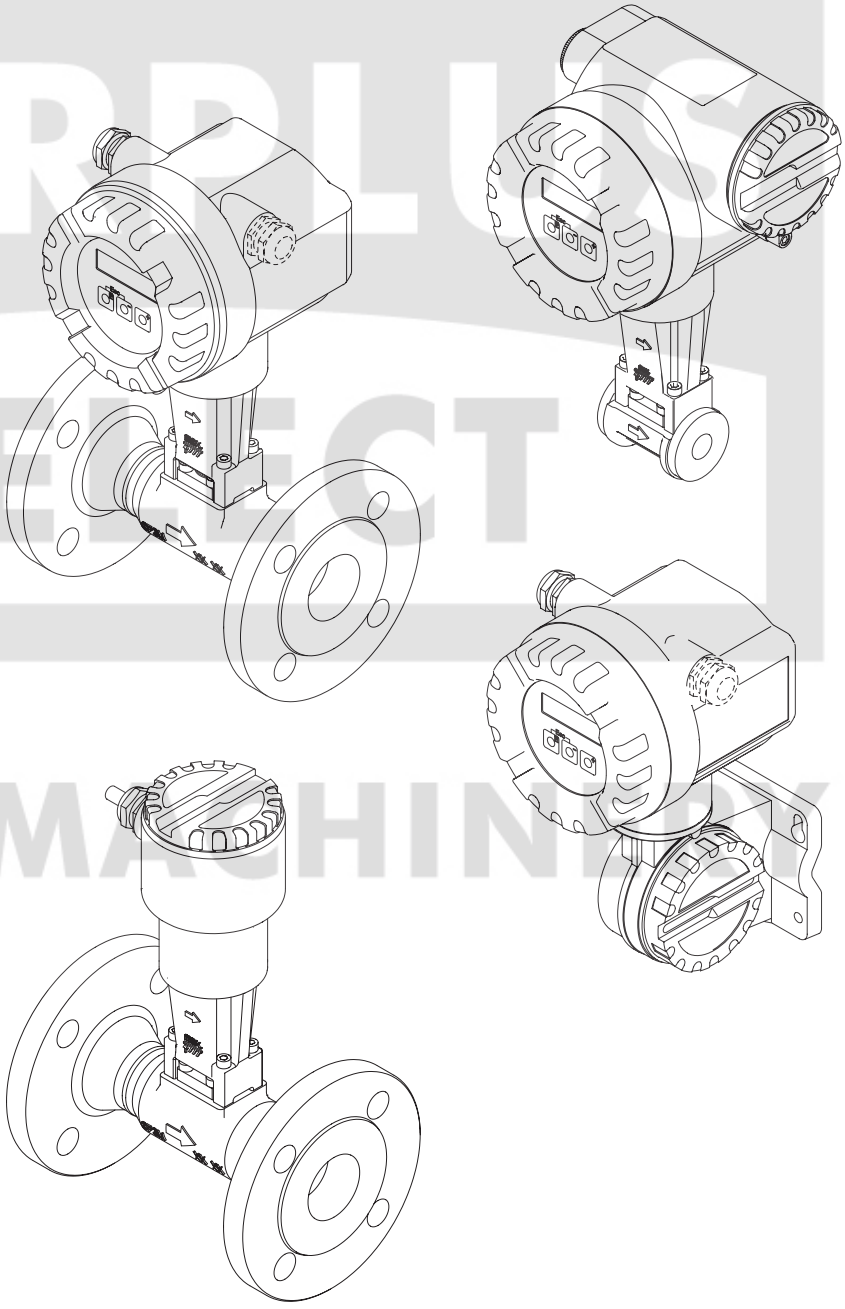
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Operating Instructions

Proline Prowirl 72

Vortex Flow Measuring System
4...20 mA HART

HART® FIELD COMMUNICATION PROTOCOL



BA084D/06/en/12.05
71008404

Valid as of software version:
V 1.02.00 (amplifier)

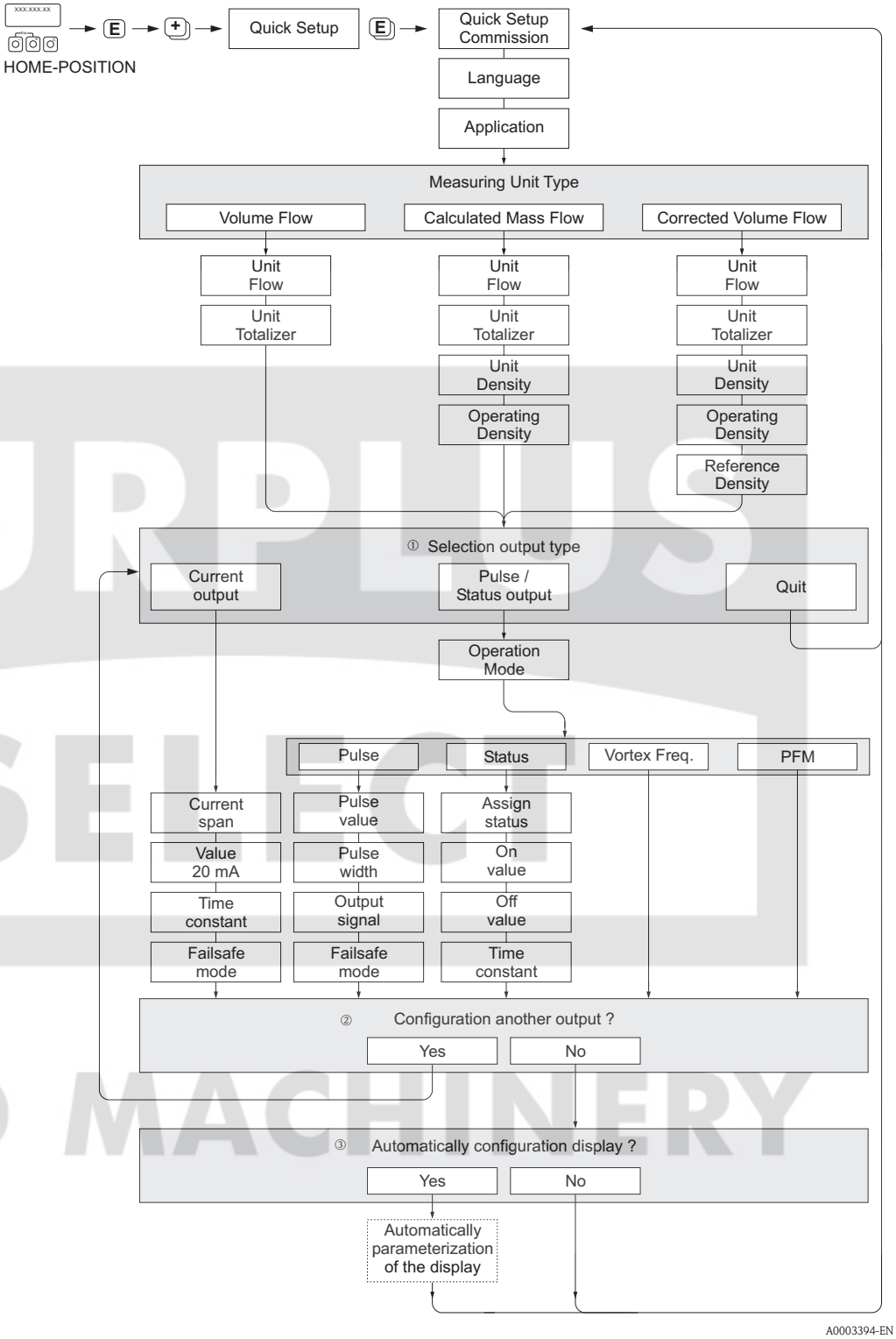
Endress+Hauser
People for Process Automation

Brief operating instructions

These brief operating instructions explain how to commission your measuring device quickly and easily:

Safety instructions	Page 7
▼	
Installation	Page 11
▼	
Wiring	Page 21
▼	
Display and operating elements	Page 27
▼	
Commissioning with "QUICK SETUP"	Page 40
You can commission your measuring device quickly and easily using the special "Quick Setup" menu. It allows you to configure important basic functions via the local display, for example display language, measured variables, engineering units, signal type etc.	
▼	
Customer-specific configuration / Description of device functions	Page 71 ff.
Complex measurement tasks require the configuration of additional functions which you can individually select, set and adapt to your process conditions using the function matrix. The function matrix of the measuring device and all the functions are described in detail in the "Description of device functions" section.	

QUICK SETUP for quick commissioning



Note!

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

① Only the output (current output or pulse/status output) not yet configured in the current Quick Setup is offered for selection after the first cycle.

② The “YES” option appears as long as a free output is still available. “NO” is the only option displayed when no further outputs are available.

③ When “YES” is selected, the flow is assigned to line 1 of the local display and the totalizer to line 2.

Table of Contents

1 Safety instructions

1.1 Designated use

The measuring system is used to measure the volume flow of saturated steam, over-heated 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.

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

1.2 Installation, commissioning and operation

Note the following points:

- Installation, 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.
- In the case of special fluids (incl. fluids for cleaning), Endress+Hauser will be happy to assist in clarifying the material resistance properties of wetted parts. However, the user is responsible for the choice of wetted materials as regards their in-process resistance to corrosion. The manufacturer refuses to accept liability.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:

- Measuring systems for use in hazardous environments are accompanied by separate “Ex documentation”, which is an *integral part* of these Operating Instructions. Strict compliance with the installation instructions and ratings as listed in this supplementary documentation is mandatory.
  The symbol on the front of the Ex documentation indicates the approval and the certification center (Ex Europe, FM USA, CSA Canada).
- The measuring system complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of EN 61326/A1 and NAMUR Recommendations NE 21 and NE 43.
- 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.

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

- Enclose special handling instructions if necessary, for example a safety data sheet as per European Directive 91/155/EEC.
- 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.

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 "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” flowmeter system consists of the following components:
- Transmitter Proline Prowirl 72
- 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 on the transmitter

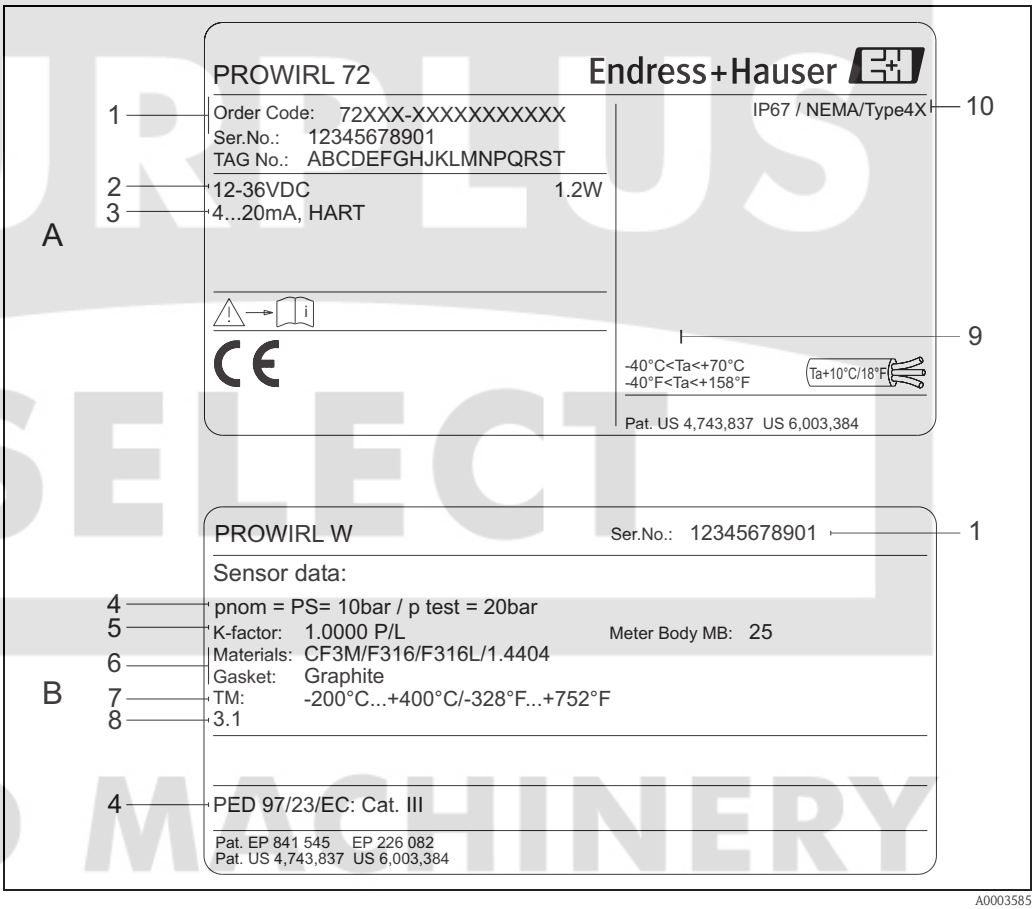


Fig. 1: Nameplate specifications for transmitter and sensor (example)
A = nameplate on transmitter, B = nameplate on transmitter (only compact version)

1 Order code / serial number: see the specifications on the order confirmation for the meanings of the individual letters and digits.
2 Power supply / frequency: 12...36 V DC, Power consumption: 1.2 W
3 Available outputs: Current output 4...20 mA
4 Data regarding Pressure Equipment Directive (optional)
5 Calibration factor
6 Material sensor and gasket
7 Medium temperature range
8 Reserved for information on special products
9 Permitted ambient temperature range
10 Degree of protection

2.1.2 Sensor nameplate (remote version)

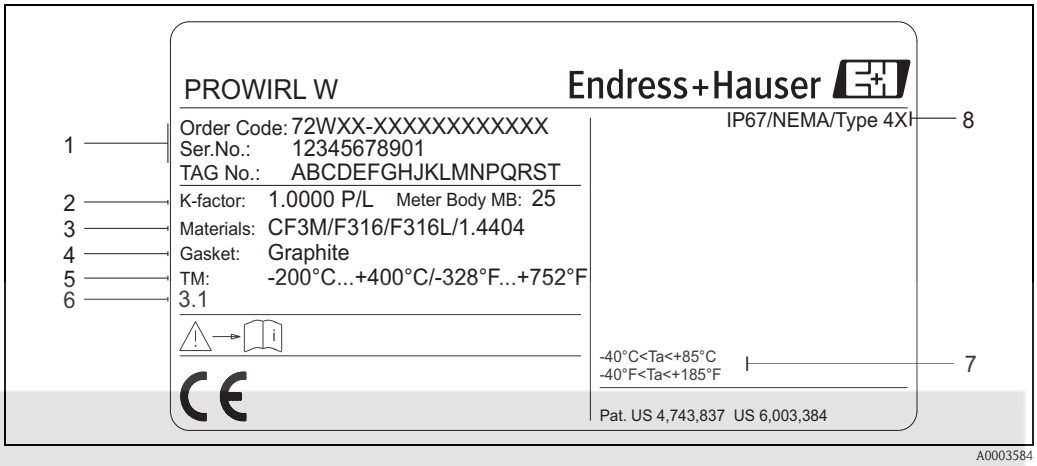


Fig. 2: Nameplate specifications for transmitter remote version "Proline Prowirl 72" (example)

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

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 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and the EMC requirements as per EN 61326/A1.
The measuring system described in these Operating Instructions is therefore in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
The measuring system is in conformity with the EMC requirements of the Australian Communications Authority (ACA).

2.3 Registered trademarks

GYLON ®
Registered trademark of Garlock Sealing Technologies, Palmyar, NY, USA

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

INCONEL ®
Registered trademark of Inco Alloys International Inc., Huntington, USA

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

ToF Tool – Fieldtool® Package, Fieldcheck®, Applicator®
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...300 may not be lifted at the transmitter housing or at the connection housing of the remote version when transporting (see Fig. 3). 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.

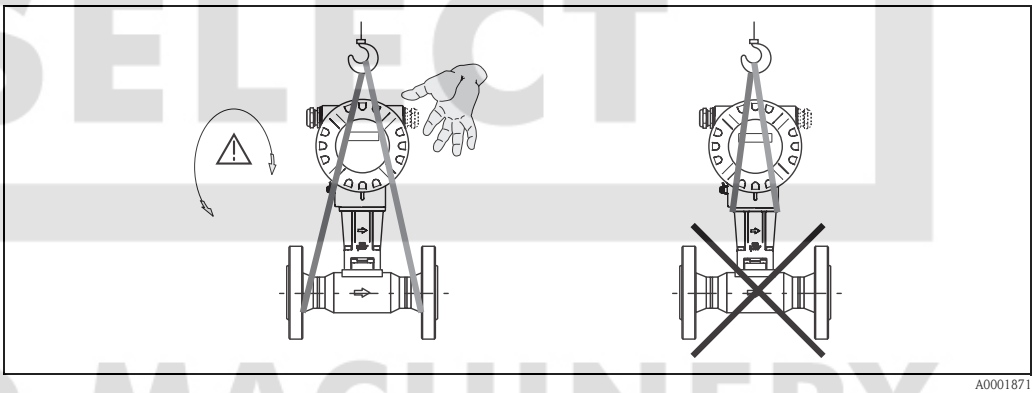


Fig. 3: Instructions for transporting sensors with DN 40...300

3.1.3 Storage

Note the following points:

- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The permissible storage temperature is –40...+80 °C (ATEX II 1/2 GD version/dust ignition-proof –20...+55 °C).
- 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 63) and fluid temperatures (see Page 63) 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 MATING PIPE DIAMETER function on Page 97).
- The correct operation of the measuring system is not influenced by plant vibrations up to 1 g, 10...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 in all directions = 100 mm
- Necessary cable length: L + 150 mm

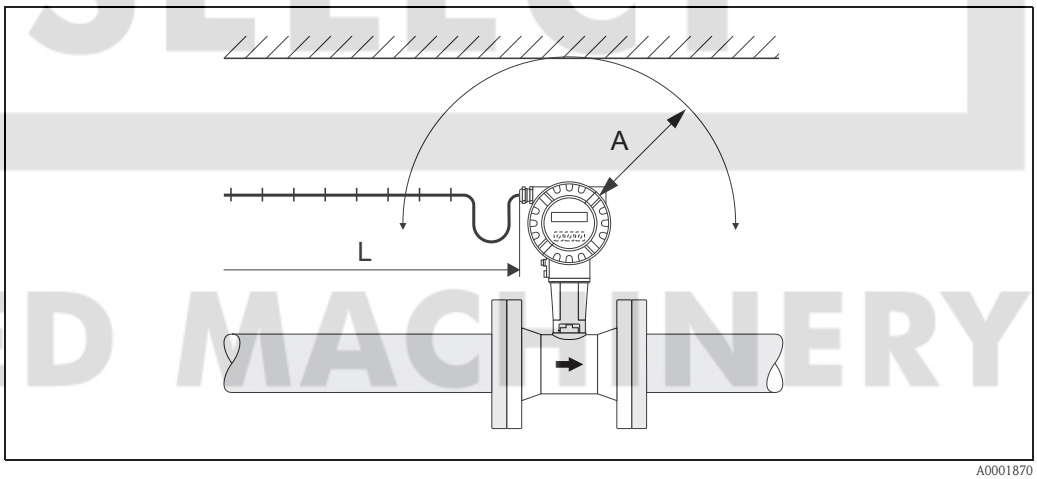


Fig. 4: A = Minimum spacing in all directions, L = cable length

3.2.3 Orientation

The device can generally be installed in any position in the piping.

In the case of liquids, there should be upward flow in vertical pipes to avoid partial pipe filling (see orientation A).

In the case of hot fluids (e.g. steam or fluid temperature ≥ 200 °C), select orientation C or D so that the permitted ambient temperature of the electronics is not exceeded. Orientations B and D are recommended for very cold fluids (e.g. liquid nitrogen) (see Page 13).

Orientations B, C and D are possible with horizontal installation (see Page 13).

The arrow indicated on the device must always point in the direction of flow in all orientations.

Caution!
- If fluid temperature is ≥ 200 °C, orientation B is **not** permitted for the wafer version (Prowirl 72 W) with a nominal diameter of DN 100 and DN 150.
- In case of vertical orientation and downward flowing liquid, the piping has always to be completely filled.

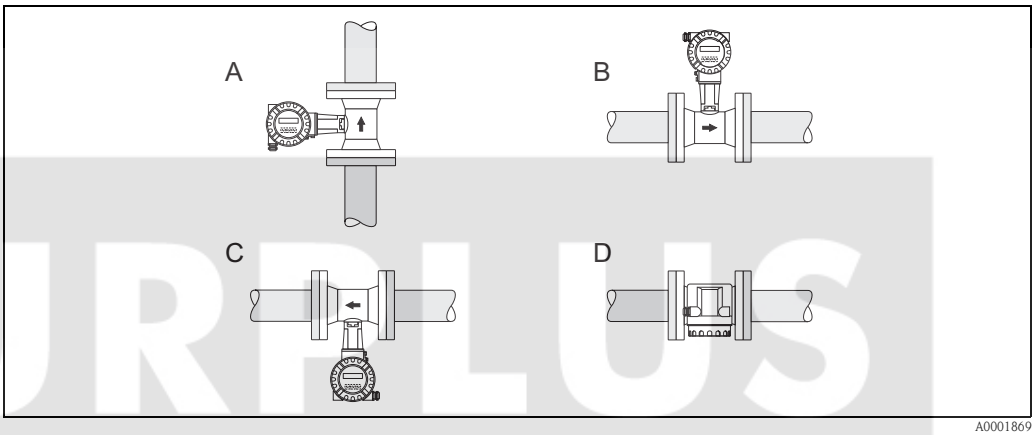


Fig. 5: Possible orientations of the device

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 diagrams. These apply equally to both the compact version and the sensor in the remote version.

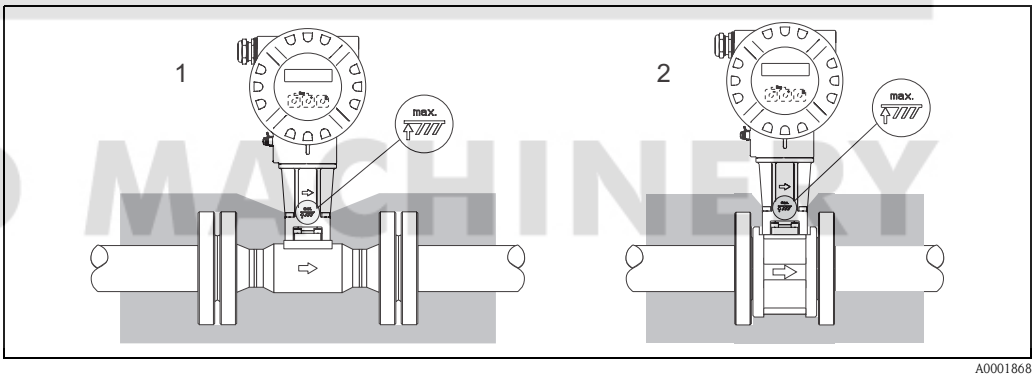


Fig. 6: 1 = Flanged version, 2 = Wafer version

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 63.

