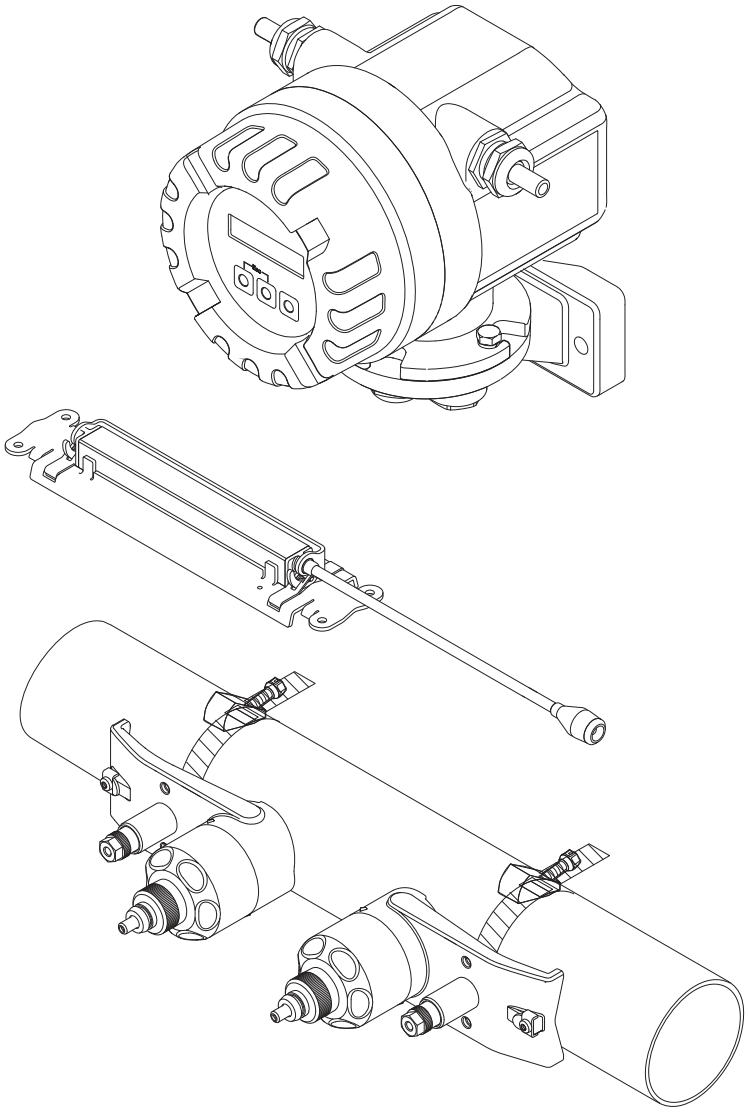
BA00100D/06/EN/14.23-00
71639915

Valid as of software version
V 1.02.XX (electronics board)

Operating Instructions
Proline Prosonic Flow 91 HART

Ultrasonic Flow Measuring System



Endress+Hauser
People for Process Automation

Brief operating instructions

The brief operating instructions are aimed at helping you commission your measuring device quickly and easily:

Safety instructions → 4

First familiarize yourself with the safety instructions to be able to carry out the following work steps quickly and easily. Here, you can find information on:

- The designated use of the measuring device
- The operational safety
- The safety symbols and conventions used in the document

▼

Connecting the transmitter → 30

Install the sensors using the transmitter software.
Therefore connect the transmitter first to the power supply.

▼

Display and operating elements → 34

A brief overview of the different display and operating elements to allow you to start quickly.

▼

Installing the sensors → 9

Installing the flowrate measuring sensors Prosonic Flow W (clamp-on)

▼

Sensor Setup → 46

Measuring devices **with** a local display:
Use the "Sensor Setup" (→ 46) to determine the data required for sensor installation such as sensor distance, wire length, pipe materials, sound velocity in liquids, etc.

- The system provides you with the sensor distance for the W "clamp-on" versions as distance data.
  For the W sensors, you also receive the data in the form of a letter for sensor 1 and in the form of a number for sensor 2. You can thus easily position the sensors with the aid of the mounting rail.

Measuring devices **without** a local display:
No Sensor Setup is available for devices without a local display.
The sensor installation procedure for such devices is explained on.

Connection of the sensor/transmitter connecting cable → 27

▼

Customer-specific configuration → 49

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. There are two options:

- Setting parameters via the configuration program "FieldCare"
- Setting parameters via the local display (optional)

All functions are described in detail, as is the function matrix itself → 77.

Note!
Always start troubleshooting with the checklist on → 56 if faults occur after commissioning or during operation. This takes you directly (via various queries) to the cause of the problem and the appropriate remedial measures.

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1 Safety instructions

1.1 Designated use

The measuring device described in these Operating Instructions is to be used only for measuring the flow of liquids in closed pipes, e.g.:
- Ultra clean water with low conductivity
- Water, wastewater, etc.

As well as measuring the volume flow, the measuring system also always measures the sound velocity of the fluid. In this way, you can distinguish between different fluids or monitor the fluid quality.

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

1.2 Installation, commissioning, operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain.
- The device must be operated by persons authorized and trained by the plant operator. Strict compliance with the instructions in these Operating Instructions is mandatory.
- Endress+Hauser is willing to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However, small changes in temperature, concentration or the degree of contamination in the process can result in changes to the chemical resistance properties. For this reason, Endress+Hauser does not accept any responsibility with regard to the corrosion resistance of materials wetted by fluids in a specific application. The user is responsible for the choice of wetted materials with regard to their in-process resistance to corrosion.
- If welding work is performed on the piping system, do not ground the welding appliance through the flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, except in cases where special protective measures have been taken (e.g. galvanically isolated power supply SELV or PELV).
- Always note the regulations applicable in your country to the operation, maintenance and repair of electrical devices. Special instructions relating to the device can be found in the relevant sections of the documentation.

1.3 Operational safety

Note the following points:
- The measuring device meets the general safety requirements according to EN 61010-1 and the EMC requirements according to IEC/EN 61326 in addition to the NAMUR recommendations NE 21, NE 43 and NE 53.
- When hot fluid passes through the measuring tube, the surface temperature of the housing increases. In the case of the sensor, in particular, users should expect temperatures that can be close to the fluid temperature. If the temperature of the fluid is high, implement sufficient measures to prevent burning or scalding.
- 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 duly completed "Declaration of Contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.

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

- Enclose special handling instructions if necessary, for example a safety data sheet as per Regulation (EC) No 1907/2006 REACH.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.



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 or injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

1.5 Notes on safety conventions and icons

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



Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in personal 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 flowmeter system consists of the following components:

- Transmitter Prosonic Flow 91
- Prosonic Flow W sensor
- Prosonic Flow W clamp on version (DN 15 to 65 / ½ to 2½")
- Prosonic Flow W clamp on version (DN 50 to 4000 / 2 to 160")

2.1.1 Nameplate of the transmitter

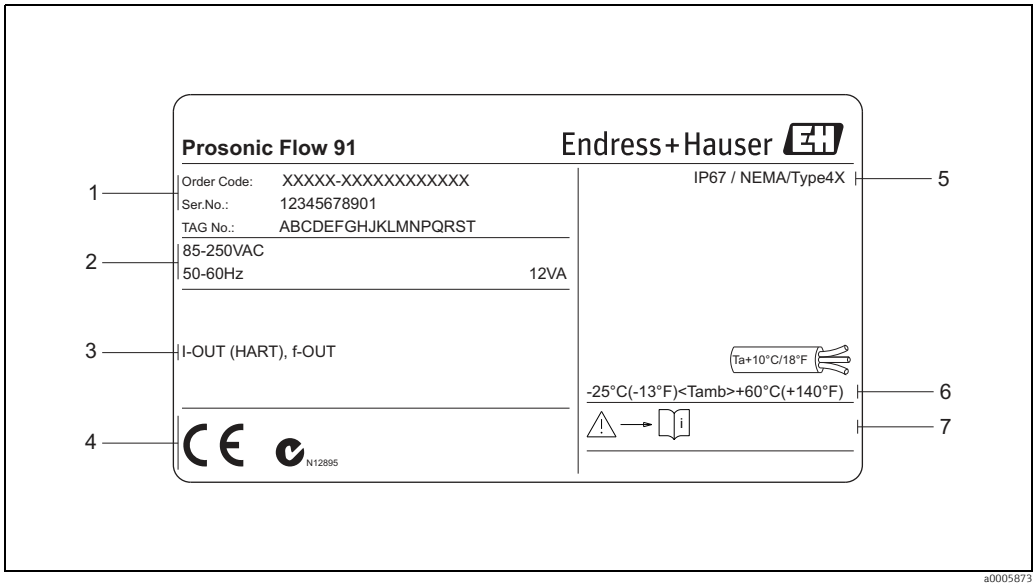


Fig. 1: Nameplate specifications for the "Prosonic Flow 91" transmitter (example)

1 Order code /serial number: see the specifications on the order confirmation for the meanings of the individual letters and digits
2 Power supply, frequency, power consumption
3 Outputs available:
I-OUT (HART): with current output (HART)
PULSE-OUT: with pulse/status output
4 Reserved for additional information on device version (approvals, certificates)
5 Permitted ambient temperature range
6 Degree of protection
7 Please comply with the Operating Instructions

2.1.2 Nameplate of the sensor

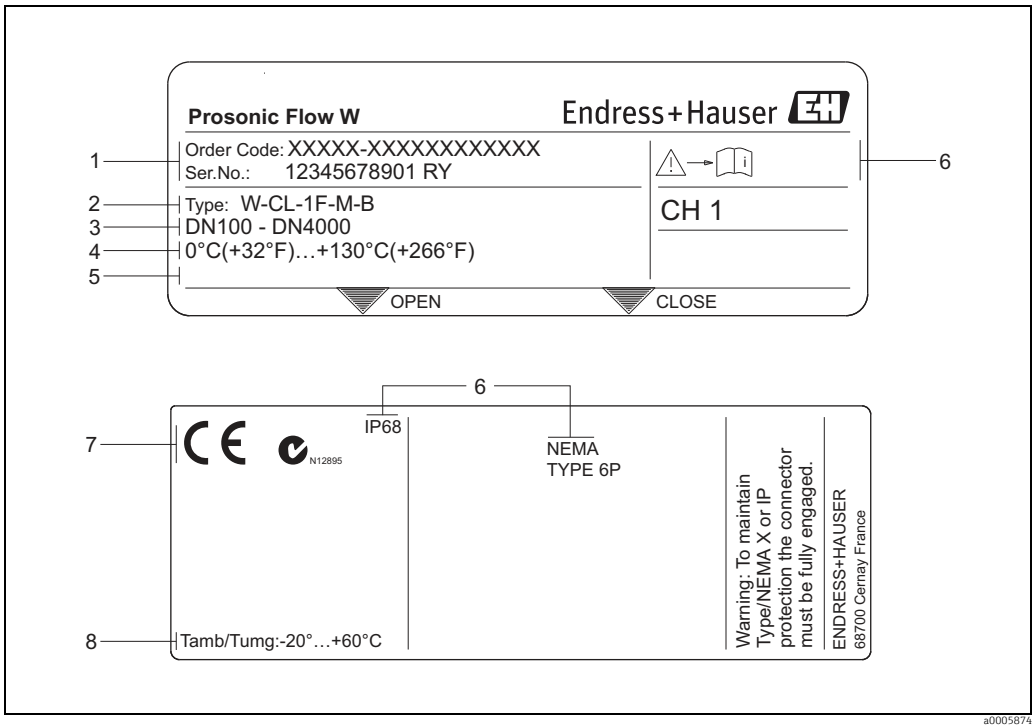


Fig. 2: Nameplate specifications for the "Prosonic Flow W" sensors (example)

1 *Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *Sensor type*
3 *Recommended operating range for sensor type*
4 *Fluid temperature range*
5 *Reserved for information on special products*
6 *Please comply with the Operating Instructions*
7 *Reserved for additional information on device version (approvals, certificates)*
8 *Degree of protection*
9 *Permitted ambient temperature range*

2.1.3 Nameplate of the connections

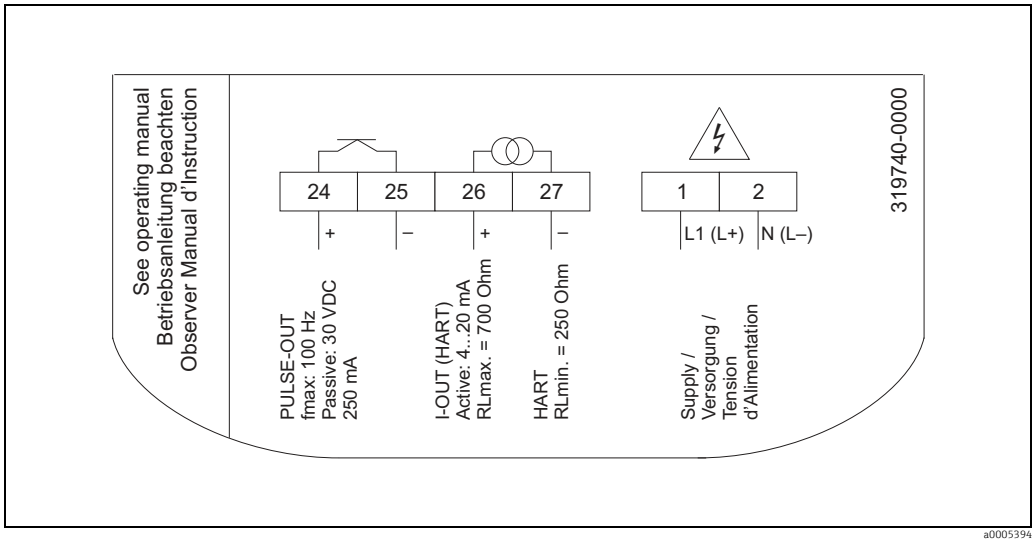


Fig. 3: Nameplate specifications for the transmitter (example)

2.2 Certificates and approvals

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

2.3 Registered trademarks

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

HistoROM™, T-DAT™, FieldCare®, Field Xpert™, Fieldcheck®, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

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

3.1.2 Transport

The devices must be transported in the container supplied when transporting them to the measuring point.

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 storage temperature corresponds to the ambient temperature range of the transmitter, the measuring sensors and the corresponding sensor cables → 72.

- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.

3.2 Installation conditions

3.2.1 Installation dimensions

The dimensions and lengths of the sensor and transmitter can be found in the "Technical Information" document for the device in question. This can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in Section "Documentation" on → 76.

3.2.2 Mounting location

Correct measuring is possible only if the pipe is full. **Avoid** the following mounting locations:
- Do not install at the highest point in the run. Risk of air accumulating!
- Do not install directly upstream from an open pipe outlet in a down pipe.

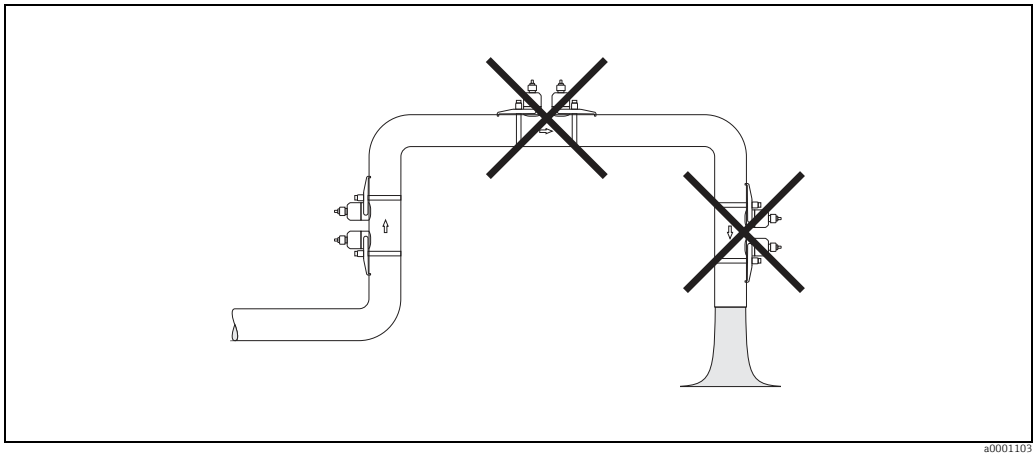


Fig. 4: Mounting location

3.2.3 Orientation

Vertical orientation

Recommended orientation with upward direction of flow (View A). Entrained solids sink down. Gases rise away from the measuring sensor when fluid is not flowing. The piping can be completely drained and protected against buildup.

Horizontal orientation

In the recommended installation range in a horizontal installation position (View B), gas and air accumulation at the pipe cover and problematic buildups at the bottom of the pipe have a minor influence on the measurement.

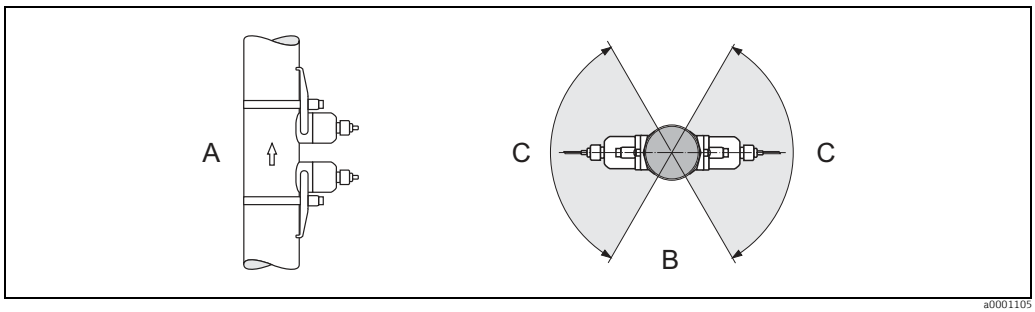


Fig. 5: Orientation

A Vertical: Recommended installation with vertical/upward direction of flow
B Horizontal: Recommended installation range with horizontal orientation
C Recommended installation range max. 120°

3.2.4 Inlet and outlet runs

If possible, install the sensor well clear of assemblies such as valves, T-pieces, elbows, etc. If several flow obstructions are installed, the longest inlet or outlet run must be considered. Compliance with the following requirements for the inlet and outlet runs is recommended to ensure measuring accuracy.

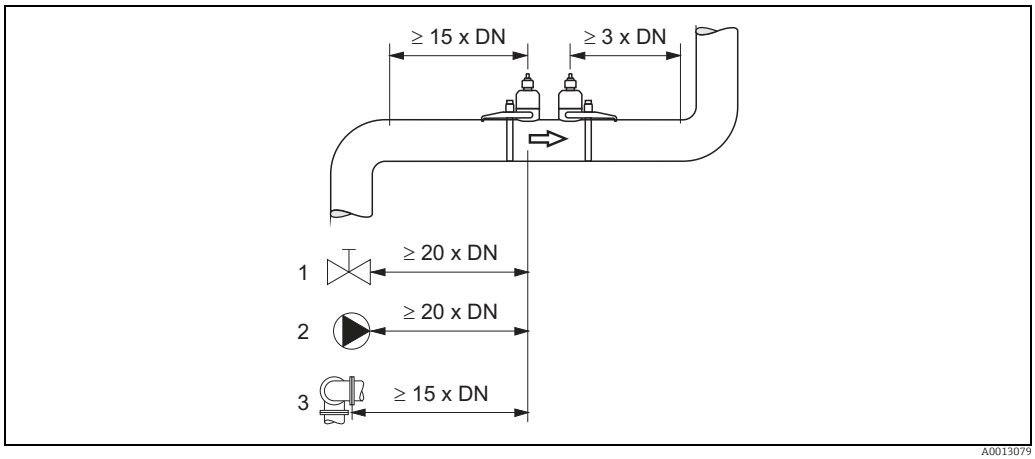


Fig. 6: Inlet and outlet runs (top view)

1 Valve (2/3 open)
2 Pump
3 Double bends

3.2.5 Sensor selection and arrangement

The sensors can be arranged in two ways:
- Mounting arrangement for measurement via one traverse: the sensors are located on opposite sides of the pipe.
- Mounting arrangement for measurement via two traverses: the sensors are located on the same side of the pipe.

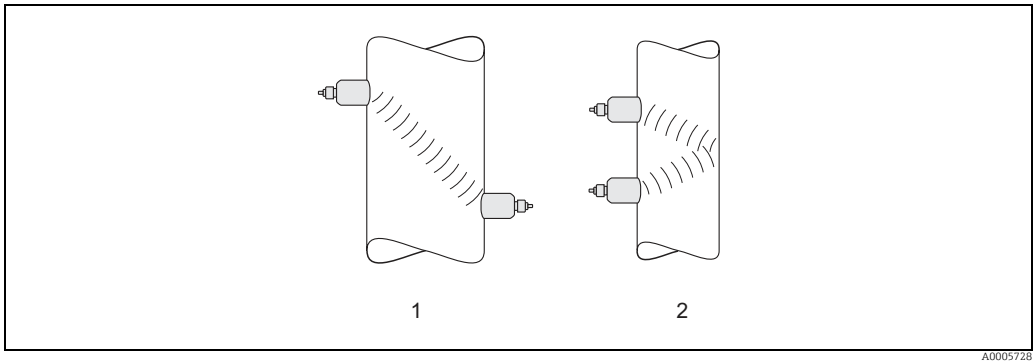


Fig. 7: Sensor mounting arrangement (top view)

1 Mounting arrangement for measurement via one traverse
2 Mounting arrangement for measurement via two traverses

Recommendations

The number of traverses required depends on the sensor type, the nominal diameter and the thickness of the pipe wall. We recommend the following types of mounting:

Sensor type	Nominal diameter	Sensor Frequency	Sensor ID	Type of mounting [1]
Prosonic Flow W	DN15 to DN65 (½" to 2½")	6 MHz	W-CL-6F	2 traverses 2)
	DN 80 (3")	2 MHz	W-CL-2F	2 traverses
	DN 100 to 300 (4" to 12")	2 MHz (or 1 MHz)	W-CL-1F W-CL-2F	2 traverses [2]
	DN 300 to 600 (12" to 24")	1 MHz (or 2 MHz)	W-CL-1F W-CL-2F	2 traverses [2]
	DN 650 to 4000 (26" to 160")	1 MHz (or 0.5 MHz)	W-CL-1F W-CL-05F	1 traverses [2]

[1] The installation of clamp-on sensors is principally recommended in the 2 traverse type installation. This type of installation allows the easiest and most comfortable type of mounting. However, in certain applications a 1 traverse installation may be preferred.

These include:
- Certain plastic pipes with wall thickness > 4 mm (0,16 in)
- Lined pipes
- Applications with fluids with high acoustic damping

[2] 0.5 MHz sensors are also recommended for applications with composite material pipes such as GRP*) and may be recommended for certain lined pipes, pipes with wall thickness >10 mm, or applications with media with high acoustic damping. In addition, for these applications we principally recommend mounting the W sensors in a 1 traverse configuration.

[3] 6 MHz sensors for applications where flow velocity ≤ 10 m/s (32.8 ft/s)

3.3 Preparatory steps prior to installation

Depending on the conditions specific to the measuring point (e.g. clamp-on, number of traverses, fluid, etc.), a number of preparatory steps have to be taken before actually installing the sensors:

1. Determination of the values for the necessary installation distances based on the conditions specific to the measuring point. A number of methods are available for determining the values:
   – Local operation of the device
   – FieldCare (operating program), connect a notebook to the transmitter
   – Applicator (software), online on the Endress+Hauser Internet site
2. Mechanical preparation of the clamp-on retainers for the sensors:
   – Premount the strapping bands (DN 50 to 200 / 2 to 8") or (DN 250 to 4000 / 10 to 160")
   – Fix the welded bolts

3.4 Determining the necessary installation distances

The installation distance that have to be maintained depend on:
- The type of sensor: W (DN 50 to 4000 / 2 to 160"), W (DN 15 to 65 / ½ to 2½")
- Type of mounting:
  – Clamp-on with strapping band or welded bolt
  – Insertion version, installation in the pipe
- Number of traverses or single-path/dual-path version

3.4.1 Installation distances for Prosonic Flow W clamp-on

DN 50 to 4000 (2 to 160")				DN 15 to 65 (½ to 2½")
Clamp-on Strapping band		Clamp-on Welded bolts		Clamp-on Strapping band
1 traverse	2 traverses	1 traverse	2 traverses	2 traverses
SENSOR DISTANCE	SENSOR DISTANCE	SENSOR DISTANCE	SENSOR DISTANCE	SENSOR DISTANCE
WIRE LENGTH	POSITION SENSOR	WIRE LENGTH	POSITION SENSOR	–

3.4.2 Determining values for installation distances

Perform the following steps to determine the installation distances:

1. Mount the transmitter.
2. Connect the power supply.
3. Switch on the measuring device.
4. Run the "Sensor Setup" menu.

3.5 Mechanical preparation

The way in which the sensors are secured differs on account of the pipe nominal diameter and the sensor type. Depending on the type of sensor, users also have the option of securing the sensors with strapping bands or screws such that they can be later removed, or permanently fixing the sensors in place with welded bolts or welded retainers.

