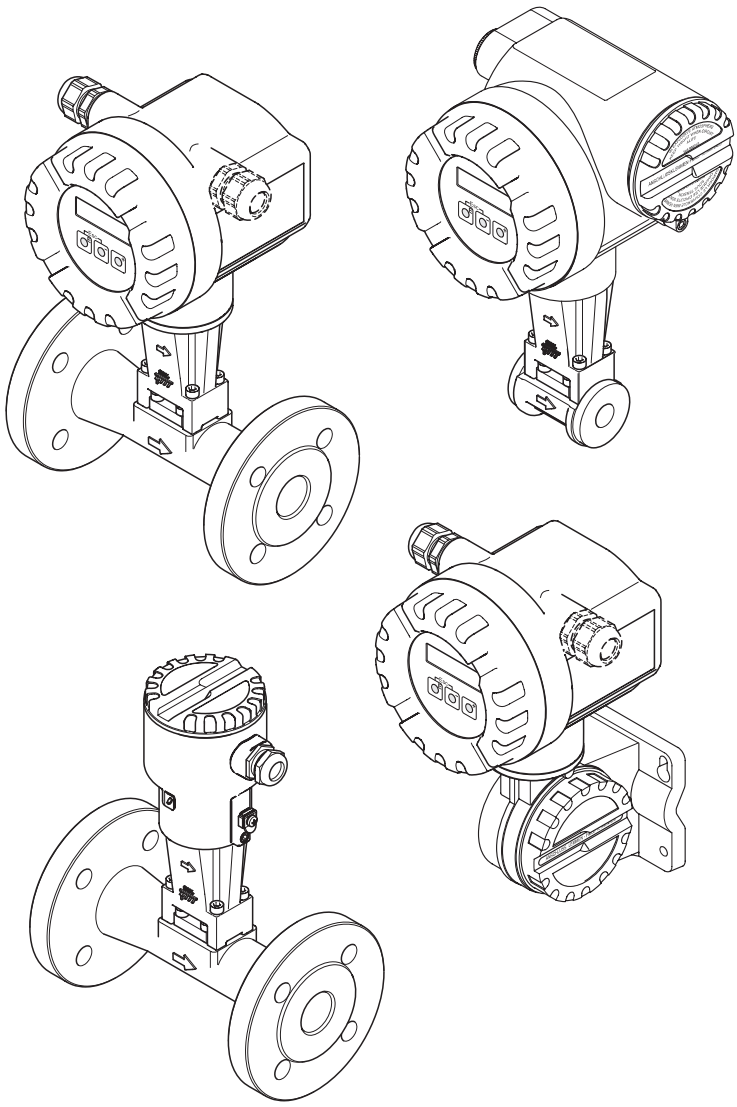
BA094D/06/en/12.03
50106435

Valid as of software version:
V 1.00.00 (amplifier)

PROline Prowirl 73
Vortex Flow Measuring System
4...20 mA HART

Operating Instructions



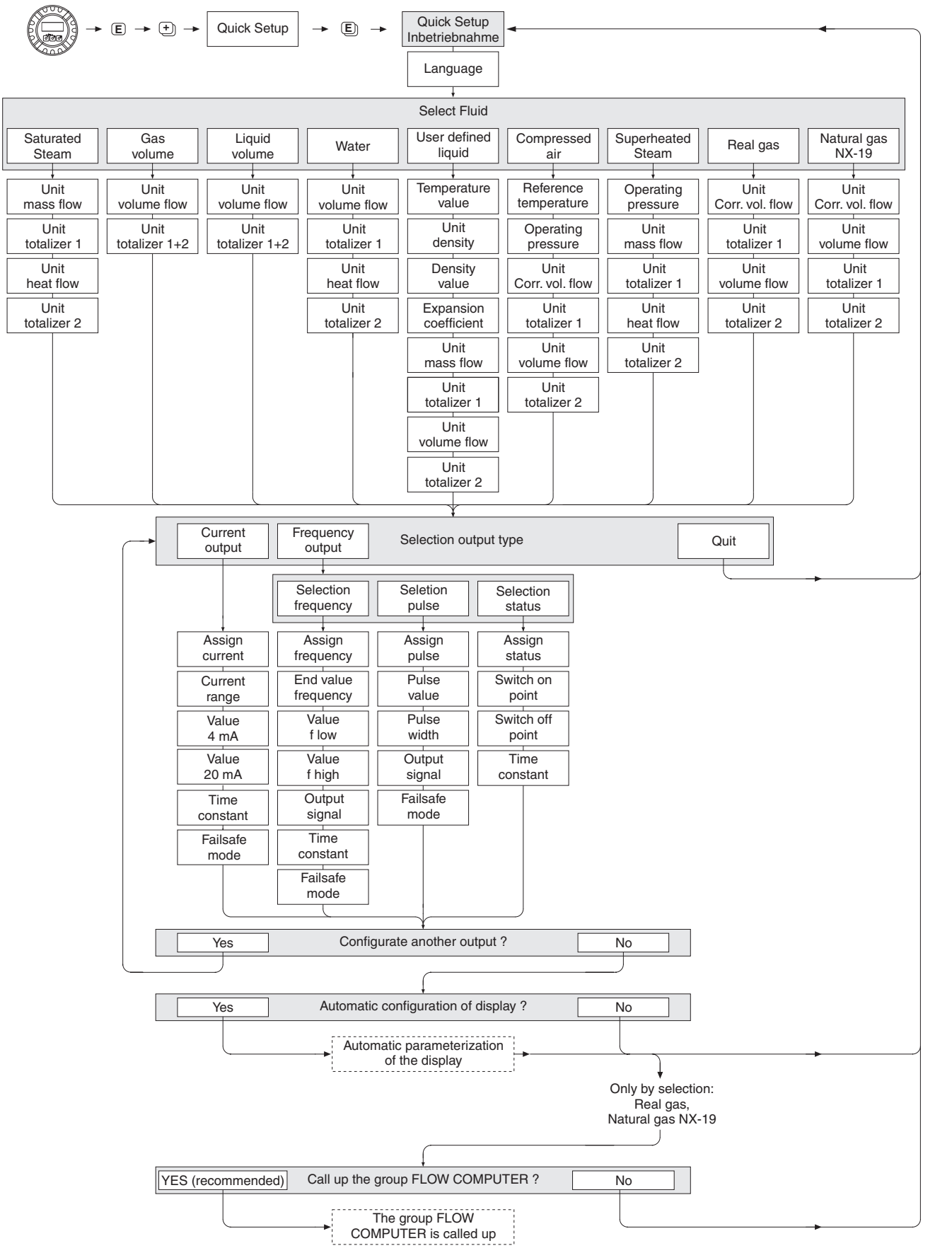
Endress+Hauser
The Power of Know How

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 29
▼	
Commissioning with “QUICK SETUP”	Page 43
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 79 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



F06-73xxxxxx-19-xx-xx-en-000

Note!

The QUICK SETUP COMMISSIONING function is described on Page 87.

- The display returns to the QUICK SETUP COMMISSIONING cell if you press the ESC key combination during interrogation.
- ① If the fluid selected is changed, the following parameters are reset to their factory settings:

In group	Parameter
Sytem units	→ all parameters
Display	→ 100% Value Line 1, 100% Value Line 2
Current output	→ all parameters
Frequency output	→ all parameters
Process parameter	→ all parameters
System parameter	→ all parameters

- ② Only the output (current output or frequency output) not yet configured in the current Quick Setup is offered for selection after the first cycle.
- ③ 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.
- ④ When “YES” is selected, the volume flow is assigned to line 1 of the local display and the temperature to line 2.
- ⑤ The SELECT FLUID function is called up. Confirm the fluid selected in this function and configure all the subsequent functions of the FLOW COMPUTER group. Configuration is complete if group selection is displayed. You can get back to the Home position by means of the ESC key combination ( ).
- Totalizer assignment depends on the fluid selected:

Selected fluid:	Totalizer 1 assignment:	Totalizer 2 assignment:
Saturated steam	→ Mass flow	→ Heat flow
Superheated steam	→ Mass flow	→ Heat flow
Water	→ Volume flow	→ Heat flow
Customer-spec. liquid	→ Mass flow	→ Volume flow
Compressed air	→ Corrected volume flow	→ Volume flow
Natural Gas NX-19	→ Corrected volume flow	→ Volume flow
Gas volume	→ Volume flow	→ Volume flow
Liquid volume	→ Volume flow	→ Volume flow

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1 Safety instructions

1. 1 Designated use

The measuring system is used to measure the flow of saturated steam, superheated steam, gases and liquids. The measured variables volume flow and temperature are measured primarily. From these values, the device can used stored data on the density and enthalpy to calculate and output the mass flow and heat flow for example.

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 authorised 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 authorised 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 centre (Ⓔx Europe, Ⓕ USA, Ⓒ 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 73” flowmeter system consists of the following components:
- Transmitter PROline Prowirl 73
- Prowirl F or Prowirl W sensor

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

2.1.1 Nameplate of the transmitter

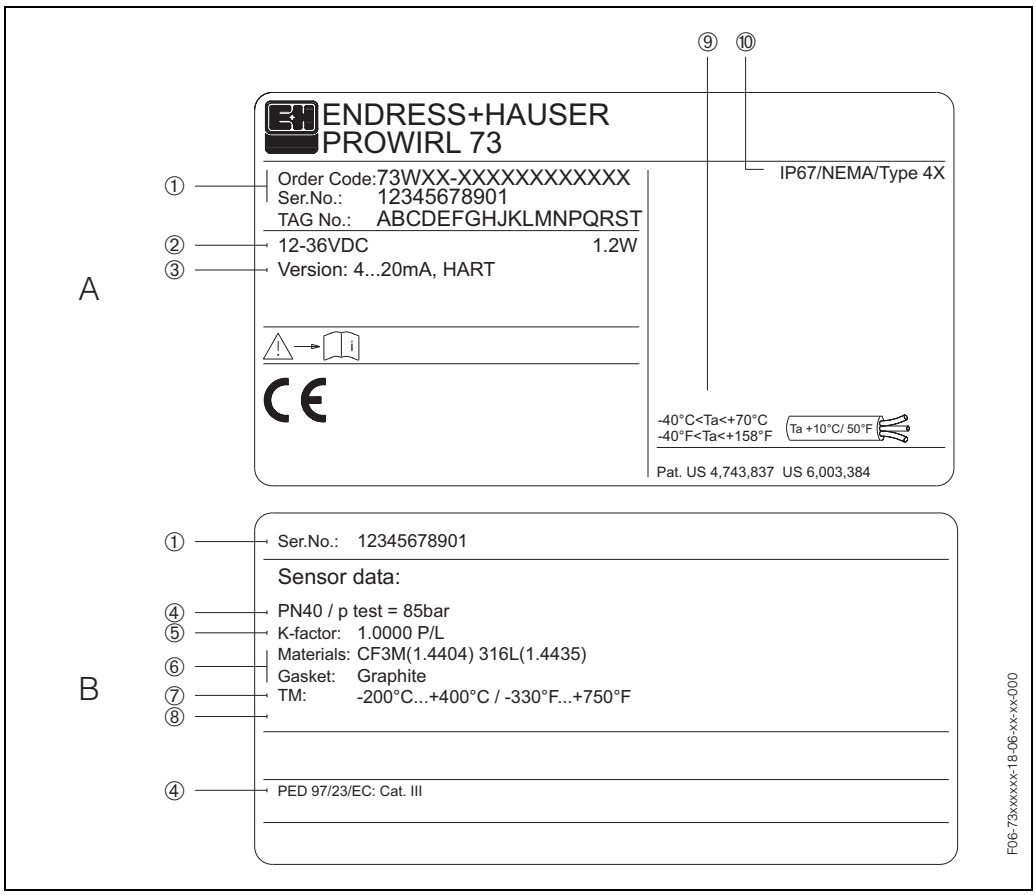


Fig. 1: Nameplate specifications for transmitter and sensor (example)
A = Nameplate on transmitter, B = Nameplate on transmitter (only compact version)

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

2.1.2 Nameplate of the sensor, remote version

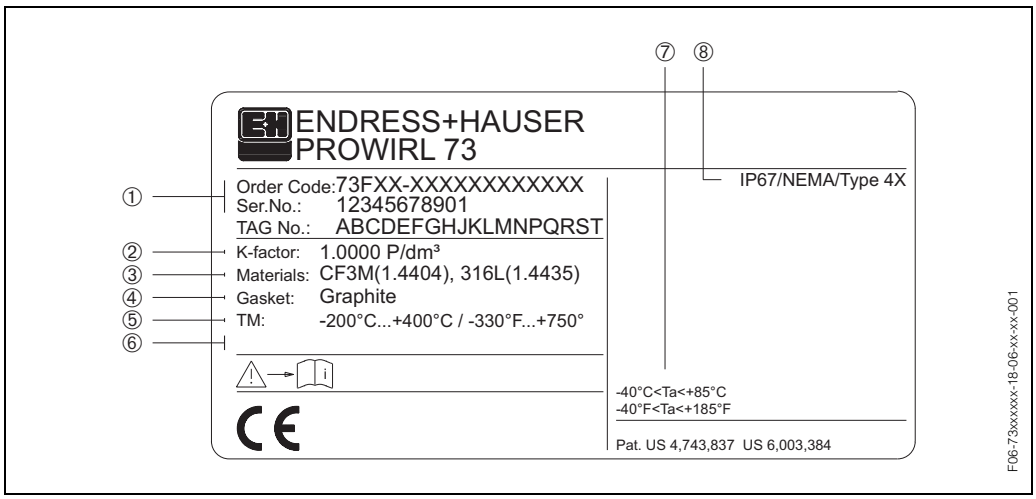


Fig. 2: Nameplate specifications for "PROline Prowirl 73" transmitter, remote version (example)

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

2. 2 CE mark, declaration of conformity

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.

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 trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA
- FieldCheck™, Applicator™, ToF Tool-FieldTool Package
  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 centre 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.

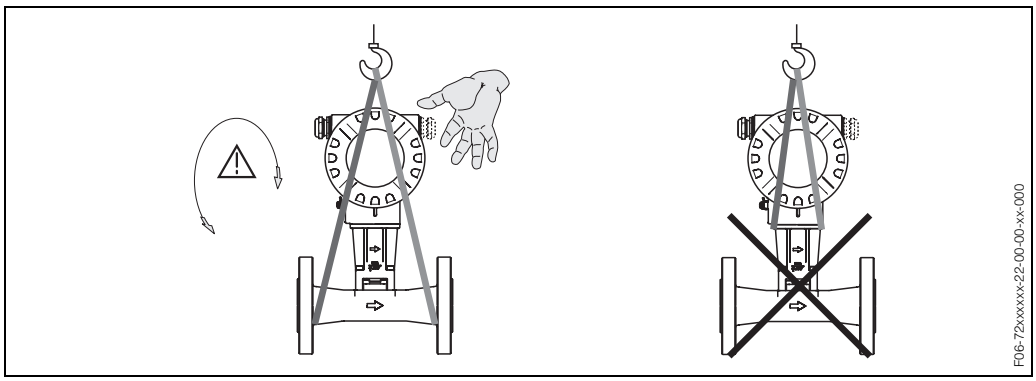


Fig. 3: Instructions for transporting sensors with DN 40...300

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 15).
- The maximum permitted ambient temperatures (see Page 69) and fluid temperatures (see Page 69) must be observed.
- Pay particular attention to the notes on orientation and piping insulation (see Page 13 ff.).
- 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 D MATING PIPE function on Page 115).
- 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 (see Page 73 ff.).

3.2.1 Dimensions

The dimensions and the lengths of the sensor and the transmitter are on Page 72 ff.

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

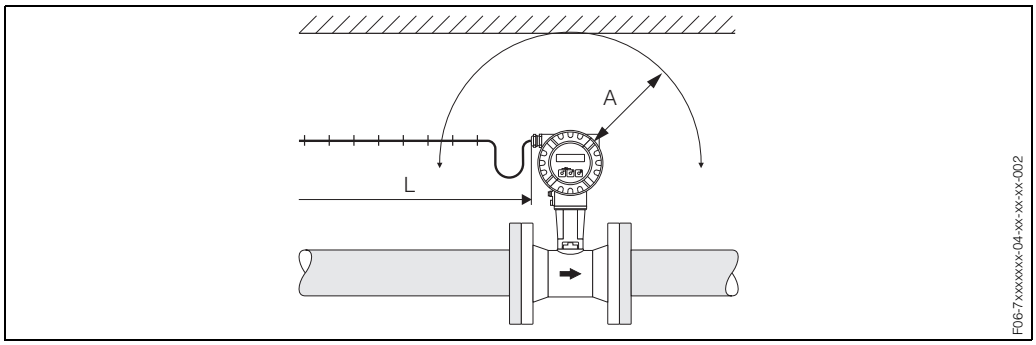


Fig. 4: A = Minimum spacing in all directions, L = cable length

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 73 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.

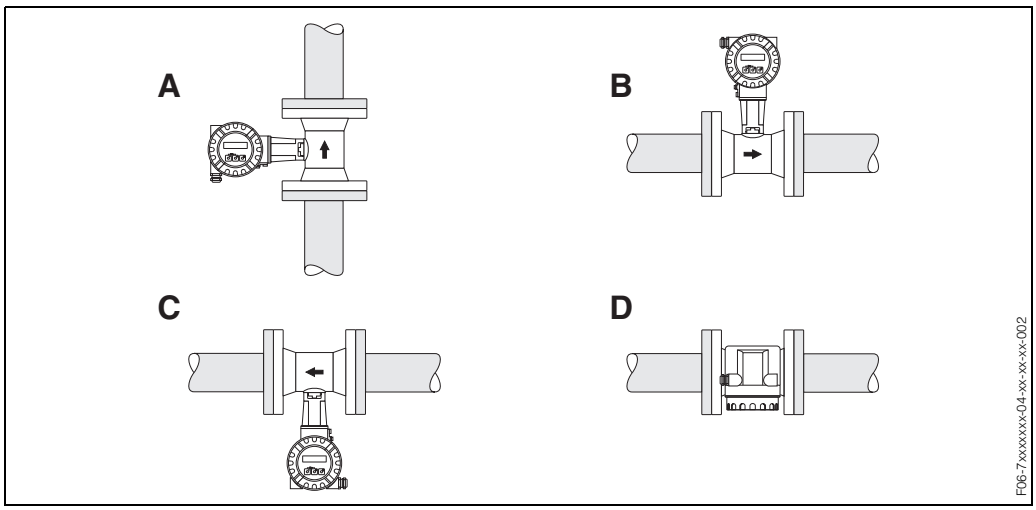


Fig. 5: Possible orientations of the device

3.2.4 Heat insulation

Some fluids require suitable measures to avoid heat transfer at the sensor to ensure optimum temperature measurement and mass calculation. 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.

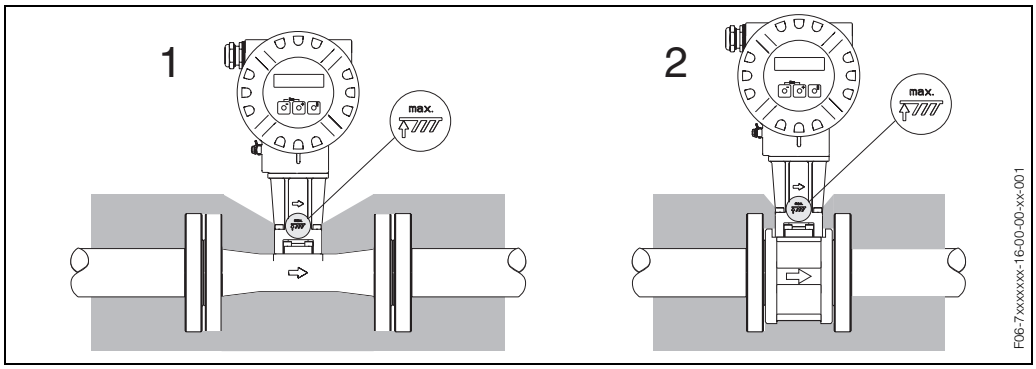


Fig. 6: 1 = Flanged version, 2 = Wafer version

Caution!
Danger of electronics overheating!

- Therefore, make sure that the adapter between sensor and transmitter and the connection housing of the remote version are always exposed.
- Note that a certain orientation might be required, depending on the fluid temperature → Page 13.
- Information on permissible temperature ranges → Page 69.

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.

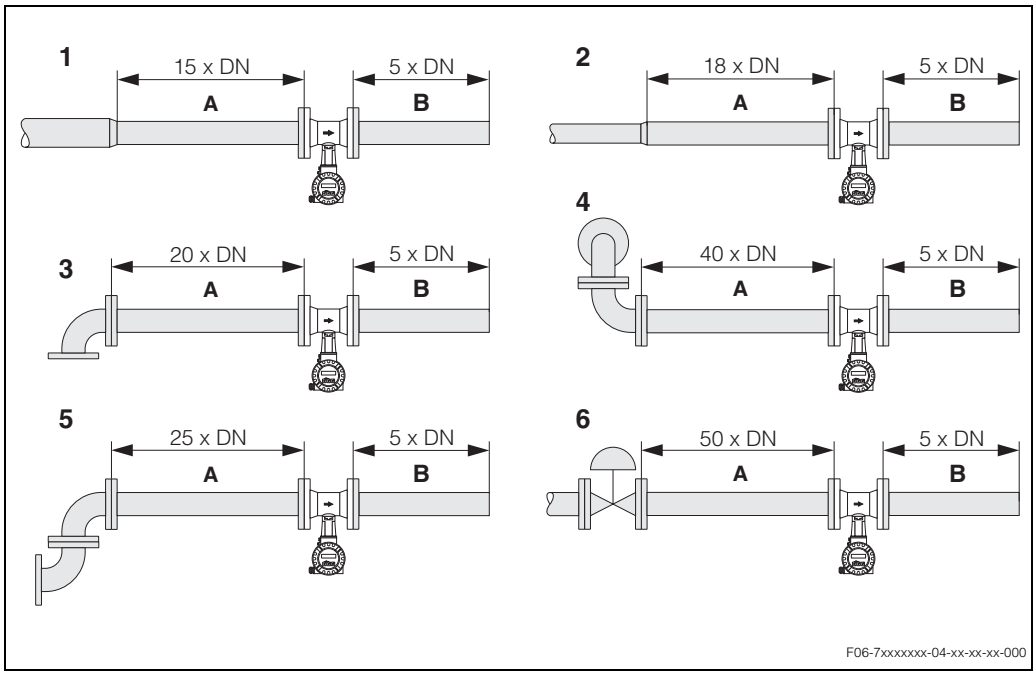


Fig. 7: Minimum inlet and outlet runs with various flow obstructions

A = Inlet run
B = Outlet run
1 = Reduction
2 = Extension
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 16).

Outlet runs with pressure measuring points

If a pressure measuring point is 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.

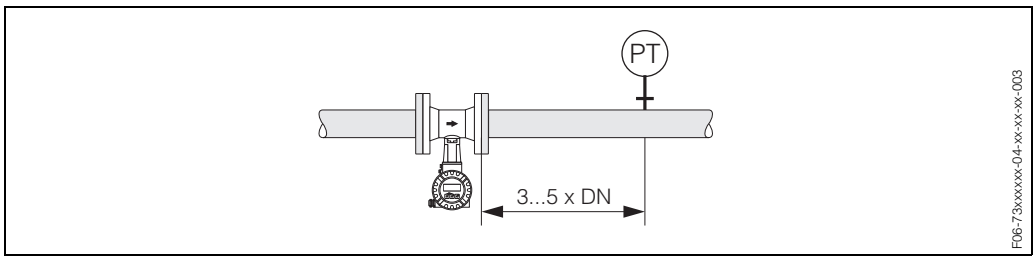


Fig. 8: Installing a pressure measuring point (PT)

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 the mounting bolts. Generally, this reduces the inlet run required to 10 x DN with complete accuracy.

