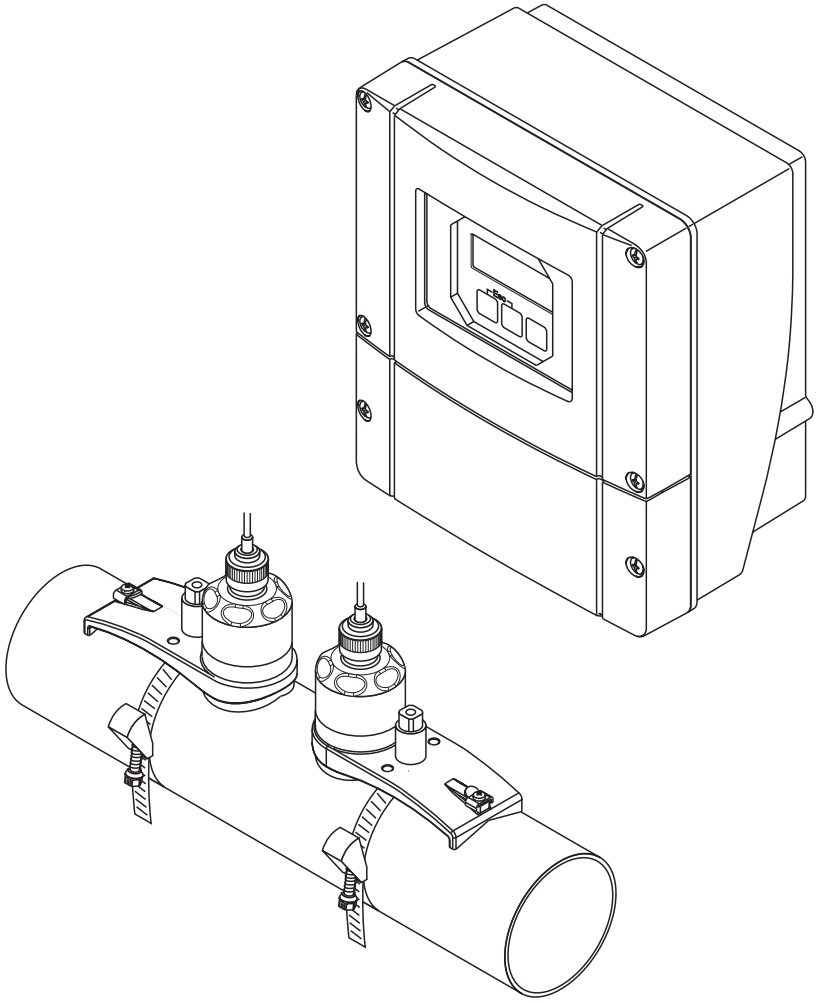
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Proline Prosonic Flow 90 (PROFIBUS PA)

Ultrasonic Flow Measuring System



BA074D/06/en/11.04
50101779
Valid as of version:
V 2.03.XX (Device software)

Endress+Hauser

People for Process Automation

Brief operating instructions

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

Safety instructions	Page 7
Please read the safety instructions through carefully.	 A0000893

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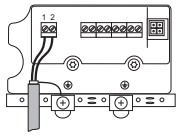
Connecting the transmitter	Page 40
Install the sensors using the transmitter software. Therefore connect the transmitter first to the power supply.	 A0001051

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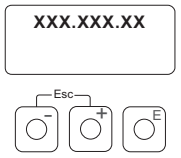
Display and operating elements	Page 48
A brief overview of the different display and operating elements to allow you to start quickly.	 A0001052

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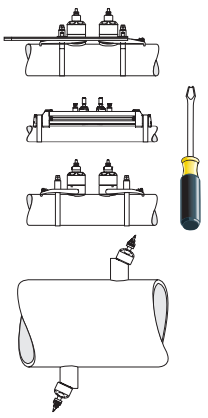
Installing the sensors	Page 18 ff.
Installing the flowrate measuring sensors Prosonic Flow P (clamp-on) Installing the flowrate measuring sensors Prosonic Flow W (clamp-on) Installing the flowrate measuring sensors Prosonic Flow U (clamp-on) Installing the flowrate measuring sensors Prosonic Flow W (Insertion)	 A0001053

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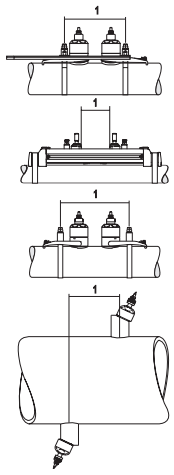
“Sensor installation” Quick Setup	Page 70
*Measuring devices **with** local operation:* Use this “Quick Setup” (→ Page 70) to determine the data required for sensor installation such as sensor distance (1), wire length, pipe materials, sound velocity in liquids, etc. – The system provides you with the sensor distance for the W/P/U “clamp-on” versions as distance data. For the W and P 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. – With the butt-weld version, you receive the sensor distance as distance data. *Measuring devices **without** local operation:* No “Sensor Installation” Quick Setup is available for devices without a local operation. The sensor installation procedure for such devices is explained on Page 73. Connection of the sensor/transmitter connecting cable → Page 38	 A0001054

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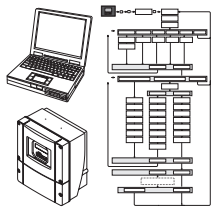
Commissioning via Quick Setup “Commissioning” / Commissioning via PROFIBUS interface	Page 71
*Measuring devices **with** local operation:* You can commission your measuring device quickly and easily using the special “Quick Setup” menu. This means that important basic functions can be configured directly via the local operation, e.g. display language, measured variables, engineering units, etc. Where necessary, the following adjustments and configurations must be carried out separately: – Zero point adjustment – Bus address – Tag name – Configuration of the totalizers *Measuring devices **without** local operation:* No “Commissioning” Quick Setup is available for devices without a local operation. The commissioning procedure for such devices is explained on Page 77.	 A0001055

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Basic configuration (device parameters, automation functions)	Page 77
Device-specific parameters are configured and the automation functions specified for the PROFIBUS interface by means of configuration programs from various manufacturers.	

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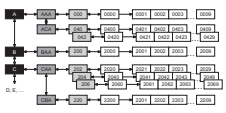
System integration	Page 79 ff.
Cyclic data exchange, configuration examples	

▼

Application-specific commissioning	Page 93 ff.
Device functions, zero point adjustment	

▼

Customer-specific configuration	Page 49 ff.
Complex measurement tasks require the configuration of additional functions which you can individually select, set and adapt to your process conditions using the function matrix. There are two options open: – Setting parameters via the configuration program (e.g. Commuwin II, ToF Tool - Fieldtool Package) – Setting parameters via the local operation (optional) All functions are described in detail, as is the function matrix itself, in the **"Description of Device Functions"** manual, which is a separate part of these Operating Instructions!	 A0001056

Note!
Always start trouble-shooting with the checklist on Page 101, if faults occur after startup.

Contents

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. The sound velocity can be used to distinguish different fluids or as a measure of fluid quality.

The manufacturer accepts no liability for damage resulting from incorrect use or other than designated use.

1.2 Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain.
- The device must be operated by persons authorized and trained by the plant operator. Strict compliance with the instructions in the Operating Instructions is mandatory.
- Endress+Hauser will be happy to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning. However the user is responsible for the choice of fluid-wetted materials as regards to their in-process resistance to corrosion. The manufacturer refuses to accept liability.
- If welding work is performed on the piping system, do not ground the welding appliance through the Prosonic flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, unless the power supply is galvanically isolated.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:
- Measuring systems for use in hazardous environments are accompanied by separate Ex documentation, which is an *integral part* of these Operating Instructions. Strict compliance with the installation instructions and ratings as listed in the supplementary Ex documentation is mandatory. The symbol on the front of the Ex documentation indicates the approval and the certification body (Ex Europe, FM USA, CSA Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1 (IEC 1326) “Emission to class A requirements”, and NAMUR Recommendation NE 21.
- 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.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.
- Remove all fluid residues. Pay special attention to the grooves for seals and crevices which could contain fluid residues. This is particularly important if the fluid is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

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

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

1.5 Notes on safety conventions and icons

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

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

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

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

2 Identification

2.1 Device designation

The “Prosonic Flow 90 PROFIBUS PA” flow measuring system consists of the following components:
- Proline Prosonic Flow 90 PROFIBUS PA transmitter
- Prosonic Flow W, P and U measuring sensors

2.1.1 Nameplate of the transmitter Prosonic Flow 90 PROFIBUS PA

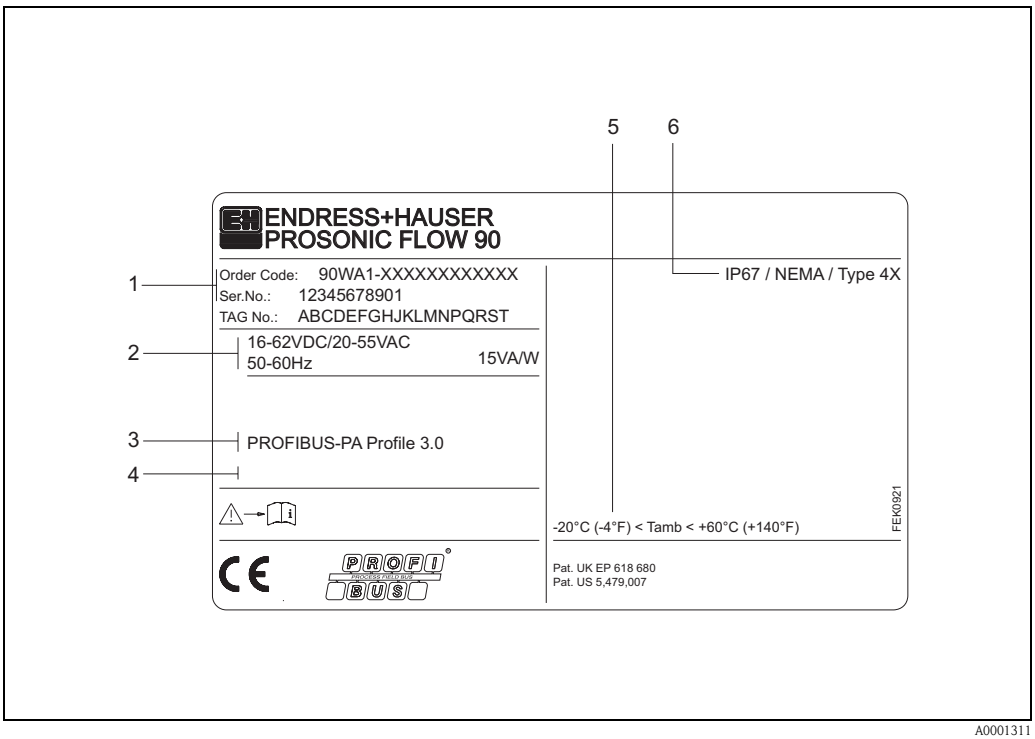


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Fig. 1: Nameplate specifications for “Prosonic Flow 90 PROFIBUS PA” transmitter (example)

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: 16...62 V DC / 20...55 V AC / 50...60 Hz
Power consumption: 15 VA / W
3 Available inputs/outputs: PROFIBUS PA
4 Reserved for information on special products
5 Ambient temperature range
6 Degree of protection

2.1.2 Nameplate of the Prosonic Flow W/P sensors

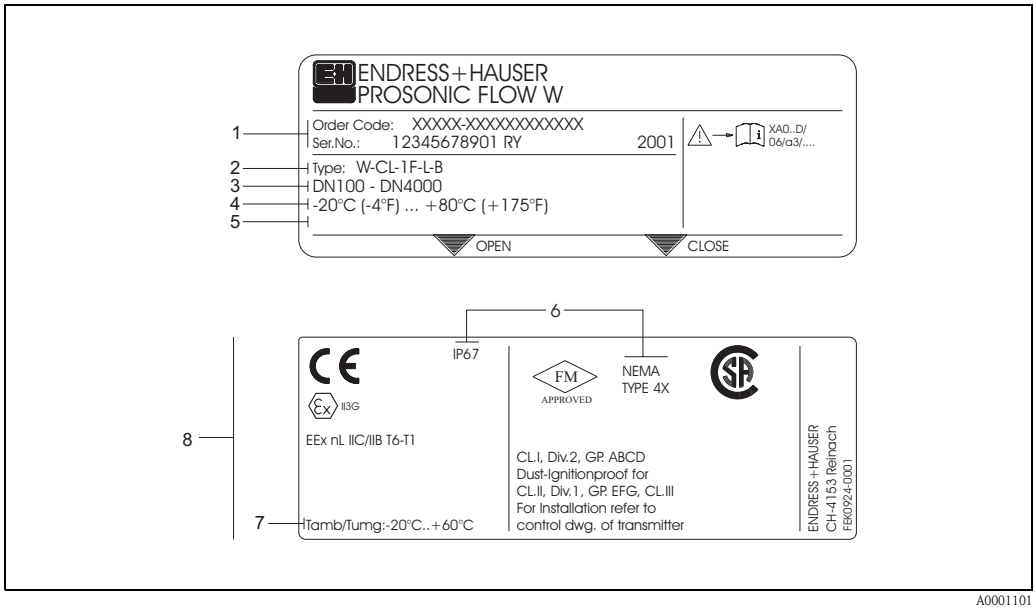

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Fig. 2: Nameplate specifications for the "Prosonic Flow W" sensors (example)

1 *Order code / serial number: see the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *Sensor type*
3 *Range of nominal diameters: DN 100...4000*
4 *Max. fluid temperature range: –20 °C (–4 °F) ... +80 °C (+175 °F)*
5 *Reserved for information on special products*
6 *Degree of protection*
7 *Ambient temperature range*
8 *Data on explosion protection*
Refer to the specific additional Ex documentation for detailed information. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

