internet → www.endress.com
- From Endress+Hauser by quoting the order number (No. 50097199)
- From the Fieldbus Foundation Organization → www.fieldbus.org

✎ Note!
Make sure you are using the correct system files for integrating field devices into the host system. Relevant version information can be queried with Prowirl 72 by means of the following parameters in the Resource Block:

FOUNDATION Fieldbus interface:

- Resource Block → DEV_REV parameter
- Resource Block → DD_REV parameter

Example:
Display in the DEV_REV parameter → 01
Display in DD_REV parameter → 01
Device description file (DD) required → 0101.sym ∕ 0101.ffo

5.4.3   Current device description files

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

Access via FOUNDATION Fieldbus:

Valid for I/O software	1.00.XX
Device data FOUNDATION Fieldbus Manufacturer ID: Device ID:	11_{hex} (ENDRESS+HAUSER) 1056_{hex}
Version data FOUNDATION Fieldbus	Device Revision 1/ DD Revision 1
Software release	06.2004
Operating program	**How to acquire:**
Device Description (DD) and Capability File (CFF)	■ www.endress.com ($\rightarrow$ Download $\rightarrow$ Software $\rightarrow$ Driver) ■ www.fieldbus.org ■ CD-ROM
Device drivers for FOUNDATION Fieldbus host systems:	**How to acquire:**
ABB (FieldController 800)	See FF standard device drivers
Allen Bradley (Control Logix)	See FF standard device drivers
Emerson (Delta V)	www.easydeltav.com
Endress+Hauser (ControlCare)	See FF standard device drivers

Access via the service protocol:

Tester/simulator	Sources for obtaining device descriptions
Fieldcheck	■ Update by means of the "FieldCare" with the Flow Device FXA/291 DTM via the "Fieldflash" module

5. 5   Hardware settings

5.5.1   Switching the write protection and simulation mode on and off

Hardware write protection and simulation mode (for AI and DO function block)
can be switched on and off by means of DIP switches on the I/O board or the amplifier board. When
write protection is active, parameters cannot be modified. The current write protection status is
displayed in the WRITE_LOCK parameter (Resource Block → Page 81).

1.   Unscrew the cover of the electronics compartment from the transmitter housing.
2.   Remove the local display module (a) from the retaining rails (b) and refit onto right retaining
       rail with the left side (this secures the local display module).
3.   Fold up the plastic cover (c).
4.   Configure the hardware write protection and simulation mode accordingly with the aid of the
       DIP switches (→ Fig. 24).
5.   Installation is the reverse of the removal procedure.

A0003788
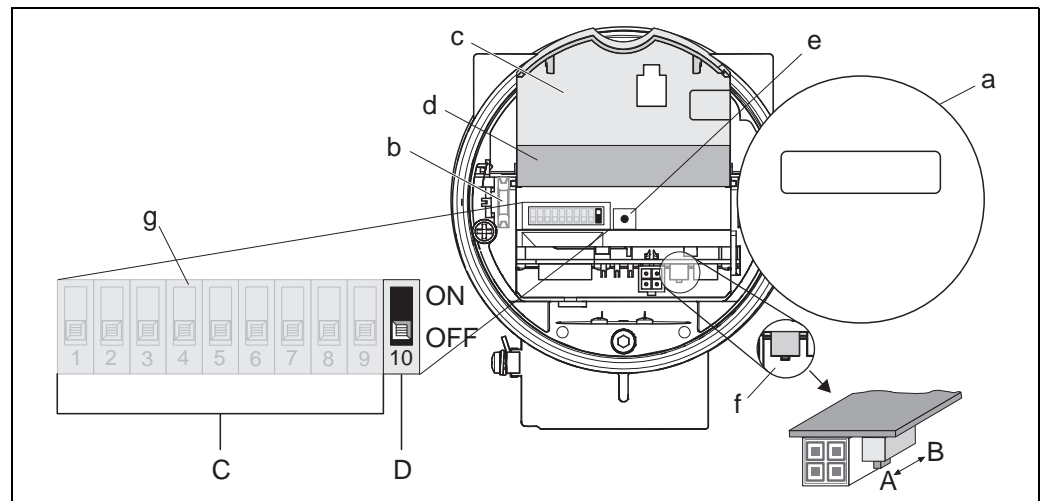
Fig. 24:   Hardware settings (I/O board or amplifier board)

a   Local display module (optional)
b   Retaining rail for the display module
c   Plastic cover
d   I/O board cover (COM module)
e   LED (light emitting diode):
       – Lit continuously = ready for operation
       – Not lit = not ready for operation
       – Flashing = system or process error present→ Page 49 ff.
f   DIP switch for hardware write protection
       *– A = write protection switched off (DIP switch to the front = factory setting) → Access to device parameters via
          FOUNDATION Fieldbus interface possible*
       *– B = write protection switched on (DIP switch to the rear) → Access to device parameters via FOUNDATION
          Fieldbus interface not possible*
g   DIP switch for simulation mode:
       – C = DIP switches 1 to 9 = not assigned
       – D = DIP switch 10 = simulation mode
          *OFF (factory setting) = simulation mode possible in the Analog Input Function Block or in the Discrete Output
          Function Block*
          ON = simulation mode not possible in the Analog Input Function Block or in the Discrete Output Function Block

6 Commissioning

6. 1 Function check

Make sure that all final checks have been completed before you commission your measuring point:
- "Post-installation check" checklist → Page 19
- "Post-connection check" checklist → Page 29

✎ Note!
- The FOUNDATION Fieldbus 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 16 mA at the device.
- Using the LED on the I/O board (see Page 35), it is possible to carry out a simple function check in the non-hazardous area.

6.1.1 Switching on the measuring device

Once the final checks have been successfully completed, it is time to switch on the supply voltage. The device is ready for operation after approx. 5 seconds!

The measuring device performs a number of internal test functions after power-up. As this procedure progresses, the following sequence of messages appears on the local display:

PROWIRL 72 **XX.XX.XX**	Startup message displaying the current amplifier software
▼	
FOUND. FIELDBUS **XX.XX.XX**	Displays the current software of the FOUNDATION Fieldbus I/O board
▼	
PD-TAG display	Displays the tag name
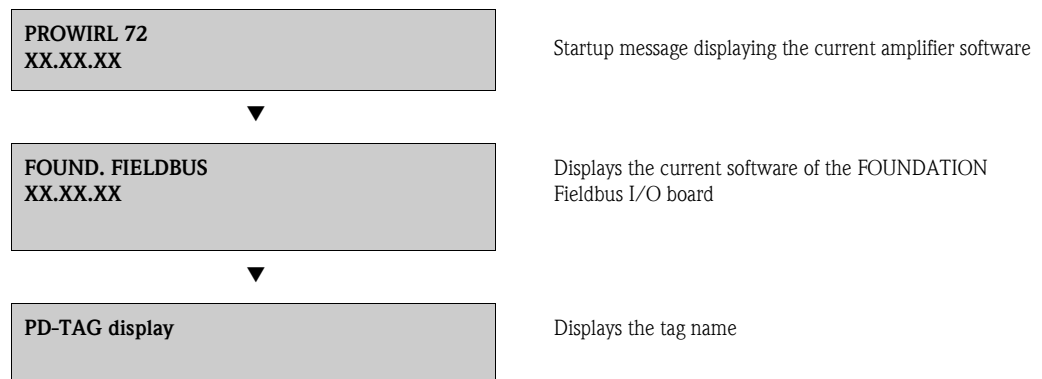
Normal measuring mode commences as soon as startup completes.
Various measured value and/or status variables appear on the display.

✎ Note!
If startup fails, an appropriate error message is displayed, depending on the cause.

6. 2   Commissioning via FOUNDATION Fieldbus

Note the following points:
- The files required for commissioning and network configuration can be obtained as described on Page 33.
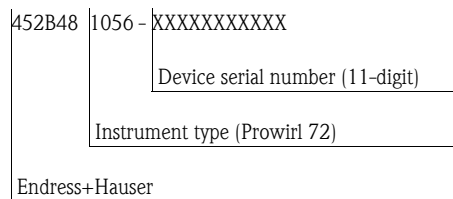- In the case of the FOUNDATION Fieldbus, the device is identified in the host or configuration system by means of the device ID (DEVICE_ID). The DEVICE_ID is a combination of the manufacturer ID, device type and device serial number. It is unique and can never be assigned twice.

The DEVICE_ID of Prowirl 72 is formed as follows:

```
452B48 1056 - XXXXXXXXXX

                    Device serial number (11-digit)

              Instrument type (Prowirl 72)

Endress+Hauser
```

6.2.1   Initial commissioning

The following description takes you step-by-step through commissioning the device and all the necessary configurations for the FOUNDATION Fieldbus:

1. Switch the device on.
2. Note the DEVICE_ID on the device nameplate (see Page 7).
3. Open the configuration program.
4. Load the device description files or the CFF file into the host system or the configuration program. Make sure you are using the right system files. Please note the example on Page 33. The first time you establish a connection, the Prowirl 72 reacts as follows:

    – E+H_PROWIRL_72_ xxxxxxxxxxx (tag name PD-TAG)
    – 452B481056- xxxxxxxxxxx (DEVICE_ID)
    – Block structure:

Display text (xxx... = serial number)	Base index	Description
RESOURCE_ xxxxxxxxxxx	400	Resource Block
TRANSDUCER_FLOW_xxxxxxxxxxx	500	Transducer Block "Flow"
TRANSDUCER_TOT_xxxxxxxxxxx	600	Transducer Block "Totalizer"
TRANSDUCER_DISP_xxxxxxxxxxx	700	Transducer Block "Display"
TRANSDUCER_DIAG_xxxxxxxxxxx	800	Transducer Block "Diagnosis"
DISCRETE_SERV_xxxxxxxxxxx	900	Transducer Block "Service"
ANALOG_INPUT_1_ xxxxxxxxxxx	1000	Analog Input Function Block 1
ANALOG_INPUT_2_ xxxxxxxxxxx	1100	Analog Input Function Block 2
DISCRETE_OUTPUT_ xxxxxxxxxxx	1200	Discrete Output Function Block

✎   Note!
Prowirl 72 is delivered from the factory with the bus address "250" and is thus in the address range between 248 and 251 reserved for readdressing the field devices. This means that the LM (Link Master) allocates a non-assigned bus address to the device in the initialization stage.

5. Using the DEVICE_ID noted, identify the field device and assign the desired tag name (PD_TAG) to the fieldbus device in question.
Factory setting: E+H_PROWIRL_72_xxxxxxxxxxx
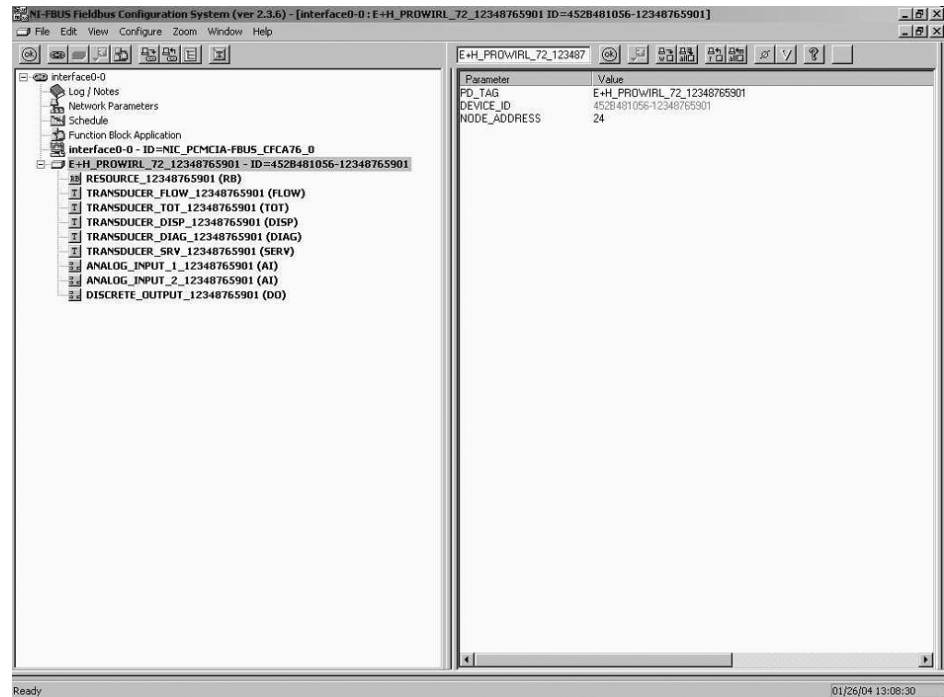
A0003789

Fig. 25:   Screen display in the configuration program "NI-FBUS Configurator" (National Instruments) after the connection has been established

Configuring the "Resource Block" (base index 400)
6. Open the Resource Block.

7. When the device is delivered, the hardware write protection is disabled so the write parameters can be accessed via the FOUNDATION Fieldbus. Check the status via the WRITE_LOCK parameter:
– Write protection enabled = LOCKED
– Write protection disabled = NOT LOCKED

Disable the write protection if necessary → Page 35.

8. Enter the desired name for the block (optional).
Factory setting: RESOURCE_ xxxxxxxxxxx

9. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to AUTO.

Configuring the "Transducer Blocks"
The individual Transducer Blocks comprise various parameter groups arranged by device-specific functions:

Flow measurement	→	Transducer Block "Flow" (base index: 500)
Totalizer	→	Transducer Block "Totalizer" (base index: 600)
Local display functions	→	Transducer Block "Display" (base index: 700)
Diagnostic functions	→	Transducer Block "Diagnosis" (base index: 800)
Service functions	→	Transducer Block "Service" (base index: 900)

The following section describes an example for the Transducer Block "Flow" (base index 500).

10. Enter the desired name for the block (optional).
    Factory setting: TRANSDUCER_FLOW_ xxxxxxxxxxx

11. Open the Transducer Block "Flow".

12. Now configure the device-specific parameters relevant for your application.
    – Enabling code in "Un-/Locking - Access Code" parameter → Transducer Block "Flow"
      → Page 89 (factory setting = 72)
    – Select state of aggregation of the fluid → Transducer Block "Flow" → "Process Param.
      Application" → Page 93

Configuration examples for commissioning:

Example 1 (volumetric unit)
You want to measure the flow of water.
The flow should be displayed in the volume flow unit m³/h.

The following settings must be made when commissioning is performed:

Transducer Block	Parameter/Function	Selection
Flow	Process Param.- Application	Liquid
	System Unit – Volume Flow	m³/h
Totalizer	Totalizer – System Unit	m³

Example 2 (mass unit)
You want to measure overheated steam with a constant temperature of 200 °C and a constant pressure of 12 bar. According to IAPWS-IF97, the density at operating conditions is 5.91 kg/m³. (IAPWS = International Association of Process Water and Steam). The flow should be displayed in the mass flow unit kg/h.

The following settings must be made when commissioning is performed:

Transducer Block	Parameter/Function	Selection
Flow	Process Param.- Application	Gas/Steam
	System Unit – Calc. Mass Flow	kg/h
	System Unit – Density	kg/m³
	Process Param.- Operating Density	5.91
Totalizer	Totalizer – System Unit	t

Example 3 (corrected volume unit)
You want to measure compressed air with a constant temperature of 60 °C and a constant pressure of 3 bar. The density at operating conditions is 3.14 kg/m³. The density of air at reference operating conditions (0 °C, 1013 mbar) is 1.2936 kg/m³. The flow should be displayed in the corrected volume flow unit Nm³/h.

The following settings must be made when commissioning is performed:

Transducer Block	Parameter/Function	Selection
Flow	Process Param.- Application	Gas/Steam
	System Unit- Corr. Volume Flow	Nm³/h
	System Unit – Density	kg/m³
	Process Param.- Operating Density	3.14
	Process Param.- Ref. Density	1.2936
Totalizer	Totalizer – System Unit	Nm³

✎   Note!
– Please note that device parameter modifications are only possible once a valid enabling code
  has been entered in the "Un-/Locking – Access Code" parameter.
– The selection of system units in the Transducer Blocks does not have any effect on the
  desired units, which are to be transmitted via the FOUNDATION Fieldbus interface. This
  setting is made separately via the corresponding AI–Block in the XD_SCALE parameter group
  (see → Configuring the "Analog Input Function Blocks" below). The unit selected in the
  Transducer Blocks is only used for the local display, low flow cut off and for simulation.

Configuring the "Analog Input Function Blocks"
Prowirl 72 has two Analog Input Function Blocks which can be assigned to the different process
variables as desired. The following section describes an example for Analog Input Function Block 1
(base index 1000).

13. Enter the required name for the Analog Input Function Block (optional). Factory setting:
    ANALOG_INPUT_1_ xxxxxxxxxxx

14. Open Analog Input Function Block 1.

15. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to OOS, i.e.
    the block is out of service.

16. Use the CHANNEL parameter to select the process variable which should be used as the input
    value for the function block algorithm (scaling and limit value monitoring functions). The
    following settings are possible:
    – CHANNEL = 1 → Calc. mass flow
    – CHANNEL = 2 → Volume flow
    – CHANNEL = 3 → Corr. volume flow
    – CHANNEL = 7 → Totalizer

17. In the XD_SCALE parameter group, select the desired engineering unit that is to be transmitted
    via the FOUNDATION Fieldbus interface as well as the block input range (measuring range of
    the flow application) for the process variable in question (see next example).

👆   Caution!
Make sure that the engineering unit selected suits the measured variable of the process variable
chosen. Otherwise, the BLOCK_ERROR parameter displays the "Block Configuration Error"
error message and the operating mode of the block cannot be set to AUTO.

18. In the L_TYPE parameter, select the type of linearization for the input variable (direct, indirect, indirect sq. root) → Page 80 ff.

☝ Caution!

Please note that if the "Direct" linearization type is selected, the settings in the OUT_SCALE parameter group are not taken into account. The engineering units selected in the XD_SCALE parameter group are decisive. XD_SCALE_UNIT is then displayed as the unit on the local display, in accordance with the process variable selected.

Example:
– The measuring range of the sensor is 0 to 30 m³/h.
– The output range to the automation system should also be 0 to 30 m³/h.

The following settings must be made:
– Analog Input Function Block / CHANNEL parameter (select input value),
    CHANNEL = 2 → Volume flow
– L_TYPE parameter → Direct
– XD_SCALE parameter group

XD_SCALE 0 %	= 0
XD_SCALE 100 %	= 30
XD_SCALE UNIT	= m³/h

19. Use the following parameters to define the limit values for the alarm and early warning messages:
    – HI_HI_LIM → Limit value for the upper alarm
    – HI_LIM → Limit value for the upper early warning alarm
    – LO_LIM → Limit value for the lower early warning alarm
    – LO_LO_LIM → Limit value for the lower alarm

    The limit values entered must be within the value range specified in the OUT_SCALE parameter group.

20. In addition to the actual limit values, the behavior in the event of limit value overshoot must be specified by "alarm priorities" (HI_HI_PRI, HI_PRI, LO_PR, LO_LO_PRI parameters) → Page 80 ff.. Reporting to the fieldbus host system only occurs if the alarm priority is greater than 2.

Configuring the "Discrete Output Function Block" (optional)

21. By means of the Discrete Output Function Block, various device functionalities can be triggered in the Transducer Blocks in question via the FOUNDATION Fieldbus interface (e.g. totalizer reset, switching the positive zero return on or off). → Configuration see Page 119 ff.

System configuration / connection of function blocks (→ Fig. 26):

22. A final "overall system configuration" is necessary so that the operating mode of the Analog
    Input Function Block can be set to AUTO and the field device is integrated into the system
    application.
    For this purpose, configuration software, e.g. NI–FBUS Configurator from National
    Instruments, is used to connect the function blocks to the desired control strategy (mostly
    using graphic display) and then the time for processing the individual process control functions
    is specified.
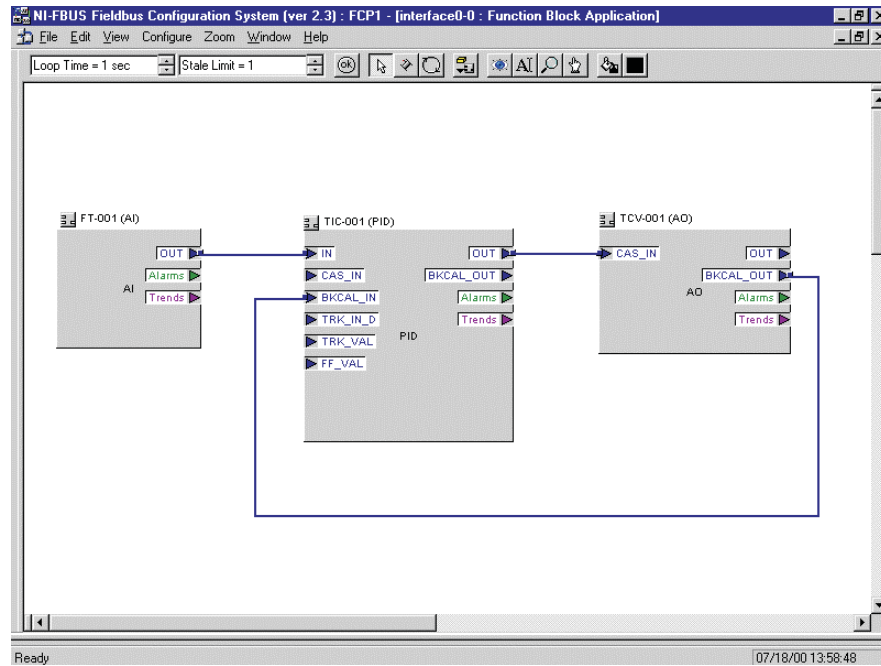
A0003790

Fig. 26:   Connecting function blocks with the aid of the "NI–FBUS Configurator"

23. Once you have specified the active LAS, download all the data and parameters to the field
    device.

24. Set the operating mode in the MODE_BLK parameter group (TARGET parameter) to AUTO.
    However, this is only possible if the following two conditions are met:
    – The function blocks are correctly connected to one another.
    – The Resource Block is in the AUTO operating mode.

7   Maintenance

The flow measuring system requires no special maintenance.

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.

Cleaning with pigs
Cleaning with pigs is **not** possible!