Overview of possible ways to secure the various sensors:

Prosonic Flow	For the measuring range	Pipe nominal diameter	Secured by
91W	DN 15 to 65 (½ to 2½")	DN ≤ 32 (1¼")	Sensor holder with U-shaped screws (small nominal diameters) → 14
		DN > 32 (1¼")	Sensor holder with strapping bands (small nominal diameters) → 15
91W	DN 50 to 4000 (2 to 160")	DN ≤ 200 (8")	Strapping bands (medium nominal diameters) → 15
			Welded bolts → 13
		DN > 200 (8")	Strapping bands (large nominal diameters) → 18
			Welded bolts → 13

3.5.1 Mounting the sensor holder with U-shaped screws (small nominal diameters)

For mounting on a pipe with a nominal diameter of DN ≤ 32 (1¼")
For sensors: Prosonic Flow (DN 15 to 65 / ½ to 2½")

Procedure

1. Disconnect the sensor from the sensor holder.
2. Position the sensor holder on the pipe.
3. Put the U-shaped screws through the sensor holder and slightly lubricate the thread.
4. Screw nuts onto the U-shaped screws.
5. Set the holder to the exact position and tighten the nuts evenly.

   ⚠ Warning!
   Risk of damaging plastic or glass pipes if the nuts of the U-shaped screws are tightened too much! The use of a metal half-shell is recommended (on the opposite side of the sensor) when working with plastic or glass pipes.

   Note!
   The visible pipe surface "A" must be smooth to ensure good acoustic contact.

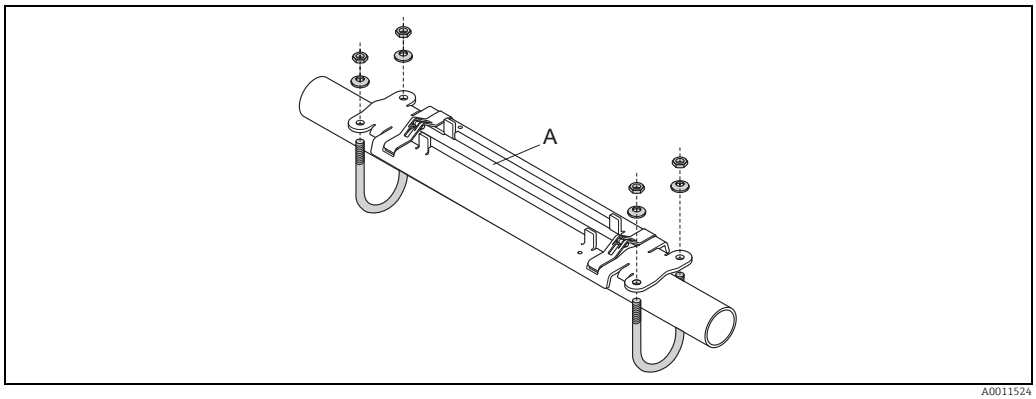


Fig. 8: Mounting the Prosonic Flow-sensor holder (DN 15 to 65 / ½ to 2½") with U-shaped screws

3.5.2 Mounting the sensor holder with strapping bands (small nominal diameters)

For mounting on a pipe with a nominal diameter of DN > 32 (1¼")

For sensors:
- Prosonic Flow 91W (DN 15 to 65 / ½ to 2½")

Procedure

1. Disconnect the sensor from the sensor holder.
2. Position the sensor holder on the pipe.
3. Wrap the strapping bands around the sensor holder and pipe without twisting them.
4. Guide the strapping bands through the strapping band locks (strapping screw is pushed up).
5. Tighten the strapping bands as tight as possible by hand.
6. Set the sensor holder to the correct position.
7. Push down the strapping screw and tighten the strapping bands so that they cannot slip.
8. Where necessary, shorten the strapping bands and trim the cut edges.

   ⚠ Warning!
   Risk of injury. To avoid sharp edges, trim the cut edges after shortening the strapping bands.

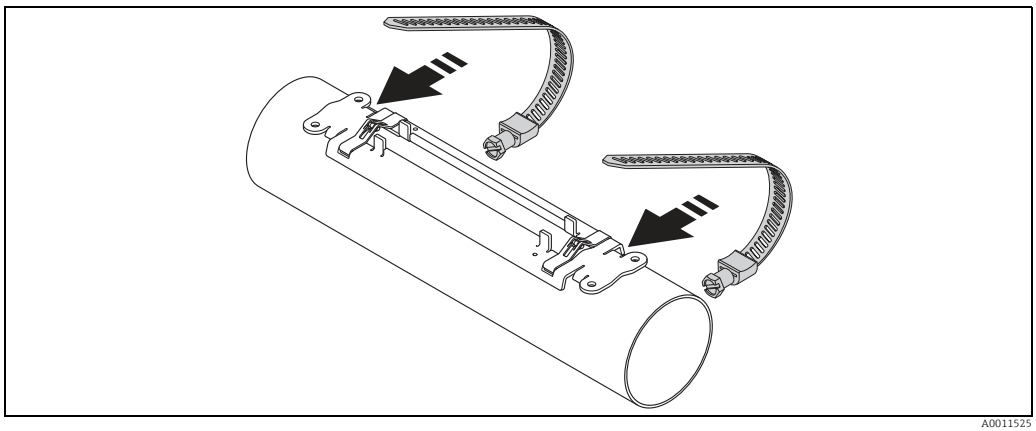


Fig. 9: Positioning the sensor holder and mounting the strapping bands

Note!
The visible pipe surface "A" must be smooth to ensure good acustic contact.

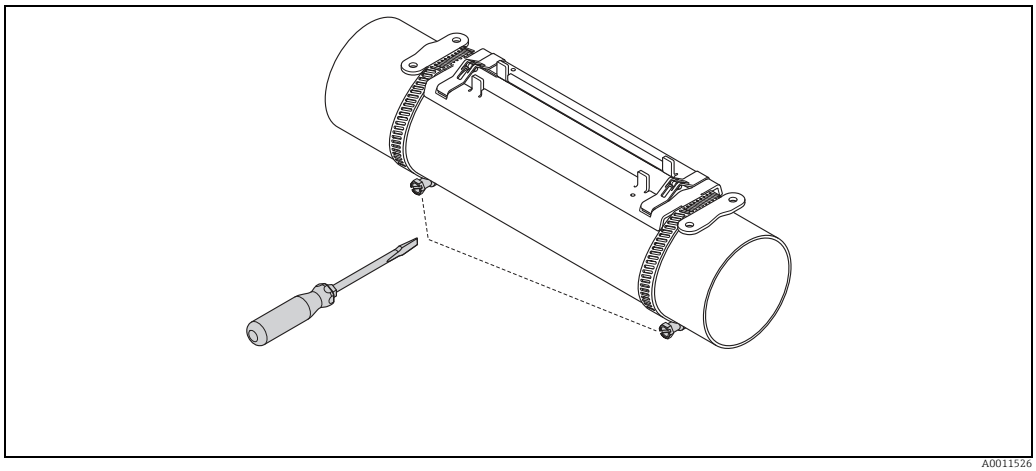


Fig. 10: Tightening the strapping screws of the strapping bands

3.5.3 Premounting the strapping bands (medium nominal diameters)

When mounting on a pipe with a nominal diameter of DN ≤ 200 (8")

For sensors:
- Prosonic Flow 91W (DN 50 to 4000 / 2 to 160")

Procedure

First strapping band

1. Fit the mounting bolt over the strapping band.
2. Wrap the strapping band around the pipe without twisting it.
3. Guide the end of the strapping band through the strapping band lock (strapping screw is pushed up).
4. Tighten the strapping band as tight as possible by hand.
5. Set the strapping band to the desired position.
6. Push down the strapping screw and tighten the strapping band so that it cannot slip.

Second strapping band

7. Proceed as for the first strapping band (steps 1 to 7). Only slightly tighten the second strapping band for final mounting. It must be possible to move the strapping band for final alignment.

Both strapping bands

8. Where necessary, shorten the strapping bands and trim the cut edges.

   ⚠ Warning!
   Risk of injury. To avoid sharp edges, trim the cut edges after shortening the strapping bands.

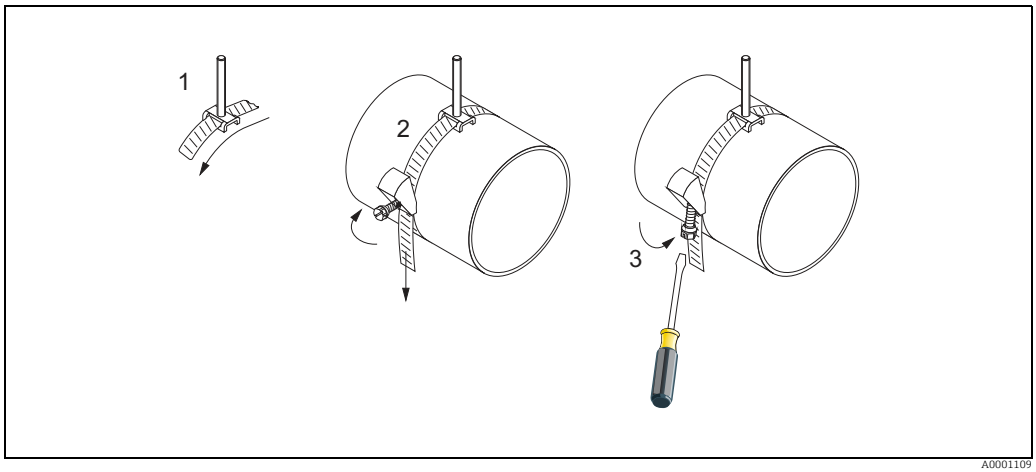


Fig. 11: Premounting strapping bands for pipe diameters DN ≤ 200 (8")

1 Mounting bolt
2 Strapping band
3 Strapping screw

3.5.4 Premounting the strapping bands (large nominal diameters)

When mounting on a pipe with a nominal diameter in the range of DN > 600 (24")

For sensors:
- Prosonic Flow 91W (DN 50 to 4000 / 2 to 160")

Procedure

1. Measure the pipe circumference.
2. Shorten the strapping bands to one length (pipe circumference + 32 cm (12.6 in)) and trim the cut edges.

   ⚠ Warning!
   Risk of injury. To avoid sharp edges, trim the cut edges after shortening the strapping bands.

First strapping band

3. Fit the mounting bolt over the strapping band.
4. Wrap the strapping band around the pipe without twisting it.
5. Guide the end of the strapping band through the strapping band lock (strapping screw is pushed up).
6. Tighten the strapping band as tight as possible by hand.
7. Set the strapping band to the desired position.
8. Push down the strapping screw and tighten the strapping band so that it cannot slip.

Second strapping band

9. Proceed as for the first strapping band (steps 3 to 8). Only slightly tighten the second strapping band for final mounting. It must be possible to move the strapping band for final alignment.

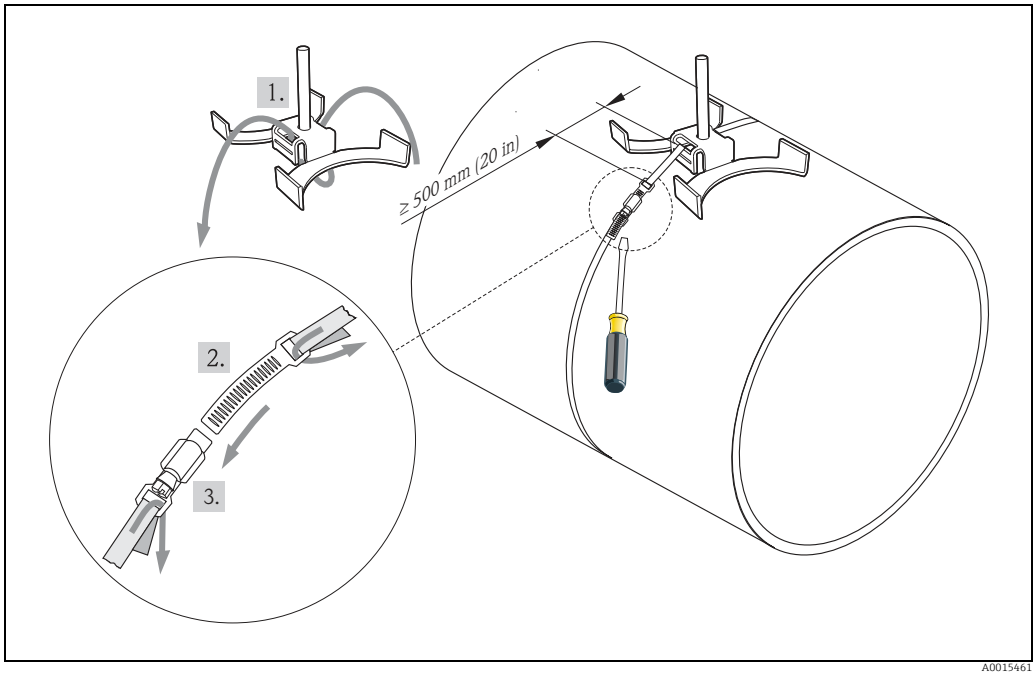


Fig. 12: Premounting strapping bands for pipe diameters DN > 600 (24 ")

*1 Mounting bolt with guide**
*2 Strapping band**
3 Strapping screw
** Distance between mounting bolt and strapping band lock min 500 mm (20 in)*

3.6 Installing Prosonic Flow W sensor

3.6.1 Installing Prosonic Flow W (DN 15 to 65 / ½ to 2½")

Mounting the sensor

Prerequisites

- The installation distance (sensor distance) is known → 13.
- The sensor holder is already mounted → 14.

Material

The following material is needed for mounting:
- Sensor incl. adapter cable
- Connecting cable for connecting to the transmitter
- Coupling fluid for an acoustic connection between the sensor and pipe

Procedure

1. Set the distance between the sensors as per the value determined for the sensor distance.
   Press the sensor down slightly to move it.

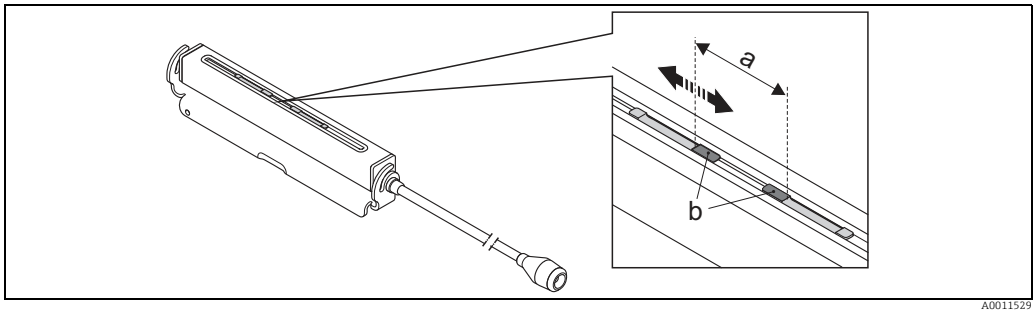


Fig. 13: Setting the distance between the sensors as per the value for the sensor distance

a Sensor distance
b Contact surfaces of the sensor

2. Coat the contact surfaces of the sensors with an even layer of coupling fluid (approx. 0.5 to 1 mm / 0.02 to 0.04") thick.
3. Fit the sensor housing on the sensor holder.

Note!
- Avoid to use a thick layer of the coupling fluid (less is more).
- Clean and reapply new coupling fluid when sensor is removed from the pipe.

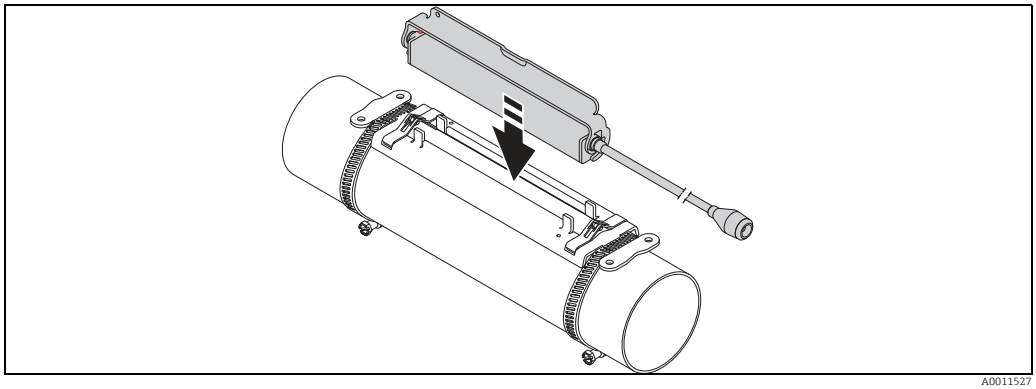


Fig. 14: Fitting the sensor housing

4. Fix the sensor housing with the bracket.

Note!
- If necessary, the holder and sensor housing can be secured with a screw/nut or a lead-seal (not part of the scope of supply).
- The bracket can only be released using an auxiliary tool.

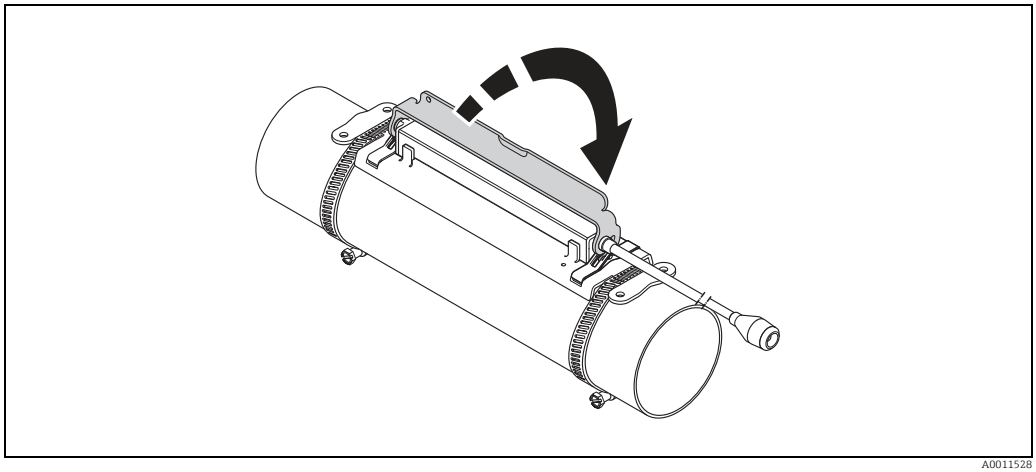


Fig. 15: Fixing the sensor housing

5. Connect the connecting cable to the adapter cable.

This completes the mounting process. The sensors can now be connected to the transmitter via the connecting cables → 27.

3.6.2 Installing Prosonic Flow W (DN 50 to 4000 / 2" to 160")

Installation for measurement via one traverse (DN 600 to 4000 /24" to 160")

Prerequisites

- The installation distances (sensor distance and wire length) are known → 13.
- The strapping bands are already mounted → 15.

Material

The following material is needed for mounting:
- Two strapping bands incl. mounting bolts and centering plates where necessary (already mounted → 15)
- Two measuring wires, each with a cable lug and a fixer to position the strapping bands
- Two sensor holders
- Coupling fluid for an acoustic connection between the sensor and pipe
- Two sensors incl. connecting cables.

Procedure

1. Prepare the two measuring wires:
   - Arrange the cable lugs and fixer such that the distance they are apart corresponds to the wire length (SL).
   - Screw the fixer onto the measuring wire.

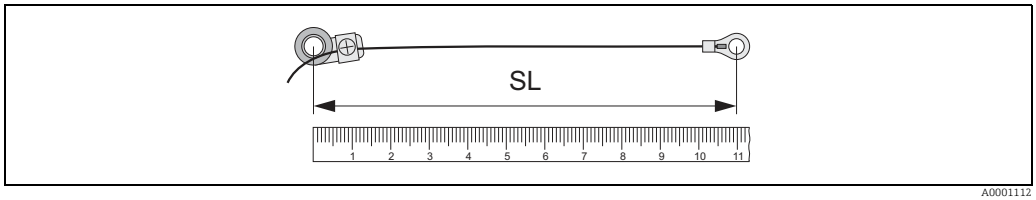


Fig. 16: Fixer (a) and cable lugs (b) at a distance that corresponds to the wire length (SL)

2. With the first measuring wire:
   - Fit the fixer over the mounting bolt of the strapping band that is already securely mounted.
   - Run the measuring wire **clockwise** around the pipe.
   - Fit the cable lug over the mounting bolt of the strapping band that can still be moved.
3. With the second measuring wire:
   - Fit the cable lug over the mounting bolt of the strapping band that is already securely mounted.
   - Run the measuring wire **counterclockwise** around the pipe.
   - Fit the fixer over the mounting bolt of the strapping band that can still be moved.
4. Take the still movable strapping band, incl. the mounting bolt, and move it until both measuring wires are evenly tensioned and tighten the strapping band so that it cannot slip.

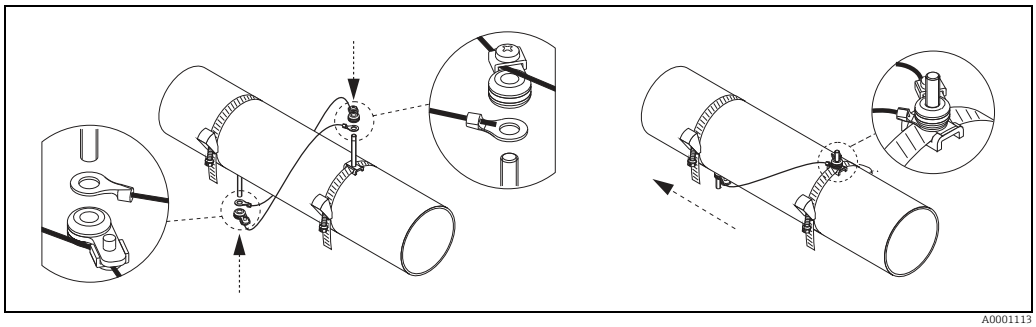


Fig. 17: Positioning the strapping bands (steps 2 to 4)

5. Loosen the screws of the fixers on the measuring wires and remove the measuring wires from the mounting bolt.
6. Fit the sensor holders over the individual mounting bolts and tighten securely with the retaining nut.

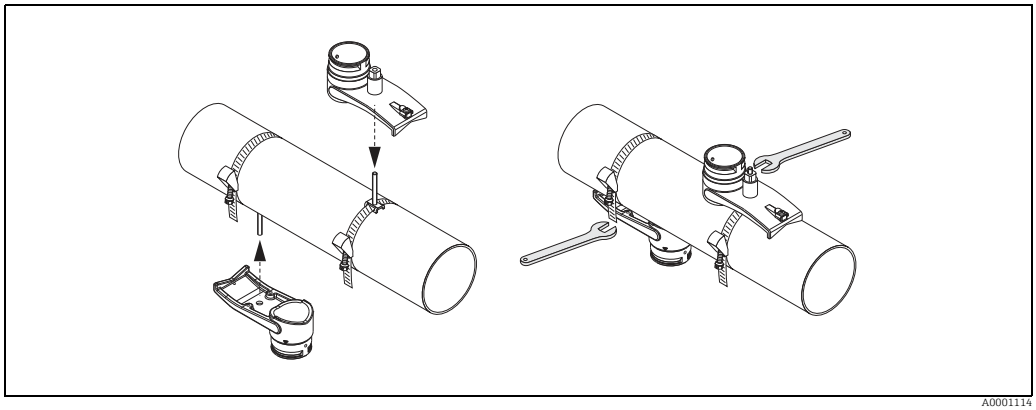


Fig. 18: Mounting the sensor holders

7. Coat the contact surfaces of the sensors with an even layer of coupling fluid approx. 1 mm (0.04") thick, going from the groove through the center to the opposite edge.

Note!

- Avoid to use a thick layer of the coupling fluid (less is more).
- Clean and reapply new coupling fluid when the sensor is removed from the pipe.
- On rough pipe surface e.g. GRP pipes ensure that the gaps crevices within the surface roughness are filled. Apply sufficient coupling fluid.

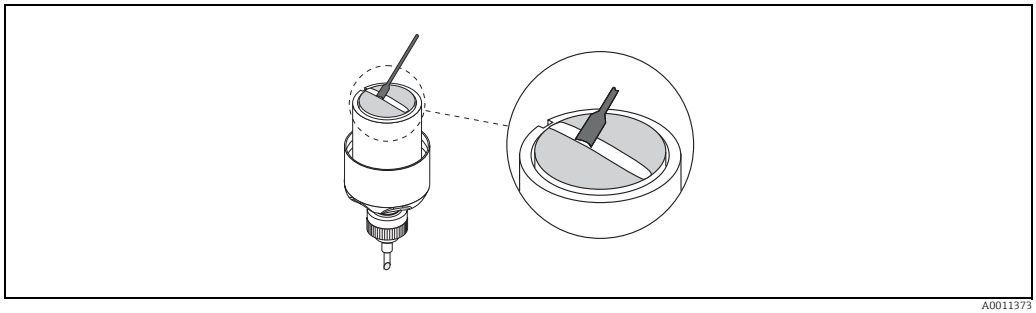


Fig. 19: Coating the contact surfaces of the sensor with coupling fluid

8. Insert the sensor into the sensor holder.

9. Fit the sensor cover on the sensor holder and turn until:
   – The sensor cover engages with a click
   – The arrows (▲ / ▼ "close") are pointing towards one another.
10. Screw the connecting cable into the individual sensor.