2.1.3 Nameplate of the Prosonic Flow U sensors

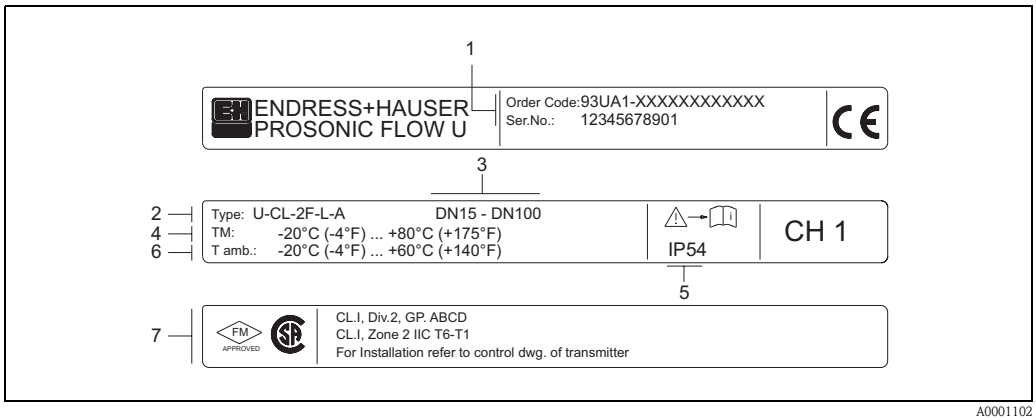

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Fig. 3: Nameplate specifications for the "Prosonic Flow U" sensors (example)

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 *Range of nominal diameters: DN 15...100*
4 *Max. fluid temperature range: –20 °C (–4 °F) ... +80 °C (+175 °F)*
5 *Degree of protection*
6 *Ambient temperature range: –20 °C (–4 °F) ... +60 °C (+140 °F)*
7 *Data on explosion protection*
Refer to the specific additional Ex documentation for detailed information. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

2.1.4 Nameplate, connections

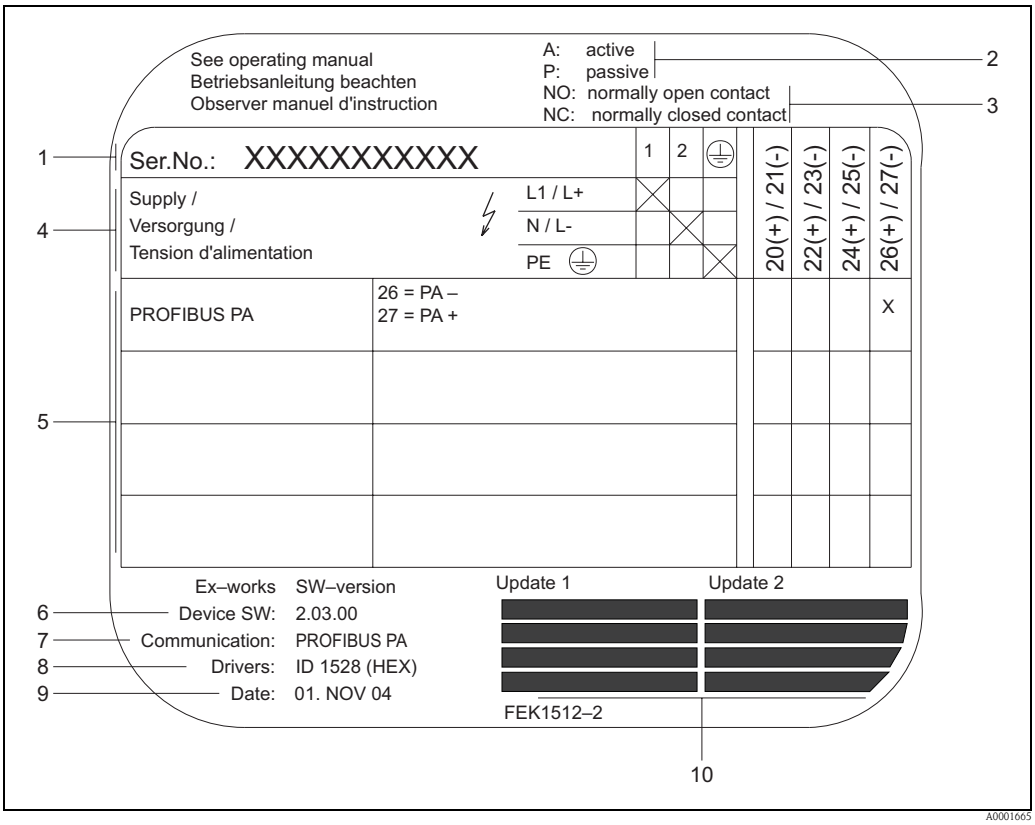

Fig. 4: Nameplate specifications for Proline transmitter (example)

1 Serial number
2 Not for PROFIBUS PA communication type
3 Not for PROFIBUS PA communication type
4 Terminal assignment, cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
5 Signals present at inputs and outputs, possible configuration and terminal assignment (20...27), see also "Electrical values of inputs/outputs"
6 Version of device software currently installed
7 Installed communication type
8 Information on current communication software
9 Date of installation
10 Current updates to data specified in points 6 to 9

2.2 CE mark, declaration of conformity

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of EN 61326/A1.
The measuring system described in these Operating Instructions thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

2.3 Device certification PROFIBUS PA

The Prosonic Flow 90 flowmeter has passed all the test procedures implemented and has been certified and registered by the PNO (PROFIBUS User Organisation). The device thus meets all the requirements of the specifications listed below:
- Certified for PROFIBUS 3.0
  Device certification number: upon request
- The instrument meets all of the PROFIBUS 3.0 Specifications.
- The device may also be operated using certified devices from other manufacturers (interoperability).

2.4 Registered trademarks

SilGel®
is a registered trademark of Wacker-Chemie GmbH, Munich, Germany.

PROFIBUS®
is a registered trademark of PROFIBUS International, Karlsruhe, Germany.

ToF Tool - Fieldtool® Package, Fieldcheck®, Applicator®
are registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, Switzerland.

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

Note 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 (Page 121) of the transmitter, the measuring sensors and the corresponding sensor cables.
- 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 Dimensions

The dimensions and the fitting lengths of the sensors and the transmitter are on Page 125 ff.

3.2.2 Installation location

Correct measuring is possible only if the pipe is full. **Avoid** the following installation 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.

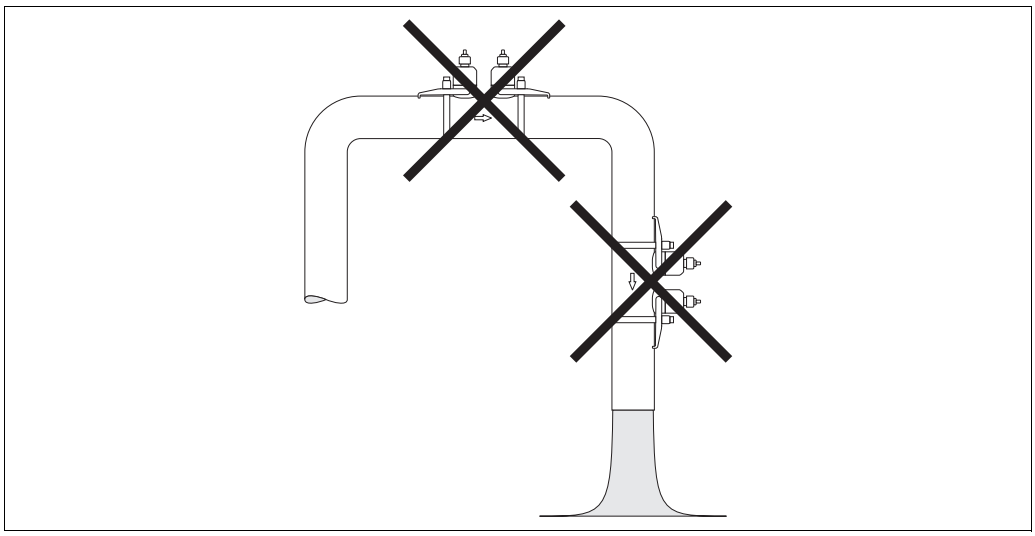

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Fig. 5: Installation location

Down pipes
Notwithstanding the above, the installation proposal below permits installation in an open down pipe. Pipe restrictions or the use of an orifice plate with a smaller cross-section than the nominal diameter prevent the pipe from running empty while measurement is in progress.

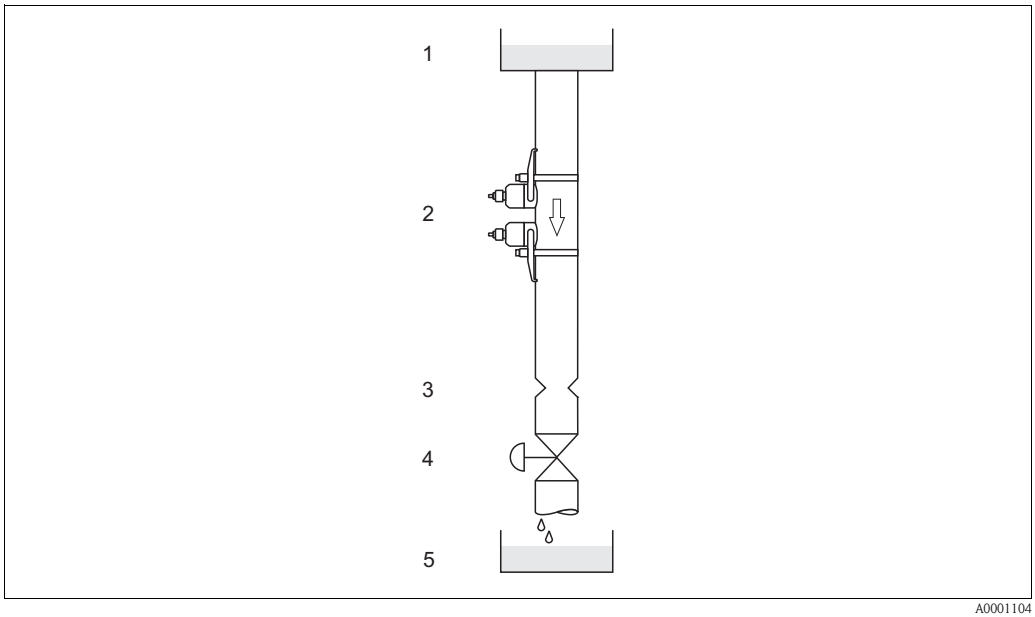

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Fig. 6: Installation in a down pipe
1 = Supply tank; 2 = Measuring sensors; 3 = Orifice plate, pipe restriction; 4 = Valve; 5 = Filling tank

3.2.3 Orientation

Vertical orientation
Recommended orientation with upward direction of flow (View 1). 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 build-up.

Horizontal orientation
In the recommended installation range in a horizontal installation position (View 2), gas and air accumulation at the pipe cover and problematic build-ups at the bottom of the pipe have a minor influence on the measurement.

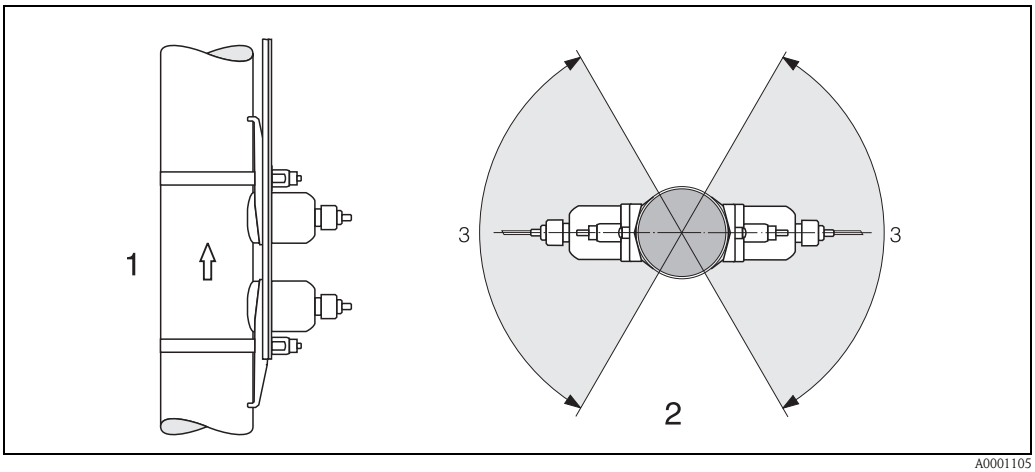


Fig. 7: Installation position (1 = Vertical, 2 = Horizontal, 3 = Recommended installation range max. 120°)

3.2.4 Inlet and outlet runs (clamp-on version)

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

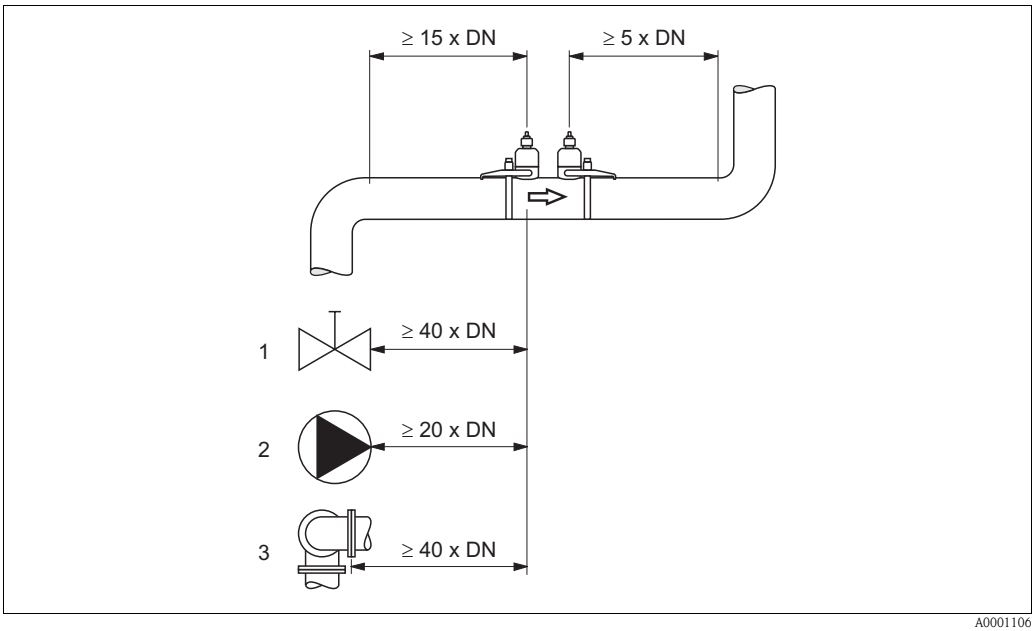


Fig. 8: Inlet and outlet runs (clamp-on version)