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.

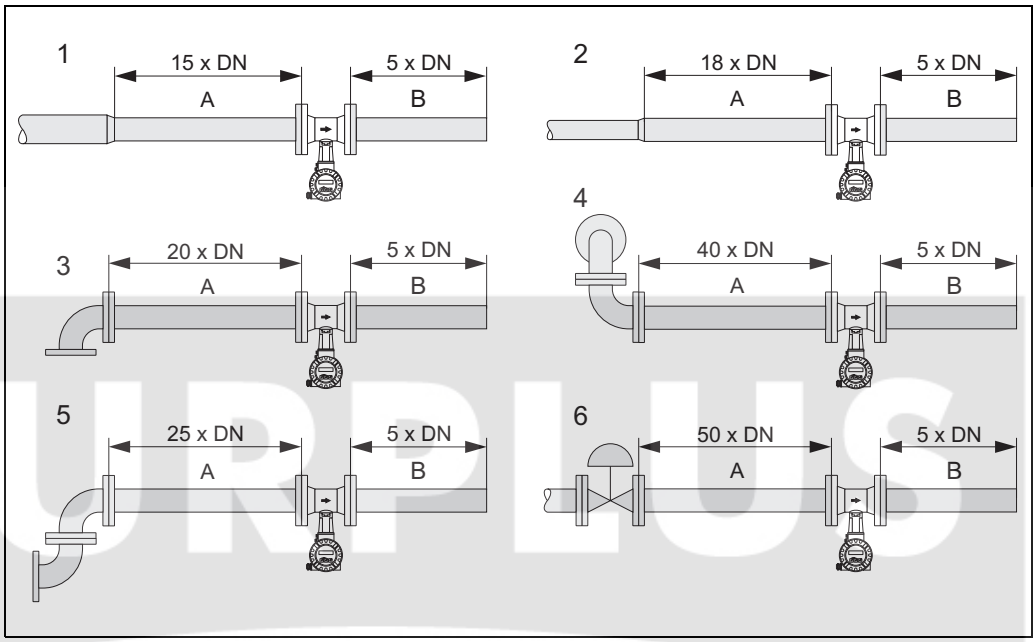


Fig. 7: Minimum inlet and outlet runs with various flow obstructions

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.

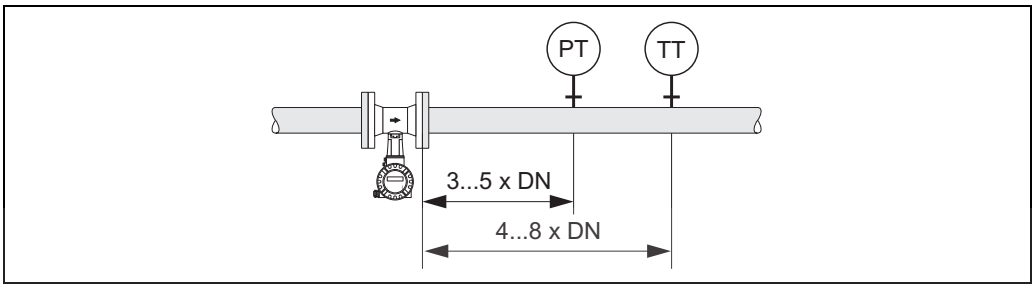


Fig. 8: Installation of pressure measuring point (PT) and temperature measuring point (TT)

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 x DN with complete accuracy.

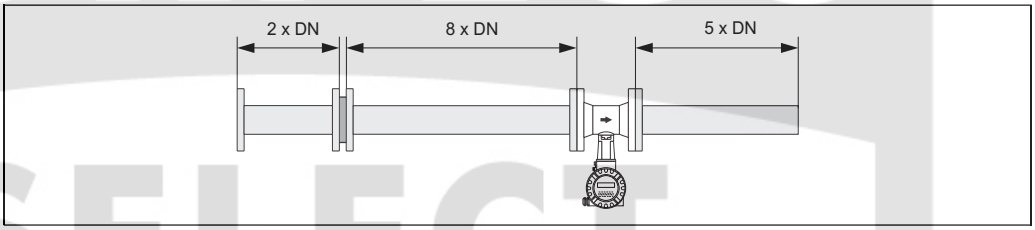


Fig. 9: Perforated plate flow conditioner

Examples of pressure loss for flow conditioner
The pressure loss for flow conditioners is calculated as follows:
Δp [mbar] = 0.0085 · ρ [kg/m³] · v² [m/s]

- Example with steam
  p = 10 bar abs
  t = 240 °C → ρ = 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...500 Hz. Consequently, the sensors require no special measures for attachment.

3.2.7 Limiting flow

See the information on Page 59 and 65.

3.3 Installation

3.3.1 Mounting the 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. For this reason, the seals supplied by Endress+Hauser for the wafer version have a slightly larger internal diameter than the measuring pipe.
- Ensure that the arrow on the measuring pipe matches the direction of flow in the piping.
- Lengths:
  – Prowirl W (wafer version): 65 mm
  – 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.

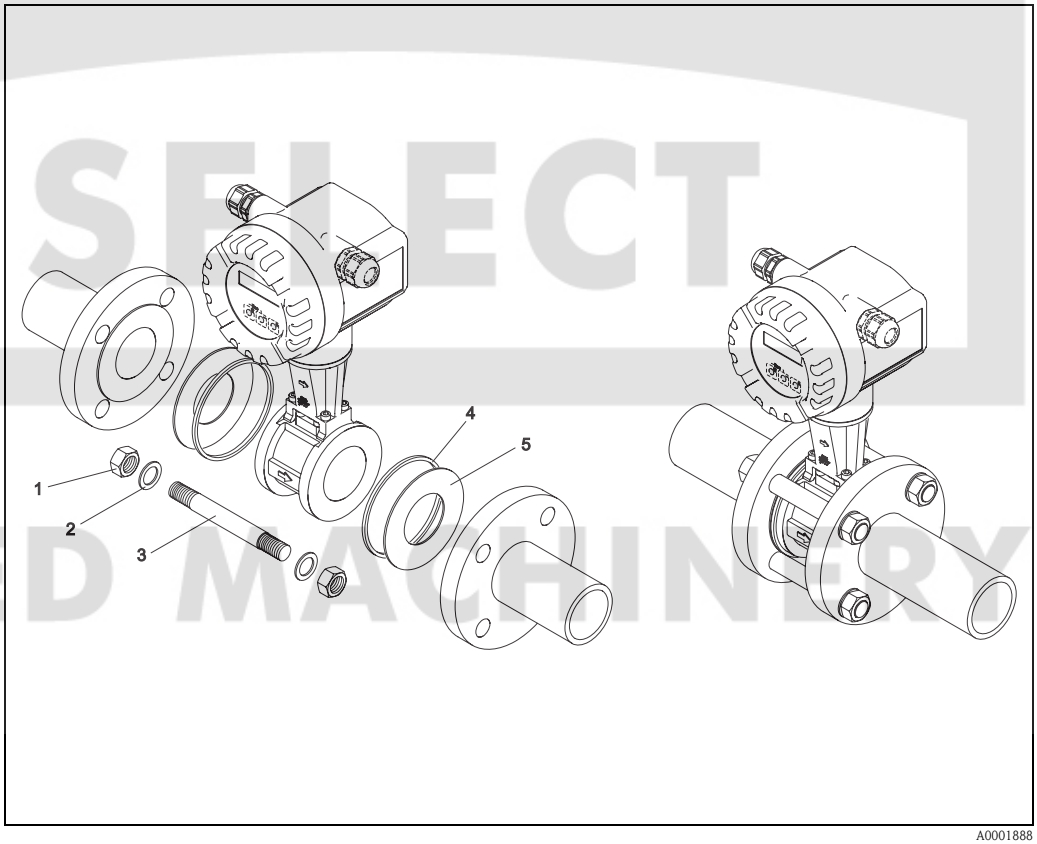


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Fig. 10: Mounting the wafer version

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.

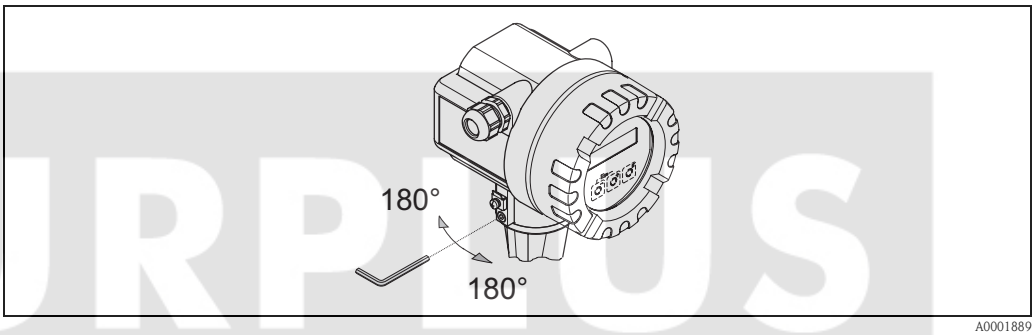

Fig. 11: Rotating the transmitter housing

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 x 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.

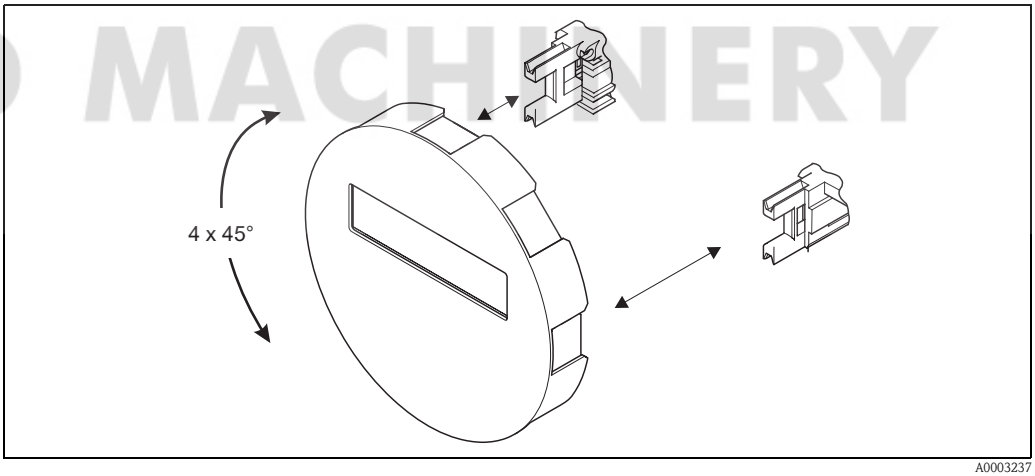

Fig. 12: Rotating the local display

3.3.4 Mounting the transmitter (remote version)

The transmitter can be mounted in the following ways:

- Wall mounting
- Pipe mounting (with separate mounting kit, accessories see Page 45)

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 value of +80 °C.

Mount the transmitter as illustrated in the diagram.

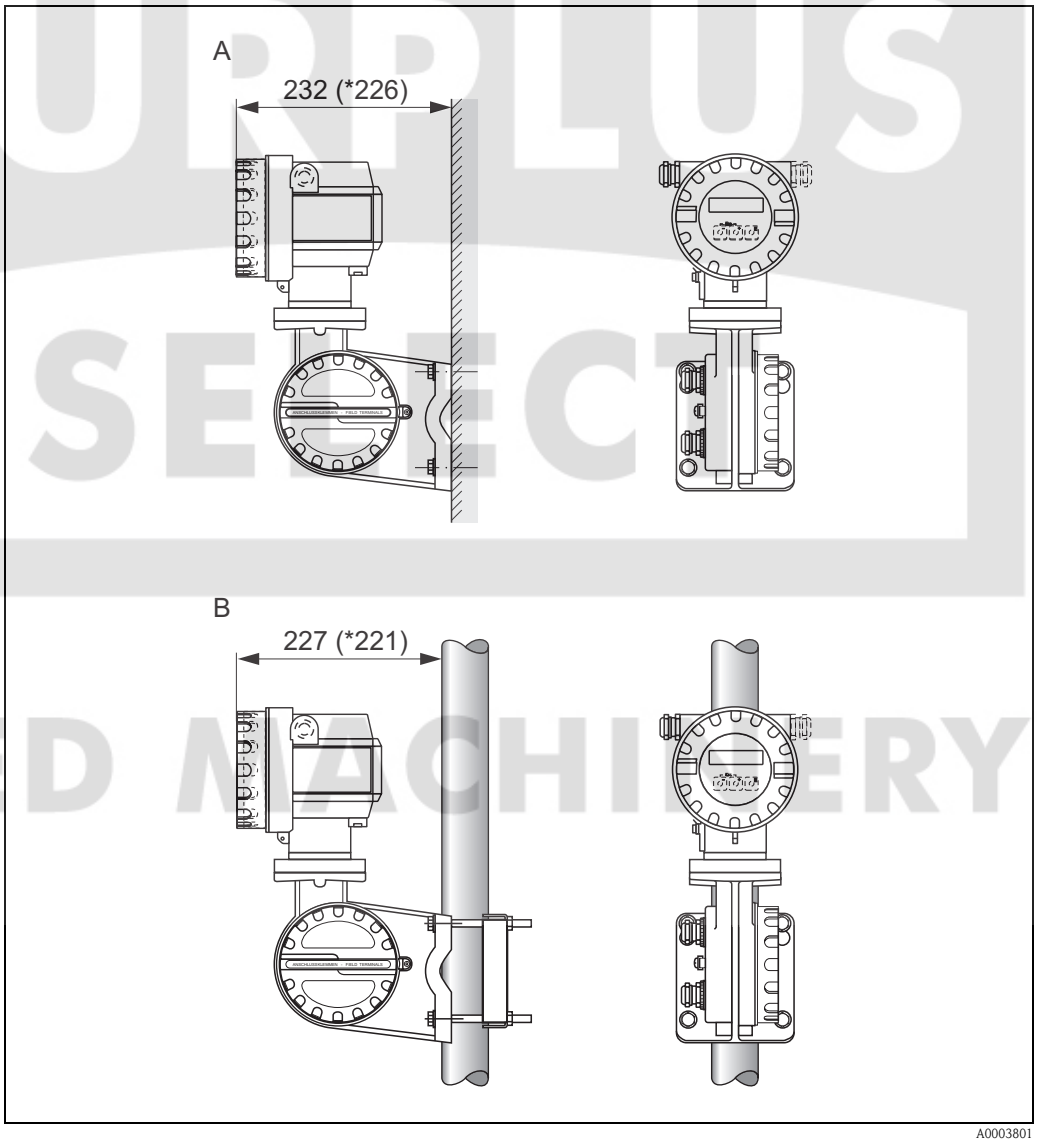

Fig. 13: Mounting the transmitter (remote version)

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

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 59 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 12 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 Connecting the remote version

4.1.1 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 connection diagram:
   → Fig. 14
   → Wiring diagram in the screw caps
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.

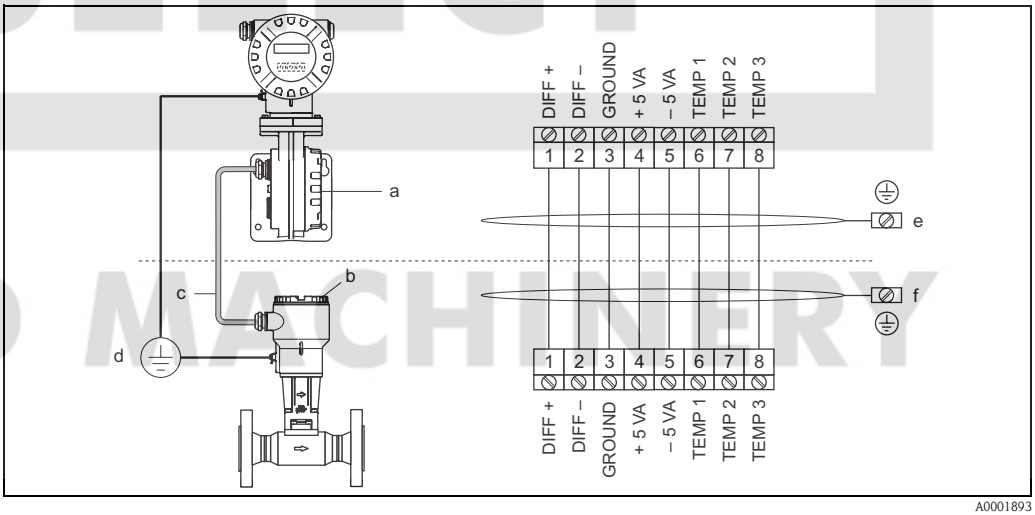

Fig. 14: Connecting the remote version

a Cover of the connection compartment (transmitter)
b Cover of the connection compartment (sensor)
c Connecting cable (signal cable)
d Identical potential matching for sensor and transmitter
e Connect cable screening, as short as possible, to the ground terminal in the transmitter housing
f Cable screening must be connected to the ground terminal in the connection housing

Wire color:
Terminal number: 1 = white; 2 = brown; 3 = green; 4 = yellow, 5 = gray; 6 = pink; 7 = blue; 8 = red

4.1.2 Cable specifications

The specifications of the cable connecting the transmitter and the sensor of the remote version are as follows:
- 4 x 2 x 0.5 mm^2 PVC cable with common shield (4 pairs, pair-stranded).
- Cable length: max. 30 m
- Conductor resistance according to DIN VDE 0295 class 5 or IEC 60228 class 5
- Capacity core/screen: < 400 pF/m
- Operating temperature: –40...+105 °C

4.2 Connecting the measuring unit

4.2.1 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... (permitted max. ambient temperature plus 10 °C).

Procedure for connecting the transmitter, Non-Ex / Ex i and Ex n version (→ Fig. 15)

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 screw (d) of the cover of the connection compartment and fold down the cover.
4. Push the cable for the power supply/current output through the cable gland (e).
   Optional: push the cable for the pulse output through the cable gland (f).
5. Tighten the cable glands (e / f) (see also → Page 26).
6. Pull the terminal connector (g) out of the transmitter housing and connect the cable for the power supply/current output (see → Fig. 17).

   Optional: Pull terminal connector (h) out of the transmitter housing and connect the cable for the pulse output (see → Fig. 17).

   ✎ Note!
   The terminal connectors (g / h) are pluggable, i.e. they can be plugged out of the transmitter housing to connect the cables.
7. Plug the terminal connectors (g / h) into the transmitter housing.

   ✎ Note!
   The connectors are coded so you cannot mix them up.

8. Only remote version: Secure the ground cable to the ground terminal (i).

9. Fold up the cover of the connection compartment and tighten the screws (d).

10. Remove the display module (b) and fit on the retaining rails (c).

Screw the cover of the electronics compartment (a) onto the transmitter housing.

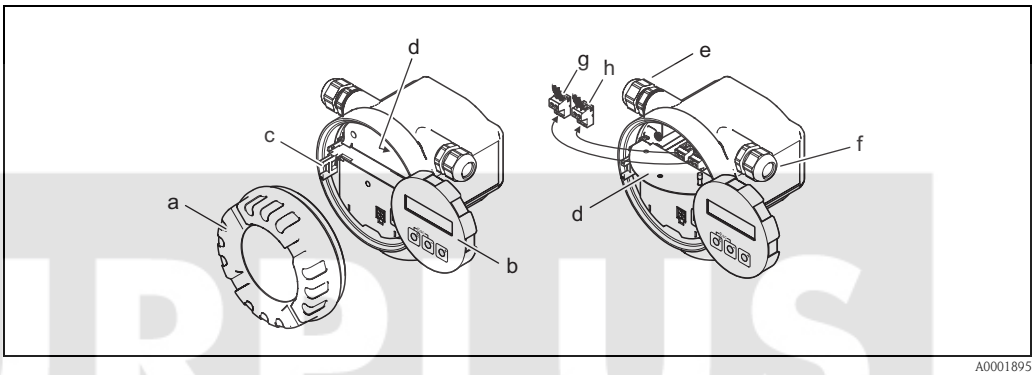

Fig. 15: Procedure for connecting the transmitter Non-Ex / Ex i and Ex n version

a Cover of electronics compartment
b Retaining rail for display module
c Display module
d Connection compartment cover threaded connection
e Cable gland for power supply/current output cable
f Cable gland for pulse output cable (optional)
g Terminal connector for power supply/current output
h Terminal connector for pulse output (optional)

Procedure for connecting the transmitter, Ex d version (→ Fig. 16)

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

1. Open the clamp (a) securing the cover of the connection compartment.

2. Unscrew the cover (b) of the connection compartment from the transmitter housing.

3. Push the cable for the power supply/current output through the cable gland (c).
Optional: push the cable for the pulse output through the cable gland (d).

4. Tighten the cable glands (c / d) (see also → Page 26).

5. Pull the terminal connector (e) out of the transmitter housing and connect the cable for the power supply/current output (see → Fig. 17).
Optional: Pull terminal connector (f) out of the transmitter housing and connect the cable for the pulse output (see → Fig. 17*).*

✎ Note!
The terminal connectors (e / f) are pluggable, i.e. they can be plugged out of the transmitter housing to connect the cables.

6. Plug the terminal connectors (e / f) into the transmitter housing.

   ✎ Note!
   The connectors are coded so you cannot mix them up.