Replacing sensor seals
Under normal circumstances, wetted seals must not be replaced. Replacement is necessary only in special circumstances, for example if aggressive or corrosive fluids are incompatible with the seal material.

✎   Note!
- The time span between the individual replacements depends on the fluid properties.
- Replacement seals (accessory) → Page 44.
  Only Endress+Hauser sensor seals may be used.

Replacing housing seals
The housing seals must be clean and undamaged when inserted into their grooves.
The seals must be dried, cleaned or replaced if necessary.

✎   Note!
If the measuring device is used in a dust atmosphere, only the associated housing seals from Endress+Hauser should be used.

8   Accessories

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

Accessory	Description	Order code
Transmitter Prowirl 72	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable entry – Display / operation – Software – Outputs / inputs	72XXX — XXXXX*****K
Mounting kit for Prowirl 72 W	Mounting kit for wafer version consisting of: – Threaded studs – Nuts incl. washers – Flange seals	DKW — **_****
Mounting kit for sensor	Mounting kit for remote version, suitable for pipe and wall mounting.	DK5WM — B
Conversion kits	Conversion kits – Prowirl 72 to Prowirl 73 – Compact version to remote version (10 meters, 30 meters)	DK7UP – **
Flow conditioner	To reduce the inlet run after interference in the flow.	DK7ST – ***
Applicator	Software for selecting and planning flowmeters. The Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 — *
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 - ************
FieldCare	Modular software package consisting of the "FieldCare" service program for the configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and pressure measuring instruments (Evolution series) as well as the "FieldCare" service program for the configuration and diagnosis of Proline flowmeters. The Proline flowmeters are accessed via a service interface or the FXA193 service interface. Contents of the "FieldCare": – Commissioning, maintenance analysis – Measuring device configuration – Service functions – Visualization of process data – Troubleshooting – Access to the verification data and updating the software of the "Fieldcheck" flow simulator Contact your Endress+Hauser representative for more information.	See the product page on the Endress+Hauser website: www.endress.com

Accessory	Description	Order code
Pressure transmitter Cerabar S	Cerabar S is used for measuring the absolute and gauge pressure of gases, steams and liquids.	PMC71 – ********* PMP71 – *********
TMT 165 temperature transmitter	Universal two-channel field transmitter for resistance thermometers, thermocouples, resistance transmitters, voltage transmitters and differential measurement, can be configured via FOUNDATION Fieldbus protocol, PID controller, galvanic isolation	TMT165 – ****AA

9   Troubleshooting

9. 1   Troubleshooting instructions

Always start troubleshooting with the checklists below if faults occur after startup or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. In such cases, the procedures on Page 6 must be carried out before you return the measuring device to Endress+Hauser.
Always enclose a fully completed "Declaration of Contamination" form with the device. A copy of the form can be found at the end of these Operating Instructions.

Check display (local display)	
No display visible – No connection to the FOUNDATION Fieldbus host system.	1. Check supply voltage → Terminal 1, 2 2. Electronics defective → Order spare part → Page 56
No display visible – However, connection has been established to the FOUNDATION Fieldbus host system.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 57 2. Display module defective → Order spare part → Page 56 3. Electronics defective → Order spare part → Page 56

▼

Error messages on display	
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Type of error: **S** = System error, **P** = Process error – Error message type: ⚡ = fault message, **!** = notice message – **DSC SENS LIMIT** = error designation (device being operated near application limits) – **03:00:05** = duration of error occurrence (in hours / minutes /seconds) – **#395** = error number ☞ Caution! Please refer also to the information on Page 32 ff.!	
Error message present	System and process error messages → Page 49

▼

Faulty connection to the fieldbus host system	
No connection can be made between the fieldbus host system and the device. Check the following points:	
Fieldbus connection	Check data lines
Fieldbus connector (optional)	– Check pin assignment / wiring → Page 24 ff. – Check connection between connector / fieldbus port. Is the coupling ring tightened correctly?

Faulty connection to fieldbus host system (contd.)	
Fieldbus voltage	Check that a min. bus voltage of 9 V DC is present at terminals 1/2. Permissible range: 9 to 32 V DC
Network structure	Check permissible fieldbus length and number of spurs → Page 21
Basic current	Is there a basic current of min. 16 mA?
Fieldbus address	Check bus address: make sure there are no double assignments!
Terminating resistors	Has the FOUNDATION Fieldbus network been terminated correctly? Each bus segment must always be terminated with a bus terminator at both ends (start and finish). Otherwise there may be interference in communication.
Current consumption Permissible feed current	Check the current consumption of the bus segment: The current consumption of the bus segment in question (= total of basic currents of all bus users) must not exceed the max. permissible feed current of the bus power supply unit.

▼

Problems when configuring function blocks	
Transducer Blocks: The operating mode cannot be set to AUTO.	Check whether the operating mode of the Resource Block is set to AUTO → MODE_BLK parameter group / TARGET parameter.
Analog Input Function Block: The operating mode cannot be set to AUTO.	There can be several reasons for this. Check the following points one after another: 1. Check whether the operating mode of the Analog Input Function Block is set to AUTO. MODE_BLK parameter group / TARGET parameter. If not and the mode cannot be changed to AUTO, first check the following points. 2. Make sure that the CHANNEL parameter (select process variable) has already been configured in the Analog Input Function Block (see Page 40). The option CHANNEL = 0 (uninitialized) is not valid. 3. Make sure that the XD_SCALE parameter group (input range, unit) has already been configured in the Analog Input Function Block (see Page 40) (incl. configuration example) ☝ Caution! Make sure that the unit selected suits the process variable chosen in the CHANNEL parameter. Otherwise the BLOCK_ERROR parameter displays the "Block Configuration Error" error message. In this state, the operating mode cannot be set to AUTO. 4. Make sure that the L_TYPE parameter (linearization type) has already been configured in the Analog Input Function Block (see Page 40). 5. Check whether the operating mode of the Resource Block is set to AUTO. MODE_BLK parameter group / TARGET parameter 6. Make sure that the function blocks are correctly connected together and that this system configuration has been sent to the fieldbus users (→ Page 42)
Analog Input Function Block: Although the operating mode is set to AUTO, the status of the AI output value OUT is "BAD" or "UNCERTAIN".	Check whether an error is pending in the Transducer Block "Diagnosis" → Transducer Block "Diagnosis" → "Diagnosis – Actual System Condition" parameter. Error messages → Page 49

– Parameters cannot be changed or – No write access to parameters	1. Parameters that only show values or settings cannot be changed! 2. The hardware write protection is enabled. Disable the write protection → Page 35 ✎ Note! You can check whether the hardware write protection is enabled or disabled via the WRITE_LOCK parameter in the Resource Block: LOCKED = write protection enabled UNLOCKED = write protection disabled 3. The block operating mode is set to the wrong mode. Certain parameters can only be changed in the OOS (out of service) mode or the MAN (manual) mode → Set the operating mode of the block to the desired mode → MODE_BLK parameter group. 4. The value entered is outside the specified input range for the parameter in question: → Enter a suitable value → Increase input range if necessary 5. Transducer Blocks: the programming level is not enabled → Enable by entering the code in the "Un-/Locking – Access Code" parameter or by means of the Service Code in the Service parameters.
Transducer Block: The manufacturer-specific parameters are not visible.	The device description file (Device Description, DD) has not yet been loaded to the host system or the configuration program? Download the file to the configuration system. For information on where to obtain the DD see Page 33 ✎ Note! Make sure you are using the correct system files for integrating field devices into the host system. Relevant version information can be queried with Prowirl 72 by means of the following functions/parameters: FOUNDATION Fieldbus interface: – Resource Block → DEV_REV parameter – Resource Block → DD_REV parameter Example: Display in the DEV_REV parameter → 01 Display in the DD_REV parameter → 01 Device description file (DD) required → 0101.sym / 0101.ffo
Analog Input Function Block: The output value OUT is not updated despite a valid "GOOD" status.	The simulation is active → Deactivate the simulation by means of the SIMULATE parameter group.

▼

Other errors (without error message)	
Some other error has occurred.	Diagnosis and remedial measures → Seite 54

9. 2   System and process error messages

General notes
The measuring device always assigns system and process errors which occur to two types of error messages, resulting in different weightings.

"Fault message" error message type:
- If this message occurs, operation is immediately interrupted or stopped.
- Display on the FOUNDATION Fieldbus → Fault messages are relayed to downstream function blocks or higher-level process control systems with the status "BAD" of the AI output parameter OUT.
- Local display → A lightning symbol (↯) flashes on the display

"Notice message" error message type:
- Normal operation continues despite this message.
- Display on the FOUNDATION Fieldbus → Notice messages are relayed to downstream function blocks or higher-level process control systems with the status "UNCERTAIN" of the AI output parameter OUT.
- Local display → An exclamation mark (!) flashes on the display.

Serious system errors, e.g. electronic module defects, are always categorized and displayed as "Fault messages" by the measuring device. On the other hand, the measuring system interprets simulations of the measured value in the Transducer Block "Flow" and positive zero return as "Notice messages".

Error messages in FOUNDATION Fieldbus configuration programs → see Table
In Prowirl 72, system/process errors are recognized and reported in the Transducer Block "Diagnosis". Such errors are displayed by means of the following parameters specified in the FOUNDATION Fieldbus Specification:
- BLOCK_ERR
- Transducer Error

In the Transducer Block "Diagnosis", detailed causes of error or device status messages are displayed via the "Diagnosis – Actual System Condition" parameter (manufacturer-specific) → Table.

Error messages on the local display → See Table

No.	Error messages: – *FOUNDATION Fieldbus (FF)* * – *Local display*	Error messages in the Transducer Block "Diagnosis"	Analog Input funct. block error messages	Cause of error / remedy	Output variables affected
* In the FOUNDATION Fieldbus, error messages are displayed in the Transducer Block "Diagnosis" by means of the "Diag. – Act. Sys. Condition" parameter (manufacturer-specific). S = System error ↯ = Fault message (with an effect on operation) ! = Notice message (without any effect on operation)					
001	*Device status message (FF):* Critical Failure – Err. No. 001 *Local display:* S: CRITICAL FAIL. ↯: # 001	BLOCK_ERR = Device needs maintenance now Transducer_Error = Electronics failure	OUT. QUALITY = BAD OUT. SUBSTATUS = Device Failure BLOCK_ERR = Input Failure (incorrect input value from Transducer Blocks)	*Cause of error:* ROM/RAM error. Error when accessing the program memory (ROM) or random access memory (RAM) of the processor. *Remedy:* Replace the amplifier board.	All

No.	Error messages: – *FOUNDATION Fieldbus (FF)* * – *Local display*	Error messages in the Transducer Block "Diagnosis"	Analog Input funct. block error messages	Cause of error / remedy	Output variables affected
11	*Device status message (FF):* Amplifier EEPROM failure – Err. No. 011 *Local display:* S AMP HW-EEPROM ⚡ # 011	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause of error:* Faulty EEPROM *Remedy:* Replace the amplifier board. Spare parts → Page 56	All
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure		
12	*Device status message (FF):* Amplifier EEPROM data inconsistent – Err. No. 012 *Local display:* S AMP SW-EEPROM ⚡ # 012	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause of error:* Error when accessing data of the amplifier EEPROM *Remedy:* Perform a warm start (= start the measuring system without disconnecting main power). ■ FF: Transducer Block "Diagnosis" (base index 800) → "System – Reset" parameter → RESTART SYSTEM	All
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure		
21	*Device status message (FF):* COM module EEPROM failure – Err. No. 021 *Local display:* S COM HW-EEPROM ⚡ # 021	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause of error:* COM module: faulty EEPROM *Remedy:* Replace COM module. Spare parts → Page 58	All
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure		
22	*Device status message (FF):* COM module EEPROM data inconsistent – Err. No. 022 *Local display:* S COM SW EEPROM ⚡ # 022	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause of error:* COM module: error when accessing data of the EEPROM *Remedy:* Contact your Endress+Hauser service organization.	All
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure		
111	*Device status message (FF):* Totalizer could not be restored at startup – Err. No. 111 *Local display:* S CHECKSUM TOT. ⚡ # 111	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause of error:* Totalizer checksum error *Remedy:* Contact your Endress+Hauser service organization.	Totalizer only (Totalizer; CHANNEL=7)
		Transducer_Error = Data integrity error	OUT. SUBSTATUS = Device Failure		
261	*Device status message (FF):* Communication failure amplifier – Err. No. 261 *Local display:* S COMMUNIC. I/O ⚡ # 261	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause of error:* Communication error. No data reception between amplifier and I/O board or faulty internal data transfer. *Remedy:* Check whether the electronics boards are correctly inserted in their holders → Page 58, 60	All
		Transducer_Error = I/O Error (communication problems)	OUT. SUBSTATUS = Device Failure		

No.	Error messages: – *FOUNDATION Fieldbus (FF)* * – *Local display*	Error messages in the Transducer Block "Diagnosis"	Analog Input funct. block error messages	Cause of error / remedy	Output variables affected
379	*Device status message (FF):* Device operated in resonance frequency – Err. No. 379 *Local display:* S RESONANCE DSC ⚡ # 379		OUT. QUALITY = BAD	*Cause of error:* The device is being operated in the resonance frequency. ✎ Note! If the device is operated in the resonance frequency, this can result in damage which can lead to complete device failure. *Remedy* Reduce the flow.	All
		Transducer_Error = Unspecific error	OUT. SUBSTATUS = Non specific		
394	*Device status message (FF):* DSC sensor defect – Err. No. 394 *Local display:* S DSC SENS DEFCT ⚡ # 394	BLOCK_ERR = Device needs maintenance now	OUT. QUALITY = BAD	*Cause of error:* The DSC sensor is defective, measurement no longer takes place. *Remedy* Contact your Endress+Hauser service organization.	All
		Transducer_Error = Mechanical component error	OUT. SUBSTATUS = Sensor Failure		
395	*Device status message (FF):* DSC sensor defect – Err. No. 394 *Local display:* S DSC SENS LIMIT # 395	BLOCK_ERR = Other	OUT. QUALITY = UNCERTAIN	*Cause of error:* The DSC sensor is being operated near application limits, device failure is probable soon. *Remedy* If this message persists, please contact your local Endress+Hauser service organization.	All
		Transducer_Error = Unspecific error	OUT. SUBSTATUS = Non specific		

No.	Error messages: – *FOUNDATION Fieldbus (FF)* * – *Local display*	Error messages in the Transducer Block "Diagnosis"	Analog Input funct. block error messages	Cause of error / remedy	Output variables affected
396	Device status message (FF): Signal outside the set filter range – Err. No. 396 *Local display:* S SIGNAL>LOW PASS ⚡ # 396	BLOCK_ERR = Other Transducer_Error = Unspecific error	OUT. QUALITY = BAD OUT. SUBSTATUS = Non specific	*Cause of error:* The device finds the signal outside the set filter range. Possible causes: ■ The flow is outside the measuring range. ■ The signal is caused by a strong vibration which is intentionally not measured and outside the measuring range. *Remedy:* ■ Check whether the device was installed in the flow direction. ■ Verify that the correct option was selected in the "Process Param. – Application" parameter in the Transducer Block "Flow" (→ Page 93). ■ Check whether the operating conditions are within the specifications of the measuring device (e.g. flow is above measuring range which means that the flow may have to be reduced) If the check does not solve the problem, please contact your E+H service organization.	All
399	Device status message (FF): Pre-amplifier disconnected – Err. No. 399 *Local display:* S PREAMP. DISCONN. ⚡ # 399	BLOCK_ERR = Device needs maintenance now Transducer_Error = Electronics component error	OUT. QUALITY = BAD OUT. SUBSTATUS = Device Failure	*Cause of error:* Pre-amplifier disconnected. *Remedy:* Check the connection between the preamplifier and amplifier board and establish connection if necessary.	All
501	Device status message (FF): Download device software active – Err. No. 501 *Local display:* S SW. UPDATE ACT. ! # 501	 Transducer_Error = Unspecific error	OUT. QUALITY = UNCERTAIN OUT. SUBSTATUS = Non specific	*Cause of error:* New amplifier software version or data being loaded into device. No other commands can be executed. *Remedy:* Wait until the procedure is complete. The device is automatically restarted.	All

No.	Error messages: – *FOUNDATION Fieldbus (FF)* * – *Local display*	Error messages in the Transducer Block "Diagnosis"	Analog Input funct. block error messages	Cause of error / remedy	Output variables affected
502	*Device status message (FF):* Up-/ Download active – Err. No. 502 *Local display:* S UP./DOWNLOAD ACT. ! # 502		OUT. QUALITY = UNCERTAIN	*Cause of error:* Device data are being uploaded. No other commands can be executed. *Remedy:* Wait until the procedure is complete.	All
		Transducer_Error = Unspecific error	OUT. SUBSTATUS = Non specific		
601	*Device status message (FF):* Positive zero return active – Err. No. 601 *Local display:* S POS. ZERO-RET. ! # 601		OUT. QUALITY = UNCERTAIN	*Cause:* Positive zero return is active. ✎ Note! This message has the highest display priority. *Remedy:* Switch off positive zero return: ▪ FF: Transducer Block "Flow" (base index 500) → "System - Positive Zero Return" parameter" → OFF	All
		Transducer_Error = Unspecific error	OUT. SUBSTATUS = Non specific		
691	*Device status message (FF):* Simulation Failsafe active – Err. No. 691 *Local display:* S SIM. FAILSAFE ! # 691	BLOCK_ERR = Simulation active	OUT. QUALITY = BAD	*Cause:* Simulation of failsafe mode (totalizer) active. *Remedy:* Switch off simulation: ▪ FF: Transducer Block "Diagnosis" (base index 800) → "System - Simulation Failsafe Mode" parameter → OFF	All
		Transducer_Error = Unspecific error	OUT. SUBSTATUS = Non specific		
692	*Device status message (FF):* Simulation measurand active – Err. No. 692 *Local display:* S SIM. MEASURAND ! # 692	BLOCK_ERR = Simulation active	OUT. QUALITY = UNCERTAIN	*Cause:* Simulation is active *Remedy:* Switch off simulation: ▪ FF: Transducer Block "Flow" (base index 500) → "Simulation -Measurand" parameter → OFF	All
		Transducer_Error = Unspecific error	OUT. SUBSTATUS = Non specific		
698	*Device status message (FF):* Device test active – Err. No. 698 *Local display:* S DEV. TEST ACT. ! # 698		OUT. QUALITY = UNCERTAIN	*Cause:* The device is tested on site by the "Fieldcheck" tester and simulator. *Remedy:* Remove "Fieldcheck" device.	All
		Transducer_Error = Unspecific error	OUT. SUBSTATUS = Non specific		

9. 3   Process errors without messages

Symptoms	Remedial measures
Remark: You may have to change or correct settings in certain functions of the function matrix in order to rectify faults. The functions listed below are explained in detail in the Section "Operation via FOUNDATION Fieldbus" on Page 80 ff.	
No flow signal	■ For liquids: Check whether the piping is completely filled. The piping must always be completely filled for accurate and reliable flow measurement. ■ Check whether all the packaging material, including the meter body protective covers, was completely removed before mounting the device. ■ Check whether the desired electrical output signal was connected correctly.
Flow signal even though there is no flow	Check whether the device is exposed to particularly strong vibrations. If so, a flow can be displayed even if the fluid is at a standstill, depending on the frequency and direction of the vibration. Remedial measures at the device: ■ Turn the sensor 90° (please observe the installation conditions when doing so, see Page 11 ff.). The measuring system is most sensitive to vibrations which follow in the direction of the sensor. Vibrations have less of an effect on the device in the other axes. ■ In the Transducer Block "Flow" → "Sensor Data - Amplification" parameter, change the amplification → Page 101. Remedy through constructive measures during installation: ■ If the source of the vibration (e.g. pump or a valve) has been identified, the vibrations can be reduced by decoupling or supporting the source. ■ Support the piping near the device. If these measures do not solve the problem, your Endress+Hauser service organization can adjust the filters of the device to suit your special application.

Faulty or highly-fluctuating flow signal	■ The fluid is not sufficiently single-phase or homogeneous. The piping must always be completely filled and the fluid must be single-phase and homogeneous for accurate and reliable flow measurement.
	■ In many instances, the following measures can be taken to improve the measurement result even under non-ideal conditions:
	  – For liquids with a low gas content in horizontal pipework, it helps to install the device with the head pointing downwards or to the side. This improves the measuring signal since the sensor is not in the area where gas accumulates when this type of installation is used.
	  – For liquids with a low solids content, avoid installing the device with the electronics housing pointing downwards.
	  – For steam or gases with a low liquid content, avoid installing the device with the electronics housing pointing downwards.
	■ The inlet and outlet runs must be present as per the installation instructions (see see Page 14).
	■ Suitable seals with an internal diameter not smaller than the pipe internal diameter must be installed and correctly centered.
	■ The static pressure must be large enough to rule out cavitation in the area of the sensor.

Symptoms	Remedial measures
(continued) Faulty or highly fluctuating flow signal (contd.)	■ Verify that the correct state of aggregation has been selected in the Transducer Block "Flow" → "Process Param. – Application" parameter → Page 93. The setting in this function determines the filter settings and can thus have an effect on the measuring range. ■ Check whether the data for the K-factor on the nameplate match the data in the Transducer Block "Flow" → "Sensor Data – K-Factor" parameter (→ Page 99). ■ Check whether the device is correctly installed in the flow direction. ■ Verify that the nominal diameter of the mating pipe and the device match (Transducer Block "Flow" → "Process Param. – Mating Pipe Diameter" parameter → Page 96). ■ The flow must be in the measuring range of the device (→ Page 62, "measuring range"). The start of measuring range depends on the density and the viscosity of the fluid. Density and viscosity depend on temperature. Density also depends on the process pressure in the case of gases. ■ Check whether the operating pressure is affected by pressure pulsations (e.g. from piston pumps). The pulsations can affect vortex shedding if they have a frequency similar to the vortex frequency. ■ Check whether the correct engineering unit was selected for the flow or totalizer.
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: **Request the services of an Endress+Hauser service technician** If you contact our service organization to have a service technician sent out, please be ready with the following information: – A brief description of the error with information on the application. – Nameplate specifications (→ Page 7 ff.): order code and serial number **Return devices to Endress+Hauser** The procedures on Page 6 must be carried out before you return a measuring device requiring repair or calibration to Endress+Hauser. Always enclose a fully completed "Declaration of Contamination" form with the flowmeter. A copy of the form can be found at the end of these Operating Instructions. **Replace transmitter electronics** Components in the electronics defective → order spare part → Page 56

9.4   Spare parts

Section 9.1 contains detailed troubleshooting instructions (→ Page 46).
The measuring device, moreover, provides additional support in the form of continuous self–diagnosis and error messages.
Troubleshooting 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 quoting the serial number printed on the transmitter nameplate (→ Page 7).