1 = Valve; 2 = Pump; 3 = Two pipe bends in different directions

3.2.5 Inlet and outlet runs (Insertion version)

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

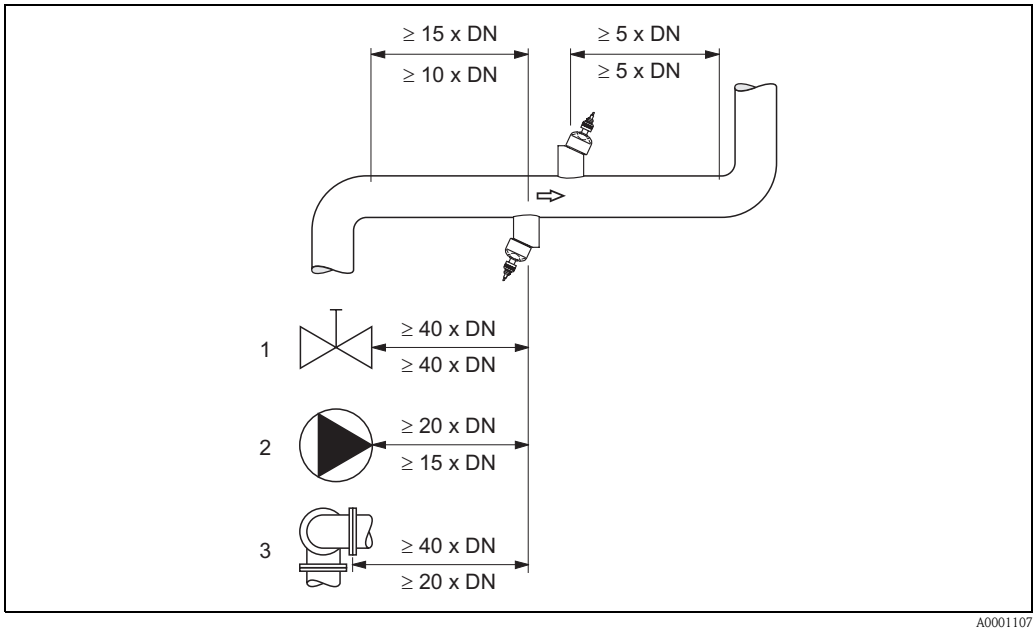


Fig. 9: Inlet and outlet runs (Insertion version)

1 = Valve; 2= Pump; 3 = Two pipe bends in different directions
Data above the dimension line: apply to the single path version
Data below the dimension line: apply to the dual path version

3.2.6 Connecting cable length

Shielded cables are offered in the following lengths:
5 m, 10 m, 15 m and 30 m

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

3.2.7 Sensor arrangement (clamp-on)

The transmitter offers a number of options between 1 and 4 traverses for the type of installation. Please note that the signal strength is reduced with each additional reflection point in the pipe. (Example: 2 traverses = 1 reflection point)
To achieve the best signal quality possible, choose the least number of traverses required for a sufficient transit time difference.

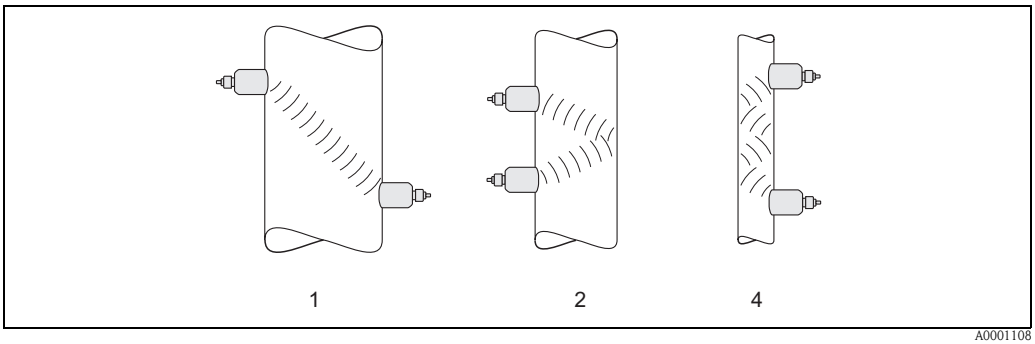


Fig. 10: Sensor arrangement (clamp-on)

1 = 1 traverse; 2 = 2 traverses; 4 = 4 traverses

Recommendations:
Due to their design and properties, the Prosonic Flow sensors are particularly suited to certain nominal diameter ranges and pipe wall thicknesses. For this reason, various sensor types are offered for Prosonic Flow W, P and U for these different applications.
Recommendations for sensor installation can be found in the following table.

Sensor type	Nominal diameter	Type of mounting
Prosonic Flow U	DN 15...100	2 traverses
Prosonic Flow W Prosonic Flow P	DN 50...60 DN 80...600 DN 650...4000	2 (or 4) traverses* 2 traverses 1 traverse

** see note below*

Note!
- The installation of clamp-on sensors is principally recommended in the 2 traverse type of installation. This type of installation allows the easiest and most comfortable type of mounting and means that a system can also be mounted even if the pipe can only be accessed from one side.
- If the pipe nominal diameter is small (DN 60 and smaller), the sensor spacing with Prosonic Flow W/P can be too small for an installation with 2 traverses. In this case, the 4 traverse type of installation must be used. In all other instances, the 2 traverse configuration is the preferred method.
- The use of Prosonic Flow W/P sensors DN 100...4000 is principally recommended for pipes with a wall thickness >4 mm, pipes made of composites such as GRP, pipes with lining, even for nominal diameters < DN 100. This applies also to applications with media with high acoustic damping. For these applications, we principally recommend mounting the W/P sensors with 1 traverse configuration.
- In the DN 15...50 nominal diameter range, Prosonic Flow U is preferred for use on plastic pipes. Both the Prosonic Flow W/P and the Prosonic Flow U sensor types can be used in the DN 50...100 nominal diameter range. The use of Prosonic Flow W/P sensors is principally recommended for applications as of DN 60.
- If the measuring device displays an insufficient signal strength, reduce the number of the traverses.

3.3 Installation instructions

3.3.1 Installing tensioning bands (clamp-on)

For W/P sensors DN 50...200

1. Push one of the supplied threaded bolts on the tensioning band.
2. Run the tensioning band around the pipe without twisting it and push the end through the tensioning band lock (make sure that the screw is pushed up).
3. By hand, make the tensioning band as tight as possible.
4. Push the screw down and tighten the tensioning band with a screwdriver so that it cannot slip.
5. If so desired, shorten the tensioning band to the desired length.

Caution!
Risk of injury. When shortening the tensioning band, try to avoid sharp edges.

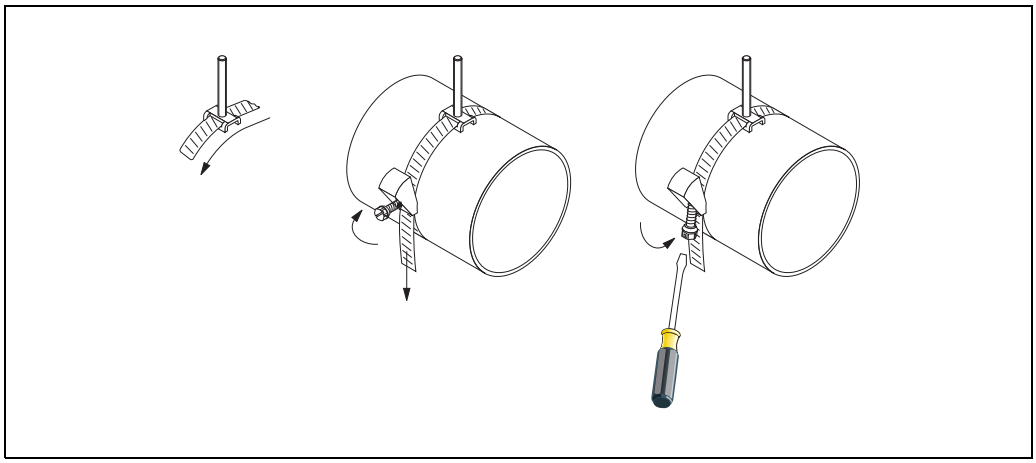


Fig. 11: Tensioning band installation for DN 50...200

For W/P sensors DN 250...4000
The following steps relate to Fig. 12 on Page 19.

1. Measure the pipe circumference.
2. Shorten the tensioning band to the pipe circumference +10 cm.

Caution!
Risk of injury. When shortening the tensioning band, try to avoid sharp edges.

3. Loop the tensioning band through one of the centering plates supplied with the threaded bolt (1).
4. Insert both ends of the tensioning bands down into the openings in the tensioning band lock (2). Bend back the ends of the tensioning bands.
5. Interlock both halves of the lock (3). Make sure that there is sufficient space for the tensioning band to be tightened with the locking screw.
6. Tighten the tensioning band using a screwdriver (4).

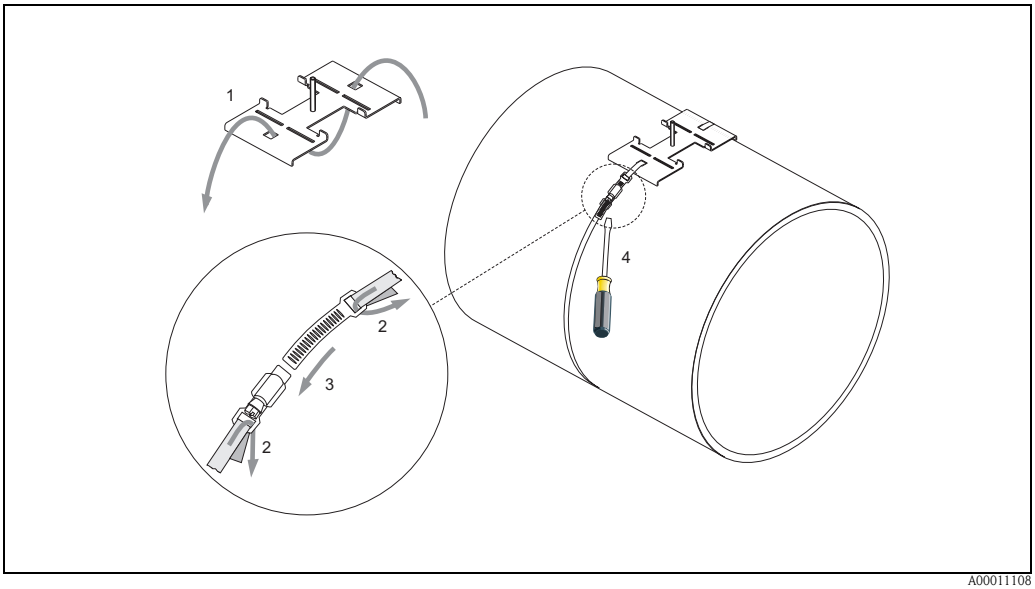


Fig. 12: Tensioning band installation for DN 250...4000

For U sensors - DN 15...100

The procedure for installing the tensioning bands for the U sensor is explained on Page 25 in the "Installing the sensor Prosonic Flow U" Section.

3.3.2 Use of welded bolts for W/P sensors

welded bolts can be used instead of tensioning bands for the following types of installation of the W/P clamp-on measuring sensors.

Note!
To determine the sensor distance (distance from the centre of the first stud to the centre of the second bolt) use:
- the “Sensor Installation” Quick Setup menu if the measuring device has a local operation. Use the Quick Setup as described on Page 70. The sensor distance is shown in the SENSOR DISTANCE function. The transmitter has to be installed and connected to the power supply to carry out the “Sensor Installation” Quick Setup.
- the procedure described on Page 73 if the measuring device has no local operation.

For an exact description of the sensor installation process, please refer to the appropriate pages of the clamp-on versions. You must keep to same installation sequence.

If you want to use a non-metric M6 ISO thread, please note the following:
- You require a sensor holder with a removable locking nut (Order code: 90WA1 – xBxxxxxxxxxx).
- Remove the preinstalled locking nut on the sensor holder with a metric ISO thread.
- Use a nut which matches your threaded bolt.