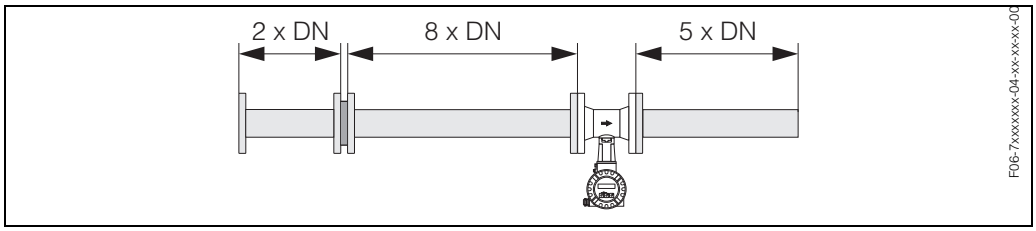


Fig. 9: Perforated plate flow conditioner

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 65 and 70.

3. 3 Installation instructions

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 have a slightly larger internal diameter than the measuring pipe.
- Ensure that the arrow on the measuring pipe matches the flow direction (direction of medium flow through the piping).
- Lengths:
  – Prowirl W (wafer version): 65 mm
  – Prowirl F (flanged version) → Page 73 ff.

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.

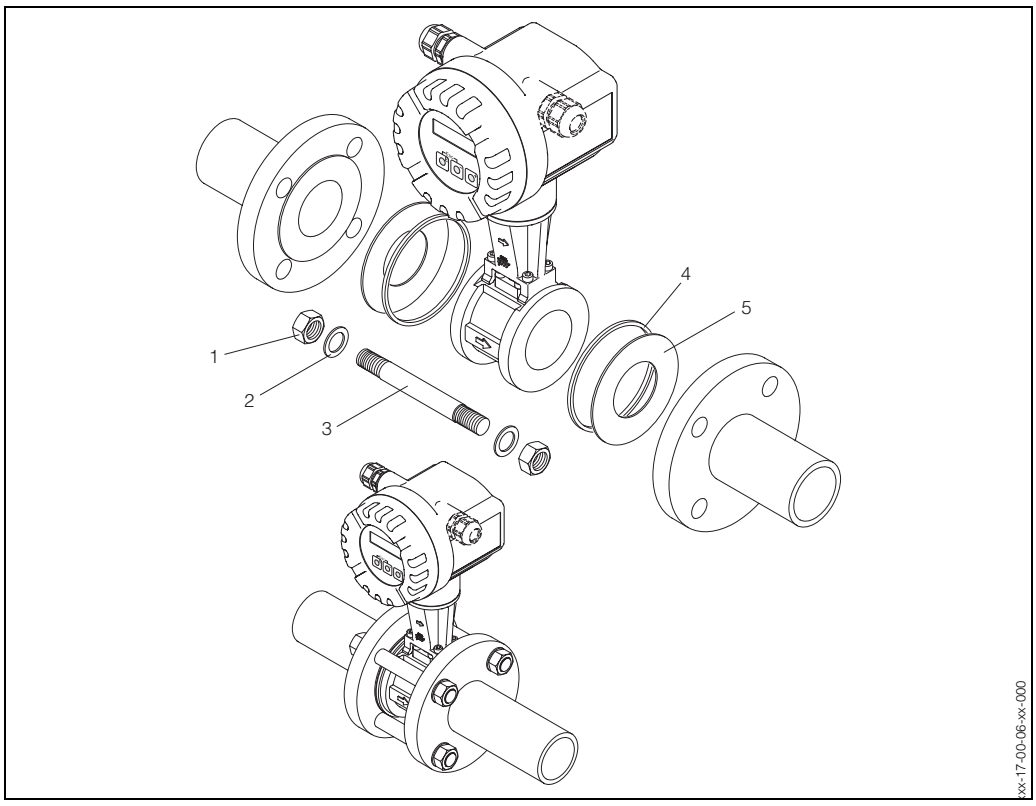


Fig. 10: Mounting the wafer version

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 (compact version only).
   These help you align the transmitter more easily.

3. Tighten the safety screw.

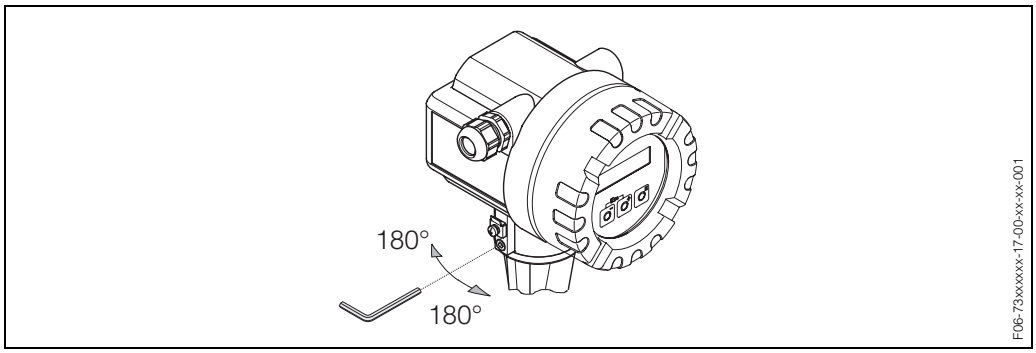


Fig. 11: Rotating the transmitter housing

3.3.3 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 47)

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 (EEx-d version: –40...+60°C; ATEX II 1/2 GD-version/dust ignition-proof: –20...+55°C).

Mount the transmitter as illustrated in the diagram.

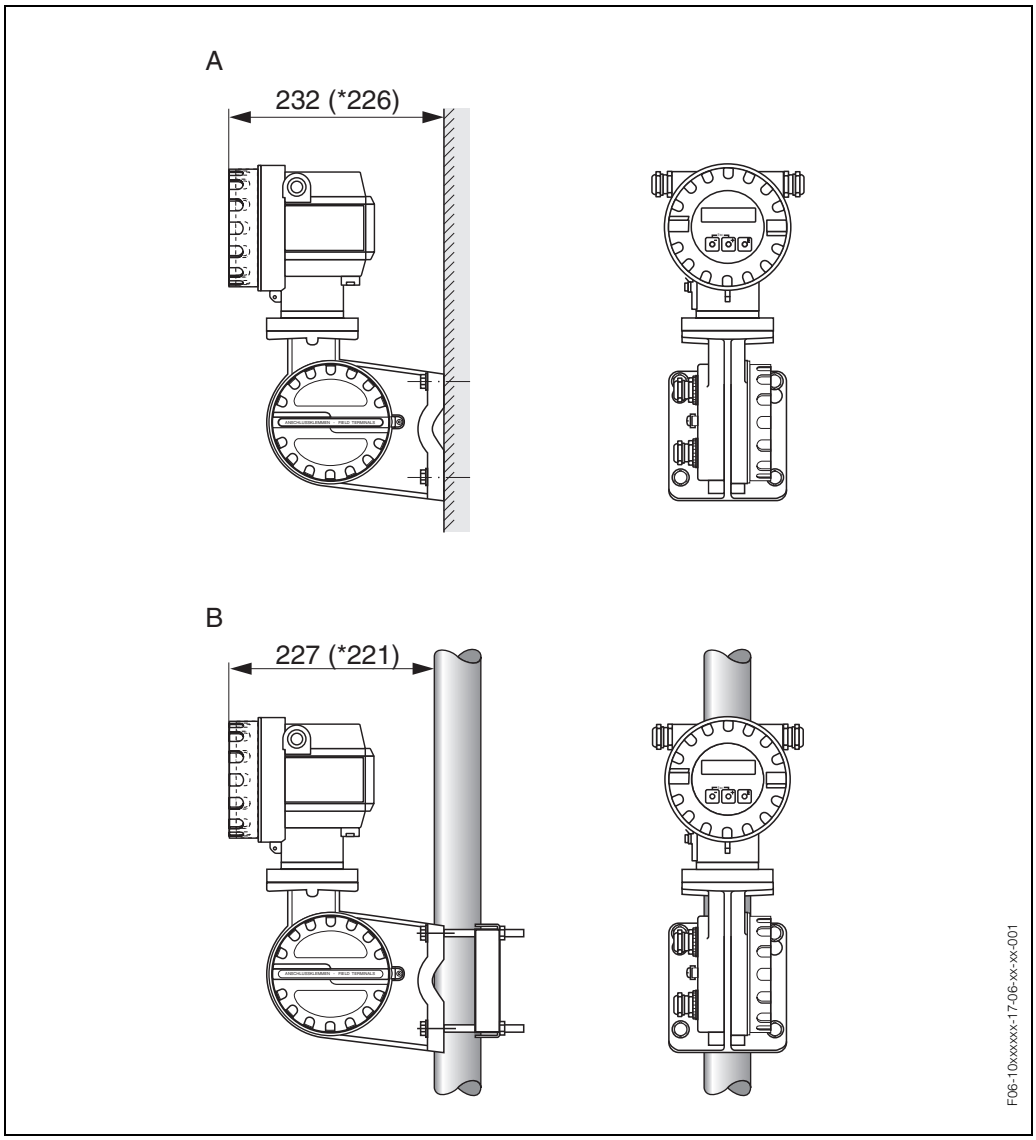


Fig. 12: Mounting the transmitter (remote version)

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

3.3.4 Rotating the local display

1. Unscrew the cover of the electronics compartment from the transmitter housing.
2. Remove the display module from the transmitter retaining 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.

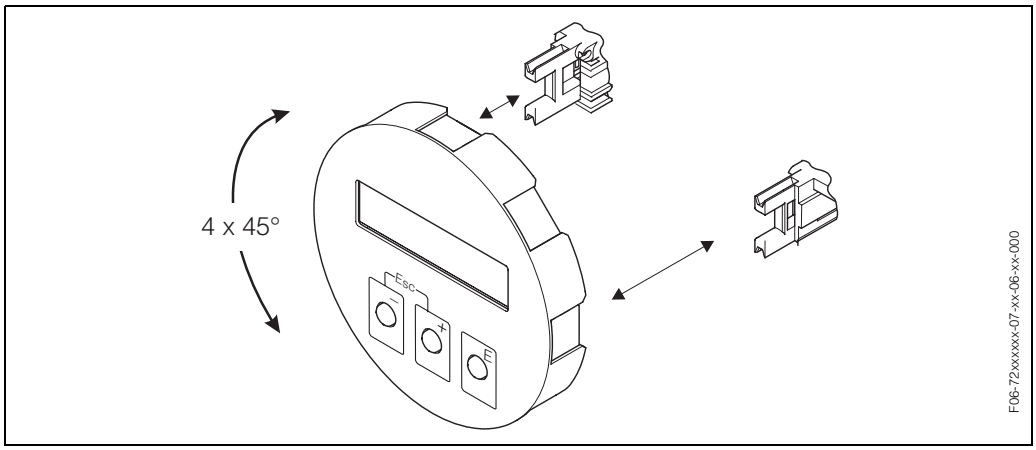


Fig. 13: Rotating the local display

3. 4 Post-installation check

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

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Do the process temperature/pressure, ambient temperature, measuring range etc. correspond to the specifications of the device?	see Page 65 ff.
Installation	Notes
Does the arrow on the sensor resp. pipe stand match the actual direction of flow through the pipe?	–
Are the measuring point number and labelling 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. If this is not observed when connecting the devices, compatibility issues (e.g. the wrong K-factor is used) can arise.

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.

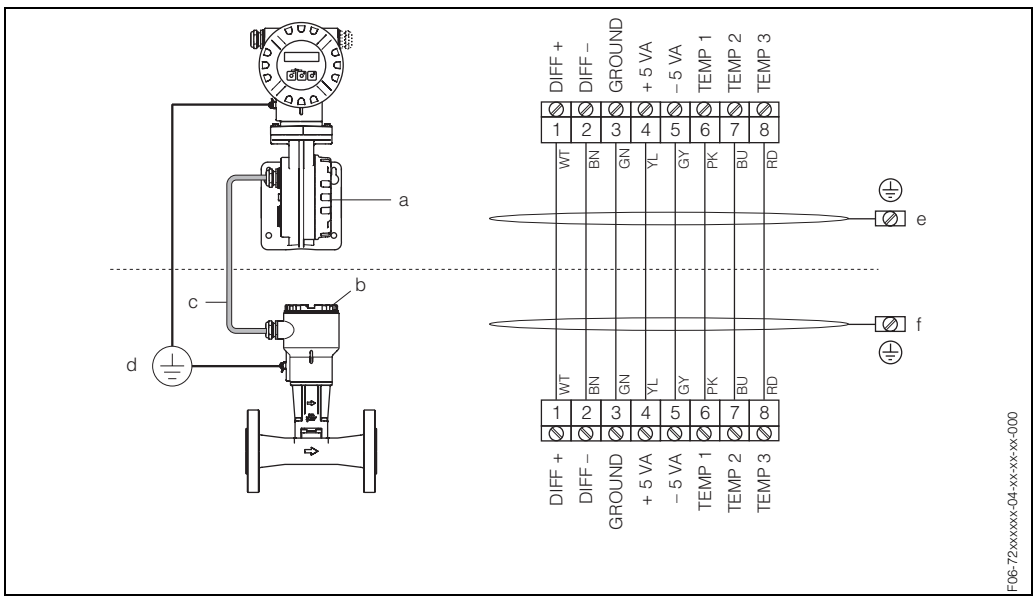


Fig. 14: Connecting the remote version

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 shield to the ground terminal in the transmitter housing and keep as short as possible
f Connect shield to the ground terminal in the connection housing

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 to DIN VDE 0295 Class 5 or IEC 60228 Class 5
- Core/shield capacitance: < 400 pF/m
- Operating temperature: –40...+105 °C

Note!
The cable resistance, as per specification is 39 Ω/km , is compensated. If a cable is used with a cable cross-section deviating from the specification, the value for the cable length must be calculated as follows and entered in the CABLE LENGTH function (see Page 128):

$$\frac{\text{Cable resistance of used cable } [\Omega/km]}{\text{Cable resistance as per specification } [\Omega/km]} \bullet \text{Actual cable length [m]} = \text{cable length to be entered [m]}$$

Example:
- Cable resistance of used cable = 26 Ω/km
- Cable resistance as per specification = 39 Ω/km
- Actual cable length = 15 m

$$\frac{26\ [\Omega/km]}{39\ [\Omega/km]} \bullet 15\ [m] = 10\ m$$

→ In the CABLE LENGTH function (see P. 128), the value 16.5 m (or 54.14 ft, depending on the unit selected in the UNIT LENGTH function) must be entered.

4. 2 Connecting the measuring unit

4.2.1 Connecting the transmitter

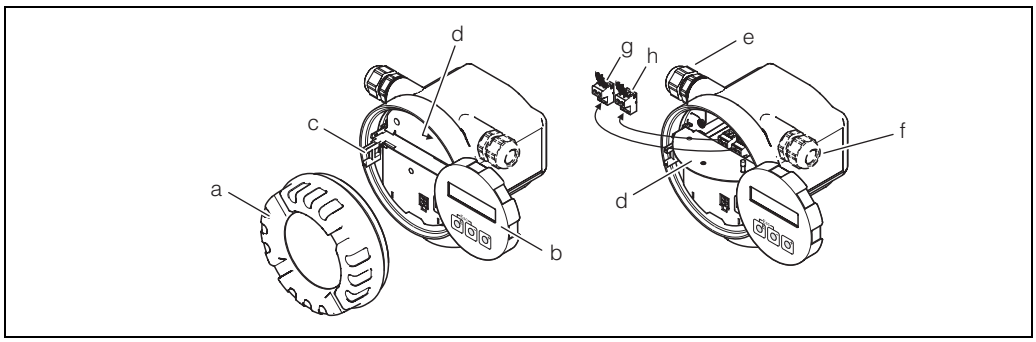
Note!
- When connecting Ex-certified devices, please refer to the notes and diagrams in the Ex-specific supplement to these Operating Instructions.
- The remote version must be grounded. In doing so, the sensor and transmitter must be connected to the same potential matching.
- The national regulations 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...(permitted max. ambient temperature +10 °C).

Procedure for connecting the transmitter, Non-Ex/ Ex-i version (see → 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 frequency output through the cable gland (f).*
5. Tighten the cable glands (e / f) (see also → Page 27).
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 frequency 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 (see Fig. 17, c).
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).
11. Screw the cover of the electronics compartment (a) onto the transmitter housing.



F06-73xxxxxx-04-06-00-xx-001

Fig. 15: Procedure for connecting the transmitter Non-Ex / Ex-i 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 frequency output cable (optional)
g Terminal connector for power supply/current output
h Terminal connector for frequency output (optional)

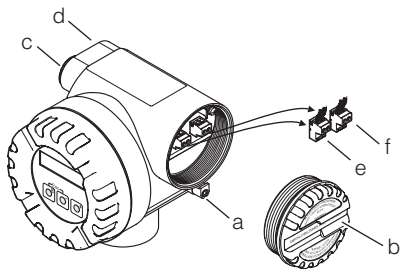
Procedure for connecting the transmitter, Ex-d version (see → Fig. 16)

✎ 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 (e). *Optional: push the cable for the frequency output through the cable gland (f).*
4. Tighten the cable glands (e / f) (see also → Page 27).
5. 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 frequency 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.
6. Plug the terminal connectors (g / h) 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 (see Fig. 17, c).
8. Screw the cover (b) of the connection compartment onto the transmitter housing.
9. Engage the clamp (a) to hold the cover of the connection compartment (b) in position and tighten the threaded fastener of the clamp.



F06-73xxxxxx-04-06-00-xx-001

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

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

Wiring diagram

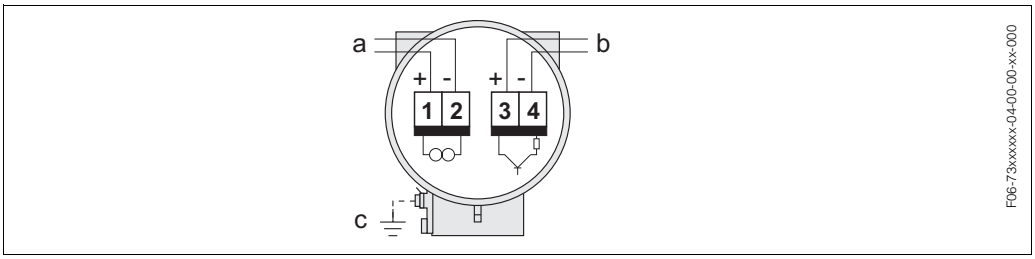


Fig. 17: Assignment of terminals

a Power supply/current output
b Optional frequency output, can also be operated as:
- Pulse or status output
- Together with flow computer RMC or RMS 621 as PFM output (see below)
c Ground terminal (only relevant for remote version)

Connecting the device to the flow computer RMC or RMS 621

Together with the flow computers RMC or RMS 621, the device can output PFM (pulse-frequency modulation) signals.

Note!
To output PFM signals, the VORTEX FREQUENCY option must be selected in the ASSIGN FREQUENCY function (see Page 99).

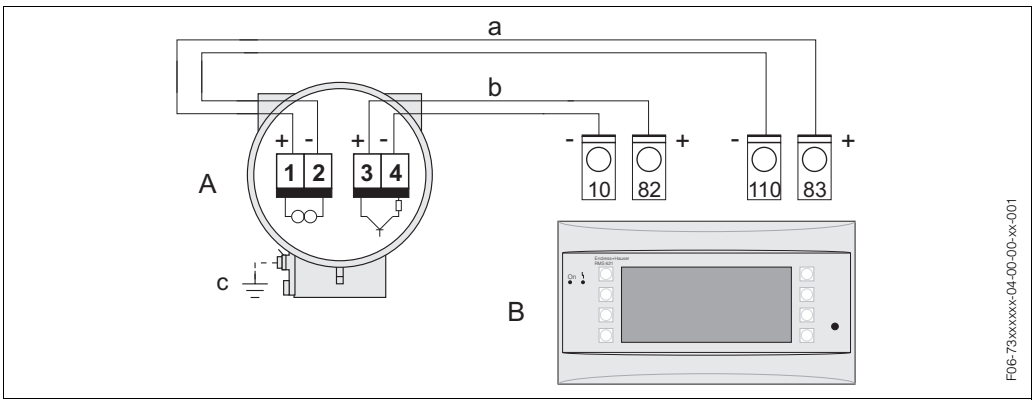


Fig. 18: Assignment of terminals for flow computer RMC or RMS 621

A = Device; B = flow computer RMC or RMS 621
a terminal 83 (Loop Supply 2 +); terminal 110 (Input 2 + mA/PFM/pulse)
b terminal 82 (Loop Supply 1 +); terminal 10 (Input 1 + mA/PFM/pulse)
c Ground terminal (only relevant for remote version)

4.2.2 Terminal assignment

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

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

Frequency output
Open collector, passive, galvanically isolated, U_{max} = 30 V, with 15 mA current limiting, R_i = 500 Ω, can be configured as frequency, 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 41)
- 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

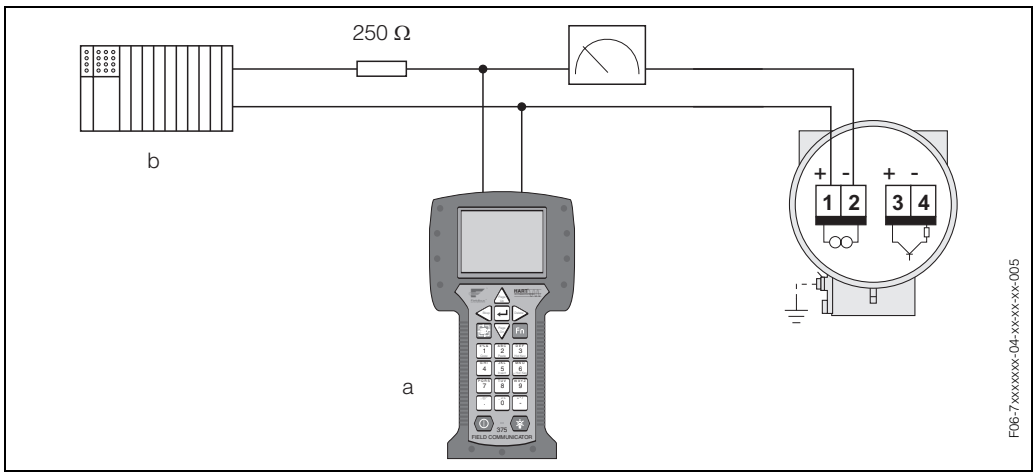


Fig. 19: Electrical connection of the HART terminal:

a HART terminal
b Additional switching units or PLC with transmitter power 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. FieldTool).

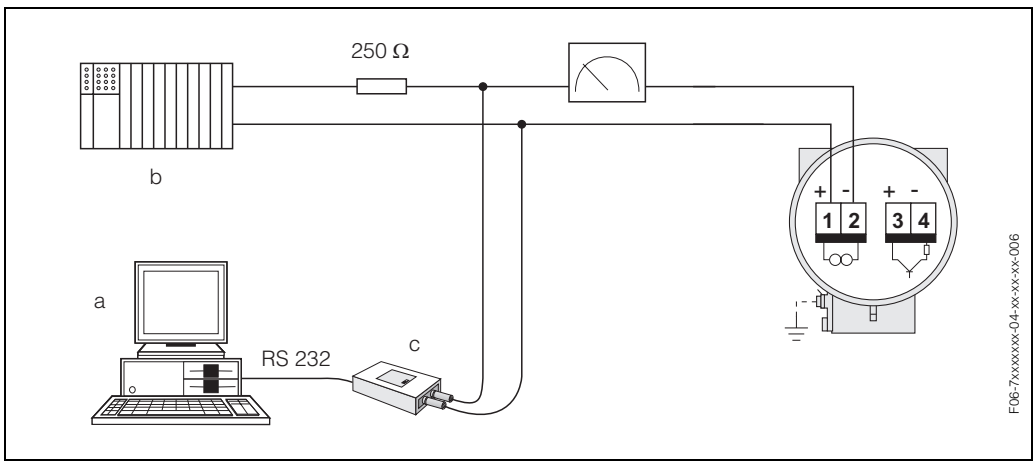


Fig. 20: Electrical connection of a PC with operating software

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 68).
- Firmly tighten the cable entry (Fig. 21).
- The cables must loop down before they enter the cable entries (“water trap”, Fig. 21). 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.