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (screws, etc.)
- Installation instructions
- Packaging
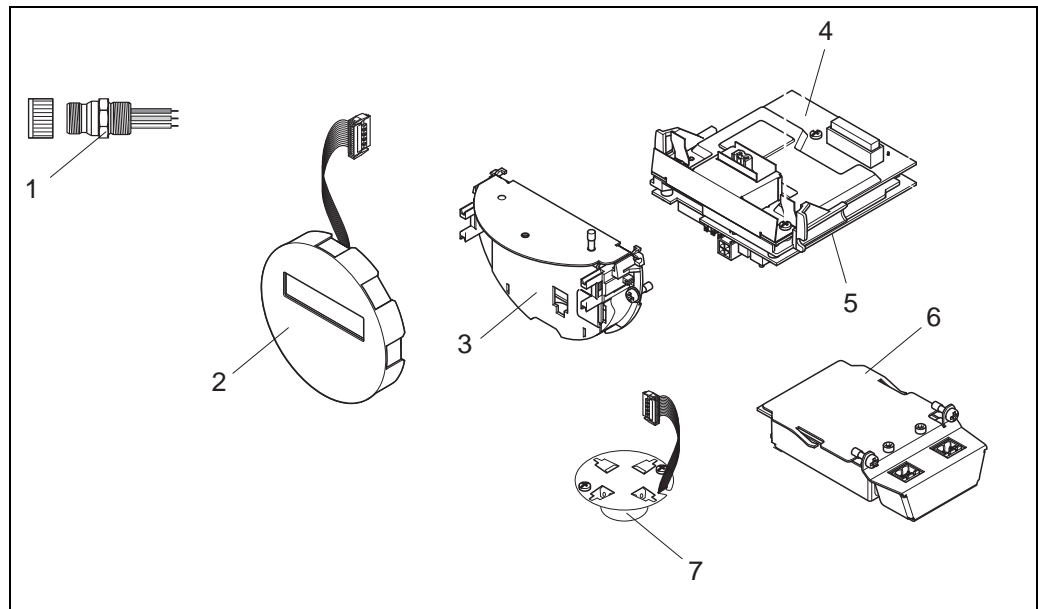
A0007372

Fig. 27:   Spare parts for Proline Prowirl 72 FOUNDATION Fieldbus transmitter (field and wall-mount housing)

1   Fieldbus connector
2   Local display module
3   Board holder
4   I/O board (COM module); Non-Ex, Ex i/IS and Ex n version
5   Amplifier board
6   I/O board (COM module); Ex–d/XP version
7   Pre–amplifier

9. 5   Installing and removing electronics boards

9.5.1   Non-Ex, Ex i/IS and Ex n version

✎   Note!
- When connecting Ex-certified devices, please refer to the notes and diagrams in the Ex-specific supplement to these Operating Instructions.

- 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!

☞   Caution!
Use only genuine Endress+Hauser parts.

Procedure when installing/removing electronics boards (→ Fig. 28)

1. Unscrew the cover (a) of the electronics compartment from the transmitter housing.
2. Remove the display module (b) from the retaining rails (c).
3. Fit the display module (b) with the left side onto the right retaining rail (c) (this secures the display module).
4. Loosen the fixing screw (d) of the cover of the connection compartment (e) and fold down the cover.
5. Pull terminal connector (f) out of the I/O board (COM module) (q).
6. Fold up the plastic cover (g).
7. Remove the signal cable connector (h) from the amplifier board (s) and release from the cable holder (i).
8. Remove the ribbon cable connector (j) from the amplifier board (s) and release from the cable holder (k).
9. Remove the local display module (b) from the right retaining rail (c).
10. Fold down the plastic cover (g) again.
11. Release both fixing screws (l) of the board holder (m).
12. Pull the board holder (m) out completely.
13. Press the side latches (n) of the board holder and separate the board holder (m) from the board body (o).

14. Replace the I/O board (COM module) (q):
    – Loosen the three fixing screws (p) of the I/O board (COM module).
    – Remove the I/O board (COM module) (q) from the board body (o).
    – Set a new I/O board (COM module) on the board body.

15. Replace the amplifier board (s):
    – Loosen fixing screws (r) of the amplifier board.
    – Remove the amplifier board (s) from the board body (o).
    – Set a new amplifier board on the board body.

16. Installation is the reverse of the removal procedure.
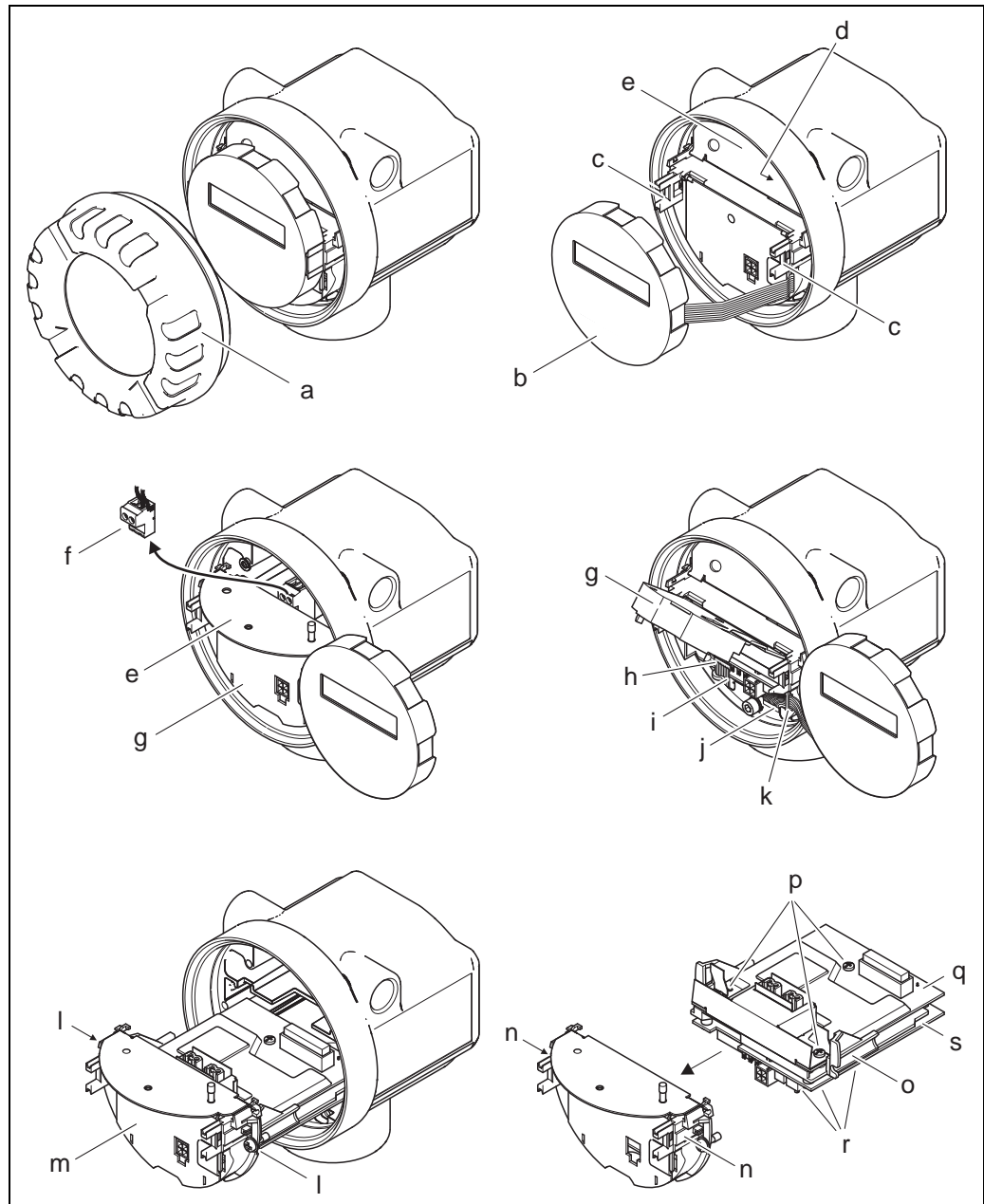
A0003792

Fig. 28:   Installing and removing electronics boards Non-Ex, Ex-i and Ex n version

a *Cover of electronics compartment*
b *Display module*
c *Display module retaining rails*
d *Fixing screw for cover of connection compartment*
e *Connection compartment cover*
f *Terminal connector*
g *Plastic cover*
h *Signal cable connector*
i *Retainer for signal cable connector*
j *Display module ribbon-cable connector*
k *Retainer for ribbon-cable connector*
l *Fixing screws for board holder*
m *Board holder*
n *Board holder latches*
o *Board body*
p *Fixing screws for I/O board (COM module)*
q *I/O board (COM module)*
r *Fixing screws for amplifier board*
s *Amplifier board*

9.5.2   Ex d/XP version

✎   Note!
- When connecting Ex–certified devices, please refer to the notes and diagrams in the Ex–specific supplement to these Operating Instructions.

- 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!

☞   Caution!
Use only genuine Endress+Hauser parts.

Procedure when installing/removing electronics boards (→ Fig. 29)

Installing/removing I/O board (COM module)

1. Release the securing clamp (a) of the connection compartment cover (b).
2. Remove connection compartment cover (b) from the transmitter housing.
3. Pull the terminal connector (c) out of the I/O board (COM module) (e).
4. Release fixing screws (d) of the I/O board (COM module) (e) and pull out the board slightly.
5. Remove connecting cable plug (f) from the I/O board (COM module) (e) and remove the board completely.
6. Installation is the reverse of the removal procedure.

Installing and removing the amplifier board

1. Unscrew the cover (g) of the electronics compartment from the transmitter housing.
2. Remove the display module (h) from the retaining rails (i).
3. Fold up the plastic cover (j).
4. Remove the ribbon–cable connector of the local display module (h) from the amplifier board (t) and release from the cable holder.
5. Remove the signal cable connector (k) from the amplifier board (t) and release from the cable holder.
6. Release the fixing screw (l) and fold down the cover (m).
7. Release both fixing screws (n) of the board holder (o).
8. Pull the board holder (o) out slightly and disconnect the connecting cable plug (p) from the board body.
9. Pull the board holder (o) out completely.
10. Press the side latches (q) of the board holder and separate the board holder (o) from the board body (r).
11. Replace the amplifier board (t):
    – Loosen fixing screws (s) of the amplifier board.
    – Remove the amplifier board (t) from the board body (r).
    – Set a new amplifier board on the board body.

12. Installation is the reverse of the removal procedure.
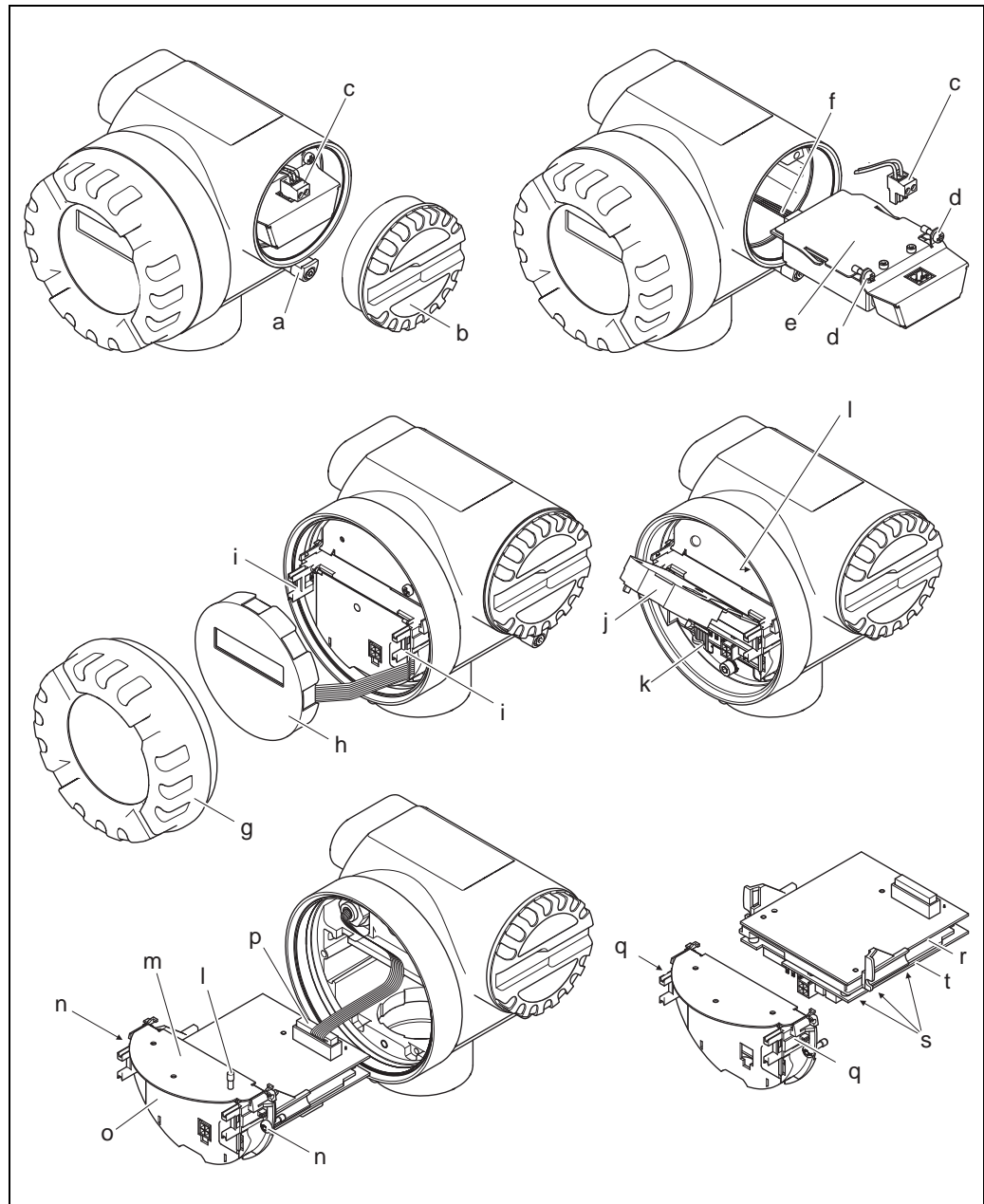
A00003793

Fig. 29:   Installing and removing electronics boards Ex d/XP version

a   *Clamp for cover of connection compartment*
b   *Cover of connection compartment*
c   *Terminal connector*
d   *Fixing screws for I/O board (COM module)*
e   *I/O board (COM module)*
f   *Connecting cable plug I/O–module*
g   *Cover of electronics compartment*
h   *Display module*
i   *Retaining rails of local display module*
j   *Plastic cover*
k   *Signal cable connector*
l   *Fixing screw for cover of connection compartment*
m   *Connection compartment cover*
n   *Fixing screws for board holder*
o   *Board holder*
p   *Connecting cable plug*
q   *Board holder latches*
r   *Board body*
s   *Fixing screws for amplifier board*
t   *Amplifier board*

9. 6   Software history

Date	Software version	Software modifications	Documentation
06.2004	Communication module: V 1.00.00	Original software	71041313/01.07 50107507/06.04
03.2004	Amplifier: V 1.01.03	Supplement: ■ Support of the Prowirl 72, 73 FOUNDATION Fieldbus communication module. Compatible with: ■ FieldCare (the current SW version can be downloaded from the home page: www.FieldCare.endress.com)	

10 Technical data

10. 1 Technical data at a glance

10.1.1 Application

The measuring system is used to measure the volume flow of saturated steam, superheated steam, gases and liquids. If the process pressure and process temperature are constant, the measuring device can also output the flow as the calculated mass flow and corrected volume flow.

10.1.2 Function and system design

Measuring principle	Vortex flow measurement on the principle of the Karman vortex street.

Measuring system

The measuring system consists of a transmitter and a sensor:
- Prowirl 72 FOUNDATION Fieldbus transmitter
- Prowirl F or W sensor

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

10.1.3 Input

Measured variable

Volumetric flow (volume flow) is proportional to the frequency of vortex shedding after the bluff body.

Volume flow can be output as the output variable, as can the calculated mass flow or corrected volume flow if process conditions are constant.

Measuring range

The measuring range depends on the fluid and the pipe diameter.

Start of measuring range
Depends on the density and the Reynolds number ($Re_{min} = 4000$, $Re_{linear} = 20\,000$). The Reynolds number is dimensionless and indicates the ratio of a fluid's inertial forces to its viscous forces. It is used to characterize the flow. The Reynolds number is calculated as follows:

$$Re = \frac{4 \cdot Q\,[m^3/s] \cdot \rho\,[kg/m^3]}{\pi \cdot di\,[m] \cdot \mu\,[Pa{\cdot}s]} \qquad Re = \frac{4 \cdot Q\,[ft^3/s] \cdot \rho\,[lb/ft^3]}{\pi \cdot di\,[ft] \cdot \mu\,[0.001\,cP]}$$

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Re = Reynolds number
Q = Flow
di = Internal diameter
μ = Dynamic viscosity
ρ = Density

$$DN\ 15...25 \rightarrow v_{min.}^* = \frac{6}{\sqrt{\rho\,[kg/m^3]}}\ [m/s] \qquad DN\ 40...300 \rightarrow v_{min.}^* = \frac{7}{\sqrt{\rho\,[kg/m^3]}}\ [m/s]$$

$$\tfrac{1}{2}...1" \rightarrow v_{min.}^* = \frac{4.92}{\sqrt{\rho\,[lb/ft^3]}}\ [ft/s] \qquad 1\tfrac{1}{2}...12" \rightarrow v_{min.}^* = \frac{5.74}{\sqrt{\rho\,[lb/ft^3]}}\ [ft/s]$$

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Full scale value

Liquids: v_{max} = 9 m/s (30 ft/s)

Gas/steam: see Table

Nominal diameter	v_{max}
Standard instrument: DN 15 (½") R-type: DN 25 (1") > DN 15 (½") S-type: DN 40 (1½") >> DN 15 (½")	46 m/s (151 ft/s) or Mach 0.3 (depending on which is smaller)
Standard instrument: DN 25 (1"), DN 40 (1½") R-type: – DN 40 (1½") > DN 25 (1") – DN 50 (2") > DN 40 (1½") S-type: – DN 80 (3") >> DN 40 (1½")	75 m/s (246 ft/s) or Mach 0.3 (depending on which is smaller)
Standard instrument: DN 50 (2") to 300 (12") R-type: – DN 80 (3") > DN 50 (2") – Nominal diameters larger than DN 80 (3") S-type: – DN 100 (4") >> DN 50 (2") – Nominal diameters larger than DN 100 (4")	120 m/s (394 ft/s) or Mach 0.3 (depending on which is smaller) Calibrated range: up to 75 m/s (246 ft/s)

✎ Note!

By using the selection and planning program "Applicator", you can determine the exact values for the fluid you use. You can obtain the Applicator from your Endress+Hauser sales center or on the Internet under www.endress.com.

K-factor range

The table is used for orientation purposes. The range in which the K-factor can be is indicated for individual nominal diameters and designs.

Nominal diameter		K-factor range [pulse/dm³]	
DIN	ANSI	72 F	72 W
DN 15	½"	390 to 450	245 to 280
DN 25	1"	70 to 85	48 to 55
DN 40	1½"	18 to 22	14 to 17
DN 50	2"	8 to 11	6 to 8
DN 80	3"	2.5 to 3.2	1.9 to 2.4
DN 100	4"	1.1 to 1.4	0.9 to 1.1
DN 150	6"	0.3 to 0.4	0.27 to 0.32
DN 200	8"	0.1266 to 0.1400	–
DN 250	10"	0.0677 to 0.0748	–
DN 300	12"	0.0364 to 0.0402	–

10.1.4   FOUNDATION Fieldbus output

Output signal	Physical data transfer (Physical Layer Type): • Fieldbus interface in accordance with IEC 61158-2 (MBP) • With integrated reverse polarity protection
Signal on alarm	Status message in accordance with Specification of the FOUNDATION Fieldbus
Starting current	Smaller than the basic current
Basic current	16 mA

Error current	0 mA
Permissible fieldbus feed voltage	9 to 32 V
Data transmission rate	31.25 kBit/s, voltage mode
Signal coding	Manchester II
Bus times	Min. rest between two telegrams: MIN_INTER_PDU_DELAY = 6 octet time (transmission time per octet)

Block information,
execution times

Block	Base index	Execution time [ms]
Resource Block	400	–
Transducer Block "Flow"	500	–
Transducer Block "Totalizer"	600	–
Transducer Block "Display"	700	–
Transducer Block "Diagnosis"	800	–
Transducer Block "Service"	900	–
Analog Input Function Block 1	1000	50
Analog Input Function Block 2	1100	50
Discrete Output Function Block	1200	50

Output data

Transducer Blocks / Analog Input Function Blocks

Block	Process variable	Channel parameter (AI Block)
Transducer Block "Flow"	Calculated mass flow	1
	Volume flow	2
	Corrected volume flow	3
Transducer Block "Totalizer"	Totalizer	7

Input data

Discrete Output Function Block

Status change			Action
Discrete state 0	→	Discrete state 1	Reserved
Discrete state 0	→	Discrete state 2	Positive zero return ON
Discrete state 0	→	Discrete state 3	Positive zero return OFF
Discrete state 0	→	Discrete state 4	Reserved
Discrete state 0	→	Discrete state 5	Reserved
Discrete state 0	→	Discrete state 6	Reserved
Discrete state 0	→	Discrete state 7	Reserved
Discrete state 0	→	Discrete state 8	Reset totalizer

LM function

LM function is supported.