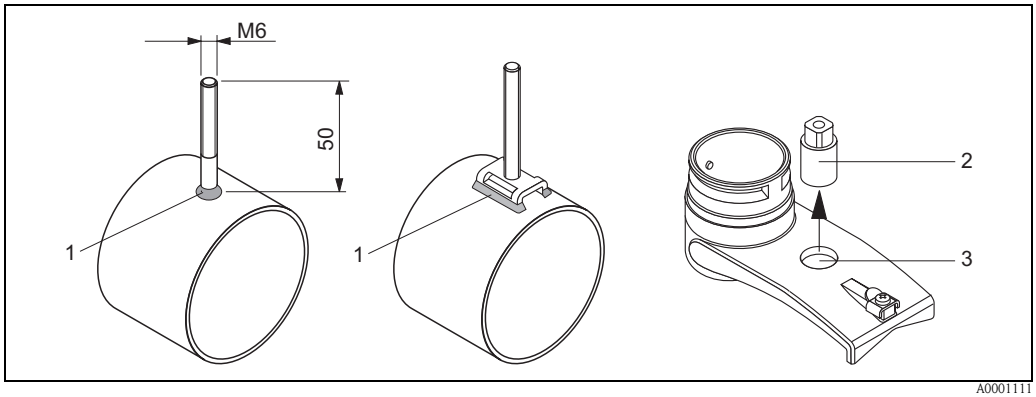


Fig. 13: Use of welded bolts

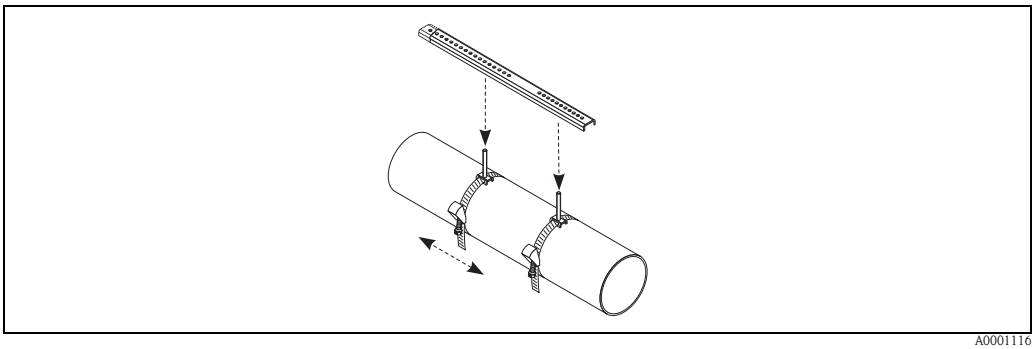
1 Welded joint
2 Locking nut
3 Hole diameter max. 8.7 mm

3.3.3 Installing the measuring sensors Prosonic Flow P

2 or 4 traverses version

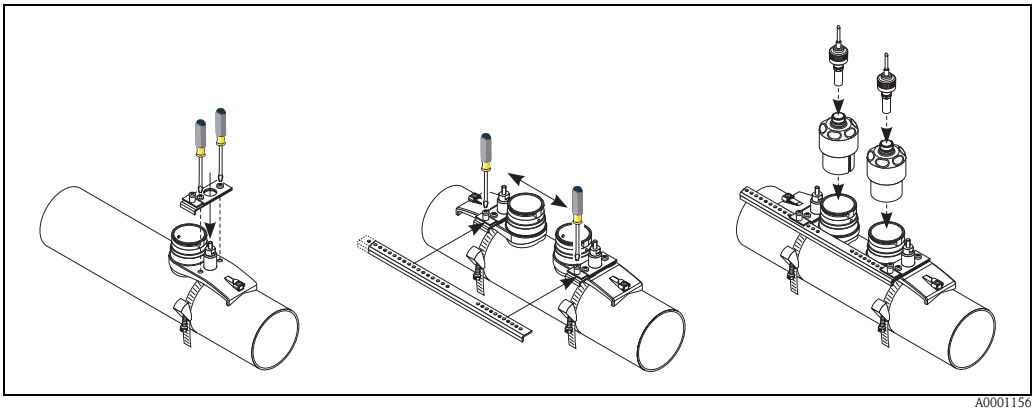
1. Fix a tensioning band for small or large nominal diameters as described on Page 18. Install the second tensioning band (threaded stud on the opposite side). The second tensioning band must still be moveable.
2. Determine the sensor distance.

   ✎ Note!
   To determine the sensor distance use:
   – the “Sensor Installation” Quick Setup menu if the measuring device has a local operation. Use the Quick Setup as described on Page 70. The sensor distance is shown in the POSITION SENSOR function, (i.e. a letter on the mounting rail for sensor 1 and a number for sensor 2). The transmitter has to be installed and connected to the power supply to carry out the “Sensor Installation” Quick Setup.
   – the procedure described on Page 73 ff. if the measuring device has no local operation.
3. Arrange the tensioning bands to the sensor distance shown in the POSITION SENSOR function. Place the mounting rail on the threaded studs and then fasten the second tensioning band. Remove the mounting rail.



A0001116

4. Fix the sensor holder to the pipe using the threaded studs. Tighten the locking nuts using a spanner (AF 13).
5. Fasten the mounting rail brackets to the sensor holders using a Philips screwdriver. Place the mounting rail on the threaded studs and then fasten the appropriate srews.
6. Coat the contact surface of the sensors with an even (approx. 1 mm thick) layer of coupling fluid (from the centre to the groove, see Page 97).
   Then carefully insert the sensor into the sensor holder. Press the sensor cover onto the sensor holder until you hear a click. Make sure that the arrows (▲ / ▼ “close”) on the sensor housing and sensor holder are pointing to each other. Then insert the sensor cable plug into the opening provided and manually tighten the plug to the stop.



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3.3.4 Installing the measuring sensors Prosonic Flow W/P (clamp-on)

1 traverse version

1. Fix a tensioning band for small or large nominal diameters as described on Page 18. Install the second tensioning band (threaded stud on the opposite side). The second tensioning band must still be moveable.
2. Determine the sensor distance and the wire length.

   ✎ Note!
   To determine the sensor distance and the wire length use:
   – the "Sensor Installation" Quick Setup menu if the measuring device has a local operation. Use the Quick Setup as described on Page 70. The sensor distance is shown in the SENSOR DISTANCE function and the wire length is shown in the WIRE LENGTH function. The transmitter has to be installed and connected to the power supply to carry out the "Sensor Installation" Quick Setup.
   – the procedure described on Page 73 ff. if the measuring device has no local operation.
3. Enter the wire length on both halves of the wire.

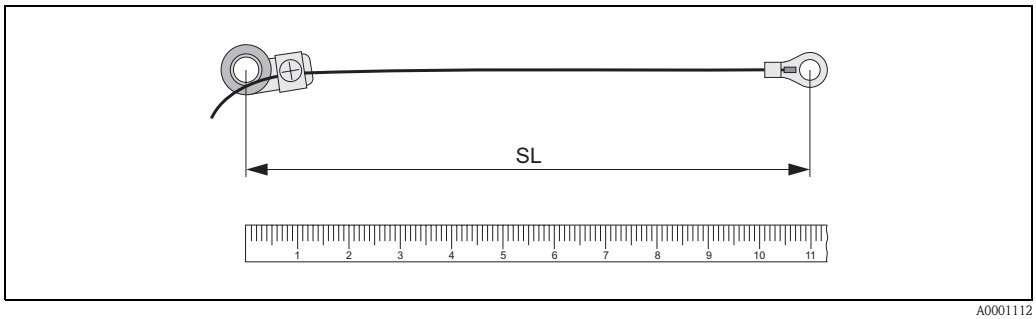


Fig. 14: Marking the determined wire length on the wire measurement equipment (SL = wire length)

4. Push the cable lug and the fixer over the first threaded stud. Lead each wire along one side of the pipe. Push the cable lug and the fixer over the second threaded stud. Pull in the threaded stud with the tensioning band until both wires are the same length.
5. Fix the tensioning band. Loosen the Phillips screws of the fixing parts. Remove the wires.

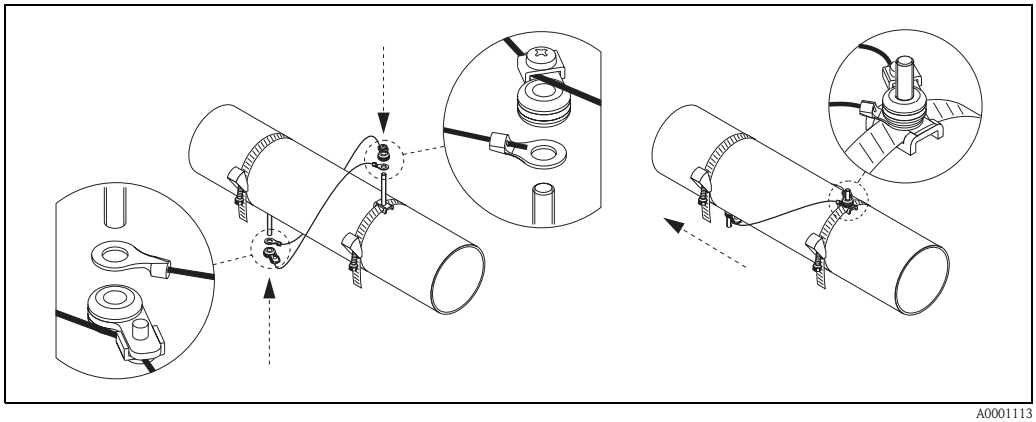
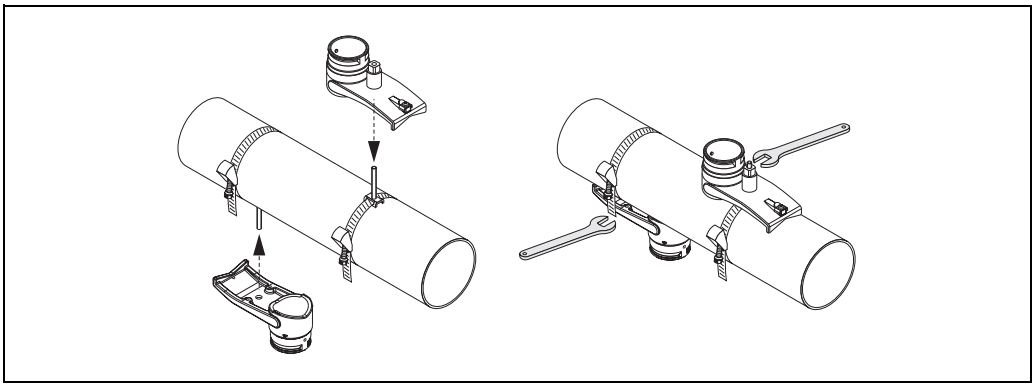


Fig. 15: Use of the wire measuring equipment for positioning of threaded studs

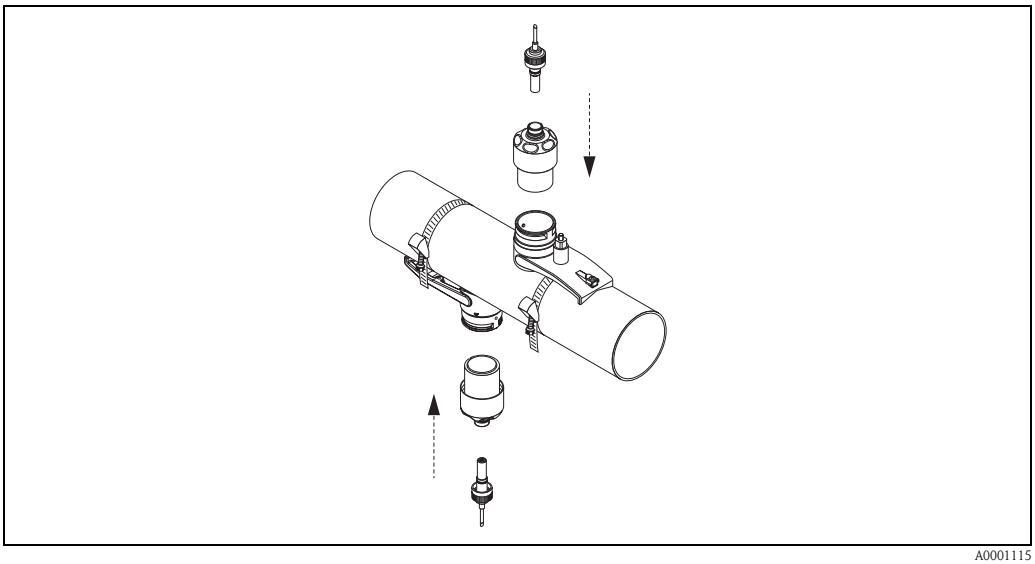
6. Push both of the sensor holders onto the pipe over the threaded studs and tighten the locking nuts using a spanner (AF 13).



A0001114

Fig. 16: Installing the sensor holders

7. Coat the contact surface of the sensors with an even (approx. 1 mm thick) layer of coupling fluid (from the centre to the groove, see Page 97).
   Then carefully insert the sensors into the sensor holder. Press the sensor cover onto the sensor holder until you hear a click. Make sure that the arrows (▲ / ▼ "close") on the sensor housing and sensor holder are pointing to each other. Then insert the sensor cable plug into the opening provided and manually tighten the plug to the stop.



A0001115

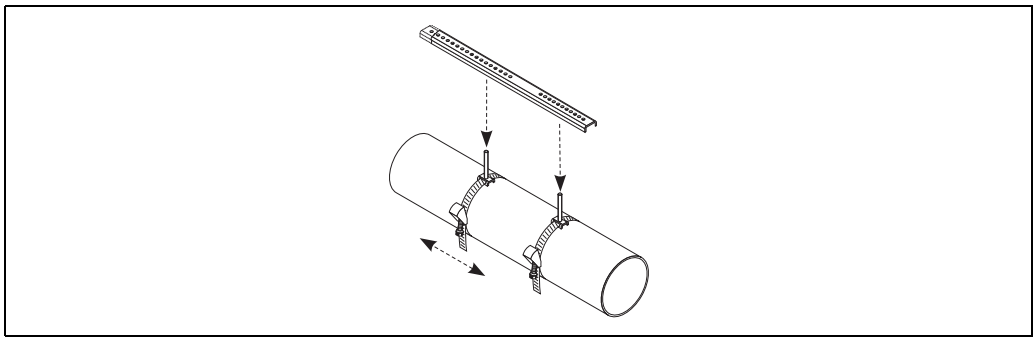
Fig. 17: Installing the sensors and the sensor connectors

3.3.5 Installing the measuring sensors Prosonic Flow W (Clamp On)

2 or 4 traverses version

1. Fix a tensioning band for small or large nominal diameters as described on Page 18. Install the second tensioning band (threaded stud on the opposite side). The second tensioning band must still be moveable.
2. Determine the sensor distance.