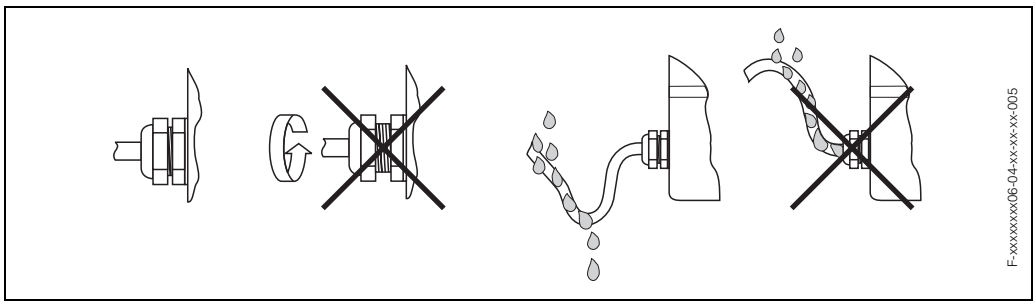


Fig. 21: Installation instructions for cable entries

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: 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, 68
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 27
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 90).

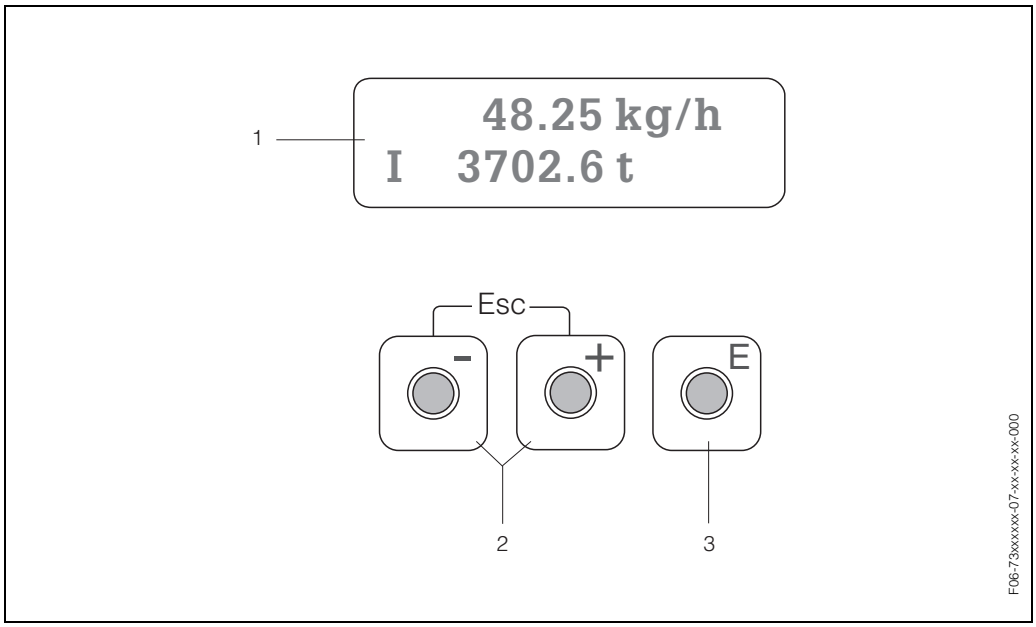


Fig. 22: Display and operating elements

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. mass flow in [kg/h] or in [%].*
- *Bottom line: shows additional measured variables and status variables, e.g. totalizer reading in [t], 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 31.
- Function matrix overview → Page 79
- Detailed description of all functions → Page 80 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 and hold down the Esc key (Esc) for longer than 3 seconds → return directly
   – Repeatedly press Esc key (Esc) → return step by step

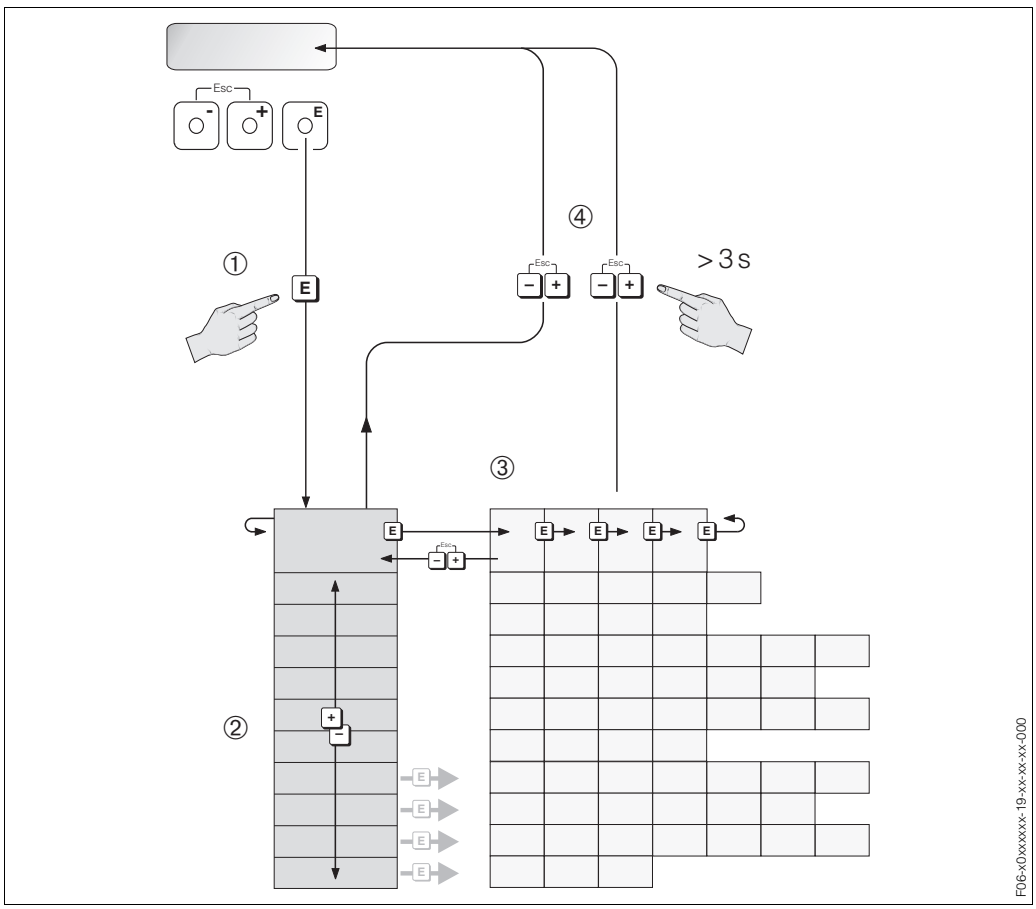


Fig. 23: Selecting and configuring functions (function matrix)

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 87) 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 customise to suit your process parameters.
The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on Page 30.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- If an unassignable option is selected in the ASSIGN LINE 1 or ASSIGN LINE 2 function for the fluid selected (e.g. corrected volume flow option for saturated steam), "– – – –" appears on the display.
- Certain functions prompt you to confirm your data entries. Press ⊞⊟ to select "SURE [YES]" and press ℡ to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is 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 79 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 = 73) has to be entered before settings can be changed. If you use a code number of your choice, you exclude the possibility of unauthorised persons accessing data (→ see ACCESS CODE function on Page 88).

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 organisation 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. → see Page 50
- *Process error:* this group includes all application errors, for example “DSC SENSOR LIMIT”, etc. → see Page 50

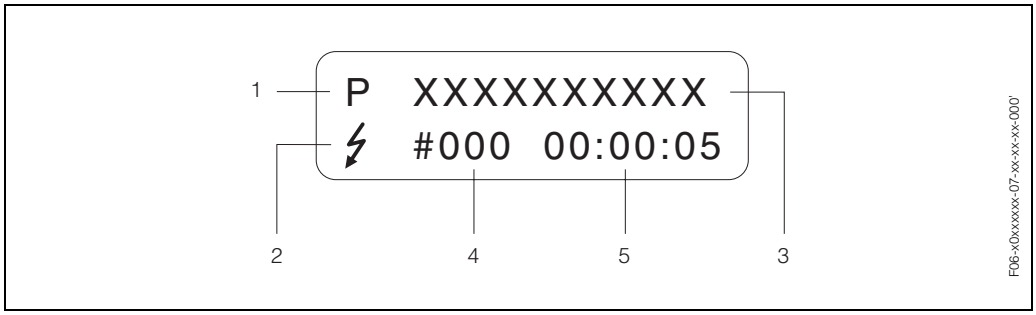


Fig. 24: Error messages on the display (example)

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 last error occurrence (in hours, minutes and seconds) , display format - see OPERATION HOURS function on Page 130

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 129).

Serious system errors, e.g. electronic module defects, are always categorised 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 57).

✎ 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 26).
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 FieldTool), 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:
  – Recognising 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 73 has all three command classes. Page 35 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 Field Communicator DXR 275 resp. 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.

Software package ToF Tool-FieldTool Package

Modular Software package, comprised of the service tools ToF Tool and FieldTool, for a complete configuration, comissioning and diagnostic of ToF level measuring devices and PROline flowmeters. Contains:

- Commissioning, maintenance analysis
- Measuring device configuration
- Service functions
- Visualisation of process data
- Trouble-shooting
- Controlling the “FieldCheck” tester/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	Volume flow
2	Temperature
3	Mass flow
4	Corrected volume flow
5	Heat flow
6	Density
7	Specific enthalpy
8	Saturation steam pressure (saturated steam)
9	Vortex frequency
10	Electronics temperature
11	Reynolds number
12	Velocity
250	Totalizer 1
252	Totalizer 2

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

- Primary process variable (PV) → volume flow
- Secondary process variable (SV) → temperature
- Third process variable (TV) → mass flow
- Fourth process variable (FV) → totalizer 1

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** (numbers in decimal form)	**Response data** (numbers 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 73 – 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 (= volume 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 = volume flow
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 = volume flow • Secondary process variable = temperature • Third process variable = mass flow • Fourth process variable = totalizer 1 ✎ 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

Command no. **HART command / access type**		**Command data** (numbers in decimal form)	**Response data** (numbers in decimal form)
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 73 – 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.
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 (= volume 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 = volume 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** (numbers in decimal form)	**Response data** (numbers 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 (vol. 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 (vol. 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 (vol. 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 (vol. 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”.
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 39

Command no. HART command / access type		Command data (numbers in decimal form)	Response data (numbers in decimal form)
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 volume flow • Secondary process variable: ID 2 for temperature • Third process variable: ID 3 for mass flow • Fourth process variable: ID 250 for totalizer 1
51	Write assignments of the device variables to the four process variables Access = Write	Set the device variables to the four 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 ID of the supported device variables:see Page 34 *Factory setting:* • Primary process variable = volume flow • Secondary process variable = temperature • Third process variable = mass flow • Fourth process variable = totalizer 1	The current variable assignment of the process variables is displayed as a response: – 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
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 34 ✎ 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
108	Burst mode CMD	Select the process values sent cyclically to the HART master. Byte 0, write: 1 = Primary process variable 2 = Current and percentage of the measuring range 3 = Current and four (previously defined) measured variables	The value set in byte 0 is shown as the response.
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 50 ff.!

Byte	Bit	Error no.	Short error description (→ Page 50 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 data of the EEPROM
	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 the 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	New amplifier software version or data being loaded into device. No other commands possible at this point.
	7	502	Device data are being uploaded. 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	–

Byte	Bit	Error no.	Short error description (→ Page 50 ff.)
4	0...1	Not assigned	–
	2	698	Current adjustment active
	3...7	Not assigned	–
5	0	310	PT breakage
	1	311	PT short-circuit
	2	312	PT breakage
	3	313	PT short-circuit
	4	314	PT breakage, electronics
	5	315	Short-circuit, PT electronics
	6	316	No T sensor
	7	317	The device autodiagnostics has found an error in the DSC sensor. This can influence the measuring of the temperature.
6	0	318	The device autodiagnostics has found an error in the DSC sensor. This can influence the measuring of the temperature and flow.
	1	355	Frequency output: the current flow is outside the set range.
	2	371	–
	3	381	The limit value for the minimum permissible fluid temperature is undershot
	4	382	The limit value for the maximum permissible fluid temperature is overshot
	5	397	The limit value for the minimum permissible ambient temperature is undershot
	6	398	The limit value for the maximum permissible ambient temperature is overshot
	7	412	No data are stored in the device for the combination of current values for medium pressure and fluid temperature.
7	0	421	The current flow velocity overshoots the specified limit value.
	1	494	The Reynolds number of 20,000 is undershot
	2	511	The current output is not receiving any valid data
	3	512	The frequency output is not receiving any valid data
	4	513	The pulse output is not receiving any valid data
	5	514	The status output is not receiving any valid data
	6	515	The display is not receiving any valid data
	7	516	Totalizer 1 is not receiving any valid data
8	0	517	Totalizer 2 is not receiving any valid data
	1	621	Simulation frequency output
	2...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. If HART write protection is enabled, it is not possible to change 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 113).
5. Installation is the reverse of the removal procedure.

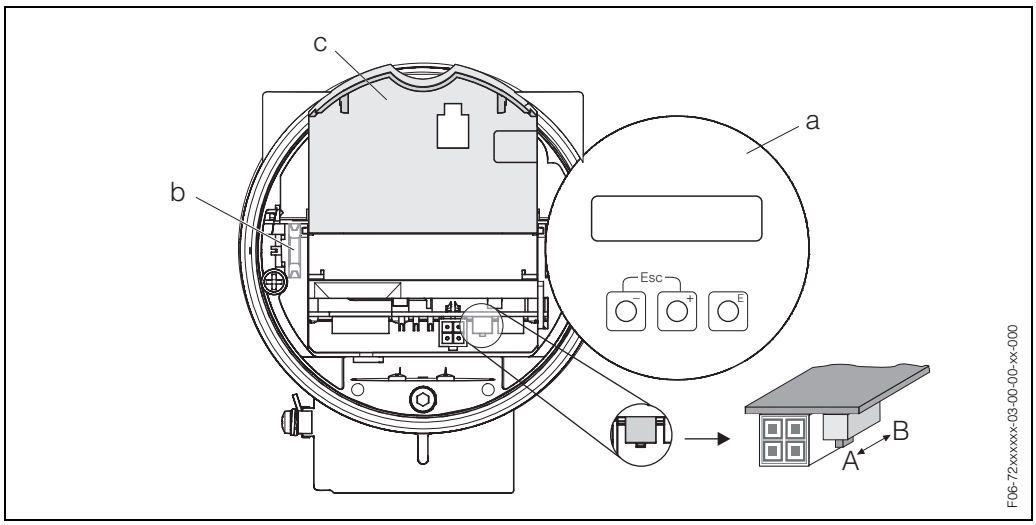


Fig. 25: DIP switch for switching HART write protection on and off

a Local display module
b Retaining rails of local display module
c Plastic cover

A = Write protection disabled (DIP switch at front)
B = 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 20
- “Post-connection check” checklist → Page 27

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. After ca. 5 seconds, 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 73 **VX.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).

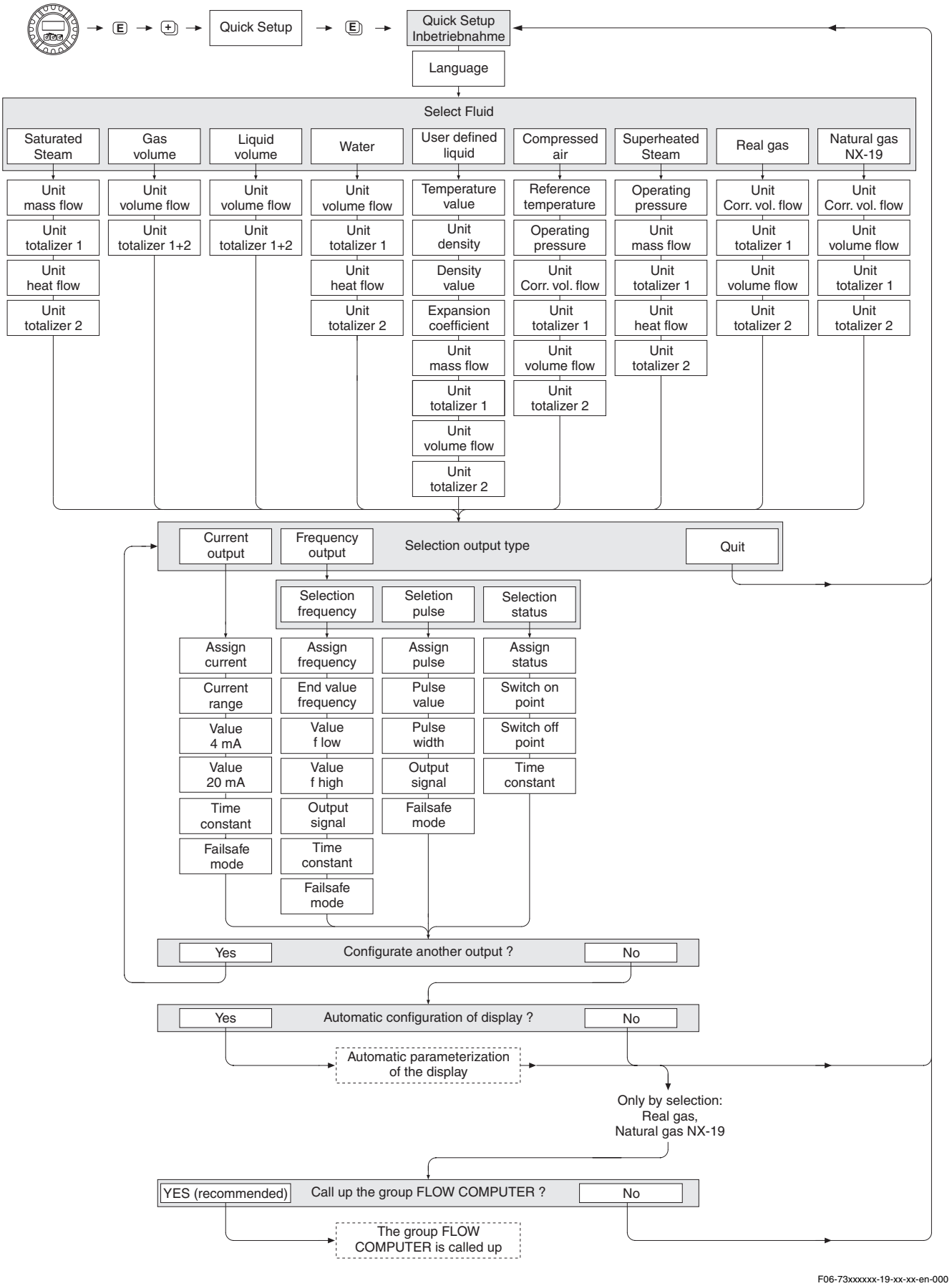
✎ Note!
If start-up fails, an appropriate error message is displayed, depending on the cause.

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.

Flowchart of “Commissioning” Quick Setup see next page.

Flowchart of "Commissioning" Quick Setup



F06-73xxxxxx-19-xx-xx-en-000

Note!

The QUICK SETUP COMMISSIONING function is described on Page 87.

- The display returns to the QUICK SETUP COMMISSIONING cell if you press the ESC key combination during interrogation.
- ① If the fluid selected is changed, the following parameters are reset to their factory settings:

In group	Parameter
Sytem units	→ all parameters
Display	→ 100% Value Line 1, 100% Value Line 2
Current output	→ all parameters
Frequency output	→ all parameters
Process parameter	→ all parameters
System parameter	→ all parameters

- ② Only the output (current output or frequency output) not yet configured in the current Quick Setup is offered for selection after the first cycle.
- ③ 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.
- ④ When “YES” is selected, the volume flow is assigned to line 1 of the local display and the temperature to line 2.
- ⑤ The SELECT FLUID function is called up. Confirm the fluid selected in this function and configure all the subsequent functions of the FLOW COMPUTER group. Configuration is complete if group selection is displayed. You can get back to the Home position by means of the ESC key combination ( ).
- Totalizer assignment depends on the fluid selected:

Selected fluid:	Totalizer 1 assignment:	Totalizer 2 assignment:
Saturated steam	→ Mass flow	→ Heat flow
Superheated steam	→ Mass flow	→ Heat flow
Water	→ Volume flow	→ Heat flow
Customer-spec. liquid	→ Mass flow	→ Volume flow
Compressed air	→ Corrected volume flow	→ Volume flow
Natural Gas NX-19	→ Corrected volume flow	→ Volume flow
Gas volume	→ Volume flow	→ Volume flow
Liquid volume	→ Volume flow	→ Volume flow

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 47.
  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 E+H service organisation can provide detailed information on the order codes in question.

Accessory	Description	Order code
Transmitter PROline Prowirl 73	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	73XXX – XXXXX * * * * * *
Mounting kit for Prowirl 72/73 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 275	Handheld terminal for remote configuration and for obtaining measured values via the current output HART (4...20 mA). Contact your E+H representative for more information.	DXR275 – * * * * * *
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 E+H 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 E+H representative for more information.	DKA80 – *
ToF Tool-FieldTool Package	Modular Software package, comprised of the service tools ToF Tool and FieldTool, for a complete configuration, comissioning and diagnostic of ToF level measuring devices and PROline flowmeters. Contains: – Commissioning, maintenance analysis – Measuring device configuration – Service functions – Visualisation of process data – Trouble-shooting – Controlling the “FieldCheck” tester/simulator Contact your E+H representative for more information.	DXS10 – * * * * *

Accessory	Description	Order code
FieldCheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the “FieldTool” software package, test results can be imported into a database, printed and used for official certification. Contact your E+H representative for more information.	DXC10 – * *
Pressure transmitter Cerabar T	Cerabar T is used to measure the absolute and gauge pressure of gases, steams and liquids.	PMC131 – * * * * PMP131 – * * * *
Active barrier RN 221 N	Active barrier with power supply for safe separation of 4...20 mA standard signal circuits: • Galvanic isolation of 4...20 mA circuits • Elimination of ground loops • Power supply of two-wire transmitters • Can be used in Ex area (ATEX, FM, CSA)	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 display unit for looping into 4...20 mA current loop; can be used in Ex area (ATEX, FM, CSA).	RIA251 – * *
Field display RIA 261	Digital field display unit for looping into 4...20 mA current loop; can be used in Ex area (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 (e.g. differnce ascertain) and 1-2 analog outputs. Optional: intrinsically safe inputs, can be used in Ex area (ATEX).	RMA422 – * * * * * * *
Overvoltage protection HWA 562 Z	Overvoltage protection for restricting overvoltage in signal lines and components.	51003575
Fieldgate FXA 520	Gateway to remote interrogation of HART sensors and actuators via Web browser • Web server for remote monitoring of up to 30 measuring points • Intrinsically safe version [EEx ia]IIC for applications in Ex area • Communication via modem, Ethernet or GSM • Visualisation via Internet/Intranet in the Web browser and/or WAP mobile • Limit value monitoring with alarms sent by e-mail or SMS • Synchronised time stamping of all measured values • Remote diagnosis and remote configuration of connected HART devices	FXA520 – * * * *
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-* * * * * * * * * *

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 58
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 59 2. Display module defective → Order spare part → Page 58 3. Electronics defective → Order spare part → Page 58
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 58

▼

Error messages on display	
Errors which occur during commissioning or operation are displayed immediately or once the set delay time has elapsed (see ALARM DELAY function on Page 130). 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 130 – **#395** = Error number Caution! • Please refer also to the information on Page 32 ff.! • The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.	
Error number: No. 001 – 400 No. 601 – 699	System error (device error) has occurred → Page 50
Error number: No. 500 – 600 No. 700 – 750	Process error (application error) has occurred → Page 50

▼

Other errors (without error message)	
Some other error has occurred.	Diagnosis and remedial measures → Page 55

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.