10.1.5 Power supply

Electrical connection	see Page 20 ff.
Supply voltage	9 to 32 V DC
Cable entry	Power supply cable/fieldbus cable (outputs): ■ Cable entry: M20 × 1.5 (6 to 12 mm / 0.24 to 0.47 inch) ■ Thread for cable entry: ½" NPT, G ½", G ½" Shimada
Cable specifications, remote version	■ Permitted temperature range: between −40 °C (−40 °F) and the max. permissible ambient temperature plus 10 °C (plus 18 °F) ■ Remote version → Page 23
Power supply failure	■ The totalizer stops at the last value determined. ■ All settings are kept in the EEPROM. ■ Error messages are stored.

10.1.6 Performance characteristics

Reference operating conditions	Error limits following ISO/DIN 11631: ■ 20 to 30 °C (68 to 86 °F) ■ 2 to 4 bar (30 to 60 psi) ■ Calibration rig traced to national standards. ■ Calibration with the process connection corresponding to the particular standard.
Maximum measured error	■ Liquid: <0.75% o.r. for Re > 20 000 <0.75% o.f.s for Re between 4000 and 20 000 ■ Gas/steam: <1% o.r. for Re > 20 000 and v < 75 m/s (246 ft/s) <1% o.f.s for Re between 4000 and 20 000 o.r. = of reading o.f.s. = of full scale value Re = Reynolds number **Diameter jump correction** Prowirl 72 can correct shifts in the calibration factor which are caused by a jump in the diameter between the device flange and the mating pipe. The diameter jump should only be corrected within the following limit values (for which test measurements have also been performed). Flange connection: DN 15 (½"): ±20% of the internal diameter DN 25 (1"): ±15% of the internal diameter DN 40 (1½"): ±12% of the internal diameter DN ≥ 50 (2"): ±10% of the internal diameter

Wafer:
DN 15 (½"): ±15% of the internal diameter
DN 25 (1"): ±12% of the internal diameter
DN 40 (1½"): ±9% of the internal diameter
DN ≥ 50 (2"): ±8% of the internal diameter

Repeatability	±0.25% o.r. (of reading)

Reaction time/step response time	If all the configurable functions are set to 0, you must reckon with a reaction time/step response time of 200 ms for vortex frequencies of 10 Hz and higher. For other settings where vortex frequencies are 10 Hz and higher, a reaction time/step response time of 100 ms has to be added to the overall filter reaction time. ■ System Param. – Flow Damping → Page 99 ■ Display – Damping → Page 110 ■ Sensor Data – Amplification → Page 101 ■ PV_FTIME → Page 114 ff.

10.1.7   Operating conditions: Installation

Installation instructions	see Page 11

Inlet and outlet run	see Page 14 ff.

10.1.8   Operating conditions: Environment

Ambient temperature range	**Compact version** ■ Standard: –40 to +70 °C (–40 to +158 °F) ■ EEx d/XP version: –40 to +60 °C (–40 to +140 °F) ■ ATEX II 1/2 GD version/dust ignition-proof: –20 to +55 °C (–4 to +131 °F) ■ Display can be read between –20 and +70 °C (–4 to +158 °F) **Sensor remote version** ■ Standard: –40 to +85 °C (–40 to +185 °F) ■ ATEX II 1/2 GD version/dust ignition-proof: –20 to +55 °C (–4 to +131 °F) **Transmitter remote version** ■ Standard: –40 to +80 °C (–40 to +176 °F) ■ EEx d/XP version: –40 to +60 °C (–40 to +140 °F) ■ ATEX II 1/2 GD version/dust ignition-proof: –20 to +55 °C (–4 to +131 °F) ■ Display can be read between –20 °C and +70 °C (–4 to +158 °F) ■ Version to –50 °C (–58 °F) on request When mounting outside, we recommend you protect from direct sunlight with a protective cover (order number 543199-0001), especially in warmer climates with high ambient temperatures.

Storage temperature	Standard: –40 to +80 °C (–40 to +176 °F) ATEX II 1/2 GD version/dust ignition-proof: –20 to +55 °C (–4 to +131 °F) Version to –50 °C (–58 °F) on request

Degree of protection	IP 67 (NEMA 4X) in accordance with EN 60529

Vibration resistance	Acceleration up to 1 g ((with factory setting for amplification), 10 to 500 Hz, following IEC 60068‑2‑6

Electromagnetic compatibility (EMC)	To IEC/EN 61326 and NAMUR Recommendation NE 21.

10.1.9   Operating conditions: Process

Medium temperature

DSC sensor (Differential Switched Capacitor)

DSC standard sensor	−40 to +260 °C (−40 to +500 °F)
DSC high/low temperature sensor	−200 to +400 °C (−328 to +752 °F)
DSC sensor Inconel (PN 63 to 160, Class 600, JIS 40K)	−200 to +400 °C (−328 to +752 °F)
DSC sensor titanium Gr. 5 (PN 250, Class 900 to 1500 and butt‑weld version)	−50 to +400 °C (−58 to +752 °F)
DSC sensor Alloy C‑22	−200 to +400 °C (−328 to +752 °F)

Seals

Graphite	−200 to +400 °C (−328 to +752 °F)
Viton	−15 to +175 °C (+5 to +347 °F)
Kalrez	−20 to +275 °C (−4 to +527 °F)
Gylon (PTFE)	−200 to +260 °C (−328 to +500 °F)

Sensor

Stainless steel	−200 to +400 °C (−328 to +752 °F)
Alloy C‑22	−40 to +260 °C (−40 to +500 °F)
Special version for very high fluid temperatures (on request)	−200 to +450 °C (−328 to +842 °F) −200 to +440 °C (−328 to +824 °F), Ex version

Medium pressure

Pressure-temperature curve to EN (DIN), (stainless steel)
PN 10 to 40 → Prowirl 72W and 72F
PN 63 to 250 → Prowirl 72F
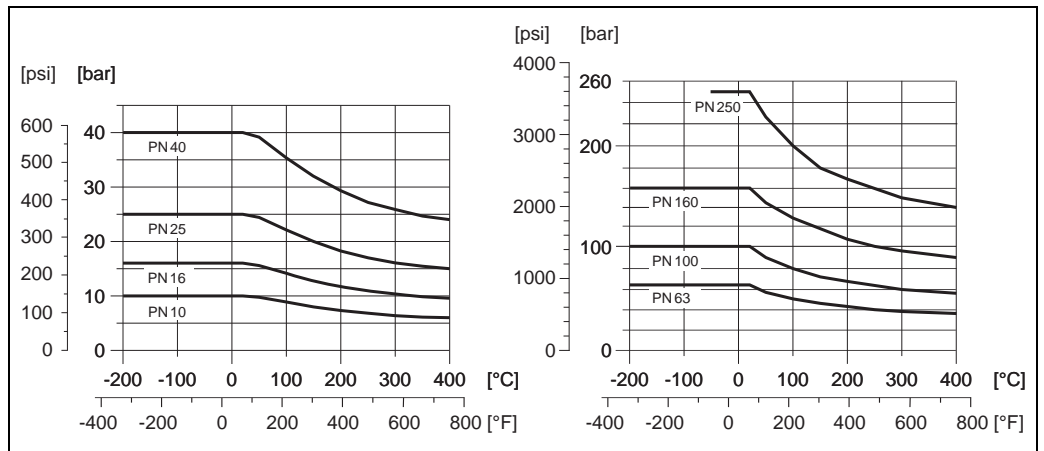
A0003238

Pressure-temperature curve according to ANSI B16.5, stainless steel
Class 150 to 300 → Prowirl 72W and 72F
Class 600 to 1500 → Prowirl 72F
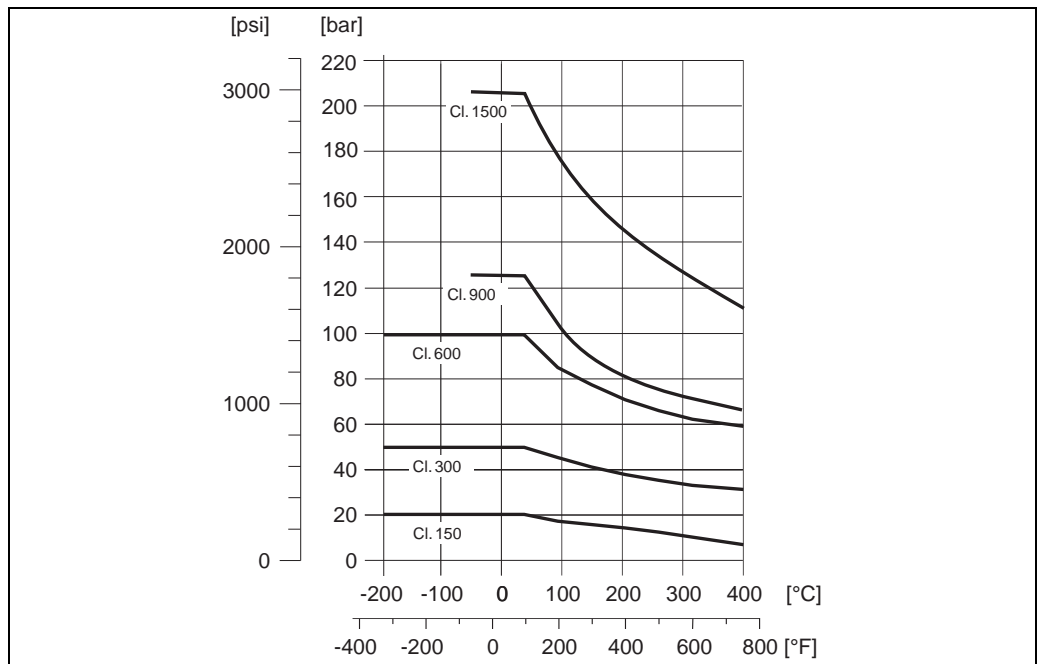
A0003402

Pressure-temperature curve according to JIS B2220, stainless steel
10 to 20K → Prowirl 72W and 72F
40K → Prowirl 72F
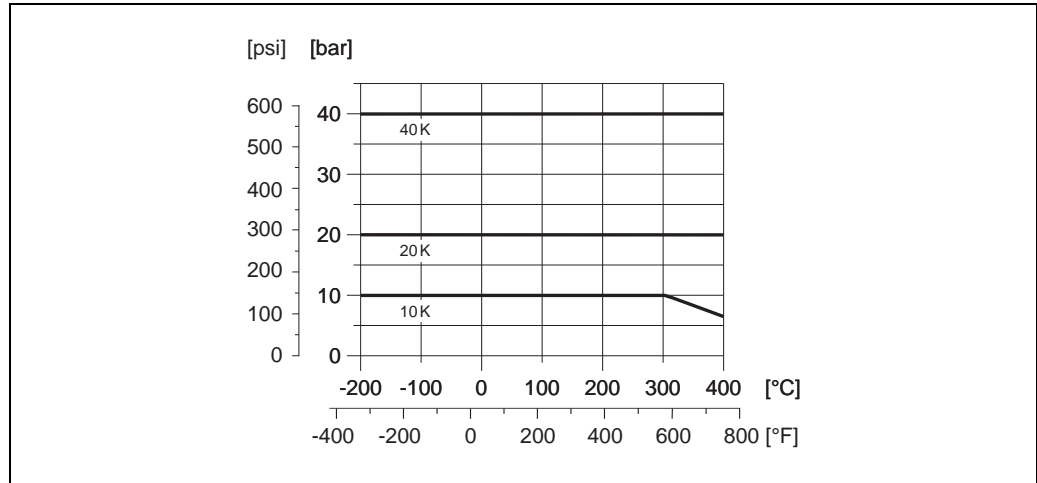
A0003404

Pressure-temperature curve to EN (DIN), ANSI B16.5 and JIS B2220, Alloy C-22
PN 16 to 40, Class 150 to 300, 10 to 20K → Prowirl 72F
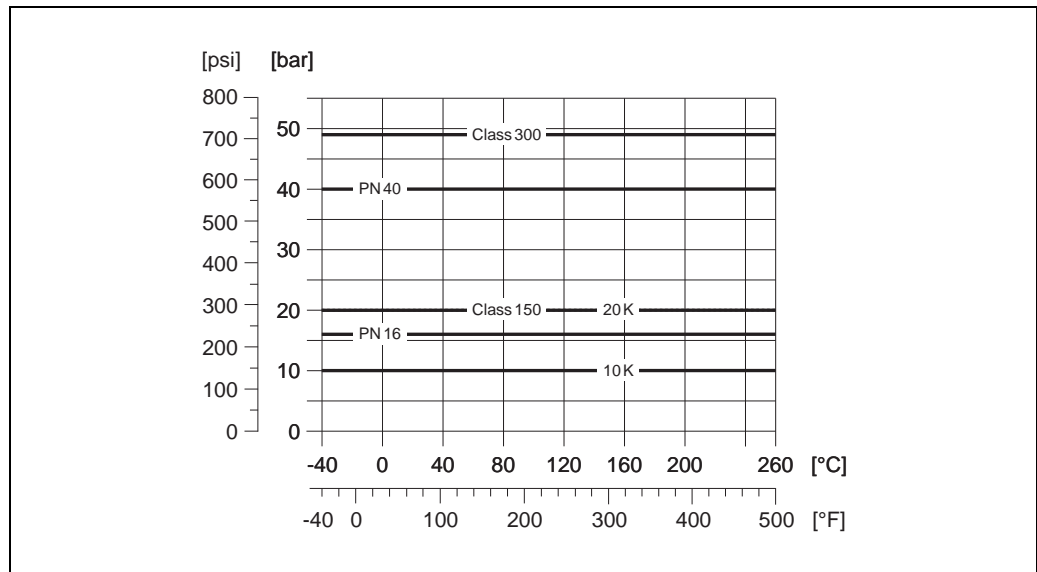
A0003395

Limiting flow	See data on Page 62 ff. ("measuring range")

Pressure loss	The pressure loss can be determined with the aid of the Applicator. The Applicator is software for selecting and planning flowmeters. The software is available both via the Internet (www.applicator.com) and on a CD-ROM for local PC installation.

10.1.10 Frequency ranges for air and water

For further media, e.g. steam, you can find information in the Applicator.

Prowirl 72W (SI units)

DN (DIN)	Air (at 0 °C, 1.013 bar)			Water (at 20 °C)			K-factor
	Corrected volume flow ($\dot{V}$) in [m³/h]			Volume flow ($\dot{V}$) in [m³/h]			[Pulse/dm³]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	min to max
DN 15	4	35	330 to 2600	0.19	7	10.0 to 520	245 to 280
DN 25	11	160	180 to 2300	0.41	19	5.7 to 300	48 to 55
DN 40	31	375	140 to 1650	1.1	45	4.6 to 200	14 to 17
DN 50	50	610	100 to 1200	1.8	73	3.3 to 150	6 to 8
DN 80	112	1370	75 to 850	4.0	164	2.2 to 110	1.9 to 2.4
DN 100	191	2330	70 to 800	6.9	279	2.0 to 100	1.1 to 1.4
DN 150	428	5210	38 to 450	15.4	625	1.2 to 55	0.27 to 0.32

Prowirl 72W (US units)

DN (ANSI)	Air (at 32 °F, 14.7 psia)			Water (at 68 °F)			K-factor
	Corrected volume flow ($\dot{V}$) in [scfm]			Volume flow ($\dot{V}$) in [gpm]			[Pulse/dm³]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	min to max
½"	2.35	20.6	330 to 2600	0.84	30.8	10.0 to 520	245 to 280
1"	6.47	94.2	180 to 2300	1.81	83.7	5.7 to 300	48 to 55
1½"	18.2	221	140 to 1650	4.84	198	4.6 to 200	14 to 17
2"	29.4	359	100 to 1200	7.93	321	3.3 to 150	6 to 8
3"	65.9	806	75 to 850	17.6	722	2.2 to 110	1.9 to 2.4
4"	112	1371	70 to 800	30.4	1228	2.0 to 100	1.1 to 1.4
6"	252	3066	38 to 450	67.8	2752	1.2 to 55	0.27 to 0.32

Prowirl 72F (SI units)

DN (DIN)	Air (at 0 °C, 1.013 bar)			Water (at 20 °C)			K-factor
	Corrected volume flow (V̇) in [m³/h]			Volume flow (V̇) in [m³/h]			[Pulse/dm³]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	min to max.
DN 15	3	25	380 to 2850	0.16	5	14.0 to 600	390 to 450
DN 25	9	125	200 to 2700	0.32	15	6.5 to 340	70 to 85
DN 40	25	310	150 to 1750	0.91	37	4.5 to 220	18 to 22
DN 50	42	510	120 to 1350	1.5	62	3.7 to 170	8 to 11
DN 80	95	1150	80 to 900	3.4	140	2.5 to 115	2.5 to 3.2
DN 100	164	2000	60 to 700	5.9	240	1.9 to 86	1.1 to 1.4
DN 150	373	4540	40 to 460	13.4	550	1.2 to 57	0.3 to 0.4
DN 200	715	8710	27 to 322	25.7	1050	1.0 to 39	0.1266 to 0.14
DN 250	1127	13 740	23 to 272	40.6	1650	0.8 to 33	0.0677 to 0.0748
DN 300	1617	19 700	18 to 209	58.2	2360	0.6 to 25	0.0364 to 0.0402

Prowirl 72F (US units)

DN (ANSI)	Air (at 32 °F, 14.7 psia)			Water (at 68 °F)			K-factor
	Corrected volume flow (V̇) in [scfm]			Volume flow (V̇) in [gpm]			[Pulse/dm³]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	min to max.
½"	1.77	14.7	380 to 2850	0.70	22.0	14.0 to 600	390 to 450
1"	5.30	73.6	200 to 2700	1.41	66.0	6.5 to 340	70 to 85
1½"	14.7	182	150 to 1750	4.01	163	4.5 to 220	18 to 22
2"	24.7	300	120 to 1350	6.6	273	3.7 to 170	8 to 11
3"	55.9	677	80 to 900	15.0	616	2.5 to 115	2.5 to 3.2
4"	96.5	1177	60 to 700	26.0	1057	1.9 to 86	1.1 to 1.4
6"	220	2672	40 to 460	59.0	2422	1.2 to 57	0.3 to 0.4
8"	421	5126	27 to 322	113	4623	1.0 to 39	0.1266 to 0.14
10"	663	8087	23 to 272	179	7265	0.8 to 33	0.0677 to 0.0748
12"	952	11 595	18 to 209	256	10 391	0.6 to 25	0.0364 to 0.0402

10.1.11 Mechanical construction

Design, dimensions	See Technical Information TI070D/06/en
Weight	See Technical Information TI070D/06/en
Material	Transmitter housing:

Material (continued)

Transmitter housing:
- Powder-coated die-cast aluminum AlSi10Mg
  - In accordance with EN 1706/EN AC-43400 (EEx d/XP version: cast aluminum EN 1706/EN AC-43000)

Sensor:
- Flanged version:
  - Stainless steel, A351-CF3M (1.4404), in conformity with NACE MR0175-2003 and MR0103-2003
  - Pressure ratings PN 250, Class 900 to 1500 and butt-weld version 1.4571 (316Ti; UNS S31635); in conformity with NACE MR0175-2003 and MR0103-2003
- Alloy C-22 version
  - Alloy C-22 2.4602 (A 494-CX2MW/N 26022); in conformity with NACE MR0175-2003 and MR0103-2003
- Wafer version
  - Stainless steel, A351-CF3M (1.4404), in conformity with NACE MR0175-2003 and MR0103-2003

Flanges:
- EN (DIN)
  - Stainless steel, A351-CF3M (1.4404), in conformity with NACE MR0175-2003 and MR0103-2003
  - DN 15 to 150 with pressure ratings to PN 40 and all devices with integrated nominal diameter reduction (R-type, S-type): construction with weld-on flanges made of 1.4404 (AISI 316L). PN 63 to 160, nominal diameters DN 200 to 300: fully cast construction A351-CF3M (1.4404 (AISI 316L)), in conformity with NACE MR0175-2003 and MR0103-2003
  - Pressure rating PN 250 1.4571 (316Ti, UNS S31635); in conformity with ACE MR0175-2003 and MR0103-2003
- ANSI and JIS
  - Stainless steel, A351-CF3M, in conformity with NACE MR0175-2003 and MR0103-2003
  - ½ to 6" with pressure ratings to Class 300 and DN 15 to 150 with pressure ratings to 20K and all devices with integrated nominal diameter reduction (R-type, S-type): construction with weld-on flanges made of 316/316L, in conformity with NACE MR0175-2003 and MR0103-2003. Class 600, DN 15 to 150 with pressure rating 40K, nominal diameters 8 to 12": fully cast construction A351-CF3M; in conformity with NACE MR0175-2003 and MR0103-2003
  - Pressure rating Class 900 to 1500: 316/316L; in conformity with NACE MR0175-2003 and MR0103-2003
- Alloy C-22 version (EN/DIN/ANSI/JIS)
  - Alloy C-22 2.4602 (A 494-CX2MW/N 26022); in conformity with NACE MR0175-2003 and MR0103-2003

DSC sensor (differential switched capacitor; capacitive sensor):
■ Wetted parts (marked as "wet" on the DSC sensor flange).
  – Standard for pressure ratings up to PN 40, Class 300, JIS 20K:
    Stainless steel 1.4435 (316L), in conformity with NACE MR0175-2003 and MR0103-2003
  – Pressure ratings PN 63 to 160, Class 600, 40K:
    Inconel 2.4668/N 07718 (B637) (Inconel 718), in conformity with NACE MR0175-2003 and MR0103-2003
  – Pressure ratings PN 250, Class 900 to 1500 and butt-weld version:
    titanium Gr. 5 (B-348; UNS R50250; 3.7165)
  – Alloy C-22 sensor:
    Alloy C-22, 2.4602/N 06022; in conformity with NACE MR0175-2003 and MR0103-2003

Non-wetted parts:
■ Stainless steel 1.4301 (304)

Support:
■ Stainless steel, 1.4308 (CF8)
■ Pressure ratings PN 250, Class 900 to 1500 and butt-weld version: 1.4305 (303)

Seals:
■ Graphite:
  – Pressure rating PN 10 to 40, Class 150 to 300, JIS 10 to 20K: Sigraflex Foil Z (BAM-tested for oxygen applications)
  – Pressure rating PN 63 to 160, Class 600, JIS 40K: Sigraflex Hochdruck^{TM} with smooth sheet metal insert made of 316(L) (BAM-tested for oxygen applications, "high quality in terms of TA Luft (German Clean Air Act)"
  – Pressure rating PN 250, Class 900 to 1500: Grafoil with 316 perforated metal insert
■ Viton
■ Kalrez 6375
■ Gylon (PTFE) 3504 (BAM-tested for oxygen applications, "high quality in terms of TA Luft (German Clean Air Act)"

10.1.12 Human interface

Display elements	■ Liquid crystal display, two-line, plain text display, 16 characters per line ■ Custom configurations for presenting different measured value and status variables
Operating elements	No local operating elements, remote operation possible.
Remote operation	Operation via: ■ FOUNDATION Fieldbus ■ FieldCare (software package from Endress+Hauser for complete configuration, commissioning and diagnosis)

10.1.13 Certificates and approvals

CE approval	The measuring device 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 device meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Ex approval	More information on the Ex approvals can be found in the separate Ex documentation.