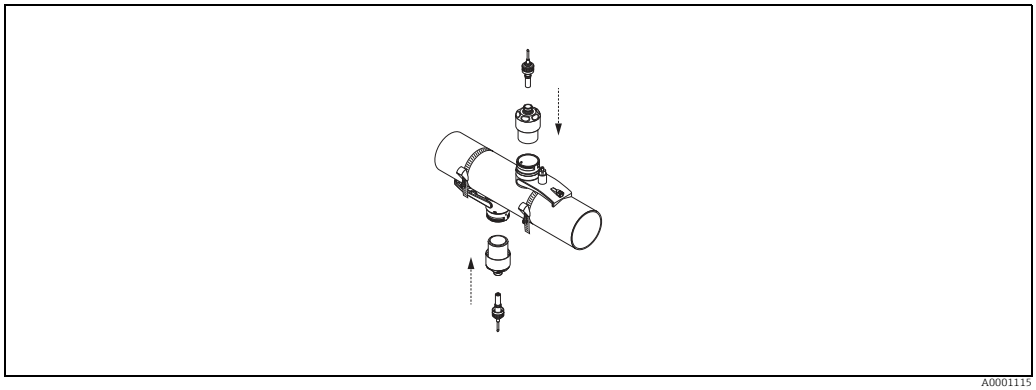


Fig. 20: Mounting the sensor and connecting the connecting cable

This completes the mounting process. The sensors can now be connected to the transmitter via the connecting cables → 27.

Installation for measurement via two traverses (DN 50 to 600 /2" to 24")

Prerequisites

- The installation distance (position sensor) is known → 13.
- The strapping bands are already mounted → 15.

Material

The following material is needed for mounting:
- Two strapping bands incl. mounting bolts and centering plates where necessary (already mounted → 15)
- A mounting rail to position the strapping bands
- Two mounting rail retainers
- Two sensor holders
- Coupling fluid for an acoustic connection between the sensor and pipe
- Two sensors incl. connecting cables.

Mounting rail and POSITION SENSOR installation distance

The mounting rail has two rows with bores. The bores in one of the rows are indicated by letters and the bores in the other row are indicated by numerical values. The value determined for the POSITION SENSOR installation distance is made up of a letter and a numerical value.
The bores that are identified by the specific letter and numerical value are used to position the strapping bands.

Procedure

1. Position the strapping bands with the aid of the mounting rail.
   – Slide the mounting rail with the bore identified by the letter from POSITION SENSOR over the mounting bolt of the strapping band that is permanently fixed in place.
   – Position the movable strapping band and slide the mounting rail with the bore identified by the numerical value from POSITION SENSOR over the mounting bolt.

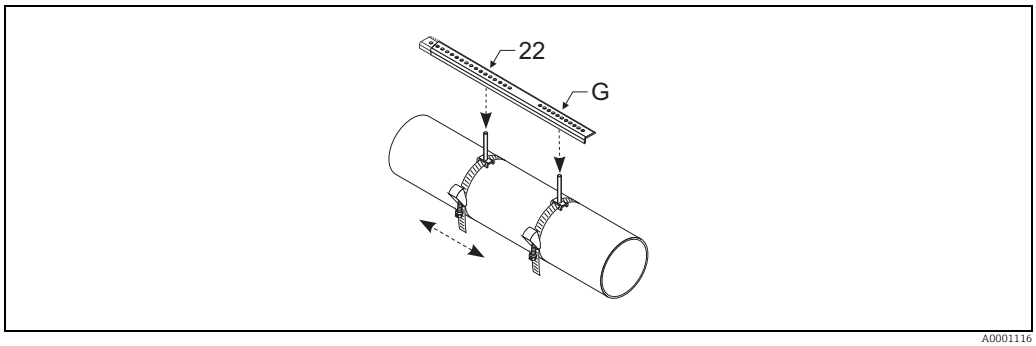


Fig. 21: Determining the distance in accordance with the mounting rail (e.g. POSITION SENSOR G22)

2. Tighten the strapping band so that it cannot slip.
3. Remove the mounting rail from the mounting bolt.
4. Fit the sensor holders over the individual mounting bolts and tighten securely with the retaining nut.

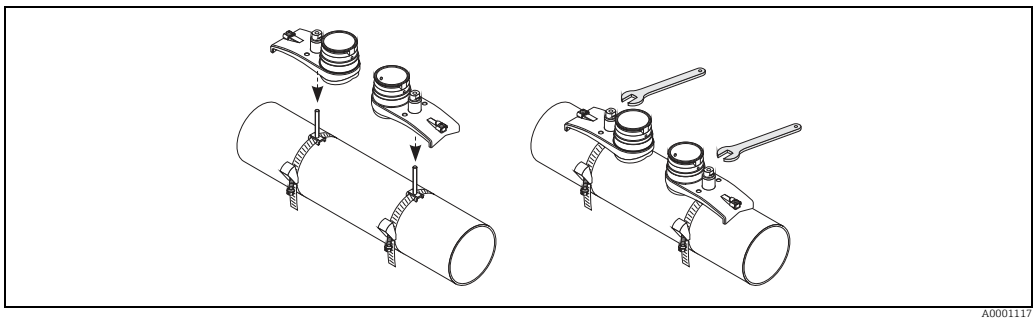


Fig. 22: Mounting the sensor

5. Coat the contact surfaces of the sensors with an even layer of coupling fluid approx. 1 mm (0.04") thick, going from the groove through the center to the opposite edge.

Note!

- Avoid to use a thick layer of the coupling fluid (less is more).
- Clean and reapply new coupling fluid when the sensor is removed from the pipe.
- On rough pipe surface e.g. GRP pipes ensure that the gaps crevices within the surface roughness are filled. Apply sufficient coupling fluid.

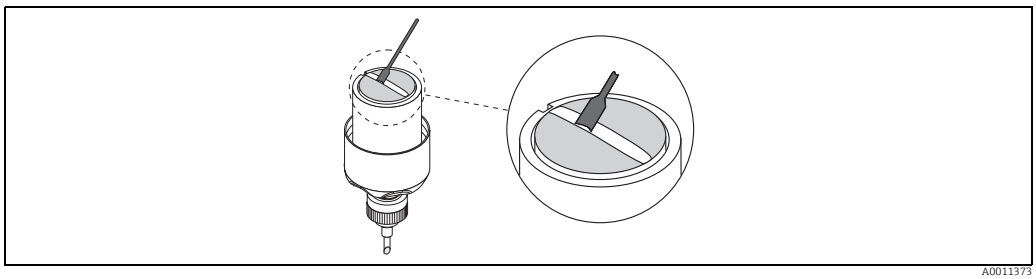


Fig. 23: Coating the contact surfaces of the sensor with coupling fluid

6. Insert the sensor into the sensor holder.
7. Fit the sensor cover on the sensor holder and turn until:
   – The sensor cover engages with a click
   – The arrows (▲ / ▼ "close") are pointing towards one another.

8. Screw the connecting cable into the individual sensor.

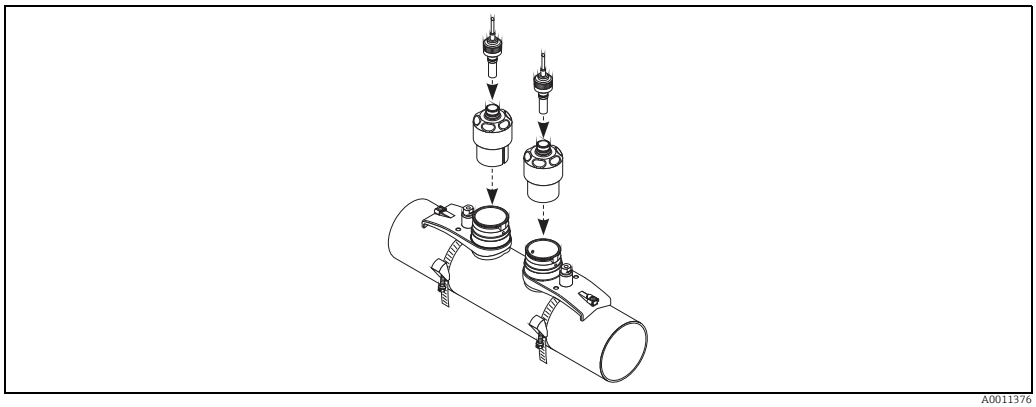


Fig. 24: Connecting the connecting cable

This completes the mounting process. The sensors can now be connected to the transmitter via the connecting cables → 30.

Affixing the local display to the blind version

A local display can be temporarily affixed to devices which do not have a local display.

1. Switch off power supply.
2. Remove the cover of the electronics compartment.
3. Affix local display.
4. Switch on power supply.

Rotating the local display

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the display module from the transmitter retainer rails.
3. Turn the display to the desired position (max. 4 × 45° in each direction).
4. Place the display back on the retaining rails.
5. Screw the cover of the electronics compartment firmly back onto the transmitter housing.

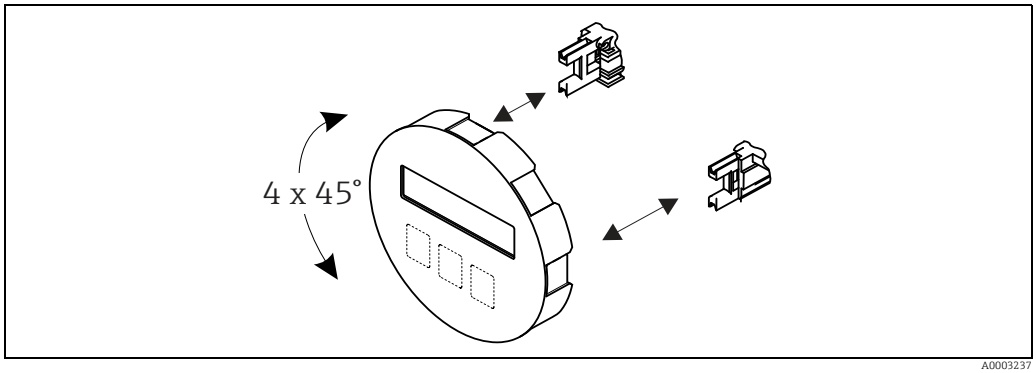


Fig. 25: Rotating the local display

3.7 Mounting the transmitter

The transmitter can be mounted in the following ways:
- Wall mounting
- Pipe mounting (with separate mounting kit, accessories → 52)

Caution!
- The ambient temperature range (−25 to +60 °C; −13 to +140 °F) may not be exceeded at the mounting location. Avoid direct sunlight.
- If a warm pipe is used for the installation, ensure that the housing temperature does not exceed the max. permitted value of +60 °C (+140 °F).

Mount the transmitter as illustrated in → 26.

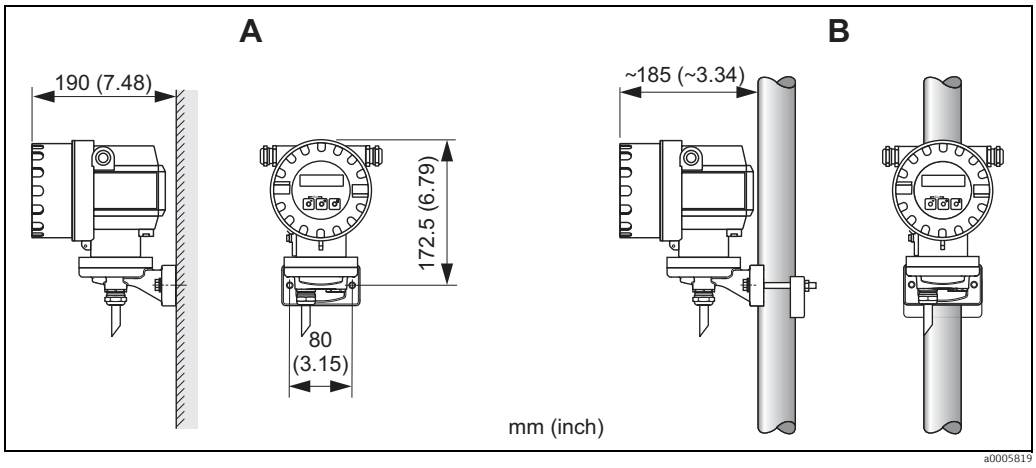


Fig. 26: Mounting the transmitter

A Direct wall mounting
B Pipe mounting

3.8 Post-installation check

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

Device condition and specifications	**Notes**
Is the device damaged (visual inspection)?	-
Does the device correspond to specifications at the measuring point, including process temperature, process pressure, ambient temperature, measuring range, etc.?	→ 73
Installation	**Notes**
Are the measuring point number and labelling correct (visual inspection)?	-
Process environment / process conditions	**Notes**
Are the inlet and outlet runs respected?	→ 11
Is the measuring device protected against moisture and direct sunlight?	-

3.9 Wiring

3.10 Connecting and grounding Prosonic Flow W (DN 50 to 4000 / 2 to 160") Two single coaxial cables

3.10.1 Connecting Prosonic Flow W

Note!
The outer shield of the sensor connecting cable (triaxial cable) is grounded by a ground disk in the cable feedthrough (A). This grounding is absolutely essential to ensure correct measurement.

1. Unscrew the cover (c) of the cable gland (A). Remove the rubber seal (d).
2. Guide the sensor connecting cables (a, b) through the cover of the cable gland.
3. Guide the sensor connecting cables individually through the ground disk in the cable gland holder (g) and into the connection compartment.
4. Plug in the connectors of the sensor connecting cables.
   Left sensor upstream (a), right sensor downstream (b).
   The connector engages with a click when correctly plugged in.
5. Spread the rubber seal (d) along side slits (e.g. using a screwdriver) and fix the cables in place appropriately. Push up the rubber seal in the cable gland until the sensor cable sleeves are pressed against the ground disk.
6. Close the cover of the cable gland (c) so that it is tight.
7. In the connection compartment, fix the two sensor connecting cables in place in the holder (i) provided.

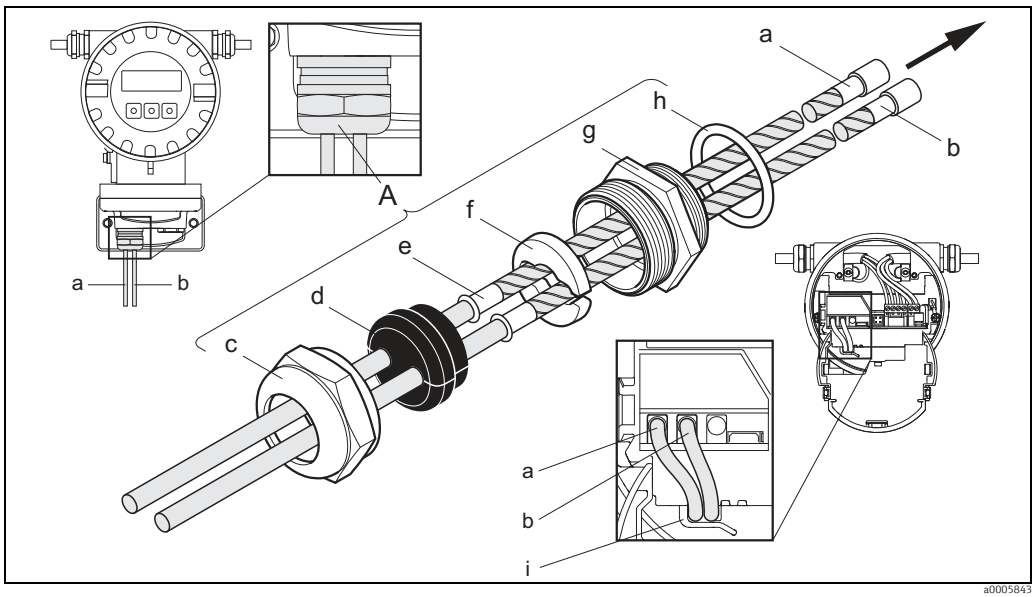


Fig. 27: Connecting the measuring system

a, b Sensor connecting cables
c Cable gland cover
d Rubber seal
e Cable fixing sleeves
f Ground disk
g Cable gland holder
h Seal
i Cable holder

3.10.2 Connecting and Grounding Prosonic Flow W DN 15 to 65 (½ to 2½") Multicore cable

The Prosonic Flow W DN 15 to 65 (½ to 2½") is grounded via the cable gland.

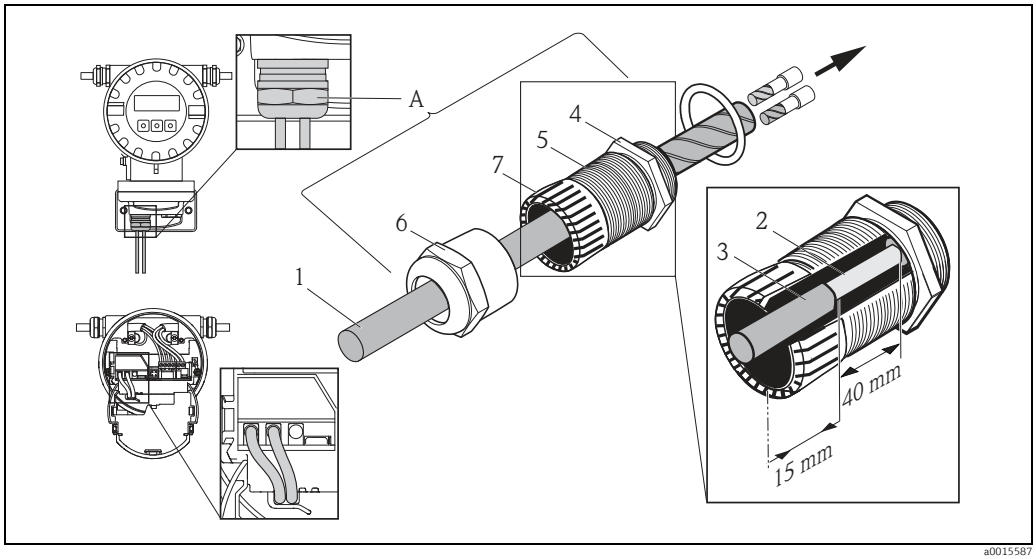


Fig. 28: Connecting and grounding the measuring system

1 Cable sheath
2 Bared braided screen (pre-prepared)
3 Rubber grommet
4 Internal contact point for the grounding on this level (External inspection not possible)
5 Cable gland
6 Cable gland cover
7 Grounding mechanism

Procedure

1. Screw the cable gland (E) into the transmitter housing.
2. Guide the sensor connecting cables through the cable gland cover (F).
3. Threat the sensor connecting cables into the transmitter housing.
   Align the outer end of the rubber grommet with the end of the cable gland/grounding mechanism. This ensures that the cable entry will be a) tight and b) the cable is correctly grounded to the transmitter housing at the internal contact point (D) once tightended. An external inspection is not possible, so it is important to follow this instruction.
4. Tighten the cable gland by turning the cable gland cover clockwise.

Note!
The red marked cable is sensor "up"; the blue marked cable is sensor "down".

Note!
The cable gland can be released from the cable by unscrewing and removing tha cable gland cover. Then retract the grounding mechanism (G) with pair of pliers. The retraction of the mechanism does not require strong force (strong force might destroy the screen). It might be required to lift the internal hooks of the grounding mechanism out of a locked position by pressing the grounding mechanism further forward by turning the cable gland clockwise. Remove the cable gland cover again. Then retry to retract with the pair of pliers.

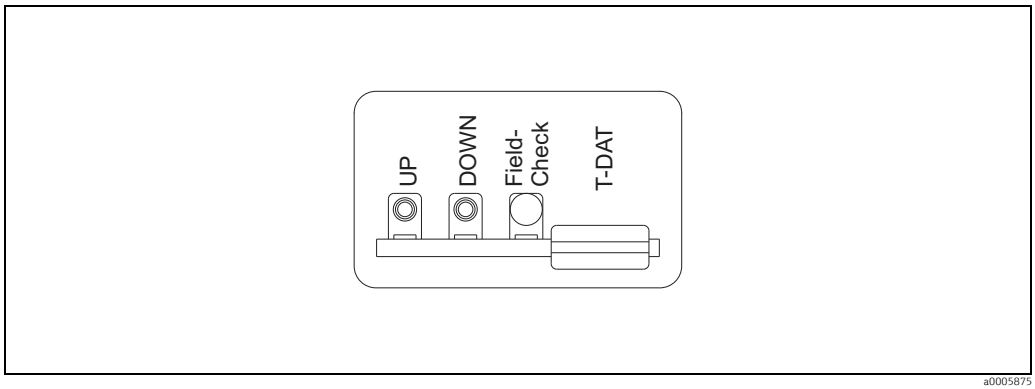


Fig. 29: Connecting nameplate for sensor connecting cables

3.10.3 Cable specifications

Sensor cable
- Use the ready-to-use cables supplied by Endress+Hauser with each sensor pair.
- The following cable lengths are available:
  – 5 m, 10 m, 15 m , 30 m, 60 m
  – 16 ft, 33 ft, 49 ft, 98 ft, 197 ft
- Cable material:
  PVC (DN 50 to 4000/ 2" to 160")
  TPE-V (DN 15 to 65 / ½" to 2½")
- Operating temperature: –20 to +70 °C (–4 to +158 °F)

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 "Emission to class A requirements", and NAMUR Recommendation NE 21.

3.11 Connecting the measuring unit

3.11.1 Transmitter

Warning!
- Risk of electric shock.
  Switch off the power supply before opening the device. **Do not** install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock.
  Connect the protective earth to the ground connection on the housing before the power supply is applied.
- Compare the specifications on the nameplate with the local supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.
- The transmitter must be included in the general circuit protection system.

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Press the side latches and flip down the cover of the connection compartment.
3. Feed the cable for the power supply and the signal cable through the appropriate cable entries.
4. Remove the terminal connectors from the transmitter housing and connect the cable for the power supply and the signal cable:
   – Wiring diagram → 30
   – Terminal assignment → 31
5. Plug the terminal connectors back into the transmitter housing.

   Note!
   The connectors are coded so you cannot mix them up.
6. Secure the ground cable to the ground terminal.
7. Flip up the cover of the connection compartment.
8. Screw the cover of the electronics compartment firmly onto the transmitter housing.

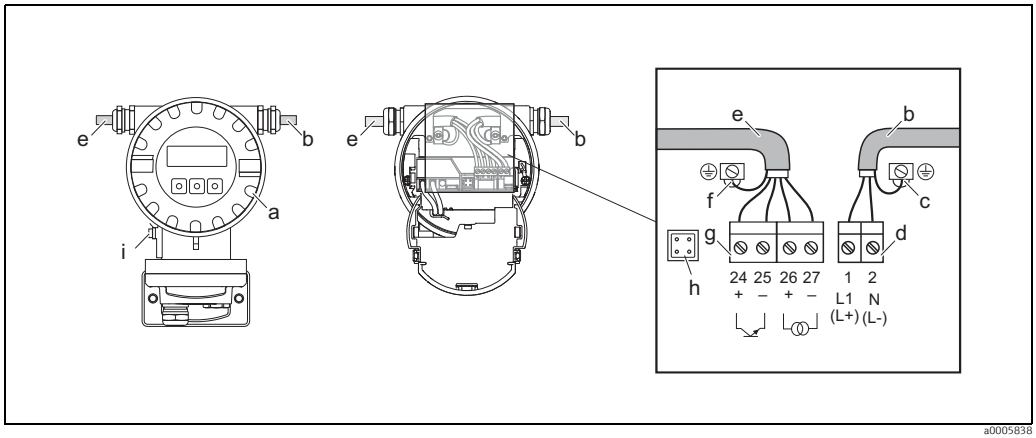


Fig. 30: Connecting the transmitter (aluminum field housing). Cable cross-section: max. 2.5 mm² (AWG 13)

a Electronics compartment cover
b Cable for power supply: 85 to 250 V AC, 11 to 40 V DC, 20 to 28 V AC
c Ground terminal for power supply cable
*d Terminal connector for power supply: **No. 1–2** → 31 (terminal assignment)*
e Signal cable
f Ground terminal for signal cable
*g Terminal connector for signal cable: **No. 24–27** → 31 (terminal assignment)*
h Service connector
i Ground terminal for potential equalization

3.11.2 Terminal assignment

Terminal No. (wiring diagram → 30)					
24 (+)	25 (–)	26 (+)	27 (–)	1 (L1/L+)	2 (N/L–)
Pulse output		HART current output		Power supply	

Note!
Functional values of the outputs and power supply → 68

3.11.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) and 27 (–)
- Connection by means of the 4 to 20 mA circuit.
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
  - CURRENT SPAN function → "4–20 mA HART"
  - Switch HART write protection on or off → 37

Connection of the HART handheld communicator

See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

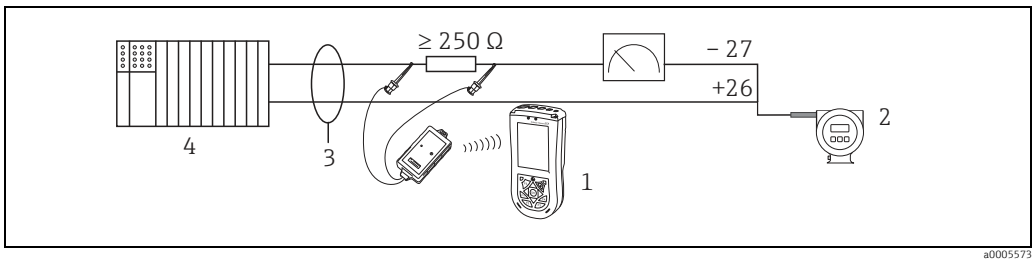


Fig. 31: Electrical connection of HART handheld Field Xpert SFX100

1 HART handheld Field Xpert SFX100
2 Auxiliary energy
3 Shielding
4 Other devices or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with an operating software (e.g. "FieldCare), a HART modem (e.g. Commubox FXA 195) is needed.