Type	Error message / No.	Cause	Remedy / spare part
Serious system errors are **always** recognised 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 32 ff. and 57. S = System error ϟ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without an effect on the inputs and outputs)			
S ϟ	CRITICAL FAIL. # 001	Serious device error	Replace the amplifier board. Spare parts → Page 58
S ϟ	AMP HW EEPROM # 011	Amplifier: Faulty EEPROM	Replace the amplifier board. Spare parts → Page 58
S ϟ	AMP SW EEPROM # 012	Amplifier: Error when accessing EEPROM data.	Contact your E+H service organisation.
S ϟ	COM HW EEPROM # 021	COM module: Faulty EEPROM	Replace COM module. Spare parts → Page 58
S ϟ	COM SW EEPROM # 022	COM module: Error when accessing EEPROM data.	Contact your E+H service organisation.
S ϟ	CHECKSUM TOT. # 111	Totalizer checksum error	Replace the amplifier board. Spare parts → Page 58
S !	PT DSC BROKEN # 310	The temperature sensor is faulty. Temperature measurement becomes inaccurate and total failure of the temperature sensor (#316) must be reckoned with.	Contact your E+H service organisation.
S !	SHORT C. PT DSC # 311		
S !	PT DSC BROKEN # 312		
S !	SHORT C. PT DSC # 313		
S !	PT ELECT BROKEN # 314	The temperature sensor is defective and temperature measurement is no longer possible. The device uses the value specified in the ERROR -> TEMPERATURE function (see Page 120).	Replace the amplifier board. Spare parts → Page 58
S !	SHORT C. PT EL # 315		
S ϟ	NO T SENSOR # 316	The temperature sensor has failed and no temperature sensor is present. The device uses the value specified in the ERROR -> TEMPERATURE function (see Page 120).	Contact your E+H service organisation. ✎ Note! If the device is intentionally operated with a Prowirl 72 DSC sensor (without temperature sensor), this message must be changed from a fault message to a notice message (see ASSIGN SYSTEM ERROR function on Page 129).

Type	Error message / No.	Cause	Remedy / spare part
S ↯	CHECK T SENSOR # 317	The self-monitoring function of the device has detected an error in the DSC sensor which can have an effect on the temperature measurement. ✎ Note! The mass flow is calculated with the value entered for the temperature in the ERROR -> TEMPERATURE function (see Page 120).	Contact your E+H service organisation.
S ↯	CHECK SENSOR # 318	The self-monitoring function of the device has detected an error in the DSC sensor which can have an effect on the flow and temperature measurement. ✎ Note! The mass flow is calculated with the value entered for the temperature in the ERROR -> TEMPERATURE function (see Page 120).	Contact your E+H service organisation. ✎ Note! In the ASSIGN SYSTEM ERROR function (see Page 129), the error status can be changed from a fault message to a notice message. Please note that although this means a measured value is output again, the error must still be eliminated.
S ↯	CURRENT RANGE # 351	Current output: the current flow is outside the set range.	1. Change full scale value entered. 2. Reduce flow.
S ↯	FREQ. RANGE # 355	Frequency output: the current flow is outside the set range.	1. Change full scale value entered. 2. Reduce flow.
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.
S ↯	RESONANCE DSC # 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.

Type	Error message / No.	Cause	Remedy / spare part
S ↯	FLUIDTEMP. MIN # 381	The limit value for the minimum permissible fluid temperature is undershot	Increase the fluid temperature.
S ↯	FLUIDTEMP. MAX # 382	The limit value for the maximum permissible fluid temperature is overshot	Reduce the fluid temperature.
S ↯	DSC SENS DEFCT # 394	The DSC sensor is defective, measurement no longer takes place.	Contact your E+H service organisation.
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 E+H service organisation.
S ↯	SIGNAL>LOW PASS # 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 is outside the measuring range.	• Check whether the device was installed in the flow direction. • Check whether the right option was selected in the SELECT FLUID function (see P. 117). • Check whether the operating conditions are within the specifications of the measuring device (e.g. flow is above measuring range which means that the flow may have to be reduced) If the checks do not solve the problem, please contact your E+H service organisation.
S ↯	T ELECTR. MIN. # 397	The limit value for the minimum permissible ambient temperature is undershot	• Check whether the device has been correctly insulated (see Page 14). • Check whether the transmitter is pointing upwards or to the side (see Page 13). • Increase the ambient temperature.
S ↯	T ELECTR. MAX. # 398	The limit value for the maximum permissible ambient temperature is overshot	• Check whether the device has been correctly insulated (see Page 14). • Check whether the transmitter is pointing downwards or to the side (see Page 13). • Reduce the ambient temperature.
S ↯	PREAMP. DISCONN. # 399	Pre-amplifier disconnected.	Check whether the connection between the preamplifier and amplifier board is established and correct and establish connection if necessary.
S !	SW. UPDATE ACT. # 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 and then restart the device.
S !	UP./DOWNLOAD ACT. # 502	Uploading the device data. No other commands possible at this point.	Wait until the procedure is complete.

Type	Error message / No.	Cause	Remedy / spare part
S !	NO DATA - ϟ ->CURRENT # 511	The current output is not receiving any valid data	• Run the “Commissioning” Quick Setup (see Page 43). • Check the option selected in the ASSIGN CURRENT function (see Page 96).
S !	NO DATA - ϟ ->FREQ. # 512	The frequency output is not receiving any valid data.	• Run the “Commissioning” Quick Setup (see Page 43). • Check the option selected in the ASSIGN FREQUENCY function (see Page 100).
S !	NO DATA - ϟ ->PULSE # 513	The pulse output is not receiving any valid data.	• Run the “Commissioning” Quick Setup (see Page 43). • Check the option selected in the ASSIGN PULSE function (see Page 105).
S !	NO DATA - ϟ ->STAT. # 514	The status output is not receiving any valid data.	• Run the “Commissioning” Quick Setup (see Page 43). • Check the option selected in the ASSIGN STATUS function (see Page 109).
S !	NO DATA - ϟ ->DISP. # 515	The display is not receiving any valid data.	• Run the “Commissioning” Quick Setup (see Page 43). • Check the option selected in the ASSIGN LINE 1 and ASSIGN LINE 2 function (see Page 90).
S !	NO DATA - ϟ ->TOT.1 # 516	Totalizer 1 is not receiving any valid data.	• Run the “Commissioning” Quick Setup (see Page 43). • Check the option selected in the ASSIGN TOTALIZER 1 function (see Page 93).
S !	NO DATA - ϟ ->TOT.2 # 517	Totalizer 2 is not receiving any valid data.	• Run the “Commissioning” Quick Setup (see Page 43). • Check the option selected in the ASSIGN TOTALIZER 2 function.
S !	POS. ZERO-RET. # 601	Positive zero return active. ☝ Caution! This message has the highest display priority.	Switch off positive zero return.
S !	SIM. CURR. OUT. # 611	Current output simulation active	Switch off simulation.
S !	SIM. FREQ. OUT. # 621	Simulation frequency output active.	Switch off simulation.
S !	SIM. PULSE # 631	Pulse output simulation active.	Switch off simulation.
S !	SIM. STAT. OUT. # 641	Status output simulation active.	Switch off simulation.
S !	SIM. FAILSAFE # 691	Simulation of failsafe mode (outputs) active.	Switch off simulation.
S !	SIM. MEASURAND # 692	Simulation of a measured variable active (e.g. mass flow).	Switch off simulation.
S !	DEV. TEST ACT. # 698	The measuring device is being checked on site via the test and simulation device.	–
S !	CURR. ADJUST # 699	Current adjustment is active.	Quit current adjustment.

9.3 Process error messages

Process errors can be defined as either “Fault” or “Notice” messages and can thereby be weighted differently. Determination of this is done via the function matrix (see Description of functions on Page 80 ff.).

Note!
- The listed error message types below correspond to the factory setting.
- Also observe the information on Page 32 ff. and Page 57.

Type	Error message / No.	Cause	Remedy / spare part
S = System error ϟ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without an effect on the inputs and outputs)			
P !	P, T -> DATA - ϟ # 412	No data are stored in the device for the combination of current values for medium pressure and fluid temperature.	• Check whether the correct fluid was selected in the SELECT FLUID function (see Page 117). • Check whether the correct pressure was entered in the OPERATING PRESSURE function (see Page 121).
P !	FLOW RANGE # 421	The current flow velocity overshoots the limit value specified in the MAXIMUM VELOCITY function (see Page 136).	Reduce the flow.
P !	Reynolds < 20000 # 494	The Reynolds number of 20,000 is undershot. If the Reynolds number is < 20,000, the accuracy is reduced.	Increase the flow.

9. 4 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 79 ff.	
No flow signal	• For liquids: Check whether the piping is completely filled. The piping must always be completely filled for accurate and reliable flow measurement. • Check whether all the packaging material, including the meter body protective covers, was completely removed before mounting the device. • Check whether the desired electrical output signal was connected correctly.
Flow signal even though there is no flow	Check whether the device is exposed to particularly strong vibrations. If so, a flow can be displayed even if the fluid is at a standstill, depending on the frequency and direction of the vibration. Remedial measures at the device: • Turn the sensor 90° (please observe the installation conditions when doing so, see Page 12 ff.). The measuring system is most sensitive to vibrations which follow in the direction of the sensor. Vibrations have less of an effect on the device in the other axes. • The amplification can be altered using the AMPLIFICATION function (see Page 128). 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 organisation can adjust the filters of the device to suit your special application.
Faulty or highly-fluctuating flow signal	• The fluid is not sufficiently single-phase or homogeneous. The piping must always be completely filled and the fluid must be single-phase and homogeneous for accurate and reliable flow measurement. • In many instances, the following measures can be taken to improve the measurement result even under non-ideal conditions: – For liquids with a low gas content in horizontal pipework, it helps to install the device with the head pointing downwards or to the side. This improves the measuring signal since the sensor is not in the area where gas accumulates when this type of installation is used. – For liquids with a low solids content, avoid installing the device with the electronics housing pointing downwards. – For steam or gases with a low liquid content, avoid installing the device with the electronics housing pointing downwards. • The inlet and outlet runs must be present as per the installation instructions (see Page 15). • Suitable seals with an internal diameter not smaller than the pipe internal diameter must be installed and correctly centred. • 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 (continued)	• Check whether the correct fluid was selected in the SELECT FLUID function (Page 117). 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 127). • Check whether the device is correctly installed in the flow direction. • Check whether the nominal diameter of the mating pipe and the device match (see Page 115). • The flow must be in the measuring range of the device (see Page 65). 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 E+H service organisation.	The following options are available for tackling problems of this nature: **Request the services of an E+H service technician** If you contact our service organisation 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 E+H** 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 58
The display shows “– – – –”	If an unassignable option is selected in the ASSIGN LINE 1 or ASSIGN LINE 2 function for the fluid selected (e.g. corrected volume flow option for saturated steam), “– – – –“ appears on the display. Select an option to suit the fluid in the ASSIGN LINE 1 or ASSIGN LINE 2 function.

9. 5 Response of outputs to errors

Note!
The failsafe mode of the totalizers and the 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 32 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
Frequency output	*FALLBACK VALUE:* 0 Hz is output. *FAILSAFE VALUE:* The frequency specified in the FAILSAFE VALUE function is output. *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
Totalizers 1 + 2	*STOP:* The totalizers stop at the last value before the alarm condition occurred. *HOLD VALUE:* The totalizers continue to count the flow on the basis of the last valid flow data (before the fault occurred). *ACTUAL VALUE:* The totalizers continue to count the flow on the basis of the current flow data. The fault is ignored.	The totalizers stop.

9. 6 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 E+H service organisation 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

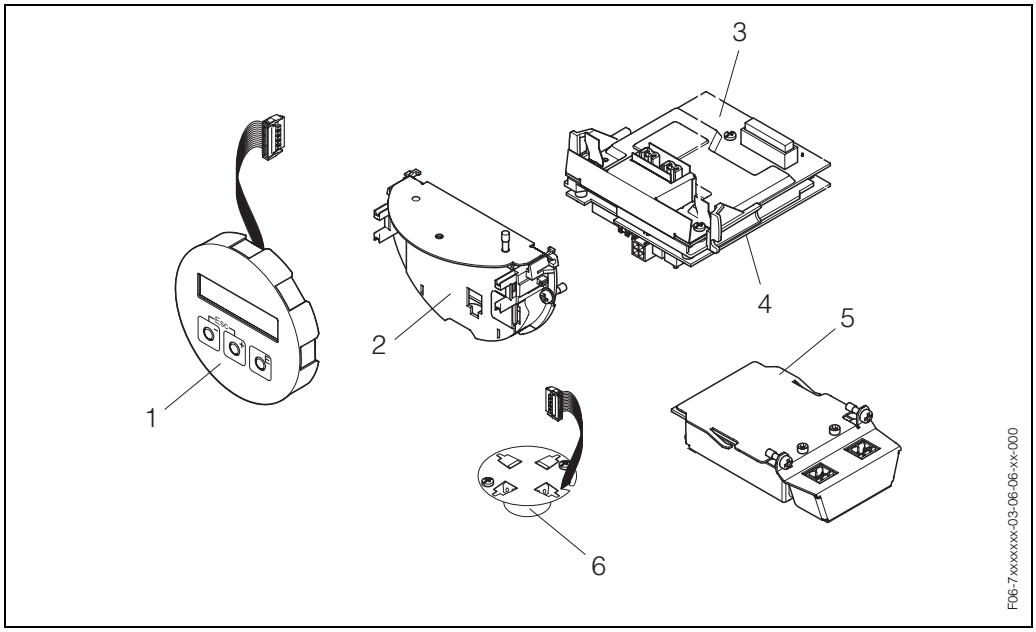


Fig. 26: Spare parts for transmitter PROline Prowirl 73

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

9. 7 Installing and removing electronics boards

9.7.1 Non-Ex, Ex-i 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)

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 ampifier 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 a new amplifier board on the board body.
16. Installation is the reverse of the removal procedure.

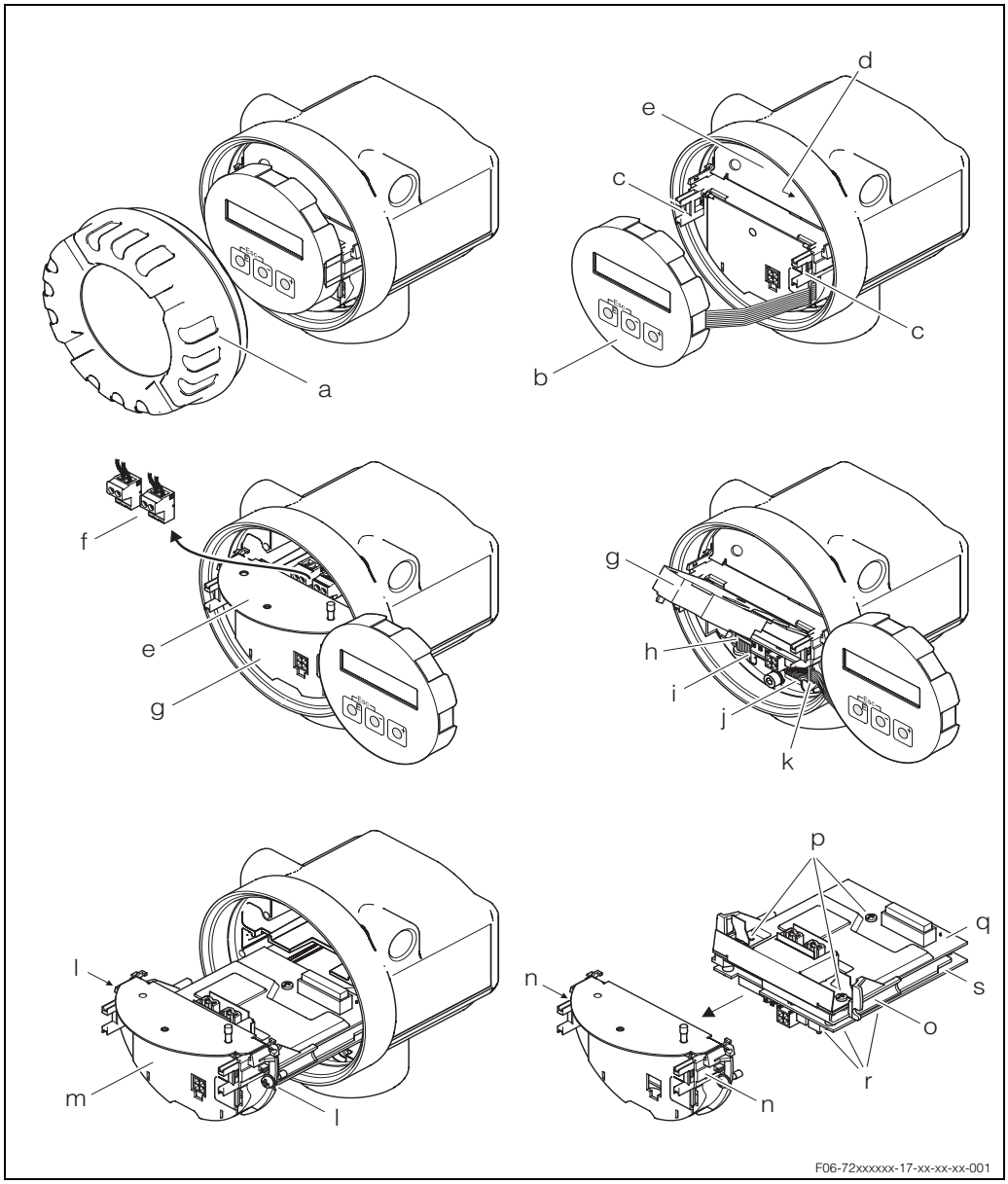


Fig. 27: Installing and removing electronics boards Non-Ex, Ex-i version

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

9.7.2 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. 28)

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.

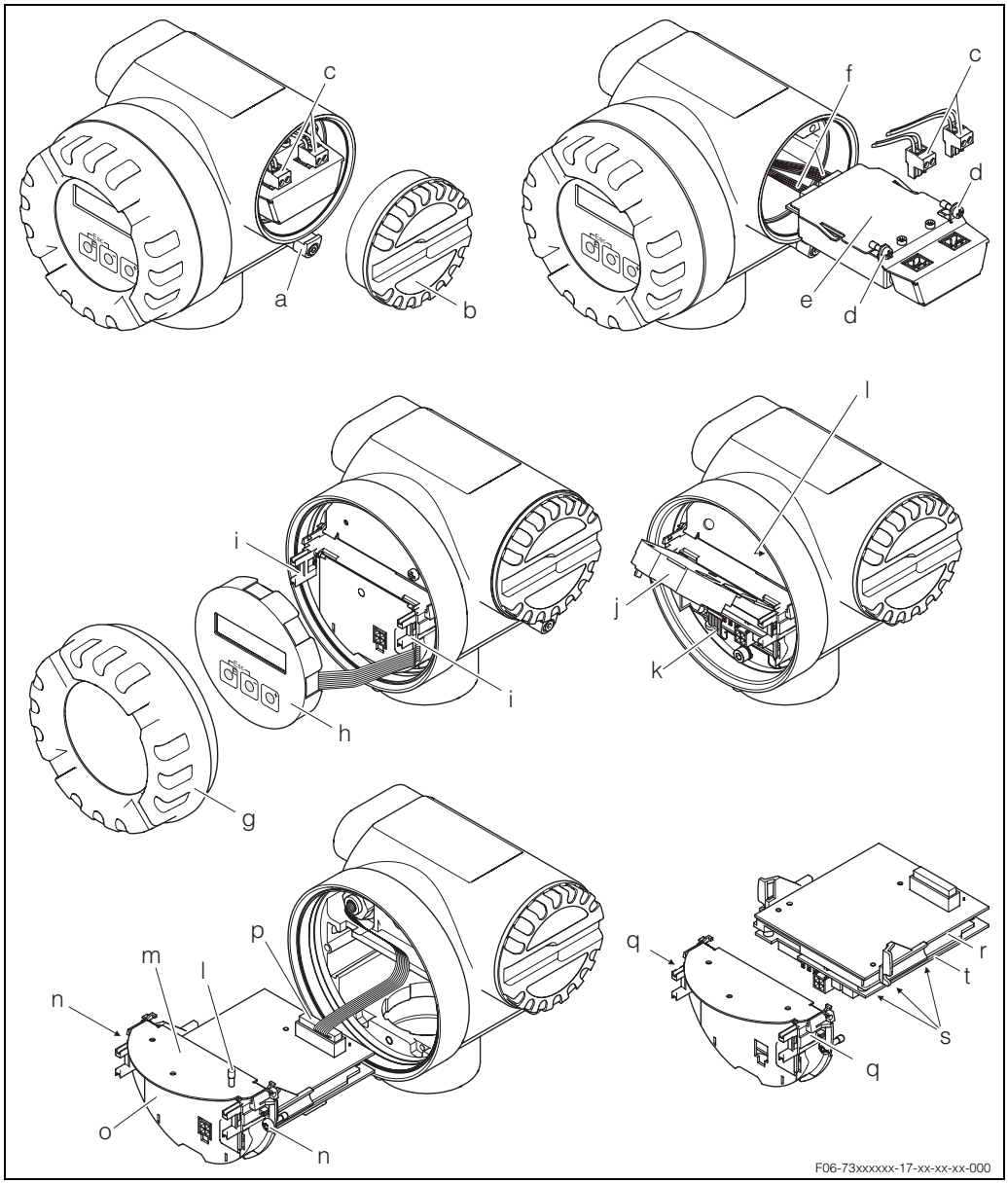


Fig. 28: Installing and removing electronics boards Ex-d version

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. 8 Software history

Software version / date	Software modification	Documentation Modifications / supplements
Amplifier		
V 1.00.00 / 10.2003	Original software Compatible with: – ToF Tool-FieldTool Package – HART Field Communicator DXR 275 resp. DXR 375	–

✎ 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 flow of saturated steam, superheated steam, gases and liquids. The measured variables volume flow and temperature are measured primarily. From these values, the device can used stored data on the density and enthalpy to calculate and output the mass flow and heat flow for example.

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 73
- 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.
- Temperature → can be output directly and is used to calculate the mass flow for example.

The measured process variables volume flow, temperature or the calculated process variables mass flow, heat flow or corrected volume flow can be output as output variables.

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 characterise 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 centre or on the Internet under www.endress.com.

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

Nominal diameter		K-factor range [pul./dm³]	
DIN	ANSI	73 F	73 W
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

Outputs, general

The following measured variables can generally be output via the outputs:

	Current output	Freq. output	Pulse output	Status output
Volume flow (oper. vol.)	X	X	X	Limit value (flow or totalizer)
Temperature	X	X	–	Limit value
Mass flow	If present	If present	If present	If present (flow or totalizer)
Corrected volume flow	If present	If present	If present	If present (flow or totalizer)
Heat flow (power)	If present	If present	If present	If present (flow or totalizer)

In addition, the calculated measured variables density, specific enthalpy, saturation steam pressure (for saturated steam), Z-Factor and flow velocity can be displayed if available via the local display.