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

- With the identification PED/G1/III on the sensor nameplate, Endress+Hauser confirms conformity with the "Basic safety requirements" of Appendix I of the Pressure Equipment Directive 97/23/EC. The device meets all the Specifications of the FOUNDATION Fieldbus H1. Interoperability Test Kit (ITK), revision status 4.5x: the device may also be operated using certified evices from other manufacturers.
- Devices with this identification (with PED) are suitable for the following types of fluid:
  – Fluids of Group 1 and 2 with a steam pressure of greater or less than 0.5 bar (7.3 psi)
  – Unstable gases
- Devices without this identification (without PED) are designed and manufactured according to good engineering practice. They correspond to the requirements of Art. 3, Section 3 of the Pressure Equipment Directive 97/23/EC. Their application is illustrated in Diagrams 6 to 9 in Appendix II of the Pressure Equipment Directive 97/23/EC.

FOUNDATION Fieldbus certification	The measuring device has successfully passed all the test procedures implemented and has been certified and registered by the Fieldbus Foundation. The flowmeter thus meets all the requirements of the specifications listed below:

- Certified to the FOUNDATION Fieldbus Specification
- The device meets all the Specifications of the FOUNDATION Fieldbus H1.
- Interoperability Test Kit (ITK), revision status 4.5x: the device may also be operated using certified devices from other manufacturers.
- Physical Layer Conformance Test of the Fieldbus Foundation

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: Electromagnetic compatibility (EMC requirements)
- NAMUR NE 21: Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NACE Standard MR0103-2003: Standard Material Requirements – Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments
- NACE Standard MR0175-2003: Standard Material Requirements – Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment
- VDI 2643: Measurement of fluid flow by means of vortex flowmeters
- ANSI/ISA-S82.01: Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment – General Requirements. Pollution degree 2, Installation Category II.
- CAN/CSA-C22.2 No. 1010.1-92: Safety Standard for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category II.

10.1.14 Ordering information

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

10.1.15 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor (→ Page 44). Your Endress+Hauser service organization can provide detailed information on the order codes of your choice.

10.1.16 Documentation

- Flow measuring technology (FA005D/06/en)
- Technical Information Proline Prowirl 72F, 72W, 73F, 73W (TI070/06/en)
- Associated Ex documentation: ATEX, FM, CSA etc.
- Information on Pressure Equipment Directive for Proline Prowirl 72/73 (SD072D/06/en)

10. 2   Dimensions of flow conditioner

Dimensions according to:
- EN 1092–1 (DIN 2501)
- ANSI B16.5
- JIS B2220

Material 1.4435 (316L), in conformity with NACE MR0175-2003 and MR0103-2003
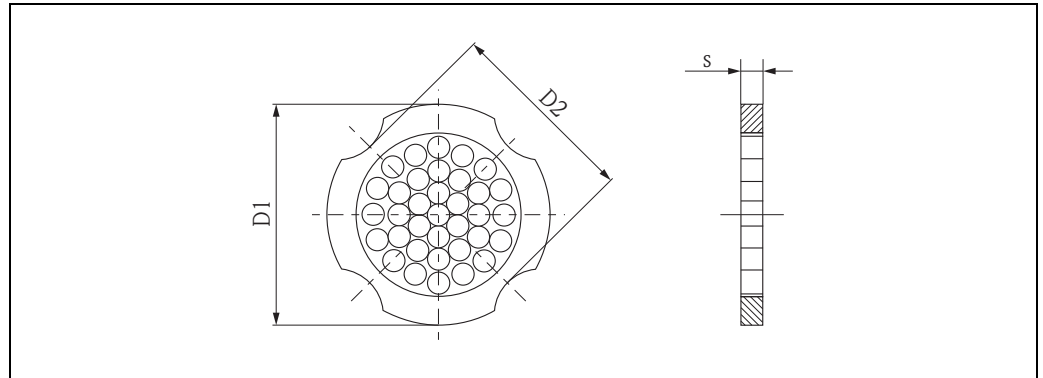
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D1: The flow conditioner is fitted at the outer diameter between the bolts.
D2: The flow conditioner is fitted at the indentations between the bolts.

Dimensions of flow conditioner according to EN (DIN)

DN	Pressure rating	Centering diameter [mm]	D1 / D2 *	s [mm]	Weight [kg]
15	PN 10 to 40 PN 63	54.3 64.3	D2 D1	2.0	0.04 0.05
25	PN 10 to 40 PN 63	74.3 85.3	D1 D1	3.5	0.12 0.15
40	PN 10 to 40 PN 63	95.3 106.3	D1 D1	5.3	0.3 0.4
50	PN 10 to 40 PN 63	110.0 116.3	D2 D1	6.8	0.5 0.6
80	PN 10 to 40 PN 63	145.3 151.3	D2 D1	10.1	1.4
100	PN 10/16 PN 25/40 PN 63	165.3 171.3 176.5	D2 D1 D2	13.3	2.4
150	PN 10/16 PN 25/40 PN 63	221.0 227.0 252.0	D2 D2 D1	20.0	6.3 7.8 7.8
200	PN 10 PN 16 PN 25 PN 40	274.0 274.0 280.0 294.0	D1 D2 D1 D2	26.3	11.5 12.3 12.3 15.9
250	PN 10/16 PN 25 PN 40	330.0 340.0 355.0	D2 D1 D2	33.0	25.7 25.7 27.5
300	PN 10/16 PN 25 PN 40	380.0 404.0 420.0	D2 D1 D1	39.6	36.4 36.4 44.7

* D1 → The flow conditioner is fitted at the outer diameter between the bolts.
  D2 → The flow conditioner is fitted at the indentations between the bolts.

Dimensions of flow conditioner according to ANSI

DN		Pressure rating	Centering diameter mm (inch)	D1 / D2 *	s mm (inch)	Weight kg (lbs)
15	½"	Cl. 150 Cl. 300	50.1 (1.97) 56.5 (2.22)	D1 D1	2.0 (0.08)	0.03 (0.07) 0.04 (0.09)
25	1"	Cl. 150 Cl. 300	69.2 (2.72) 74.3 (2.93)	D2 D1	3.5 (0.14)	0.12 (0.26)
40	1½"	Cl. 150 Cl. 300	88.2 (3.47) 97.7 (3.85)	D2 D2	5.3 (0.21)	0.3 (0.66)
50	2"	Cl. 150 Cl. 300	106.6 (4.20) 113.0 (4.45)	D2 D1	6.8 (0.27)	0.5 (1.1)
80	3"	Cl. 150 Cl. 300	138.4 (5.45) 151.3 (5.96)	D1 D1	10.1 (0.40)	1.2 (2.6) 1.4 (3.1)
100	4"	Cl. 150 Cl. 300	176.5 (6.95) 182.6 (7.19)	D2 D1	13.3 (0.52)	2.7 (6.0)
150	6"	Cl. 150 Cl. 300	223.9 (8.81) 252.0 (9.92)	D1 D1	20.0 (0.79)	6.3 (14) 7.8 (17)
200	8"	Cl. 150 Cl. 300	274.0 (10.8) 309.0 (12.2)	D2 D1	26.3 (1.04)	12.3 (27) 15.8 (35)
250	10"	Cl. 150 Cl. 300	340.0 (13.4) 363.0 (14.3)	D1 D1	33.0 (1.30)	25.7 (57) 27.5 (61)
300	12"	Cl. 150 Cl. 300	404.0 (15.9) 402.0 (16.5)	D1 D1	39.6 (1.56)	36.4 (80) 44.6 (98)

* D1 → The flow conditioner is fitted at the outer diameter between the bolts.
  D2 → The flow conditioner is fitted at the indentations between the bolts.

Dimensions of flow conditioner according to JIS

DN	Pressure rating	Centering diameter [mm]	D1 / D2 *	s [mm]	Weight [kg]
15	10K	60.3	D2	2.0	0.06
	20K	60.3	D2	2.0	0.06
	40K	66.3	D1	2.0	0.06
25	10K	76.3	D2	3.5	0.14
	20K	76.3	D2	3.5	0.14
	40K	81.3	D1	3.5	0.14
40	10K	91.3	D2	5.3	0.31
	20K	91.3	D2	5.3	0.31
	40K	102.3	D1	5.3	0.31
50	10K	106.6	D2	6.8	0.47
	20K	106.6	D2	6.8	0.47
	40K	116.3	D1	6.8	0.5
80	10K	136.3	D2	10.1	1.1
	20K	142.3	D1	10.1	1.1
	40K	151.3	D1	10.1	1.3
100	10K	161.3	D2	13.3	1.8
	20K	167.3	D1	13.3	1.8
	40K	175.3	D1	13.3	2.1
150	10K	221.0	D2	20.0	4.5
	20K	240.0	D1	20.0	5.5
	40K	252.0	D1	20.0	6.2
200	10K	271.0	D2	26.3	9.2
	20K	284.0	D1	26.3	9.2
250	10K	330.0	D2	33.0	15.8
	20K	355.0	D2	33.0	19.1
300	10K	380.0	D2	39.6	26.5
	20K	404.0	D1	39.6	26.5

* D1 → The flow conditioner is fitted at the outer diameter between the bolts.
 D2 → The flow conditioner is fitted at the indentations between the bolts.

11   Operation via FOUNDATION Fieldbus

11. 1   Block model

In the FOUNDATION Fieldbus interface, all the device parameters are categorized according to their functional properties and task and are generally assigned to three different blocks. A block may be regarded as a container in which parameters and the associated functionalities are contained. A FOUNDATION Fieldbus device has the following block types:

- A Resource Block (device block):
  The Resource Block contains all the device–specific features of the unit.

- One or more Transducer Blocks: A Transducer Block contains all the device's measurement–related and device–specific parameters. The measurement principles (e.g. flow, temperature) are depicted in the Transducer Blocks in accordance with the FOUNDATION Fieldbus Specification.

- One or more function blocks: function blocks contain the device's automation functions. We distinguish between different function blocks, e.g. Analog Input Function Block, Analog Output Function Block. Each of these function blocks is used to execute different application functions.

Depending on how the individual function blocks are arranged and connected, various automation tasks can be realized. In addition to these blocks, a field device may have other blocks, e.g. several Analog Input Function Blocks if more than one process variable is available from the field device.

Proline Prowirl 72 FOUNDATION Fieldbus has the following blocks:
- A Resource Block (device block)
- Five Transducer Blocks
- Three function blocks consisting of:
  – Two Analog Input Function Blocks for the process variables volume flow, corrected volume flow, calculated mass flow and totalizer.
  – A Discrete Output
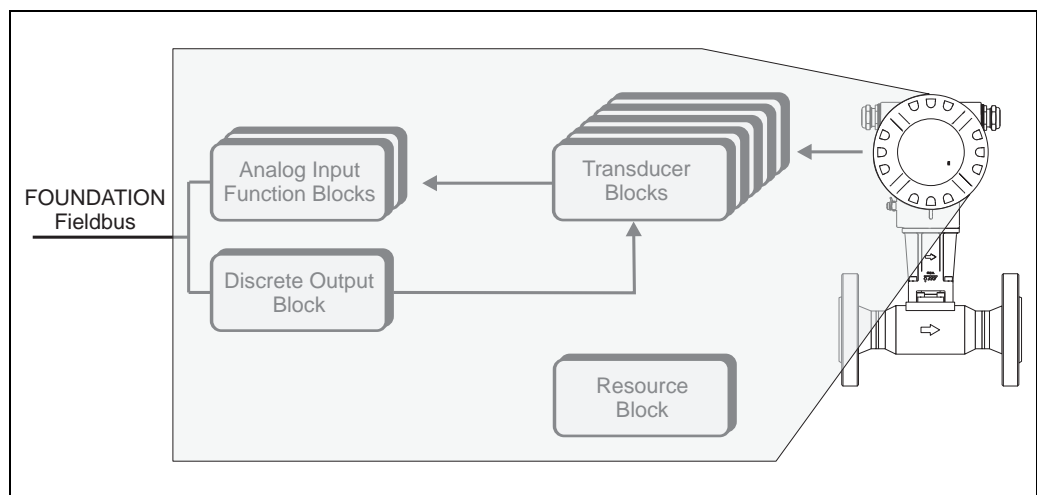
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Fig. 30:   Prowirl 72 FF block model

The sensor signal is first prepared in the measuring block, the Transducer Block "Flow". The process variables mass flow and volume flow are then passed to the Analog Input Function Blocks for technical processing (e.g. scaling, limit value processing).

In the Transducer Block "Totalizer", the measured variables for the totalizer are derived from the process variables volume flow, corrected volume flow and calculated mass flow. These are also available as process variables at the output of the Transducer Block.

All the important parameters for configuring the local display (display language, display values, etc.) can be configured via the Transducer Block "Display".

The Transducer Block "Diagnosis" contains all the important parameters for diagnosis and device maintenance. These can be used to query the device status or reasons for error messages, for example.

The process variables run through the entire function block algorithm and are available as an output variable to other function blocks to connect up the desired application function.

The Discrete Output Function Block (DO) allows various actions and functions in Prowirl 72 FF to be triggered or controlled via FOUNDATION Fieldbus, e.g. resetting the totalizer.

11. 2 Resource Block (device block)

A Resource Block contains all the data that clearly identify and characterize the field device. It is an electronic version of a nameplate on the field device. Parameters of the Resource Block include the device type, device name, manufacturer ID, serial number, etc.

A further task of the Resource Block is the management of overall parameters and functions that have an influence on the execution of the remaining blocks in the field device. The Resource Block is thus the central unit that also checks the device status and thereby influences or controls the operability of the other blocks and thus also of the device. As the Resource Block does not have any block input and block output data, it cannot be linked to other blocks.

The most important functions and parameters of the Resource Block are listed below.

11.2.1 Selecting the operating mode

The operating mode is set by means of the MODE_BLK parameter group. The Resource Block supports the following operating modes:

- AUTO (automatic mode)

- OOS (out of service)

✎ Note!
The OOS operating mode is also displayed by means of the BLOCK_ERR parameter. In the OOS operating mode, all write parameters can be accessed without restriction if write protection has not been enabled.

11.2.2 Block status

The current operating status of the Resource Block is displayed in the RS_STATE parameter.

The Resource Block can assume the following states:

– STANDBY	The Resource Block is in the OOS operating mode. The other blocks cannot be executed.
– ONLINE LINKING	The configured connections between the function blocks have not yet been established.
– ONLINE	Normal operating status, the Resource Block is in the AUTO operating mode. The configured connections between the function blocks have been established.

11.2.3 Write protection and simulation

The write protection of the device parameters and the simulation in the Analog Input and Discrete Output Function Block can be enabled or disabled via DIP switches on the FOUNDATION Fieldbus I/O board or the amplifier board → Page 35.

The WRITE_LOCK parameter shows the status of the hardware write protection. The following statuses are possible:

– LOCKED	= The device data cannot be altered via the FOUNDATION Fieldbus interface.
– NOT LOCKED	= The device data can be altered via the FOUNDATION Fieldbus interface.

The BLOCK_ERR parameter indicates whether simulation in the Analog Input and Discrete Output Function Block is possible.

– Simulation active	= Simulation possible in the Analog Input Function Block via the SIMULATE parameter and in the Discrete Output Function Block via the SIMULATE_D parameter.

11.2.4 Alarm detection and processing

Process alarms provide information on certain block states and events.
The status of the process alarms is communicated to the fieldbus host system by means of the BLOCK_ALM parameter. The ACK_OPTION parameter allows you to specify whether an alarm has to be acknowledged by means of the fieldbus host system. The following process alarms are generated by the Resource Block:

Block process alarms
The following block process alarms of the Resource Block are displayed by means of the BLOCK_ALM parameter:

- OUT OF SERVICE

- SIMULATE ACTIVE

Write protection process alarm

If the write protection is disabled (→ Page 35), the alarm priority specified in the WRITE_PRI parameter is checked before the status change is relayed to the fieldbus host system. The alarm priority specifies the behavior in the event if an active write protection alarm WRITE_ALM.

✎ Note!

- If the option of a process alarm was **not** activated in the ACK_OPTION parameter, this process alarm must only be acknowledged in the BLOCK_ALM parameter.
- The ALARM_SUM parameter shows the current status of all the process alarms.

11.2.5 Resource Block parameters

The following table shows all the Endress+Hauser–specific parameters of the Resource Block.

Resource Block (device block) / base index 400		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
Serial Number	**Read only**	The serial number of the sensor appears on the display
Sensor – Type	**Read only**	The sensor type (e.g. Prowirl F) appears on the display.
Sensor – Serial Number DSC Sensor	**Read only**	The serial number of the DSC sensor appears on the display
Amplifier – HW Revision No.	**Read only**	The hardware revision number of the amplifier appears on the display
Amplifier – HW Identification	**Read only**	The hardware identification number of the amplifier appears on the display
Amplifier – SW Revision No.	**Read only**	The software revision number of the amplifier appears on the display
Amplifier – SW Identification	**Read only**	The software identification number of the amplifier appears on the display
Amplifier – Production No.	**Read only**	The production number of the amplifier appears on the display.
I/O Module – HW Revision No.	**Read only**	The hardware revision number of the I/O module appears on the display
I/O Module – HW Identification	**Read only**	The hardware identification number of the I/O module appears on the display
I/O Module – SW Revision No.	**Read only**	The software revision number of the I/O module appears on the display
I/O Module – SW Identification	**Read only**	The software identification number of the I/O module appears on the display
I/O Module – Production No.	**Read only**	The production number of the I/O module appears on the display

11.3 Transducer Block

The Transducer Block of the Proline Prowirl 72 FOUNDATION Fieldbus contains all the measuring and device-specific parameters of the flowmeter. All the settings directly connected with the application/flow measurement are made here.
It forms the interface between sensor-specific measured value preprocessing and the function blocks required for automation.

A Transducer Block allows you to influence the input and output variables of a function block. The parameters of a Transducer Block include information on the sensor configuration, physical units, calibration, damping, error messages, etc. as well as the device-specific parameters.

The device-specific parameters and functions of Proline Prowirl 72 FOUNDATION Fieldbus are split into several Transducer Blocks, each covering different task areas.

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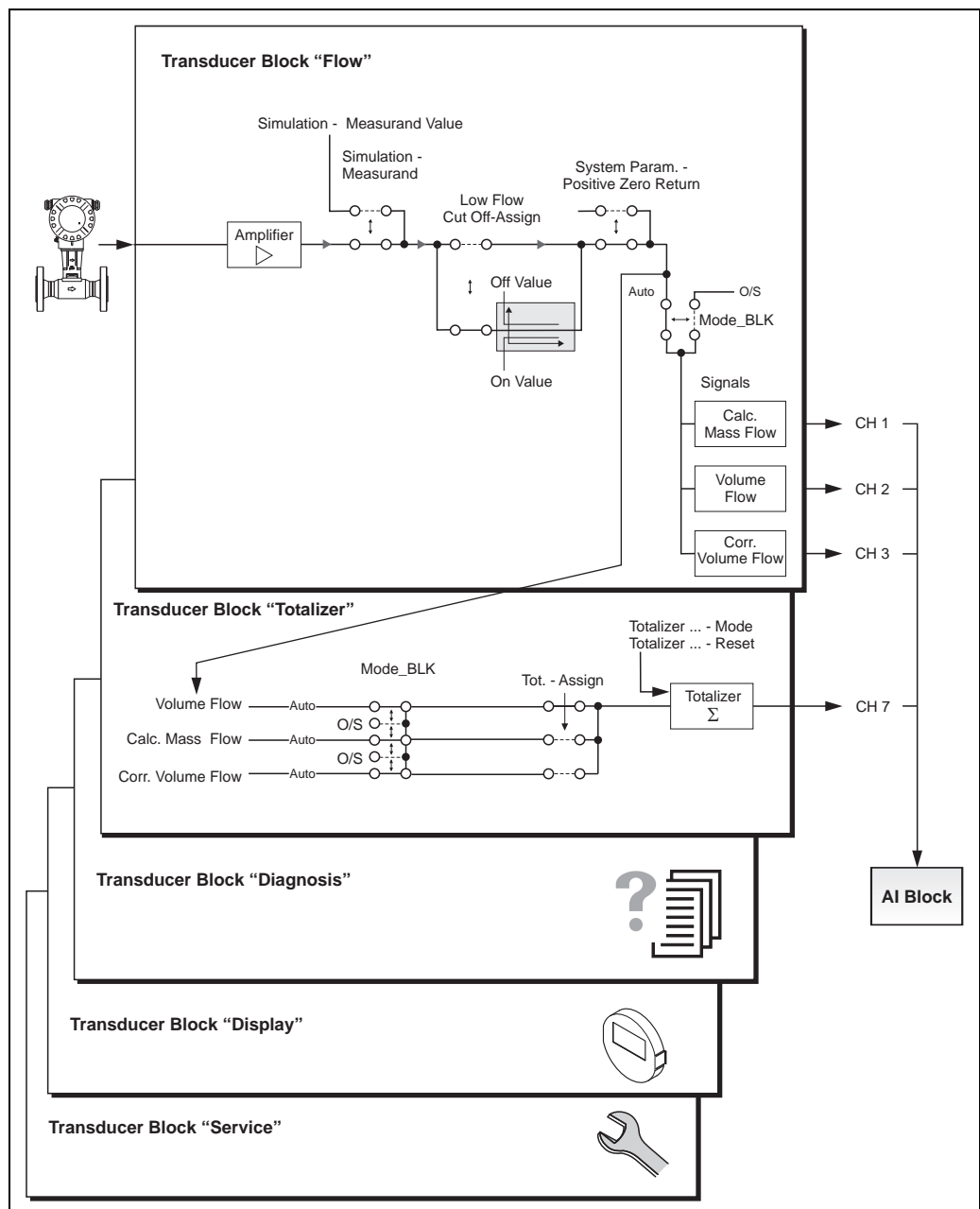
Fig. 31:   Structure and function of the individual Transducer Blocks

Fig. 31 schematically illustrates the internal structure of the various Transducer Blocks:

Transducer Block "Flow"→ TRANSDUCER_FLOW / base index 500:
This block contains all the flow-specific parameters and functions, e.g. calibration functions, sensor data, etc. → Page 89

Transducer Block "Totalizer"→ TRANSDUCER_TOT / base index 600:
This block contains all the parameters for configuring the totalizer
  → Page 103

Transducer Block "Display"→ TRANSDUCER_DISP / base index 700:
This block contains all the parameters for configuring the local display
  → Page 107

Transducer Block "Diagnosis" → TRANSDUCER_DIAG / base index 800:
This block contains all the parameters for system diagnosis, e.g. current system status, etc.
  → Page 112

Transducer Block "Service" → TRANSDUCER_SERV / base index 900:
This block contains all the service parameters. Access is by entering the special service code.
  → Page 114

Caution!
Changing the settings of the service functions can result in a malfunction or device failure. Should this occur, remove the device and return it to Endress+Hauser.