7. Only remote version: Secure the ground cable to the ground terminal (Fig. 17, c).

8. Screw the cover (b) of the connection compartment onto the transmitter housing.

9. Tighten the clamp (a) securing the cover of the connection compartment.

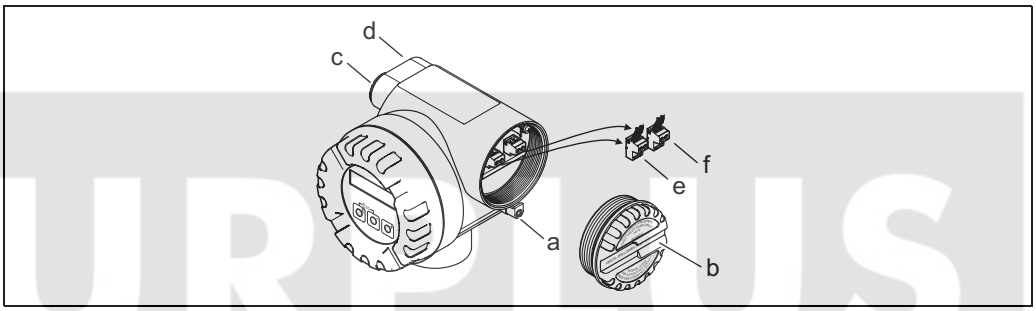

Fig. 16: Procedure for connecting the transmitter Ex d version

a Clamp securing the cover of the connection compartment
b Cover of connection compartment
c Cable gland for power supply/current output cable
d Cable gland for pulse output cable (optional)
e Terminal connector for power supply/current output
f Terminal connector for pulse output (optional)

Wiring diagram

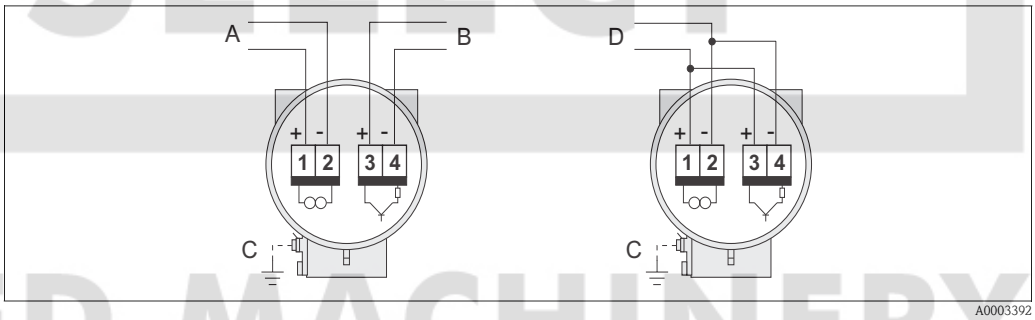

Fig. 17: Assignment of terminals

A Power supply/current output
B Optional pulse output/status output
C Ground terminal (only relevant for remote version)
D PFM wiring (pulse-frequency modulation)

4.2.2 Terminal assignment

Order variant	Terminal no. (inputs/outputs) 1 – 2	3 – 4
72***-**********W	HART current output	–
72***-**********A	HART current output	Pulse/status output

HART current output
Galvanically isolated, 4...20 mA with HART

Pulse/status output
Open collector, passive, galvanically isolated, U_{max} = 30 V, with 15 mA current limiting, R_i = 500 Ω, can be configured as pulse or status output

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 1 (+) / 2 (–)
- Connection by means of the 4...20 mA circuit

Note!
- The measuring circuit's minimum load must be at least 250 Ω.
- After commissioning, make the following setting:
  – Switch HART write protection on or off (see Page 38)
- For connecting, please refer also to the documentation issued by the HART Communication Foundation, in particular HCF LIT 20: “HART, a technical summary”.

Connecting the HART handheld terminal

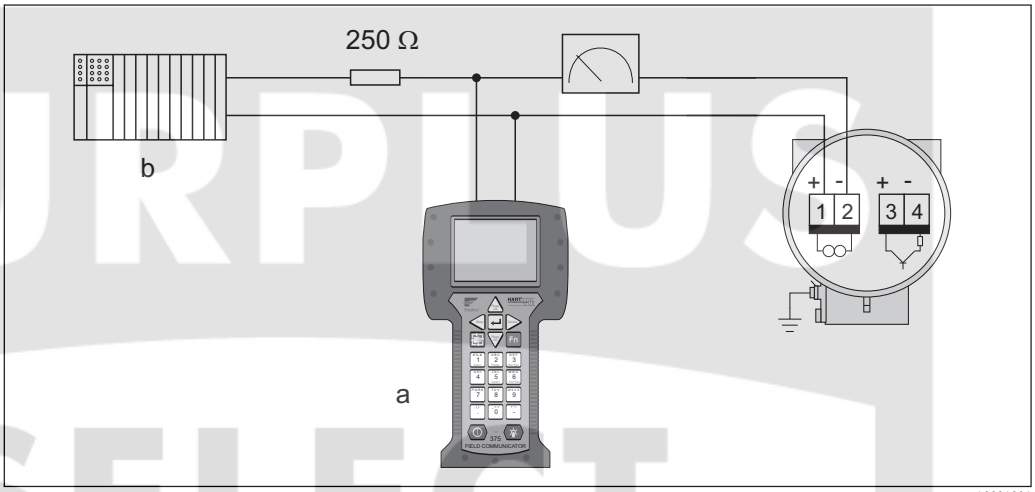

Fig. 18: Electrical connection of the HART terminal:

a HART terminal
b Additional switching units or PLC with transmitter supply

Connecting a PC with operating software

A HART modem (e.g. Commubox FXA 191) is required for connecting a personal computer with operating software (e.g. ToF Tool – Fieldtool Package).

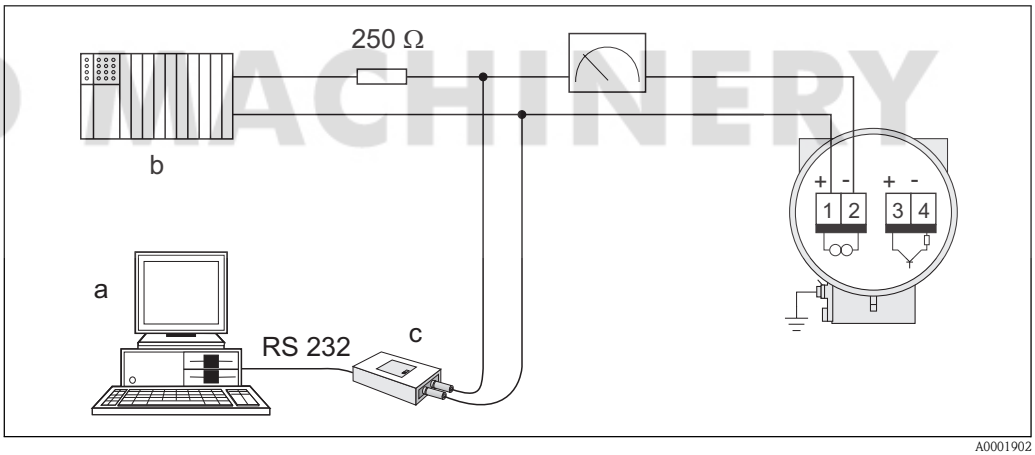

Fig. 19: Electrical connection of a PC with operating software

a PC with operating software
b Additional switching units or PLC with passive input
c HART modem, e.g. Commubox FXA 191

4.3 Degree of protection

The devices fulfill all the requirements for IP 67 degree of protection. Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that IP 67 protection is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary. If the device is used in a dust atmosphere, only the associated Endress+Hauser housing seals can be used.
- All housing screws and screw caps must be firmly tightened.
- The cables used for connection must be of the specified outside diameter (see Page 61).
- Firmly tighten the cable entry (Fig. 20).
- The cables must loop down before they enter the cable entries ("water trap", Fig. 20). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Replace all unused cable entries with dummy plugs.
- Do not remove the grommet from the cable entry.

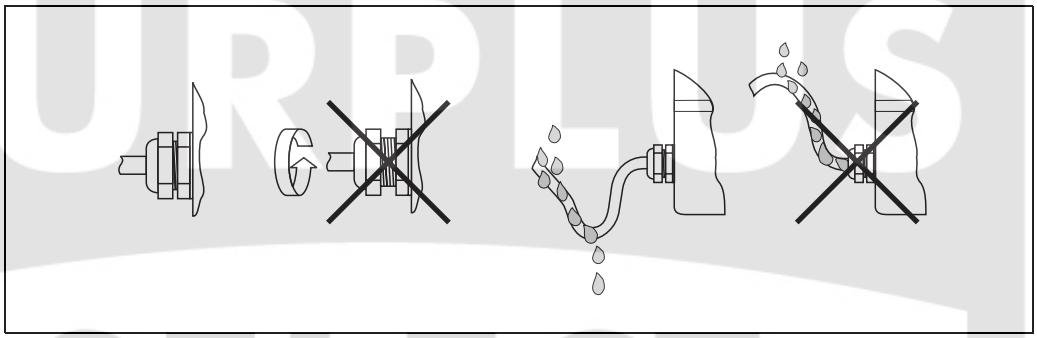

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Fig. 20: Installation instructions for cable entries

4.4 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate? ■ Non-Ex: 12...36 V DC (with HART: 18...36 V DC) ■ Ex i and Ex n: 12...30 V DC (with HART 18...30 V DC) ■ Ex d: 15...36 V DC (with HART 21...36 V DC)	–
Do the cables used comply with the specifications?	see Page 22, 61
Do the cables have adequate strain relief?	–
Are the cables for power supply/current output, frequency output (optional) and grounding connected correctly?	see Page 22
Only remote version: is the connecting cable between sensor and transmitter connected correctly?	see Page 21
Are all terminals firmly tightened?	–
Are all the cable entries installed, tightened and sealed? Cable run with "water trap"?	see Page 26
Are all the housing covers installed and tightened?	–

5 Operation

5.1 Display and operating elements

The local display enables you to read important parameters directly at the measuring point and also configure the device.

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 different variables to suit your needs and preferences (→ see USER INTERFACE function group on Page 80).

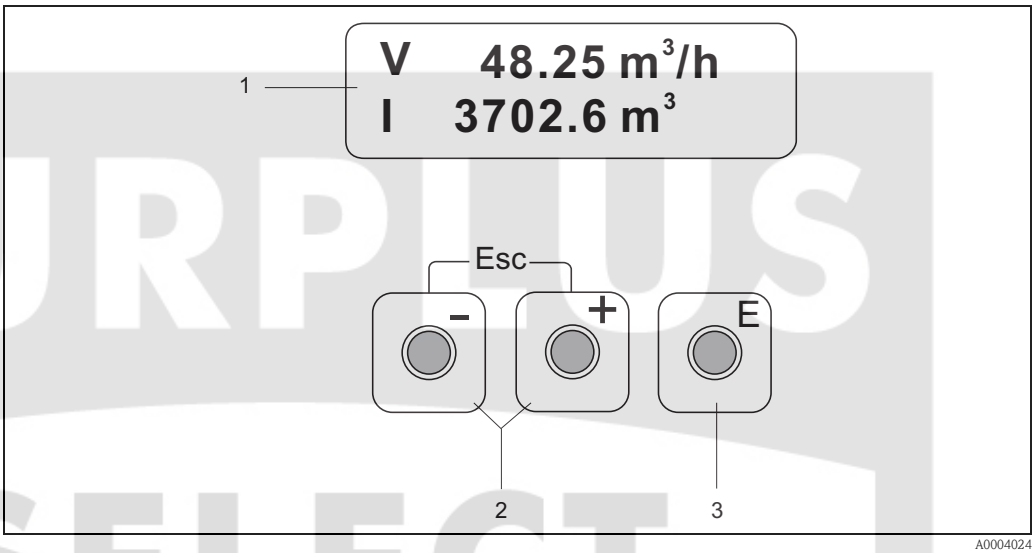


Fig. 21: Display and operating elements

Liquid crystal display (1)
The two-line liquid-crystal display shows measured values, dialog texts, fault messages and notice messages. The display as it appears during standard measuring mode is known as the HOME position (operating mode).
- *Top line: shows main measured values, e.g. 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.*

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

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

Enter key (3)
- *HOME position → enter the function matrix*

Save the numerical values you input or settings you changed

5.2 The function matrix: layout and use

Note!
- Please refer to the general notes on Page 29.
- Function matrix overview → Page 71
- Detailed description of all functions → Page 72 ff.

The function matrix is a two-level construct: the function groups form one level and the groups' functions the other. The groups are the highest-level grouping of the control options for the measuring device. A number of functions is assigned to each group.
You select a group in order to access the individual functions for operating and configuring the measuring device.

1. HOME position → E → enter the function matrix
2. Select a function group (e.g. CURRENT OUTPUT)
3. Select a function (e.g. TIME CONSTANT)
   Change parameter / enter numerical values:
   +/− → select or enter: release code, parameters, numerical values
   E → save your entries
4. Exit the function matrix (return to HOME position):
   – Press the Esc key (Esc) for longer than 3 seconds → return directly
   – Repeatedly press Esc key (Esc) → return step by step

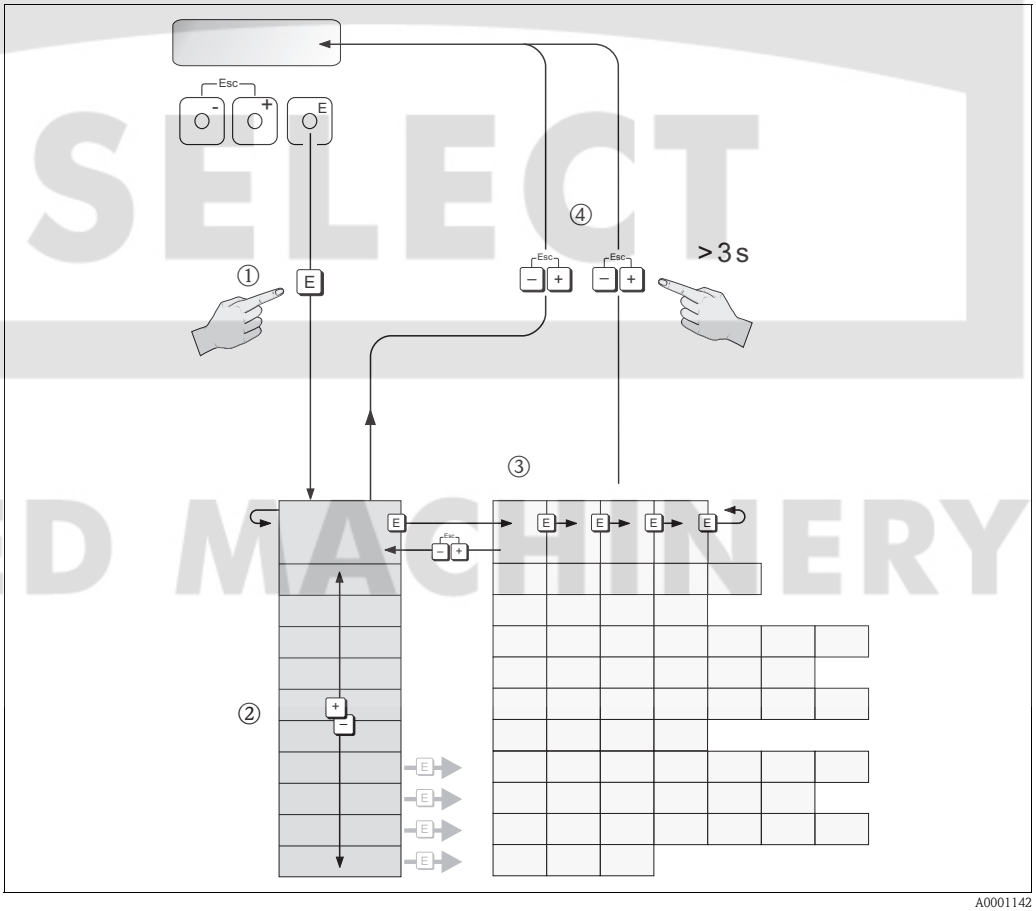


Fig. 22: Selecting and configuring functions (function matrix)

Example of how to configure a function (changing the language of the UI):
① Enter the function matrix (E key).
② Select the OPERATION group.
③ Select the LANGUAGE function, change the setting from ENGLISH to DEUTSCH + and save E (all text on the display now appears in German).
④ Exit the function matrix (press Esc for longer than 3 seconds).

5.2.1 General notes

The Quick Setup menu (see Page 77) is adequate for commissioning with the necessary standard settings.
Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process conditions.
The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on Page 28.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press ⊞ ⊟ to select "SURE [YES]" and press E to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is automatically disabled if you do not press a key within 60 seconds following return to the HOME position.

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

Caution!
All functions are described in detail, as is the function matrix itself on Page 71 ff.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings.
A numerical code (factory setting = 72) has to be entered before settings can be changed. If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see ACCESS CODE function on Page 78).

Comply with the following instructions when entering codes:
- If programming is disabled and the ⊞ ⊟ keys are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the private code, programming is always enabled.
- Your Endress+Hauser service organization can be of assistance if you mislay your private code.

5.2.3 Disabling the programming mode

Programming mode is disabled if you do not press a key within 60 seconds following automatic return to the HOME position.
You can also disable programming by entering any number (other than the private code) in the ACCESS CODE function.

5.3 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, the error with the highest priority is always 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. → Page 48
- *Process error:* this group includes all application errors, for example "DSC SENSOR LIMIT", etc. → Page 48

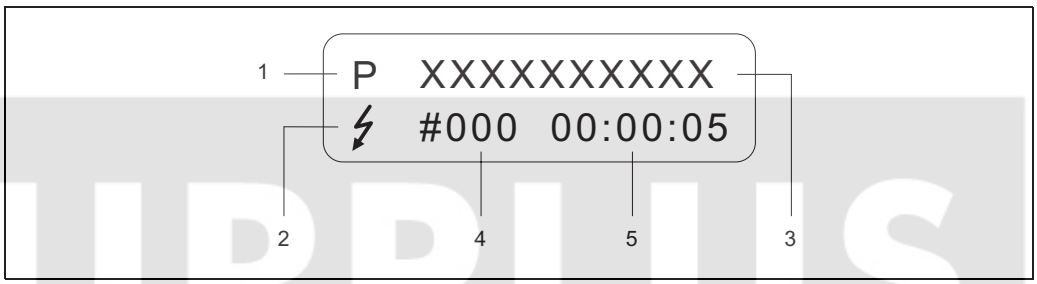


Fig. 23: Error messages on the display (example)

1 Type of error: P = Process error, S = System error
2 Error message type: ϟ = Fault message, ! = Notice message (definition: see below)
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), display format - see OPERATION HOURS function on Page 103

Type of error message
Users have the option of weighting system and process errors differently by defining them as **Fault messages** or **Notice messages**. This is specified via the function matrix (→ see SUPERVISION function group on Page 102).

Serious system errors, e.g. electronic module defects, are always categorized and displayed as "fault messages" by the measuring device.

Notice message (!)
- Displayed as → exclamation mark (!), error group (S: system error, P: process error).
- The error in question has no effect on the inputs or outputs of the measuring device.

Fault message (ϟ)
- Displayed as → lightning flash(ϟ), error designation (S: system error, P: process error)
- The error in question has a direct effect on the inputs or outputs.
  The response of the inputs/outputs (failsafe mode) can be defined by means of functions in the function matrix (see Page 52).

✎ Note!
Error messages can be output via the current output in accordance with NAMUR NE 43.

5.4 Communication (HART)

In addition to via local operation, the measuring device can also be configured and measured values obtained by means of the HART protocol. Digital communication takes place using the 4...20 mA current output HART (see Page 25).

The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes. HART masters, such as a handheld terminal or PC-based operating programs (such as ToF Tool – Fieldtool Package), require device description (DD) files. They are used to access all the information in a HART device. Such information is transferred solely via “commands”.
There are three different command classes:

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

✎ Note!
Prowirl 72 has all three command classes. Page 32 ff. provides you with a list of all the supported “Universal commands” and “Common practice commands”.

5.4.1 Operating options

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

HART Communicator DXR 375
Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART operating instructions in the carrying case of the HART handheld terminal contain more detailed information on the device.

Operating program “ToF Tool - Fieldtool Package”
Modular software package consisting of the service program “ToF Tool” for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and evolution of pressure measuring instruments as well as the "Fieldtool" service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193 or the HART protocol.
Contents of the “ToF Tool - Fieldtool Package”:

- Commissioning, maintenance analysis
- Configuring flowmeters
- Service functions
- Visualisation of process data
- Trouble-shooting
- Access to the verification data and update to software of the "Fieldcheck" flow simulator.

Further operating programs

- “AMS” operating program (Fisher Rosemount)
- “SIMATIC PDM” operating program (Siemens)

5.4.2 Device variables and process variables

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

ID (decimal)	Device variable
0	OFF (not assigned)
1	Flow
250	Totalizer

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

- Primary process variable (PV) → flow
- Secondary process variable (SV) → totalizer
- Third process variable (TV) → not assigned
- Fourth process variable (FV) → not assigned

5.4.3 Universal / common practice HART commands

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

Command no. **HART command / access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
Universal commands			
0	Read the unique device identifier Access type = Read	None	The device identifier provides information on the device and manufacturer; it cannot be altered. The response consists of a 12-byte device ID: – Byte 0: fixed value 254 – Byte 1: manufacturer ID, 17 = E+H – Byte 2: device type ID, 56 = Prowirl 72 – Byte 3: number of preambles – Byte 4: rev. no. universal commands – Byte 5: rev. no. device-spec. Commands – Byte 6: software revision – Byte 7: hardware revision – Byte 8: additional device information – Byte 9-11: device identification
1	Read the primary process variable Access type = Read	None	– Byte 0: HART unit ID of the primary process variable – Byte 1-4: primary process variable Primary process variable = flow ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240”.
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = Read	None	– Byte 0-3: current current of the primary process variable in mA – Byte 4-7: percentage of the set measuring range Primary process variable = flow

Command no. **HART command / access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
3	Read the primary process variable as current in mA and four (preset using command 51) dynamic process variables Access type = Read	None	24 bytes are sent as a response: – Byte 0-3: current of the primary process variable in mA – Byte 4: HART unit ID of the primary process variable – Byte 5-8: primary process variable – Byte 9: HART unit ID of the secondary process variable – Byte 10-13: secondary process variable – Byte 14: HART unit ID of the third process variable – Byte 15-18: third process variable – Byte 19: HART unit ID of the fourth process variable – Byte 20-23: fourth process variable *Factory setting:* ■ Primary process variable = flow ■ Secondary process variable = totalizer ■ Third process variable = not assigned ■ Fourth process variable = not assigned ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240”.
6	Set HART short-form address Access type = Write	Byte 0: desired address (0...15) *Factory setting:* 0 ✎ Note! With an address >0 (multidrop mode), the current output of the primary process variable is fixed to 4 mA.	Byte 0: active address
11	Read the unique device identifier using the TAG Access type = Read	Byte 0-5: TAG	The device identifier provides information on the device and manufacturer; it cannot be altered. The response consists of a 12-byte device ID if the given TAG matches the one saved in the device: – Byte 0: fixed value 254 – Byte 1: manufacturer ID, 17 = E+H – Byte 2: device type ID, 56 = Prowirl 72 – Byte 3: number of preambles – Byte 4: rev. no. universal commands – Byte 5: rev. no. device-spec. Commands – Byte 6: software revision – Byte 7: hardware revision – Byte 8: additional device information – Byte 9-11: device identification
12	Read user message Access type = Read	None	Byte 0-24: user message ✎ Note! You can write the user message using command 17.
13	Read TAG, TAG description and date Access type = Read	None	– Byte 0-5: TAG – Byte 6-17: TAG description – Byte 18-20: date ✎ Note! You can write the TAG, TAG description and date using command 18.