Output signal

Current output:
- 4...20 mA with HART
- Start value, full scale value and time constant (0...100 s) can be set
- Temperature coefficient: typically 0.005% o.r. / °C (o.r. = of reading)

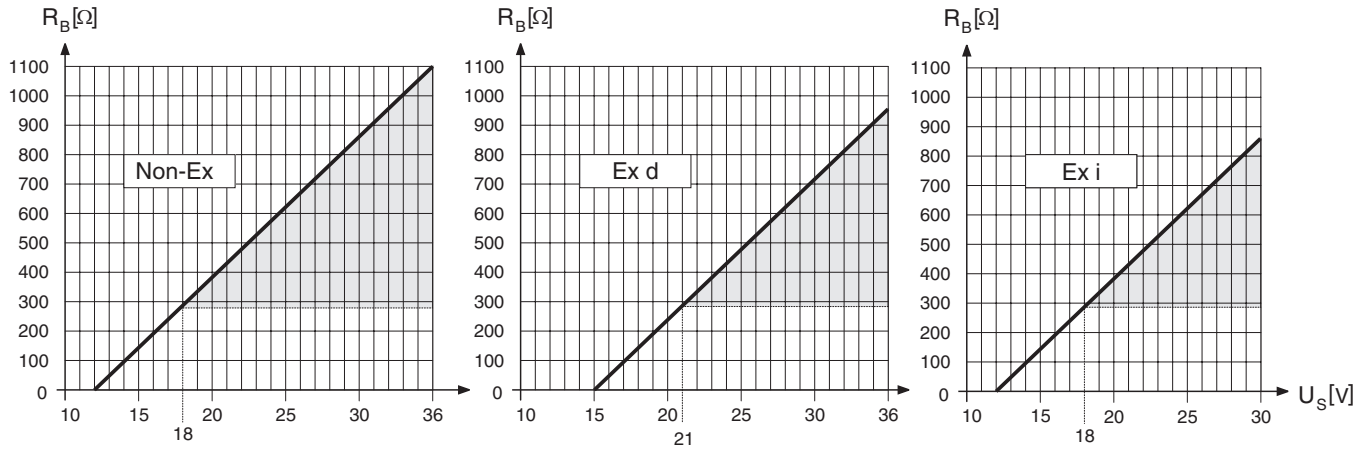
Frequency output:
Open collector, passive, galvanically isolated
- Non-Ex, Ex d version: U_{max} = 36 V, with 15 mA current limiting, R_i = 500 Ω
- Ex i version: U_{max} = 30 V, with 15 mA current limiting, R_i = 500 Ω

The frequency output can be configured as:
- Frequency output:
  End frequency 0...1,000 Hz (f_{max} = 1,250 Hz)
- Pulse output:
  Pulse value and polarity can be selected,
  Pulse width adjustable (0.01...10s)
  Pulse frequency max. 100 Hz
- Status output:
  Can be configured for error messages or flow and temperature limit values
- Vortex frequency:
  Unscaled vortex pulses directly output 0.5...2,850 Hz (e.g. for connecting to a flow computer RMC 621)
- PFM signal (pulse-frequency modulation):
  By external connecting with flow computer RMC or RMC 621 (see Page 25).

Signal on alarm

- Current output: failsafe mode can be selected (e.g. in accordance with NAMUR Recommendation NE 43)
- Frequency output: failsafe mode can be selected
- Status output: “not conductive” during fault

Load



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The area marked in grey indicates the permissible load (with HART: min. 250 Ω)

The load is calculated as follows:

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

R_B Load, load resistance
U_S Supply voltage:
- Non-Ex = 12...36 V DC
- Ex d = 15...36 V DC
- Ex i = 12...30 V DC
U_{KI} Terminal voltage:
- Non-Ex = min. 12 V DC
- Ex d = min. 15 V DC
- Ex i = 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

All electrical connections are galvanically isolated themselves.

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: 12...30 V DC (with HART 18...30 V DC) Ex 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" (not for remote version)
Cable specification	• Permissible temperature range: –40 °C...(max. ambient temperature +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 process connection corresponding to the particular standard.
Maximum measured error	• Volume flow (liquid): < 0.75% o.r. for Re > 20,000 < 0.75% o.f.s for Re between 4,000...20,000 • Volume flow (gas/steam): < 1% o.r. for Re > 20,000 < 1% o.f.s for Re between 4,000...20,000 • Temperature: < 1 °C (T > 100 °C, saturated steam); Risetime 50% (agitated under water, following IEC 60751): 8 s • Mass flow (saturated steam): – For flow velocities v 20...50 m/s, T > 150 °C (423 K) < 1.7% o.r. (2% o.r. for remote version) for Re > 20,000 < 1.7% o.f.s (2% o.f.s for remote version) for Re between 4,000...20,000 – For flow velocities v 10...70 m/s, T > 140 °C (413 K) < 2% o.r. (2.3% o.r. for remote version) for Re > 20,000 < 2% o.f.s (2.3% o.f.s for remote version) for Re between 4,000...20,000 • Mass flow (other fluids) Depends on the pressure value, specified in the OPERATING PRESSURE function (see Page 121). An individual error observation must be carried out. o.r. = of measured value, o.f.s = of full scale value, Re = Reynolds number
Repeatability	±0.25% o.r. (of measured value)

Installation

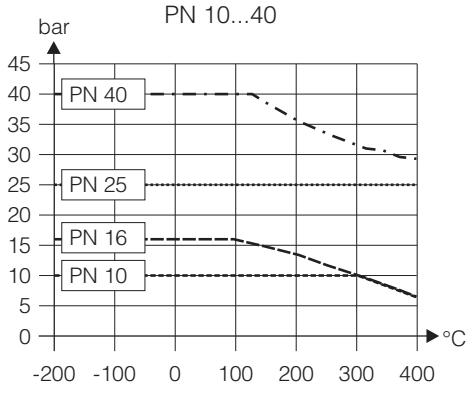
Installation instructions	see Page 12 ff.
Inlet and outlet run	see Page 15 ff.

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) in accordance with 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

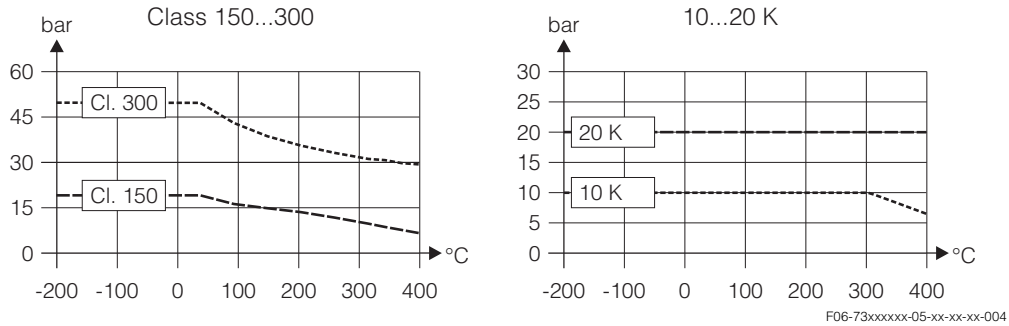
Process

Medium temperature range	• DSC sensor (digital switched capacitor), capacitive sensor: –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 to EN (DIN), stainless steel** EN (DIN) → PN 10...40



F06-7xxxxxxx-05-xx-xx-xx-003

Pressure-temperature curve to ANSI B16.5 and JIS, stainless steel
ANSI B 16.5 → Class 150...300
JIS → 10...20 K



Limiting flow

See data on Page 65 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.

10.1.7 Mechanical construction

Design, dimensions

see Page 72 ff.

Weight

see Page 72 ff.

Material

- Transmitter housing: Powder-coated die-cast aluminum

- Sensor:
  – Flanged and wafer version
  Stainless steel, A351-CF3M (1.4404), in conformity with NACE MR 0175

- Flanges:
  – EN (DIN) → Stainless steel, A351-CF3M (1.4404), in conformity with NACE MR 0175 (DN 15...150: as of 2004 changeover from fully cast construction to construction with weld-on flanges in 1.4404)
  – ANSI and JIS → Stainless steel, A351-CF3M, in conformity with NACE MR 0175 (DN 15...150, ½"...6": as of 2004 changeover from fully cast construction to construction with weld-on flanges in 316/316L, in conformity with NACE MR 0175)

- DSC sensor (differential switched capacitor; capacitive sensor):
  – Wetted parts (marked as “wet” on the DSC sensor flange),
  Stainless steel 1.4435 (316L), in conformity with NACE MR 017

- Non-wetted parts: Stainless steel 1.4301 (CF3)

- Support: Stainless steel, 1.4308 (CF8)

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

10.1.8 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 • ToF Tool-FieldTool Package (Endress+Hauser service- and operating programme)

10.1.9 Certificates and approvals

CE approval	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). In addition, optional approvals to Category III are available for larger nominal diameters where necessary (depending on the fluid and operating pressure). The devices are suitable for all fluids as well as unstable gases and have been designed and manufactured in accordance with good engineering practice.
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: Standardisation of the signal level for the breakdown information of digital transmitters with analog output signal • 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 Labatory Use. Pollution degree 2, Installation Category II. • American Gas Association (1962): A.G.A. Manual for the Determination of Supercompressibility Factors for Natural Gas - PAR Research Project NX-19. • The International Association for the Properties of Water and Steam - Release on the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam. • ASME International Steam Tables for Industrial Use (2000)
Ordering information	Your Endress+Hauser service organisation can provide detailed ordering information and information on the order codes on request.

10.1.10 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor (see Page 47). Your Endress+Hauser service organisation can provide detailed information on the order codes of your choice.

10.1.11 Documentation

- ❑ Related Ex documentation
- ❑ Additional documentation on Pressure Equipment Directive
- ❑ System Information PROline Prowirl 72/73

10. 2 Dimensions of transmitter, remote version

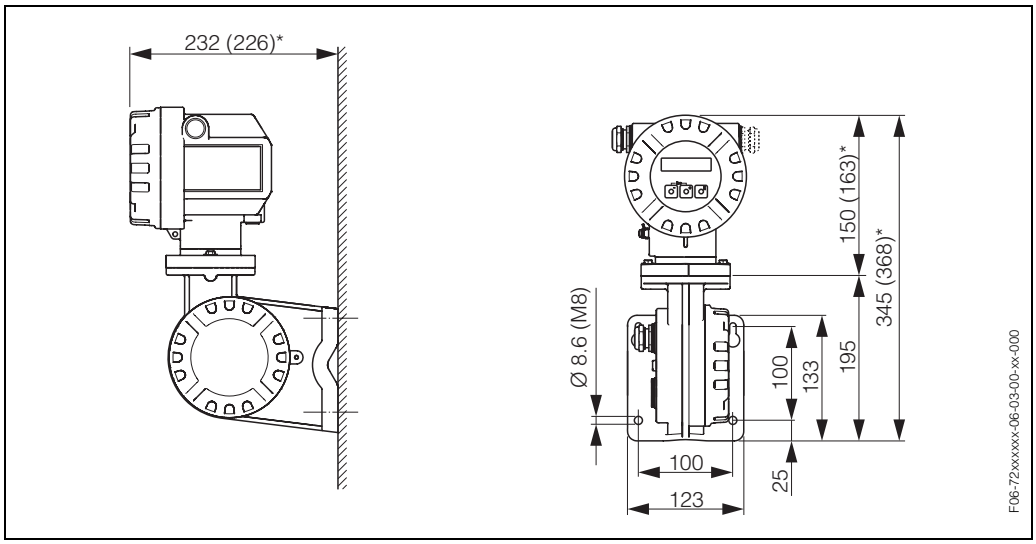


Fig. 29: Dimensions of transmitter, remote version

** The following dimensions differ depending on the version:*
- *The dimension 232 mm changes to 226 mm in the blind version (without local operation).*
- *The dimension 150 mm changes to 163 mm in the Ex d version.*
- *The dimension 345 mm changes to 368 mm in the Ex d version.*

10.3 Dimensions of Prowirl 73 W

Wafer version for flanges to:
- EN 1092-1 (DIN 2501), PN 10...40,
- ANSI B16.5, Class 150...300, Sch 40
- JIS B2238, 10...20K, Sch40

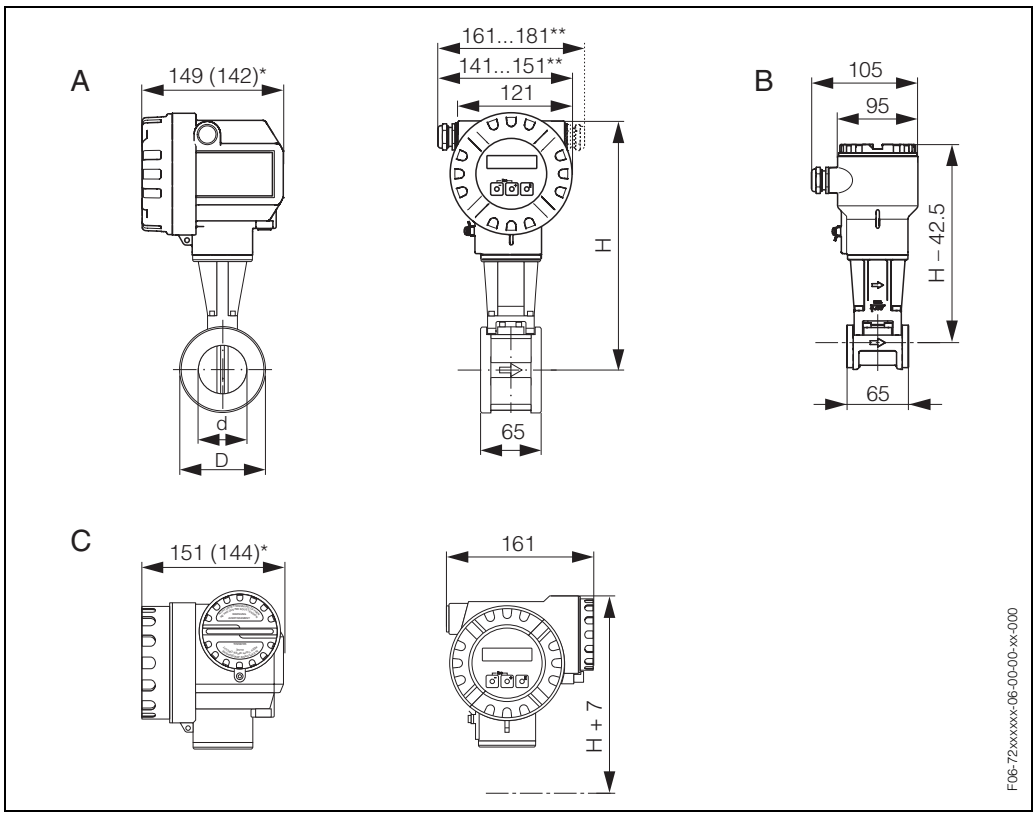


Fig. 30: Dimensions of Prowirl 73 W

A = Standard and Ex-i version
B = Remote version
C = Ex-d version (transmitter)

** The following dimensions change as follows in the blind version (without local operation):*
– Standard and Ex-i version: the dimension 149 mm changes to 142 mm in the blind version.
– Ex-d version: the dimension 151 mm changes to 144 mm in the blind version.
*** The dimension depends on the cable gland used.*

DN		d	D	H	Weight
DIN/JIS	ANSI	[mm]	[mm]	[mm]	[kg]
15	½"	16.50	45.0	276	3.0
25	1"	27.60	64.0	286	3.2
40	1½"	42.00	82.0	294	3.8
50	2"	53.50	92.0	301	4.1
80	3"	80.25	127.0	315	5.5
100	4"	104.75	157.2	328	6.5
150	6"	156.75	215.9	354	9.0

10. 4 Dimensions of Prowirl 73 F

- EN 1092-1 (DIN 2501), R_a = 6,3...12,5 µm, raised face to EN 1092-1 Form B1 (DIN 2526 Form C)
- ANSI B16.5, Class 150...300, R_a = 125...250 µin
- JIS B2238, 10...20K, R_a = 125...250 µin

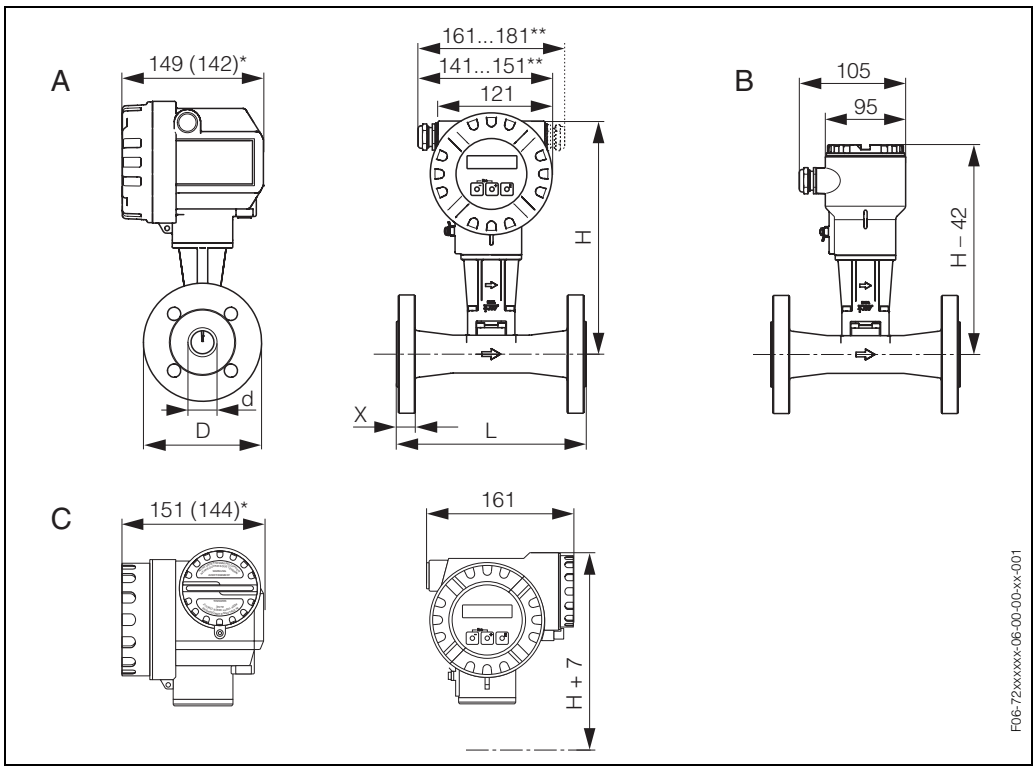


Fig. 31: Dimensions of Prowirl 73 F

A = Standard and Ex i version, B = remote version, C = Ex d version (transmitter)
** The following dimensions change as follows in the blind version (without local operation):*
– Standard and Ex-i version: the dimension 149 mm changes to 142 mm in the blind version.
– Ex-d version: the dimension 151 mm changes to 144 mm in the blind version.

*** The dimension depends on the cable gland used.*

Table: dimensions of Prowirl 73 F to EN 1092-1 (DIN 2501)

DN	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	x [mm]	Weight [kg]
15	PN 40	17.3	95.0	277	200	16	5.5
25	PN 40	28.5	115.0	284	200	18	7.5
40	PN 40	43.1	150.0	292	200	21	10.5
50	PN 40	54.5	165.0	299	200	23	12.5
80	PN 40	82.5	200.0	312	200	29	20.5
100	PN 16	107.1	220.0	324	250	32	27.5
	PN 40	107.1	235.0				
150	PN 16	159.3	285.0	348	300	37	51.5
	PN 40	159.3	300.0				
200	PN 10	207.3	340.0	377	300	42	63.5
	PN 16	207.3	340.0				62.5
	PN 25	206.5	360.0				68.5
	PN 40	206.5	375.0				72.5

DN	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	x [mm]	Weight [kg]
250	PN 10	260.4	395.0	404	380	48	88.5
	PN 16	260.4	405.0				92.5
	PN 25	258.8	425.0				100.5
	PN 40	258.8	450.0				111.5
300	PN 10	309.7	445.0	427	450	51	121.5
	PN 16	309.7	460.0				129.5
	PN 25	307.9	485.0				140.5
	PN 40	307.9	515.0				158.5

Table: dimensions of Prowirl 73 F to ANSI B16.5

DN	Pressure rating		d [mm]	D [mm]	H [mm]	L [mm]	x [mm]	Weight [kg]
½"	Schedule 40	Cl. 150	15.7	88.9	277	200	16	5.5
		Cl. 300	15.7	95.0				
	Schedule 80	Cl. 150	13.9	88.9				
		Cl. 300	13.9	95.0				
1"	Schedule 40	Cl. 150	26.7	107.9	284	200	18	7.5
		Cl. 300	26.7	123.8				
	Schedule 80	Cl. 150	24.3	107.9				
		Cl. 300	24.3	123.8				
1½"	Schedule 40	Cl. 150	40.9	127.0	292	200	21	10.5
		Cl. 300	40.9	155.6				
	Schedule 80	Cl. 150	38.1	127.0				
		Cl. 300	38.1	155.6				
2"	Schedule 40	Cl. 150	52.6	152.4	299	200	23	12.5
		Cl. 300	52.6	165.0				
	Schedule 80	Cl. 150	49.2	152.4				
		Cl. 300	49.2	165.0				
3"	Schedule 40	Cl. 150	78.0	190.5	312	200	29	20.5
		Cl. 300	78.0	210.0				
	Schedule 80	Cl. 150	73.7	190.5				
		Cl. 300	73.7	210.0				
4"	Schedule 40	Cl. 150	102.4	228.6	324	250	32	27.5
		Cl. 300	102.4	254.0				
	Schedule 80	Cl. 150	97.0	228.6				
		Cl. 300	97.0	254.0				
6"	Schedule 40	Cl. 150	154.2	279.4	348	300	37	51.5
		Cl. 300	154.2	317.5				
	Schedule 80	Cl. 150	146.3	279.4				
		Cl. 300	146.3	317.5				
8"	Schedule 40	Cl. 150	202.7	342.9	377	300	42	64.5
		Cl. 300	202.7	381.0				76.5
10"	Schedule 40	Cl. 150	254.5	406.4	404	380	48	92.5
		Cl. 300	254.5	444.5				109.5
12"	Schedule 40	Cl. 150	304.8	482.6	427	450	60	143.5
		Cl. 300	304.8	520.7				162.5

Table: dimensions of Prowirl 73 F to JIS B2238

DN	Pressure rating		d [mm]	D [mm]	H [mm]	L [mm]	x [mm]	Weight [kg]
15	Schedule 40	20K	16.1	95.0	277	200	16	5.5
	Schedule 80	20K	13.9	95.0				
25	Schedule 40	20K	27.2	125.0	284	200	18	7.5
	Schedule 80	20K	24.3	125.0				
40	Schedule 40	20K	41.2	140.0	292	200	21	10.5
	Schedule 80	20K	38.1	140.0				
50	Schedule 40	10K	52.7	155.0	299	200	23	12.5
		20K	52.7	155.0				
	Schedule 80	10K	49.2	155.0				
		20K	49.2	155.0				
80	Schedule 40	10K	78.1	185.0	312	200	29	20.5
		20K	78.1	200.0				
	Schedule 80	10K	73.7	185.0				
		20K	73.7	200.0				
100	Schedule 40	10K	102.3	210.0	324	250	32	27.5
		20K	102.3	225.0				
	Schedule 80	10K	97.0	210.0				
		20K	97.0	225.0				
150	Schedule 40	10K	151.0	280.0	348	300	37	51.5
		20K	151.0	305.0				
	Schedule 80	10K	146.3	280.0				
		20K	146.3	305.0				
200	Schedule 40	10K	202.7	330.0	377	300	42	58.5
		20K	202.7	350.0				64.5
250	Schedule 40	10K	254.5	400.0	404	380	48	90.5
		20K	254.5	430.0				104.5
300	Schedule 40	10K	304.8	445.0	427	450	51	119.5
		20K	304.8	480.0				134.5