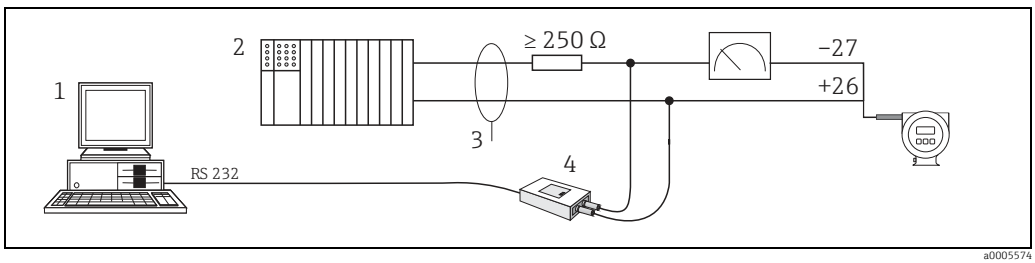


Fig. 32: Electrical connection of a PC with an operating software

1 PC with an operating software
2 Other evaluation devices or PLC with passive input
3 Shield
4 HART modem, e.g. Commubox FXA 195

3.12 Potential equalization

For potential equalization no special measures are necessary.

3.13 Degree of protection

Transmitter

The transmitter meets 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.
- All housing screws and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter → 29.
- Firmly tighten the cable entries (→ 33).
- Remove all unused cable entries and insert dummy plugs instead.
- Do not remove the grommet from the cable entry.

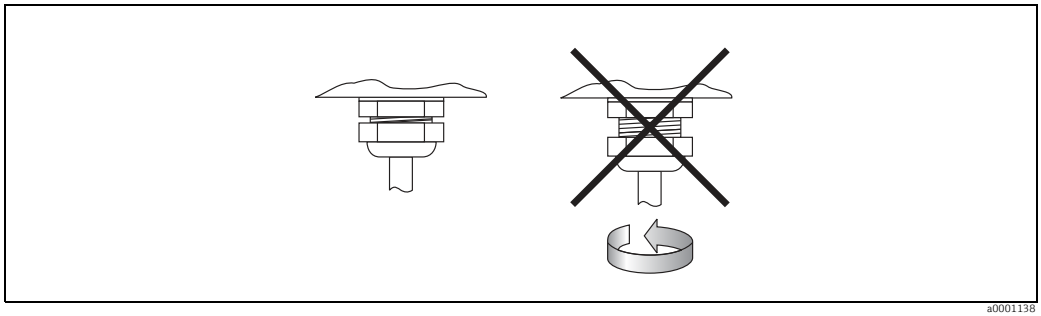


Fig. 33: Installation instructions for cable entries on the transmitter housing

Flowrate measuring sensors W (clamp-on)

The flowrate measuring sensors W, depending on the type, meet all the requirements for IP 67 or IP 68 degree of protection (please observe the information on the nameplate of the sensor). Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67/68 protection is maintained:
- Only use cables supplied by Endress+Hauser with the corresponding sensor connectors.
- The cable connector seals (1) must be clean, dry and undamaged when inserted in the seal groove. Replace them if necessary.
- Insert the cable connectors, do not cant and then tighten them to the stop.

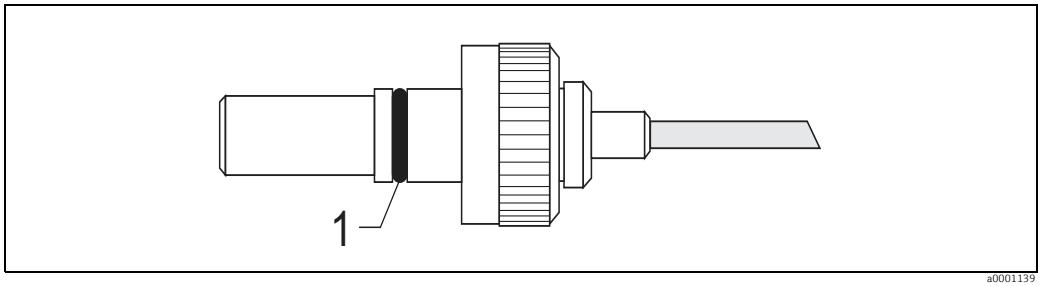


Fig. 34: Installation instructions for IP 67/68 degree of protection for sensor connectors

3.14 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	-
Electrical connection	**Notes**
Does the supply voltage match the specifications on the nameplate?	▪ 85 to 250 V AC (50 to 60 Hz) ▪ 20 to 28 V AC (50 to 60 Hz), 10 to 40 V DC
Do the cables comply with the specifications?	→ 📄 29
Do the cables have adequate strain relief?	-
Is the cable type route completely isolated? Without loops and crossovers?	-
Are the power supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Are all screw terminals firmly tightened?	-
Have the measures for grounding/potential equalization been correctly implemented?	→ 📄 32
Are all cable entries installed, firmly tightened and correctly sealed?	→ 📄 32
Are all housing covers installed and firmly tightened?	-

4 Operation

4.1 Display and operating elements

The configured measured variables are indicated on the local display.
Diagnosis messages can appear during commissioning or in the event of a certain malfunction in operation. The diagnosis message is indicated on the display, alternating with the configured measured variable. List of diagnosis messages: → 57
The assignment of the display lines in operating mode is specified. The top line displays the volume flow and the bottom line displays the totalizer status (see Appendix on device functions → 77).

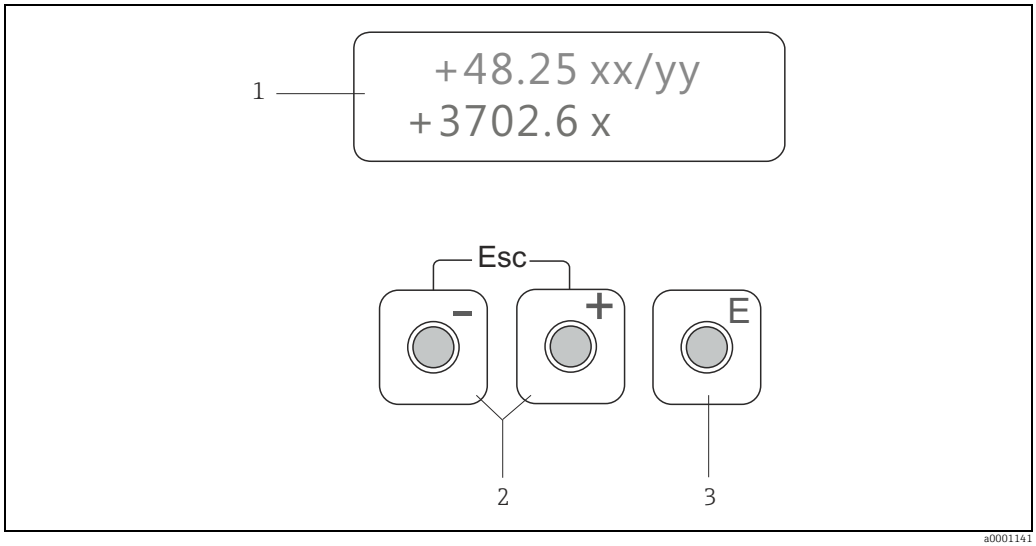


Fig. 35: Display and operating elements

1 Liquid crystal display
The illuminated, two-line liquid crystal display shows measured values, dialog texts and diagnosis messages. The display as it appears during standard measuring mode is known as the HOME position (operating mode).
- *Top line: shows main measured values, e.g. volume flow, [e.g. in ml/min / fl.oz/min]*
- *Bottom line: shows additional measured variables and status variables, e.g. totalizer reading in [m^3 / ft^3], bar graph representation, tag name*
- *The display alternates between a diagnosis message and the measured variable during commissioning or in the event of a malfunction in normal measuring operation.*
  The first line displays the diagnosis code starting with the letters F, C, S or M. The diagnosis message is displayed on the second line as short text.

2 Plus/minus keys
- *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 the +/- keys for more than 3 seconds → Return directly to HOME position*
- *Cancel data entry*

3 Enter key
- *HOME position → Enter the function matrix*
- *Save the numerical values entered or settings changed*

4.2 Brief guide to the function matrix

Note!
- Please refer to the general notes on → 36.
- Function matrix overview → 77
- Detailed description of all functions → 79

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 operating 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 parameterizing the measuring device.

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g. OPERATION)
3. Select a function (e.g. LANGUAGE)
   Change parameter/enter numerical values:
   ± → Select or enter enable code, parameters, numerical values
   E → Save your entries
4. Exit the function matrix:
   – Press and hold down the Esc key (Esc) for more than 3 seconds → HOME position
   – Repeatedly press Esc key (Esc) → Return step by step to HOME position

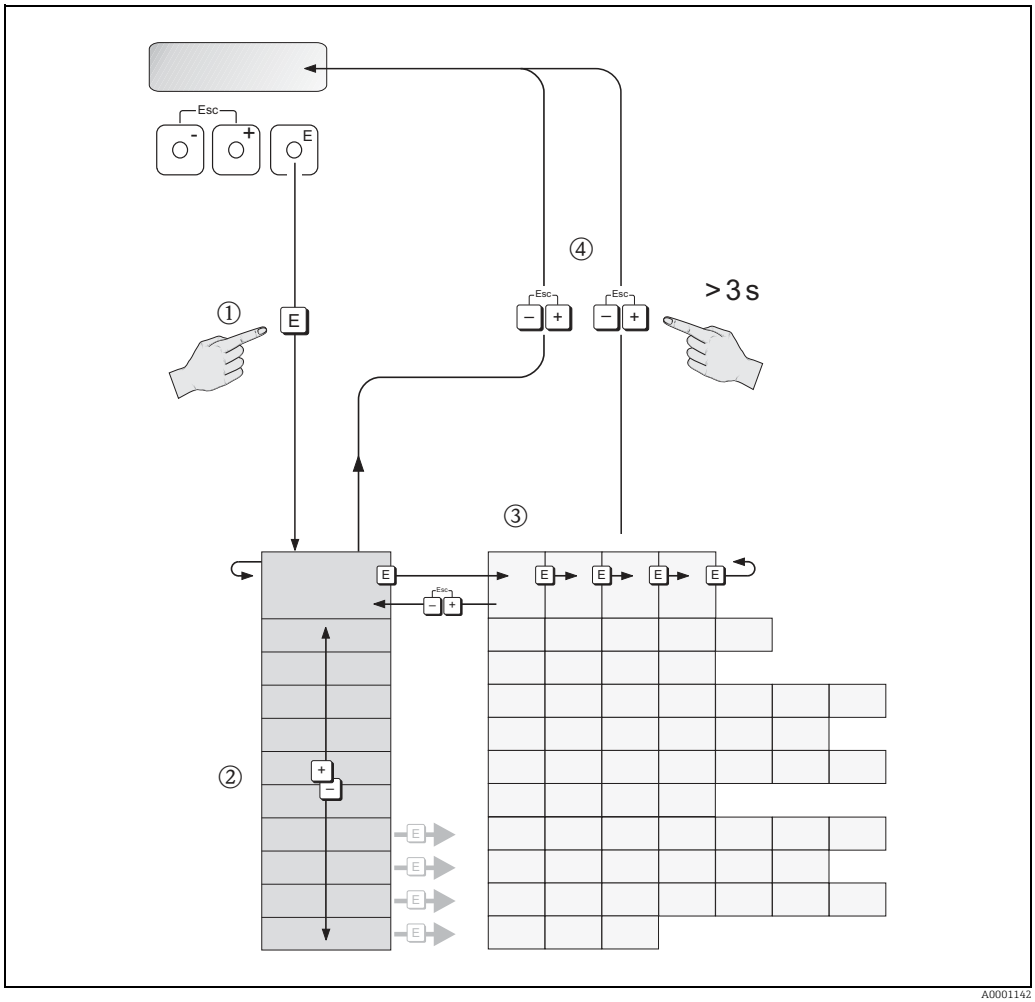


Fig. 36: Selecting functions and configuring parameters (function matrix)

4.2.1 General notes

The brief commissioning guide (→ 45) is adequate for commissioning a standard set-up of the transmitter. Complex measurement tasks require set-up by means of the function matrix, which comprises an additional functions. 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:
- Select functions as described on → 35.
- Certain functions can be switched off (OFF). If functions are switched off related functions in other function groups will no longer be displayed.
- Certain functions require confirmation of the data entries.
  Press ± to select "SURE [YES]" and press E again to confirm. The setting is saved or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

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.

4.2.2 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 = 91) has to be entered before settings can be changed.
If the "private code" is activated, this excludes the possibility of unauthorized persons accessing data, see ACCESS CODE function → 83.

Comply with the following instructions when entering codes:
- If programming is disabled and the ± operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is specified as the private code, programming is always enabled.
- The Endress+Hauser service organization can be of assistance if the personal code is lost.

Caution!
Changing certain sensor specific parameters may influence characteristics of numerous functions of the entire measuring device, particularly measuring accuracy.
This type of parameters may not be changed! Please contact Endress+Hauser if you have any questions.

4.2.3 Disabling the programming mode

Programming is disabled if the operating elements is not pressed within 60 seconds following a return to the HOME position.
This programming is disable by entering any number in the function "ACCESS CODE" (any other than the customer's code).

4.3 Communication

In addition to 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 → 31.
The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes.
The HART masters, e.g. a handheld terminal or PC-based operating programs (such as FieldCare), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using so-called "commands". There are three different command groups:

- *Universal commands*:
  All HART devices support and use universal commands.
  The following functionalities are linked to them:
  – Recognizing HART devices
  – Reading digital measured values (volume flow, totalizer, etc.)
- *Common practice commands:*
  Common practice commands offer functions which are supported and can be executed by most 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 empty-pipe/full-pipe adjustment values, low flow settings etc.

Note!
The measuring device has access to all three command classes. A list of all the "Universal commands" and "Common Practice Commands" can be found on → 39.

4.3.1 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:

Field Xpert HART Communicator
Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix. The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program "FieldCare"
FieldCare is Endress+Hauser's FDT-based plant asset management tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flowmeters are accessed via a service interface or via the service interface FXA291.

Operating program "SIMATIC PDM" (Siemens)
SIMATIC PDM is a standardized, manufacturer-independent tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

Operating program "AMS" (Emerson Process Management)
AMS (Asset Management Solutions): program for operating and configuring devices.

Note!
In the CURRENT SPAN function, the HART protocol demands the setting "4 to 20 mA HART" or "4-20 mA (25 mA) HART".
HART write protection can be disabled or enabled by means of a jumper on the I/O board.

4.3.2 Device description files for operating programs

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

Valid for device software:	V 1.01.XX	→ Function DEVICE SOFTWARE
HART device data:		
Manufacturer ID:	11hex (ENDRESS+HAUSER)	→ Function MANUFACT ID
Device ID:	62hex(98dec)	→ Function DEVICE ID
Device Revision:	1	
DD Revision:	1	
Software release:	02.2010	

Operating program/device description:	**Sources for obtaining device descriptions/program updates:**
Handheld terminal Field Xpert SFX100	Use update function of handheld terminal
FieldCare / DTM	▪ www.endress.com → Download ▪ CD-ROM (Endress+Hauser order number 56004088) ▪ DVD (Endress+Hauser order number 70100690)
AMS	www.endress.com → Download
SIMATIC PDM	www.endress.com → Download

Tester/simulator:	**Sources for obtaining device descriptions:**
Fieldcheck	Update via FieldCare using the Flow Device FXA193/291 DTM in the Fieldflash module

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

4.3.3 Device variables

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

ID (decimal)	Device variable
0	OFF (not assigned)
30	Volume flow
250	Totalizer 1

Process variables:

At the factory, the process variables are assigned to the following device variables:
▪ Primary process variable (PV) → Volume flow
▪ Second process variable (SV) → Totalizer

4.3.4 Universal / common practice HART commands

The following table contains all the universal commands supported by the device.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Universal Commands			
0	Read unique device identifier Access type = Read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. 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, 98 = Prosonic Flow 91 – Byte 3: number of preambles – Byte 4: universal commands rev. no. – Byte 5: device-specific commands rev. no. – Byte 6: software revision – Byte 7: hardware revision – Byte 8: additional device information – Byte 9-11: device identification
1	Read primary process variable Access type = Read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: primary process variable Factory setting: primary process variable = Volume flow Note! ▪ You can set or change the assignment of device variables to process variables using Command 51. ▪ Manufacturer-specific units are represented using the HART unit code "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: %- value of the set measuring range Factory setting: primary process variable = Volume flow Note! You can set or change the assignment of device variables to process variables using Command 51.
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: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: primary process variable – Byte 9: HART unit code of the secondary process variable – Bytes 10-13: second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: fourth process variable *Factory setting:* ▪ Primary process variable = Volume flow ▪ Secondary process variable = Totalizer ▪ Third process variable = Sound velocity ▪ Fourth process variable = Flow velocity Note! ▪ Manufacturer-specific units are represented using the HART unit code "240".

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
6	Set HART shortform address Access type = Write	Byte 0: desired address (0 to 15) Factory setting: 0 Note! With an address > 0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address
11	Read unique device identification using the TAG (measuring point designation) Access type = Read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12-byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: manufacturer ID, 17 = E+H – Byte 2: device type ID, 98 = Prosonic Flow 91 – Byte 3: number of preambles – Byte 4: universal commands rev. no. – Byte 5: device-specific commands rev. no. – 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	Bytes 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	– Bytes 0-5: TAG – Byte 6-17: TAG description – Bytes 18-20: date Note! You can write the TAG, TAG descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: sensor serial number – Byte 3: HART unit code of the sensor limits and measuring range of the primary process variable – Bytes 4-7: upper sensor limit – Bytes 8-11: lower sensor limit – Bytes 12-15: minimum span Note! ▪ The data relate to the primary process variable (= volume flow). ▪ Manufacturer-specific units are represented using the HART unit code "240".

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
15	Read output information of primary process variable Access type = Read	none	– Byte 0: alarm selection ID – Byte 1: transfer function code – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: end of measuring range, value for 20 mA – Bytes 7-10: start of measuring range, value for 4 mA – Bytes 11-14: attenuation constant in [s] – Byte 15: write protection code – Byte 16: OEM dealer code, 17 = E+H Factory setting: primary process variable = Volume flow Note! ▪ Manufacturer-specific units are represented using the HART unit code "240".
16	Read the device production number Access type = Read	none	Bytes 0-2: production number
17	Write user message Access = Write	Any 32-character long text can be saved in the device under this parameter: Bytes 0-23: desired user message	Displays the current user message in the device: Bytes 0-23: current user message in the device
18	Write TAG, TAG descriptor and date Access = Write	With this parameter, you can store an 8-character TAG, a 16-character TAG description and a date: – Bytes 0-5: TAG – Byte 6-17: TAG description – Bytes 18-20: date	Displays the current information in the device: – Bytes 0-5: TAG – Byte 6-17: TAG description – Bytes 18-20: date
19	Write the device production number Access = Write	Bytes 0-2: production number	Bytes 0-2: production number

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

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
Common practice commands			
34	Write damping value for primary process variable Access = Write	Byte 0-3: damping value of the primary process variable in seconds *Factory setting:* Primary process variable = Volume flow	Displays the current attenuation constant in the device: Bytes 0-3: attenuation constant in seconds
35	Write measuring range of primary process variable Access = Write	Write the desired measuring range: – Byte 0: HART unit code for the primary process variable – Byte 1-4: end of measuring range, value for 20 mA – Bytes 5-8: start of measuring range, value for 4 mA *Factory setting:* Primary process variable = Volume flow Note! ▪ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is shown as the response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Byte 1-4: end of measuring range, value for 20 mA – Bytes 5-8: start of measuring range, value for 4 mA Note! Manufacturer-specific units are represented using the HART unit code "240".
38	Device status reset "Configuration changed" Access = Write	none Note! This HART command can also be executed if the write protection is switched on (= ON)!	none
40	Simulate output current of 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 = Volume flow	The momentary 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 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 code *Factory setting:* Primary process variable = Volume flow Note! ▪ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ▪ A change of the unit of the primary process variable has a direct impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
48	Read extended device status Access = Read	none	The current device status is displayed in extended form as the response: Encoding: see Table → 44.

Command No. HART command / Access type		Command data (numeric data in decimal form)	Response data (numeric data 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 code for the primary process variable – Byte 1: device variable code for the second process variable – Byte 2: device variable code for the third process variable – Byte 3: device variable code for the fourth process variable *Factory setting:* ▪ Primary process variable: code 30 for volume flow ▪ Secondary process variable: code 250 for totalizer ▪ Third process variable: code 40 for sound velocity ▪ Fourth process variable: code 49 for flow velocity
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 code – Byte 1: HART unit code *Code of the supported device variables:* See data → 📄 38 Note! ▪ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ▪ A change of the unit of the primary process variable has a direct impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: device variable code – Byte 1: HART unit code Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Set number of preambles in message responses Access = Write	This parameter sets the number of preambles which are inserted in the message responses: Byte 0: number of preambles (2 to 20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: number of preambles

4.3.5 Device status/diagnosis messages

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

Note!

- For detailed information on the device status/diagnosis messages and how they are rectified → 57
- Bits and bytes not listed are not assigned.

Byte	Bit	Diagnosis code	Brief description of the diagnosis message
0	7	C - 284	Software update
	6	C - 481	Diagnosis active
	5	C - 281	Initialization
	4	C - 411	Upload/download
	3	F - 001	Device fault
	2	F - 282	Data storage
	1	F - 283	Memory contents
	0	F - 062	Sensor connection - Down
1	7	F - 062	Sensor connection - Up
	6	F - 881	Sensor signal
	5	C - 431	Calibration
	4	C - 412	Writing backup
	3	C - 413	Reading backup
	2	C - 461	Signal output - Current adjust
	1	C - 453	Hide value - Pos. Zero return
	0	C - 484	Simulation error
2	7	C - 485	Simulation value
	6	C - 482	Simulation output - Current
	5	C - 482	Simulation output - Frequency
	4	C - 482	Simulation output - Pulse
	3	C - 482	Simulation output - Status
	2	S - 461	Signal output -Current
	1	S - 461	Signal output - Frequency
	0	S - 461	Signal output - Pulse
3	0	S - 437	Configuration - Sound velocity
	1	S - 437	Configuration - Interference
	2	-	-
	3	-	-
	4	-	-
	5	-	-
	6	-	-
	7	-	-

5 Commissioning

5.1 Function check

Make sure that all final checks have been completed before you commission your measuring point:
- "Post-installation check" checklist → 26
- "Post-connection check" checklist → 33

5.2 Switching on the measuring device

Once the post-connection checks have been successfully completed, it is time to switch on the supply voltage. The device is ready for operation! The measuring device performs a number of self-tests after power-on. As this procedure progresses the following sequence of messages appears on the local display:

PROSONIC FLOW 91 **STARTING. . .**	→	Startup message
DEVICE SOFTWARE **V X.XX.XX**	→	Current software is displayed (example)
SYSTEM OK **→ OPERATION**	→	Beginning of standard measuring mode

Normal measuring mode commences as soon as startup completes. Various measured value and/or status variables appear on the display (HOME position).

Note!
If startup fails, an error message indicating the cause is displayed.

5.3 Commissioning via a configuration program

5.3.1 Sensor Setup/sensor installation

For sensor installation with the configuration program "FieldCare" any "Quick Setup" menus which correspond to the local operation exist.
Other methods (see table) are available for determining the relevant values for sensor distance, wire length, etc. The procedure is illustrated in detail on → 46.

Sensor type	Required values for the sensor installation procedure	Local display [1]	FieldCare [2]	Applicator [3]
clamp-on version	Position sensor	x	x	x
	Wire length	x	x	x
	Sensor distance	x	x	x

[1] Conditions that must be met before determining the values via the local display using the "Sensor" Sensor Setup (→ 80):
- Transmitter installed (→ 30)
- Transmitter connected to power supply (→ 30)

[2] FieldCare is a configuration software package for flowmeters in the field. Conditions that must be met before determining the values via "FieldCare":
- Transmitter installed (→ 30)
- Transmitter connected to power supply (→ 30)
- "FieldCare" configuration package installed on a notebook/PC
- Connection made between notebook/PC and device via the FXA291 service interface (→ 30)

[3] Applicator is software for selecting and configuring flowmeters.
The values required can be determined without having to connect the transmitter beforehand.
The "Applicator" can be found on the Internet (→ www.endress.com/de/onlinetools).

Procedure (determining data for sensor installation)

The following table can be used to select and configure, the functions required to install the sensor:

Note!
Enter a valid release code to allow that device parameters can be changed or activated. The code (factory setting = 91) is entered by means of the corresponding matrix cell.