Command no. **HART command / access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
14	Read sensor information on the primary process variable Access type = Read	None	– Byte 0-2: serial number of the sensor – Byte 3: HART unit ID of the sensor limits and measuring range of the primary process variable – Byte 4-7: upper sensor limit – Byte 8-11: lower sensor limit – Byte 12-15: minimum span ✎ Note! ■ The data relate to the primary process variable (= flow). ■ Manufacturer-specific units are represented using the HART unit ID “240”.
15	Read output information of the primary process variable Access type = Read	None	– Byte 0: alarm selection ID – Byte 1: ID for transfer function – Byte 2: HART unit ID for the set measuring range of the primary process variable – Byte 3-6: end of measuring range, value for 20 mA – Byte 7-10: start of measuring range, value for 4 mA – Byte 11-14: attenuation constant in [s] – Byte 15: ID for write protection – Byte 16: ID for OEM dealer, 17 = E+H Primary process variable = flow ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240”.
16	Read the device production number Access type = Read	None	Byte 0-2: production number
17	Write user message Access = Write	You can save any 32-character long text in the device with this parameter: Byte 0-23: desired user message	Displays the current user message in the device: Byte 0-23: current user message in the device
18	Write TAG, TAG description and date Access = Write	You can save an 8-character TAG, a 16-character TAG description and a date with this parameter: – Byte 0-5: TAG – Byte 6-17: TAG description – Byte 18-20: date	Displays the current information in the device: – Byte 0-5: TAG – Byte 6-17: TAG description – Byte 18-20: date

Command no. **HART command / access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
Common practice commands			
34	Write attenuation constant for primary process variable Access = Write	Byte 0-3: attenuation constant of the primary process variable in seconds *Factory setting:* Primary process variable = flow	Displays the current attenuation constant in the device: Byte 0-3: attenuation constant in seconds
35	Write measuring range of the primary process variable Access = Write	Write the desired measuring range: – Byte 0: HART unit ID for the primary process variable – Byte 1-4: end of measuring range, value for 20 mA – Byte 5-8: start of measuring range, value for 4 mA *Factory setting:* Primary process variable = volume flow ✎ Note! If the HART unit ID does not suit the process variable, the device will continue with the last valid unit.	The measuring range currently set is shown as the response: – Byte 0: HART unit ID for the set measuring range of the primary process variable – Byte 1-4: end of measuring range, value for 20 mA – Byte 5-8: start of measuring range, value for 4 mA (is always at "0") ✎ Note! Manufacturer-specific units are represented using the HART unit ID "240".
38	Device status reset "configuration changed" Access = Write	None	None
40	Simulate output current of the primary process variable Access = Write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Byte 0-3: output current in mA *Factory setting:* Primary process variable = flow	The current output current of the primary process variable is displayed as a response: Byte 0-3: output current in mA
42	Perform device reset Access = Write	None	None
44	Write unit of the primary process variable Access = Write	Specify the unit of the primary process variable. Only units which are suitable for the process variable are accepted by the device: Byte 0: HART unit ID *Factory setting:* Primary process variable = flow ✎ Note! ■ If the written HART unit ID does not suit the process variable, the device will continue with the last valid unit. ■ If you change the unit of the primary process variable, this has an impact on the 4...20 mA output.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit ID ✎ Note! Manufacturer-specific units are represented using the HART unit ID "240".

Command no. **HART command / access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
48	Read extended device status Access = Read	None	The current device status is displayed in extended form as the response: Encoding: see table on Page 37
50	Read assignment of the device variables to the four process variables Access = Read	None	Display of the current variable assignment of the process variables: – Byte 0: device variable ID to the primary process variable – Byte 1: device variable ID to the secondary process variable – Byte 2: device variable ID to the third process variable – Byte 3: device variable ID to the fourth process variable *Factory setting:* ■ Primary process variable: ID 1 for flow ■ Secondary process variable: ID 250 for totalizer ■ Third process variable: ID 0 for OFF (not assigned) ■ Fourth process variable: ID 0 for OFF (not assigned)
53	Write device variable unit Access = Write	This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: device variable ID – Byte 1: HART unit ID *ID of the supported device variables:* See data on Page 32 ✎ Note! If the written unit does not suit the device variable, the device will continue with the last valid unit.	The current unit of the device variables is displayed in the device as a response: – Byte 0: device variable ID – Byte 1: HART unit ID ✎ Note! Manufacturer-specific units are represented using the HART unit ID “240”.
59	Specify number of preambles in message responses Access = Write	This parameter specifies the number of preambles which are inserted in the message responses: Byte 0: Number of preambles (2...20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: Number of preambles
109	Burst mode control Access = Write	This parameter switches the burst mode on and off. Byte 0: 0 = burst mode off 1 = burst mode on	The value set in byte 0 is shown as the response.

5.4.4 Device status / error messages

You can read the extended device status, in this case, current error messages, via command “48”. The command delivers bit-encoded information (see table below).

✎ Note!
Detailed information on the device status messages and error messages, and how they are rectified, can be found on Page 48 ff.!

Byte	Bit	Error no.	Short error description (→ Page 48 ff.)
0	0	001	Serious device error.
	1	011	Faulty amplifier EEPROM.
	2	012	Error when accessing data of the amplifier EEPROM.
	3	021	COM module: Faulty EEPROM.
	4	022	COM module: Error when accessing EEPROM data.
	5	111	Totalizer checksum error.
	6	351	Current output: the current flow is outside the set range.
	7	Not assigned	–
1	0	359	Pulse output: the pulse output frequency is outside the set range.
	1	Not assigned	–
	2	379	Device being operated in its resonance frequency.
	3	Not assigned	–
	4	Not assigned	–
	5	394	DSC sensor defective, no measurement.
	6	395	DSC sensor being operated near application limits, device failure probable soon.
	7	396	Device finds signal outside the set filter range.
2	0...1	Not assigned	–
	2	399	Pre-amplifier disconnected.
	3...5	Not assigned	–
	6	501	Loading a new amplifier software version or data into the device. No other commands possible at this point.
	7	502	Uploading the device data. No other commands possible at this point.
3	0	601	Positive zero return active.
	1	611	Current output simulation active.
	2	Not assigned	–
	3	631	Pulse output simulation active.
	4	641	Status output simulation active.
	5	691	Simulation of failsafe mode (outputs) active.
	6	692	Simulation measurand.
	7	Not assigned	–
4	0...1	Not assigned	–
	2	698	Current adjustment active
	3...7	Not assigned	–

5.4.5 Switching HART write protection on/off

A DIP switch on the amplifier board provides the means of activating or deactivating the HART write protection. When the HART write protection is active, it is not possible to change the parameters via the HART protocol.

1. Unscrew the cover of the electronics compartment from the transmitter housing.
2. Remove the display module (a) from the retaining rails (b) and refit onto right retaining rail with the left side (this secures the display module).
3. Fold up the plastic cover (c).
4. Set the DIP switch to the desired position.

   Position **A**, DIP switch at front = HART write protection disabled
   Position **B**, DIP switch at rear = HART write protection enabled

   ✎ Note!
   The current status of the HART write protection is displayed in the WRITE PROTECTION function (see Page 94).
5. Installation is the reverse of the removal procedure.

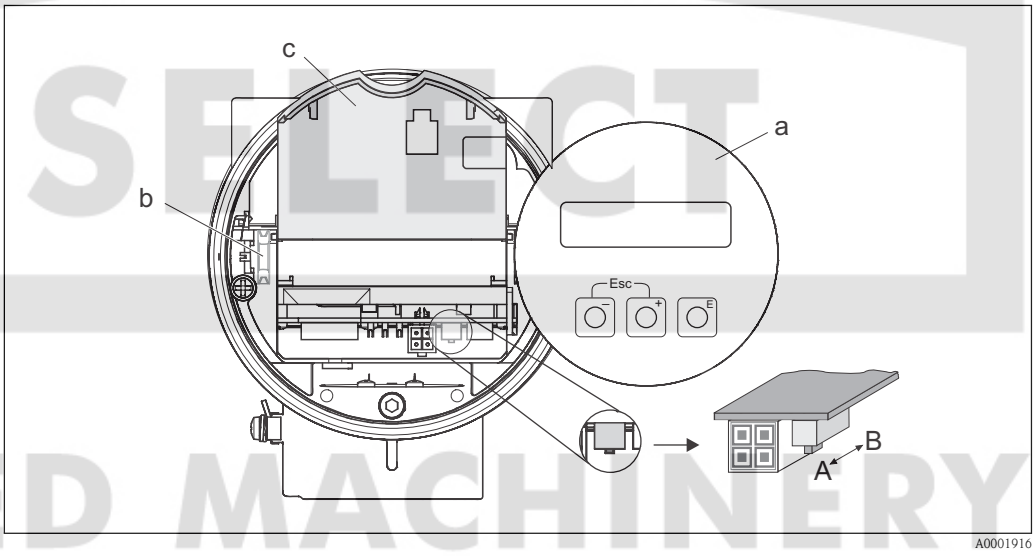


Fig. 24: Switching HART write protection on/off

a Local display module
b Retaining rail for the display module
c Plastic cover

A HART write protection disabled (DIP switch at front)
B HART write protection enabled (DIP switch at rear)

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 26

6.2 Commissioning

6.2.1 Switching on the measuring device

Once the function checks have been successfully completed, it is time to switch on the supply voltage. The device is ready for operation!
The measuring device performs a number of internal test functions after power-up.
As this procedure progresses the following message appears on the local display:

PROWIRL 72 **XX.XX.XX**	Start-up message Displays the current software (example)

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

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

6.2.2 "Commissioning" Quick Setup

The "Commissioning" Quick Setup guides you systematically through all the major functions of the device that have to be configured for standard measuring operation.

You will find a flowchart of the "Commissioning" Quick Setup menu on Page 41 and the function description on Page 77.

Examples of configuration for the "Commissioning" Quick Setup.

Example 1 (volumetric unit):
You want to measure the flow of water.
The flow should be displayed in the volume flow unit m^3/h.

The following settings must be made in the "Commissioning" Quick Setup:
- APPLICATION = LIQUID
- MEASURING UNIT TYPE = VOLUME FLOW
- UNIT FLOW = m^3/h
- UNIT TOTALIZER = m^3
- Output configuration

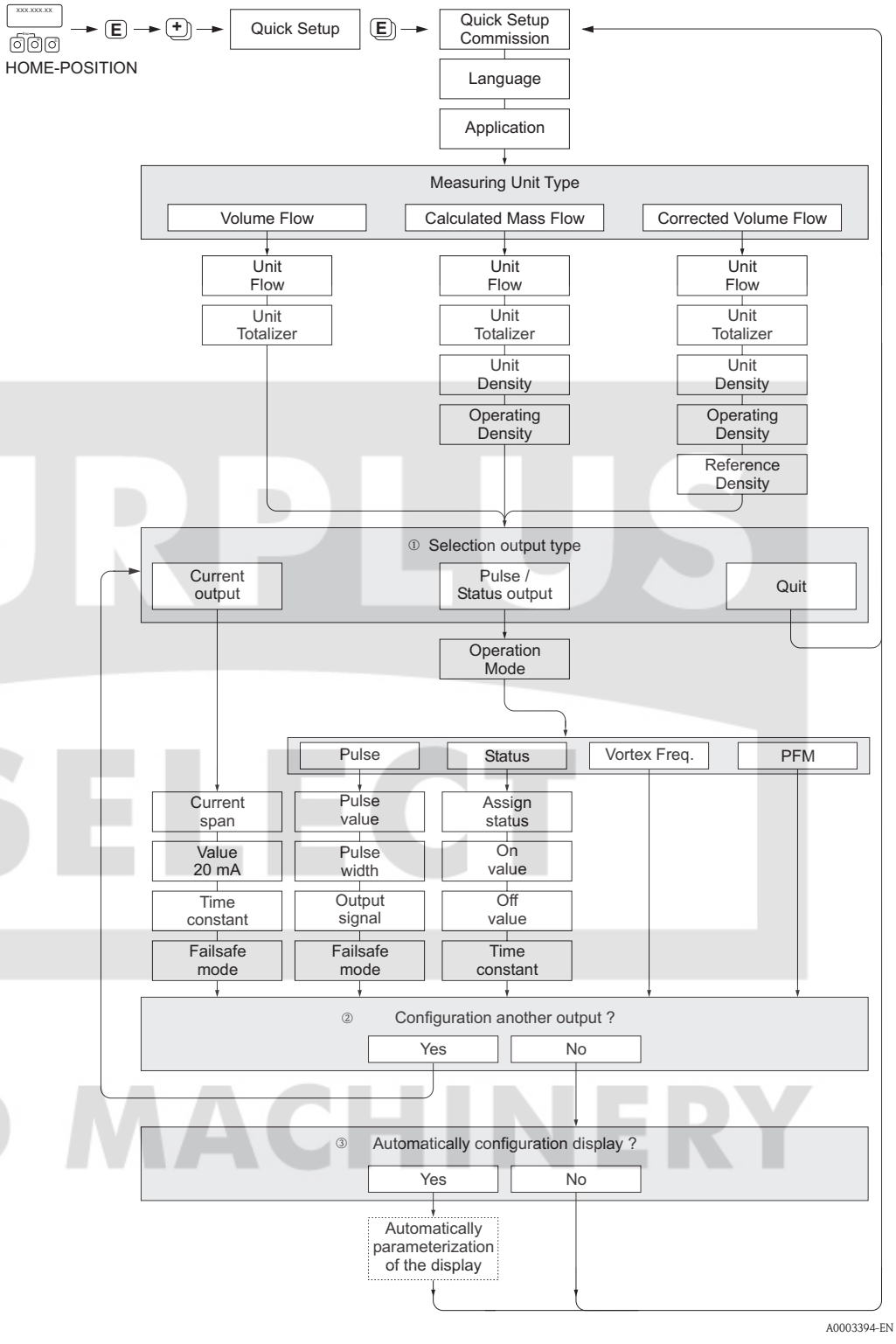
Example 2 (mass unit):
You want to measure overheated steam with a constant temperature of 200 °C and a constant pressure of 12 bar. According to IAPWS-IF97, the density at operating conditions is 5.91 kg/m^3. (IAPWS = International Association of Process Water and Steam). The flow should be displayed in the mass flow unit kg/h.

The following settings must be made in the "Commissioning" Quick Setup:
- APPLICATION = GAS/STEAM
- MEASURING UNIT TYPE = CALCULATED MASS FLOW
- UNIT FLOW = kg/h
- UNIT TOTALIZER = t
- UNIT DENSITY = kg/m^3
- OPERATING DENSITY = 5.91
- Output configuration

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/m^3. The density of air at reference operating conditions (0 °C, 1013 mbar) is 1.2936 kg/m^3. The flow should be displayed in the corrected volume flow unit Nm^3/h.

The following settings must be made in the "Commissioning" Quick Setup:
- APPLICATION = GAS/STEAM
- MEASURING UNIT TYPE = CORRECTED VOLUME FLOW
- UNIT FLOW = Nm^3/h
- UNIT TOTALIZER = Nm^3
- UNIT DENSITY = kg/m^3
- OPERATING DENSITY = 3.14
- REFERENCE DENSITY = 1.2936
- Output configuration

Flowchart of "Commissioning" Quick Setup



✎ Note!

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

① Only the output (current output or pulse/status output) not yet configured in the current Quick Setup is offered for selection after the first cycle.

② The "YES" option appears as long as a free output is still available. "NO" is the only option displayed when no further outputs are available.

③ When "YES" is selected, the flow is assigned to line 1 of the local display and the totalizer to line 2.

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 45.
  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 device is used in a dust atmosphere, only the associated Endress+Hauser housing seals can 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 Proline 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 * * * * * *
Mounting kit for Prowirl 72 W	Mounting kit comprising: – Threaded studs – Nuts incl. washers – Flange seals	DKW – **–***
Mounting kit for transmitter	Mounting kit for remote version, suitable for pipe and wall mounting.	DK5WM – B
Flow conditioner	Flow conditioner	DK7ST – * * * *
HART Field Communicator DXR 375	Handheld terminal for remote configuration and for obtaining measured values via the current output HART (4...20 mA) and FOUNDATION Fieldbus (FF). Contact your Endress+Hauser representative for more information.	DXR375 – * * * * * * *
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 – *
ToF Tool - Fieldtool Package	Modular software package consisting of the service program “ToF Tool” for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and the "Fieldtool" service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193. Contents of the “ToF Tool - Fieldtool Package”: – Commissioning, maintenance analysis – Configuring flowmeters – Service functions – Visualisation of process data – Trouble-shooting – Access to the verification data and update to software of the "Fieldcheck" flow simulator. Contact your Endress+Hauser representative for more information.	DXS10 – * * * * *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the “ToF Tool - Fieldtool Package” software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	DXC10 – * *

Accessory	Description	Order code
Energy manager RMS 621	Steam and heat computer for industrial energy calculation of steam and water. Calculation of the following applications: ■ Steam mass ■ Steam heat quantity ■ Net steam quantity ■ Steam - heat - differential ■ Water heat quantity ■ Water - heat - differential Calculation of up to 3 applications per unit	RMS 621 – * * * * * * * * *
Energy Manager RMC 621	Universal Energy Manager for gas, liquids, steam and water. Calculation of volumetric flow and mass flow, standard volume, heat flow and energy.	RMC621-* * * * * * * * * *
Pressure transducer Cerabar T	Cerabar T is used to measure the absolute and gauge pressure of gases, steams and liquids.	PMC 131 – * * * * PMP 131 – * * * *
RTD Thermometer Omnigrad TR10	General purpose process thermometer. Mineral insulated replaceable inset; with thermowell, threaded process connection and extension neck.	TR10 – * * * * * * * * * * * *
Active barrier RN 221 N	Active barrier with power supply for safe separation of 4...20 mA current circuits: ■ Galvanic isolation of 4...20 mA circuits ■ Elimination of ground loops ■ Powering 2 wire transmitters ■ Suitable for Ex-applications (ATEX, FM and CSA) ■ Optional: relay output	RN221N – * *
Process display RIA 250	Multifunctional 1-channel display unit with universal input, transmitter power supply, limit relay and analog output.	RIA250 – * * * * * *
Process display RIA 251	Digital loop powered display for 4... 20 mA current loops; suitable for Ex-applications (ATEX, FM, CSA).	RIA251 – * *
Field display RIA 261	Digital loop powered field display (IP 66) for 4...20 mA current loops; suitable for Ex- applications (ATEX, FM, CSA).	RIA261 – * * *
Process transmitter RMA 422	Multifunctional 1-2 channel top-hat rail device with intrinsically safe current inputs and transmitter power supply, limit value monitoring, mathematic functions and 1-2 analog outputs. Optional: intrinsically safe inputs; suitable for Ex-applications (ATEX).	RMA422 – * * * * * * *
Overvoltage protection HAW 562 Z	Overvoltage protection limiting high voltages on signal cables and components.	51003575
Overvoltage protection HAW569	Overvoltage protection limiting high voltages in Prowirl 72 and other sensors for direct mounting on the device.	HAW569 - **1A
Fieldgate FXA 520	Gateway for Remote Monitoring of HART Sensors and Actuators via Web Browsers: ■ Web server for remote monitoring of up to 30 measuring points ■ Intrinsically safe version [EEx ia]IIC for applications in hazardous areas ■ Communication via modem, Ethernet or GSM ■ Visualization via Internet/Intranet in the web browser and/or WAP cellular phone ■ Limit value monitoring with alarm signaling via e-mail or SMS ■ Synchronized time stamping of all measured values ■ Remote diagnosis and remote configuration of connected HART devices	FXA520 – * * * *

9 Trouble-shooting

9.1 Trouble-shooting instructions

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

Check the display	
No display visible and no output signals present	1. Check supply voltage → terminal 1, 2 2. Electronics defective → order spare part → Page 53
No display visible but output signals are present	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 54 2. Display module defective → order spare part → Page 53 3. Electronics defective → order spare part → Page 53
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the +/– keys and switch on the measuring device again. The display text will appear in English and is displayed at 50% contrast.
Measured value indicated, but no signal output at the current or pulse output	Electronics board defective → order spare part → Page 53

▼

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: ϟ = Fault message, **!** = Notice message
- **DSC SENS LIMIT** = Error designation (device being operated near application limits)
- **03:00:05** = Duration of most recent error occurrence (in hours, minutes and seconds), display format - see OPERATION HOURS function on Page 103
- **#395** = Error number

Caution!
- Please refer also to the information on Page 30 ff.!
- The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.

▼

Other errors (without error message)	
Some other error has occurred.	Diagnosis and remedial measures → Page 50

9.2 System error messages

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 8 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.

No.	Error message / Type	Cause	Remedy / spare part
Serious system errors are **always** recognized by the device as "fault messages" and are indicated with a lightning flash (ϟ) on the display! Fault messages have a direct effect on the inputs and outputs. Simulations and positive zero return, on the other hand, are only classed and displayed as "notice messages". Please pay attention to the information on → Page 30 ff. and 52. S = System error ϟ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without an effect on the inputs and outputs)			
001	S CRITICAL FAIL. ϟ # 001	Serious device error	Replace the amplifier board. Spare parts → Page 53
011	S AMP HW EEPROM ϟ # 011	Amplifier: Faulty EEPROM	Replace the amplifier board. Spare parts → Page 53
012	S AMP SW-EEPROM ϟ # 012	Amplifier: Error when accessing data of the EEPROM	Contact your Endress+Hauser service organization.
021	S COM HW EEPROM ϟ # 021	COM module: Faulty EEPROM	Replace COM module. Spare parts → Page 53
022	S COM SW EEPROM ϟ # 022	COM module: Error when accessing data of the EEPROM	Contact your Endress+Hauser service organization.
111	S CHECKSUM TOT. ϟ # 111	Totalizer checksum error	Replace the amplifier board. Spare parts → Page 53
351	S CURRENT RANGE ! # 351	Current output: The current flow is outside the set range.	1. Change upper range value entered. 2. Reduce flow.
359	S PULSE RANGE ! # 359	Pulse output: The pulse output frequency is outside the set range.	1. Increase pulse value. 2. When entering the pulse width, select a value that can still be processed by a connected totalizer (e.g. mechanical totalizer, PLC, etc.). Determine pulse width: – Method 1: enter the minimum time for which a pulse has to be present at a connected totalizer in order to be recorded. – Method 2: enter the maximum (pulse) frequency as a half "reciprocal value" for which a pulse has to be present at a connected totalizer in order to be recorded. Example: The maximum input frequency of the connected totalizer is 10 Hz. The pulse width to be entered is: (1 / (2·10 Hz) = 50 ms. 3. Reduce flow.
379	S RESONANCE DSC ϟ # 379	The device is being operated in the resonance frequency. Caution! If the device is operated in the resonance frequency, this can result in damage which can lead to complete device failure.	Reduce the flow.