11.3.1   Block output variables

The Transducer Blocks make the following output variables (process variables) available:

- Transducer Block "Flow"
  – Calculated mass flow
  – Volume flow
  – Corrected volume flow
- Transducer Block "Totalizer"
  – Totalizer
- Transducer Block "Diagnosis", "Display" and "Service" do not have any output variables.

The CHANNEL parameter in the Analog Input Function Block is used to assign which process variable is read in and processed in the downstream Analog Input Function Block:

- Process variable calculated mass flow →CHANNEL = 1 (Analog Input Function Block)
- Process variable volume flow   →   CHANNEL = 2 (Analog Input Function Block)
- Process variable corrected volume flow → CHANNEL = 3 (Analog Input Function Block)
- Process variable totalizer → CHANNEL = 7 (Analog Input Function Block)

11.3.2 Selecting the operating mode

The operating mode is set by means of the MODE_BLK parameter group (see → Page 87).
The Transducer Blocks support the following operating modes:
- AUTO (automatic mode)
- OOS (out of service)

✎ Note!
- The OOS block status mode is also displayed by means of the BLOCK_ERR parameter
  (→ Page 88). In the OOS operating mode, all write parameters can be accessed without
  restriction if write protection has not been enabled and the Access Code is entered.
- If problems occur during the configuration of the function blocks → Page 47, Section 9. 1.

11.3.3 Alarm detection and processing

The Transducer Blocks do not generate any process alarms. The status of the process variables is
evaluated in the downstream Analog Input Function Blocks. If the Analog Input Function Block
does not receive an input value that can be evaluated from the Transducer Blocks "Flow" or
"Totalizer", then a process alarm is generated. This process alarm is displayed in the BLOCK_ERR
parameter of the Analog Input Function Block.
The BLOCK_ERR parameter (Transducer Block "Diagnosis" → Page 88) displays the device error
that produced an input value that could not be evaluated and thus triggered the process alarm in
the Analog Input Function Block. In addition, the active device error is displayed via the Transducer
Block "Diagnosis" in the "Diagnosis – Actual System Condition" parameter (→ Page 112).
More information on eliminating errors can be found on Page 46.

11.3.4 Accessing the manufacturer-specific parameters

To access the manufacturer-specific parameters, the following requirements must be met:

1. Hardware write protection must be disabled (→ Page 35).
2. The correct code must be entered by means of the corresponding Transducer Block in the
    "Un-/Locking – Access Code" parameter.

11.3.5 Selecting the units

The selection of system units in the Transducer Blocks does not have any effect on the desired units,
which are to be transmitted via the FOUNDATION Fieldbus interface. This setting is made
separately via the corresponding AI-Block in the XD_SCALE parameter group → Page 116. The
unit selected in the Transducer Blocks is only used for the local display, low flow cut off and for
simulation.

11. 4   FOUNDATION Fieldbus parameters

The following table lists all the specified FOUNDATION Fieldbus parameters of the Transducer Blocks.
The Endress+Hauser–specific parameters are described as of Page 89.

FOUNDATION Fieldbus parameters (Transducer Blocks)		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
ST_REV	**Read only**	The revision status of the static data appears on the display. ✎ Note! The revision status parameter is incremented with every change of the static data.
TAG_DESC	AUTO - OOS	Use this function to enter a user-specific text of max. 32 characters for unique identification and assignment of the block. **Factory setting:** (_____) no text
STRATEGY	AUTO - OOS	Parameter for grouping and thus faster evaluation of blocks. Grouping is carried out by entering the same numerical value in the STRATEGY parameter of each individual block. **Factory setting:** 0 ✎ Note! These data are neither checked nor processed by the Transducer Blocks.
ALERT_KEY	AUTO - OOS	Use this function to enter the identification number of the plant unit. This information can be used by the fieldbus host system for sorting alarms and events. **User input:** 1 to 255 **Factory setting:** 0

MODE_BLK	AUTO - OOS	For displaying the current (Actual) and the desired (Target) operating mode of the relevant Transducer Block, the permitted modes supported by the Transducer Block in question (Permitted) and the normal operating mode (Normal).
		
		 Display:
		 AUTO
		 OOS
		
		 ✎ Note!
		 The Transducer Blocks support the following operating modes:
		 ■ AUTO (automatic mode):
		    the block is executed.
		 ■ OOS (out of service):
		    the block is in the "out of service" mode.

FOUNDATION Fieldbus parameters (Transducer Blocks)		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**

BLOCK_ERR	**Read only**	The active block errors appear on the display.
		
		Display:
		■ OUT OF SERVICE
		  The block is in the "out of service" operating mode.
		
		Block errors which are only shown in the Transducer Block "Diagnosis"
		■ SIMULATE ACTIVE
		  Simulation via the "Simulation – Measurand"
		  parameter (→ Page 101) in the Transducer Block "Flow" is active.
		
		■ MAINTENANCE NEEDED
		  The device must be checked since an active device error is pending. A detailed display of the cause of the error can be called up in the Transducer Block "Diagnosis" by means of the "Diagnosis – Actual System Condition" parameter (→ Page 112).

UPDATE_ EVT	**AUTO - OOS**	Indicates whether static block data have been altered, including date and time.
BLOCK_ALM	**AUTO - OOS**	The current block status appears on the display with information on pending configuration, hardware or system errors, including information on the alarm period (date, time) when the error occurred. ✎ Note! ■ In addition, the active block alarm can be acknowledged in this parameter group. ■ Prowirl 72 FF does not use this parameter to display a process alarm since this is generated in the BLOCK_ALM parameter of the Analog Input Function Block.
Transducer Type	**Read only**	The Transducer Block type appears on the display. **Display:** Standard flow with calibration
Transducer Error	**Read only**	The active device error appears on the display. **Possible display:** ■ No Error (normal status) ■ Electronics Failure ■ Data Integrity Error ■ Mechanical Error ■ Configuration Error ■ General Error ✎ Note! ■ The display of the device error is standardized. Precise information on the error pending is available by means of the manufacturer-specific error display which can be read off via the Transducer Block "Diagnosis" in the "Diagnosis – Actual System Condition" parameter. ■ An exact error description as well as information on rectifying errors can be found on Page 49 ff..

11.5   Endress+Hauser parameters: Transducer Block "Flow"

The following table shows all the Endress+Hauser–specific parameters of the Transducer Block "Flow". These can only be changed after entering an enabling code in the "Un–/Locking – Access Code" parameter.

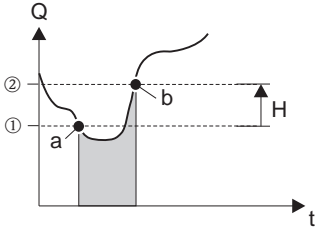| Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	Write access for operating mode (MODE_BLK)	Description
✎ Note! The FOUNDATION Fieldbus parameters of this block are described on Page 87.		
Un–/Locking – Access Code	AUTO - OOS	All data of the measuring system are protected against inadvertent change. Programming of the manufacturer-specific parameters is disabled and the settings cannot be changed until a code is entered in this function. You can enable programming by entering the: ■ Code 72 (factory setting) ■ Personal code, see "Un–/Locking – Define Private Code" parameter (→ Page 108) Transducer Block "Display" **User input:** Max. 4-digit number (0 to 9999) ✎ Note! ■ If write protection is enabled, access to manufacturer-specific parameters is denied even if the right code is entered. Write protection can be enabled or disabled by means of DIP switches (→ Page 35). ■ You can disable programming again by entering any number in this function (other than the Access Code). ■ The Endress+Hauser service organization can be of assistance if you mislay your private code. ■ Certain parameters can only be altered if a special Service Code is entered. This Service Code is known to your Endress+Hauser service organization. Please contact your Endress+Hauser service point if anything needs clarification.
Un–/Locking – Access Status	Read only	Use this function to display the current status of the possibilities for accessing the manufacturer-specific parameters of the device. **Display:** ■ LOCKED (parameters cannot be modified) ■ ACCESS CUSTOMER (parameters can be modified) ■ ACCESS SERVICE (parameters can be modified, access to service level)
System Value – Volume Flow	Read only	The current volume flow appears on the display. ✎ Note! The unit is displayed in the "System Unit – Volume Flow" parameter (→ Page 90).

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500

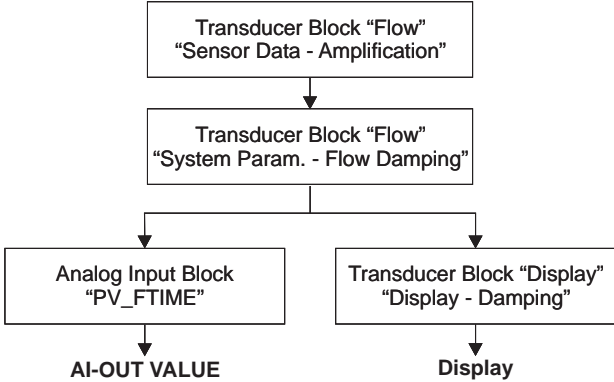| Parameter	Write access for operating mode (MODE_BLK)	Description

System Unit – Volume Flow	**AUTO - OOS**	Use this function to select the unit for the volume flow (volume/time).
		
		The unit you select here is also valid for:
		■ Simulation
		■ Low flow cut off
		■ Display value (local display)
		
		✎ **Note!**
		The following time units can be selected:
		s = second, m = minute, h = hour, d = day
		
		Options:
		Metric:
		– Cubic centimeter → cm³/time unit
		– Cubic decimeter → dm³/time unit
		– Cubic meter → m³/time unit
		– Milliliter → ml/time unit
		– Liter → l/time unit
		– Hectoliter → hl/time unit
		– Megaliter → Ml/time unit MEGA
		
		US:
		– Cubic centimeter → cc/time unit
		– Acre foot → af/time unit
		– Cubic foot → ft³/time unit
		– Fluid ounce → ozf/time unit
		– Gallon → US gal/time unit
		– Mega gallon → US Mgal/time unit
		– Barrel (normal fluids: 31.5 gal/bbl)
		  → US bbl/time unit NORM.
		– Barrel (beer: 31.0 gal/bbl) → US bbl/time unit BEER
		– Barrel (petrochemicals: 42.0 gal/bbl)
		  → US bbl/time unit PETR.
		– Barrel (filling tanks: 55.0 gal/bbl) → US bbl/time unit TANK
		
		Imperial:
		– Gallon → imp. gal/time unit
		– Mega gallon → imp. Mgal/time unit
		– Barrel (beer: 36.0 gal/bbl) → imp. bbl/time unit BEER
		– Barrel (petrochemicals: 34.97 gal/bbl)
		  → imp. bbl/time unit PETR.
		
		Factory setting:
		Depends on country (metric system units, → Page 121, or US units, → Page 122)

System Value – Calc. Mass Flow	**Read only**	The calculated mass flow appears on the display. The calculated mass flow is calculated using the measured volume flow and the value entered in the "Process Param. – Operating Density" parameter (→ Page 94). A fixed value is used for the calculation (specified operating density). For this reason only select this process variable if the process conditions are known and do not change. ✎ **Note!** The unit is displayed in the "System Unit – Calc. Mass Flow" parameter. (→ Page 91)
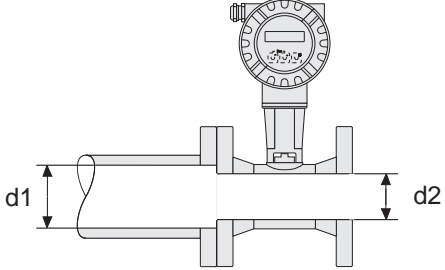
Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
System Unit – Calc. Mass Flow	**AUTO - OOS**	Use this function to select the unit for the calculated mass flow. The unit you select here is also valid for: ▪ Simulation ▪ On-value low flow cut off ▪ Display value (local display) ✎ Note! The following units of time can be selected: s = second, m = minute, h = hour, d = day **Options:** Metric: gram → g/time unit kilogram → kg/time unit Metric ton → t/time unit US: ounce → oz/time unit US pound → lb/time unit ton → ton/time unit **Factory setting:** Depends on country (metric system units, → Page 121, or US units, → Page 122)
System Value – Corr. Volume Flow	**Read only**	The corrected volume flow appears on the display. The corrected volume flow is calculated using the measured volume flow and the ratio between the values entered in the "Process Param. – Operating Density" parameter (→ Page 94) and the "Process Param. – Ref. Density" parameter (→ Page 94). Fixed values are used for the calculation (specified operating density and reference density). For this reason only select this process variable if the process conditions are known and do not change. ✎ Note! The unit is displayed in the "System Unit – Corr. Volume Flow" parameter (→ Page 92).

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	Write access for operating mode (MODE_BLK)	Description
System Unit – Corr. Volume Flow	**AUTO - OOS**	Use this function to select the unit for the corrected volume flow. The unit you select here is also valid for: ■ Simulation ■ On-value low flow cut off ■ Display value (local display) ✎ Note! The following units of time can be selected: s = second, m = minute, h = hour, d = day **Options:** Metric: norm liter → Nl/time unit norm cubic meter → Nm³/time unit US: standard cubic meter → Sm³/time unit standard cubic feet → Scf/time unit **Factory setting:** Depends on country (metric system units, → Page 121, or US units, → Page 122)
System Value – Vortex Frequency	**Read only**	The vortex frequency currently measured appears on the display in Hz. ✎ Note! This function is only used for a plausibility check.
System Unit – Density	**AUTO - OOS**	Use this function to select the desired unit for the fixed operating density entered (→ Page 94, "Process Param. – Operating Density") and reference density (→ Page 94, "Process Param. – Ref. Density"). **Options:** Metric: g/cm³; g/cc; kg/dm³; kg/l; kg/m³; SD 4 °C, SD 15 °C, SD 20 °C; SG 4 °C, SG 15 °C, SG 20 °C US: lb/ft³; lb/US gal; lb/US bbl NORM (normal fluids); lb/US bbl BEER (beer); lb/US bbl PETR. (petrochemicals); lb/US bbl TANK (filling tanks) Imperial: lb/imp. gal; lb/imp. bbl BEER (beer); l b/imp. bbl PETR. (petrochemicals) **Factory setting:** Depends on country (metric system units, → Page 121, or US units, → Page 122) SD = Specific Density, SG = Specific Gravity The specific density is the ratio between the fluid density and the density of the water (at water temperature = 4, 15, 20 °C)

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
System Unit – Temperature	**AUTO - OOS**	Use this function to select the desired unit for the operating temperature to be entered in the "Process Param. – Operating Temp." function (→ Page 95). **Options:** °C (Celsius) K (Kelvin) °F (Fahrenheit) R (Rankine) **Factory setting:** Depends on country (metric system units, → Page 121, or US units, → Page 122)
System Unit – Length	**AUTO - OOS**	Use this function to select the unit for the length of the nominal diameter. The unit you select here is valid for: Mating pipe diameter, (→ Page 96, "Process Param. – Mating Pipe Diameter") **Options:** – Millimeter → mm – Inch → inch **Factory setting:** Depends on country (metric system units, → Page 121, or US units, → Page 122)
Process Param. - Application	**AUTO - OOS**	Use this function to specify the state of aggregation of the fluid. **Options:** Gas/Steam or Liquid **Factory setting:** "Liquid". ✎ Note! If the option selected in this function is changed, the values in the following functions in the Transducer Block "Display" must be adjusted if used: ■ Line 1 – 100% Value, → Page 108 ■ Line 2 – 100% Value, → Page 109 ☞ Caution! If the option selected in this function is changed, the totalizer is reset to 0.

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	Write access for operating mode (MODE_BLK)	Description
Process Param. – Operating Density	**AUTO – OOS**	Use this function to enter a fixed value for the density at process conditions (operating density). This value is used to calculate the calculated mass flow and corrected volume flow. **User input:** 5-digit floating-point number **Factory setting:** "1" ✎ Note! ■ The unit is displayed in the "Process Param. – Operating Density Unit" parameter (→ Page 94). ■ If the value in this function is changed, we recommend you reset the totalizer.
Process Param. – Operating Density Unit	**Read only**	The unit for the operating density appears on the display. ✎ Note! The unit for the operating density is determined by means of the "System Unit – Density" function (→ Page 92).
Process Param. – Ref. Density	**AUTO – OOS**	Use this function to enter a fixed value for the density at reference/norm conditions. This value is used to calculate the corrected volume flow. **User input:** 5-digit floating-point number **Factory setting:** "1" ✎ Note! ■ The unit is displayed in the "Process Param. – Ref. Density Unit" parameter (→ Page 94). ■ If the value in this function is changed, we recommend you reset the totalizer.
Process Param. – Ref. Density Unit	**Read only**	The unit for the reference density appears on the display. ✎ Note! The unit for the reference density is determined by means of the "System Unit – Density" function (→ Page 92).

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	Write access for operating mode (MODE_BLK)	Description
Process Param. – Operating Temp.	AUTO - OOS	Use this function to specify a fixed value for the process temperature (operating temperature). ✎ Note! The sensor (measuring pipe and bluff body) expands differently depending on the existing process temperature. This has a proportional effect on the accuracy of the measuring system since the device was calibrated at a fixed calibration temperature of 20 °C (293 K). However, this effect on the current measured value and the internal totalizer can be compensated by entering an average process temperature in this function. **User input:** 5-digit floating-point number **Factory setting:** 20°C / 293.15 K / 68 °F / 527.67 R ✎ Note! The unit is displayed in the "Process Param. – Operating Temp. Unit" parameter (→ Page 95). ☞ Caution! This setting does not change the permitted temperature range of the measuring system. Please pay particular attention to the temperature application limits specified in the product specification (→ Page 67).
Process Param. – Operating Temp. Unit	Read only	The unit for the operating temperature appears on the display. ✎ Note! The unit for the operating temperature is determined by means of the "System Unit – Temperature" function (→ Page 93).

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500

Parameter	Write access for operating mode (MODE_BLK)	Description
Process Param. – Mating Pipe Diameter	AUTO - OOS	The device is able to correct mismatches between inner diameter of piping and inner diameter of the flowmeter. This functionality can be activated by entering the actual diameter of the mating pipe in this function (→ Fig. 32). If the mating pipe (d1) and the measuring pipe (d2) have different diameters, this alters the flow profile. A diameter jump can occur if: ■ The mating pipe has a different pressure rating to that of the measuring device. ■ The mating pipe has another schedule to that of the measuring pipe (e.g. 80 instead of 40), for ANSI. ■ The mating pipe is made of another material, for DIN. To correct any resulting shift in the calibration factor, enter the actual value of the mating pipe (d1) in this function. A0001982 *Fig. 32: Mating pipe/measuring pipe* *d1 > d2* *d1 = Diameter of mating pipe* *d2 = Diameter of measuring pipe* **User input:** ■ Depends on the meter body type MB ■ 5-digit floating-point number **Factory setting:** 0 ✎ Note! ■ Inlet correction is switched off if 0 is entered in this function. ■ The associated unit is displayed in the "Process Param. – Mating Pipe Diameter Unit" function (→ Page 97). ■ Only diameter jumps within the same nominal diameter class (e.g. DN 50/2") can be corrected. ■ If the internal diameter of the process mating flange is larger than the internal diameter ot the Vortex flange, you must reckon with an additional uncertainty of typically 0.1% (of the reading) per 1 mm deviation. ■ If the internal diameter of the process mating flange is smaller than the internal diameter ot the Vortex flange, you must reckon with an additional uncertainty of typically 0.2% (of the reading) per 1 mm deviation. ■ The diameter jump should only be corrected within the following limit values (for which test measurements have also been performed). Flange connection: DN 15 (½"): ±20% of the internal diameter DN 25 (1"): ±15% of the internal diameter DN 40 (1½"): ±12% of the internal diameter DN ≥ 50 (2"): ±10% of the internal diameter

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Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	Write access for operating mode (MODE_BLK)	Description
Process Param. – Mating Pipe Diameter (continued)		Wafer: DN 15 (½"): ±15% of the internal diameter DN 25 (1"): ±12% of the internal diameter DN 40 (1½"): ±9% of the internal diameter DN ≥ 50 (2"): ±8% of the internal diameter
Process Param. – Mating Pipe Diameter Unit	Read only	The unit for the diameter jump correction appears on the display. ✎ Note! The unit for the diameter jump correction is determined by means of the "System Unit – Length" function (→ Page 93).
Low Flow Cut Off – Assign	AUTO - OOS	Use this parameter to specify which process variable the low flow cut off acts on. **Options:** Off Volume Flow Calc. Mass Flow Corr. Volume Flow **Factory setting:** Volume Flow
Low Flow Cut Off – On Value	AUTO - OOS	Use this function to enter the on-value for low flow cut off. Low flow cut off is switched on if the value entered is not equal to 0. Device response when low flow cut off is active: ■ A flow value of "0" is output. ■ The totalizer stops adding up. ■ An inverted plus sign is shown on the local display of the flow value. **User input:** 5-digit floating-point number **Factory setting:** Below the standard measuring range. ✎ Note! ■ The associated unit is displayed in the "Low Flow Cut Off. – Unit" function. ■ The on-value can be set at a value corresponding to a Reynolds number of Re = 20000. This has the effect that measurements in the nonlinear range are not evaluated. The Reynolds number and the flow (at Reynolds number = 20000) can be determined using the Endress+Hauser "Applicator" software. ■ The Applicator is software for selecting and planning flowmeters. The values required can be determined without having to connect the transmitter beforehand. The Applicator is available both via the Internet (www.applicator.com) and on a CD-ROM for local PC installation.