"Clamp-on" sensor installation	
Procedure **Selection - Input - display**	**Local display (Sensor Setup)** ▼
Liquid in the pipe	LIQUID
Liquid temperature	TEMPERATURE
Liquid sound velocity	SOUND VELOCITY LIQUID
Pipe material	PIPE MATERIAL
Pipe sound velocity	SOUND VELOCITY PIPE
Pipe circumference	CIRCUMFERENCE
Pipe diameter	PIPE DIAMETER
Wall thickness	WALL THICKNESS
Liner material	LINER MATERIAL
Liner sound velocity	SOUND VELOCITY LINER
Liner thickness	LINER THICKNESS
Sensor type	SENSOR TYPE
Sensor configuration	SENSOR CONFIGURATION

"Clamp-on" sensor installation	
Procedure **Selection - Input - display**	**Local display (Sensor Setup)** ▼
Cable length	CABLE LENGTH
Display sensor position (for sensor installation)	POSITION SENSOR
Display wire length (for sensor installation)	WIRE LENGTH
Display sensor distance (for sensor installation)	SENSOR DISTANCE
Note! A detailed description of all the functions can be found on → 77	

5.3.2 Commissioning

Additionally to the settings for the sensor installation (→ 46) the following functions have to be configured for the standard application:

- System units
- Outputs

5.3.3 Data backup/transmission

Using the T-DAT SAVE/LOAD function (→ 84), you can transfer data (device parameters and settings) between the T-DAT (exchangeable memory) and the EEPROM (device storage unit).

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

Note!
For information on installing and removing the T-DAT → 62

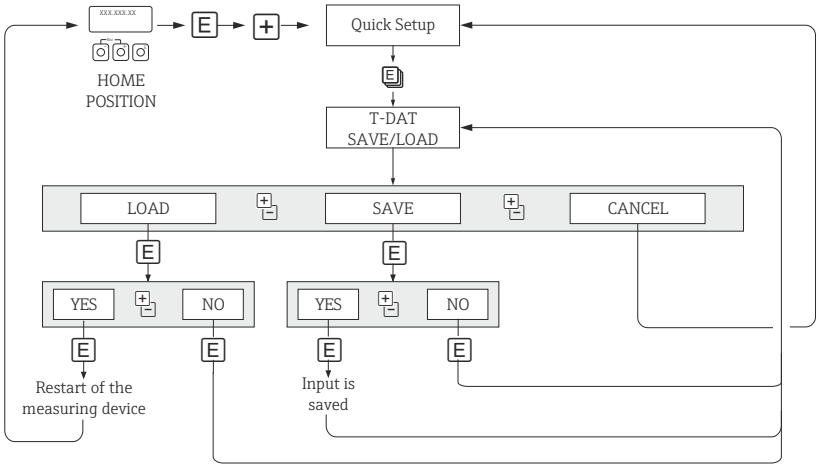


Fig. 37: Data backup/transmission with T-DAT SAVE/LOAD function

Information on the LOAD and SAVE options available:

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

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

SAVE:
Data are transferred from the EEPROM to the T-DAT

5.4 Application specific commissioning

5.4.1 Zero point adjustment

Consequently, zero point adjustment is generally not necessary.

Experience shows that the zero point adjustment is advisable only in special cases:
- To achieve highest measuring accuracy also with very small flow rates.
- Under extreme process or operating conditions (e.g. very high process temperatures or very high-viscosity fluids).

Preconditions for a zero point adjustment
Note the following before performing a zero point adjustment:

- A zero point adjustment can be performed only with fluids that contain no gas or solid contents.
- Zero point adjustment is performed with the pipe completely filled and at zero flow (v = 0 m/s). This can be achieved, for example, with shutoff valves upstream and/or downstream of the measuring range or by using existing valves and gates (→ 38).
  - Standard operation → valves 1 and 2 open
  - Zero point adjustment with pump pressure → valve 1 open / valve 2 closed
  - Zero point adjustment without pump pressure → valve 1 closed / valve 2 open

Caution!
- If the fluid is very difficult to measure (e.g. containing entrained solids or gas) it may prove impossible to obtain a stable zero point despite repeated zero point adjustments. In instances of this nature, please contact your Endress+Hauser service center.
- You can view the currently valid zero point value using the "ZERO POINT" function (→ 105).

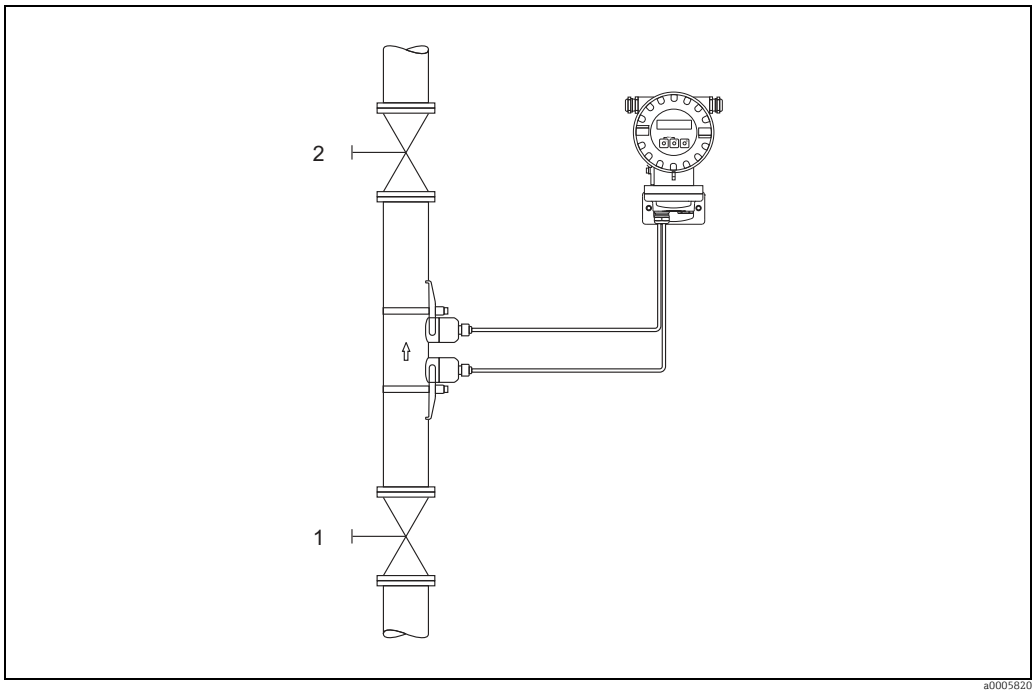


Fig. 38: Zero point adjustment and shutoff valves

Performing a zero point adjustment

1. Operate the system until normal operating conditions resume.
2. Stop the flow (v = 0 m/s).
3. Check the shutoff valves for leaks.

4. Check that operating pressure is correct.
5. Using the local display, select the "ZERO POINT ADJUSTMENT" function in the function matrix:
   HOME → E → ⊞ → PROCESS PARAMETER
   PROCESS PARAMETER → E → ⊞ → ZERO POINT ADJ.
6. When you press ⊞ you are automatically prompted to enter the code if the function matrix is still disabled. Enter the code.
7. Use ⊞ to select START and press E to confirm.
   Select YES at the prompt and press E again to confirm. Zero point adjustment now starts.
   - The message "ZEROPOINT ADJUST RUNNING" appears on the display for 30 to 60 seconds while adjustment is in progress.
   - If the fluid velocity in the pipe exceeds 0.1 m/s, the following error message appears on the display: ZERO ADJUST NOT POSSIBLE.
   - When the zero point adjustment is completed, the "ZERO ADJUST." function reappears on the display.
8. Back to the HOME position
   - Press and hold down Esc key (⊞) for more than 3 seconds
   - Repeatedly press and release the Esc key (⊞).

5.5 Data storage devices

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

5.5.1 HistoROM/T-DAT (transmitter DAT)

The T-DAT is an exchangeable data storage device in which all transmitter parameters and settings are stored.
Storing of specific parameter settings from the device memory (EEPROM) to the T-DAT module and vice versa must be carried out by the user (= manual save function). Detailed instructions regarding this can be found on → 84.

6 Maintenance

No special maintenance work is required.

6.1 Exterior cleaning

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

6.2 Coupling fluid

A coupling fluid is required to ensure the acoustic link between the sensor and the piping. This is applied to the sensor surface during commissioning. Periodic replacement of the coupling fluid is usually not required.

Note!

If too much coupling fluid is applied, signal transmission is reduced by up to 10 dB.

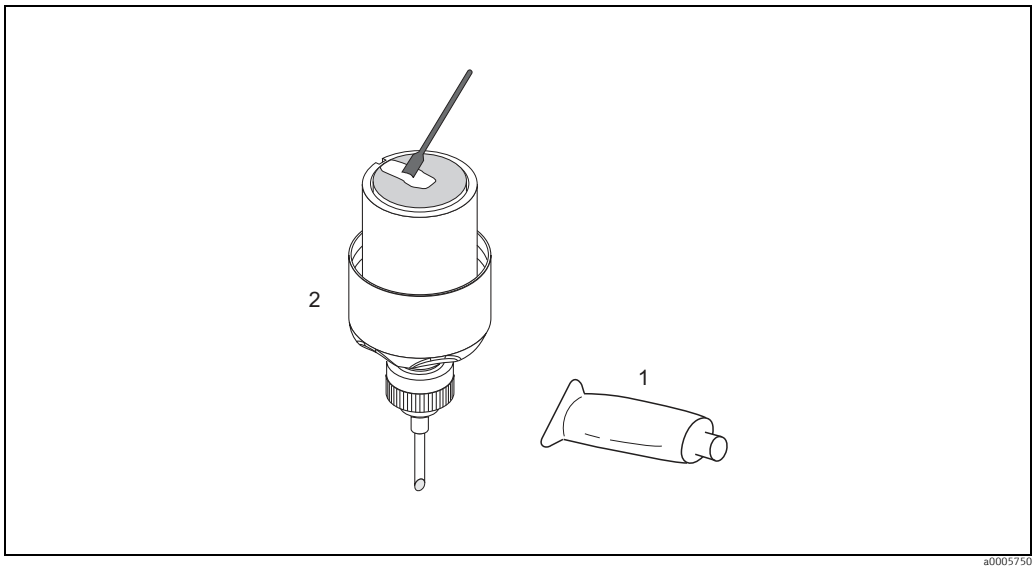


Fig. 39: Application of the coupling fluid

1 Coupling fluid
2 Sensor surface, Prosonic Flow W

Note!

- Avoid to use a thick layer of the coupling fluid (less is more).
- Clean and reapply new coupling fluid when sensor is removed from the pipe.
- On rough pipe surfaces e.g. GRP pipes ensure that the gaps are filled. Apply sufficient coupling fluid.
- A change in the signal strength might indicate a need to use a different coupling fluid. No action is required as long as the signal strength is higher than 50 dB.

7 Accessories

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

7.1 Device-specific accessories

Accessory	Description	Order code
Sensor W DN 15 to 65, (½" to 2½") Clamp-on version	DN 15 to 65, −20 to +80 °C (½" to 2½ ", −4 to +176 °F), 5.0 MHz ▪ IP 67 / NEMA 4X ▪ IP 68 / NEMA 6P	 DK9WS - 1* DK9WS - 3*
	DN 15 to 65, 0 to +55 °C (½" to 2½ ", 32 to +212 °F), 5.0 MHz ▪ IP 67 / NEMA 4X ▪ IP 68 / NEMA 6P	 DK9WS - 2* DK9WS - 4*
Sensor W DN 50 to 4000, (2" to 157") Clamp-on version	DN 50 to 300, −20 to +80 °C (2" to 12", −4 to +176 °F), 2.0 MHz ▪ IP 67 / NEMA 4X ▪ IP 68 / NEMA 6P	 DK9WS - B* DK9WS - N*
	DN 100 to 4000, −20 to +80 °C (4" to 160", −4 to +176 °F)1.0 MHz ▪ IP 67 / NEMA 4X ▪ IP 68 / NEMA 6P	 DK9WS - A* DK9WS - M*
	DN 100 to 4000, 0 to +130 °C (4" to 160", +32 to +266 °F), 1.0 MHz ▪ IP 67 / NEMA 4X	 DK9WS - P*
	DN 50 to 300, 0 to +130 °C (2" to 12", +32 to +266 °F), 2.0 MHz ▪ IP 67 / NEMA 4X	 DK9WS - S*
	DN 100 to 4000, 0 to +130 °C (4" to 160", +32 to +266 °F) 0.5 MHz ▪ IP 67 / NEMA 4X ▪ IP 68 / NEMA 6P	 DK9WS - R* DK9WS - T*

7.2 Accessories specific to measuring principle

Accessory	Description	Order code
Mounting kit for aluminum field housing	Mounting kit for wall-mount housing.	DK9WM - C
Sensor holder set	Prosonic Flow W (DN 15 to 65, ½" to 2 ½") ▪ Sensor holder, clamp-on version Prosonic Flow W (DN 50 to 4000, 2" to 160") ▪ Sensor holder, fixed retaining nut, clamp-on version ▪ Sensor holder, detachable retaining nut, clamp on version	 DK9SH - 1 DK9SH - A DK9SH - B

Accessory	Description	Order code
Clamp-on installation set	Sensor fastening for Prosonic Flow W (DN 15 to 65, ½" to 2½") ▪ U-Bolt DN 15 to 32 (½ to 1¼") ▪ Strapping bands DN 40 to 65 (1½ to 2½") (DN 50 to 4000, 2" to 160") ▪ Without sensor fastening ▪ Strapping bands DN 50 to 200 (2" to 8") ▪ Strapping bands DN 600 to 2000 (24" to 80") ▪ Strapping bands DN 2000 to 4000 (80" to 160") ▪ Without mounting tools ▪ Spacing ruler DN 50 to 200 (2" to 8") ▪ Spacing ruler DN 200 to 600 (8" to 24") ▪ Fastener, 1 Traverse DN 50 to 4000 (2" to 160")	 DK9IC - 11* DK9IC - 21* DK9IC - A* DK9IC - C* DK9IC - D* DK9IC - E* DK9IC - *1 DK9IC - *2 DK9IC - *3 DK9IC - *6
Conduit adapter for connecting cable	Prosonic Flow W (DN 15 to 65, ½" to 2 ½") ▪ Conduit adapter incl. cable entry M20× 1,5 ▪ Conduit adapter incl. cable entry ½" NPT ▪ Conduit adapter incl. cable entry G ½" Prosonic Flow W (DN 50 to 4000, 2" to 160") ▪ Conduit adapter incl. cable entry M20× 1,5 ▪ Conduit adapter incl. cable entry ½" NPT ▪ Conduit adapter incl. cable entry G ½"	 DK9CB - AA1 DK9CB - AA2 DK9CB - AA3 DK9CB - AB1 DK9CB - AB2 DK9CB - AB3
Connecting cable	For sensor DN 15 to 65, ½" to 2 ½") 5 m (16 ft) sensor cable, TPE-V, −20 to +70 °C (−4 to 158 °F) 10 m (33 ft) sens. cable, TPE-V, −20 to +70 °C (−4 to 158 °F) 15 m (49 ft) sens. cable, TPE-V, −20 to +70 °C (−4 to 158 °F) 30 m (98 ft) sens. cable, TPE-V, −20 to +70 °C (−4 to 158 °F) For sensor DN 50 to 4000, 2" to 160") 5 m (16 ft) sensor cable, PVC, −20 to +70 °C (−4 to 158 °F) 10 m (33 ft) sensor cable, PVC, −20 to +70 °C (−4 to 158 °F) 15 m (49 ft) sensor cable, PVC, −20 to +70 °C (−4 to 158 °F) 30 m (98 ft) sensor cable, PVC, −20 to +70 °C (−4 to 158 °F) 60 m (197 ft) sens. cable, PVC, −20 to +70 °C (−4 to 158 °F)	 DK9SS - AAA DK9SS - AAB DK9SS - AAC DK9SS - AAD DK9SS - ABA DK9SS - ABB DK9SS - ABC DK9SS - ABD DK9SS - ABJ
Acoustic coupling fluid	▪ Coupling fluid −40 to 170 °C (−40 to 338 °F), Standard ▪ Adhesive coupling fluid −40 to +80 °C (−40 to 176 °F) ▪ Water-soluble coupling fluid −20 to +80 °C (−4 to 176 °F) ▪ Coupling fluid DDU 19, −20 to +60 °C (−4 to 140 °F) ▪ Coupling fluid −40 to +100 °C (−40 to 212 °F), Standard, type MBG2000	DK9CM - 2 DK9CM - 3 DK9CM - 4 DK9CM - 6 DK9CM - 7

7.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator Field Xpert SFX 100	Handheld terminal for remote configuration and for obtaining measured values via the 4 to 20 mA HART current output. Contact your Endress+Hauser representative for more information.	SFX100 – *******
Fieldgate FXA320	Gateway for remote interrogation of HART sensors and actuators via Web browser: ▪ 2-channel analog input (4 to 20 mA) ▪ 4 binary inputs with event counter function and frequency measurement ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values.	FXA320 – *****

Accessory	Description	Order code
Fieldgate FXA520	Gateway for 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 hazardous areas ▪ Communication via modem, Ethernet or GSM ▪ Visualization via Internet/Intranet in Web browser and/or WAP cellular phone ▪ Limit value monitoring with alarm by e-mail or SMS ▪ Synchronized time stamping of all measured values ▪ Remote diagnosis and remote configuration of connected HART devices	FXA520 – ****
FXA195	The Commubox FXA195 connects intrinsically safe Smart transmitters with HART protocol to the USB port of a personal computer. This makes the remote operation of the transmitters possible with the aid of configuration programs (e.g. FieldCare). Power is supplied to the Commubox by means of the USB port	FXA195 – *

7.4 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be found on the Internet. Contact your Endress+Hauser representative for more information.	DXA80 – *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	50098801
FieldCare	FieldCare is Endress+Hauser's FDT-based plant asset management tool. It can configure all intelligent field devices in your plant and supports you in the administration of these devices. Through the use of status information, it is also an easy but effective means of monitoring the status of these devices.	See product list on the Endress+Hauser website: www.endress.com
FXA291	Service interface of device to the PC for operation via FieldCare.	FXA291 – *
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all relevant process variables: Measuring values are recorded reliably, limit values monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on an SD card or USB stick. The PC software package ReadWin® 2000, which is supplied as standard, is used for configuration, visualization and storage of the recorded data. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.	RSG40-**********

8 Troubleshooting

8.1 Troubleshooting instructions

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

Check the display	
No display visible and no output signals present	1. Check supply voltage → Terminal 1, 2 2. Check device fuse → 📄 65 85 to 250 V AC: 1 A slow-blow / 250 V 20 to 28 V AC and 11 to 40 V DC: 1.6 A slow-blow / 250 V 3. Electronics defective → Order spare part → 📄 62
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 → 📄 63 2. Display module defective → Order spare part → 📄 62 3. Electronics defective → Order spare part → 📄 62
Display texts are in a foreign language.	Switch off power supply. Press and hold down the ⊞ keys simultaneously and switch on the measuring device again. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal output at the current or pulse output.	Electronics PCB defective → Order spare part → 📄 62
↓	
Diagnosis code on the display	
The measuring device is monitored during commissioning and operation. The results are shown on the display in the form of diagnosis code messages. Diagnosis code messages help the user detect current conditions and errors. Depending on the diagnosis code displayed, it is then possible to service the measuring device. Depending on the diagnosis code, the behavior of the device can also be affected. Where permitted, the user has the option of deactivating alarms and defining them as notice messages. There are 4 categories of diagnosis code messages: F, C, S, and M: **Category F (failure):** The device does not function as it should such that the measured values cannot be used. This also includes some process errors. **Category C (function check):** The device is being serviced, assembled, configured or is in the simulation mode. The output signals do not correspond to the actual process values and thus cannot be used. **Category S (outside specification):** One or more measured values (e.g. flow etc.) are outside the specified limit values that were specified at the factory or by the users themselves. Diagnosis messages of this category are also displayed during measuring device startup or during cleaning processes. **Category M (maintenance):** The measuring signals are still valid but are affected by factors such as wear, corrosion or fouling. The diagnosis code messages are grouped as follows within the F, C, S and M Categories: **No. 000 – 199:** Messages affecting the sensor. **No. 200 – 399:** Messages affecting the transmitter. **No. 400 – 599:** Configuration-related messages (simulation, download, data storage etc.) **No. 800 – 999:** Process-specific messages	
↓	
Other errors (without error messages)	
Some other error has occurred.	Diagnosis and remedial measures → 📄 60

8.2 Diagnosis code messages

8.2.1 Category F diagnosis code messages

Code on local display	Cause	Remedy (Spare parts → 62)	Device behavior: factory setting ( ) = options
F 001 Device fault	Serious device error	Replace the amplifier board.	Alarm (–)
F 062 Sensor connection	Connection between "down" sensor and transmitter interrupted. Connection between "up" sensor and transmitter interrupted.	– Check the cable connection between the sensor and the transmitter. – Check that the sensor connector is fully screwed in. – The sensor may be defective. – Incorrect sensor connected – A wrong sensor was selected in the function SENSOR TYPE.	Alarm (–)
F 282 Data storage	Faulty EEPROM	Replace printed circuit board.	Alarm (–)
F 283 Memory contents	Error accessing EEPROM data	Replace printed circuit board.	Alarm (–)
F 412 Writing backup	DAT transmitter: Data back-up (download) to T-DAT failed or error when accessing (uploading) the values saved in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → 41. 2. Replace T-DAT if defective. Before replacing a DAT, check whether the new replacement DAT is compatible with the existing electronics. Check the: – Spare part set number – Hardware revision code 3. Replace electronics boards if necessary.	Notice (–)
F 413 Reading backup			Alarm (–)
F 881 Sensor signal	Attenuation of acoustic measurement section too high.	– Check to see if the coupling fluid must be renewed. – It is possible that the fluid indicates too much attenuation. – It is possible that the pipe indicates too much attenuation. – Check the sensor spacing (Installation dimensions). – Reduce the number of traverses if possible.	Alarm (–)

8.2.2 Category C diagnosis code messages

Code on local display	Cause	Remedy (Spare parts → 62)	Device behavior: factory setting ( ) = options
C 281 Initialization	Initialization is running. All outputs are set to 0.	Wait until the procedure is finished.	Notice (–)
C 284 Software update	Loading new software version. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.	Alarm (–)
C 411 Upload/download	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until the procedure is finished.	Notice (–)
C 431 Calibration	Static zero point adjustment is not possible or was canceled.	Check that the flow velocity is = 0 m/s.	Alarm (–)
C 453 Hide value	Positive zero return active. Caution! This is the highest priority notice message.	Switch off positive zero return.	Notice (–)
C 461 Signal output	Current adjustment is active.	End current adjustment.	Alarm (–)
C 481 Diagnosis active	The measuring device is being checked on site via the test and simulation device.	–	Notice (–)
C 482 Simulation outp.	Simulation current output active	Switch off simulation	Notice (–)
	Simulation frequency output active		
	Simulation pulse output active		
	Simulation status output active		
C 484 Simulation error	Simulation of response to error (outputs) active	Switch off simulation	Alarm (–)
C 485 Simulation value	Simulation of volume flow active	Switch off simulation	Notice (–)

8.2.3 Category S diagnosis code messages

Code on local display	Cause	Remedy (Spare parts → 62)	Device behavior: factory setting ( ) = options
S 437 Configuration	The sound velocity is outside the search range of the transmitter.	– Check the installation dimensions. – If possible, check the sound velocity of the fluid or check the specialist literature. If the actual sound velocity is outside the defined search range, the corresponding parameters must be changed in the LIQUID DATA function group. More detailed information on this is provided in the SOUND VELOCITY LIQUID function (→ 101).	Notice (–)
	The pipe transmitted wave may superpose the signal. We recommend you alter the sensor configuration in the event of this error message. Caution! A change of the sensor configuration is required if the measuring device indicates zero or low flow.	– In the SENSOR CONFIGURATION function, change the number of traverses from 2 or 4 to 1 or 3 and mount the sensors accordingly.	
S 461 Signal output	Current output: The current flow is outside the set range.	– Change the upper or lower limit setting, as applicable. – Increase or reduce flow, as applicable.	Notice (–)
	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting. 2. When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC, etc.). *Determine the pulse width:* – Version 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Version 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected totalizer is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ 3. Reduce flow	

8.3 Process errors without messages

Symptoms	Remedial measures
Note! You may have to change or correct settings in certain functions in the matrix in order to rectify faults.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Check wiring→ 33. If necessary, reverse the connections at terminals "up" and "down. 2. Change the setting in the "INSTALLATION DIRECTION, SENSOR" function accordingly
Measured value reading fluctuates even though flow is steady.	1. Check the fluid for presence of gas bubbles. 2. "TIME CONSTANT" function (current output) → Increase value 3. "FLOW DAMPING" function (system parameter) → Increase value
There are differences between the flowmeter's internal totalizer and the external metering device.	This symptom is due primarily to backflow in the piping, because the pulse output cannot subtract in the "STANDARD or SYMMETRY" measuring modes.
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check the fluid for presence of gas bubbles. 2. Activate the "ON-VALUE LOW FLOW CUT OFF" function, i.e. enter or increase the value for the switching point.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Set the "FIELDBUS ADDRESS" function to "0". 2. Low flow too high. Reduce value in the "ON-VALUE LOW FLOW CUT OFF" function.
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: **Request the services of an Endress+Hauser service technician** If you contact our service organization to have a service technician sent out, please be ready with the following information: – Brief description of the fault – Nameplate specifications (→ 6): ordering code and serial number **Returning devices to Endress+Hauser** The necessary procedures must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser (→ 66). In all cases, enclose a fully completed "Declaration of contamination" form with the flowmeter. A copy of the "Dangerous Goods Sheet" can be found at the end of these Operating Instructions. **Replace transmitter electronics** Components in the electronics defective → Order spare part → 62.