No.	Error message / Type	Cause	Remedy / spare part
394	S DSC SENS DEFCT ϟ # 394	The DSC sensor is defective, measurement no longer takes place.	Contact your Endress+Hauser service organization.
395	S DSC SENS LIMIT ! # 395	The DSC sensor is being operated near application limits, device failure is probable soon.	If this message is permanently displayed, contact your Endress+Hauser service organization.
396	S SIGNAL>LOW PASS ϟ # 396	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.	■ Check whether the device was installed in the flow direction. ■ Check whether the right choice was made in the APPLICATION function (see Page 95). ■ Check whether the operating conditions are within the specifications of the device (e.g. flow is above measuring range, i.e. the flow may have to be reduced) If the checks do not solve the problem, please contact your Endress+Hauser service organization.
399	S PREAMP. DISCONN. ϟ # 399	Pre-amplifier disconnected.	Check the connection between the preamplifier and amplifier board and establish connection if necessary.
501	S SW.-UPDATE AKT. ! # 501	Loading a new amplifier software version or data into the device. No other commands possible at this point.	Wait until the procedure is complete The device is automatically restarted.
502	S UP./DOWNLOAD AKT. ! # 502	Uploading the device data. No other commands possible at this point.	Wait until the procedure is complete
601	S POS. ZERO-RET. ! # 601	Positive zero return active. ☞ Caution! This message has the highest display priority.	Switch off positive zero return.
611	S SIM. CURR. OUT ! # 611	Current output simulation active	Switch off simulation.
631	S SIM. PULSE ! # 631	Pulse output simulation active	Switch off simulation.
641	S SIM. STAT. OUT ! # 641	Status output simulation active	Switch off simulation.
691	S SIM. FAILSAFE ! # 691	Simulation of failsafe mode (outputs) active	Switch off simulation.
692	S SIM. MEASURAND ! # 692	Simulation of a measured variable active (e.g. mass flow)	Switch off simulation.
698	S DEV. TEST ACT. ! # 698	The measuring device is being checked on site via the test and simulation device.	–
699	S CURR. ADJUST ! # 699	Current adjustment is active.	Quit current adjustment.

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 outlined below, such as FLOW DAMPING etc. are described in detail in the section "Description of device functions" on Page 71 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 ° (note therefore the installation conditions, see → Page 12 ff.). The measuring system is most sensitive to vibrations which follow in the sensor axis. Vibrations have less of an effect on the device in the other axes. ■ The amplification can be altered using the AMPLIFICATION function (→ 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 adequately 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 (→ 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. Continued on next page

Symptoms	Remedial measures
Faulty or highly-fluctuating flow signal (contd.)	■ Check whether the correct fluid was selected in the APPLICATION function (see Page 95). 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 K-FACTOR function (see Page 100). ■ Check whether the device is correctly mounted in flow direction. ■ Check whether the inner diameter of the mating pipe accords with the inner diameter of the flowmeter (see Page 97). ■ The flow must be in the measuring range of the device (see Page 59). 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. ■ Check whether the current output or pulse value was correctly set.
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 9 ff.): order code and serial number **Return devices to Endress+Hauser** The procedures on Page 8 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 53

9.4 Response of outputs to errors

Note!
The failsafe mode of totalizers and current, pulse and frequency outputs can be configured by means of various functions in the function matrix.

Positive zero return and error response:
You can use positive zero return to set the signals of the current, pulse and frequency outputs to their fallback value, for example when operation has to be interrupted while a pipe is being cleaned. This function has priority over all other device functions; simulations are suppressed, for example.

Response of outputs and totalizers to errors		
	Process/system error present	Positive zero return activated
Caution! System or process errors defined as "notice messages" have no effect whatsoever on the inputs and outputs. Please refer also to the information on Page 30 ff.		
Current output	*MIN. CURRENT* Depends on the setting selected in the CURRENT RANGE function. If the current range is: 4...20 mA HART NAMUR → output current = 3.6 mA 4...20 mA HART US → output current = 3.75 mA *MAX. CURRENT* 22.6 mA *HOLD VALUE* Measured value output is based on the last measured value saved before the error occurred. *ACTUAL VALUE* Measured value output is based on the current flow measurement. The fault is ignored.	Output signal corresponds to zero flow
Pulse output	*FALLBACK VALUE* Signal output → output 0 pulse *HOLD VALUE* Measured value output is based on the last valid flow data before the error occurred. *ACTUAL VALUE* Measured value output is based on the current flow measurement. The fault is ignored.	Output signal corresponds to zero flow
Status output	In the event of a fault or power supply failure: Status output → not conductive	No effect on the status output
Totalizer	*STOP* The totalizer stops at the last value before the alarm condition occurred. *HOLD VALUE* The totalizer continues to count the flow on the basis of the last valid flow data (before the fault occurred). *ACTUAL VALUE* The totalizer continues to count the flow on the basis of the current flow data. The fault is ignored.	Totalizer stops

9.5 Spare parts

Section 9.1 contains detailed trouble-shooting instructions. The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages. Trouble-shooting 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 (see Page 9).

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

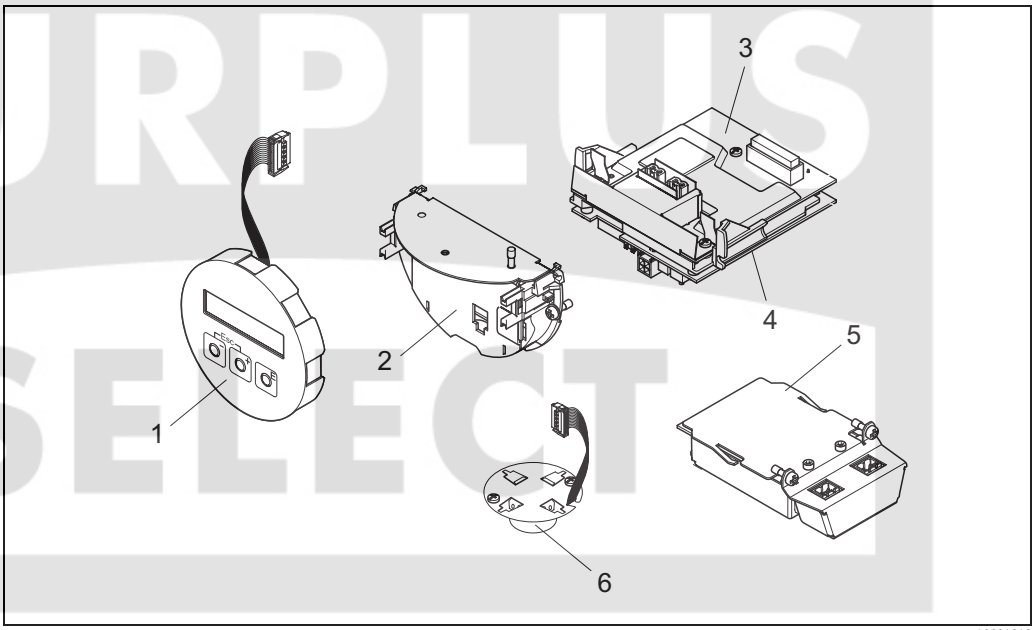


Fig. 25: Spare parts for transmitter Proline Prowirl 72

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

9.6 Installing and removing electronics boards

9.6.1 Non-Ex / Ex-i 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 (see Fig. 26)

1. Unscrew the cover (a) of the electronics compartment from the transmitter housing.
2. Remove the local display module (b) from the retaining rails (c).
3. Fit the local display module (b) with the left side onto the right retaining rail (c) (this secures the local 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 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 new amplifier board onto board body.
16. Installation is the reverse of the removal procedure.

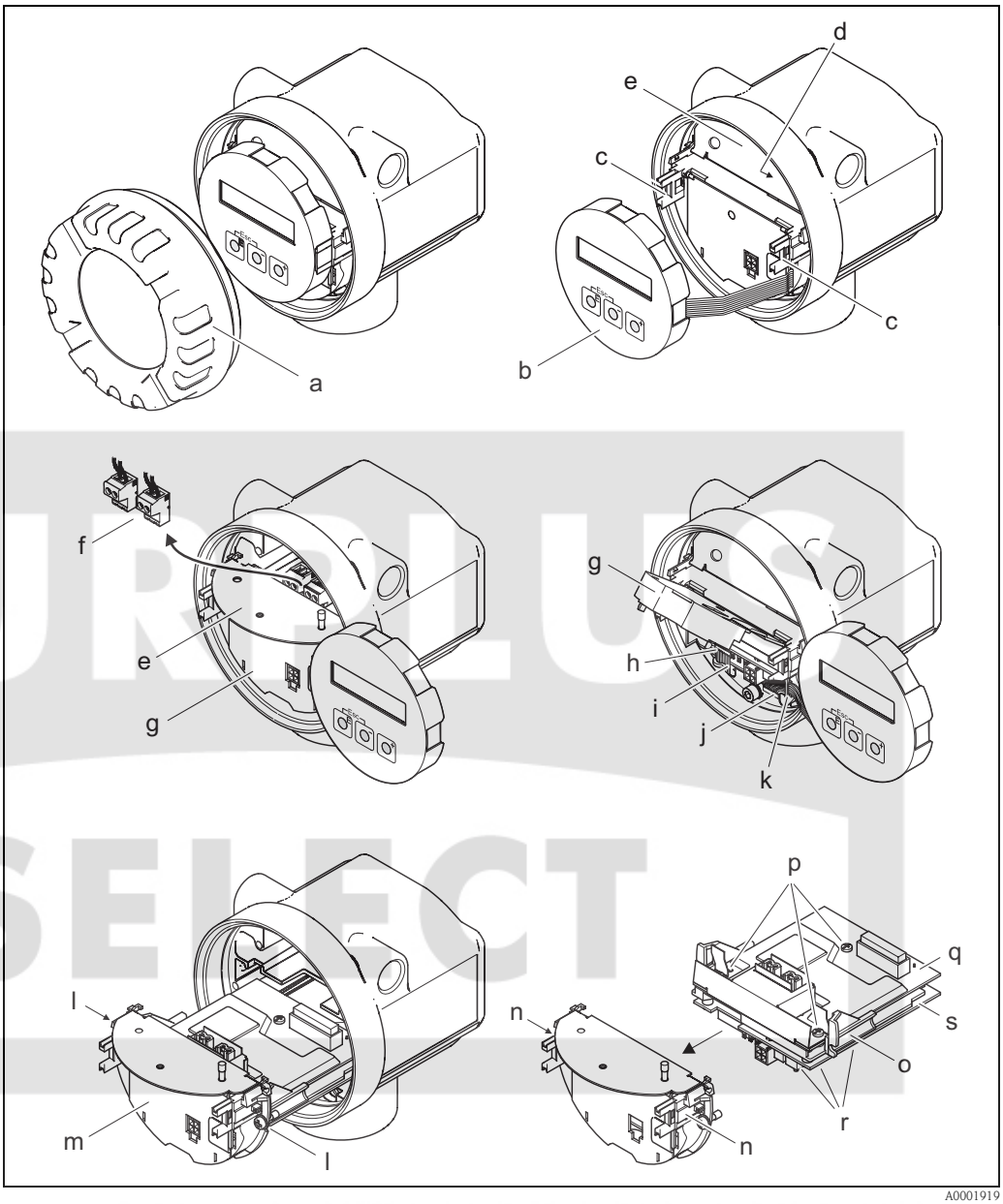


Fig. 26: Installing and removing electronics boards Non-Ex / Ex-i and Ex n version

a Cover of electronics compartment
b Local display module
c Retaining rails of local display module
d Fixing screws 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 Board holder threaded connection
m Board holder
n Board holder latches
o Board body
p I/O board (COM module) threaded connection
q I/O board (COM module)
r Amplifier board threaded connection
s Amplifier board

9.6.2 Ex d 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 (see Fig. 27)

Installing/removing the I/O board (COM module)

1. Release securing clamp (a) of the connection compartment cover (b).
2. Remove connection compartment cover (b) from the transmitter housing.
3. Disconnect terminal connector (c) from the I/O board (COM module) (e).
4. Release threaded connection (d) of the I/O board (COM module) (e) and pull out the board slightly.
5. Disconnect connection 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/removing the amplifier board

1. Unscrew the cover (g) of the electronics compartment from the transmitter housing.
2. Remove the local display module (h) from the retaining rails (i).
3. Fold up the plastic cover (j).
4. Remove 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 screws (n) of the board holder (o).
8. Pull out the board holder (o) slightly and disconnect 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 new amplifier board onto board body.
12. Installation is the reverse of the removal procedure.

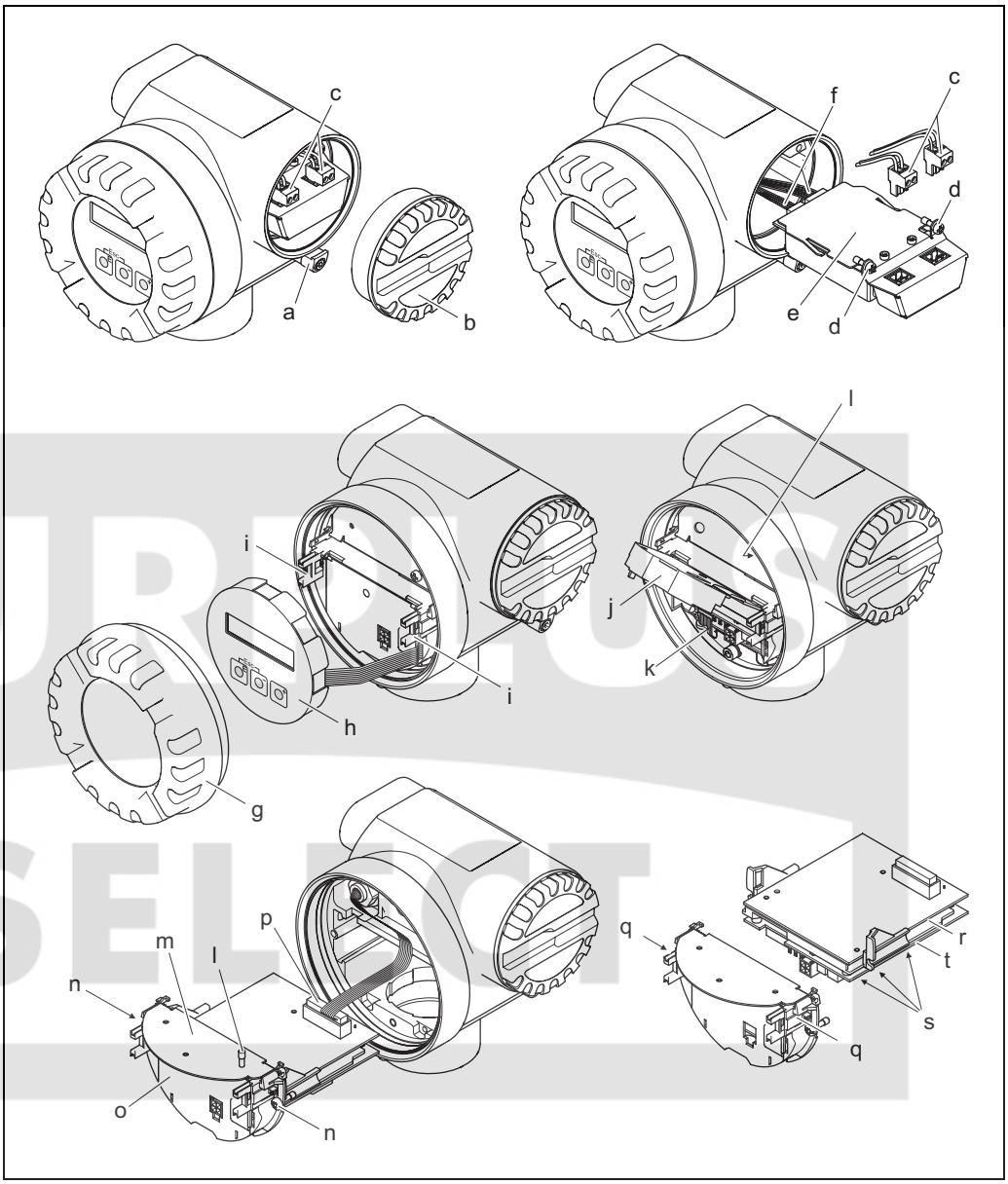


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Fig. 27: Installing and removing electronics boards Ex d version

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

9.7 Software history

Date	Software version	Software modification	Documentation Modifications / supplements
11.2004	Amplifier: V 1.02.XX	Software extension: – SIL-2 as of V: 1.02.01 New functionality: – Operation in Polish and Czech as of V 1.02.01	71008404/12.05
07.2003	Amplifier: V 1.01.XX	Upload/download via HART using ToF Tool - Fieldtool Package	50103643/12.03
01.2003	Amplifier: V 1.00.00	Original software Compatible with: – ToF Tool - Fieldtool Package – HART Communicator DXR 275 (OS 4.6 or higher) and DRX 375 with rev. 1, DD rev. 1.	

Note!
Upload/download between different software versions is normally only possible with special service software.

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, overheated 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:
- Transmitter Prowirl 72
- 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.

The output variables are volume flow or, if the process conditions are non-varying, calculated mass flow or corrected volume flow.

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} = 4,000, 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:

$$Re = \frac{4 \cdot Q\ [m^3/s] \cdot \rho\ [kg/m^3]}{\pi \cdot di\ [m] \cdot \mu\ [Pa \cdot s]}$$

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

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

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Full scale value:
– Gas / steam: v_{max} = 75 m/s (DN 15: v_{max} = 46 m/s)
– Liquids: v_{max} = 9 m/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 a guide. The range in which the K-factor can be is indicated for individual nominal diameters and designs.

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

10.1.4 Output

Output signal

Current output:
- 4...20 mA with HART
- Full scale value and time constant (0...100 s) can be set

Pulse/status output:
Open collector, passive, galvanically isolated

- Non-Ex, EEx d - version:
  U_{max} = 36 V, with 15 mA current limiting, R_i = 500 Ω

- Ex i and Ex n version:
  U_{max} = 30 V, with 15 mA current limiting, R_i = 500 Ω

The pulse/status output can be configured as:
- Pulse output:
  – Pulse value and pulse polarity can be selected (5... 2,000 ms),
  – Pulse width can be configured (0.005...2s)
  – Pulse frequency max. 100 Hz

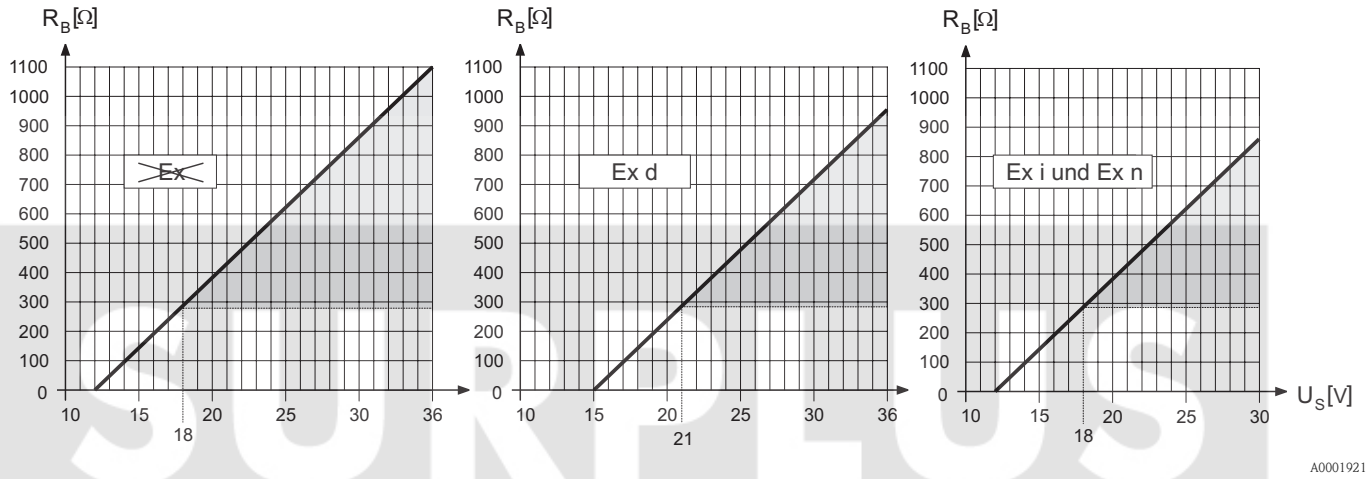
- Status output:
  Can be configured for error messages or flow limit values

- Vortex frequency:
  – Unscaled vortex pulses directly output 0.5...2,850 Hz (e.g. for connecting to a flow computer RMC 621)
  – Pulse ratio 1:1

- PFM signal (pulse/frequency modulation):
  for external connection with flow computer RMC or RMS 621

Signal on alarm	■ Current output: Failsafe mode can be selected (e.g. in accordance with NAMUR Recommendation NE 43) ■ Pulse output: Failsafe mode can be selected ■ Status output: “not conductive” in event of fault

Load



The area marked in gray indicates the permissible load (with HART: min. 250 Ω)
The load is calculated as follows:

$$R_B = \frac{(U_S - U_{KI})}{(I_{max} - 10^{-3})} = \frac{(U_S - U_{KI})}{0.022}$$

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R_B Load, load resistance
U_S Supply voltage:
- Non-Ex = 12...36 V DC
- Ex d = 15...36 V DC
- Ex i and Ex n = 12...30 V DC
U_{KI} Terminal voltage:
- Non-Ex = min. 12 V DC
- Ex d = min. 15 V DC
- Ex i and Ex n = min. 12 V DC
I_{max} Output current (22.6 mA)

Low flow cut off	Switch points for low flow cut off can be selected as required
Galvanic isolation	The electrical connections are galvanically isolated from one another.

10.1.5 Power supply

Electrical connection	see Page 21 ff.
Supply voltage	Non-Ex: 12...36 V DC (with HART: 18...36 V DC) Ex i and Ex n: 12...30 V DC (with HART 18...30 V DC) EEx-d: 15...36 V DC (with HART: 21...36 V DC)
Cable entry	Power supply cable / signal cable (outputs): ■ Cable entry: M20 x 1.5 (8...11.5 mm) ■ Thread for cable entry: ½" NPT, G ½", G ½" Shimada

Cable specification	■ Permitted temperature range: –40 °C...(max. ambient temperature plus 10 °C) ■ Remote version → Page 22
Power supply failure	■ Totalizer stops at the last value determined (can be configured). ■ All settings are kept in the EEPROM. ■ Error messages (incl. value of operated hours counter) are stored.