   ✎ Note!
   To determine the sensor distance use:
   – the "Sensor Installation" Quick Setup menu if the measuring device has a local operation. Use the Quick Setup as described on Page 70. The sensor distance is shown in the POSITION SENSOR function, (i.e. a letter on the mounting rail for sensor 1 and a number for sensor 2). The transmitter has to be installed and connected to the power supply to carry out the "Sensor Installation" Quick Setup.
   – the procedure described on Page 73 ff. if the measuring device has no local operation.
3. Arrange the tensioning bands to the sensor distance shown in the POSITION SENSOR function. Place the mounting rail on the threaded studs and then fasten the second tensioning band. Remove the mounting rail.



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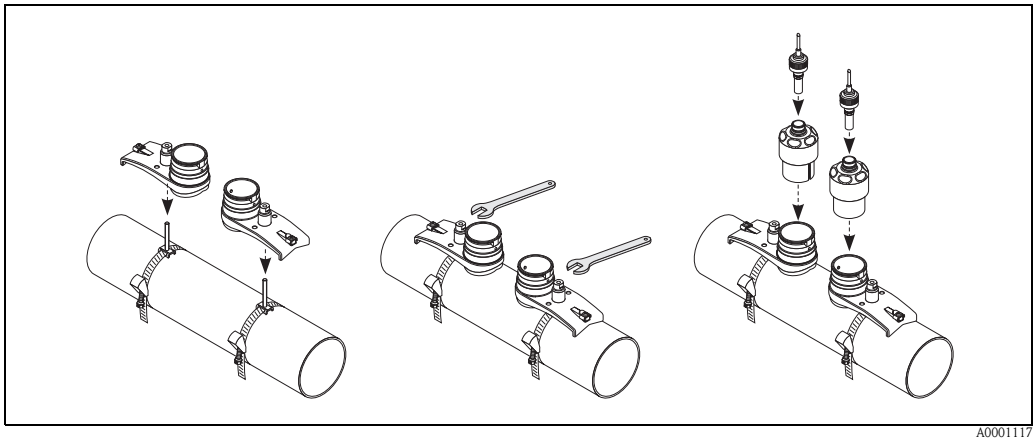
4. Fix the sensor holder to the pipe using the threaded studs. Tighten the locking nuts using a spanner (AF 13).
5. Coat the contact surface of the sensors with an even (approx. 1 mm thick) layer of coupling fluid (from the centre to the groove, see Page 97).
   Then carefully insert the sensor into the sensor holder. Press the sensor cover onto the sensor holder until you hear a click. Make sure that the arrows (▲ / ▼ "close") on the sensor housing and sensor holder are pointing to each other. Then insert the sensor cable plug into the opening provided and manually tighten the plug to the stop.



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3.3.6 Installing the measuring sensors Prosonic Flow U (clamp-on)

1. In the case of pipes in the DN 15…32 nominal diameter range, use the retaining vee (a) supplied to reinforce the pipe. This retaining vee is only included in the DN 15….40 installation set (see Accessories on Page 98). Loop the tensioning bands (b) through the retaining vee as illustrated below. Pull the tensioning bands freely through the tensioning band locks to such an extent that the bands can later be guided over the ends of the sensor assembly (please note that the screw of the tensioning band lock must be opened).

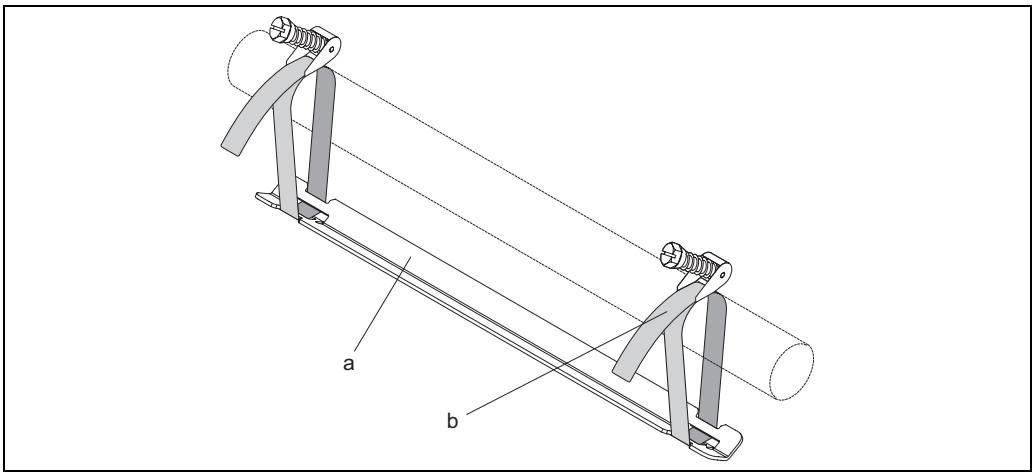

Fig. 18: Preparing sensor installation with retaining vee

a Retaining vee
b Tensioning band

2. Determine the sensor distance.

   ✎ Note!
   To determine the sensor distance use:
   – the “Sensor Installation” Quick Setup menu if the measuring device has a local operation. Use the Quick Setup as described on Page 70. The sensor distance is shown in the SENSOR DISTANCE function. The transmitter has to be installed and connected to the power supply to carry out the “Sensor Installation” Quick Setup.
   – the procedure described on Page 73 ff. if the measuring device has no local operation.

   The U sensor is designed for 2 traverses only. Please ensure that “NO. TRAVERSE: 2” is selected for the number of traverses in the SENSOR CONFIGURATION function (see Page 70).

3. Set the sensor distance on the sensor assembly by moving the sensors (c) along the assembly frame and tightening the sensor fixing nuts (d). Preferably, the sensor position is set symmetrically to the rail centre.
   Turn the sensor adjustment screw counter-clockwise (e) so that the sensor moves upwards inside the assembly frame. Coat the sensors with coupling fluid as explained on Page 70.

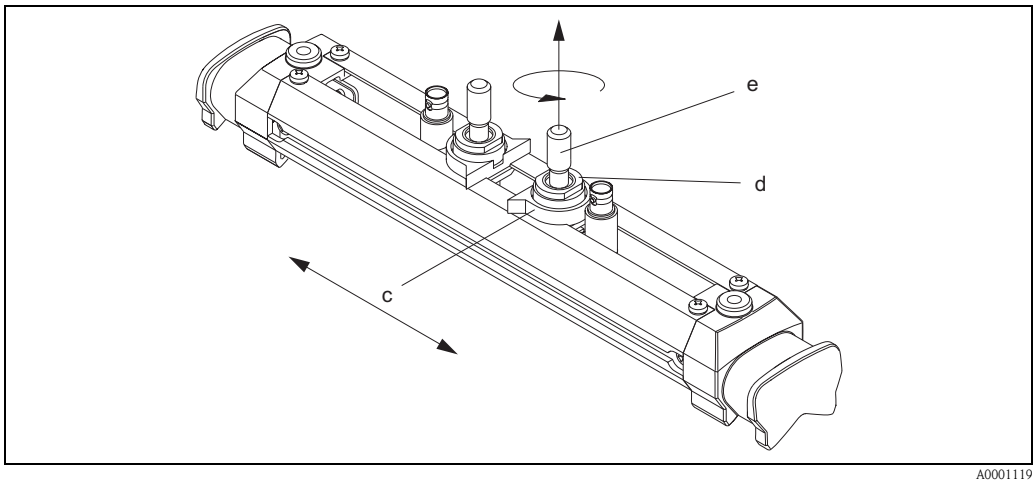

Fig. 19: Preparing the sensor assembly for the installation

c Sensor
d Sensor fixing nut
e Sensor adjustment screw

4. Then position the sensor assembly (f) on the pipe. Guide the tensioning bands over the ends of the sensor assembly (g) and pull the bands tight by hand (please note that).

   ✎ Note!
   The screw of the tensioning band lock must be opened.

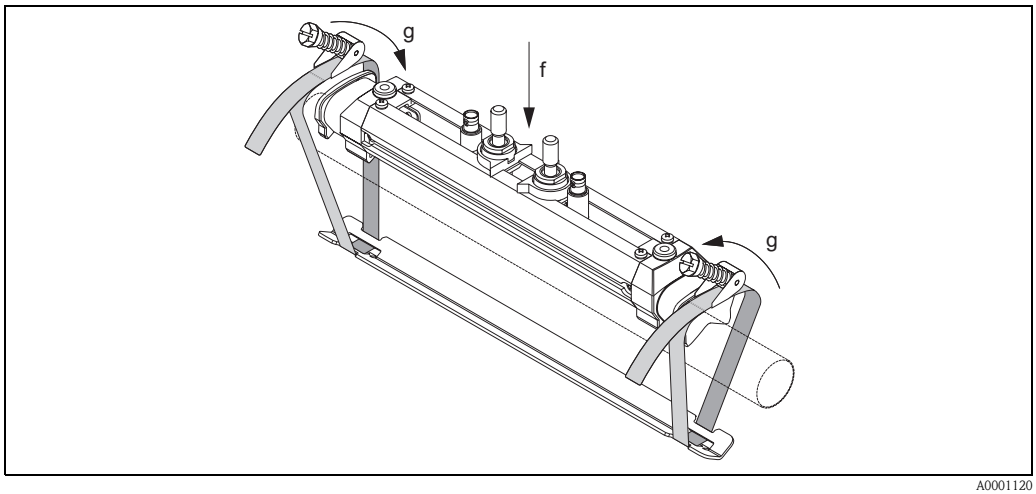

Fig. 20: Positioning the sensor and looping the tensioning bands

f Sensor assembly
g End of sensor assembly

5. Push down the screws (h) of tensioning band lock and tighten with a screwdriver so the bands cannot slip. If so desired, shorten the tensioning band then to the desired length.

   Caution!
   – Danger of injury! Avoid sharp edges when shortening the tensioning band.
   – If pulled too tightly, there is the risk of damaging the pipe (applies particularly to plastic pipes).

   Turn the sensor adjustment screws (i) clockwise until slight resistance is felt. The sensor is in the optimum position at this point.

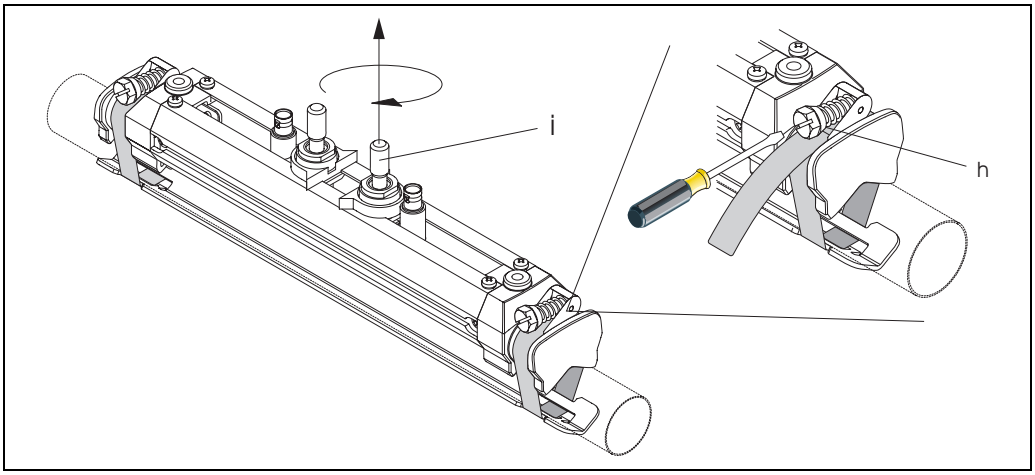

Fig. 21: Tightening the tensioning bands and the screw adjustment

h Screw of tensioning band lock
i Sensor adjustment screw

6. With the flat sides facing each other, fit the sensor protection cap (k) on the sensor adjustment screws and the sensor fixing nuts.
   Attach the BNC sensor cable connector (l) to the connections provided (upstream and downstream) and then screw the screw of the sensor cable grounding (m) into the thread provided. This ensures perfect grounding.

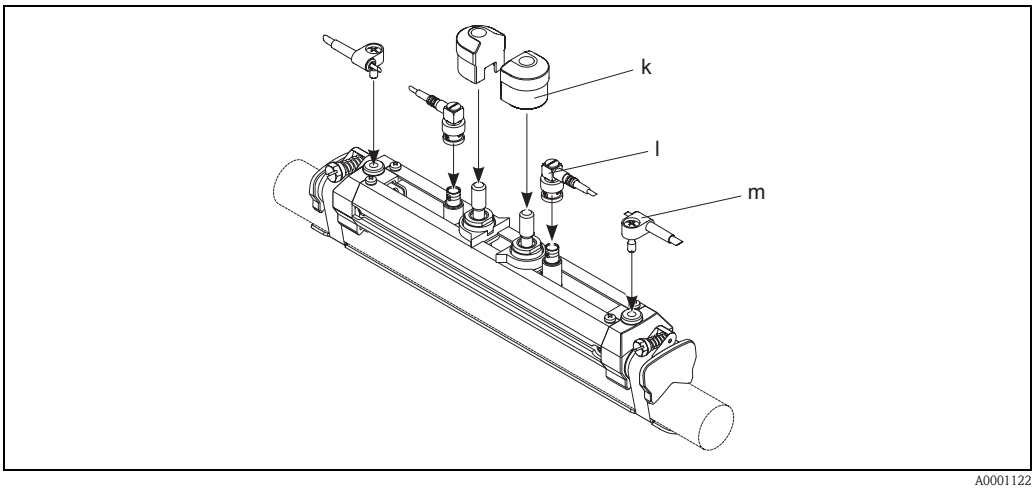

Fig. 22: Fitting the sensor protection cap, mounting the sensor cable connector and grounding

k Sensor protection cap
l BNC sensor cable connector
m Sensor protection cap

3.3.7 Term explanations for Prosonic Flow W (Insertion version)

The graphic below provides you with an overview of the terms used when installing Prosonic Flow W (Insertion version).