8.4 Response of outputs to errors

Note!
The response of the totalizer, current output, pulse output and status output is defined in the FAILSAFE MODE function (→ 109).

The outputs can be set to their fallback value by means of the positive zero return. Applicable when operation has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions; simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	Process/system error is present	**Positive zero return is activated**
Current output	*MINIMUM VALUE* 4–20 mA (25 mA) → 2 mA 4–20 mA NAMUR → 3.5 mA 4–20 mA US → 3.75 mA 4–20 mA (25 mA) HART → 2 mA 4–20 mA HART NAMUR → 3.5 mA 4–20 mA HART US → 3.75 mA *MAXIMUM VALUE* *4–20 mA (25 mA) → 25mA* 4–20 mA NAMUR → 22.6 mA 4–20 mA US → 22.6 mA 4–20 mA (25 mA) HART → 25 mA 4–20 mA HART NAMUR → 22.6 mA 4–20 mA HART US → 22.6 mA *ACTUAL VALUE* Fault is ignored, i.e. standard measured value output on the basis of ongoing flow measurement (not recommended).	Output signal corresponds to "zero flow"
Pulse output	MINIMUM/MAXIMUM VALUE → FALLBACK VALUE Signal output → No pulses ACTUAL VALUE Fault is ignored, i.e. standard measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer	*MINIMUM/MAXIMUM VALUE → STOP* The totalizer is paused until the fault is rectified. *ACTUAL VALUE* The fault is ignored. The totalizer continues to count in accordance with the current flow value.	Totalizer stops
Status output	In the event of fault or power supply failure: status output → Non-conductive	No effect on status output

8.5 Spare parts

The previous sections contain a detailed troubleshooting guide → 56
The measuring device, more over, provides additional support in the form of continuous self-diagnosis and error messages.

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

Note!
You can order spare parts directly from your Endress+Hauser service organization by quoting the serial number printed on the transmitter nameplate → 6.

1. Choose the Endress+Hauser Device Viewer via web browser:
   www.endress.com/deviceviewer
2. Enter the serial number of the device into the Device Viewer.
3. The list of the available spare parts for the device is displayed.

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

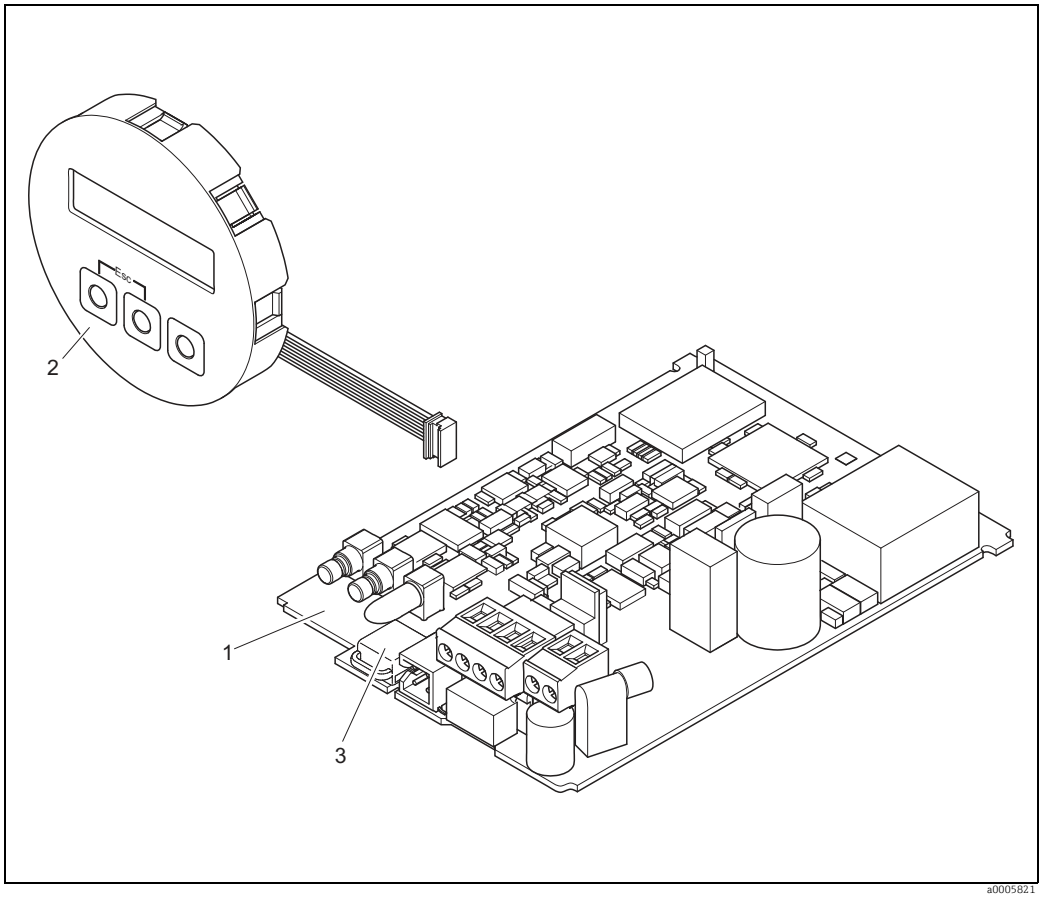


Fig. 40: Spare parts for Prosonic Flow 91 transmitter

1 Electronics board
2 Display module
3 HistoROM/T-DAT (transmitter-DAT)

8.6 Removing and installing electronics boards

8.6.1 Field housing: removing and installing electronics boards → 41

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

Caution!
Use only genuine Endress+Hauser parts.

Commissioning a new electronics board:

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Remove the local display (a) from the connection compartment cover.
4. Press the side latches (b) and flip down the cover of the connection compartment.
5. Disconnect the connector of the sensor cable (c).
6. Disconnect the connector for the power supply (d) and the outputs (e).
7. Disconnect the connector of the local display (f).
8. Release the screws of the board carrier (g).
9. Pull entire module (plastic retainer and electronics board) out of the housing.
10. Plug out the ground cable (h) of the electronics board.
11. Disconnect T-DAT.
12. Press the side latches (i) slightly outwards and partly push out the electronics board towards the rear from the front.
13. Remove the electronics board from the plastic retainer from the rear.
14. Installation is the reverse of the removal procedure.

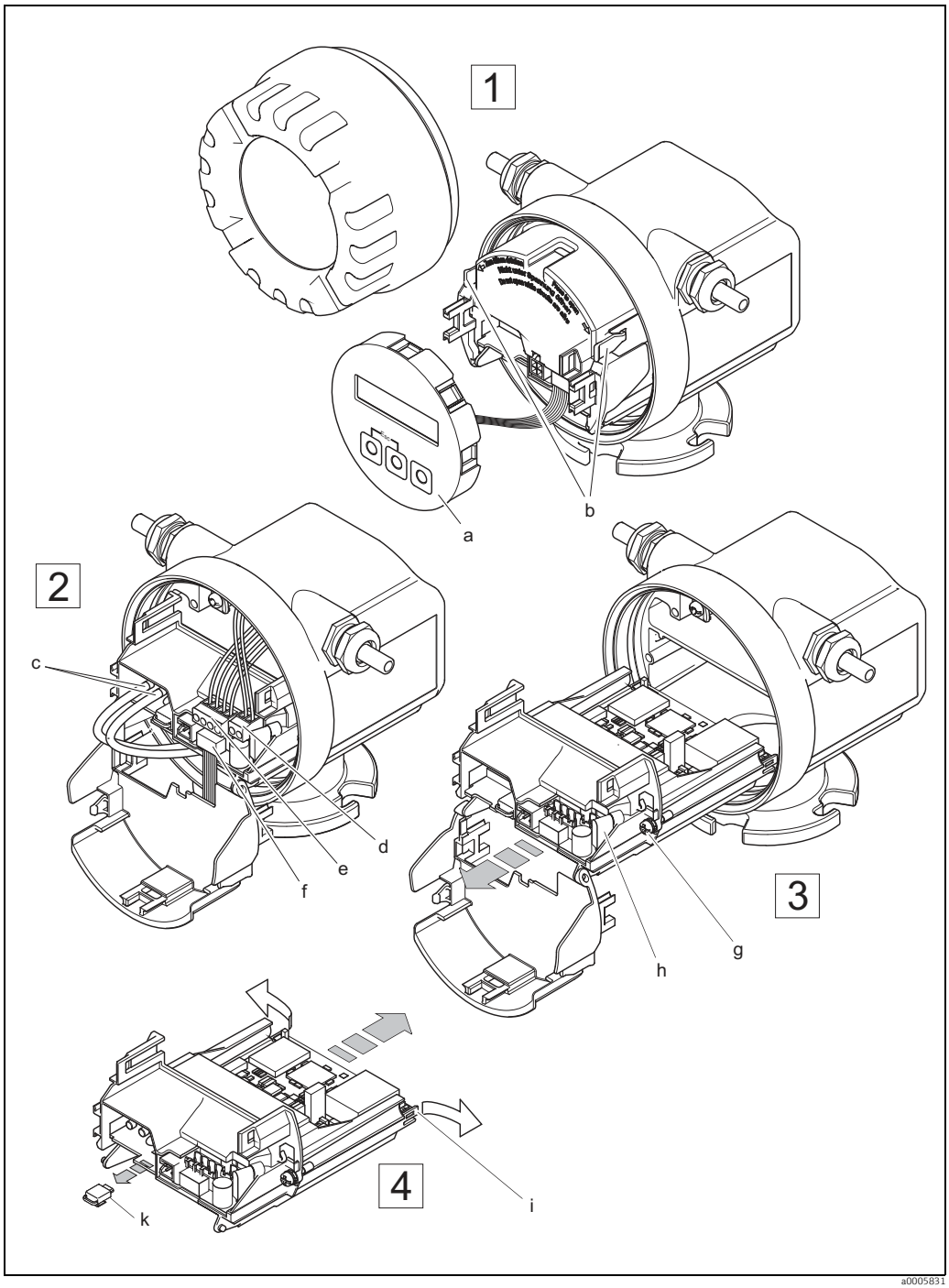


Fig. 41: Field housing: removing and installing electronics boards

a Local display
b Latches
c Connectors for sensor cable
d Connector for power supply
e Connector for current output and pulse/status output
f Connector of local display
g Securing screws of the board carrier
h Connector of the ground cable
i Latches for the electronics board
k T-DAT (transmitter-DAT)

8.7 Replacing the device fuse

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

The device fuse is located on the electronics board (→ 42).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Unscrew cover of the electronics compartment from the transmitter housing.
3. Press the side latches and flip down the cover of the connection compartment.
4. Remove the connector for the power supply (a).
5. Replace device fuse (b). Only use the following fuse type.
   Use only fuses of the following type:
   – Power supply 11 to 40 V DC / 20 to 28 V AC → 1.6 A slow-blow / 250 V TR5
   – Power supply 85 to 250 V AC → 1 A slow-blow / 250 V TR5
6. Installation is the reverse of the removal procedure.

Caution!
Use only genuine Endress+Hauser parts.

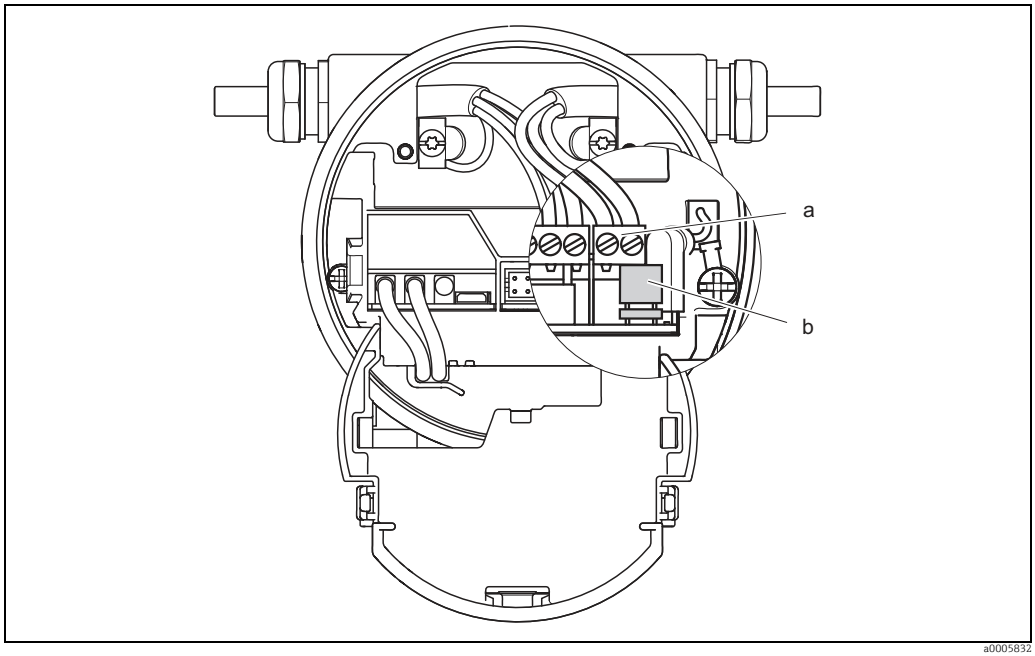


Fig. 42: Replacing the device fuse on the electronics board

a Connector for power supply
b Device fuse

8.8 Return

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

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

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

8.9 Disposal

Observe the regulations applicable in your country!

8.10 Software history

Date	Software version	Changes to software	Operating Instructions
09.2011	V 1.02.XX	New Prosonic Flow W Sensor types	71130013/09.11
02.2010	V 1.01.XX	New Prosonic Flow W Sensor types	71109049/02.10
04.2006	V 1.00.00	Original software	71024989/04.06

Note!
An upload or download between the individual software versions is only possible with a special service software.

9 Technical data

9.1 Technical data at a glance

9.1.1 Application

- Measuring the flow rate of fluids in closed piping systems.
- Applications in measuring, control and regulation technology for monitoring processes.

9.1.2 Function and system design

Measuring principle

Prosonic Flow operates on the principle of transit time difference.

Measuring system

The measuring system consists of a transmitter and sensors.

The following version is available:
Version for installing in safe area

Transmitter
Prosonic Flow 91

Measuring sensors
Prosonic Flow W clamp-on version (hot-and cold water/wastewater applications)
for nominal diameters DN 15 to 4000 (½" to 160")

9.1.3 Input

Measured variable

Flow velocity
(transit time difference proportional to flow velocity)

Measuring range

Typically v = 0 to 15 (0 to 50 ft/s) with the specified measuring accuracy

Operable flow range

Over 150 : 1

9.1.4 Output

Output signal

Current output
- Galvanically isolated
- Full scale value adjustable
- Temperature coefficient: typ. 2 µA/°C, resolution: 1.5 µA
- Active: 4 to 20 mA, R_L < 700 Ω (for HART: RL ≥ 250 Ω)

Pulse/status output:
- Galvanically isolated
- Open collector
- 30 V DC / 250 mA
- Passive
- Can be configured as:
  - **Pulse output**: pulse value and pulse polarity can be selected, max. pulse width adjustable (5 to 2000 ms), pulse frequency max. 100 Hz
  - **Status output**: for example, can be configured for error messages, empty pipe detection, flow recognition, limit value

Signal on alarm
- Current output, pulse output → Failsafe mode can be selected → 📄 109
- Status output → "Not conductive" in the event of fault or power supply failure

Load

See "Output signal"

Low flow cut off

Low flow cut off → Switch-on point can be selected as required

Galvanic isolation

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

9.1.5 Power supply

Electrical connections

See → 📄 27

Supply voltage (power supply)

Transmitter
85 to 250 V AC, 45 to 65 Hz
20 to 28 V AC, 45 to 65 Hz
11 to 40 V DC

Sensor
Powered by the transmitter

Cable entry

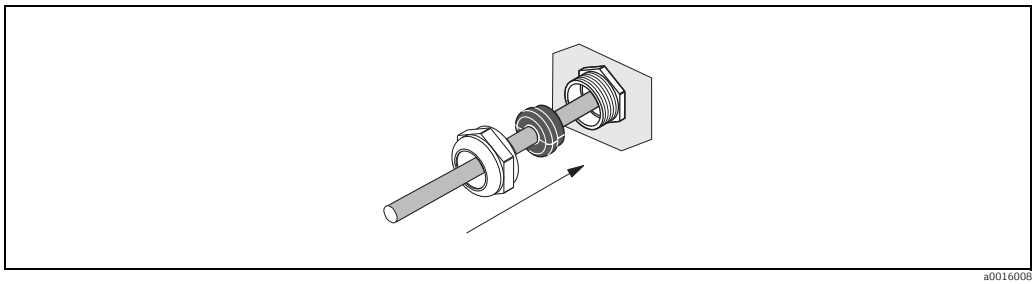
Power supply and signal cables (inputs/outputs)

- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Cable gland for cables, 6 to 12 mm (0.24 to 0.47")
- Thread for cable entry ½" NPT, G ½"

Connecting cable (sensor/transmitter)

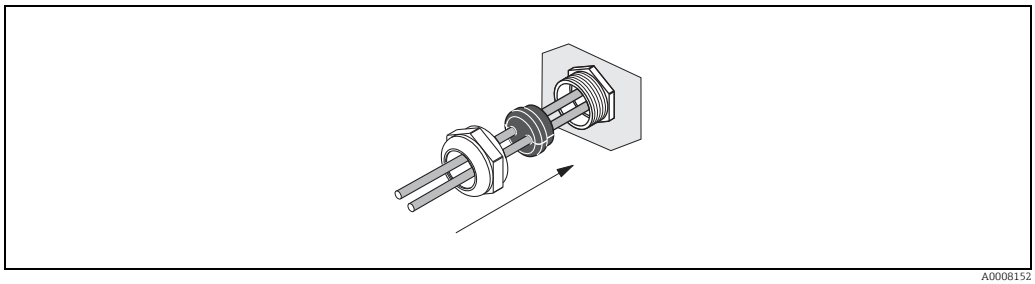
Cable gland for one connecting cable (1 × Ø 8 mm) per cable entry
- Cable gland M20 × 1.5
- Thread for cable entry ½" NPT, G ½"

Cable gland for two connecting cables (2 × Ø 4 mm) per cable entry
- Cable gland M20 × 1.5
- Thread for cable entry ½" NPT, G ½"



a0016008

Fig. 43: Cable gland for one multicore connecting cable (1 × Ø 8 mm / 0.31 in) per cable entry



A0008152

Fig. 44: Cable gland for two connecting cables (2 × Ø 4 mm / 0.16 in) per cable entry

Cable entry

Power supply and signal cables (inputs/outputs):
- Cable entry M20 × 1,5 (8 to 12 mm; 0,31 to 0,47 in)
- Thread for cable entries ½" NPT, G ½"

Cable specifications

Only use the connecting cables supplied by Endress+Hauser.

Different versions of the connecting cables are available → 29.

Prosonic Flow

- Cable material:
  - Prosonic Flow 91W (DN 50 to 4000 / 2 to 160"): PVC (standard) or
  - Prosonic Flow 91W (DN 15 to 65 / ½ to 2½"): TPE-V
- Cable length:
  - For use in a non-hazardous zone: 5 to 60 m (16.4 to 196.8 ft)
  - For use in a hazardous zone: 5 to 30 m (16.4 to 98.4 ft)

Note!
To ensure correct measuring results, route the connecting cable well clear of electrical machines and switching elements.

Power consumption

85 to 250 V AC: < 12 VA (incl. measuring sensor)
20 to 28 V AC: < 7 VA (incl. measuring sensor)
11 to 40 V DC: < 5 W (incl. measuring sensor)

Power supply failure

Lasting min. 1 power cycle.
HistoROM/T-DAT save measuring system data if the power supply fails.

Potential equalization

For potential equalization, no special measures are necessary.

9.1.6 Performance characteristics

Reference operating conditions

- Fluid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up period: 30 minutes

Installation:
- Sensor and transmitter grounded.
- The measuring sensors are mounted correctly.

Maximum measured error

Measured error

The measured error depends on a number of factors. A distinction is made between the measured error of the device (Prosonic Flow 91 = 0.5 % of the measured value) and an additional installation-specific measured error (typically 1.5 % of the measured value) that is independent of the device.

The installation-specific measured error depends on the installation conditions on site, such as the nominal diameter, wall thickness, real pipe geometry, fluid etc. The sum of the two measured errors is the measured error at the measuring point.

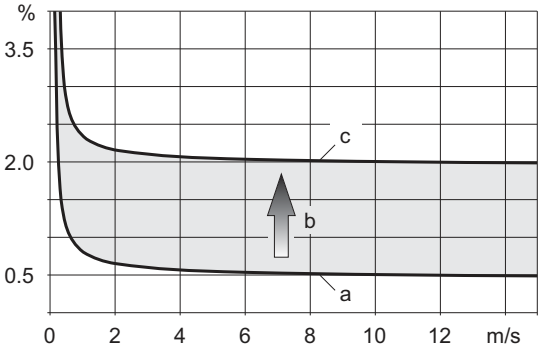


Fig. 45: Example of the measured error in a pipe with a nominal diameter DN > 200

a Measured error of the device (0.5 % o.r. ± 3 mm/s)
b Measured error due to installation conditions (typically 1.5 % o.r.)
c Measured error at the measuring point: 0.5 % o.r. ± 3 mm/s + 1.5 % o.r. = 2 % o.r. ± 3 mm/s

Measured error at the measuring point

The measured error at the measuring point is made up of the measured error of the device (0.5 % o.r.) and the measured error resulting from the installation conditions on site. Given a flow velocity > 0.3 m/s and a Reynolds number > 10000, the following are typical error limits:

Nominal diameter	Device error limits	+	Installation-specific error limits (typical)	→	Error limits at the measuring point (typical)
DN 15 (½")	±0.5 % o.r. ± 5 mm/s	+	±2.5 % o.r.	→	±3 % o.r. ± 5 mm/s
DN 25 to 200	±0.5 % o.r. ± 7,5 mm/s	+	±1.5 % o.r.	→	±2 % o.r. ± 7.5 mm/s
> DN 200	±0.5 % o.r. ± 3 mm/s	+	±1.5 % o.r.	→	±2 % o.r. ± 3 mm/s

o.r. = of reading

Measurement Report

If required, the device can be supplied with a measurement report. To certify the performance of the device, a measurement is performed under reference conditions. Here, the sensors are mounted on a pipe with a nominal diameter of DN 15 (½"), DN 25 (1"), DN 40 (1½"), DN 50 (2") or DN 100 (4") respectively.

The measurement report guarantees the following error limits of the device [at a flow velocity > 0.3 m/s (1 ft/s) and a Reynolds number > 10000]:

Sensor	Nominal diameter	Guaranteed error limits of the device
Prosonic W	DN 15 (½"), DN 25 (1"), DN 40 (1½"), DN 50 (2")	±0.5 % o.r. ± 5 mm/s
Prosonic W	DN 100 (4")	±0.5 % o.r. ± 7.5 mm/s

o.r. = of reading

Repeatability

Max. ± 0.3% for flow velocities > 0.3 m/s (0.98 ft/s)

9.1.7 Operating conditions: Installation

Installation instructions

Any orientation (vertical, horizontal)
Restrictions and additional installation instructions → 10

Inlet and outlet runs

Clamp-on version → 11

Length of connecting cable

Shielded cables are offered in the following lengths:
5 m, 10 m, 15 m, 30 m
60 m only available for sensors DN50...4000
15 feet, 30 feet, 45 feet, 90 feet
180 feet only available for sensors DN 2" to 160"

Route the cable well clear of electrical machines and switching elements.

9.1.8 Operating conditions: Environment

Ambient temperature range

Transmitter

−25 to +60 °C (−13 to +140 °F)

At ambient temperatures below −20 °C (−4 °F) the readability of the display may be impaired. Install the transmitter at a shady location. Avoid direct sunlight, particularly in warm climatic regions.

Sensor

−20 to +80 °C (−4 to +176 °F)
Optional: 0 to +130 °C (−32 to +265 °F)

It is permitted to insulate the sensors mounted on the pipe.

Connecting cable (sensor/transmitter)

- Standard (TPE-V): −20 to +80 °C (−4 to +175 °F) (multi core)
- Standard (PVC): −20 to +70 °C (−4 to +158 °F) (single core)
- Optional (PTFE): −40 to +170 °C (−40 to +338 °F) (single core)

Note!
- It is permitted to insulate the sensors mounted on the pipes.
- Mount the transmitter in a shady location and avoid direct sunlight, particularly in warm climatic regions.

Storage temperature

The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors and the corresponding sensor cable (see above).

Degree of protection

Transmitter

IP 67 (NEMA 4X)

Sensors

IP 67 (NEMA 4X)
Optional: IP 68 (NEMA 6P)

Shock resistance

according to IEC 68-2-31

Vibration resistance

Acceleration up to 1g, 10 to 150 Hz, according to IEC 68-2-6

Electromagnetic compatibility (EMC)

As per IEC/EN 61326 and NAMUR Recommendation NE 21.
In the frequency operating range of the sensor (1 to 3 MHz), failsafe values up to 5 V do not affect the measured values.

9.1.9 Operating conditions: Process

Medium temperature range

Flowrate measuring sensors Prosonic Flow W (clamp-on):
−20 to +80 °C (−4 to +176 °F)
Optional: 0 to +130 °C (+32 to +266 °F)

Medium pressure range (nominal pressure)

Perfect measurement requires that the static fluid pressure is higher than vapor pressure, to avoid outgasing.