10. 5 Dimensions of flow conditioner

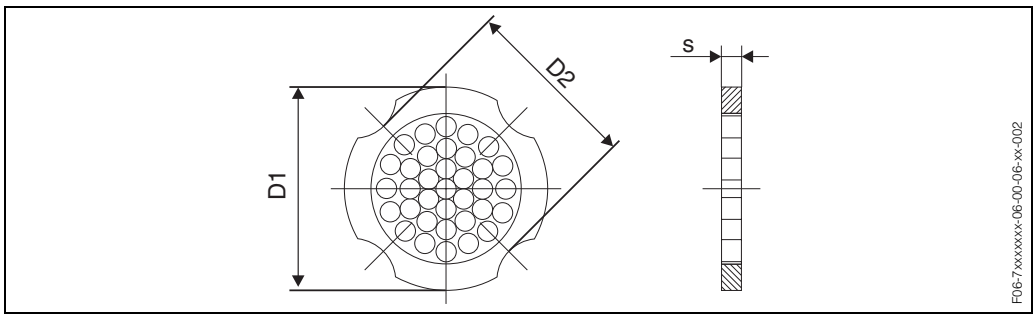


Fig. 32: Dimensions of flow conditioner to EN (DIN)/ANSI, material 1.4435 (316L)

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 to EN (DIN)

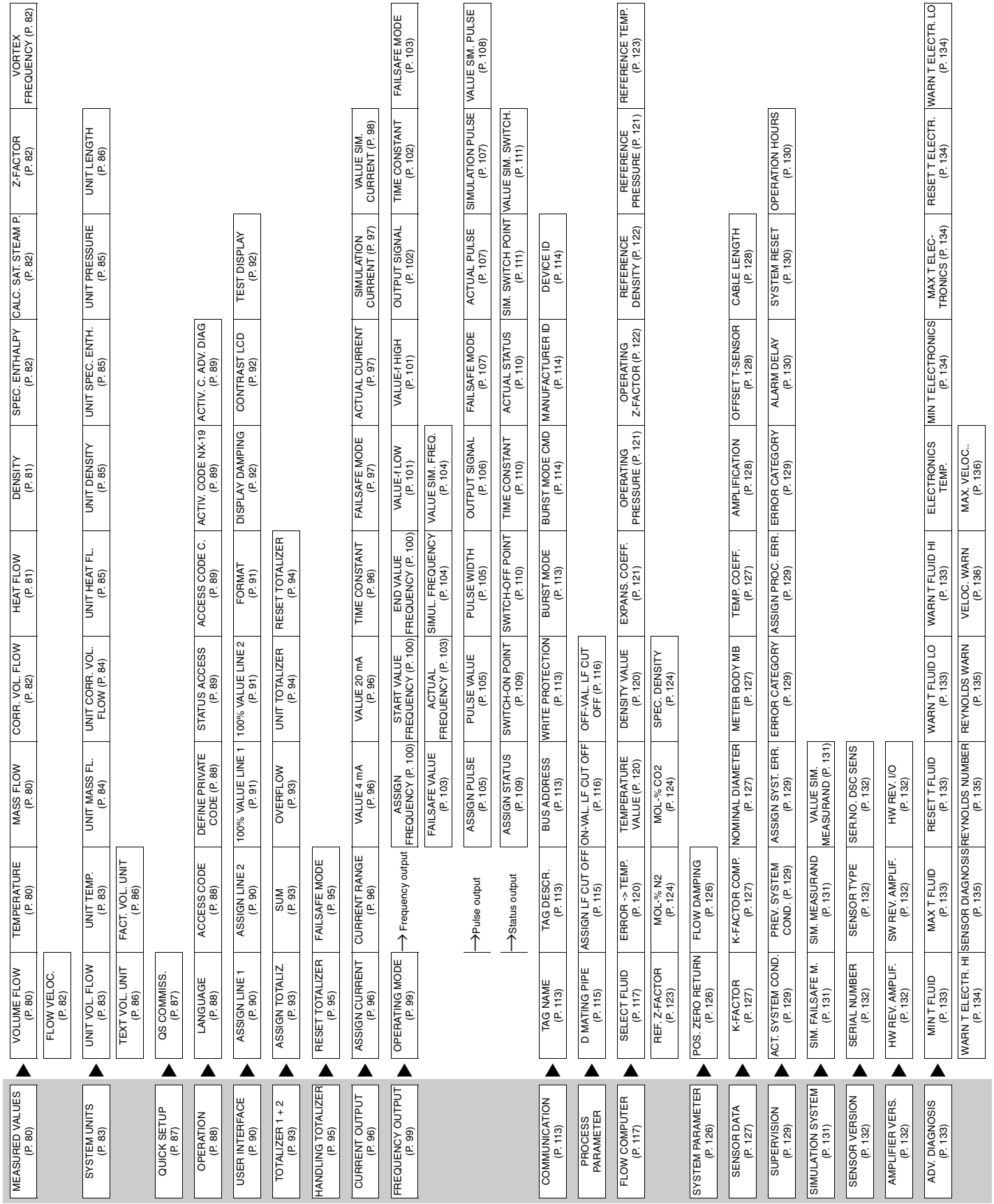
DN	Pressure rating	Centering ∅ [mm]	D1 / D2	s [mm]	Weight [kg]
15	PN 10...40	54.3	D2	2.0	0.04
25	PN 10...40	74.3	D1	3.5	0.12
40	PN 10...40	95.3	D1	5.3	0.3
50	PN 10...40	110.0	D2	6.8	0.5
80	PN 10...40	145.3	D2	10.1	1.4
100	PN 10/16 PN 25/40	165.3 171.3	D2 D1	13.3	2.4
150	PN 10/16 PN 25/40	221.0 227.0	D2 D2	20.0	6.3 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 to ANSI

DN	Pressure rating	Centering ∅ [mm]	D1 / D2	s [mm]	Weight [kg]
½"	Cl. 150 Cl. 300	51.1 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	223.6 252.0	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

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	
VOLUME FLOW	The volume flow currently measured appears on the display. **Display:** 5-digit floating-point number, including unit (e.g. 5.5445 dm^3/min; 1.4359 m^3/h; etc.) ✎ Note! The appropriate unit is taken from the UNIT VOLUME FLOW function (see Page 83).
TEMPERATURE	The temperature currently measured appears on the display. **Display:** Max. 4-digit fixed-point number, including unit and sign (e.g. –23.4 °C, 160.0 °F, 295.4 K, etc.) ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83).
MASS FLOW	✎ Note! This value is not available unless the SATURATED STEAM, SUPERHEATED STEAM, WATER, COMPRESSED AIR, REAL GAS, NATURAL GAS NX-19 or USER-DEFINED LIQUID option was selected in the SELECT FLUID function (Page 117). "– – – –" appears on the display if another option was selected. The calculated mass flow appears on the display. **Display:** 5-digit floating-point number, including unit (e.g. 462.87 kg/h; 731.63 lb/min; etc.) ✎ Note! • The mass flow is calculated using the measured volume flow and the measured temperature. • The appropriate unit is taken from the UNIT MASS FLOW function (see Page 84).
CORRECTED VOLUME FLOW	✎ Note! This value is not available unless the WATER, USER-DEFINED LIQUID, COMPRESSED AIR, REAL GAS or NATURAL GAS NX-19 option was selected in the SELECT FLUID function (Page 117). "– – – –" appears on the display if another option was selected. The calculated corrected volume flow appears on the display. **Display:** 5-digit floating-point number, including unit (e.g. 5.5445 Nm^3/min; 1.4359 Sm^3/h; etc.) ✎ Note! • The corrected volume flow is calculated using the measured volume flow and the measured temperature. • The appropriate unit is taken from the UNIT CORRECTED VOLUME FLOW function (see Page 84).

Function description MEASURED VALUES	
HEAT FLOW	✎ Note! This value is not available unless the SATURATED STEAM, SUPERHEATED STEAM or WATER option was selected in the SELECT FLUID function (Page 117). "– – – –" appears on the display if another option was selected. The heat flow determined appears on the display. **Display:** 5-digit floating point number, incl. unit, corresponds to 0.1000...6.000 MJ/h, (e.g. 1.2345 MJ/h, 993.5 MW, etc.) ✎ Note! • The heat flow is determined using the fluid selected in the SELECT FLUID function and the measured temperature. • The appropriate unit is taken from the UNIT HEAT FLOW function (see Page 85).
DENSITY	✎ Note! This function is not available unless the GAS VOLUME or LIQUID VOLUME option was selected in the SELECT FLUID function (Page 117). The density determined appears on the display. **Display:** 5-digit floating point number, incl. unit, corresponds to 0.100000...6.00000 kg/dm^3, (e.g. 1.2345 kg/dm^3, 1.0015 SG 20 °C, etc.) ✎ Note! • The density is determined using the fluid selected in the SELECT FLUID function (Page 117) and the measured temperature. • The appropriate unit is taken from the UNIT DENSITY function (see Page 85).
SPECIFIC ENTHALPY	✎ Note! This function is not available unless the SATURATED STEAM, WATER or SUPERHEATED STEAM option was selected in the SELECT FLUID function (Page 117). The specific enthalpy determined appears on the display. **Display:** 5-digit floating point number, (e.g. 5.1467 kJ/kg, etc.) ✎ Note! • The enthalpy is determined using the fluid selected in the SELECT FLUID function (Page 117) and the measured temperature. • The appropriate unit is taken from the UNIT SPECIFIC ENTHALPY function (see Page 85). • The enthalpy output by the device refers to the specific enthalpy of the boiling liquid at the triple point as per IAPWS-IF97. This means that the specific internal enthalpy and the specific entropy of the boiling liquid are set to zero at the triple point. It results that the specific enthalpy is 0.611783 J/g^{-1} at that point.

Function description MEASURED VALUES	
CALCULATED SATURATED STEAM PRESSURE	✎ Note! This function is not available unless the SATURATED STEAM option was selected in the SELECT FLUID function (Page 117) . The calculated steam pressure (of the saturated steam) appears on the display. **Display:** 5-digit floating point number, (e.g. 5.1467 bara, etc.) ✎ Note! • The steam pressure of the saturated steam is determined using the fluid selected in the SELECT FLUID function (Page 117) and the measured temperature. • The appropriate unit is taken from the UNIT SPECIFIC ENTHALPY function (see Page 85).
Z-FACTOR	✎ Note! This function is not available unless the NATURAL GAS NX-19 or COMPRESSED AIR option was selected in the SELECT FLUID function (Page 117). • If the COMPRESSED AIR option was selected, the calculated real gas constant Z appears on the display. • If the NATIRAL GAS NX-19 option was selected, the “Supercompressibility Factor” appears on the display. **Display:** 5-digit floating-point number, e.g. 0.9467 ✎ Note! The real gas constant Z indicates how far a real gas differs from an ideal gas which exactly fulfills the general gas law (p x V / T = constant, Z = 1). The real gas constant approaches the value 1 the further the real gas is from its liquefaction point.
VORTEX FREQUENCY	The vortex frequency currently measured appears on the display. **Display:** 5-digit floating-point number, incl. unit Hz, (e.g. 120.23 Hz) ✎ Note! This function is only used for a plausibility check.
VELOCITY	The flow velocity through the device appears on the display. This is calculated from the current flow through the device and the cross-sectional area flowed through. **Display:** 3-digit floating-point number, including unit ✎ Note! The unit displayed in this function depends on the option selected in the UNIT LENGTH function (see Page 86): • Selected option UNIT LENGTH = mm → unit in this function = m/s • Selected option UNIT LENGTH = inch → unit in this function = ft/s

11.2.2 Group SYSTEM UNITS

Function description SYSTEM UNITS	
UNIT VOLUME FLOW	For selecting the unit required and displayed for the volume flow. The unit you select here is also valid for: • Flow display • Current output (value 20 mA) • Frequency output (pulse value; value-f low, value-f high; on-value/off-value) • 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:** *Metric:* Cubic centimetre → cm^3/time unit Cubic decimetre → dm^3/time unit Cubic metre → m^3/time unit Millilitre → ml/time unit Litre → l/time unit Hectolitre → hl/time unit Megalitre → 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 86). **Factory setting** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) ✎ Note! The units for the totalizers are independent of the option selected here; they are selected in the UNIT TOTALIZER function (see P. 94).
UNIT TEMPERATURE	For selecting the unit required and displayed for the temperature. **Options:** °C (CELSIUS) K (KELVIN) °F (FAHRENHEIT) R (RANKINE) **Factory setting:** Depends on country, see Page 137 (metric units) or Page 138 (US units)

Function description SYSTEM UNITS	
UNIT MASS FLOW	For selecting the unit required and displayed for the calculated mass flow. The unit you select here is also valid for: • Flow display • Current output (value 20 mA) • Frequency output (pulse value; value-f low, value-f high; on-value/off-value) • 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:** *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)
UNIT CORRECTED VOLUME FLOW	For selecting the unit required and displayed for the corrected volume flow. The unit you select here is also valid for: • Flow display • Current output (value 20 mA) • Frequency output (pulse value; value-f low, value-f high; on-value/off-value) • 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:** *Metric:* – Norm litre → Nl/time unit – Norm cubic metre → Nm^3/time unit *US:* – Standard cubic meter → Sm^3/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)

Function description SYSTEM UNITS	
UNIT HEAT FLOW	For selecting the unit required and displayed for the heat flow. ✎ Note! The following units of time can be selected: s = second, m = minute, h = hour, d = day **Options:** *Metric:* – kW – MW – kJ/time unit – MJ/time unit – GJ/time unit – kcal/time unit – Mcal/time unit – Gcal/time unit *US:* – tons – kBtu/time unit – MBtu/time unit – GBtu/time unit **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions)
UNIT DENSITY	For selecting the unit required and displayed for the density. **Options:** *Metric* → g/cm³; g/cc; kg/dm³; kg/l; kg/m³; SD 4 °C, SD 15 °C, SD 20 °C; SG 4 °C, SG 15 °C, SG 20 °C *US* → lb/ft³; lb/US gal; lb/US bbl NORM (normal fluids); lb/US bbl BEER (beer); lb/US bbl PETR. (petrochemicals); lb/US bbl TANK (filling tanks) *Imperial* → lb/imp. gal; lb/imp. bbl BEER (beer); lb/imp. bbl PETR. (petrochemicals) **Factory setting:** Depends on country, see Page 137 (metric units) or Page 138 (US units) 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 SPECIFIC ENTHALPY	For selecting the unit required and displayed for the specific enthalpy of saturated steam, superheated steam or water. **Options:** *Metric* → kWh/kg; kJ/kg; MJ/kg; kcal/kg *US* → Btu/lb **Factory setting:** Depends on country, see P. 137 (metric units) or Page 138 (US units)
UNIT PRESSURE	For selecting the unit required and displayed for the pressure. **Options:** bara (bar absolute) psia (pounds per square inch absolute) **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions)

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 127). The unit you select here also affects: • The unit in which the cable length is entered (see Page 128) • The unit of velocity on the local display (see Page 82) **Options:** MILLIMETER INCH **Factory setting:** Depends on country, see Page 137 (metric units) or Page 138 (US units)
TEXT ARBITRARY VOLUME UNIT	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 VOLUME FLOW function (see Page 83). **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 VOLUME FLOW function (see Page 83).
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 / litre

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 43 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, see P. 137 (metr. units) or P. 138 (US units) ✎ Note! If you press the ⊟ keys (ESC) 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 = 73**, 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 organisation 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:** 73 ✎ 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	
STATUS ACCESS	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	The number of times the private and service code was entered to access the device appears on the display. **Display:** Integer (delivery status: 0)
ACTIVATION CODE NX-19	Use this function to enter the activation code of the software option “Natural gas NX-19” (only relevant if the amplifier board was exchanged). **User input:** 8-digit number: 0...99999999 ✎ Note! If you have ordered the measuring device with this software option, the activation code for this option is also printed on the service nameplate in the cover of electronics compartment.
ACTIVATION CODE ADVANCED DIAGNOSIS	Use this function to enter the activation code of the software option “Advanced Diagnostics” (only relevant if the amplifier board was exchanged). **User input:** 8-digit number: 0...99999999 ✎ Note! If you have ordered the measuring device with this software option, the activation code for this option is also printed on the service nameplate in the cover of electronics compartment.

11.2.5 Group USER INTERFACE

Function description USER INTERFACE	
ASSIGN LINE 1	For selecting the display value for the main line (top line of the local display) which should be displayed during normal operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % TEMPERATURE MASS FLOW MASS FLOW IN % CORRECTED VOLUME FLOW CORRECTED VOLUME FLOW IN % HEAT FLOW HEAT FLOW IN % TOTALIZER 1 TOTALIZER 2 **Factory setting:** VOLUME FLOW (if no data specified or LIQUID VOLUME or GAS VOLUME specified as fluid when ordering), otherwise MASS FLOW ✎ Note! • The appropriate unit is selected in the Group SYSTEM UNITS (see Page 83). • On the local display, totalizer 1 is displayed with I and totalizer 2 with II.
ASSIGN LINE 2	For selecting the display value for the additional line (bottom line of the local display) which should be displayed during normal operation. **Options:** OFF VOLUME FLOW VOLUME FLOW IN % BARGRAPH VOLUME FLOW IN % TEMPERATURE TOTALIZER 1 TOTALIZER 2 TAG NAME OPERATING/SYSTEM CONDITIONS MASS FLOW MASS FLOW IN % BARGRAPH MASS FLOW IN % CORRECTED VOLUME FLOW CORRECTED VOLUME FLOW IN % BARGRAPH CORRECTED VOLUME FLOW IN % HEAT FLOW HEAT FLOW IN % BARGRAPH HEAT FLOW IN % **Factory setting:** TEMPERATURE ✎ Note! • The appropriate unit is selected in the Group SYSTEM UNITS (see Page 83). • On the local display, totalizer 1 is displayed with I and totalizer 2 with II.

Function description USER INTERFACE	
100% VALUE LINE 1	✎ Note! This function is not available unless one of the following was selected in the ASSIGN LINE 1 function. • VOLUME FLOW IN % • MASS FLOW IN % • CORRECTED VOLUME FLOW IN % • HEAT FLOW IN % Use this function to enter the flow value which should be shown on the display as the 100% value. **User input:** 5-digit floating-point number **Factory setting:** 10 l/s (with volume flow) 10 kg/h (with mass flow) 10 Nm^3/h (with corrected volume flow) 10 kW (with heat flow)
100% VALUE LINE 2	✎ Note! This function is not available unless one of the following was selected in the ASSIGN LINE 2 function. • VOLUME FLOW IN % • MASS FLOW IN % • CORRECTED VOLUME FLOW IN % • HEAT FLOW IN % • BARGRAPH VOLUME FLOW IN % • BARGRAPH MASS FLOW IN % • BARGRAPH CORRECTED VOLUME FLOW IN % • BARGRAPH HEAT FLOW IN % Use this function to enter the flow value which should be shown on the display as the 100% value. **User input:** 5-digit floating-point number **Factory setting:** 10 l/s (with volume flow) 10 kg/h (with mass flow) 10 Nm^3/h (with corrected volume flow) 10 kW (with heat flow)
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.

Function description USER INTERFACE	
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 126).
CONTRAST LCD	Use this function to optimise 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 TOTALIZERS 1 and 2

Function description TOTALIZER	
ASSIGN TOTALIZER	Use this function to assign a measured variable to the totalizer. **Options (totalizer 1 and 2):** OFF VOLUME FLOW MASS FLOW CORRECTED VOLUME FLOW HEAT FLOW **Factory setting (totalizer 1):** VOLUME FLOW (if no data specified or LIQUID VOLUME or GAS VOLUME specified as fluid when ordering), otherwise MASS FLOW **Factory setting (totalizer 2):** VOLUME FLOW ✎ Note! • If the option selected is changed, you are asked whether the totalizer in question should be reset. This prompt must be confirmed before the new selected option is accepted and the totalizer reset to the value “0”. • If the option selected is changed, the related unit must be adjusted to suit the option in the UNIT TOTALIZER function (see Page 94)! • If you select OFF, only the ASSIGN TOTALIZER function is displayed in the Group Totalizer 1 or 2.
SUM TOTALIZER	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.15467.4m³) ✎ Note! • The totalizers' response to errors is defined in the FAILSAFE MODE function (see Page 95). • On the local display, totalizer 1 is displayed with I and totalizer 2 with II.
OVERFLOW TOTALIZER	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 unit, e.g. 2 E7 kg

Function description TOTALIZER	
UNIT TOTALIZER	Use this function to define the unit for the totalizer. Depending on what is selected in the ASSIGN TOTALIZER function (see Page 93), only the associated units are offered for selection here. **Option selected (ASSIGN TOTALIZER = VOLUME FLOW):** *Metric:* Cubic centimetre → cm^3 Cubic decimetre → dm^3 Cubic metre → m^3 Millilitre → ml Litre → l Hectolitre → hl Megalitre → 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. *Arbitrary volume unit:* This option does not appear unless a volume unit was defined via the TEXT ARBITRARY VOLUME UNIT function (see Page 86). **Factory setting** Depends on country, see Page 137 (metric) or Page 138 (US) **Option selected (ASSIGN TOTALIZER = MASS FLOW):** *Metric* → g, kg, t *US* → oz, lb, ton **Factory setting:** Depends on country, see Page 137 (metric) or Page 138 (US) **Option selected (ASSIGN TOTALIZER = CORRECTED VOLUME FLOW)** *Metric* → Nl, Nm^3 *US* → Sm^3, Scf **Factory setting:** Depends on country, see Page 137 (metric) or Page 138 (US) **Option selected (ASSIGN TOTALIZER = HEAT FLOW):** *Metric* → kWh, MWh, MJ, GJ, kcal, Mcal, Gcal *US* → kBtu, MBtu, tonh **Factory setting:** Depends on country, see Page 137 (metric) or Page 138 (US)
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to 0 (= RESET). **Options:** NO YES **Factory setting:** NO

11.2.7 Group HANDLING TOTALIZER

Function description HANDLING TOTALIZER	
RESET ALL TOTALIZERS	Use this function to reset the sum and the overflow of both totalizers to 0 (= RESET). **Options:** NO YES **Factory setting:** NO
FAILSAFE MODE	Use this function to define the response of both totalizers to an alarm condition. **Options:** STOP The totalizer does not continue to count the flow if a fault is present. The totalizer stops at the last value before the alarm condition occurred. ACTUAL VALUE The totalizer continues to count the flow on the basis of the current flow data. The fault is ignored. HOLD VALUE The totalizer continues to count the flow on the basis of the last valid flow data (before the fault occurred). **Factory setting:** STOP

11.2.8 Group CURRENT OUTPUT

Function description CURRENT OUTPUT	
ASSIGN CURRENT	Use this function to assign a measured variable to the current output. **Options:** VOLUME FLOW TEMPERATURE MASS FLOW CORRECTED VOLUME FLOW HEAT FLOW **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions)
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 4 mA	Use this function to assign the 4 mA current a value. The value must be smaller than the value entered in the VALUE 20 mA function. **User input:** 5-digit floating-point number **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. The value must be greater than the value entered in the VALUE 4 mA function. **User input:** 5-digit floating-point number **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions)
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 (see Page 126) function.

Function description CURRENT OUTPUT	
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 96). 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
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” (see Page 53) 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.

Function description CURRENT OUTPUT	
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.

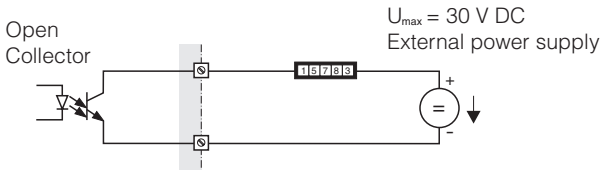
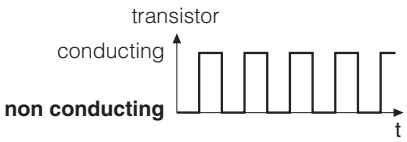
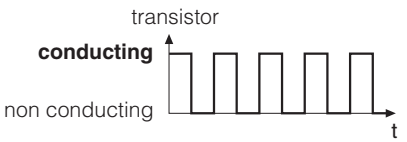
11.2.9 Group FREQUENCY OUTPUT

✎ Note!
The frequency output can also be operated as a pulse or status output.