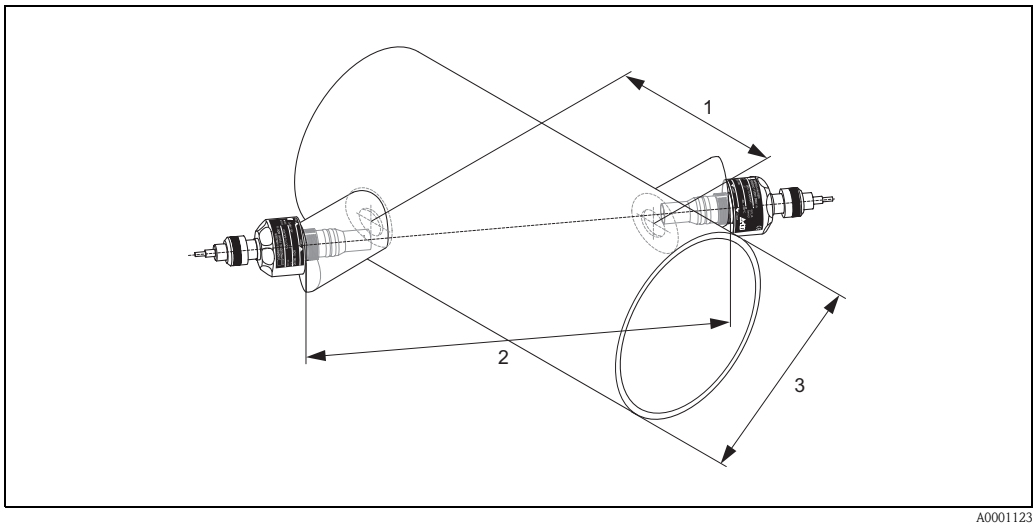

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Fig. 23: Explanation of terms for single path version

1 = Sensor distance
2 = Path length
3 = Pipe outer diameter (determined by application)

Arc length: $b = \frac{\Pi \cdot d \cdot \alpha}{360°}$

3.3.8 Installing the measuring sensors Prosonic Flow W (single path Insertion version)

1. Determine the installation area (e) on the pipe section:
   – Installation location: Page 14
   – Inlet/outlet runs: Page 16
   – Space required by the measuring point approx. 1x pipe diameter.
2. Mark the middle line on the pipe at the mounting location and mark the position of the first drillhole (drillhole diameter: 65 mm).

   ✎ Note!
   Make the middle line longer than the drillhole!

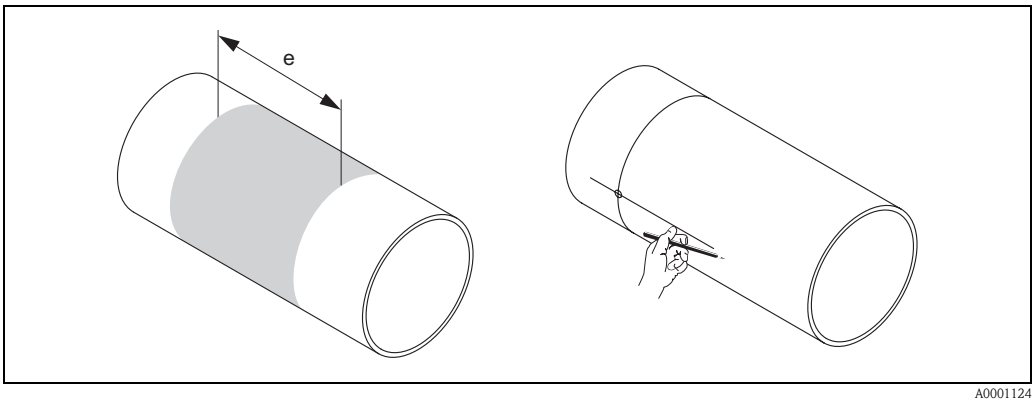

Fig. 24: Installing the measuring sensors, steps 1 and 2

3. Drill the first hole, e.g. with a plasma cutter. If the wall thickness of the pipe is unknown, measure it at this point.
4. Determine the sensor distance.

   ✎ Note!
   To determine the sensor distance use:
   – the “Sensor Installation” Quick Setup menu if the measuring device has a local operation. Use the Quick Setup as described on Page 70. The sensor distance is shown in the SENSOR DISTANCE function. The transmitter has to be installed and connected to the power supply to carry out the “Sensor Installation” Quick Setup.
   – the procedure described on Page 73 if the measuring device has no local operation.

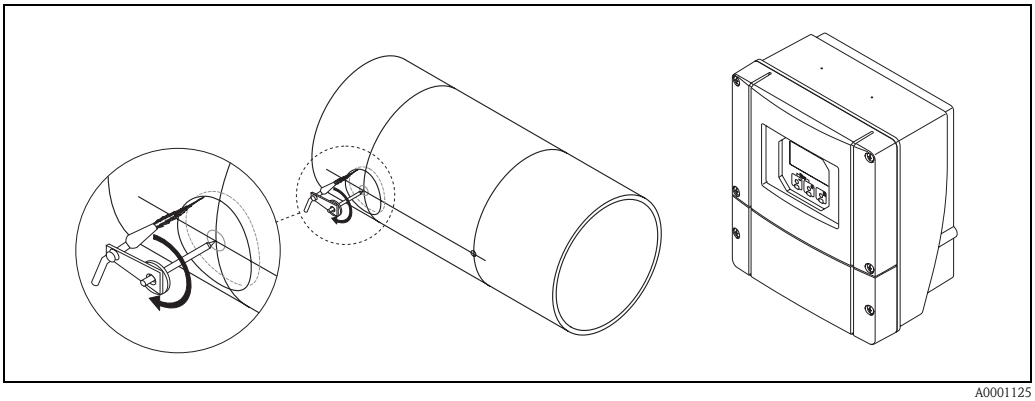

Fig. 25: Installing the measuring sensors, steps 3 and 4

5. Mark the sensor distance (a) starting from the middle line of the first drillhole.
6. Project the middle line to the back of the pipe and draw it on.

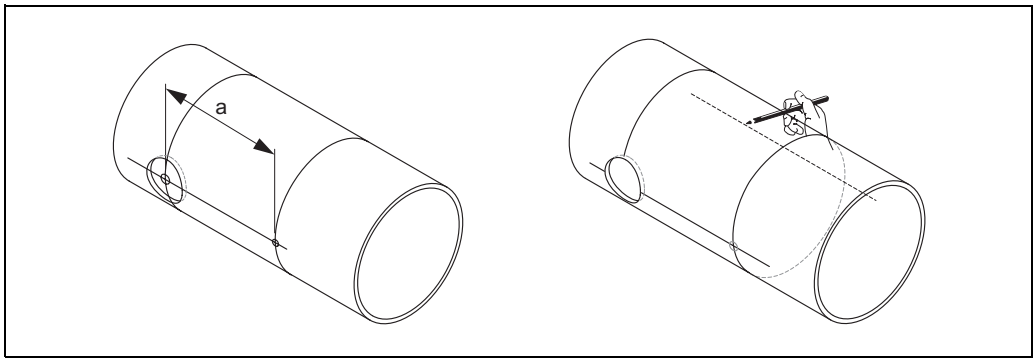

Fig. 26: Installing the measuring sensors, steps 5 and 6

7. Mark the drillhole on the middle line on the back of the pipe.
8. Cut out the second drillhole and prepare the holes for welding the sensor holders (deburr, clean, etc.).

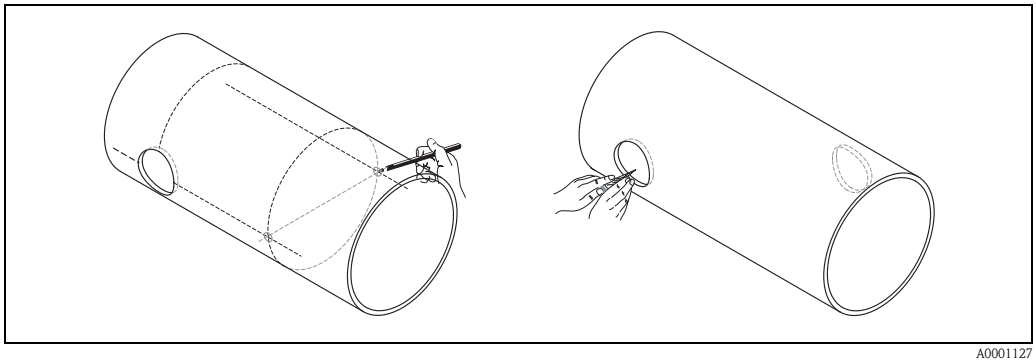

Fig. 27: Installing the measuring sensors, steps 7 and 8

9. Insert the sensor holders into the two drill holes. To adjust the weld-in depth, both sensor holders can be fixed with the special tool for insertion depth regulation (optional) and then aligned using the tie rod. The sensor holder must be flush with the inner side of the pipe. Now pinpoint both sensor holders.

   ✎ Note!
   To align the tie rod, two bearing shells must be screwed onto the sensor holders.

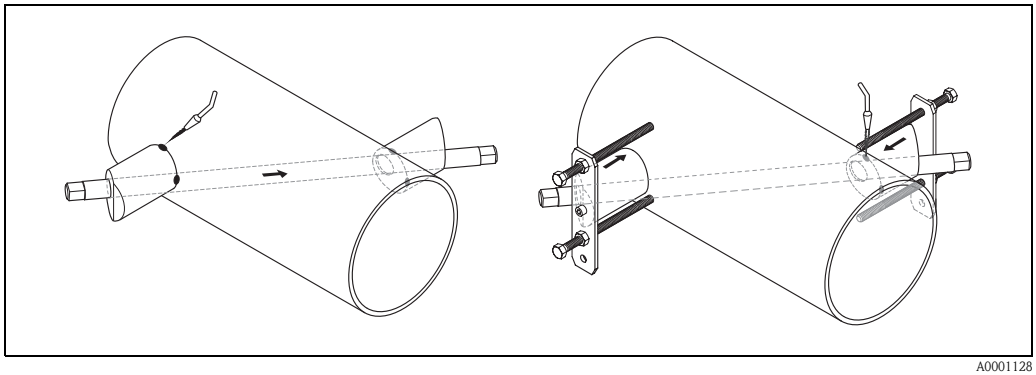

Fig. 28: Installing the measuring sensors, step 9

10. Weld in both sensor holders. After welding, check the distance between the drill holes once again and measure the path length.

    ✎ Note!
    To determine the path length use:
    – the “Sensor Installation” Quick Setup menu if the measuring device has a local operation. Use the Quick Setup as described on Page 70. The path length is shown in the PATH LENGTH function. The transmitter has to be installed and connected to the power supply to carry out the “Sensor Installation” Quick Setup.
    – the procedure described on Page 73 ff. if the measuring device has no local operation.

11. Then screw the sensors into the sensor holders by hand. If you use a tool, the maximum torque permissible is 30 Nm.

12. Then insert the sensor cable plug into the intended opening and manually tighten the plug to the stop.

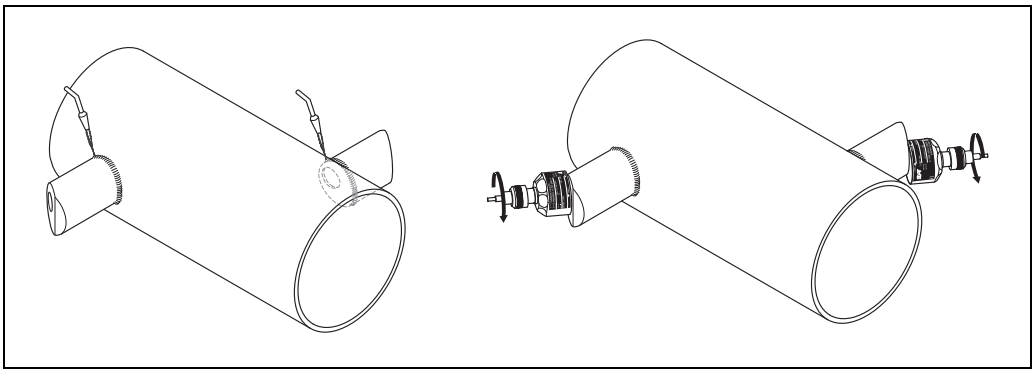

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Fig. 29: Installing the measuring sensors, steps 10 to 12

3.3.9 Installing the wall-mount housing

There are various ways of installing the wall-mount housing:
- Direct wall mounting
- Panel mounting (with separate mounting set, accessories → Page 98)
- Pipe mounting (with separate mounting set, accessories → Page 98)

Caution!
- Make sure that the ambient temperature at the mounting location does not exceed the permissible range (–20 °C...+60 °C). Install the device in a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Direct wall mounting

1. Drill the holes as illustrated in Fig. 30.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm
   – Screw head: max. Ø 10.5 mm
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

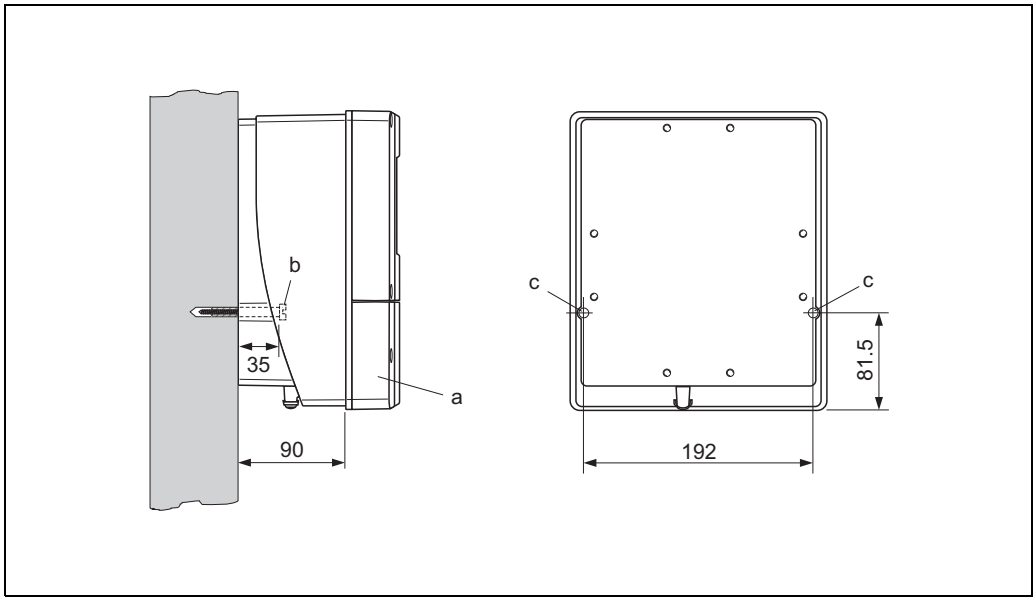


Fig. 30: Mounted directly on the wall

Panel mounting

1. Prepare the installation opening in the panel (Fig. 31).
2. Slide the housing into the panel cutout from the front.
3. Screw the fasteners to the wall-mount housing.
4. Place the threaded rods in the fasteners and screw them down until the housing is seated tightly against the panel. Tighten the counter nuts. No further support is necessary.