10.1.6 Performance characteristics

Reference operating conditions	Error limits following ISO/DIN 11631: ■ 20...30 °C ■ 2...4 bar ■ Calibration rig traced to national standards. ■ Calibration with the correlatively process connection of the accordingly norms.
Maximum measured error	■ Liquid: < 0.75% o.r. for Re > 20,000 < 0.75% o.f.s for Re between 4,000...20,000 ■ Gas/steam: < 1% o.r. for Re > 20,000 < 1% o.f.s for Re between 4,000...20,000 o.r. = Of reading o.f.s = Of full scale Re = Reynolds number
Repeatability	±0.25% o.r. (of reading)
Reaction time/ step response time	If all configurable functions are set to 0, you must reckon with a reaction time/step response time of 200 ms for vortex frequencies as of 10 Hz. For other settings, a reaction time/step response time of 100 ms must be added to the total filter reaction time for vortex frequencies as of 10 Hz. → Page 99: FLOW DAMPING
Influence of ambiente temperature	**Current output (additional error, in reference to the span of 16 mA):** ■ Zero point (4 mA) average T_k: 0.05%/10 K, max. 0.6% over the entire temperature range –40 °C ... +80 °C ■ Span (20 mA): average T_k: 0.05%/10 K, max. 0.6% over the entire temperature range –40 °C ... +80 °C **Digital outputs (pulse output, PFM, HART)** Due to the digital measuring signal (vortex pulse) and further digital processing, there is no interface-related error from changing ambient temperature.

10.1.7 Operating conditions: installation

Installation instructions	see Page 12 ff.
Inlet and outlet run	see Page 14 ff.

10.1.8 Operating conditions: environment

Ambient temperature range

- Compact version: –40...+70 °C
  (EEx d version: –40...+60°C; ATEX II 1/2 GD version/dust ignition-proof: –20...+55°C)
  Display can be read between –20 °C...+70 °C

- Remote version:
  Sensor –40...+85 °C
  (ATEX II 1/2 GD version/dust ignition-proof: –20...+55°C)
  Transmitter –40...+80 °C
  (EEx-d version: –40...+60°C; ATEX II 1/2 GD version/dust ignition-proof: –20...+55°C)
  Display can be read between –20 °C...+70 °C

When mounting outside, we recommend you protect from direct sunlight with a protective cover (order number 543199), especially in warmer climates with high ambient temperatures.

Storage temperature

–40...+80 °C (ATEX II 1/2 GD version/dust ignition-proof: –20...+55°C)

Degree of protection

IP 67 (NEMA 4X) according to EN 60529

Vibration resistance

Acceleration up to 1 g, 10...500 Hz, following IEC 60068-2-6

Electromagnetic compatibility (EMC)

To EN 61326/A1 and NAMUR Recommendation NE 21

10.1.9 Operating conditions: process

Medium temperature range

- DSC sensor (digital switched capacitor; capacitive sensor):

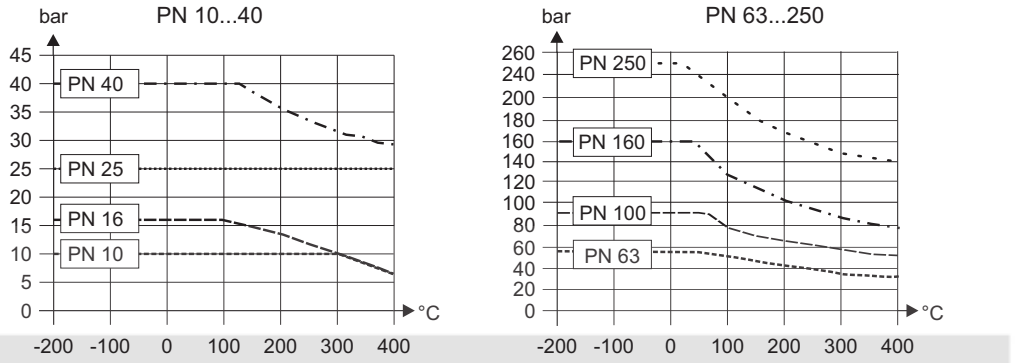
DSC standard sensor	–40...+260 °C
DSC high/low temperature sensor	–200...+400 °C
DSC sensor Inconel (only PN 63...160, Class 600, JIS 40K and Dualsens version)	–200...+400 °C
DSC sensor titanium Gr. 5 (PN 250, Class 900…1500 and butt-weld version)	–50...+400 °C
DSC sensor Alloy C-22	–200...+400 °C

- Seals:

Grafoil (graphite)	–200...+400 °C
Viton	–15...+175 °C
Kalrez	–20...+275 °C
Gylon (PTFE)	–200...+260 °C

Medium pressure

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



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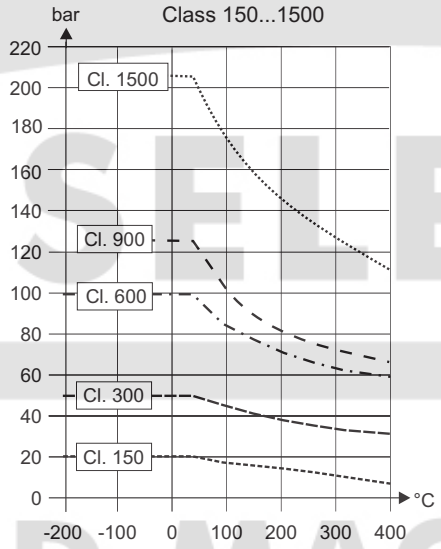
Pressure-temperature curve according to ANSI B16.5, stainless steel

- ANSI B16.5:
  Class 150...300 → Prowirl 72W and 72F
  Class 600...1500 → Prowirl 72F



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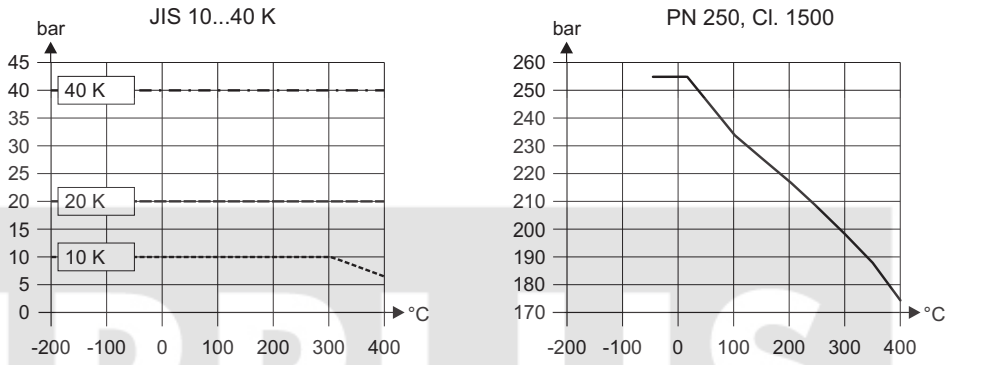
Pressure-temperature curve according to JIS B2238 and butt-weld version, stainless steel

- JIS B2238:
  10...20K → Prowirl 72W and 72F
  40K → Prowirl 72F
- Butt-weld version:
  PN 250, Cl 1500 → Prowirl 72F



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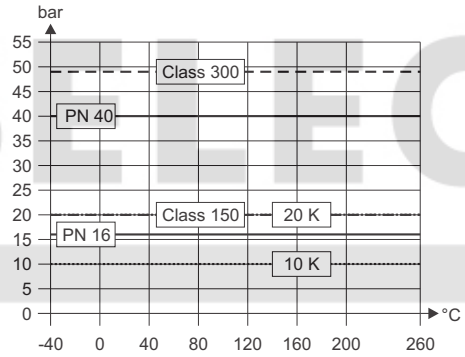
Pressure-temperature curve according to EN (DIN), ANSI B16.5 and JIS B2238, Alloy C-22
PN 16...40, Class 150...300, 10...20K → Prowirl 72F



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Limiting flow

See data on Page 59 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

DN DIN / ANSI	**Air** (at 0 °C, 1.013 bar) [m^3/h]			**Water** (at 20 °C) [m^3/h]			**K-factor** [$Pulse/dm^3$]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	min....max.
DN 15	4	35	330...2600	0.19	7	10.0...520	245...280
DN 25	11	160	180...2300	0.41	19	5.7...300	48...55
DN 40	31	375	140...1650	1.1	45	4.6...200	14...17
DN 50	50	610	100...1200	1.8	73	3.3...150	6...8
DN 80	112	1370	75...850	4.0	164	2.2...110	1.9...2.4
DN 100	191	2330	70...800	6.9	279	2.0...100	1.1...1.4
DN 150	428	5210	38...450	15.4	625	1.2...55	0.27...0.32

Prowirl 72F

DN DIN / ANSI	**Air** (at 0 °C, 1.013 bar) [m^3/h]			**Water** (at 20 °C) [m^3/h]			**K-factor** [$Pulse/dm^3$]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range [Hz]	min....max.
DN 15	3	25	380...2850	0.16	5	14.0...600	390...450
DN 25	9	125	200...2700	0.32	15	6.5...340	70...85
DN 40	25	310	150...1750	0.91	37	4.5...220	18...22
DN 50	42	510	120...1350	1.5	62	3.7...170	8...11
DN 80	95	1150	80...900	3.4	140	2.5...115	2.5...3.2
DN 100	164	2000	60...700	5.9	240	1.9...86	1.1...1.4
DN 150	373	4540	40...460	13.4	550	1.2...57	0.3...0.4
DN 200	715	8710	27...322	25.7	1050	1.0...39	0.1266...0.14
DN 250	1127	13740	23...272	40.6	1650	0.8...33	0.0677...0.0748
DN 300	1617	19700	18...209	58.2	2360	0.6...25	0.0364...0.0402

10.1.11 Mechanical construction

Design, dimensions

See Page 69 and Technical Information Prowirl 72, 73 (TI070D/06/en)

Weight

See Technical Information Prowirl 72, 73 (TI070D/06/en)

Material

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

- Flanges:
  - EN (DIN) → Stainless steel, 316/316L/1.4404, in conformity with NACE MR0175 and MR0103
    DN 15...150 with pressure ratings of PN 63-160 and nominal diameters of DN 200-300: fully cast construction A351-CF3M (1.4404), in conformity with NACE MR0175 and MR0103
  - Pressure rating PN250: 1.4571 (316Ti; UNS S31635); in conformity with NACE MR0175 and MR0103
  - ANSI and JIS -> Stainless steel, 316/316L, in conformity with NACE MR0175 and MR0103
  - ½"...6" with pressure ratings of Cl 600, DN 15...150 with pressure rating of 40 K, nominal diameters of 8"-12" and DN 200-300:
    fully cast construction A351-CF3M, in conformity with NACE MR0175 and MR0103
  - Pressure rating Cl 900…1500: 316/316L; in conformity with NACE MR0175 and MR0103
  - Alloy C-22 version (EN/DIN/ANSI/JIS) → Alloy C-22 2.4602 (A 494-CX2MW/ N 26022); in conformity with NACE MR0175 and MR0103

- 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, Cl 300, JIS 40 K: Stainless steel 1.4435 (316L), in conformity with NACE MR0175 and MR0103
  - Pressure ratings PN 63...160, Cl 600, 40 K and Dualsens version:
    Inconel 2.4668/N 07718 (B637) (Inconel 718), in conformity with NACE MR0175 and MR0103
  - Pressure ratings PN 250, Cl 900…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 and MR0103

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

- Support:
  - Stainless steel, 1.4308 (CF8)
    pressure ratings PN 250, Cl 900…1500 and butt-weld version: 1.4305 (303)

- Seals:
  - Graphite (Grafoil)
  - Viton
  - Kalrez 6375
  - Gylon (PTFE) 3504

10.1.12 Human interface

Display elements

- Liquid crystal display, two-line, plain text display, 16 characters per line
- Display can be configured individually, e.g. for measured variables and status variables, totalizers

Operating elements

- Local operation with three keys (+, −, E)
- Quick Setup for quick commissioning
- Operating elements accessible also in Ex zones

Remote operation

Operation via:
- HART protocol
- Fieldtool (Endress+Hauser software package for complete configuration, commissioning and diagnosis)

10.1.13 Certificates and approvals

CE approval	see Page 10
C-Tick mark	see Page 10
Ex approval	More information on the Ex approvals can be found in the separate Ex documentation.
Pressure measuring device approval	Devices with a nominal diameter smaller than or equal to DN 25 correspond to Article 3 (3) of the EC Directive 97/23/EC (Pressure Equipment Directive). For larger nominal diameters, certified flowmeters to Category III are optionally also available if necessary (depends on fluid and operating pressure). All devices are applicable for all fluids and unstable gases on principle and have been designed and manufactured in accordance to sound engineering practice.
Functional safety	SIL-2: in accordance with IEC 61508 / IEC 61511-1
Other standards and guidelines	■ EN 60529: Degrees of protection by housing (IP code) ■ EN 61010: Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures ■ EN 61326/A1: Electromagnetic compatibility (EMC requirements) ■ NAMUR NE 21: Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment ■ NAMUR NE 43: Standardization of the signal level for the breakdown information of digital transmitters with analog output signal ■ NACE Standard MR0103: Standard Material Requirements - Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments ■ NACE Standard MR0175: 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.
Ordering information	Your Endress+Hauser service organization can provide detailed ordering information and information on the order codes on request.

10.1.14 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor (see Page 45). Your Endress+Hauser service organization can provide detailed information on the order codes of your choice.

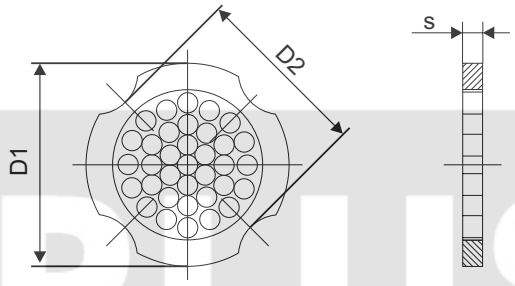
10.1.15 Documentation

- Technical Information Prowirl 72, 73 (TI070D/06/en)
- Associated Ex documentation: ATEX, FM, CSA
- Related documentation for Pressure Equipment Directive
- Functional Safety Manual (Safety Integrity Level)

10.2 Dimensions of flow conditioner according to EN (DIN) / ANSI / JIS

Dimensions according to:
- EN 1092-1 (DIN 2501)
- ANSI B16.5
- JIS B2238

Material 1.4435 (316L), in conformity with NACE MR0175 and MR0103



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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.

Table: dimensions of flow conditioner according to EN (DIN)

DN	Pressure rating	Centering diameter [mm]	D1 / D2	s [mm]	Weight [kg]
15	PN 10...40 PN 63	54.3 64.3	D2 D1	2.0	0.04 0.05
25	PN 10...40 PN 63	74.3 85.3	D1 D1	3.5	0.12 0.15
40	PN 10...40 PN 63	95.3 106.3	D1 D1	5.3	0.3 0.4
50	PN 10...40 PN 63	110.0 116.3	D2 D1	6.8	0.5 0.6
80	PN 10...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

Table: dimensions of flow conditioner according to ANSI

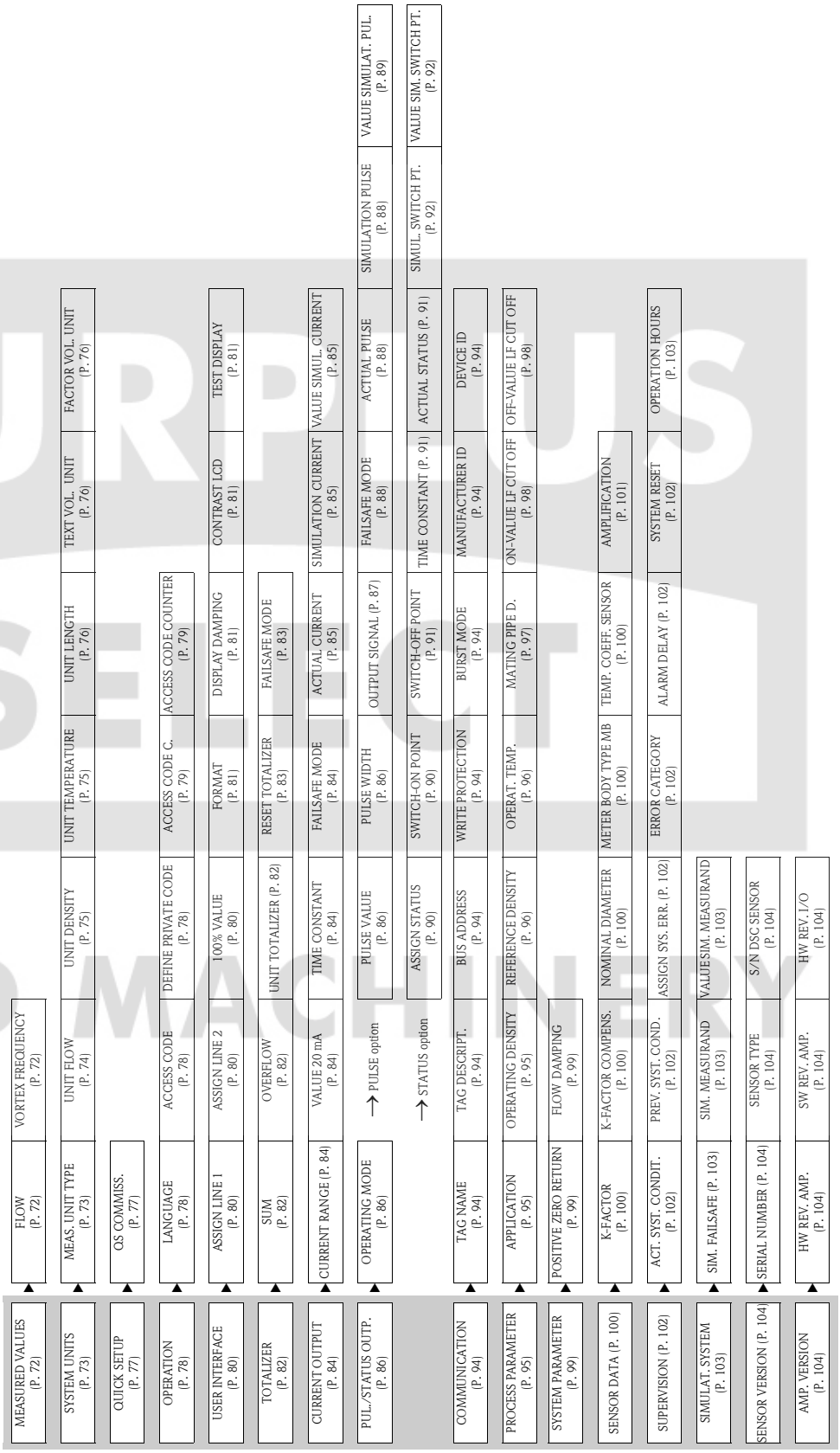
DN	Pressure rating	Centering diameter [mm]	D1 / D2	s [mm]	Weight [kg]
½"	Cl. 150 Cl. 300	50.1 56.5	D1 D1	2.0	0.03 0.04
1"	Cl. 150 Cl. 300	69.2 74.3	D2 D1	3.5	0.12
1½"	Cl. 150 Cl. 300	88.2 97.7	D2 D2	5.3	0.3
2"	Cl. 150 Cl. 300	106.6 113.0	D2 D1	6.8	0.5
3"	Cl. 150 Cl. 300	138.4 151.3	D1 D1	10.1	1.2 1.4
4"	Cl. 150 Cl. 300	176.5 182.6	D2 D1	13.3	2.7
6"	Cl. 150 Cl. 300	223.9 252.0	D1 D1	20.0	6.3 7.8
8"	Cl. 150 Cl. 300	274.0 309.0	D2 D1	26.3	12.3 15.8
10"	Cl. 150 Cl. 300	340.0 363.0	D1 D1	33.0	25.7 27.5
12"	Cl. 150 Cl. 300	404.0 402.0	D1 D1	39.6	36.4 44.6

Table: 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	D2	20	4.5
	20K	240	D1	20	5.5
	40K	252	D1	20	6.2
200	10K	271	D2	26.3	9.2
	20K	284	D1	26.3	9.2
250	10K	330	D2	33	15.8
	20K	355	D2	33	19.1
300	10K	380	D2	39.6	26.5
	20K	404	D1	39.6	26.5

11 Description of device functions

11.1 Illustration of the function matrix



11.2 Description of functions

11.2.1 Group MEASURED VALUES

Function description MEASURED VALUES	
FLOW	The flow currently measured appears on the display. **Display:** 5-digit floating-point number, including unit (e.g. 5.545 dm³/min; 1.4359 kg/h; 731.63 gal/d, etc.) ✎ Note! The appropriate unit is taken from the UNIT FLOW function (see Page 74).
VORTEX FREQUENCY	The vortex frequency currently measured appears on the display. **Display:** 5-digit floating-point number, including unit Hz (e.g. 120.23 Hz) ✎ Note! This function is only used for a plausibility check.

11.2.2 Group SYSTEM UNITS

Function description SYSTEM UNITS	
MEASURING UNIT TYPE	Use this function to specify the type of unit the measuring device should use to output the flow. The following types of units are available: ■ Volumetric flow (volume flow) The device measures the volumetric flow; no other calculation is carried out. ■ Calculated mass flow The calculated mass flow is calculated using the measured volume flow and the value entered in the OPERATING DENSITY function (see Page 95). ■ Calculated corrected volume flow The corrected volume flow is calculated using the measured volume flow and the ratio between the values entered in the OPERATING DENSITY function (see Page 95) and in the REFERENCE DENSITY function (see Page 96). ✎ Note! The “calculated mass flow” and “calculated corrected volume flow” unit types are calculated with fixed values (specified OPERATING DENSITY and REFERENCE DENSITY). For this reason **only** select these types of units if the process conditions are known and do **not** change. If the process conditions are not known or if the process conditions are subject to change, we recommend you use a flow computer (e.g. Compart DXF 351 or RMC 621). Even when the process conditions change, these flow computers can calculate the flow correctly by means of pressure and temperature compensation. **Options:** VOLUME FLOW CALCULATED MASS FLOW CORRECTED VOLUME FLOW (calculated) **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! If the type of unit is changed, you are asked whether the totalizer should be reset to 0. The new type of unit is only accepted if you confirm this message with yes. If the message is not confirmed, the measuring system continues working with the type of unit previously active.