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
Low Flow Cut Off – Unit	**Read only**	The unit for the low flow cut off appears on the display. ✎ **Note!** Depending on the option selected in the "Low Flow Cut Off – Assign" function (→ Page 97), the unit for low flow cut off is determined by means of the "System Unit – Volume Flow", "System Unit – Calc. Mass Flow" or "System Unit – Corr. Volume Flow" parameter (see Pages 90, 91, 92).
Low Flow Cut Off – Off Value	**AUTO - OOS**	Use this function to enter the off-value (b) for low flow cut off. Enter the off-value as a positive hysteresis (H) from the on-value (a). **User input:** Integer 0 to 100% **Factory setting:** 50% A0003882 ① = *On-value*, ② = *Off-value* *a = Low flow cut off is switched on* *b = Low flow cut off is switched off (a + a · H)* *H = Hysteresis value: 0 to 100%* ■ *= Low flow cut off active* *Q = Flow*
System Param. – Positive Zero Return	**AUTO - OOS**	Use this function to interrupt evaluation of measured variables. This is necessary when a pipe is being cleaned, for example. This setting acts on all parameters and calculations of the measuring device. **Options:** Off On (signal output is set to the "ZERO FLOW" value) **Factory setting:** Off Device response when positive zero return is active: ■ A flow value of "0" is output. ■ The totalizers stop adding up. ■ Device status → notice message #601 "POSITIVE ZERO RETURN" active, → Page 53 ✎ **Note!** Positive zero return can also be controlled via FOUNDATION Fieldbus using cyclic data transfer via the Discrete Output Function Block → Page 119 ff.

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500

Parameter	Write access for operating mode (MODE_BLK)	Description
System Param. - Flow Damping	AUTO - OOS	For setting the filter depth. This reduces the sensitivity of the measuring signal to interference peaks (e.g. in the event of high solids content, gas bubbles in the fluid, etc.). The measuring system reaction time increases with the filter setting. **User input:** 0 to 100 **Factory setting:** 1 s ✎ Note! Damping acts on all parameters and on all downstream FOUNDATION Fieldbus Analog Input Function Blocks. *Fig. 33: Setting the filter depth*
Sensor Data - K-Factor	AUTO - OOS	The current calibration factor of the sensor appears on the display. **Display:** e.g. 100 P/l (pulse per liter) ✎ Note! The K-factor is also given on the nameplate, the sensor and the calibration protocol under "K-fct.". ☞ Caution! Do not change this value, because a change will inevitably affect the accuracy of the measuring device.
Sensor Data - K-Factor Compens.	AUTO - OOS	The current compensated calibration factor of the sensor appears on the display. The temperature-dependent expansion of the sensor and diameter jumps in the inlet of the device are compensated. **Display:** e.g. 100 P/l (pulse per liter) ☞ Caution! Do not change this value, because a change will inevitably affect the accuracy of the measuring device.

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
Sensor Data – Nominal Diameter	**AUTO - OOS**	The nominal diameter of the sensor appears on the display. **Display:** e.g. "DN 25 mm – 1 Inch" ☞ Caution! Do not change this value, because a change will inevitably affect the accuracy of the measuring device.
Sensor Data – Meter Body MB	**AUTO - OOS**	The type of meter body (MB) of the sensor appears on the display. **Display:** e.g. 71 ✎ Note! Use this function to specify the nominal diameter and the sensor type. The type of meter body (MB) is also indicated on the nameplate ☞ Caution! Do not change this value, because a change will inevitably affect the accuracy of the measuring device.
Sensor Data – Temperature Coeff.	**AUTO - OOS**	The temperature effect on the calibration factor appears on the display. Due to changes in temperature, the meter body expands differently, depending on the material. The expansion has an effect on the K-factor. **Display:** $4.88\ e^{-5}/K \rightarrow 4.88 \cdot 10^{-5}$ (stainless steel) $2.6\ e^{-5}/K \rightarrow 2.6 \cdot 10^{-5}$ (Alloy C-22) ☞ Caution! Do not change this value, because a change will inevitably affect the accuracy of the measuring device.

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	Write access for operating mode (MODE_BLK)	Description
Sensor Data – Amplification	AUTO - OOS	Devices are always optimally configured for the process conditions you specified. Under certain process conditions, however, interference signals (e.g. strong vibrations) can be suppressed or the measuring range extended by adjusting the amplification. The amplification is configured as follows: ■ A larger value can be entered for the amplification if the fluid is slow-flowing, the density is low and there are minor disturbance influences (e.g. plant vibrations). ■ A smaller value can be entered for the amplification if the fluid is fast-flowing, the density is high and there are strong disturbance influences (e.g. plant vibrations). 🖑 Caution! Incorrectly configured amplification can have the following effects: ■ The measuring range is limited in such a way that small flows cannot be recorded or displayed. In this instance, the value for the amplification must be increased. ■ Undesired interference signals are registered by the device which means that a flow is recorded and displayed even if the fluid is at a standstill. In this instance, the value for the amplification must be reduced. **Options:** 1 to 5 (1 = smallest amplification, 5= largest amplification) **Factory setting:** 3
Simulation – Measurand	AUTO - OOS	Use this parameter to activate the simulation of the volume flow/mass flow. **Options:** Off Volume Flow Calc. Mass Flow Corr. Volume Flow **Factory setting:** Off Device response when simulation is active: Device status → notice message #692 "SIMULATION MEASURAND" active, → Page 53 🖑 Caution! ■ The measuring device cannot be used for measuring while this simulation is in progress. ■ The simulation acts regardless of the setting of the DIP switch for the simulation mode. ■ The setting is not saved if the power supply fails.

Transducer Block "Flow" (Endress+Hauser parameters) / base index 500		
Parameter	Write access for operating mode (MODE_BLK)	Description
Simulation – Measurand Value	AUTO - OOS	✎ Note! This function is not effective unless the "Simulation – Measurand" function is active. Use this function to specify a selectable value (e.g. 12 dm³/s). This is used to check the assigned parameters in the device itself and downstream signal circuits. **User input:** 5-digit floating-point number **Factory setting:** 0 ✎ Note! The unit is taken from the "Simulation – Unit" parameter (→ Page 102). ☝ Caution! The setting is not saved if the power supply fails.
Simulation – Unit	Read only	The current unit for the simulation value in the "Simulation – Measurand Value" parameter appears on the display. ✎ Note! Depending on the option selected in the "Simulation – Measurand" function (→ Page 101), the unit is determined by means of the "System Unit – Volume Flow", "System Unit – Calc. Mass Flow" or "System Unit – Corr. Volume Flow" parameter (→ Page 90, 91, 92).
Serial Number	Read only	The serial number of the sensor appears on the display.
Sensor – Type	Read only	Use this function to view the sensor type.
Sensor – Serial Number DSC Sensor	Read only	The serial number of the DSC sensor appears on the display.

11. 6   Endress+Hauser parameters: Transducer Block "Totalizer"

The following table shows all the Endress+Hauser-specific parameters of the Transducer Block "Totalizer". These can only be changed after entering an enabling code in the "Un-/Locking - Access Code" parameter.

Transducer Block "Totalizer" (Endress+Hauser parameters) / base index 600		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
✎ Note! The FOUNDATION Fieldbus parameters are described on Page 87		
Un-/Locking - Access Code	**AUTO - OOS**	All data of the measuring system are protected against inadvertent change. Programming of the manufacturer-specific parameters is disabled and the settings cannot be changed until a code is entered in this function. You can enable programming by entering the: ■ Code 72 (factory setting) ■ Personal code, see "Un-/Locking – Define Private Code" parameter (→ Page 108) Transducer Block "Display" **User input:** Max. 4-digit number (0 to 9999) ✎ Note! ■ If write protection is enabled, access to manufacturer-specific parameters is denied even if the right code is entered. Write protection can be enabled or disabled by means of DIP switches (→ Page 35). ■ You can disable programming again by entering any number in this function (other than the Private Code). ■ The Endress+Hauser service organization can be of assistance if you mislay your private code. ■ Certain parameters can only be altered if a special Service Code is entered. This Service Code is known to your Endress+Hauser service organization. Please contact your Endress+Hauser service point if anything needs clarification.
Un-/Locking - Access Status	**Read only**	Use this function to display the current status of the possibilities for accessing the manufacturer-specific parameters of the device. **Display:** ■ LOCKED (parameters cannot be modified) ■ ACCESS CUSTOMER (parameters can be modified) ■ ACCESS SERVICE (parameters can be modified, access to service level)
Totalizer - System Value	**Read only**	The total for the totalizer's measured variable aggregated since measuring commenced appears on the display. ✎ Note! ■ The unit is displayed in the "Totalizer - System Unit" parameter (→ Page 104). ■ The behavior of the totalizers in the event of a fault is determined in the "Totalizer - Failsafe Mode" parameter (→ Page 106).

Transducer Block "Totalizer" (Endress+Hauser parameters) / base index 600		
Parameter	Write access for operating mode (MODE_BLK)	Description

Totalizer – System Unit	AUTO - OOS	Use this function to define the unit for the totalizer.
		
		The suitable units have to be configured depending on the option selected in the "Totalizer – Assign" function (→ Page 105) (volume or mass or standard volume).
		
		Options:
		■ For function "Totalizer – Assign" = Volume Flow
		  Metric:
		  Cubic centimeter → cm³
		  Cubic decimeter → dm³
		  Cubic meter → m³
		  Milliliter → ml
		  Liter → l
		  Hectoliter → hl
		  Megaliter → Ml MEGA
		
		  US:
		  Cubic centimeter → cc
		  Acre foot → af
		  Cubic foot → ft³
		  Fluid ounce → oz f
		  Gallon → US gal
		  Million gallon → US Mgal
		  Barrel → US bbl NORM.FL. (normal fluids)
		  Barrel → US bbl BEER (beer)
		  Barrel → US bbl PETROCH.(petrochemicals)
		  Barrel → US bbl TANK (filling tanks)
		
		  Imperial:
		  Gallon → imp. gal
		  Mega gallon → imp. Mgal
		  Barrel (beer: 36.0 gal/bbl) → imp. bbl BEER
		  Barrel (petrochemicals: 34.97 gal/bbl) → imp. bbl PETROCH.
		
		■ For function "Totalizer – Assign" = Calc. Mass Flow
		  Metric:
		  Gram → g
		  Kilogram → kg
		  Metric ton → t
		
		  US:
		  Ounce → oz
		  Pound → lb
		  ton → Ton
		
		■ For function "Totalizer – Assign " = Corr. Volume Flow
		
		  Metric:
		  Norm liter → Nl
		  Norm cubic meter → Nm³
		
		  US:
		  Standard cubic meter → Sm³
		  Standard cubic feet → Scf
		
		Factory setting
		Depends on country (metric system units, → Page 121, or US units, → Page 122)

Transducer Block "Totalizer" (Endress+Hauser parameters) / base index 600		
Parameter	Write access for operating mode (MODE_BLK)	Description
Totalizer – Assign	AUTO - OOS	Use this function to assign a measured variable for the totalizer. **Options:** Off Volume Flow Calc. Mass Flow Corr. Volume Flow **Factory setting:** Volume Flow ✎ Note! The totalizer is reset to "0" as soon as the selection is changed.
Totalizer – Reset	AUTO - OOS	Use this function to reset the totalizer ("Totalizer – System Value" parameter) to 0 (= RESET). **Options:** No Yes **Factory setting:** No ✎ Note! Totalizer resetting can be controlled or triggered via FOUNDATION Fieldbus by means of cyclic data transfer via the Discrete Output Function Block (→ Page 119 ff.).
Totalizer – Reset All	AUTO - OOS	Use this function to reset the totalizer ("Totalizer – System Value" parameter) to 0 (= RESET). **Options:** No Yes **Factory setting:** No ✎ Note! Totalizer resetting can be controlled or triggered via FOUNDATION Fieldbus by means of cyclic data transfer via the Discrete Output Function Block (→ Page 119 ff.).

Transducer Block "Totalizer" (Endress+Hauser parameters) / base index 600		
Parameter	Write access for operating mode (MODE_BLK)	Description
Totalizers – Failsafe Mode	AUTO – OOS	Use this function to define the response of the totalizers to an alarm condition. **Options:** *Stop* The totalizer does not continue to count the flow if a fault is present. The totalizer stops at the last value before the alarm condition occurred. *Actual Value* The totalizer continues to count the flow on the basis of the current flow data. The fault is ignored. *Hold Value* The totalizer continues to count the flow on the basis of the last valid flow data (before the fault occurred). **Factory setting:** *Stop*

11. 7   Endress+Hauser parameters: Transducer Block "Display"

The following table shows all the Endress+Hauser–specific parameters of the Transducer Block "Display". These can only be changed after entering an enabling code in the "Un-/Locking – Access Code" parameter.

Transducer Block "Display" (Endress+Hauser parameters) / base index 700		
Parameter	Write access for operating mode (MODE_BLK)	Description
✎ Note! The FOUNDATION Fieldbus parameters of this block are described on Page 87.		
Un-/Locking – Access Code	AUTO - OOS	All data of the measuring system are protected against inadvertent change. Programming of the manufacturer-specific parameters is disabled and the settings cannot be changed until a code is entered in this function. You can enable programming by entering the: ■ Code 72 (factory setting) ■ Personal code, see "Un-/Locking – Define Private Code" parameter (→ Page 108) Transducer Block "Display" **User input:** Max. 4-digit number (0 to 9999) ✎ Note! ■ If write protection is enabled, access to manufacturer-specific parameters is denied even if the right code is entered. Write protection can be enabled or disabled by means of DIP switches (→ Page 35). ■ You can disable programming again by entering any number in this function (other than the Access Code). ■ The Endress+Hauser service organization can be of assistance if you mislay your private code. ■ Certain parameters can only be altered if a special Service Code is entered. This Service Code is known to your Endress+Hauser service organization. Please contact your Endress+Hauser service point if anything needs clarification.
Un-/Locking – Access Status	Read only	Use this function to display the current status of the possibilities for accessing the manufacturer-specific parameters of the device. **Display:** ■ LOCKED (parameters cannot be modified) ■ ACCESS CUSTOMER (parameters can be modified) ■ ACCESS SERVICE (parameters can be modified, access to service level)

Transducer Block "Display" (Endress+Hauser parameters) / base index 700		
Parameter	Write access for operating mode (MODE_BLK)	Description
Un–/Locking – Define Private Code	AUTO - OOS	Use this function to specify the personal code used to enable the configuration of the manufacturer-specific parameters in the Transducer Blocks. **User input:** Max. 4-digit number: 0 to 9999 **Factory setting:** 72 ✎ Note! • Programming is always enabled if the code defined = 0. • Programming has to be enabled before this code can be changed. When programming is disabled this function cannot be edited, thus preventing others from accessing your personal code.
Line 1– Assign	AUTO - OOS	Use this function to define which display value is assigned to the main line (top line of the local display) for display during normal measuring operation. **Options:** Off Volume Flow Volume Flow in % Mass Flow Mass Flow in % Corr. Volume Flow Corr. Volflow in % Totalizer 1 AI1 – OUT VALUE AI2 – OUT VALUE **Factory setting:** Volume Flow
Line 1 – 100%-Value	AUTO - OOS	✎ Note! The entry made only becomes effective if one of the following options was selected in the "Line 1 – Assign" parameter: Volume Flow in % Mass Flow in % Corr. Volflow in % Use this function to specify the flow value to be shown on the display as the 100% value. **User input:** 5-digit floating-point number **Factory setting** Depends on the nominal diameter, fluid and country (→ Page 122 ff.)

Transducer Block "Display" (Endress+Hauser parameters) / base index 700		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
Line 2–Assign	**AUTO – OOS**	Use this function to define which display value is assigned to the additional line (bottom line of the local display) for display during normal measuring operation. **Options:** Off Volume Flow Volume Flow in % Volume Flow Bargr. % Mass Flow Mass Flow in % Mass Fl.Bargr.% Corr. Volume Flow Corr. Volflow in % Corr. VolFl.Bar.% Totalizer 1 Oper/Sys.Condit. Tag Name AI1 – OUT VALUE AI2 – OUT VALUE **Factory setting:** Totalizer
Line 2–100%–Value	**AUTO – OOS**	✎ Note! The entry made only becomes effective if one of the following options was selected in the "Add. Line – Assign" parameter: Volume Flow in % Volume Flow Bargr. % Mass Flow in % Mass Fl.Bargr.% Corr. Volflow in % Corr. VolFl.Bar.% Use this function to specify the flow value to be shown on the display as the 100% value. **User input:** 5–digit floating–point number **Factory setting** Depends on country (metric system units, → Page 121, or US units, → Page 122)

Transducer Block "Display" (Endress+Hauser parameters) / base index 700		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
Display – Language	AUTO – OOS	Use this function to select the language for all texts and messages shown on the local display. **Options:** English Deutsch Francais Espanol Italiano Nederlands Norsk Svenska Suomi Portugues Polski Cesky **Factory setting** Depends on country (metric system units, → Page 121, or US units, → Page 122)
Display – Format	AUTO – OOS	Use this function to define the maximum number of places after the decimal point for the value displayed in the main line. **Options:** XXXXX. XXXX.X XXX.XX XX.XXX X.XXXX **Factory setting** XX.XXX ✎ Note! ■ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ■ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In these instances an arrow appears on the display between the measured value and the engineering unit (e.g. 1.2 →kg/h), indicating that the measuring system is computing with more decimal places than can be shown on the display.
Display – Damping	AUTO – OOS	Use this function to enter a time constant defining how the display reacts to severely fluctuating flow variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** 0 to 100 s **Factory setting** 5 s ✎ Note! ■ The setting 0 seconds switches off damping. ■ The function reaction time depends on the time specified in the "System Param. – Flow Damping" function (→ Page 99).

Transducer Block "Display" (Endress+Hauser parameters) / base index 700		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
Display – Contrast LCD	**AUTO – OOS**	Use this function to optimize the display contrast to suit local operating conditions. **User input:** 10 to 100% **Factory setting** 50%
Display – Test	**AUTO – OOS**	Use this function to test the operability of the local display and its pixels. **Options:** Off On **Factory setting:** Off Test sequence: 1. Start the test by selecting "On". 2. All pixels of the main line and additional line are darkened for minimum 0.75 seconds. 3. The main line and additional line show an "8" in each field for minimum 0.75 seconds. 4. The main line and additional line show a "0" in each field for minimum 0.75 seconds. 5. The main line and additional line show nothing (blank display) for minimum 0.75 seconds. 6. When the test is completed, the local display returns to its initial state and displays the option "Off".

11. 8 Endress+Hauser parameters: Transducer Block "Diagnosis"

The following table shows all the Endress+Hauser-specific parameters of the Transducer Block "Diagnosis". These can only be changed after entering an enabling code in the "Un-/Locking – Access Code" parameter.

Transducer Block "Diagnosis" (Endress+Hauser parameters) / base index 800		
Parameter	**Write access for operating mode (MODE_BLK)**	**Description**
✎ Note! The FOUNDATION Fieldbus parameters of this block are described on Page 87.		
Diagnosis – Actual System Condition	**Read only**	The current system status appears on the display. **Display:** "SYSTEM OK" or the fault/notice message with the highest priority. ✎ Note! An exact error description as well as information on rectifying errors can be found on Page 49 ff..
Diagnosis – Previous System Condition	**Read only**	The last error message to occur appears on the display.
Un-/Locking – Access Code	AUTO - OOS	All data of the measuring system are protected against inadvertent change. Programming of the manufacturer-specific parameters is disabled and the settings cannot be changed until a code is entered in this function. You can enable programming by entering the: ■ Code 72 (factory setting) ■ Personal code, see "Un-/Locking – Define Private Code" parameter (→ Page 108) Transducer Block "Display" **User input:** Max. 4-digit number (0 to 9999) ✎ Note! ■ If write protection is enabled, access to manufacturer-specific parameters is denied even if the right code is entered. Write protection can be enabled or disabled by means of DIP switches (→ Page 35). ■ You can disable programming again by entering any number in this function (other than the Access Code). ■ The Endress+Hauser service organization can be of assistance if you mislay your private code. ■ Certain parameters can only be altered if a special Service Code is entered. This Service Code is known to your Endress+Hauser service organization. Please contact your Endress+Hauser service point if anything needs clarification.
Un-/Locking – Access Status	**Read only**	Use this function to display the current status of the possibilities for accessing the manufacturer-specific parameters of the device. **Display:** ■ LOCKED (parameters cannot be modified) ■ ACCESS CUSTOMER (parameters can be modified) ■ ACCESS SERVICE (parameters can be modified, access to service level)

Transducer Block "Diagnosis" (Endress+Hauser parameters) / base index 800		
Parameter	Write access for operating mode (MODE_BLK)	Description
System – Alarm Delay	**AUTO – OOS**	Use this function to define a time span for which the criteria for an error have to be satisfied without interruption before a fault or notice message is generated. ✎ Note! Depending on the setting and type of error, this alarm delay affects both the display and the outputs of the FOUNDATION Fieldbus. **User input:** 0 s to 100 s (in steps of one second) **Factory setting:** 0 s ☝ Caution! If this parameter is used, fault and notice messages are delayed by the time corresponding to the setting before being forwarded to the downstream function blocks or the fieldbus host system. It is therefore imperative to check in advance whether a delay of this nature could affect the safety requirements of the process. If fault and notice messages may not be suppressed, a value of 0 seconds must be entered here.
System – Simulation Failsafe Mode	**AUTO – OOS**	Use this function to set the totalizers to their defined failsafe modes, in order to check whether they respond correctly. The failsafe mode of the totalizer is determined via the "Totalizer – Failsafe All" parameter in the Transducer Block "Totalizer" (→ Page 106). Device response when error simulation is active: Device status → notice message #691 "SIM. FAILSAFE" active, (→ Page 53) **Options:** Off On **Factory setting:** Off
System – Reset	**AUTO – OOS**	Use this function to reset the measuring system. **Options:** *No* *Restart System* Restart without disconnecting main power. *Reset Delivery* Restart without disconnecting main power, the saved settings of the delivery status (factory settings) are applied. **Factory setting:** No

11. 9 Endress+Hauser parameters: Transducer Block "Service"

All the parameters required for service purposes are located in the Transducer Block "Service" (base index 900). As these parameters affect the accuracy and the functionality of the device, changes may only be carried out by Endress+Hauser service technicians. The parameters of the Transducer Block "Service" are not described in these Operating Instructions → Please refer to the special Service Manual.