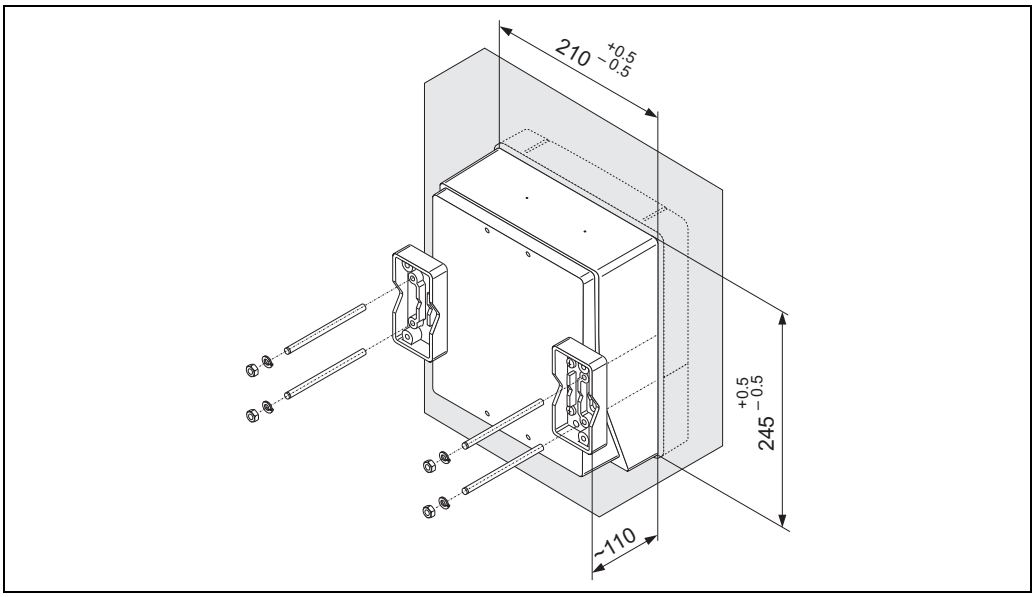


Fig. 31: Panel mounting (wall-mount housing)

Pipe mounting
Installation according to the instructions in Fig. 32.

Caution!
If a warm pipe is used for the installation, ensure that the housing temperature does not exceed the max. permitted value of +60 °C.

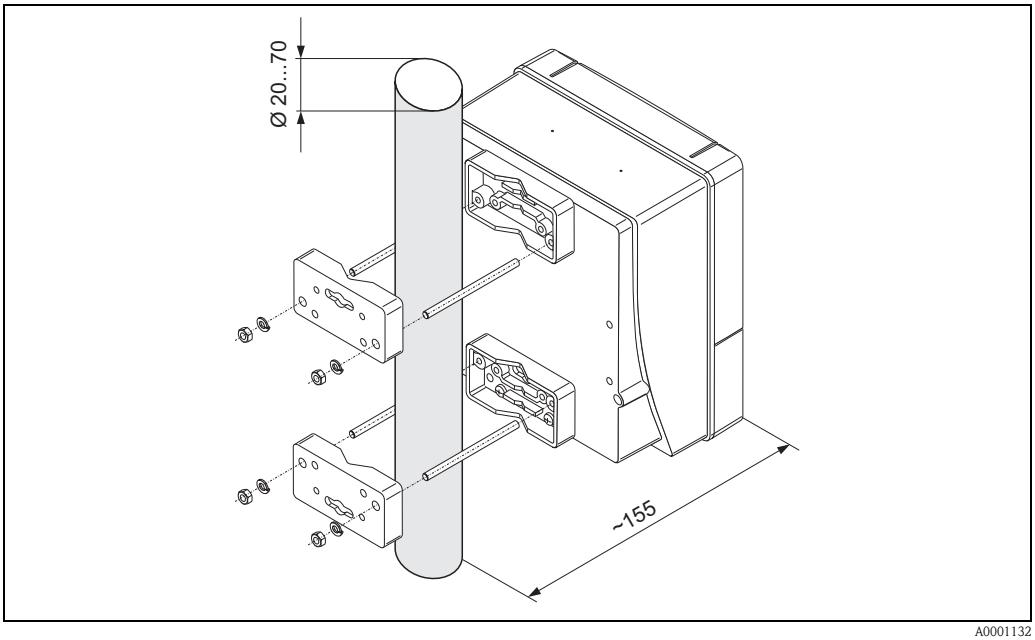


Fig. 32: Pipe mounting (wall-mount housing)

3.4 Post-installation check

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

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Does the device correspond to specifications at the measuring point, including process temperature, ambient temperature, measuring range, etc.?	see Page 117 ff.
Installation	Notes
Are the measuring point number and labeling correct (visual inspection)?	–
Process environment / process conditions	Notes
Are the inlet and outlet runs respected?	see Page 15, 16
Is the measuring device protected against moisture and direct sunlight?	–

4 Wiring

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

4.1 Cable specifications for PROFIBUS PA

Cable type
Twin-core cables are required for connecting the device to the fieldbus. By analogy with IEC 61158-2 (MBP) protocol four different cable types (A, B, C, D) can be used with the fieldbus protocol, only two of which (cable types A and B) are shielded.
- Cable types A or B are particularly preferable for new installations. Only these types have cable shielding that guarantees adequate protection from electromagnetic interference and thus the most reliable data transfer. On multi-pair cables (type B), it is permissible to operate multiple fieldbuses (with the same degree of protection) on one cable. No other circuits are permissible in the same cable.
- Practical experience has shown that cable types C and D should not be used due to the lack of shielding, since the freedom from interference generally does not meet the requirements described in the standard.

The electrical data of the fieldbus cable have not been specified but determine important characteristics of the design of the fieldbus, such as distances bridged, number of users, electromagnetic compatibility, etc.

	Cable type A	**Cable type B**
Cable structure	twisted pair, shielded	one or more twisted pairs, fully shielded
Wire size	0.8 mm^2 (AWG 18)	0.32 mm^2 (AWG 22)
Loop-resistance (DC)	44 Ω/km	112 Ω/km
Impedance at 31.25 kHz	100 Ω ± 20%	100 Ω ± 30%
Attenuation at 39 kHz	3 dB/km	5 dB/km
Capacitive asymmetry	2 nF/km	2 nF/km
Envelope delay distortion (7.9...39 kHz)	1.7 µs/km	*
Shield coverage	90%	*
Max. cable length (inc. spurs >1 m)	1900 m	1200 m
* not specified		

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

Maximum overall cable length
The maximum network expansion depends on the type of explosion protection and the cable specifications. The overall cable length is made up of the length of the main cable and the length of all spurs (>1 m). Note the following points:
- The maximum permissible overall cable length depends on the cable type used.

Type A	1900 m
Type B	1200 m

- If repeaters are used the maximum permissible cable length is doubled.
  A maximum of four repeaters are permitted between station and master.

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

Number of spurs	1...12	13...14	15...18	19...24	25...32
Max. length per spur	120 m	90 m	60 m	30 m	1 m

Number of field devices
In systems that meet FISCO in the EEx ia type of protection, the line length is limited a max. of 1000 m.
A maximum of 32 users per segment in non Ex-areas or a maximum of approximately 10 stations in an Ex-area (EEx ia IIC) are possible. The actual number of stations must be determined during the project planning.

Bus termination
The start and end of each fieldbus segment are always to be terminated with a bus terminator. With various junction boxes (non Ex) the bus termination can be activated via a switch. If this is not the case a separate bus terminator must be installed. Note the following points in addition:
- In the case of a branched bus segment, the device furthest from the segment coupler represents the end of the bus.
- If the fieldbus is extended with a repeater then the extension must also be terminated at both ends.

Shielding and grounding (PROFIBUS PA)
When planning the shielding and grounding for a fieldbus system, there are three important points to consider:
- Electromagnetic compatibility (EMC)
- Explosion protection
- Safety of the personnel

To ensure the optimum electromagnetic compatibility of systems, it is important that the system components and above all the cables, which connect the components, are shielded and that no portion of the system is unshielded.
Ideally, the cable shields will be connected to the field devices' housings, which are usually metal. Since these housings are generally connected to the protective earth, the shield of the bus cable will thus be grounded many times.
This approach, which provides the best electromagnetic compatibility and personnel safety, can be used without restriction in systems with good potential equalisation.
In the case of systems without potential equalisation, a mains frequency (50 Hz) equalising current can flow between two grounding points which, in unfavorable cases, e.g. when it exceeds the permissible shield current, may destroy the cable.

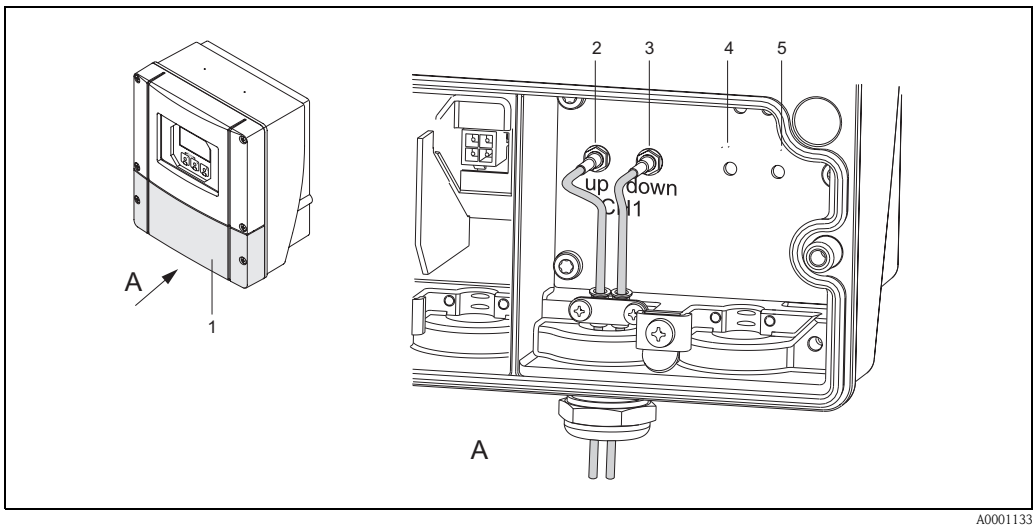
To suppress the low frequency equalising currents on systems without potential equalisation, it is therefore recommended to connect the cable shield directly to the building ground (or protective earth) at one end only and to use capacitive coupling to connect it to all other grounding points.

Further information
General information and further notes regarding the wiring can be found in the BA 198F/00/en "Field Communication – PROFIBUS DP/PA: Guidelines for planning and commissioning".

4.2 Connection of the sensor connecting cable

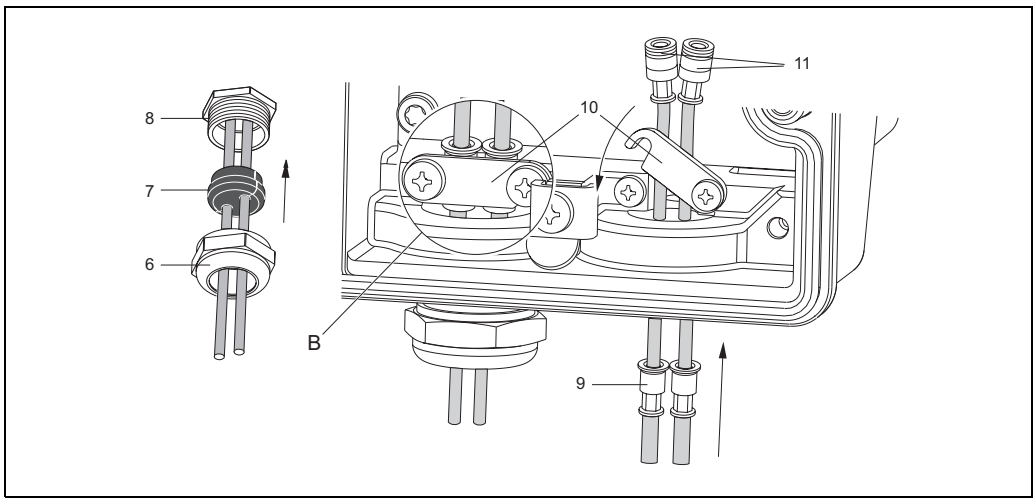
4.2.1 Connection of Prosonic Flow W/P/U

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.