Function description FREQUENCY OUTPUT	
OPERATING MODE	Use this function to specify whether the output functions as a frequency output, pulse output or status output. The functions available in this function group vary, depending on which option you select here. **Options:** FREQUENCY PULSE STATUS VORTEX FREQUENCY (unscaled pulses, together with flow computer RMC or RMS 621, see Page 25) PFM **Factory setting:** PULSE ✎ Note! • If PFM is selected, the Current Output Group (see Page 96 ff.) is no longer available. Current simulation is automatically activated with a simulation value of 4 mA. If the transmitter was wired for pulse-frequency modulation (see Page 25), 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 also taken into account.

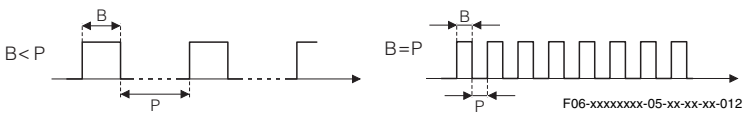
Function description FREQUENCY OUTPUT	
ASSIGN FREQUENCY	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to assign a measured variable to the frequency output. **Options:** VOLUME FLOW TEMPERATURE MASS FLOW CORRECTED VOLUME FLOW HEAT FLOW **Factory setting:** VOLUME FLOW ✎ Note! If FREQUENCY is selected in the OPERATING MODE function and OFF is selected in this function, only the OPERATING MODE and ASSIGN FREQUENCY functions continue to be displayed in this function group.
START VALUE FREQUENCY	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to define a start frequency for the frequency output. You specify the associated measured value of the measuring range in the VALUE-f LOW function on Page 101. **User input:** 4-digit fixed-point number 0...1000 Hz **Factory setting:** 0 Hz Example: • Start frequency = 0 Hz, VALUE-f low = 0 kg/h: i.e. a frequency of 0 Hz is output with a flow of 0 kg/h. • Start frequency = 10 Hz, VALUE-f low = 1 kg/h: i.e. a frequency of 10 Hz is output with a flow of 1 kg/h.
END VALUE FREQUENCY	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to define an end frequency for the frequency output. You specify the associated measured value of the measuring range in the VALUE-f HIGH function on Page 101. **User input:** 5-digit fixed-point number: 2...1,000 Hz **Factory setting:** 1,000 Hz Example: • End frequency = 1000 Hz, VALUE-f high = 1000 kg/h: i.e. a frequency of 1000 Hz is output with a flow of 1000 kg/h. • End frequency = 1000 Hz, VALUE-f high = 3600 kg/h: i.e. a frequency of 1000 Hz is output with a flow of 3600 kg/h. ✎ Note! In the FREQUENCY operating mode the output signal is symmetrical (on/off ratio = 1:1).

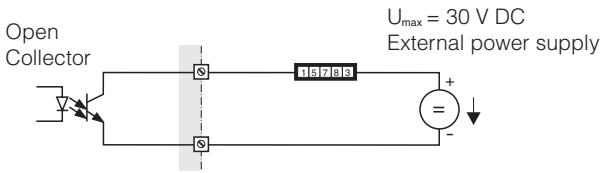
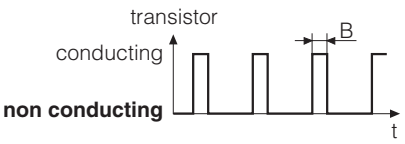
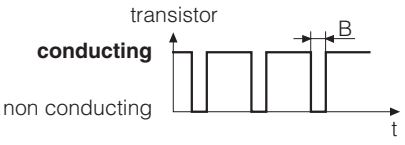
Function description FREQUENCY OUTPUT	
VALUE-f LOW	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to assign a value to the start frequency (see P. 100). The value entered here must be smaller than the value assigned to the VALUE-f HIGH. A negative value is only permitted when TEMPERATURE is selected in the ASSIGN FREQUENCY function. You define the desired span by specifying the VALUE-f LOW and VALUE-f HIGH. **User input:** 5-digit floating-point number **Factory setting:** Depends on the option selected in the ASSIGN FREQUENCY function – 0 UNIT VOLUME FLOW – 0 °C (converted to the UNIT TEMPERATURE) – 0 UNIT MASS FLOW – 0 UNIT CORRECTED VOLUME FLOW – 0 UNIT HEAT FLOW ✎ Note! The appropriate unit is taken from the Group SYSTEM UNITS (Page 83 ff.).
VALUE-f HIGH	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to assign a value to the end frequency (see P. 100). The value entered here must be greater than the value assigned to the VALUE-f LOW. A negative value is only permitted when TEMPERATURE is selected in the ASSIGN FREQUENCY function. You define the desired span by specifying the VALUE-f LOW and VALUE-f HIGH. **User input:** 5-digit floating-point number **Factory setting:** Depends on the option selected in the ASSIGN FREQUENCY function. – 10 l/s (converted to the UNIT VOLUME FLOW) – 200 °C (converted to the UNIT TEMPERATURE) – 10 kg/h (converted to the UNIT MASS FLOW) – 10 Nm^3/h (converted to the UNIT CORRECTED VOLUME FLOW) – 10 kW (converted to the UNIT HEAT FLOW) ✎ Note! The appropriate unit is taken from the Group SYSTEM UNITS (Page 83 ff.)

Function description FREQUENCY OUTPUT	
OUTPUT SIGNAL	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to select the polarity of the frequency. **Options:** PASSIVE - POSITIVE PASSIVE - NEGATIVE **Factory setting:** PASSIVE - POSITIVE **PASSIVE:**  F-xxxxxxx-04-xx-xx-en-000 Wiring diagram see Page 25. ✎ Note! For continuous currents up to 15 mA **PASSIVE-NEGATIVE**  F06-7xxxxxxx-05-xx-xx-en-000 **PASSIVE-POSITIVE**  F06-7xxxxxxx-05-xx-xx-en-001
TIME CONSTANT	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to enter a time constant defining how the frequency output signal reacts to severely fluctuating measured variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). **User input:** Floating-point number 0...100 s **Factory setting:** 5 s

Function description FREQUENCY OUTPUT	
FAILSAFE MODE	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. The dictates of safety render it advisable to ensure that the frequency 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 frequency output. It has no effect on other outputs or the display (e.g. totalizers). **Options:** – FALLBACK VALUE 0 Hz is output. – FAILSAFE VALUE The frequency specified in the FAILSAFE VALUE function is output. – 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
FAILSAFE VALUE	✎ Note! This function is not available unless FREQUENCY was selected in the OPERATING MODE function and FAILSAFE VALUE was selected in the FAILSAFE MODE function. Use this function to define the frequency that the measuring device outputs in the event of an error. **User input:** Max. 4-digit number: 0...1250 Hz **Factory setting:** 1250 Hz
ACTUAL FREQUENCY	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. The computed actual value of the output frequency appears on the display. **Display:** 0...1250 Hz

Function description FREQUENCY OUTPUT	
SIMULATION FREQUENCY	✎ Note! This function is not available unless the FREQUENCY option was selected in the OPERATING MODE function. Use this function to activate simulation of the frequency output. **Options:** OFF ON **Factory setting:** OFF ✎ Note! • The “SIMULATION FREQUENCY OUTPUT” notice message 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 FREQUENCY	✎ Note! This function is not available unless FREQUENCY was selected in the OPERATING MODE function and ON was selected in the SIMULATION FREQUENCY function. Use this function to define a selectable frequency value (e.g. 500 Hz) to be output at the frequency output. This value is used to test downstream devices and the measuring device itself. Simulation is started once the specified value is confirmed with the E key. **User input:** 0...1250 Hz **Factory setting:** 0 Hz ✎ 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 FREQUENCY 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 OUTPUT	
ASSIGN PULSE	✎ Note! This function is not available unless the PULSE option was selected in the OPERATING MODE function. Use this function to assign a measured variable to the pulse output. **Options:** – VOLUME FLOW – MASS FLOW – CORRECTED VOLUME FLOW – HEAT FLOW **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions)
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 totalled 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 Group SYSTEM UNITS (Page 83 ff.).
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 configured. However, they must at least correspond to the pulse width (B = P).  B = Pulse width entered (the illustration applies to positive pulses) P = Intervals between the individual pulses

Function description PULSE OUTPUT	
PULSE WIDTH (contd.)	✎ 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 105) and the current flow is too large to maintain the pulse width selected (the interval P is smaller than the pulse width B entered), a system error message (#359, PULSE RANGE, see Page 51) 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 can be operated with 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:**  F-xxxxxxx-04-xx-xx-en-000 Wiring diagram see Page 25. ✎ Note! For continuous currents up to 15 mA **PASSIVE-NEGATIVE** Pulse (B = Pulse width)  F06-7xxxxxxx-05-xx-xx-en-002 **PASSIVE-POSITIVE** Pulse (B = Pulse width)  F06-7xxxxxxx-05-xx-xx-en-003

Function description PULSE OUTPUT	
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 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 OUTPUT	
SIMULATION PULSE (contd.)	**Factory setting:** OFF ✎ Note! • The notice message #631 “SIM. PULSE” (see Page 53) 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 STATUS OUTPUT	
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 – VOLUME FLOW LIMIT VALUE – TEMPERATURE LIMIT VALUE – MASS FLOW LIMIT VALUE – CORRECTED VOLUME FLOW LIMIT VALUE – HEAT FLOW LIMIT VALUE – TOTALIZER 1 LIMIT VALUE – TOTALIZER 2 LIMIT VALUE **Factory setting:** FAULT MESSAGE ✎ Note! • The status output displays quiescent current behaviour, 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 behaviour of the status output (see Page 112). • 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 a limit value 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 permissible (exception TEMPERATURE LIMIT VALUE). **User input:** 5-digit floating-point number, including unit **Factory setting:** Depends on the option selected in the ASSIGN STATUS function – If VOLUME FLOW LIMIT VALUE was selected: see Tab. on Page 137/138 – If TEMPERATURE LIMIT VALUE was selected: 180 °C (converted to the selected UNIT TEMPERATURE) – If MASS FLOW LIMIT VALUE was selected: 10 kg/h (converted to the selected UNIT MASS FLOW) – If CORRECTED VOLUME FLOW LIMIT VALUE was selected: 10 Nm^3/h (converted to the selected UNIT CORRECTED VOLUME FLOW) – If HEAT FLOW LIMIT VALUE was selected: 10 kW (converted to the selected UNIT HEAT FLOW) – If TOTALIZER 1 LIMIT VALUE was selected: 0 (converted to the selected UNIT TOTALIZER 1) – If TOTALIZER 2 LIMIT VALUE was selected: 0 (converted to the selected UNIT TOTALIZER 2) ✎ Note! The appropriate unit is taken from the Group SYSTEM UNITS (Page 83 ff.)

Function description STATUS OUTPUT	
SWITCH-OFF POINT	✎ Note! This function is not available unless a limit value 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 permissible (exception TEMPERATURE LIMIT VALUE). **User input:** 5-digit floating-point number, including unit **Factory setting:** Depends on the option selected in the ASSIGN STATUS function – If VOLUME FLOW LIMIT VALUE was selected: see Tab. on Page 137/138 – If TEMPERATURE LIMIT VALUE was selected: 170 °C (converted to the selected UNIT TEMPERATURE) – If MASS FLOW LIMIT VALUE was selected: 9 kg/h (converted to the selected UNIT MASS FLOW) – If CORRECTED VOLUME FLOW LIMIT VALUE was selected: 9 Nm^3/h (converted to the selected UNIT CORRECTED VOLUME FLOW) – If HEAT FLOW LIMIT VALUE was selected: 9 kW (converted to the selected UNIT HEAT FLOW) – If TOTALIZER 1 LIMIT VALUE was selected: 0 (converted to the selected UNIT TOTALIZER 1) – If TOTALIZER 2 LIMIT VALUE was selected: 0 (converted to the selected UNIT TOTALIZER 2) ✎ Note! The appropriate unit is taken from the Group SYSTEM UNITS (Page 83 ff.).
TIME CONSTANT	✎ Note! This function is not available unless a limit value (except TOTALIZER 1 or 2 LIMIT VALUE) 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 126).
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

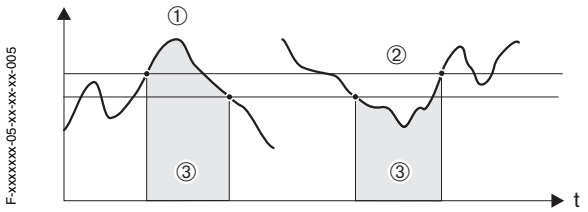
Function description STATUS OUTPUT	
SIMULATION SWITCH POINT	Note! This function is not available unless the STATUS option was selected in the OPERATING MODE function. Use this function to activate simulation of the status output. **Options:** OFF ON **Factory setting:** OFF Note! • The notice message #641 “SIMULATION STATUS OUTPUT” (see Page 53) 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 behaviour 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 behaviour of the status output during the simulation. The prompt “CONDUCTIVE” or “NOT CONDUCTIVE” appears if the + or − key is pressed. Select the desired switching behaviour 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.

11.2.10 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.

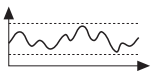
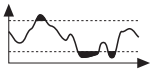
Status output configured for limit value
The status output switches as soon as the current measured variable undershoots or overshoots a defined switch point.
Application: monitoring flow or process-related boundary conditions.

Measured variable



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

Switching behaviour of the status output

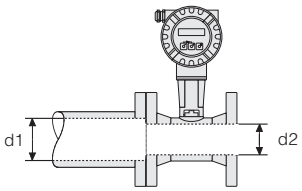
Function	Status	Open collector behaviour (transistor)
ON (operation)	System in operation	Conductive
	System not in operation (power supply failure)	Not conductive
Fault message	System OK	Conductive
	(System or process error) Fault → failsafe mode outputs/inputs and totalizers	Not conductive
Notice message	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

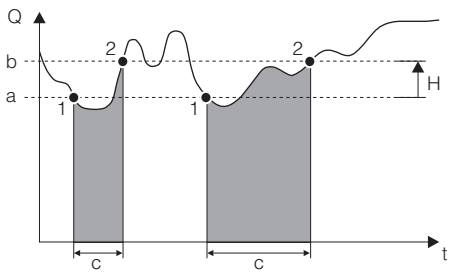
11.2.11 Group COMMUNICATION

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 41).
BURST MODE	Use this function to activate cyclic data exchange of the process variables selected in the BURST MODE CMD function to achieve faster communication. **Options:** OFF ON **Factory setting:** OFF

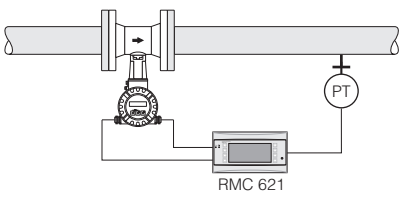
Function description COMMUNICATION	
BURST MODE CMD	Use this function to select the process values which are cyclically sent to the HART master in the Burst Mode. **Options:** CMD 1 Read primary measured variable (e.g. volume flow). CMD 2 Read current and percentage of the measuring range. CMD 3 Read current and four (previously defined) measured variables (see HART command No. 51, Page 38). **Factory setting:** CMD 1
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:** 57 = (87 dec) for Prowirl 73

11.2.12 Group PROCESS PARAMETER

Function description PROCESS PARAMETER	
D MATING PIPE	The device has diameter step correction. This can be activated by entering the actual value of the mating pipe (see Fig., d1) in this parameter. If the mating pipe (d1) and the measuring pipe (d2) have different diameters, this alters the flow profile. A diameter step can occur if: • The mating pipe has a different pressure rating to that of the measuring device. • The mating pipe has another schedule to that of the measuring pipe (e.g. 80 instead of 40), for ANSI. To correct any resulting shift in the calibration factor, enter the actual value of the mating pipe (d1) in this parameter.  F06-72xxxxxx-16-00-00-xx-000 d1 > d2 d1 = Mating pipe diameter d2 = Measuring pipe diameter **User input:** 5-digit floating-point number **Factory setting:** 0 ✎ Note! • Inlet correction is switched off if 0 is entered. • The appropriate unit is taken from the UNIT LENGTH function (see Page 86). • Only diameter steps within the same nominal diameter class (e.g. DN 50 / ½“) can be corrected. • If the standard internal diameter of the process connection ordered for the device and the internal diameter of the mating pipe differ, you must reckon with an additional uncertainty of measurement of typ. 0.1% o.r. (of reading) for every 1 mm diameter deviation.
ASSIGN LOW FLOW CUT OFF	For selecting the process variable on which low flow cut off should act. **Options:** – OFF – VOLUME FLOW – MASS FLOW – CORRECTED VOLUME FLOW – HEAT FLOW – REYNOLDS NUMBER* **Factory setting:** VOLUME FLOW * This option is not available unless the SATURATED STEAM, WATER, COMPRESSED AIR, SUPERHEATED STEAM or NATURAL GAS NX-19 option was selected in the SELECT FLUID function. ✎ Note! If you choose a selection that can‘t be calculated for your selected media (e.g. corrected volume for saturated steam), low flow cut off is not taken into account.

Function description PROCESS PARAMETER	
ON-VALUE LOW FLOW CUT OFF	✎ Note! This function is **not** available if the OFF option was selected in the ASSIGN LOW FLOW CUT OFF function. Use this function to enter the on-value for low flow cut off. **If VOLUME FLOW, MASS FLOW, CORRECTED VOLUME FLOW or HEAT FLOW is selected in the ASSIGN LOW FLOW CUT OFF function (see Page 115):** Low flow cut off is switched on if the value entered is not equal to 0. An inverted plus sign is shown on the local display of the flow value as soon as the low flow cut off is active. **User input:** 5-digit floating-point number **Factory setting:** Below the standard measuring range ✎ Note! The appropriate unit is taken from the Group SYSTEM UNITS (Page 83 ff.). **If REYNOLDS NUMBER is selected in the ASSIGN LOW FLOW CUT OFF function (see Page 115):** If the Reynolds number entered here is undershot, low flow cut off becomes active. An inverted plus sign is shown on the local display of the flow value when the low flow cut off is active. **User input:** 4,000...99,999 **Factory setting:** 20,000
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:  F06-80xxxxxx-05-xx-xx-xx-007 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

11.2.13 Group FLOW COMPUTER

Function description FLOW COMPUTER	
SELECT FLUID	✎ Note! We recommend you only change the fluid selected by means of the Commissioning Quick Setup (see Page 43). In the Commissioning Quick Setup, you can adjust all the relevant parameters to suit the newly selected fluid. **Options:** SATURATED STEAM GAS VOLUME (only volume and temperature measurement possible) LIQUID VOLUME (only volume and temperature measurement possible) WATER USER-DEFINED LIQUID COMPRESSED AIR SUPERHEATED STEAM REAL GAS (for all gases not listed here; pay attention to Note) NATURAL GAS NX-19 (only available as option, P. 89; pay attention to Note) **Factory setting:** See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions) **Information on the fluids which can be selected** **Selected fluid → SATURATED STEAM** *Applications:* Calculation of the mass flow and the enthalpy it contains at the output of a steam generator or an individual consumer. *Calculated variables:* The mass flow, heat flow, density and the specific enthalpy are calculated from the measured volume flow and the measured temperature, with the aid of the saturated steam curve to the international standard IAPWS-IF97 (ASME steam data). *Formula for calculation:* • Mass flow → $m = q \cdot \rho\ (T)$ • Heat flow → $E = q \cdot \rho\ (T) \cdot h_D\ (T)$ m = Mass flow E = Heat flow q = Volume flow (measured) h_D = Specific enthalpy T = Operating temperature (measured) ρ = Density* * from saturated steam curve in accordance with IAPWS-IF97 (ASME), for the measured temperature **Selected fluid → GAS VOLUME or LIQUID VOLUME** *Applications:* The measured volume flow and the measured temperature are made available to an external flow computer (e.g. RMC 621). The flow can be calculated at non-constant pressure in conjunction with an external pressure transmitter (PT). *Calculated variables:* None in the device; calculation takes place in the flow computer. Example of application:  F06-73xxxxxx-04-xx-xx-xx-000 Continued on next page

Function description FLOW COMPUTER	
SELECT FLUID (contd.)	**Selected fluid → SUPERHEATED STEAM** *Applications:* Calculation of the mass flow and the enthalpy it contains at the output of a steam generator or an individual consumer. ✎ Note! The average operating pressure (p) in the steam line is needed for calculating the process variables and the measuring range limit values. The average operating pressure is not available as an input signal but must be entered in the OPERATING PRESSURE function (see P. 121), i.e. exact calculation can only take place at a constant operating pressure. *Calculated variables:* The mass flow, heat flow, density and the specific enthalpy are calculated from the measured volume flow, the measured temperature and the specified operating pressure, with the aid of the steam data to the international standard IAPWS-IF97 (ASME steam data). *Formula for calculation:* • Mass flow → $m = q \cdot \rho\ (T, p)$ • Heat flow → $E = q \cdot \rho\ (T, p) \cdot h_D\ (T, p)$ m = Mass flow E = Heat flow q = Volume flow (measured) h_D = Specific enthalpy T = Operating temperature (measured) p = Operating pressure (see Page 121) ρ = Density* * from steam data in accordance with IAPWS-IF97 (ASME), for the measured temperature and the specified pressure **Selected fluid → WATER** *Applications:* Calculation of the enthalpy in a flow of water, e.g. to determine the residual heat in the return of a heat exchanger. ✎ Note! The average operating pressure (p) in the water line is needed for calculating the process variable. The average operating pressure is not available as an input signal but must be entered in the OPERATING PRESSURE function (see P. 121), i.e. exact calculation can only take place at a constant operating pressure. *Calculated variables:* The mass flow, heat flow, density and the specific enthalpy are calculated from the measured volume flow, the measured temperature and the specified operating pressure, with the aid of the water data to the international standard IAPWS-IF97 (ASME water data). *Formula for calculation:* • Mass flow → $m = q \cdot \rho\ (T, p)$ • Heat flow → $E = q \cdot \rho\ (T, p) \cdot h\ (T)$ • Corrected volume flow → $q_{ref} = q \cdot (\rho\ (T, p) \div \rho_{ref})$ m = Mass flow E = Heat flow q = Volume flow (measured) q_{ref} = Corrected volume flow h = Specific enthalpy of water T = Operating temperature (measured) p = Operating pressure (see Page 121) ρ = Density* ρ_{ref} = Reference density (see Page 122) * from water data in accordance with IAPWS-IF97 (ASME), for the measured temperature and the specified pressure. Continued on next page

Function description FLOW COMPUTER	
SELECT FLUID (contd.)	**Selected fluid → USER-DEFINED LIQUID** *Applications:* Calculation of the mass flow of a user-defined liquid, e.g. a thermal oil. *Calculated variables:* The mass flow, density and the corrected volume flow are calculated from the measured volume flow and the measured temperature. *Formula for calculation:* • Mass flow → $m = q \cdot \rho_{(T)}$ • Density → $\rho = \rho_{1\,(T_1)} \div (1 + \beta_p \cdot [T - T_1])$ • Corrected volume flow → $q_{ref} = q \cdot (\rho_{(T)} \div \rho_{ref})$ m = Mass flow q = Volume flow (measured) q_{ref} = Corrected volume flow T = Operating temperature (measured) T_1 = temp. at which the value for ρ_1 applies (see Page 120)* ρ = Density ρ_{ref} = Reference density (see Page 122) ρ_1 = Density at which the value for T_1 applies (see Page 120)* β_p = Expansion coeff. of the liquid at T_1 (see Page 121)* * For possible combinations of these values, see Table on Page 125 **Selected fluid → REAL GAS (nitrogen, CO_2, etc.), COMPRESSED AIR or NATURAL GAS NX-19** *Applications:* Calculation of the mass flow and the corrected volume flow of gases. ✎ Note! The average operating pressure (p) in the gas line is needed for calculating the process variables and the measuring range limit values. The average operating pressure is not available as an input signal but must be entered in the OPERATING PRESSURE function (see Page 121), i.e. exact calculation can only take place at a constant operating pressure. *Calculated variables:* The mass flow, density and the corrected volume flow are calculated from the measured volume flow, the measured temperature and the specified operating pressure using data stored in the device. ✎ Note! The NX-19 equation is suitable for natural gas with a specific density between 0.554...0.75. The specific density describes the ratio of the reference density of the natural gas to the reference density of air (see P. 124). *Formula for calculation:* • Mass flow → $m = q \cdot \rho_{(T, p)}$ • Density (natural gas) → $\rho_{(T, p)} = \rho_{ref} \cdot (p \div p_{ref}) \cdot (T_{ref} \div T) \cdot (Z_{ref} \div Z)$ • Corrected volume flow → $q_{ref} = q \cdot (\rho_{(T, p)} \div \rho_{ref})$ m = Mass flow q = Volume flow (measured) q_{ref} = Corrected volume flow T = Operating temperature (measured) T_{ref} = Reference temperature (see Page 123) p = Operating pressure (see Page 121) p_{ref} = Reference pressure (see Page 122) ρ = Density* ρ_{ref} = Reference density (see Page 122)* Z = Operating Z-factor (see Page 122)* Z_{ref} = reference Z-factor (see Page 123)* * The values from the functions are only used for real gas. For compressed air and natural gas NX-19, the necessary data are taken from tables stored in the device.