Pressure loss

There is no pressure loss.

9.1.10 Mechanical construction

Design, dimensions

The dimensions and lengths of the sensor and transmitter can be found in the "Technical Information" document for the device in question. This can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in Section "Documentation" on → 76.

Weight

- Transmitter housing: 2.4 kg (5.2 lb)
- Flowrate measuring sensors W (clamp-on) incl. mounting rail and tensioning bands: 2.8 kg (6.2 lb)

Materials

Transmitter

Wall-mounted housing: powder-coated die-cast aluminum

Sensor

Prosonic Flow W clamp-on version
- Sensor holder: stainless steel 1.4308/CF-8
- Sensor housing: stainless steel 1.4301/304
- Strapping bands/bracket: stainless steel 1.4301/304
- Sensor contact surfaces: chemically stable plastic

Connecting cable (sensor/transmitter)

- PVC/TPE-V connecting cable
  - Cable sheath: PVC/TPE-V
  - Cable connector: nickeled brass 2.0401/C38500

9.1.11 Human interface

Display elements

- Liquid crystal display: illuminated, two lines with 16 characters per line
- Custom configurations for presenting different measured value and status variables
- 1 totalizer

Operating elements

Local operation via three operating keys (−, +, E)

Remote operation

Operation via HART protocol and FieldCare

Languages

English, German, Spanish, Italian, French

9.1.12 Certificates and approvals

Ex approval

Information about currently available Ex versions (FM, CSA) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

CE mark

The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

C-tick mark

The measuring system meets the EMC requirements of the Australian Communication and Media Authority (ACMA).

Other standards and guidelines

- EN 60529:
  Degrees of protection by housing (IP code).
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use.
- IEC/EN 61326
  "Emission in accordance with requirements for Class A". Electromagnetic compatibility (EMC requirements)
- ANSI/ISA-61010-1 (82.02.01)
  Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements. Pollution degree 2.
- CAN/CSA-C22.2 No. 1010.1-92
  Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use.
  Pollution degree 2, Installation Category II
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics.

9.1.13 Ordering information

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

9.1.14 Accessories

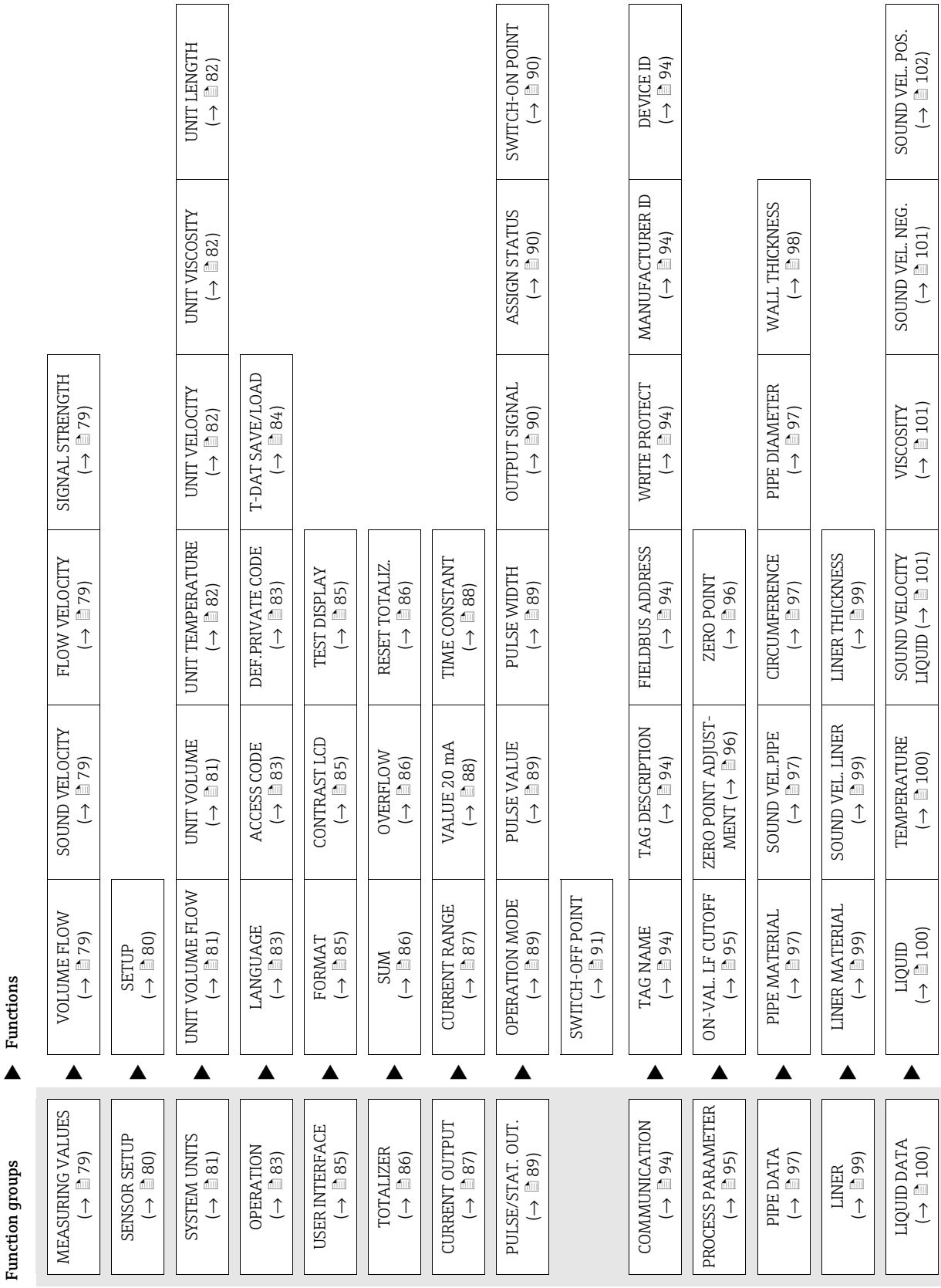
Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor → 52.
Your Endress+Hauser service organization can provide detailed information on the order codes in question.

9.1.15 Documentation

- Flow Measurement (FA005D/06)
- Technical Information Prosonic Flow 91W (TI105D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA

10 Description of device functions

10.1 Illustration of the function matrix



Function groups
Functions
CONFIG. CHANNEL (→ 103)
SENSOR TYPE (→ 103)
SENSOR CONFIG. (→ 103)
CABLE LENGTH (→ 103)
POS.SENSOR (→ 104)
WIRE LENGTH (→ 104)
SENSOR DISTANCE (→ 104)
CALIBRATION DATA (→ 105)
CAL. FACTOR (→ 105)
ZERO POINT (→ 105)
ZEROPOINT STAT. (→ 105)
CORR. FACTOR (→ 105)
SYSTEM PARAMETER (→ 106)
INSTL. DIR. SENSOR (→ 106)
MEASURING MODE (→ 106)
POS. ZERO RETURN (→ 108)
FLOW DAMPING (→ 108)
SUPERVISION (→ 109)
FAILSAFE MODE (→ 109)
ACTUAL SYS. COND (→ 109)
PREV. SYST. COND (→ 109)
ALARM DELAY (→ 110)
SYSTEM RESET (→ 110)
SIMULATION SYSTEM (→ 111)
SIM. FAILSAFE (→ 111)
SIM. MEASURAND (→ 111)
VALUE SIM. MEAS. (→ 111)
SENSOR VERSION (→ 112)
SERIAL NUMBER (→ 112)
AMPLIFIER VERSION (→ 112)
SOFTW. REV. NO. (→ 112)

10.2 Group MEASURING VALUES

Functional description MEASURING VALUES	
Note! ▪ **The engineering unit of the measured variable displayed here can be set in the SYSTEM UNITS group, (→ 81).** ▪ **If the fluid in the pipe flows backwards, a negative sign prefixes the flow reading on the display.**	
VOLUME FLOW	The volume flow currently measured appears on the display. **Display**: 5-digit floating-point number, including unit and sign (e.g. 5.5445 dm^3/min; 1.4359 m^3/h; −731.63 gal/d; etc.)
SOUND VELOCITY	The current measured sound velocity in the liquid appears on the display. **Display**: 5-digit fixed-point number, incl. unit (e.g. 1400.0 m/s, 5249.3 ft/s)
FLOW VELOCITY	The flow velocity currently measured appears on the display. **Display**: 5-digit floating-point number, including unit and sign (e.g. 8.0000 m/s, 26.247 ft/s)
SIGNAL STRENGTH	The signal strength appears on the display. **Display**: 4-digit fixed-point number (e.g. 80.0 dB) Note! To ensure reliable measurement takes place, Prosonic Flow requires a signal strength of > 30 dB.

10.3 Group SENSOR SETUP

Functional description SENSOR SETUP	
SETUP	Picklist SENSOR SETUP: ▪ SETUP ▪ LIQUID ▪ PIPE DATA ▪ LINER ▪ CONFIG. CHANNEL ▪ POS. SENSOR ▪ QUIT SETUP: LIQUID → TEMPERATURE → SOUND VEL. LIQUID → PIPE MATERIAL → SOUND VEL.PIPE → CIRCUMFERENCE → PIPE DIAMETER → WALL THICKNESS → LINER MATERIAL → SOUND VEL. LINER → LINER THICKNESS → SENSOR TYPE → SENSOR CONFIG. → CABLE LENGTH → POS.SENSOR/WIRE LENGTH → SENSOR DISTANCE LIQUID: LIQUID → TEMPERATURE → SOUND VEL. LIQUID PIPE DATA: PIPE MATERIAL → SOUND VEL.PIPE → CIRCUMFERENCE → PIPE DIAMETER → WALL THICKNESS LINER: LINER MATERIAL → SOUND VEL. LINER → LINER THICKNESS CONFIG. CHANNEL: SENSOR TYPE → SENSOR CONFIG. → CABLE LENGTH POS.SENSOR: POS.SENSOR/WIRE LENGTH → SENSOR DISTANCE The following information is required for a successful setup: ▪ Sound velocity of the liquid ▪ Operating temperature ▪ Pipe circumference or pipe outer diameter ▪ Sound velocity of the pipe material ▪ Wall thickness ▪ Sound velocity of the lining material (if present) ▪ Thickness of the lining (if present) ▪ Sensor type ▪ Sensor arrangement (direct or reflection mode) ▪ Length of the sensor cable The relative sensor positions and the proportionality factor (meter factor) are determined from these application-specific data. The functionality of the device is ensured by correctly specifying the sound velocity of the liquid, the nominal diameter of the pipe, the sensor type and the sensor arrangement, provided the unit is mounted correctly. The correct information for the sensor cable length and the wall and liner thickness primarily affect the quality of the measurement.

10.4 Group SYSTEM UNITS

Functional description SYSTEM UNITS	
Use this function group to select the unit required and displayed for the measured variable.	
UNIT VOLUME FLOW	Use this function to select the unit for displaying the volume flow. The unit you select here is also valid for: ▪ Volume flow display ▪ Current output ▪ Switch points (limit value for volume flow, flow direction) ▪ Low flow **Options:** *Metric*: Cubic centimeter → cm^3/s; cm^3/min; cm^3/h; cm^3/day Cubic decimeter → dm^3/s; dm^3/min; dm^3/h; dm^3/day Cubic meter → m^3/s; m^3/min; m^3/h; m^3/day Milliliter → ml/s; ml/min; ml/h; ml/day Liter → l/s; l/min; l/h; l/day Hectoliter → hl/s; hl/min; hl/h; hl/day Megaliter → Ml/s; Ml/min; Ml/h; Ml/day *US*: Cubic centimeter → cc/s; cc/min; cc/h; cc/day Acre foot → af/s; af/min; af/h; af/day Cubic foot → ft^3/s; ft^3/min; ft^3/h; ft^3/day Fluid ounce → oz f/s; oz f/min; oz f/h; oz f/day Gallon → gal/s; gal/min; gal/h; gal/day Kilo gallons → Kgal/s; Kgal/min; Kgal/h: Kgal/day Million gallons → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (normal fluids: 31.5 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (beer: 31.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 42.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (filling tanks: 55.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day *Imperial*: Gallon → gal/s; gal/min; gal/h; gal/day Mega gallon → Mgal/s; Mgal/min; Mgal/h; Mgal/day Barrel (beer: 36.0 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day Barrel (petrochemicals: 34.97 gal/bbl) → bbl/s; bbl/min; bbl/h; bbl/day **Factory setting**: Depends on nominal diameter and country (dm^3/min to m^3/h or US-gal/min), corresponding to the full scale value unit factory setting → 🖹 113
UNIT VOLUME	Use this function to select the unit for displaying the volume. The unit you select here is also valid for: ▪ Totalizer status display ▪ Unit totalizer ▪ Pulse value (e.g. m^3/p) **Options**: *Metric* → cm^3; dm^3; m^3; ml; l; hl; Ml *US* → cc; af; ft^3; oz f; gal; Kgal; Mgal; bbl (normal fluids); bbl (beer); bbl (petrochemicals); bbl (filling tanks) *Imperial* → gal; Mgal; bbl (beer); bbl (petrochemicals) **Factory setting**: Depends on nominal diameter and country (dm^3 to m^3 or US-gal), corresponds to the totalizer unit factory setting → 🖹 113

Functional description SYSTEM UNITS	
UNIT TEMPERATURE	Use this function to select the unit for the liquid temperature. Note! The liquid temperature is entered in the function TEMPERATURE (→ 100). **Options**: °C (Celsius) K (Kelvin) °F (Fahrenheit) °R (Rankine) **Factory setting**: °C
UNIT VELOCITY	Use this function to select the unit for velocity. The unit you select here is also valid for: ▪ Sound velocity ▪ Flow velocity **Options**: m/s ft/s **Factory setting**: m/s
UNIT VISCOSITY	Use this function to select the unit for liquid viscosity. **Options**: mm^2/s cSt St **Factory setting**: mm^2/s
UNIT LENGTH	Use this function to select the unit for the measure of length. The unit you select here is also valid for: ▪ Nominal diameter ▪ Diameter ▪ Wall thickness ▪ Liner thickness ▪ Wire length ▪ Sensor distance **Options**: MILLIMETER INCH **Factory setting**: MILLIMETER

10.5 Group OPERATION

Functional 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 **Factory setting**: Depends on country, see factory setting → 113 ff. Note! If you press the ⊞ keys simultaneously at startup, the language defaults to "ENGLISH".
ACCESS CODE	All data of the measuring system are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered in this function. If you press the ⊞ keys in any function, the measuring system automatically goes to this function and the prompt to enter the code appears on the display (when programming is disabled). You can activate programming by entering your private code (**factory setting = 91**, see also the subsequent DEFINE PRIVATE CODE function) **User input**: Max. 4-digit number: 0 to 9999 Note! ▪ The programming levels are disabled if you do not press a key within 60 seconds following automatic return to the HOME position. ▪ You can also disable programming in this function by entering any number (other than the defined private code). ▪ The Endress+Hauser service organization can be of assistance if you mislay your personal code.
DEF.PRIVATE CODE	Use this function to enter a personal code to enable programming. **User input:** 0 to 9999 (max. 4-digit number) **Factory setting:** 91 Note! ▪ This function only appears if the private code was entered in the ACCESS CODE function. ▪ Programming is always enabled with the code "0". ▪ Programming has to be enabled before this code can be changed. When programming is disabled this function is not available, thus preventing others from accessing your personal code.

Functional description OPERATION	
T-DAT SAVE/LOAD	In this function, the configuration/settings of the transmitter can be saved to a transmitter DAT (T-DAT) or uploading a configuration from the T-DAT to the EEPROM can be activated (**manual** back-up function). Application examples: ▪ After commissioning, the current measuring point parameters can be saved to the T-DAT (backup). ▪ When exchanging the transmitter, the data can be loaded from the T-DAT to the new transmitter (EEPROM). **Options:** CANCEL SAVE (from EEPROM to T-DAT) LOAD (from the T-DAT to the EEPROM) **Factory setting:** CANCEL Note! ▪ If the target device has an older software version, the message "TRANSM. SWDAT" is displayed during startup. Then only the SAVE function is available. ▪ LOAD This function is only possible if the target device has the same software version as, or a more recent software version than, the source device. ▪ SAVE This function is always available.

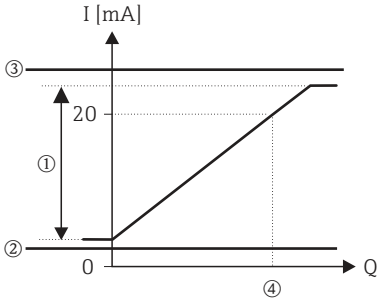
10.6 Group USER INTERFACE

Functional description USER INTERFACE	
FORMAT	Use this function to define the maximum number of places after the decimal point displayed for the reading in the main line. **Options**: XXXXX. XXXX.X XXX.XX XX.XXX X.XXXX **Factory setting**: X.XXXX 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 such instances an arrow appears on the display between the measuring value and the engineering unit (e.g. 1.2 → l/h), indicating that the measuring system is computing with more decimal places than can be shown on the display.
CONTRAST LCD	Use this function to optimize display contrast to suit local operating conditions. **User input**: 10 to 100% **Factory setting**: 50%
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 at least 0.75 seconds. 3. The main line and additional line show an "8" in each field for at least 0.75 seconds. 4. The main line and additional line show a "0" in each field for at least 0.75 seconds. 5. The main line and additional line show nothing (blank display) for at least 0.75 seconds. When the test completes the local display returns to its initial state and the setting changes to "OFF".

10.7 Group TOTALIZER

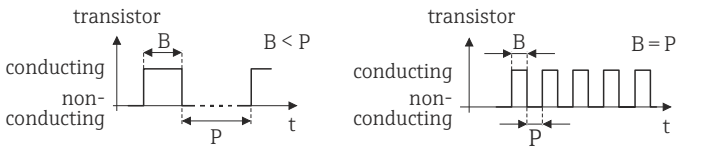
Functional description TOTALIZER	
SUM	The total for the totalizer's measured variable aggregated since measuring commenced appears on the display. This value can be positive or negative, depending on: ▪ Flow direction and/or ▪ Setting in the MEASURING MODE function → 106 **Display**: Max. 6-digit floating-point number, incl. sign and unit (e.g. 15467.4 m^3) Note! ▪ The totalizer's response to faults is defined in the central "FAILSAFE MODE" function → 109. ▪ The unit of the totalizer is defined in the UNIT VOLUME function → 81.
OVERFLOW	The total for the totalizer's overflow aggregated since measuring commenced appears on the display. Total flow quantity is represented by a floating-point number consisting of max. 6 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 OVERFLOW function plus the value displayed in the SUM function. **Example:** Reading for 2 overflows: 2 E7 dm^3 (= 20,000,000 dm^3) The value displayed in the function "SUM" = 196,845 dm^3 Effective total quantity = 20,196,845 dm^3 **Display**: Integer with exponent, including sign and unit, e.g. 2 E7 dm^3
RESET TOTALIZER	Use this function to reset the sum and the overflow of the totalizer to "zero" (= RESET). **Options**: NO YES **Factory setting**: NO

10.8 Group CURRENT OUTPUT

Functional description CURRENT OUTPUT	
Note! **The functions of the CURRENT OUTPUT group are only available if the "0" value was entered in the BUS ADDRESS function → 94.**	
CURRENT RANGE	Use this function to specify the current range. You can configure the current output either in accordance with the NAMUR recommendation (max. 20.5 mA) or for a maximum drive of 25 mA. **Options**: OFF 4-20 mA (25 mA) 4-20 mA (25 mA) HART 4-20 mA NAMUR 4-20 mA HART NAMUR 4-20 mA US 4-20 mA HART US **Factory setting**: 4-20 mA (25 mA) HART NAMUR **Current span, operational range and signal on alarm level**  A ① ② ③ OFF 4 mA - - 4-20 mA (25 mA) 4 - 24 mA 2 25 4-20 mA (25 mA) HART 4 - 24 mA 2 25 4-20 mA NAMUR 3,8 - 20,5 mA 3,5 22,6 4-20 mA HART NAMUR 3,8 - 20,5 mA 3,5 22,6 4-20 mA US 3,9 - 20,8 mA 3,75 22,6 4-20 mA HART US 3,9 - 20,8 mA 3,75 22,6 a0005392 *A = Work range* *① = Work range* *② = Lower signal on alarm level* *③ = Upper signal on alarm level* *④ = Scaled full scale value* *Q = Flow* Note! ▪ If the measured value is outside the measuring range (defined in the VALUE 20 mA function → 88), a notice message is generated. ▪ The current output's response to faults is defined in the central FAILSAFE MODE function → 109.

Functional description CURRENT OUTPUT	
VALUE 20 mA	Use this function to assign the 20 mA current a full scale value. Positive and negative values are permissible. The required measuring range is defined by defining the VALUE 20 mA . In the SYMMETRY measuring mode → 106, the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the flow direction selected. **User input**: 5-digit floating-point number, with sign **Factory setting**: Depends on nominal diameter and country, [value] / [dm^3 to m^3 or US-gal to US-Mgal] Corresponds to the factory setting for the full scale value → 113. Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group → 81. ▪ The value for 4 mA always corresponds to the zero flow (0 [unit]). This value is fixed and cannot be edited.
TIME CONSTANT	Use this function to enter a time constant defining how the current 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**: Fixed point number 0.01 to 100.00 s **Factory setting**: 1.00 s

10.9 Group PULSE/STATUS OUTPUT

Functional description PULSE/STATUS OUTPUT	
OPERATION MODE	Configuration of the output as a pulse or status output. The functions available in this function group vary, depending on which option you select here. **Options**: OFF PULSE STATUS **Factory setting**: PULSE
PULSE VALUE	Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to define the flow at which a pulse is triggered. These pulses can be totalled by an external totalizer and the total flow since measuring started can be recorded in this way. In the SYMMETRY measuring mode → 106, the value assigned applies to both flow directions; in the STANDARD measuring mode it applies only to the positive flow direction. **User input**: 5-digit floating-point number, [unit] **Factory setting**: Depends on nominal diameter and country, [value] [dm^3 to m^3 or US-gal] / pulse; Corresponds to the factory setting for the pulse value → 113. Note! The appropriate unit is taken from the SYSTEM UNITS group.
PULSE WIDTH	Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to enter the maximum pulse width of the output pulses. **User input:** 5 to 2000 ms **Factory setting:** 100 ms Pulse output is always with the pulse width (B) entered in this function. The pauses (P) between the individual pulses are automatically configured. However, they must at least correspond to the pulse width (B = P).  P= Intervals between the individual pulses B = Pulse width entered (the illustration applies to positive pulses) Caution! Buffering (pulse memory) takes place if the number of pulses is too large to output the pulses with the selected pulse width (see PULSE VALUE function on → 89). The system error message RANGE PULSE is displayed if more pulses are in the pulse memory than can be output in 4 seconds. Note! ▪ When entering the pulse width, select a value that can still be processed by an external totalizer (e.g. mechanical totalizer, PLC etc.). ▪ The pulse output's response to faults is defined in the central FAILSAFE MODE function → 109.

Functional description PULSE/STATUS OUTPUT	
OUTPUT SIGNAL	Note! This function is not available unless the PULSE setting was selected in the OPERATING MODE function. Use this function to configure the output in such a way that it matches an external counter, for example. Depending on the application, you can select the direction of the pulses here. **Options**: PASSIVE - POSITIVE PASSIVE - NEGATIVE **Factory setting**: PASSIVE - NEGATIVE
ASSIGN STATUS OUTPUT	Note! This function is not available unless the STATUS setting was selected in the OPERATING MODE function. Configuration of the status output. **Options**: ON (operation) ALARM NOTICE MESSAGE ALARM or NOTICE MESSAGE FLOW DIRECTION VOLUME FLOW LIMIT VALUE **Factory setting**: ALARM Note! ▪ The behavior of the status output is a normally closed behavior, in other words the output is closed (transistor conductive) when normal, error-free measuring is in progress. ▪ It is very important to read and comply with the information on the switching characteristics of the status output → 93.
SWITCH-ON POINT	Note! This function is not available unless LIMIT VALUE or FLOW DIRECTION was selected in the ASSIGN STATUS OUTPUT function. Use this function to assign a value to the switch-on point (status output pulls up). The value can be equal to, greater than or less than the switch-off point. Positive and negative values are permissible. **User input**: 5-digit floating-point number, [unit] **Factory setting**: 0 [unit] Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group. ▪ Only the switch-on point is available for flow direction output (no switch-off point). If you enter a value not equal to the zero flow (e.g. 5), the difference between the zero flow and the value entered corresponds to half the switchover hysteresis.

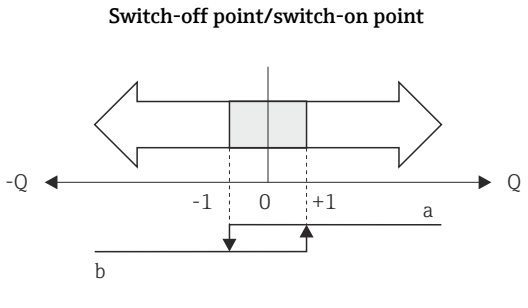
Functional description PULSE/STATUS OUTPUT	
SWITCH-OFF POINT	Note! This function is not available unless LIMIT VALUE was selected in the ASSIGN STATUS OUTPUT function. Use this function to assign a value to the switch-off point (status output drops off). The value can be equal to, greater than or less than the switch-on point. Positive and negative values are permissible. **User input**: 5-digit floating-point number, [unit] **Factory setting**: 0 [unit] Note! ▪ The appropriate unit is taken from the SYSTEM UNITS group. ▪ If SYMMETRY is selected in the MEASURING MODE function and values with different signs are entered for the switch-on and switch-off points, the notice message "INPUT RANGE EXCEEDED" appears.