Function description SYSTEM UNITS	
UNIT FLOW	Use this function to select the unit for displaying the flow. Depending on what is selected in the MEASURING UNIT TYPE function (see Page 73), only the associated units (volume or mass or corrected volume) are displayed here. The unit you select here is also valid for: ■ Flow display ■ Current output (value 20 mA) ■ Pulse/status output (pulse value, switch-off point/switch-on point) ■ On-value low flow cut off ■ Simulation measurand ✎ Note! The following units of time can be selected: s = second, m = minute, h = hour, d = day **Options:** (with MEASURING UNIT TYPE function = VOLUME FLOW) *Metric:* Cubic centimeter → cm^3/time unit Cubic decimeter → dm^3/time unit Cubic meter → m^3/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 → ft^3/time unit Fluid ounce → ozf/time unit Gallon → US gal/time unit Million 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. *Arbitrary volume unit:* This option does not appear unless a volume unit was defined via the TEXT ARBITRARY VOLUME UNIT function (see Page 76). **Factory setting** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) **Options:** (with MEASURING UNIT TYPE function = CALCULATED MASS FLOW) *Metric:* Gram → g/time unit Kilogram → kg/time unit Metric ton → t/time unit *US:* Ounce → oz/time unit Pound → lb/time unit Ton → ton/time unit **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions). (Continued overleaf)

Function description SYSTEM UNITS	
UNIT FLOW (contd.)	**Options:** (with MEASURING UNIT TYPE function = CORRECTED VOLUME FLOW) *Metric:* Standard liter → Nl/time unit Standard cubic meter → Nm³/time unit *US:* Standard cubic meter → Sm³/time unit Standard cubic feet → Scf/time unit **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! The unit for the totalizer is independent of the option selected here; it is selected in the UNIT TOTALIZER function (see Page 82).
UNIT DENSITY	✎ Note! This function is not available unless the CALCULATED MASS FLOW or CORRECTED VOLUME FLOW (calculated) option was selected in the MEASURING UNIT TYPE function (see Page 73). Use this function to select the unit displayed for the density to be entered in the OPERATING DENSITY function (see Page 95) and REFERENCE DENSITY function (see Page 96). **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 TANKS (filling tanks) *Imperial:* lb/imp. gal; lb/imp. bbl BEER (beer); lb/imp. bbl PETR. (petrochemicals) **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) SD = Specific Density, SG = Specific Gravity The specific density is the ratio of fluid density to water density (at water temperature = 4, 15, 20 °C).
UNIT TEMPERATURE	Use this function to select the unit displayed for the temperature to be entered in the OPERATING TEMPERATURE function (see Page 96). **Options:** °C (CELSIUS) K (KELVIN) °F (FAHRENHEIT) R (RANKINE) **Factory setting:** Depends on country (metric system units, → Page 105, or US units, → Page 107)

Function description SYSTEM UNITS	
UNIT LENGTH	Use this function to select the unit displayed for the length of the nominal diameter in the NOMINAL DIAMETER function (see Page 100). **Options:** MILLIMETER INCH **Factory setting:** Depends on country (metric system units, → Page 105, or US units, → Page 107)
TEXT ARBITRARY VOLUME UNIT	✎ Note! This function is not available unless the VOLUME FLOW option was selected in the MEASURING UNIT TYPE function (see Page 73). Use this function to enter a text for a selectable volume flow unit. You define only the text, the associated unit of time is selected in the UNIT FLOW function (see Page 74). **User input:** xxxx (max. 4 characters) Valid characters are A-Z, 0-9, +, -, decimal point, white space or underscore **Factory setting:** "– – – –" (no text) Example: see FACTOR ARBITRARY VOLUME UNIT function. ✎ Note! The volume unit defined in this function is offered as a possible option (*arbitrary volume unit*) in the UNIT FLOW function (see Page 74).
FACTOR ARBITRARY VOLUME UNIT	✎ Note! This function is not available unless a text was entered in the TEXT ARBITRARY VOLUME UNIT function. Use this function to define a quantity factor (without time) for the selectable volume flow unit. The volume unit on which this factor is based is one liter. **User input:** 5-digit floating-point number **Factory setting:** 1 **Unit:** Text arbitrary volume unit / liter Example: You want to measure saturated steam at 180°C constant and display the heat flow. Take the following values from a table document (e.g. IAPWS-IF97): a) density: 5.158 kg/m³ b) enthalpy: 2777.22 kJ/kg Thus 1 m³ steam has an enthalpy of 2777 kJ/kg · 5.158 kg/m3 = 14323 kJ/m³, 1 liter corresponds to 14.323 kJ. In the TEXT ARBITRARY VOLUME UNIT function, you could enter "KJ", for example, as the name for the volume unit (appears as an option in the UNIT FLOW function). The value 14.323 would have to be specified in the FACTOR ARBITRARY VOLUME UNIT function.

11.2.3 Group QUICK SETUP

Function description QUICK SETUP	
QUICK SETUP COMMISSIONING	Use this function to start the Quick Setup for commissioning. **Options:** NO YES **Factory setting:** NO ✎ Note! Please refer to Page 40 for a detailed description of the "Commissioning" Quick Setup menu.

11.2.4 Group OPERATION

Function description OPERATION	
LANGUAGE	Use this function to select the language for all texts, parameters and messages shown on the local display. **Options:** ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO NEDERLANDS NORSK SVENSKA SUOMI PORTUGUES POLSKI CESKI **Factory setting:** Depends on country (metric system units, → Page 105, or US units, → Page 107) ✎ Note! If you press the ⊟ keys simultaneously at startup, the language defaults to "ENGLISH".
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the ⊟ keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can enable programming by entering the private code (**factory setting = 72**, see DEFINE PRIVATE CODE function). **User input:** Max. 4-digit number: 0...9999 ✎ Note! ■ The programming levels are disabled if you do not press a key within 60 seconds following a return to the HOME position. ■ You can also disable programming in this function by entering any number (other than the private code). ■ The Endress+Hauser service organization can be of assistance if you mislay your private code.
DEFINE PRIVATE CODE	Use this function to specify the private code for enabling programming. **User input:** Max. 4-digit number: 0...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.

Function description OPERATION	
ACCESS CODE C.	The access status for the function matrix appears on the display. **Display:** ACCESS CUSTOMER (parameters can be modified) LOCKED (parameters cannot be modified)
ACCESS CODE COUNTER (in preparation)	The number of times the private and service code was entered to access the device appears on the display. **Display:** Integer (delivery status: 0)

11.2.5 Group USER INTERFACE

Function description USER INTERFACE	
ASSIGN LINE 1	Use this function to define which display value is assigned to the main line (top line of the local display) for display during normal measuring operation. **Options:** OFF FLOW FLOW IN % **Factory setting:** FLOW
ASSIGN LINE 2	Use this function to define which display value is assigned to the additional line (bottom line of the local display) for display during normal measuring operation. **Options:** OFF FLOW FLOW IN % TOTALIZER TAG NAME OPERATING/SYSTEM CONDITIONS FLOW BARGRAPH IN % **Factory setting:** TOTALIZER
100% VALUE	✎ Note! This function is not available unless ■ the FLOW IN % option was selected in the ASSIGN LINE 1 function or ■ the FLOW IN % or FLOW BARGRAPH IN % option was selected in the ASSIGN LINE 2 function Use this function to define the flow value to be shown on the display as the 100% value. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter, application and country (metric system units, → Page 105, or US units, → Page 107) ✎ Note! If a value was specified for the VALUE 20 mA function when ordering, this value is also used here as the factory setting.

Function description USER INTERFACE	
FORMAT	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	Use this function to enter a time constant defining how the display reacts to severely fluctuating flow variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** 0...100 s **Factory setting:** 5 s ✎ Note! ■ The setting 0 seconds switches off damping. ■ The reaction time of the function depends on the time specified in the FLOW DAMPING function (see Page 99).
CONTRAST LCD	Use this function to optimize the display contrast to suit local operating conditions. **User input:** 10...100% **Factory setting:** 50% ✎ Note! If you press the ⊟ keys simultaneously at startup, the language defaults to “ENGLISH” and the contrast is reset to the factory setting.
TEST DISPLAY	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 the displays the option OFF.

11.2.6 Group TOTALIZER

Function description TOTALIZER	
SUM	The total for the totalizer's measured variable aggregated since measuring commenced appears on the display. **Display:** Max. 7-digit floating-point number, including unit (e.g. 15467.4 m^3) ✎ Note! The totalizer's response to errors is defined in the "FAILSAFE MODE" function (see Page 83).
OVERFLOW	The total for the totalizer's overflow aggregated since measuring commenced appears on the display. Total flow is represented by a floating-point number consisting of max. 7 digits. You can use this function to view higher numerical values (>9,999,999) as overflows. The effective quantity is thus the total of the SUM function plus the value displayed in the OVERFLOW function. Example: Reading after 2 overflows: 2 E7 kg (= 20,000,000 kg) The value displayed in the SUM function = 196,845.7 kg Effective total quantity = 20,196,845.7 kg **Display:** Integer with exponent, including sign and unit, e.g. 2 E7 kg
UNIT TOTALIZER	Use this function to define the unit for the totalizer. Depending on what is selected in the MEASURING UNIT TYPE function (see Page 73), only the associated units (volume or mass or corrected volume) are displayed here for selection. **Options:** (with MEASURING UNIT TYPE function = VOLUME FLOW) *Metric:* Cubic centimeter → cm^3 Cubic decimeter → dm^3 Cubic meter → m^3 Milliliter → ml Liter → l Hectoliter → hl Megaliter → Ml *US:* Cubic centimeter → cc Acre foot → af Cubic foot → ft^3 Fluid ounce → ozf Gallon → gal Million gallon → Mgal Barrel → bbl (normal fluids) Barrel → bbl (beer) Barrel → bbl (petrochemicals) Barrel → bbl (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/... PETR. Continued on next page

Function description TOTALIZER	
UNIT TOTALIZER (contd.)	*Arbitrary volume unit:* This option does not appear unless a volume unit was defined via the TEXT ARBITRARY VOLUME UNIT function (see Page 76). **Factory setting** Depends on country (metric system units, → Page 105, or US units, → Page 107) **Options:** (with MEASURING UNIT TYPE function = CALCULATED MASS FLOW) *Metric:* Gram → g Kilogram → kg Metric ton → t *US:* Ounce → oz Pound → lb Ton → ton **Factory setting:** Depends on country (metric system units, → Page 105, or US units, → Page 107) **Options:** (with MEASURING UNIT TYPE function = CORRECTED VOLUME FLOW) *Metric:* Standard liter → Nl Standard cubic meter → Nm^3 *US:* Standard cubic meter → Sm^3 Standard cubic feet → Scf **Factory setting:** Depends on country (metric system units, → Page 105, or US units, → Page 107)
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to 0 (= RESET). **Options:** NO YES **Factory setting:** NO
FAILSAFE MODE	Use this function to define the response of the totalizer 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

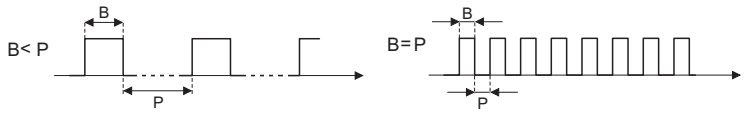
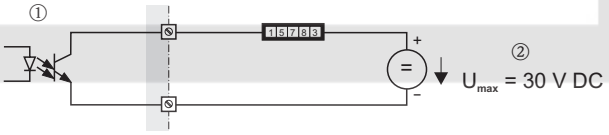
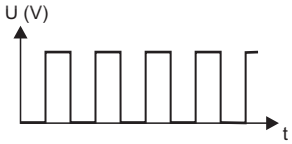
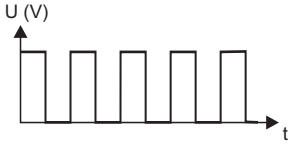
11.2.7 Group CURRENT OUTPUT

Function description CURRENT OUTPUT	
CURRENT RANGE	Use this function to define the current range. You can configure the current output either in accordance with the NAMUR recommendation or for the values common in the United States. **Options:** 4...20 mA HART NAMUR 4...20 mA HART US **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions)
VALUE 20 mA	Use this function to assign the 20 mA current a value. **User input:** 5-digit floating-point number **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! The appropriate unit is taken from the UNIT FLOW function (see Page 74).
TIME CONSTANT	Use this function to select a time constant defining how the current output signal reacts to severely fluctuating measured variables, either very quickly (low time constant) or with damping (high time constant). **User input:** Fixed-point number: 0...100 s **Factory setting:** 5 s ✎ Note! The reaction time of the function also depends on the time specified in the FLOW DAMPING function (see Page 99).
FAILSAFE MODE	The dictates of safety render it advisable to ensure that the current output assumes a predefined state in the event of a fault. Use this function to define the response of the current output to fault. The setting you select here affects only the current output. It has no effect on other outputs or the display (e.g. totalizers). **Options:** MIN. CURRENT Depends on the option selected in the CURRENT RANGE function (see Page 84). If the current range is: 4...20 mA HART NAMUR → output current = 3.6 mA 4...20 mA HART US → output current = 3.75 mA MAX. CURRENT 22.6 mA HOLD VALUE Measured value output is based on the last measured value saved before the error occurred. ACTUAL VALUE Measured value output is based on the current flow measurement. The fault is ignored. **Factory setting:** MAX. CURRENT

Function description CURRENT OUTPUT	
ACTUAL CURRENT	The current computed actual value of the output current appears on the display. **Display:** 3.60...22.60 mA
SIMULATION CURRENT	Use this function to activate simulation of the current output. **Options:** OFF ON **Factory setting:** OFF Note! ■ The notice message #611 "SIMULATION CURRENT OUTPUT" indicates that simulation is active. ■ The value which should be output at the current output is defined in the VALUE SIMULATION CURRENT function. ■ The measuring device continues to measure while simulation is in progress, i.e. the current measured values are output correctly via the other outputs and the display. Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION CURRENT	Note! This function is not available unless the ON option was selected in the SIMULATION CURRENT function. Use this function to define a selectable value (e.g. 12 mA) to be output at the current output. This value is used to test downstream devices and the measuring device itself. **User input:** Floating-point number: 3.60...22.60 mA **Factory setting:** 3.60 mA Caution! The setting is not saved if the power supply fails. Note! Simulation is started by confirming the simulation value with the E key. If the E key is pressed again afterwards, the prompt "End simulation" (NO/YES) appears. If you choose "NO", simulation remains active and the group selection is called up. The simulation can be switched off again via the SIMULATION CURRENT function. If you choose "YES", you end the simulation and the group selection is called up.

11.2.8 Group PULSE/STATUS OUTPUT

Function description PULSE/STATUS OUTPUT (pulse)	
OPERATING MODE	Use this function to specify whether the output functions as a pulse output or status output. The functions available in this function group vary, depending on which option you select here. **Options:** PULSE STATUS VORTEX FREQUENCY (unscaled pulses) PFM **Factory setting:** PULSE
	✎ Note! ■ After PFM is selected, the group current output is no longer available (Page 84 ff.). If PFM is selected, current simulation with a simulation value of 4 mA is automatically activated. If the transmitter was wired for pulse-frequency modulation (see Page 24), the HART protocol is not available. ■ If VORTEX FREQUENCY and PFM are selected, the vortex pulses are passed on directly. The low flow cut off is taken into account.
PULSE VALUE	✎ Note! This function is not available unless the PULSE option was selected in the OPERATING MODE function. Use this function to define the flow at which a pulse should be output. These pulses can be totaled by an external totalizer and in this way the total flow since measuring commenced can be registered. ✎ Note! Select the pulse value in such a way that the pulse frequency does **not** exceed a value of 100 Hz with maximum flow. **User input:** 5-digit floating-point number **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! The appropriate unit is taken from the UNIT FLOW function (see Page 74).
PULSE WIDTH	✎ Note! This function is not available unless the PULSE option was selected in the OPERATING MODE function. Use this function to enter the maximum pulse width of the output pulses. **User input:** 5...2000 ms **Factory setting:** 20 ms Pulse output is **always** with the pulse width (B) entered in this function. The intervals (P) between the individual pulses are automatically adjusted. However, they must at least correspond to the pulse width (B = P). Continued on next page

Function description PULSE/STATUS OUTPUT (pulse)	
PULSE WIDTH (contd.)	 A0001233 *B = Pulse width entered (the illustration applies to positive pulses)* *P = Intervals between the individual pulses* Note! When entering the pulse width, select a value that can still be processed by a connected totalizer (e.g. mechanical totalizer, PLC, etc.). Caution! If the pulse number or frequency resulting from the pulse value entered (see PULSE VALUE function on Page 86) and from the current flow is too large to maintain the pulse width selected (interval P is smaller than the pulse width B entered), a system error message (#359, PULSE RANGE) is generated after buffering/balancing has occurred.
OUTPUT SIGNAL	Note! This function is not available unless the PULSE option was selected in the OPERATING MODE function. Use this function to configure the pulse output in such a way that it suits an external totalizer, for example. Depending on the application, you can select the direction of the pulses here. **Options:** PASSIVE - POSITIVE PASSIVE - NEGATIVE **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) **PASSIVE:**  A0001225 ① *Open collector* ② *External power supply* Note! For continuous currents up to 15 mA **PASSIVE-NEGATIVE** Pulse (B: pulse width)  A0001975 **PASSIVE-POSITIVE** Pulse (B: pulse width  A0001981

Function description PULSE/STATUS OUTPUT (pulse)	
FAILSAFE MODE	✎ Note! This function is not available unless the PULSE option was selected in the OPERATING MODE function. The dictates of safety render it advisable to ensure that the pulse output assumes a predefined state in the event of a fault. Use this function to define this state. The setting you select here affects only the pulse output. It has no effect on other outputs or the display (e.g. totalizers). **Options:** FALLBACK VALUE Output is 0 pulse. HOLD VALUE Measured value output is based on the last measured value saved before the error occurred. ACTUAL VALUE Measured value output is based on the current flow measurement. The fault is ignored. **Factory setting:** FALLBACK VALUE
ACTUAL PULSE	✎ Note! This function is not available unless the PULSE option was selected in the OPERATING MODE function. The current computed actual value of the output frequency appears on the display. **Display:** 0...100 pulse/second
SIMULATION PULSE	✎ Note! This function is not available unless the PULSE option was selected in the OPERATING MODE function. Use this function to activate simulation of the pulse output. **Options:** OFF COUNTDOWN The pulses specified in the VALUE SIMULATION PULSE function are output. CONTINUOUSLY Pulses are continuously output with the pulse width specified in the PULSE WIDTH function. Simulation is started once the CONTINUOUSLY option is confirmed with the E key. ✎ Note! Simulation is started by confirming the CONTINUOUSLY option with the E key. If the E key is pressed again afterwards, the prompt “End simulation” (NO/YES) appears. If you choose “NO”, simulation remains active and the group selection is called up. The simulation can be switched off again via the SIMULATION PULSE function. If you choose “YES”, you end the simulation and the group selection is called up. Continued on next page

Function description PULSE/STATUS OUTPUT (pulse)	
SIMULATION PULSE (contd.)	**Factory setting:** OFF ✎ Note! ■ The notice message #631 “SIM. PULSE” indicates that simulation is active. ■ The on/off ratio is 1:1 for both types of simulation. ■ The measuring device continues to measure while simulation is in progress, i.e. the current measured values are output correctly via the other outputs. ☝ Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION PULSE	✎ Note! This function is not available unless the COUNTDOWN option was selected in the SIMULATION PULSE function. Use this function to specify the number of pulses (e.g. 50) which are output during the simulation. This value is used to test downstream devices and the measuring device itself. The pulses are output with the pulse width specified in the PULSE WIDTH function. The on/off ratio is 1:1. Simulation is started once the specified value is confirmed with the E key. The display remains at 0 if the specified pulses have been output. **User input:** 0...10,000 **Factory setting:** 0 ✎ Note! Simulation is started by confirming the simulation value with the E key. If the E key is pressed again afterwards, the prompt “End simulation” (NO/YES) appears. If you choose “NO”, simulation remains active and the group selection is called up. The simulation can be switched off again via the SIMULATION PULSE function. If you choose “YES”, you end the simulation and the group selection is called up. ☝ Caution! The setting is not saved if the power supply fails.

Function description PULSE/STATUS OUTPUT (status)	
ASSIGN STATUS	✎ Note! This function is not available unless the STATUS option was selected in the OPERATING MODE function. Use this function to assign a switching function to the status output. **Options:** OFF ON (operation) FAULT MESSAGE NOTICE MESSAGE FAULT MESSAGE or NOTICE MESSAGE LIMIT FLOW LIMIT TOTALIZER **Factory setting:** FAULT MESSAGE ✎ Note! ■ The status output displays quiescent current behavior, in other words the output is closed (transistor conductive) when normal, error-free operation is in progress. ■ Please pay particular attention to the illustrations and detailed information on the switching behavior of the status output (see Page 93). ■ If you select OFF, the only function shown in this function group is this function (ASSIGN STATUS).
SWITCH-ON POINT	✎ Note! This function is not available unless the LIMIT FLOW or LIMIT TOTALIZER option was selected in the ASSIGN STATUS function. Use this function to assign a value to the switch-on point (status output pulls up). The value can be greater or less than the switch-off point. Only positive values are permitted. **User input:** 5-digit floating-point number **Factory setting:** ■ If LIMIT FLOW was selected in the ASSIGN STATUS function: Depends on nominal diameter, application and country (metric system units, → Page 105, or US units, → Page 107) ■ If LIMIT TOTALIZER was selected in the ASSIGN STATUS function: 0 ✎ Note! The appropriate unit is taken from the UNIT FLOW function (see Page 74) or UNIT TOTALIZER function (see Page 82).

Function description PULSE/STATUS OUTPUT (status)	
SWITCH-OFF POINT	✎ Note! This function is not available unless the LIMIT FLOW or LIMIT TOTALIZER option was selected in the ASSIGN STATUS function. Use this function to assign a value to the switch-off point (status output drops out). The value can be greater or less than the switch-on point. Only positive values are permitted. **User input:** 5-digit floating-point number **Factory setting:** Depends on nominal diameter, application and country (metric system units, → Page 105, or US units, → Page 107) ✎ Note! The appropriate unit is taken from the UNIT FLOW function (see Page 74).
TIME CONSTANT	✎ Note! This function is not available unless the LIMIT FLOW option was selected in the ASSIGN STATUS function. Use this function to select a time constant defining how the measuring signal reacts to severely fluctuating measured variables, either very quickly (low time constant) or with damping (high time constant). The purpose of damping, therefore, is to prevent the status output changing state continuously in response to fluctuations in flow. **User input:** 0...100 s **Factory setting:** 0 s ✎ Note! The reaction time of the function depends on the time specified in the FLOW DAMPING function (see Page 99).
ACTUAL STATUS OUTPUT	✎ Note! This function is not available unless the STATUS option was selected in the OPERATING MODE function. The current status of the status output appears on the display. **Display:** NOT CONDUCTIVE CONDUCTIVE

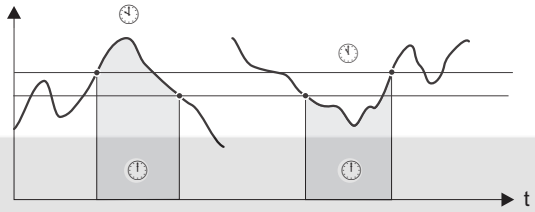
Function description PULSE/STATUS OUTPUT (status)	
SIMULATION SWITCH POINT	Note! This function is not available unless the STATUS option was selected in the OPERATING MODE function. Use this function to activate simulation of the status output. **Options:** OFF ON **Factory setting:** OFF Note! ■ The notice message #641 “SIMULATION STATUS OUTPUT” indicates that simulation is active. ■ The measuring device continues to measure while simulation is in progress, i.e. the current measured values are output correctly via the other outputs. Caution! The setting is not saved if the power supply fails.
VALUE SIMULATION SWITCH POINT	Note! This function is not available unless the ON option was selected in the SIMULATION SWITCH POINT function. Use this function to define the switching behavior of the status output during the simulation. This value is used to test downstream devices and the measuring device itself. **User input:** NOT CONDUCTIVE CONDUCTIVE **Factory setting:** NOT CONDUCTIVE Note! You can change the switching behavior of the status output during the simulation. The prompt “CONDUCTIVE” or “NOT CONDUCTIVE” appears if the + or − key is pressed. Select the desired switching behavior and start the simulation with the E key. If the E key is pressed again afterwards, the prompt “End simulation” (NO/YES) appears. If you choose “NO”, simulation remains active and the group selection is called up. The simulation can be switched off again via the SIMULATION SWITCH POINT function. If you choose “YES”, you end the simulation and the group selection is called up. Caution! The setting is not saved if the power supply fails.