11. 10 Analog Input Function Block

In the Analog Input Function Block, the process variables of the Transducer Blocks "Flow" and "Totalizer" are prepared for subsequent automation functions (e.g. scaling and limit value processing). The automation function is defined by connecting up the outputs.

A0003800
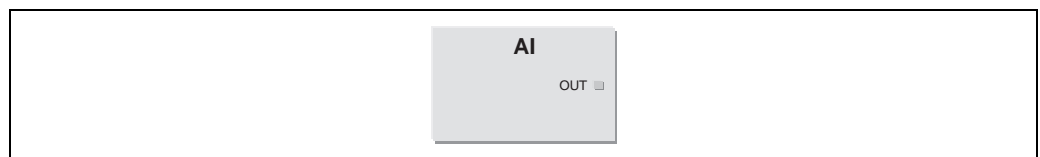
Fig. 34:   Defining the automation function in the Analog Input Function Block

OUT = output value and status of the Analog Input Function Block

11.10.1 Signal processing

The figure schematically illustrates the internal structure of the Analog Input Function Blocks available:

A0003804-EN
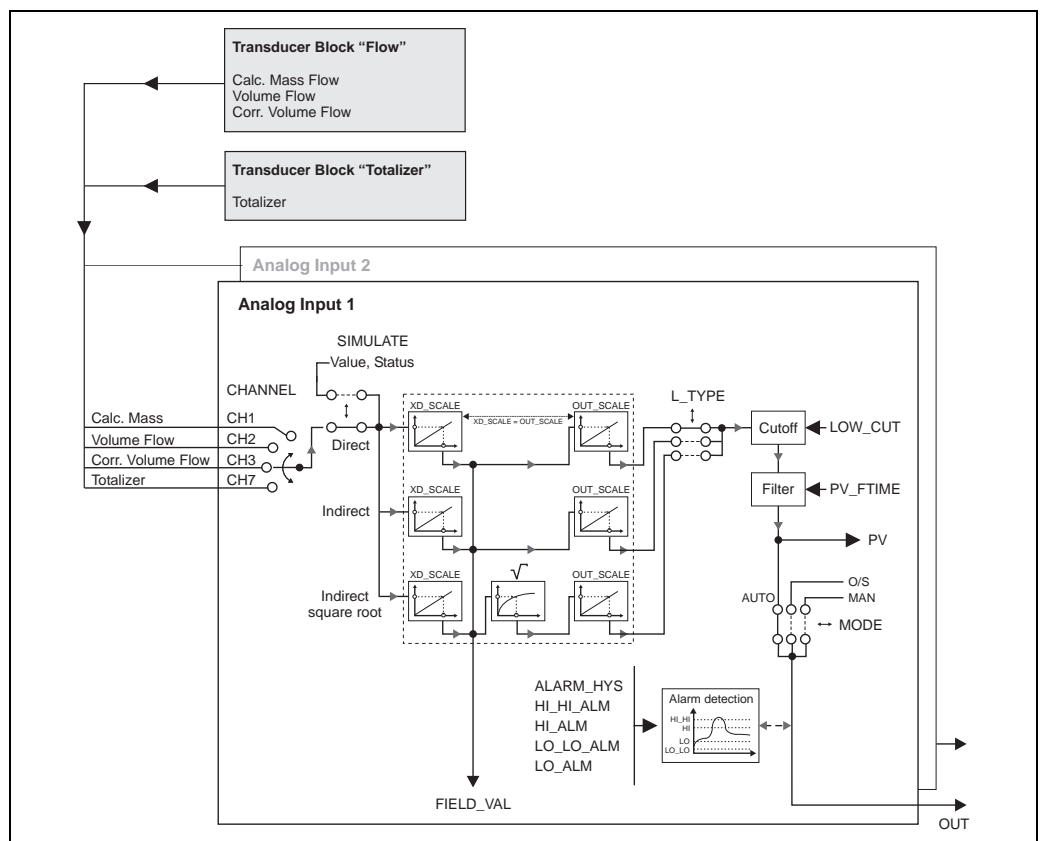
Fig. 35:   Signal processing and structure of the Analog Input Function Blocks

The Analog Input Function Block receives its input value from the Transducer Block "Flow" or "Totalizer"(→ Page 84 ff.). The CHANNEL parameter is used to select which input value should be processed by the Analog Input Function Block.
- CHANNEL = 1 → Calculated mass flow
- CHANNEL = 2 → Volume flow
- CHANNEL = 3 → Corrected volume flow
- CHANNEL = 7 → Totalizer

The SIMULATE parameter group allows you to replace the input value with a simulation value and activate simulation. By specifying the status and the simulation value, the reaction of the complete Analog Input Function Block can be tested.

✎ Note!
The simulation mode is enabled by means of a DIP switch (→ Page 117)

The L_TYPE parameter is used to select the type of linearization of the input and/or simulation value (→ Page 40 ff.):
- Direct signal conversion
  The input value is forwarded without any conversion (XD_SCALE = OUT_SCALE). This is selected if the input value is already in the physical units you want.

- Indirect signal conversion
  In this setting, the input value is rescaled linearly via the input scaling XD_SCALE to the desired output range OUT_SCALE (further information on rescaling the input value can be found on Page 118).

- Indirect signal conversion with root
  In this setting, the input value is rescaled via the XD_SCALE parameter group and calculated again using a root function. Further rescaling follows to the desired output range via the OUT_SCALE parameter group.

The LOW_CUT parameter can be used to specify a limit value for low flow cut off. Low flow cut off is activated via the IO_OPTS parameter. If the converted input value (PV) is below the limit value, it is set to "Zero".

In the PV_FTIME parameter, a filter time can be specified for filtering the converted input value (PV). If a time of 0 seconds is specified, the input value is not filtered.

The MODE_BLK parameter group (→ Page 87) is used to select the operating mode of the Analog Input Function Block. If the MAN (manual) operating mode is selected, the output value OUT can be specified directly.

The OUT output value is compared against early warning and alarm limits (e.g. HI_LIM, LO_LO_LIM, etc.) that can be entered via various parameters. If one of these limit values is violated, a limit value process alarm (e.g. HI_ALM, LO_LO_ALM, etc.) is triggered.

The most important functions and parameters of the Analog Input Function Block are listed below.

11.10.2 Selecting the operating mode

The operating mode is set by means of the MODE_BLK parameter group (see → Page 87).
The Analog Input Function Block supports the following operating modes:
- AUTO
- MAN
- OOS

✎ Note!
The OOS block status mode is also displayed by means of the BLOCK_ERR parameter
(→ Page 88). In the OOS operating mode, all write parameters can be accessed without
restriction if write protection has not been enabled.

11.10.3 Selecting the process variable

Prowirl 72 FF has two Analog Input Function Blocks. The input value (process variable) to be
processed is assigned via the CHANNEL parameter:
- CHANNEL = 1 → Calculated mass flow
- CHANNEL = 2 → Volume flow
- CHANNEL = 3 → Corrected volume flow
- CHANNEL = 7 → Totalizer

11.10.4 Linearization types

In the Analog Input Function Block, the input value from the Transducer Block can be linearized
via the L_TYPE parameter (→ Page 40 ff.). The following linearization types are available:

- Direct
  In this setting, the input value bypasses the linearization function and is looped unchanged with
  the XD_SCALE unit through the Analog Input Function Block.

- Indirect
  In this setting, the input value is rescaled linearly via the XD_SCALE input scaling to the desired
  output range OUT_SCALE.

- Indirect Square Root
  In this setting, the input value is rescaled via the XD_SCALE parameter group and calculated
  again using a root function. Further rescaling follows to the desired output range via the
  OUT_SCALE parameter group.

11.10.5 Selecting the units

The XD_SCALE parameter group is used to determine with which physical unit the input value
from the Transducer Blocks should be read in and processed in the Analog Input Function Block.
Make sure that the unit selected suits the input value chosen in the CHANNEL parameter. The
output value OUT is specified via the OUT_SCALE parameter group.

✎ Note!
- Example for rescaling the input value (→ Page 118)
- The system units selected in the Transducer Blocks in question do not have any effect on the
  setting of the system units in the Analog Input Function Block. The units are specified
  independently of one another and must be configured separately. The unit selected in the
  Transducer Blocks is only used for the local display, low flow cut off and for simulation.

11.10.6 Status of the output value OUT

The status of the Analog Input Function Block and the validity of the output value OUT are relayed to the downstream function blocks by means of the status of the OUT parameter group. The following statuses can be displayed:

■ GOOD_NON_CASCADE
The Analog Input Function Block is in the AUTO operating mode, i.e. the output value OUT is valid and can be used for further processing.

■ UNCERTAIN
The output value OUT can only be used for further processing to a limited extent. The "UNCERTAIN" status signals to the downstream function blocks that a "notice message" is present in the device, e.g. arising from active positive zero return or simulation.

■ BAD
The output value OUT is not valid. The following causes are possible:
   – The Analog Input Function Block is in the OOS operating mode.
   – The Resource Block is in the OOS operating mode.
   – The "BLOCK CONFIGURATION" status is displayed by means of the BLOCK_ERR parameter (→ Page 40 ff.).
   – A "fault message" is present in the device arising from a critical device error, e.g. an electronics module defect.

✎ Note!
In the Transducer Block "Diagnosis", the cause of the error message (notice/fault message) is displayed via the "Diagnosis – Actual System Condition" parameter in the Transducer Block "Diagnosis". A list of all the error messages, incl. remedial measures, can be found on Page 49 ff.

11.10.7 Simulation of input/output

Certain parameters of the Analog Input Function Block allow simulation of the input and output of the function block:

1.   Simulating the input of the Analog Input Function Block: The input value (measured value and status) can be specified by means of the SIMULATE parameter group (→ Page 101). Since the simulation value runs through the entire function block, all the parameter settings of the block can be checked.

   ✎ Note!
   If simulation is not enabled by means of the DIP switch (→ Page 35), the simulation mode cannot be activated in the SIMULATE parameter (→ Page 101). The BLOCK_ERR parameter (→ Page 88) in the Resource Block indicates whether simulation of the Analog Input Function Block is possible.

2.   Simulating the output of the Analog Input Function Block: Set the operating mode in the MODE BLK parameter group (→ Page 87) to MAN and directly specify the desired output value in the OUT parameter.

11.10.8 Diagnosis

Block errors and diagnosis information are displayed in the Analog Input Function Block via the BLOCK_ERR parameter.

✎ Note!
Further information on troubleshooting and fault elimination during the configuration of the Analog Input Function Block can be found on Page 46.

11.10.9 Rescaling the input value

In the Analog Input Function Block, the input value or input range can be scaled in accordance with the automation requirements.

Example:
- The measuring range of the sensor is 0 to 30 m³/h.
- The output range to the automation system should be 0 to 100%.

The Analog Input Function Block must be configured as follows:
- Select the input value in the CHANNEL parameter
  Select CHANNEL = 2 → Volume flow

L_TYPE parameter (see Page 40)
    Select: L_TYPE = Indirect
    The process variable "Volume Flow" of the Transducer Block "Flow" is rescaled linearly in the AI Block via the input scaling XD_SCALE to the desired output range OUT_SCALE.

XD_SCALE parameter group (see Page 40)
    XD_SCALE 0 % = 0
    XD_SCALE 100 % = 30
    XD_SCALE UNIT = m³/h

OUT_SCALE parameter group (see Page 40)
    OUT_SCALE 0 % = 0
    OUT_SCALE 100 % = 100
    OUT_SCALE UNIT = %

The result is that with an input value of, for example, 15 m³/h an output value of 50% is output via the OUT parameter.
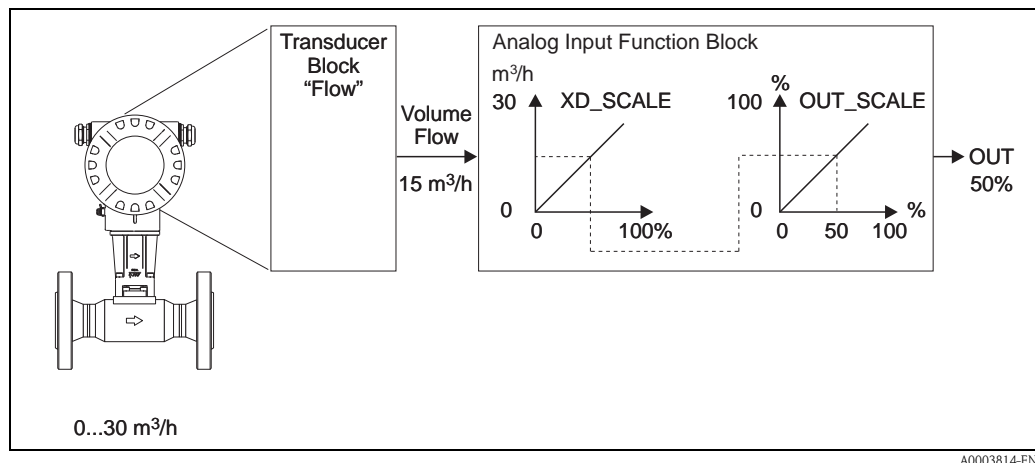
Fig. 36:   Rescaling the input value

12   Discrete Output Function Block

The Discrete Output Function Block (DO) processes the discrete set point received from an upstream function block or higher-level process control system which can be used to trigger various device functionalities (e.g. totalizer reset) in the downstream Transducer Blocks.
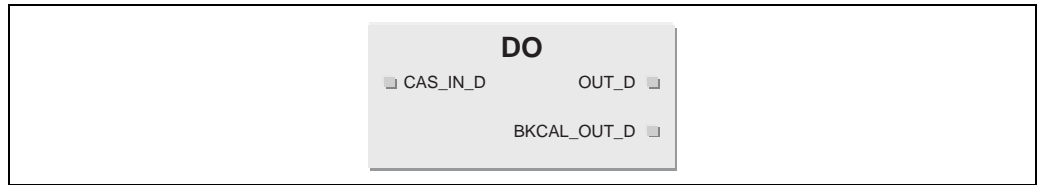
A0003816-EN

Fig. 37:   Example for Discrete Output Function Block

CAS_IN _D = External input value and status from an upstream block
OUT_D = Discrete output value and status
BKCAL_OUT_D = Output value and status for the BCAL_IN_D input of another block

✎   Note!
For a description of the most important parameters and functions of the Discrete Output Function Block, refer to the Operating Instructions "FOUNDATION Fieldbus Overview" (BA013S). Available at: → www.endress.com → Download.
The most important parameter settings of the Discrete Output Function Block are listed below.

12. 1   Assignment: Discrete Output Function Block/Transducer Blocks

The assignment or connection between the Discrete Output Function Block and the Transducer Blocks is established by means of the CHANNEL parameter (option "16" = Discrete Output Function Block).

12. 2   Values for the CAS_IN_D, RCAS_IN_D, OUT_D, and SP_D parameters

By means of the Discrete Output Function Block, various device functionalities can be triggered in the Transducer Blocks in question via manufacturer-specific, specified set points from an upstream function block.
Here, you must note that the desired function is not executed until a change of state from the value 0 (Discrete state 0) to the corresponding function value takes place (→ Page 120). Thus, the value = 0 always serves as the starting point for triggering the device functions. A change of status from a value other than 0 to another value does not have any effect.

Input assignment of the CAS_IN_D, RCAS_IN_D, OUT_D, SP_D parameters

Status change			Action
Discrete state 0	→	Discrete state 1	Reserved
Discrete state 0	→	Discrete state 2	Positive zero return ON
Discrete state 0	→	Discrete state 3	Positive zero return OFF
Discrete state 0	→	Discrete state 4	Reserved
Discrete state 0	→	Discrete state 5	Reserved
Discrete state 0	→	Discrete state 6	Reserved
Discrete state 0	→	Discrete state 7	Reserved
Discrete state 0	→	Discrete state 8	Reset totalizer

Example for controlling positive zero return via the Discrete Output Function Block
The following example is intended to illustrate how positive zero return can be activated and deactivated during a rinsing process by an upstream function block via the Discrete Output Function Block.

1. First of all, the connection between the Discrete Output Function Block and the Transducer Blocks must be established. For this purpose, the value "16" (= Discrete Output) has to be assigned to the CHANNEL parameter.
2. By means of the SHED_OPT parameter, select the response in the event of the monitoring time being exceeded (SHED_OPT) in the RCAS operating mode.

    ✎   Note!
    The option SHED_OPT = 0 (uninitialized) is not valid.

3. Download all the data and parameters into the field device.

In the CAS operating mode, the Discrete Output Function Block processes the set point specified by an upstream function block at the CAS_IN_D input and transmits this to the Transducer Blocks.

Switching on positive zero return
Starting from the output value 0 (Discrete state 0), positive zero return is switched on through a change in state from 0 → 2 at the CAS_IN_D input.

Switching off positive zero return:
Positive zero return can only be switched off again if the input value at CAS_IN_D is set to the output value 0 (Discrete state 0) beforehand. Only then can positive zero return be switched off by a change in state from 0 → 3 at the CAS_IN_D input.

13   Factory settings

13. 1   Metric system units (not for USA and Canada)

Units flow (Transducer Block "Flow")

Flow	Units factory setting
System Unit – Volume Flow	m³/h
System Unit – Calc Mass Flow	kg/h
System Unit – Corr. Volume Flow	Nm³/h

Units density, length, temperature (Transducer Block "Flow")

	Units factory setting
System Unit – Density	kg/m³
System Unit – Length	mm
System Unit – Temperature	°C

Language (see Page 110)

Country	Language	Country	Language
Australia	English	Norway	Norsk
Belgium	English	Austria	Deutsch
Denmark	English	Poland	Polski
Germany	Deutsch	Portugal	Portugues
England	English	Sweden	Svenska
Finland	Suomi	Switzerland	Deutsch
France	Francais	Singapore	English
The Netherlands	Nederlands	Spain	Espanol
Hong Kong	English	South Africa	English
India	English	Thailand	English
Italy	Italiano	Czechia	Cesky
Luxembourg	Francais	Hungary	English
Malaysia	English	Other countries	English

100% value line 1 and line 2 (Transducer Block "Display")
The factory settings in the table are given in the unit dm³/s. If another unit is selected, the corresponding value is converted and displayed in the selected unit.

Nominal diameter DN		Flange		Wafer	
DIN [mm]	ANSI [inch]	Gas [dm³/s]	Liquid [dm³/s]	Gas [dm³/s]	Liquid [dm³/s]
15	½"	7.2	1.4	8	2
25	1"	32	4	48	6
40	1½"	80	10	80	16
50	2"	160	16	160	20
80	3"	320	40	400	48
100	4"	560	64	640	80
150	6"	1280	160	1600	160
200	8"	2400	320	–	–
250	10"	4000	480	–	–
300	12"	5600	640	–	–

Unit totalizer (Transducer Block "Totalizer")
Depending on the option selected in the "Totalizer – Assign" function, the following units are set:

Selection in the "Totalizer – Assign" function	Unit
Volume Flow	m³
Calc Mass Flow	kg
Corr. Volume Flow	Nm³

13. 2   US units (only for USA and Canada)

Units flow (Transducer Block "Flow")

Flow	Units factory setting
System Unit – Volume Flow	US gal/h
System Unit – Calc Mass Flow	lb/min
System Unit – Corr. Volume Flow	Sm³/h

Units density, length, temperature (Transducer Block "Flow")

	Units factory setting
System Unit – Density	lb/ft³
System Unit – Length	Inch
System Unit – Temperature	°F

Language (see Page 110)

Country	Language
USA	English
Canada	English

100% value line 1 and line 2 (Transducer Block "Display")
The factory settings in the table are given in the unit dm³/s. If another unit is selected, the corresponding value is converted and displayed in the selected unit.

Nominal diameter DN		Flange		Wafer	
DIN [mm]	ANSI [inch]	Gas [US gal/min]	Liquid [US gal/min]	Gas [US gal/min]	Liquid [US gal/min]
15	½"	110	22	120	32
25	1"	550	63	760	95
40	1½"	1300	160	1300	250
50	2"	2500	250	2500	310
80	3"	5100	630	6300	760
100	4"	8900	1000	10000	1300
150	6"	20000	2500	25000	2500
200	8"	38000	5100	–	–
250	10"	63000	7600	–	–
300	12"	89000	10000	–	–

Unit totalizer (Transducer Block "Totalizer")
Depending on the option selected in the "Totalizer – Assign" function, the following units are set:

Selection in the "Totalizer – Assign" function	Unit
Volume Flow	US gal
Calc Mass Flow	lb
Corr. Volume Flow	Sm³

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Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De-Contamination

Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

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

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

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

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

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

Process data/ *Prozessdaten*   Temperature / *Temperatur* _____ [°F] _____ [°C]   Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* _____ [µS/cm]   Viscosity / *Viskosität* _____ [cp] _____ [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; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

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

Description of failure / *Fehlerbeschreibung* _____
_____
_____

Company data / *Angaben zum Absender*

Company / *Firma* _____
_____

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*

P/SF/Konta XIV

Endress+Hauser **EH**

People for Process Automation

www.endress.com/worldwide