10.9.1 Information on the response of the status output

General

If you have configured the status output for "LIMIT VALUE" or "FLOW DIRECTION", you can configure the requisite 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 flow direction



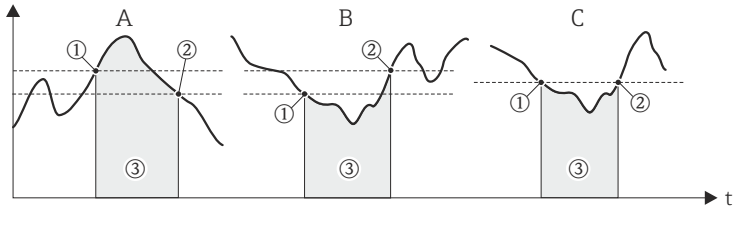
a = Status output conductive
b = Status output not conductive

The value entered in the function ON-VALUE defines the switch point for the positive and negative directions of flow. If, for example, the switch point entered is = 1 m^3/h, the status output switches off at −1 m^3/h (not conductive) and switches on again at +1 m^3/h (conductive). Set the switch point to 0 if your process calls for direct switchover (no switching hysteresis). If low flow cut off is used, it is advisable to set hysteresis to a value greater than or equal to the low flow.

Status output configured for limit value

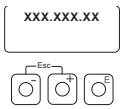
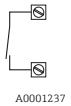
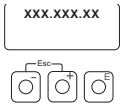
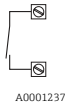
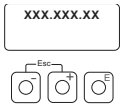
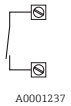
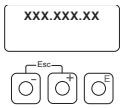
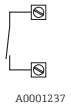
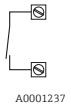
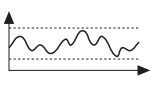
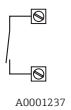
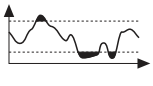
The status output switches as soon as the measured variable undershoots or overshoots a defined switch point.

Application: Monitoring flow or process-related boundary conditions.



- A = Maximum safety:
  → ① SWITCH-OFF POINT > ② SWITCH-ON POINT
- B = Minimum safety:
  → ① SWITCH-OFF POINT < ② SWITCH-ON POINT
- C = Minimum safety:
  → ① SWITCH-OFF POINT = ② SWITCH-ON POINT (this configuration should be avoided)
- ③ = Relay de-energized

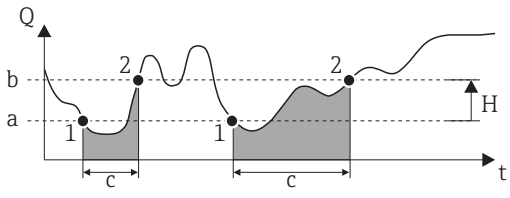
10.9.2 Switching behavior of the status output

Function	Status	Open collector behavior (Transistor)
ON (operation)	System in measuring mode 	conductive  A0001237
	System not in measuring mode (power supply failed) 	not conductive  A0001239
Alarm	System OK 	conductive  A0001237
	Alarm → Error response of outputs/inputs and totalizer 	not conductive  A0001239
Notice message	System OK 	conductive  A0001237
	(System error or process error) Notice → Continuation of measuring 	not conductive  A0001239
Alarm or notice message	System OK 	conductive  A0001237
	Alarm → Failsafe mode or Notice → Continuation of measuring 	not conductive  A0001239
Flow direction	Forward  a0001241	conductive  A0001237
	Reverse  a0001242	not conductive  A0001239
Volume flow limit value	Limit value not overshot or undershot  a0001243	conductive  A0001237
	Limit value overshot or undershot (cannot be set at the same time)  a0001244	not conductive  A0001239

10.10 Group COMMUNICATION

Functional description COMMUNICATION	
Note! **The communication group is only visible if the HART option was selected in the CURRENT RANGE function.**	
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, +,-, underscore, space, period **Factory setting**: "_ _ _ _ _ _ _ _" (without text)
TAG DESCRIPTION	Use this function to enter a tag description for the measuring device. You can edit and read this tag description at the local display or via the HART protocol. **User input**: Max. 16-character text, permitted characters are: A-Z, 0-9, +,-, underscore, space, period **Factory setting**: "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _" (without text)
FIELDBUS ADDRESS	Use this function to define the address for the exchange of data with the HART protocol. **User input**: 0 to 15 **Factory setting**: 0 Note! Addresses 1 to 15: a constant 4 mA current is applied.
WRITE PROTECT	Use this function to activate HART write protection. **Options**: OFF = function can be edited/read via the HART protocol ON = HART protocol write-protected (only readable) **Factory setting**: OFF
MANUFACTURER ID	Use this function to view the manufacturer number in decimal numerical format. **Display**: – Endress+Hauser – 17 (≙ 11 hex) for Endress+Hauser
DEVICE ID	Use this function to view the device ID in hexadecimal numerical format. **Display**: 62 hex (≙ 98 dez) for Prosonic Flow 91

10.11 Group PROCESS PARAMETER

Functional description PROCESS PARAMETER	
ON-VALUE LOW FLOW CUT OFF	Use this function to enter the switch-on point for low flow cut off. Low flow cut off is active if the value entered is not equal to 0. The sign of the flow value is highlighted on the display to indicate that low flow cut off is active. **User input**: 5-digit floating-point number, [unit] **Factory setting**: Depends on nominal diameter and country, [value] / [dm^3 to m^3 or US-gal] Corresponds to the factory setting for the low flow → 📄 113. Note! The appropriate unit is taken from the SYSTEM UNITS group. The switch-off point is specified as a positive hysteresis from the switch-on point with 50%.  a0001245 *Q* *Flow [volume/time]* *t* *Time* *H* *Hysteresis* *a* *SWITCH-ON POINT LOW FLOW CUT OFF = 200 dm^3/h* *b* *Low flow switch-off point = 50%* *c* *Low flow cut off active* *1* *Low flow cut off is switched on at 200 dm^3/h* *2* *Low flow cut off is switched off at 300 dm^3/h*

Functional description PROCESS PARAMETER	
ZERO POINT ADJUSTMENT	Use this function to start zero point adjustment automatically. The new zero point determined by the measuring system is adopted by the ZERO POINT function. Options: CANCEL START **Factory setting**: CANCEL Note! ▪ Zero point adjustment must only be carried out if the sensors have been replaced. The value determined should not be over 3 ns. If the value is overshot, check whether the pipe actually has zero flow. For example, sunshine can partially warm the pipe and the resulting movement in liquid is measured as flow. ▪ Programming is locked during zero point adjustment The message "ZEROPOINT ADJUST RUNNING" appears on the display. ▪ If the zero point adjustment is not possible, (e.g. if v > 0.1 m/s), or has been cancelled, then the alarm message "ZERO ADJUST NOT POSSIBLE" is shown on the display.
ZERO POINT	Use this function to display the zero point correction value for the measuring pipe and the measuring sensors. Display: Max. 5-digit number **Factory setting**: 0 ns

10.12 Group PIPE DATA

Functional description PIPE DATA	
PIPE MATERIAL	Use this function to display the pipe material. This is specified by the option selected in the function PIPE STANDARD. If you edit the predetermined value, the pipe standard will be reset to the option OTHER and the function NOMINAL DIAMETER does not appear. The pipe material must be selected if the option OTHER was selected in the function PIPE STANDARD and thus a pipe standard is not defined. **Options**: CARBON STEEL DUCTILE IRON STAINLESS STEEL ALLOY C PVC GRP* ASBESTOS CEMENT PE LDPE HDPE PVDF PTFE PA PP GLASS PYREX OTHER **Factory setting**: STAINLESS STEEL Note! *GRP not recommended!
SOUND VELOCITY PIPE	Use this function to display the sound velocity in the pipe material. The sound velocity in the pipe must be specified. **User input**: Fixed-point number 800 to 6500 m/s **Factory setting**: 3120 m/s
CIRCUMFERENCE	Use this function to display the pipe outer circumference. The pipe outer circumference or the pipe diameter must be specified. **User input**: Fixed point number 31.4 to 15,700.0 mm **Factory setting**: 279.3 mm
PIPE DIAMETER	Use this function to display the pipe outer diameter. The pipe outer diameter or the pipe circumference must be specified. **User input**: Fixed-point number 10.0 to 5000.0 mm **Factory setting**: 33,7 mm für DN 15 to 65 88,9 mm für DN 50 to 4000

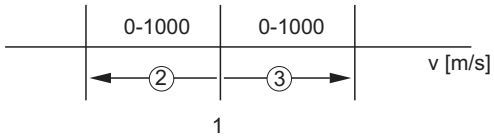
Functional description PIPE DATA	
WALL THICKNESS	Use this function to display the wall thickness of the pipe. The wall thickness must be entered. **User input**: Fixed point number 0.1 to max. 1000 mm (depends on nominal diameter) **Factory setting**: 3.2 mm

10.13 Group LINER

Functional description LINER	
LINER MATERIAL	Use this function to display the liner material of the pipe. The liner material must be specified if a liner is present. **Options**: LINER NONE MORTAR RUBBER TAR EPOXY OTHER **Factory setting**: LINER NONE
SOUND VELOCITY LINER	Use this function to display the sound velocity of the liner. This is specified by the option selected in the function LINER MATERIAL. If you edit the predetermined value the liner material will be reset to the option OTHERS. The sound velocity of the liner must be entered if the option OTHER was selected in the function LINER MATERIAL. **User input**: Fixed-point number 800 to 6500 m/s **Factory setting**: Depends on the setting selected in the function LINER MATERIAL
LINER THICKNESS	Use this function to enter the thickness of the liner. User input: Fixed-point number 0.0 to 99.9 mm **Factory setting**: 0 mm

10.14 Group LIQUID DATA

Functional description LIQUID DATA	
LIQUID	Use this function to select the liquid in the pipe. **Options**: WATER SEA WATER DISTILLED WATER AMMONIA ALCOHOL BENZENE BROMIDE ETHANOL GLYCOL KEROSENE MILK METHANOL TOLUOL LUBE OIL FUEL OIL PETROL OTHER **Factory setting**: WATER Note! The selection specifies the values for the sound velocity and viscosity. If OTHER is selected, these must be entered via the SOUND VELOCITY LIQUID and VISCOSITY functions.
TEMPERATURE	Use this function to enter the process temperature of the liquid. Via the sound velocity, the value influences the determination of the sensor distance. Enter the process temperature at normal operating conditions to achieve an optimum configuration of the measuring system. **User input**: Fixed-point number −273.15 °C to 726.85 °C **Factory setting**: 20 °C

Functional description LIQUID DATA	
SOUND VELOCITY LIQUID	Use this function to display the sound velocity of the liquid. This is determined via the values of the functions LIQUID and TEMPERATURE. If you edit the predetermined value, the function LIQUID will be reset to the option OTHER. The sound velocity of the liquid must be entered if the liquid is not available for selection in the function LIQUID and the option OTHER was selected here. **Transmitter search range**: The measuring device searches for the measuring signal within a defined sound velocity range. The search range is specified in the functions SOUND VELOCITY NEGATIVE or SOUND VELOCITY POSITIVE. An error message is displayed if the sound velocity of the liquid is outside the search range. Note! We recommend you select a smaller search range in the event of unfavorable signal conditions (signal strength < 50%).  a0001246 1 = Sound velocity liquid ② = Lower search range: defined in the function SOUND VELOCITY NEGATIVE ③ = Upper search range: defined in the function SOUND VELOCITY POSITIVE **User input**: Fixed-point number 400 to 3000 m/s **Factory setting:** 1487.4 m/s
VISCOSITY	This function displays the viscosity of the liquid. This is determined via the values of the LIQUID and TEMPERATURE functions. If you edit the predetermined value the function LIQUID will be reset to the option OTHER. The viscosity must be entered if the liquid is not available for selection in the function LIQUID and the option OTHER was selected here. **User input**: Fixed-point number 0.0 to 5000.0 mm^2/s **Factory setting**: 1 mm^2/s
SOUND VELOCITY NEGATIVE	Use this function to specify the lower search range for the sound velocity of the liquid. **User input**: Fixed-point number 0 to 1000 m/s **Factory setting**: 500 m/s Note! Pay particular attention to the information in the function SOUND VELOCITY LIQUID.

Functional description LIQUID DATA	
SOUND VELOCITY POSITIVE	Use this function to specify the upper search range for the sound velocity of the liquid. **User input**: Fixed-point number 0 to 1000 m/s **Factory setting**: 500 m/s Note! Pay particular attention to the information in the function SOUND VELOCITY LIQUID.

10.15 Group CONFIG. CHANNEL

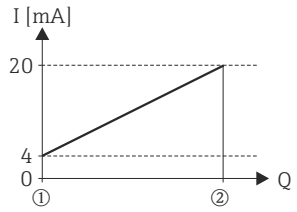
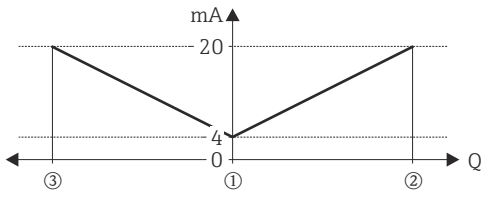
Functional description CONFIG. CHANNEL	
SENSOR TYPE	**Options**: W-CL-1F-L-B W-CL-2F-L-B W-CL-1F-L-C W-CL-05F-L-B W-CL-1F-M-B W-CL-2F-M-B W-CL-6F-L-C W-CL-6F-M-C **Factory setting:** W-CL-2F-L-B
SENSOR CONFIGURATION	Use this function to select the configuration for the ultrasonic clamp-on sensors. **Options**: NO. TRAVERSE: 1 NO. TRAVERSE: 2 NO. TRAVERSE: 4 **Factory setting**: NO. TRAVERSE: 2 Note! ▪ 1 traverse for nominal diameters larger than DN 600, for certain plastic pipes with a wall thickness greater than 4 mm or if the signal strength is not sufficient in other arrangements. ▪ 2 traverses is the recommended configuration for pipes smaller than DN 600. ▪ 4 traverses can only be used for DN 50 in exceptional circumstances. The recommended configuration is 1 traverse.
CABLE LENGTH	Use this function to select the length of the sensor cable. **Options**: LENGTH 5 m/15 feet LENGTH 10 m/30 feet LENGTH 15 m/45 feet LENGTH 30 m/90 feet LENGTH 60 m/180 feet **Factory setting**: LENGTH 5 m/15 feet Note! The influence on the flow measurement caused by the cable length is minimal with nominal diameters under DN 80. For larger nominal diameters, the result is negligible.

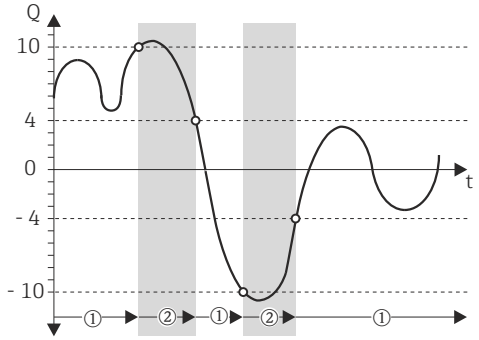
Functional description CONFIG. CHANNEL	
POSITION SENSOR	Use this function to view the position of both sensors on the rail. Display: 4-digit number combination Note! This function is only available if the number of traverses is 2 or 4 (see function SENSOR CONFIGURATION).
WIRE LENGTH	The wire length for assembling the sensors at the correct distance apart appears on the display. Display: max. 4-digit number, including unit (e.g. 200 mm) Note! This function is only available if the number of traverses is 1 (see function SENSOR CONFIGURATION).
SENSOR DISTANCE	The distance between sensor 1 and sensor 2 appears on the display. **Display**: max. 5-digit number, including unit (e.g. 200 mm) Note! 2 traverses cannot be used if the sensor distance is <180 mm.

10.16 Group CALIBRATION DATA

Functional description CALIBRATION DATA	
CAL. FACTOR	Use this function to call up the calibration factor currently used. Data indicated: 5-digit floating-point number (typically 1.000)
ZERO POINT	Use this function to call up the zero point correction currently used. **Data indicated**: 5-digit floating-point number with sign (e.g. +0200.0)
ZEROPOINT STAT.	Use this function to call up or manually change the static zero point correction currently being used. **User input**: 5-digit floating-point number, including unit and sign (e.g. +0010.0 ns)
CORR. FACTOR	Use this function to enter a correction factor at the client's site. User input: 5-digit floating-point number between 0.5 and 2. **Factory setting**: 1.000 (no correction)

10.17 Group SYSTEM PARAMETER

Functional description SYSTEM PARAMETER	
ISTALLATION DIRECTION SENSOR	Use this function to reverse the sign of the flow quantity, if necessary. **Options**: FORWARDS (flow as indicated by the arrow) BACKWARDS (flow opposite to direction indicated by the arrow) **Factory setting**: NORMAL
MEASURING MODE	Use this function to select the measuring mode for all outputs and for the internal totalizer. **Options**: STANDARD SYMMETRY **Factory setting**: STANDARD The responses of the individual outputs and the internal totalizer in each of the measuring modes are described in detail on the following pages: **Current output** STANDARD Only the flow components for the selected flow direction are output, (positive or negative full scale value ② = flow direction). Flow components in the opposite direction are not taken into account (suppression). Example for current output:  a0001248 SYMMETRY The output signals of the current output are independent of the direction of flow (absolute amount of the measured variable). The "VALUE 20mA" ③ (e.g. backflow) corresponds to the mirrored VALUE 20 mA ② (e.g. flow). Positive and negative flow components are taken into account. Example for current output:  a0001249 Note! The direction of flow can be output via the configurable status output. (continued on next page)

Functional description SYSTEM PARAMETER	
MEASURING MODE (Contd)	**Pulse output** STANDARD Only flow components of the positive flow direction are output. Components in the opposite direction are not taken into account. SYMMETRY The absolute value of the positive and negative flow components is taken into account. **Status output** Note! The information is only applicable if LIMIT VALUE was selected in the function ASSIGN STATUS OUTPUT. STANDARD The status output signal switches at the defined switch points. SYMMETRY The status output signal switches at the defined switch points, irrespective of the sign. In other words, if you define a switch point with a positive sign, the status output signal switches as soon as the value is reached in the negative direction (negative sign), (see illustration). Example for the SYMMETRY measuring mode: Switch-on point: Q = 4 Switch-off point: Q = 10 ① = Status output switched on (conductive) ② = Status output switched off (nonconductive)  A0001247 **Totalizer** STANDARD Only positive flow components are output. Negative components are not taken into account. SYMMETRY The positive and negative flow components are balanced. In other words, net flow in the flow direction is registered.

Functional description SYSTEM PARAMETER	
POSITIVE ZERO RETURN	Use this function to interrupt evaluation of measured variables. This is necessary when a piping system is being cleaned, for example. This setting acts on all function and outputs of the measuring device. **Options**: OFF ON → Signal output is set to the "ZERO FLOW" value. **Factory setting**: OFF
FLOW DAMPING	Use this function to set the filter depth of the digital filter. The sensitivity of the measurement signal can be reduced with respect to interference peaks (e.g. in the event of a high solid content, gas bubbles in the fluid etc.). The reaction time of the measuring system increases with the filter setting. **User input**: 0 to 60 s **Factory setting**: 2 s Note! ▪ The system damping acts on all functions and outputs of the measuring device. ▪ The higher the value set, the stronger the damping (higher response time).

10.18 Group SUPERVISION

Functional description SUPERVISION	
FAILSAFE MODE	The dictates of safety render it advisable to ensure that the device signal processing assumes a predefined state in the event of an alarm. The setting you select here is valid for: ▪ Current output ▪ Pulse output ▪ Totalizer Note! This has no effect on the display. **Options**: MINIMUM VALUE MAXIMUM VALUE CURRENT VALUE (not recommended) **Factory setting**: MINIMUM VALUE The response of the individual outputs and the totalizer is listed below. **Current output**: MINIMUM VALUE The current output adopts the value of the lower signal on alarm level (as defined in the CURRENT SPAN function on → 87). MAXIMUM VALUE The current output adopts the value of the upper signal on alarm level (as defined in the CURRENT SPAN function on → 87). ACTUAL VALUE Measuring value output based on the actual flow measurement (alarm is ignored). **Pulse output**: MINIMUM or MAXIMUM VALUE Output is zero pulse ACTUAL VALUE Measuring value output based on the actual flow measurement (alarm is ignored). **Totalizer**: MINIMUM or MAXIMUM VALUE The totalizer is paused while an alarm is present. ACTUAL VALUE The totalizer continues to count on the basis of the current flow value. The fault is ignored.
ACTUAL SYSTEM CONDITION	Use this function to check the current system condition. **Display**: "SYSTEM OK" or the diagnosis message with the highest priority.
PREVIOUS SYSTEM CONDITIONS	Use this function to view the 20 most recent diagnosis messages since measuring last started. **Display**: The last 20 diagnosis messages.

Functional description SUPERVISION	
ALARM DELAY	Use this function to define a time span in which the criteria for an error have to be satisfied without interruption before an error or notice message is generated. Depending on the setting and the type of error, this suppression acts on the: ▪ Display ▪ Current output ▪ Pulse/status output **User input**: 0 to 100 s (in steps of one second) **Factory setting**: 0 s Caution! If this function is activated error and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-order controller (process controller, etc.). It is therefore imperative to check in advance in order to make sure whether a delay of this nature could affect the safety requirements of the process. If error and notice messages cannot be suppressed, a value of 0 seconds must be entered here.
SYSTEM RESET	Use this function to perform a reset of the measuring system. **Options**: NO RESTART SYSTEM (restart without interrupting power supply) MEASURING PIPE DATA (restore the original calibration data) Note! The T-DAT has to be present for the original calibration data to be restored successfully when the MEASURING PIPE DATA option is selected. If this is not the case, the error message DATA STORAGE appears. **Factory setting**: MEASURING PIPE DATA

10.19 Group SIMULATION SYSTEM

Functional description SIMULATION SYSTEM	
SIMULATION FAILSAFE MODE	Use this function to set all outputs and the totalizer to their defined failsafe modes, in order to check whether they respond correctly. During this time, the words "SIMULATION FAILSAFE MODE" appear on the display. **Options**: ON OFF **Factory setting**: OFF
SIMULATION MEASURAND	Use this function to set all outputs and the totalizer to their defined flow-response modes, in order to check whether they respond correctly. During this time, the words "SIMULATION MEASURAND" appear on the display. **Options**: OFF VOLUME FLOW **Factory setting**: OFF Note! ▪ The measuring device cannot be used for measuring while this 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 (= VOLUME FLOW). Use this function to define a freely selectable value (e.g. 12 m^3/s). This is used to test downstream devices and the measuring device itself. **User input**: 5-digit floating-point number [unit], with sign **Factory setting**: 0 [unit] Caution! The setting is not saved if the power supply fails. Note! The appropriate unit is taken from the SYSTEM UNITS group.

10.20 Group SENSOR VERSION

Functional description SENSOR VERSION	
SERIAL NUMBER	Use this function to view the serial number of the measuring system.

10.21 Group AMPLIFIER VERSION

Functional description AMPLIFIER VERSION	
SOFTWARE REVISION NUMBER	Use this function to view the software revision number of the electronics board.

10.22 Factory settings

10.22.1 SI units

Parameter	Factory setting
Nominal diameter	80 [mm]
Low flow (v ≈ 0.04 m/s)	12 [l/min]
Full scale value (v ≈ 2.5 m/s)	750 [l/min]
Pulse value	5.0 [l]
Unit totalizer	[l]
Unit length	mm
Unit temperature	°C

10.22.2 US units (for USA and Canada only)

Parameter	Factory setting
Nominal diameter	3"
Low flow (v ≈ 0.04 m/s)	2.5 [gal/min]
Full scale value (v ≈ 2.5 m/s)	200 [gal/min]
Pulse value	2.0 [gal]
Unit totalizer	gal
Unit length	mm
Unit temperature	°C

10.22.3 Language

Country	Language
Australia	English
Belgium	English
Canada	English
China	English
Denmark	English
Germany	Deutsch
England	English
Finland	English
France	Francais
Holland	English
Hong Kong	English
India	English
Indonesia	English
International Instruments	English
Italy	Italiano
Japan	English
Malaysia	English
Norway	English

Country	Language
Poland	English
Portugal	English
Austria	Deutsch
Russia	English
Sweden	English
Switzerland	Deutsch
Singapore	English
Spain	Espanol
South Africa	English
Thailand	English

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Declaration of Contamination
Erklärung zur Kontamination

Endress+Hauser
People for Process Automation

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or – even better – attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

Process data/ *Prozessdaten*

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

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

Medium and warnings
Warnhinweise zum Medium



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

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

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

Reason for return / *Grund zur Rücksendung* _____

_____

_____

Company data / *Angaben zum Absender*

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

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

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

_____
(place, date / *Ort, Datum*)

_____
(Company stamp and legally binding signature)
(Firmenstempel und rechtsverbindliche Unterschrift)



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