11.2.9 Information on the response of the status output

General information
If you have configured the status output for "LIMIT VALUE", you can specify the required switch points in the SWITCH-ON POINT and SWITCH-OFF POINT functions. When the measured variable in question reaches these predefined values, the status output switches as shown in the illustrations below.

Status output configured for limit value
The status output switches as soon as the current measured variable undershoots or overshoots a defined switch point.
Application: monitoring flow or process-related boundary conditions.

Measured variable



A0003592

① = *ON ≤ SWITCH-OFF POINT (maximum safety)*
② = *ON > SWITCH-OFF POINT (minimum safety)*
③ = *Status output switched off (not conductive)*

Switching behavior of the status output

Function	Status	Open collector behavior (transistor)
ON (operation)	System in operation	Conductive
	System not in operation (power supply failure)	Not conductive
Fault message	System OK	Conductive
	(System or process error) Fault → failsafe mode outputs/ INputs and totalizers	Not conductive
Notice message	System OK	Conductive
	(System or process error) Fault → continuation of operation	Not conductive
Fault message or notice message	System OK	Conductive
	(System or process error) Fault → failsafe mode or Notice → continuation of operation	Not conductive
Limit value ▪ Volume flow ▪ Totalizer	Limit value not overshot or undershot	Conductive
	Limit value overshot or undershot	Not conductive

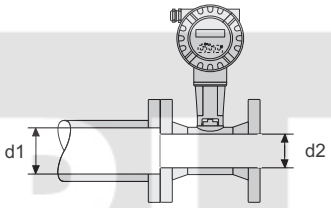
11.2.10 Group COMMUNICATION

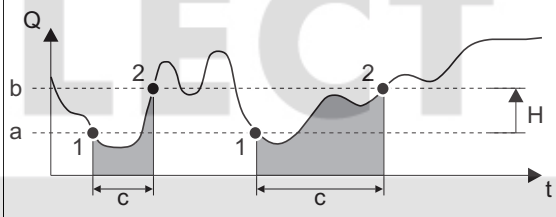
Function description COMMUNICATION	
TAG NAME	Use this function to enter a tag name for the measuring device. You can edit and read this tag name via the local display or the HART protocol. **User input:** Max. 8-character text, permitted characters are: A-Z, 0-9, +,–, punctuation marks **Factory setting:** "– – – – – – – –" (no text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag name via the local display or the HART protocol **User input:** Max. 16-character text, permitted characters are: A-Z, 0-9, +,–, punctuation marks **Factory setting:** "– – – – – – – – – – – – – – – –" (no text)
BUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. **User input:** 0...15 **Factory setting:** 0 ✎ Note! A constant 4 mA current is applied with addresses 1...15.
WRITE PROTECTION	Use this function to check whether the measuring device can be write-accessed. **Display:** OFF (execution status) = Data exchange possible ON = Data exchange disabled ✎ Note! Write protection is activated and deactivated by means of a DIP switch on the amplifier board (see Page 38).
BURST MODE	Use this function to activate cyclic data exchange of the process variables flow and sum to achieve faster communication. **Options:** OFF ON **Factory setting:** OFF
MANUFACTURER ID	The manufacturer number in decimal numerical format appears on the display. **Display:** 17 = (11 hex) for Endress+Hauser
DEVICE ID	The instrument number in hexadecimal numerical format appears on the display. **Display:** 56 = (86 dec) for Prowirl 72

11.2.11 Group PROCESS PARAMETER

Function description PROCESS PARAMETER	
APPLICATION	Use this function to specify the state of aggregation of the fluid. **Options:** GAS/STEAM LIQUID **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! ■ If the selection in this function is changed, the values in the following functions have to be adapt: – VALUE 20 mA, see Page 84 – PULSE WIDTH, see Page 86 – 100% VALUE (line 1), see Page 80 – 100% VALUE (line 2), see Page 80 ■ If the selection is changed in this function, you are asked whether the totalizer should be reset to 0. We recommend you confirm this message and reset the totalizer.
OPERATING DENSITY	✎ Note! This function is not available unless the CALCULATED MASS FLOW or CORRECTED VOLUME FLOW option was selected in the MEASURING UNIT TYPE function. Use this function to enter a fixed value for the density at process conditions. This value is used to calculate the calculated mass flow and corrected volume flow (see MEASURING UNIT TYPE function on Page 73). **User input:** 5-digit floating-point number **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! ■ The appropriate unit is taken from the UNIT DENSITY function (see Page 74). ■ If the selection is changed in this function, you are asked whether the totalizer should be reset to 0. We recommend you confirm this message and reset the totalizer.

Function description PROCESS PARAMETER	
REFERENCE DENSITY	✎ Note! This function is not available unless the CORRECTED VOLUME FLOW option was selected in the MEASURING UNIT TYPE function. Use this function to enter a fixed value for the density at reference/standard conditions. This value is used to calculate the corrected volume flow (see MEASURING UNIT TYPE function on Page 73). **User input:** 5-digit floating-point number **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! ▪ The appropriate unit is taken from the UNIT DENSITY function (see Page 74). ▪ If the selection is changed in this function, you are asked whether the totalizer should be reset to 0. We recommend you confirm this message and reset the totalizer.
OPERATING TEMPERATURE	Use this function to specify a fixed value for the process 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. ▪ If the process temperature is subject to severe changes, we recommend you use a flow computer (e.g. RMC 621 or RMS 621). These flow computers can compensate the effect on the K-factor by means of temperature compensation. If a flow computer is used, the value of the factory setting (20°C, 293.16 K, 68 °F, 527.67 R) must be specified in this function. **User input:** 5-digit floating-point number **Factory setting:** 20°C / 293.16 K / 68 °F / 527.67 R ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 75). ☝ 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 (see Page 63).

Function description PROCESS PARAMETER	
MATING PIPE DIAMETER	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. 28). If the inner diameter of the mating pipe (d1) and the inner diameter of the flowmeter (d2) are different, this results in a distorted flow profile. A mismatch of the inner pipe diameter can be present, if the mating pipework is different from the flowmeter in: ■ pressure rate. ■ Schedule (ANSI pipes, e.g. Sched. 80 instead of 40). ■ material (DIN pipes). In order to correct the resulting shift of the instrument's calibration factor, enter the actual inner diameter of the mating pipework (d1) in this function.  A0001982 *Fig. 28: Mating pipe (d1)* *d1 > d2* *d1 = diameter mating pipework* *d2 = diameter flowmeter* **User input:** 5-digit floating-point number **Factory setting:** 0 ✎ Note! ■ The inlet correction is switched off if 0 is entered in the function. ■ The appropriate unit is taken from the UNIT LENGTH function (→ Page 76). ■ Mismatches between diameters can only be corrected within the same nominal diameter class (e.g. DN 50 / 2"). ■ If the standard inner diameter of the process connection ordered for the device and the inner diameter of the pipe line are different, then an additional uncertainty of typically 0.1% of measurement per 1 mm difference of diameter has to be allowed for.

Function description PROCESS PARAMETER	
ON-VALUE LOW FLOW CUT OFF	Use this function to enter the on-value for low flow cut off. Low flow cut off is on if the value entered is not equal to 0. As soon as the low flow cut off is active, an inverted plus sign is shown on the display. **User input:** 5-digit floating-point number **Factory setting:** Below the standard measuring range ✎ Note! ■ The appropriate unit is taken from the UNIT FLOW function (see Page 74). ■ The on-value can be set at a value corresponding to a Reynolds number of Re = 20,000. This has the effect that measurements in the non-linear range are not evaluated. The Reynolds number and the flow (at Reynolds number = 20,000) 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.
OFF-VALUE LOW FLOW CUT OFF	Use this function to enter the off-value for low flow cut off. Enter the off-value as a positive hysteresis from the on-value. **User input:** Integer 0...100% **Factory setting:** 50% Example:  A0001245 *Q = Flow [volume/time]* *t = Time* *a = ON-VALUE LOW FLOW CUT OFF = 20 m³/h* *b = OFF-VALUE LOW FLOW CUT OFF = 10%* *c = Low flow cut off active* *1 = Low flow cut off is switched on at 20 m³/h* *2 = Low flow cut off is switched off at 22 m³/h* *H = Hysteresis*

11.2.12 Group SYSTEM PARAMETER

Function description SYSTEM PARAMETER	
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a pipe is being cleaned, for example. The setting acts on all functions and outputs of the measuring device. If positive zero return is active, the notice message #601 "POS. ZERO- RET." is displayed. **Options:** OFF ON (signal output is set to the value for zero flow). **Factory setting:** OFF
FLOW DAMPING	Use this function to set the filter depth of the digital filter. This reduces the sensitivity of the measuring signal to interference peaks (e.g. 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...100 s **Factory setting:** 1 s ✎ Note! The flow damping acts on the following functions and outputs of the measuring device: → Function DISPLAY DAMPING → Display Function AMPLIFICATION → Function FLOW DAMPING → Function TIME CONSTANT → Current output → Function TIME CONSTANT → Status output

11.2.13 Group SENSOR DATA

Function description SENSOR DATA	
All sensor data such as the calibration factor, nominal diameter etc. are set at the factory. ☝ Caution! Under normal circumstances these settings may not be changed because changes affect numerous functions of the entire measuring system, and the accuracy of the measuring system in particular. Please contact your Endress+Hauser service organization if you have any questions on these functions.	
K-FACTOR	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.".
K-FACTOR COMPENSATED	The current compensated calibration factor of the sensor appears on the display. The following are compensated: ■ The temperature-dependent expansion of the sensor (see Page 96). ■ Diameter jumps in the inlet of the device (see Page 97). **Display:** e.g. 102 P/l (pulse per liter)
NOMINAL DIAMETER	The nominal diameter of the sensor appears on the display. **Display:** e.g. DN 25
METER BODY TYPE MB	The type of meter body (MB) of the sensor appears on the display (→ Page 108). **Display:** e.g. 71 ✎ Note! ■ Use this function to specify the nominal diameter and the sensor type. ■ The Meter Body Type MB is also given on the parameter printout and the type plate.
TEMPERATURE COEFFICIENT	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:** $4.8800*10^{-5}$ / K (stainless steel) $2.6000*10^{-5}$ / K (Alloy C-22)

Function description SENSOR DATA	
AMPLIFICATION	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...5 (1 = smallest amplification, 5 = largest amplification) **Factory setting:** 3

11.2.14 Group SUPERVISION

Function description SUPERVISION	
ACTUAL SYSTEM CONDITION	The current system status appears on the display. **Display:** "SYSTEM OK" or the fault/notice message with the highest priority.
PREVIOUS SYSTEM CONDITIONS	The last 16 fault and notice messages appear on the display.
ASSIGN SYSTEM ERROR	All system errors appear on the display. If you select a single system error you can change its error category. **Display:** List of system errors ✎ Note! ▪ Each individual message can be selected using the ⊞ and ⊟ key. ▪ If the ℡ key is pressed twice, the ERROR CATEGORY function is called up. ▪ Use the ⊞ ⊟ key combination or select "CANCEL" (in the system error list) to exit the function.
ERROR CATEGORY	Use this function to define whether a system error triggers a notice message or a fault message. If you select "FAULT MESSAGES", all outputs respond to an error in accordance with their defined failsafe mode. **Options:** NOTICE MESSAGES (display only) FAULT MESSAGES (outputs and display) ✎ Note! ▪ If the ℡ key is pressed twice, the ASSIGN SYSTEM ERROR function is called up. ▪ Use the ⊞ ⊟ key combination to exit the function.
ALARM DELAY	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. Depending on the setting and the type of error, this suppression acts on the display, the current output and the pulse/status output. **User input:** 0...100 s (in steps of one second) **Factory setting:** 0 s ☝ Caution! If this function is used, fault and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-level controller (PCS, etc.). 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 RESET	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

Function description SUPERVISION	
OPERATION HOURS (in preparation)	The hours of operation of the device appear on the display. **Display:** Depends on the number of hours of operation elapsed: Hours of operation < 10 hours → display format = 0:00:00 (hr:min:sec) Hours of operation 10...10,000 hours → display format = 0000:00 (hr:min) Hours of operation < 10,000 hours → display format = 000000 (hr)

11.2.15 Group SIMULATION SYSTEM

Function description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all inputs, outputs and the totalizer to their error-response modes, in order to check whether they respond correctly. During this time, the message #691 "SIMULATION FAILSAFE" appears on the display. **Options:** OFF ON **Factory setting:** OFF
SIMULATION MEASURAND	Use this function to set all inputs, outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the message "#692 SIMULATION MEASURAND" appears on the display. **Options:** OFF FLOW **Factory setting:** OFF Caution! ■ The measuring device can only be used for measuring to a certain extent while the simulation is in progress. ■ The setting is not saved if the power supply fails.
VALUE SIMULATION MEASURAND	Note! This function is not available unless the SIMULATION MEASURAND function is active. Use this function to specify a selectable value (e.g. 12 dm^3/s). This value is used to test downstream devices and the measuring device itself. **User input:** 5-digit floating-point number **Factory setting:** 0 Note! The appropriate unit is taken from the UNIT FLOW function (see Page 74). Caution! The setting is not saved if the power supply fails.

11.2.16 Group SENSOR VERSION

Function description SENSOR VERSION	
SERIAL NUMBER	The serial number of the sensor appears on the display.
SENSOR TYPE	The sensor type (e.g. Prowirl F) appears on the display.
SERIAL NUMBER DSC SENSOR	The serial number of the DSC sensor appears on the display.

11.2.17 Group AMPLIFIER VERSION

Function description AMPLIFIER VERSION	
HARDWARE REVISION NUMBER AMPLIFIER	The hardware revision number of the amplifier appears on the display.
SOFTWARE REVISION NUMBER AMPLIFIER	The software revision number of the amplifier appears on the display.
HARDWARE REVISION NUMBER I/O MODULE	The hardware revision number of the I/O module appears on the display.

12 Factory settings

12.1 Metric system units (not for USA and Canada)

Length, temperature units (see Page 75 ff.)

	Unit
Length	mm
Temperature	°C

Language (see Page 78)

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	Ceski
Luxembourg	Francais	Hungary	English
Malaysia	English	Other countries	English

100% value line 1 and line 2 (see Page 80)

The factory settings in the table are given in the unit dm³/s. If another unit is selected in the UNIT FLOW function (see Page 74), 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	–	–

Totalizer unit (see Page 82)

Flow	Unit
Volume flow	m³
Calculated mass flow	kg
Corrected volume flow	Nm³

Switch-on point and switch-off point, Prowirl W (see Page 90)
The factory settings in the table are given in the unit dm³/s. If another unit is selected in the UNIT FLOW function (see Page 74), the corresponding value is converted and displayed in the selected unit.

Nominal diameter DN		Gas		Liquid	
DIN [mm]	ANSI [inch]	Switch-on point [dm³/s]	Switch-off point [dm³/s]	Switch-on point [dm³/s]	Switch-off point [dm³/s]
15	½"	13	10	2.1	1.7
25	1"	49	40	5.9	4.8
40	1½"	110	94	14	11
50	2"	190	150	22	18
80	3"	420	340	50	41
100	4"	710	580	85	70
150	6"	1600	1300	190	160
200	8"	–	–	–	–
250	10"	–	–	–	–
300	12"	–	–	–	–

Switch-on point and switch-off point, Prowirl F (see Page 90)
The factory settings in the table are given in the unit dm³/s. If another unit is selected in the UNIT FLOW function (see Page 74), the corresponding value is converted and displayed in the selected unit.

Nominal diameter DN		Gas		Liquid	
DIN [mm]	ANSI [inch]	Switch-on point [dm³/s]	Switch-off point [dm³/s]	Switch-on point [dm³/s]	Switch-off point [dm³/s]
15	½"	7.7	6.3	1.5	1.2
25	1"	38	31	4.6	3.8
40	1½"	94	77	11	9.2
50	2"	160	130	19	15
80	3"	350	290	42	35
100	4"	610	500	73	60
150	6"	1400	1100	170	140
200	8"	2700	2200	320	260
250	10"	4200	3400	500	410
300	12"	6000	4900	720	590

12.2 US units (only for USA and Canada)

Length, temperature units (see Page 75 ff.)

	Unit
Length	Inch
Temperature	°F

Language (see Page 78)

Country	Language
USA	English
Canada	English

100% value line 1 and line 2 (see Page 80)

The factory settings in the table are given in the unit US gal/min (GPM). If another unit is selected in the UNIT FLOW function (see Page 74), 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	10,000	1300
150	6"	20,000	2500	25,000	2500
200	8"	38,000	5100	–	–
250	10"	63,000	7600	–	–
300	12"	89,000	10,000	–	–

Totalizer unit (see Page 82)

Flow	Unit
Volume flow	US gal
Calculated mass flow	lb
Corrected volume flow	Sm^3

Switch-on point and switch-off point, Prowirl W (see Page 90)

The factory settings in the table are given in the unit US gallons/min. If another unit is selected in the UNIT FLOW function (see Page 74), the corresponding value is converted and displayed in the selected unit.

Nominal diameter DN		Gas		Liquid	
DIN [mm]	ANSI [inch]	Switch-on point [US gal/s]	Switch-off point [US gal/s]	Switch-on point [US gal/s]	Switch-off point [US gal/s]
15	½"	200	160	34	27
25	1"	780	640	94	77
40	1½"	1800	1500	220	180
50	2"	2900	2400	350	290
80	3"	6600	5400	790	650
100	4"	11000	9200	1400	1100
150	6"	25000	21000	3000	2500
200	8"	–	–	–	–
250	10"	–	–	–	–
300	12"	–	–	–	–

Switch-on point and switch-off point, Prowirl F (see Page 90)
The factory settings in the table are given in the unit US gallons/min. If another unit is selected in the UNIT FLOW function (see Page 74), the corresponding value is converted and displayed in the selected unit.

Nominal diameter DN		Gas		Liquid	
DIN [mm]	ANSI [inch]	Switch-on point [US gal/s]	Switch-off point [US gal/s]	Switch-on point [US gal/s]	Switch-off point [US gal/s]
15	½"	120	100	24	19
25	1"	610	500	73	60
40	1½"	1500	1200	180	150
50	2"	2500	2000	300	240
80	3"	5600	4600	6700	550
100	4"	9700	7900	1200	950
150	6"	22000	18000	2600	2200
200	8"	42000	35000	5100	4100
250	10"	67000	54000	8000	6500
300	12"	95000	78000	11000	9400

12.3 Meter body type MB (meter body)

Sensor type	Pressure rating	Standard	½" DN15	1" DN25	1½" DN40	2" DN50	3" DN80	4" DN100	6" DN150	8" DN200	10" DN250	12" DN300
F	10K	JIS40	–	–	–	376	396	416	436	156	176	196
		JIS80	–	–	–	377	397	417	437	–	–	–
	20K	JIS40	318	338	358	378	398	418	438	158	178	198
		JIS80	319	339	359	379	399	419	439	–	–	–
	Cl 150	ANSI40	310	330	350	370	390	410	430	150	170	190
		ANSI80	311	331	351	371	391	411	431	–	–	–
	Cl 300	ANSI40	312	332	352	372	392	412	432	152	172	192
		ANSI80	313	333	353	373	393	413	433	–	–	–
	Cl 600	ANSI80	14	34	54	74	94	114	134	–	–	–
	Cl 900	ANSI80	15	35	55	75	95	115	135	–	–	–
	Cl 1500	ANSI80	442	446	450	454	458	462	466	–	–	–
		Butt-weld version	443	447	451	455	459	463	467	–	–	–
	PN 10	DIN	–	–	–	–	–	–	–	141	161	181
	PN 16 (N)	DIN	–	–	–	–	–	403	423	143	163	183
	PN 25	DIN	–	–	–	–	–	–	–	144	164	184
	PN 40 (N)	DIN	306	326	346	366	386	406	426	146	166	186
	PN 63	DIN	–	–	–	67	87	107	127	–	–	–
	PN 100	DIN		28	48	68	88	108	128	–	–	–
	PN 160	DIN	9	29	49	69	89	109	129	–	–	–
	PN 250	DIN	440	444	448	452	456	460	464	–	–	–
		Butt-weld version	441	445	449	453	457	461	465	–	–	–
W	10K	JIS40	–	–	–	231	239	247	255	–	–	–
	20K	JIS40	208	216	224	232	240	248	256	–	–	–
	Cl 150	ANSI40	205	213	221	229	237	245	253	–	–	–
	Cl 300	ANSI40	206	214	222	230	238	246	254	–	–	–
	PN 10	DIN	–	–	–	–	–	241	249	–	–	–
	PN 16	DIN	–	–	–	–	–	242	250	–	–	–
	PN 25	DIN	203	211	219	227	235	243	251	–	–	–
	PN 40	DIN	204	212	220	228	236	244	252	–	–	–

Index of key words

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Declaration of Contamination
Erklärung zur Kontamination

Endress+Hauser
People for Process Automation

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or – even better – 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", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

Process data/ *Prozessdaten* Temperature / *Temperatur* _____ [°C] Pressure / *Druck* _____ [Pa]

Conductivity / *Leitfähigkeit* _____ [S] Viscosity / *Viskosität* _____ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium

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

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

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

Reason for return / *Grund zur Rücksendung* _____

Company data / *Angaben zum Absender*

Company / *Firma* _____
_____
Address / *Adresse*
_____
_____

Contact person / *Ansprechpartner* _____
Department / *Abteilung* _____
Phone number/ *Telefon* _____
Fax / E-Mail _____
Your order No. / *Ihre Auftragsnr.* _____

We hereby certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free from any residues in dangerous quantities.
Hiermit bestätigen wir, dass die zurückgesandten Teile sorgfältig gereinigt wurden, und nach unserem Wissen frei von Rückständen in gefahrbringender Menge sind.

_____ _____
(place, date / *Ort, Datum*) (Company stamp and legally binding signature)
(Firmenstempel und rechtsverbindliche Unterschrift)

www.endress.com/worldwide

Endress+Hauser

People for Process Automation

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FM+SGML 6.0