Function description FLOW COMPUTER	
ERROR -> TEMPERATURE	Use this function to enter a temperature value for temperature measurement failure. If temperature measurement fails, the device continues to work with the temperature value entered here. **User input:** 5-digit floating-point number; incl. unit **Factory setting:** 20 °C ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83).
TEMPERATURE VALUE	✎ Note! This function is not available unless the USER-DEFINED LIQUID option was selected in the SELECT FLUID function. Use this function to enter the fluid temperature for the density specified in the DENSITY VALUE function for calculating the operating density of user-defined liquids (formula for calculation, see SELECT FLUID function, Page 117). **User input:** 5-digit floating-point number **Factory setting:** 293.15 K (20 °C) ✎ Note! • The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83). • If the value in this function is changed, we recommend you reset the totalizers. • A table with sample values (for the TEMPERATURE VALUE, DENSITY VALUE and EXPANSION COEFFICIENT functions) for various fluids can be found on Page 125. ☝ 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 69).
DENSITY VALUE	✎ Note! This function is not available unless the USER-DEFINED LIQUID option was selected in the SELECT FLUID function. Use this function to enter the density at the fluid temperature specified in the TEMPERATURE VALUE function, for calculating the operating density of user-defined liquids (formula for calculation, see SELECT FLUID function, Page 117). **User input:** 5-digit floating-point number **Factory setting:** 1.0000 kg/dm³ ✎ Note! • The appropriate unit is taken from the UNIT DENSITY function (see Page 85). • If the value in this parameter is changed, we recommend you reset the totalizer. • A table with sample values (for the TEMPERATURE VALUE, DENSITY VALUE and EXPANSION COEFFICIENT functions) for various fluids can be found on Page 125.

Function description FLOW COMPUTER	
EXPANSION COEFFICIENT	✎ Note! This function is not available unless the USER-DEFINED LIQUID option was selected in the SELECT FLUID function. Use this function to enter the expansion coefficient for calculating the operating density of user-defined liquids (formula for calculation, see SELECT FLUID function, Page 117). **User input:** 5-digit floating-point number, incl. unit (10^{-4} · 1/UNIT TEMPERATURE) **Factory setting:** 2.0700 [10^{-4} · 1/K] (expansion coefficient for water at 20 °C) ✎ Note! • If the value in this function is changed, we recommend you reset the totalizers. • You can determine the expansion coefficient with the aid of the Applicator ("Fluid Properties" tab). Applicator is software from Endress+Hauser for selecting and planning flowmeters. The Applicator is available both via the Internet (www.applicator.com) and on a CD-ROM for local PC installation. • If two value pairs are known for temperature and density (density ρ_1 at temperature T_1 and density ρ_2 at temperature T_2), the expansion coefficient can be calculated as follows: $\beta_p = \frac{\left(\frac{\rho_1}{\rho_2} - 1\right)}{(T_1 - T_2)}$ • A table with sample values (for the TEMPERATURE VALUE, DENSITY VALUE and EXPANSION COEFFICIENT functions) for various fluids can be found on Page 125. ✎ Note! The appropriate unit of temperature is taken from the UNIT TEMPERATURE function (see Page 83).
OPERATING PRESSURE	✎ Note! This function is not available unless the WATER, COMPRESSED AIR, SUPERHEATED STEAM, REAL GAS or NATURAL GAS NX-19 option was selected in the SELECT FLUID function. Use this function to enter the medium pressure to calculate the operating density (formula for calculation, see SELECT FLUID function, Page 117). **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! See parameter printout supplied (the parameter printout is an integral part of these Operating Instructions)

Function description FLOW COMPUTER	
OPERATING Z-FACTOR	✎ Note! This function is not available unless the REAL GAS option was selected in the SELECT FLUID function. Use this function to enter the Z-factor for gas under operating conditions, i.e. for the average temperature to be expected (formula for calculation, see SELECT FLUID function, Page 117). The real gas constant Z indicates how far a real gas differs from an ideal gas which exactly fulfills the general gas law (p x V / T = constant, Z = 1). The real gas constant approaches the value 1 the further the real gas is from its liquefaction point. **User input:** 5-digit floating-point number (Entry value must be > 0) **Factory setting:** 1.0000 ✎ Note! You can determine the Z-factor with the aid of the Applicator. Applicator is software from Endress+Hauser for selecting and planning flowmeters. The Applicator is available both via the Internet (www.applicator.com) and on a CD-ROM for local PC installation.
REFERENCE DENSITY	✎ Note! This function is not available unless the REAL GAS or USER-DEFINED LIQUID option was selected in the SELECT FLUID function. Use this function to enter the reference density of the fluid to calculate the standard volume and the density of real gas (formula for calculation, see SELECT FLUID function, Page 117), as well as the standard volume of a user-defined liquid. **User input:** As per order, otherwise 1 ✎ Note! • The appropriate unit is taken from the UNIT DENSITY function (see Page 85). • If the value in this function is changed, we recommend you reset the totalizers.
REFERENCE PRESSURE	✎ Note! This function is not available unless the REAL GAS, COMPRESSED AIR or NATURAL GAS NX-19 option was selected in the SELECT FLUID function. Use this function to enter the reference pressure of the fluid for calculating the operating density of real gas and natural gas NX-19 (formula for calculation, see SELECT FLUID function, Page 117), as well as for the standard volume calculation of compressed air and natural gas NX-19. **User input:** 5-digit floating-point number (Entry value must be > 0) **Factory setting:** 1.0000 ✎ Note! The appropriate unit is taken from the UNIT PRESSURE function (see Page 85).

Function description FLOW COMPUTER	
REFERENCE TEMPERATURE	✎ Note! This function is not available unless the WATER, REAL GAS, COMPRESSED AIR or NATURAL GAS NX-19 option was selected in the SELECT FLUID function. Use this function to enter the reference temperature of the fluid for calculating the operating density of real gas and natural gas NX-19 (formula for calculation, see SELECT FLUID function, Page 117), as well as for the standard volume calculation of compressed air and natural gas NX-19. **User input:** 5-digit floating-point number **Factory setting:** 273.15K ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83). ☝ 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 69).
REFERENCE Z-FACTOR	✎ Note! This function is not available unless the REAL GAS option was selected in the SELECT FLUID function. Use this function to enter the Z-factor for gas under reference conditions. The values defined in the REFERENCE PRESSURE (Page 122) and REFERENCE TEMPERATURE (Page 123) functions apply as the reference conditions (formula for calculation, see function SELECT FLUID, Page 117). The real gas constant Z indicates how far a real gas differs from an ideal gas which exactly fulfills the general gas law (p x V / T = constant, Z = 1). The real gas constant approaches the value 1 the further the real gas is from its liquefaction point. **User input:** 5-digit floating-point number **Factory setting:** 1.0000 ✎ Note! You can determine the Z-factor with the aid of the Applicator. Applicator is software from Endress+Hauser for selecting and planning flowmeters. The Applicator is available both via the Internet (www.applicator.com) and on a CD-ROM for local PC installation.

Function description FLOW COMPUTER	
SPECIFIC DENSITY	✎ Note! This function is not available unless the NATURAL GAS NX-19 option was selected in the SELECT FLUID function. Use this function to enter the specific density of natural gas (ratio of density of natural gas at reference conditions to density of air at reference conditions). **User input:** 5-digit floating-point number **Factory setting:** 0.6640 ✎ Note! The values entered in the SPECIFIC DENSITY, MOL-% N2 and MOL-% CO2 functions are interdependent. For this reason, if the value is changed in one of these functions, the values in the other functions should be adjusted accordingly.
MOL-% N2	✎ Note! This function is not available unless the NATURAL GAS NX-19 option was selected in the SELECT FLUID function. Use this function to enter the mol-% nitrogen in the expected natural gas mixture. **User input:** 5-digit floating-point number **Factory setting:** 0.0000% ✎ Note! The values entered in the SPECIFIC DENSITY, MOL-% N2 and MOL-% CO2 functions are interdependent. For this reason, if the value is changed in one of these functions, the values in the other functions should be adjusted accordingly.
MOL-% CO2	✎ Note! This function is not available unless the NATURAL GAS NX-19 option was selected in the SELECT FLUID function. Use this function to enter the mol-% carbon dioxide in the expected natural gas mixture. **User input:** 5-digit floating-point number **Factory setting:** 0.0000% ✎ Note! The values entered in the SPECIFIC DENSITY, MOL-% N2 and MOL-% CO2 functions are interdependent. For this reason, if the value is changed in one of these functions, the values in the other functions should be adjusted accordingly.

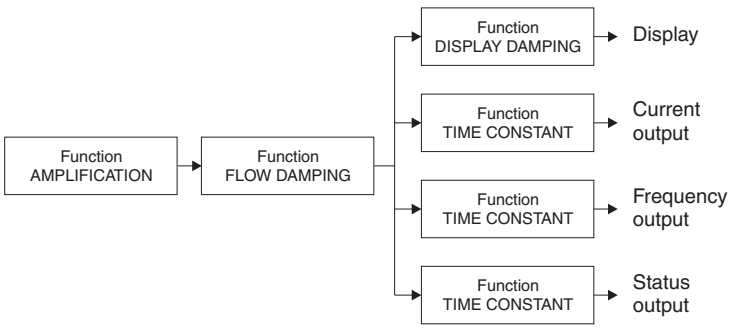
11.2.14 Sample values for the functions: TEMPERATURE VALUE, DENSITY VALUE and EXPANSION COEFFICIENT

The calculation of the density for customer-defined liquids (see Page 119) is better the nearer the operating temperature is to the particular value in the temperature value column. If the operating temperature deviates a lot from the value in the temperature value column, the expansion coefficient should be calculated as per the formula on Page 121.

Fluid (Liquid)	**Temperature value [K]**	**Density value [kg/m^3]**	**Expansion coefficient [10^{-4} 1/K]**
Air	123.15	594	18.76
Ammonia	298.15	602	25
Argon	133.15	1028	111.3
n-butane	298.15	573	20.7
Carbon dioxide	298.15	713	106.6
Chlorine	298.15	1398	21.9
Cyclohexane	298.15	773	11.6
n-decane	298.15	728	10.2
Ethane	298.15	315	175.3
Ethylene	298.15	386	87.7
n-heptane	298.15	351	12.4
n-hexane	298.15	656	13.8
Hydrogen chloride	298.15	796	70.9
i-butane	298.15	552	22.5
Methane	163.15	331	73.5
Nitrogen	93.15	729	75.3
n-octane	298.15	699	11.1
Oxygen	133.15	876	95.4
n-pentane	298.15	621	16.2
Propane	298.15	493	32.1
Vinyl chloride	298.15	903	19.3

Table values from Carl L. Yaws (2001): Matheson Gas Data Book, 7th edition

11.2.15 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 (see Page 53). **Options:** OFF ON (signal output is set to the value for zero flow). **Factory setting:** OFF
FLOW DAMPING	For setting the filter depth. This reduces the sensitivity of the measuring signal to interference peaks (e.g. in the event of high solids content, gas bubbles in the fluid, etc.). The measuring system reaction time increases with the filter setting. **User input:** 0...100 s **Factory setting:** 1 s ✎ Note! The flow damping acts on the following functions and outputs of the measuring device:  F06-73xxxxxx-19-xx-xx-en-003

11.2.16 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 E+H service organisation 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 litre) ✎ 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 below, TEMPERATURE COEFFICIENT function). • Diameter steps in the inlet of the device (see Page 115). **Display:** e.g. 102 P/l (pulse per litre)
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. **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.
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)

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
OFFSET T-SENSOR	Use this function to enter the zero offset value for the temperature sensor. The value entered in this function is added to the measured temperature value. **User input:** -10 to 10 °C (-18 to 18°F; converted to UNIT TEMPERATURE) **Factory setting:** 0.00 °C
CABLE LENGTH	Use this function to enter the cable length for the remote version. Note! • A cable length of 0 m is specified for the compact version. • If the cable supplied for connecting the device is shortened, the new cable length must be entered here in this function. The cable length can be rounded up or off since the value entered is in steps of a metre (example: new cable length = 7.81 m → value entered = 8 m) • If a cable is used which does not correspond to the cable specification, the value for this function must be calculated (see Note in Cable specifications Section on Page 22). **User input:** 0-30 m or 0-98 ft **Unit:** The unit depends on the option selected in the UNIT LENGTH function (see Page 86): • Selected option UNIT LENGTH = mm → unit in this function = m • Selected option UNIT LENGTH = inch → unit in this function = ft **Factory setting:** • For compact version: 0 m or 0 ft • For remote version 10 m or 30 ft: 10 m or 30 ft • For remote version 30 m or 98 ft: 30 m or 98 ft

11.2.17 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 E 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 MESSAGE (display only) FAULT MESSAGE (outputs and display) ✎ Note! • If the E key is pressed twice, the ASSIGN SYSTEM ERROR function is called up. • Use the ⊞⊟ key combination to exit the function.
ASSIGN PROCESS ERROR	All process errors appear on the display. If you select a single process error you can change its error category. **Display:** List of process errors ✎ Note! • Each individual message can be selected using the ⊞ and ⊟ key. • If the E 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 MESSAGE (display only) FAULT MESSAGE (outputs and display) ✎ Note! • If the E key is pressed twice, the ASSIGN SYSTEM ERROR function is called up. • Use the ⊞⊟ key combination to exit the function.

Function description SUPERVISION	
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 frequency 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
OPERATION HOURS	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)

11.2.18 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 (see Page 53). **Options:** OFF ON **Factory setting:** OFF ☞ Caution! The setting is not saved if the power supply fails.
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 (see Page 53). **Options:** OFF VOLUME FLOW TEMPERATURE MASS FLOW CORRECTED VOLUME FLOW HEAT 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 unit depends on the option selected in the SIMULATION MEASURAND function and is taken from the related function (UNIT VOLUME FLOW, UNIT TEMPERATURE, UNIT MASS FLOW, etc.). ☞ Caution! The setting is not saved if the power supply fails.

11.2.19 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.

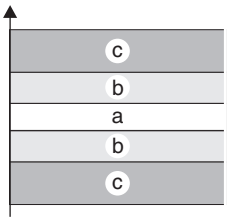
11.2.20 Group AMPLIFIER VERSION

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. ✎ Note! You can also read off the software revision number of the amplifier from the service plate in the electronics compartment cover.
HARDWARE REVISION NUMBER I/O MODULE	The hardware revision number of the I/O module appears on the display.

11.2.21 Group ADVANCED DIAGNOSIS (optional)

Function description ADVANCED DIAGNOSIS	
MIN T FLUID	Smallest fluid temperature measured since the last reset (RESET T FLUID function). **Display:** 5-digit floating-point number, including unit and sign (e.g. 95.3 °C)
MAX T FLUID	Largest fluid temperature measured since the last reset (RESET T FLUID function). **Display:** 5-digit floating-point number, including unit and sign (e.g. 218.1 °C)
RESET T FLUID	Resets the values in the MIN T FLUID and MAX T FLUID functions. **Options:** NO YES **Factory setting:** NO
WARN T FLUID LO	Use this function to enter the lower limit value for monitoring the fluid temperature. This limit value is used to generate a fault message which should indicate a change in the temperature of the fluid in the direction of the specification limits of the device in order to prevent device failure or prevent the process undercooling. **User input:** 5-digit floating-point number, incl. sign **Factory setting:** –202 °C ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83).
WARN T FLUID HI	Use this function to enter the upper limit value for monitoring the fluid temperature. This limit value is used to generate a fault message which should indicate a change in the temperature of the fluid in the direction of the specification limits of the device in order to prevent device failure or prevent the process overheating. **User input:** 5-digit floating-point number, incl. sign **Factory setting:** 402 °C ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83).

Function description ADVANCED DIAGNOSIS	
ELECTRONICS TEMPERATURE	The temperature on the electronics board currently measured appears on the display. **Display:** 4-digit floating-point number, including unit and sign (e.g. –23.5 °C, 160.0 °F, 295.4 K, etc.)
MIN T ELECTRONICS	Smallest electronics board temperature measured since the last reset (RESET T ELECTRONICS function). **Display:** 5-digit floating-point number, including unit and sign (e.g. 20.2 °C)
MAX T ELECTRONICS	Largest electronics board temperature measured since the last reset (RESET T ELECTRONICS function). **Display:** 5-digit floating-point number, including unit and sign (e.g. 65.3 °C)
RESET T ELECTRONICS	Resets the values in the MIN T ELECTRONICS and MAX T ELECTRONICS functions. **Options:** NO YES **Factory setting:** NO
WARN T ELECTRONICS LO	Use this function to enter the lower limit value for monitoring the temperature on the electronics board. This limit value is used to generate a fault message which should indicate a change in the temperature in the direction of the specification limits of the device in order to prevent device failure. **User input:** 5-digit floating-point number, incl. sign **Factory setting:** –41 °C ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83).
WARN T ELECTRONICS HI	Use this function to enter the upper limit value for monitoring the temperature on the electronics board. This limit value is used to generate a fault message which should indicate a change in the temperature in the direction of the specification limits of the device in order to prevent device failure. **User input:** 5-digit floating-point number, incl. sign **Factory setting:** 86 °C ✎ Note! The appropriate unit is taken from the UNIT TEMPERATURE function (see Page 83).

Function description ADVANCED DIAGNOSIS	
SENSOR DIAGNOSIS	Monitoring of the capacitive signal of the DSC sensor. The system checks in which area the capacitive signal of the DSC sensor is located (see graphic): a = Signal correct b = Warning prior to meas. failure → error mess. #395 DSC SENS LIMIT c = Measurement failure → error message #394 DSC SENS DEFCT  F06-73xxxxxx-05-xx-xx-xx-000 **Options:** OFF (error message #395 DSC SENS LIMIT is switched off) STANDARD **Factory setting:** STANDARD
REYNOLDS NUMBER	✎ Note! This function is not available unless the SATURATED STEAM, SUPERHEATED STEAM, NATURAL GAS NX-19, WATER or COMPRESSED AIR option was selected in the SELECT FLUID function. The Reynolds number appears on the display. The Reynolds number is determined using the selected fluid and the measuredtemperature. **Display:** 8-digit fixed-point number (e.g. 25800)
REYNOLDS WARNING	✎ Note! This function is not available unless the SATURATED STEAM, SUPERHEATED STEAM, NATURAL GAS NX-19, WATER or COMPRESSED AIR option was selected in the SELECT FLUID function. Use this function to activate monitoring of the Reynolds number. If a Reynolds number of < 20,000 is determined during active monitoring, a notice message #494 RE < 20,000 is displayed (see Page 54). ✎ Note! • With a Reynolds number of < 20,000, reduced accuracy of the device must be reckoned with. • There is no fault message at zero flow. • The notice message does not appear if the REYNOLDS NUMBER option was selected in the ASSIGN LOW FLOW CUT OFF function. **Options:** OFF (function switched off) ON **Factory setting:** OFF

Function description ADVANCED DIAGNOSIS	
VELOCITY WARNING	Use this function to activate monitoring of the fluid velocity. If, during active monitoring, the fluid velocity exceeds the value for the limit velocity, a notice message is displayed. **Options:** OFF (function switched off) ON **Factory setting:** OFF
LIMIT VELOCITY	Use this function to specify the maximum fluid velocity. If the specified maximum fluid velocity is overshot, the fault message #421 FLOW RANGE (see Page 54) is output. **User input:** 5-digit floating-point number **Factory setting:** 75 m/s ✎ Note! The unit displayed in this function depends on the option selected in the UNIT LENGTHfunction (see Page 86): • Selected option UNIT LENGTH = mm → unit in this function = m/s • Selected option UNIT LENGTH = inch → unit in this function = ft/s

11. 3 Factory settings

11.3.1 Metric units (not for USA and Canada)

Units for temperature, density, spec. enthalpy, length (see Page 83 ff.)

	Unit
Temperature	°C
Density	kg/m³
Specific enthalpy	kWh/kg
Length	mm

Language (see Page 88)

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

Unit for totalizers 1 + 2 (see Page 94)

Totalizer assignment	Unit
Volume flow	m³
Calculated mass flow	kg
Corrected volume flow	Nm³
Heat flow	kWh

Switch-on point and switch-off point (see Page 109 and Page 110)

The factory settings in the table are given in the unit dm³/s. If another unit is selected in the UNIT VOLUME FLOW function, (see Page 83), 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

11.3.2 US units (only for USA and Canada)

Units for temperature, density, spec. enthalpy, length (see Page 83 ff.)

	Unit
Temperature	°F
Density	lb/ft³
Specific enthalpy	Btu/lb
Length	Inch

Language (see Page 88)

Country	Language
USA	English
Canada	English

Unit for totalizers 1 + 2 (see Page 94)

Flow	Unit
Volume flow	US gal
Calculated mass flow	lb
Corrected volume flow	Sm³
Heat flow	KBtu

Switch-on point and switch-off point (see Page 109 and Page 110)

The factory settings in the table are given in the unit US gallons/min. If another unit is selected in the UNIT VOLUME FLOW function, (see Page 83), 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/min]	Switch-off point [US Gal/min]	Switch-on point [US Gal/min]	Switch-off point [US Gal/min]
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

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Declaration of contamination

Dear customer,
Because of legal determinations and for the safety of our employees and operating equipment we need this "Declaration of contamination" with your signature before your order can be handled. Please put the completely filled in declaration to the instrument and to the shipping documents in any case. Add also safety sheets and/or specific handling instructions if necessary.

type of instrument / sensor: _____ serial number: _____

medium / concentration: _____ temperature: _____ pressure: _____

cleaned with: _____ conductivity: _____ viscosity: _____

Warning hints for medium used:

☐ radioactive ☐ explosive ☐ caustic ☐ poisonous ☐ harmful to health ☐ biologically hazardous ☐ inflammable ☐ safe

Please mark the appropriate warning hints.

Reason for return:

_____

_____

Company data:

company: _____ contact person: _____

_____ _____

_____ department: _____

address: _____ phone number: _____

_____ fax / e-mail: _____

_____ your order no.: _____

I hereby certify that the returned equipment has been cleaned and decontaminated acc. to good industrial practices and is in compliance with all regulations. This equipment poses no health or safety risks due to contamination.

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