A0001133

Fig. 33: Connecting the measuring system



A0001134

Fig. 34: Connection of the sensor connecting cable (Prosonic Flow 93 is shown for clarification purposes)

A View A
B Detail B
1 Connection compartment cover
2 Channel 1 sensor cable plug, upstream
3 Channel 1 sensor cable plug, downstream
4 Cable entry (not required)
5 Cable entry (not required)
6 Cable gland cover
7 Rubber seal
8 Cable gland holder
9 Cable fixing sleeves
10 Earth contact terminals
11 Sensor cable plug

Procedure:

1. Transmitter: Loosen the screws and remove the cover (1) from the connection compartment.
2. Remove the blank cover for the cable entries.
3. Disassemble the special cable entry which is supplied with the sensors. Run both sensor connection cables through the cover of the cable gland (6) and into the connection compartment.
4. Position the cable fixing sleeves (9) of both sensor cables exactly next to each other (Detail B). Push in the earth contact terminals (10) and screw tight. This ensures perfect grounding.
5. Spread the rubber seal (7) along the side slit with a suitable tool (e.g. a large screwdriver) so that both sensor cables can be fixed into place. Push up the rubber seal in the cable gland holder (8). Close the cover of the cable gland (6) so that it is tight.
6. Plug in the sensor cable plugs (11) in the way shown in Fig. 33.
7. Transmitter: Secure cover (1) on the connection compartment.

4.2.2 Cable specifications

Sensor cable:
- Use the ready-to-use cables supplied by Endress+Hauser with each sensor pair.
- The cables are available in lengths of 5 m, 10 m, 15 m and 30 m.
- You can choose between PTFE and PVC cable materials.

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1 (IEC 1326) “Emission to class A requirements” and NAMUR Recommendation NE 21.

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing.

4.3 Connecting the measuring unit

4.3.1 Connecting the 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 terminal on the housing before the power supply is applied (not necessary if the power supply is galvanically isolated).
- Compare the specifications on the nameplate with the local supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and PROFIBUS cable (b) through the appropriate cable entries.

   ✎ Note!
   Prosonic Flow 90 can also be supplied with the option of a ready-mounted fieldbus connector. More information on this can be found on Page 42.
3. Wiring:
   – Wiring diagram (wall-mount housing) → Fig. 35
   – Terminal assignment → Page 41

   ☝ Caution!
   – The PROFIBUS cable can be damaged!
     If the shielding of the cable is grounded at more than one point in systems without additional potential equalisation, network frequency equalisation currents can occur that damage the cable or the shielding.
     In such cases the shielding of the cable is to be grounded on only one side, i.e. it must not be connected to the ground terminal of the housing. The shield that is not connected should be insulated!
   – We recommend that the PROFIBUS not be looped using conventional cable glands. If you later replace even just one measuring device, the bus communication will have to be interrupted.

   ✎ Note!
   – The terminals for the PROFIBUS PA connection (26/27) have an integral reverse polarity protection. This ensures correct signal transmission via the fieldbus even if lines are confused.
   – Conductor cross-section: max. 2.5 mm^2
   – Observe the grounding concept.
   – PROFIBUS PA connection values:
     V_i = 30 V AC; I_i = 500 mA; P_i = 5.5 W; L_i = 10.0 µH; C_i = 5.0 nF
4. Screw the cover of the connection compartment (f) firmly back onto the transmitter housing.

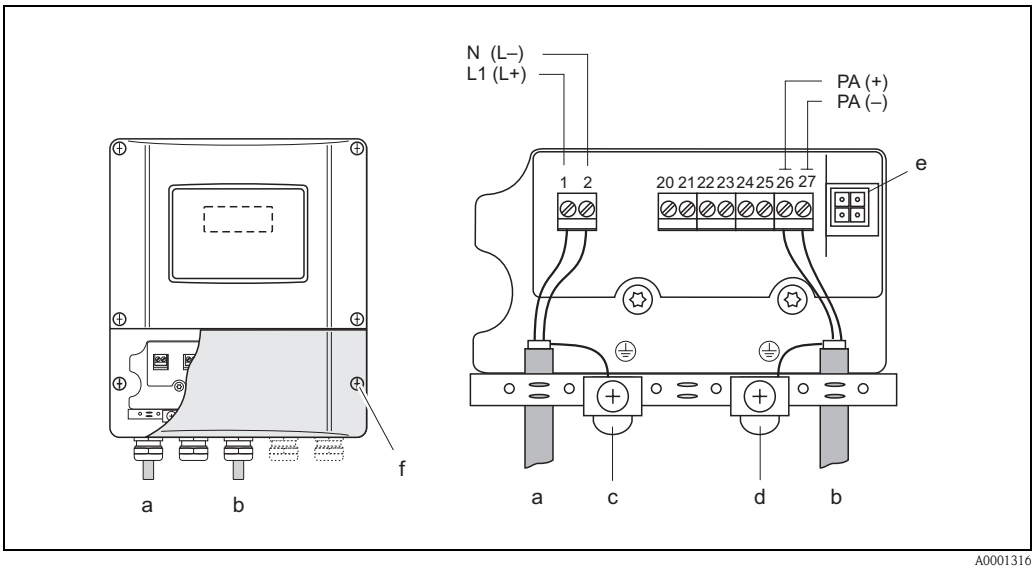


Fig. 35: Connecting the transmitter (wall-mount housing). Conductor cross-section: max. 2.5 mm²

a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC;*
*Terminal **No. 2**: N for AC, L– for DC*
b PROFIBUS PA line:
*Terminals **No. 26: PA**+*
*Terminals **No. 27: PA**–*
c Ground terminal for protective earth
d Ground terminal for signal-cable shield
e Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)
f Cover of the connection compartment

4.3.2 Terminal assignment

Order variant	**Terminals No. (outputs/inputs)** **26**: PA+ **27**: PA–
90***-**********H	PROFIBUS PA (non Ex)
Connection values PROFIBUS PA	
PROFIBUS PA: V_i = 30 V AC, I_i = 500 mA, P_i = 5.5 W, L_i = 10.0 µH, C_i = 5.0 nF	

4.3.3 Fieldbus connector

The connection technology of PROFIBUS PA allows measuring devices to be connected to the fieldbus via uniform mechanical connections such as T-boxes, junction boxes, etc. This connection technology using prefabricated distribution modules and plug-in connectors offers substantial advantages over conventional wiring:

- Field devices can be removed, replaced or added at any time during normal operation. The communications will not be interrupted.
- This simplifies installation and maintenance significantly.
- Existing cable infrastructures can be used and expanded instantly, e.g. when constructing new star distributors using 4-channel or 8-channel junction boxes.

Prosonic Flow 90 can therefore be supplied with the option of a ready-mounted fieldbus connector. Fieldbus connectors for retrofitting can be ordered from Endress+Hauser as a spare part (please contact your Endress+Hauser service centre).

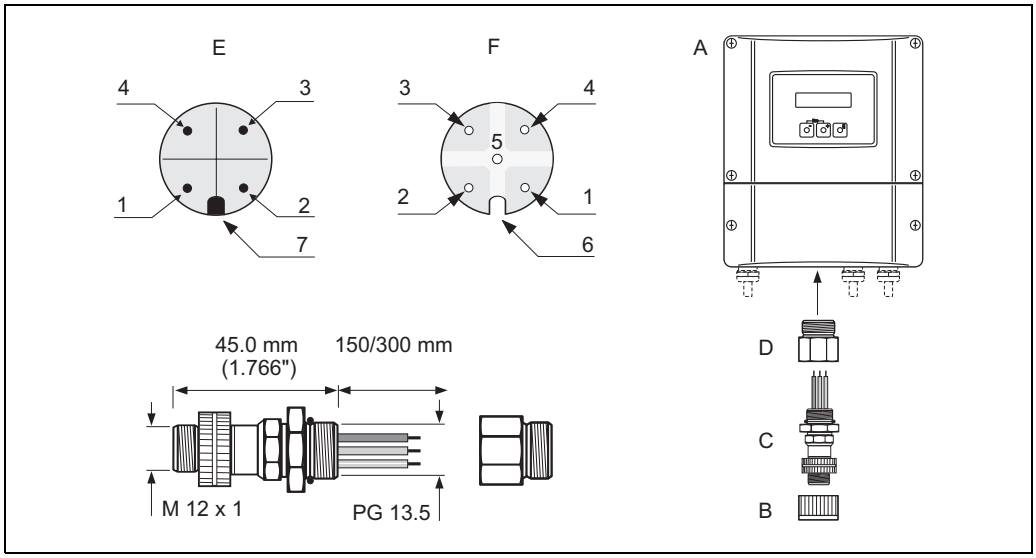


Fig. 36: Connectors for connecting to the PROFIBUS PA

A = Wall-mount housing
B = Protection cap for connector
C = Fieldbus connector
D = Adapter PG 13.5 / M 20.5
E = Connector on housing (male)
F = Connector (female)

Pin assignment / colour codes:
1 = Brown wire: PA+ (terminal 26)
2 = Not connected
3 = Blue wire: PA – (terminal 27)
4 = Black wire: ground (notes on connection see Page 41)
5 = Female connector in centre not assigned
6 = Positioning groove
7 = Positioning key

Technical data (connector):

Connection cross section	0.75 mm^2
Connector thread	PG 13.5
Degree of protection	IP 67 in accordance with DIN 40 050 IEC 529
Contact surface	CuZnAu
Housing material	Cu Zn, surface Ni
Flammability	V - 2 in accordance with UL - 94
Operating temperature	–40...+85 °C
Ambient temperature	–40...+150 °C
Nominal current per contact	3 A
Nominal voltage	125...150 V DC in accordance with the VDE standard 01 10/ISO Group 10
Resistance to tracking	KC 600
Volume resistance	≤8 Ωm in accordance with IEC 512 Part 2
Insulation resistance	$\leq 10^{12}$ Ω in accordance with IEC 512 Part 2

4.4 Potential equalisation

For potential equalisation no special measures are necessary.

Note!
For instruments for use in hazardous areas, observe the corresponding guidelines in the specific Ex documentation.

4.5 Degree of protection

Transmitter (wallmount housing)
The transmitter fulfills all the requirements for IP 67 degree of protection. Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 degree of 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 threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter (see Page 118).
- Firmly tighten the cable entries (Fig. 37).
- Remove all unused cable entries and insert dummy plugs instead.
- Do not remove the grommet from the cable entry.

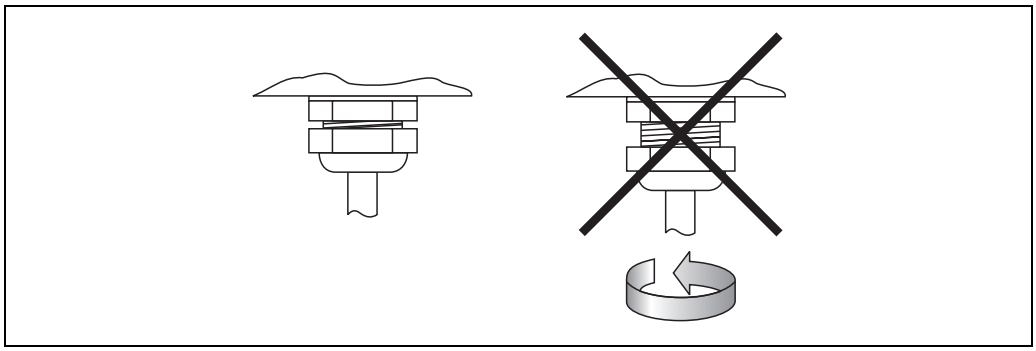


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Fig. 37: Installation instructions for cable entries on the transmitter housing

Flowrate measuring sensors W/P (clamp-on / insertion)
The flowrate measuring sensors W/P fulfill all the requirements for IP 67 or IP 68 degree of protection (please observe the informations 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 degree of 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.

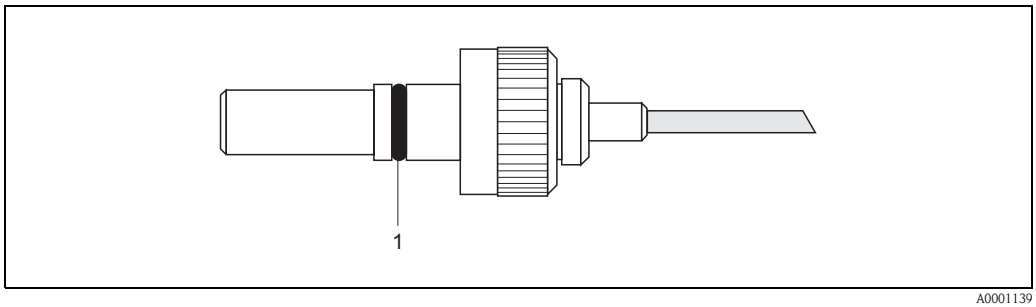

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Fig. 38: Installation instructions for IP 67/68 degree of protection for sensor connectors

Flowrate measuring sensors U (clamp-on)
The flowrate measuring sensors U fulfill all the requirements for IP 54 degree of protection. Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 54 protection is maintained:

- Only use cables supplied by Endress+Hauser with the corresponding sensor connectors.
- The BNC cable connectors (1) must be clean, dry and undamaged.
- Insert the BNC cable connectors (1), do not cant and then tighten them to the stop.

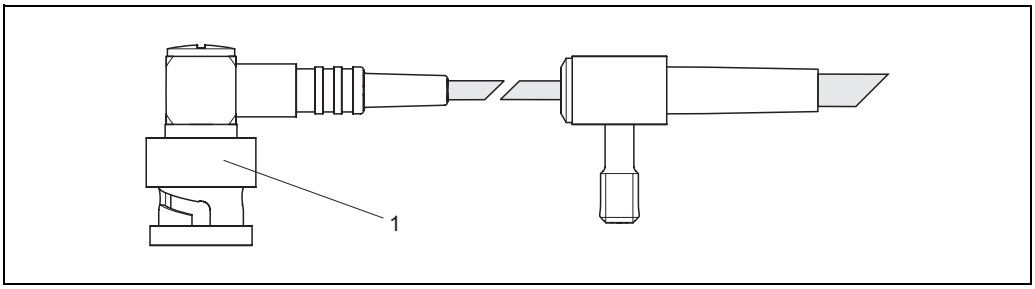


Fig. 39: Installation instructions for IP 54 degree of protection for BNC sensor connectors

4.6 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...260 V AC (45...65 Hz) 20...55 V AC (45...65 Hz) 16...62 V DC
Do the cables comply with the specifications?	PROFIBUS PA → Page 35 Sensor cables → Page 39, 118
Do the cables have adequate strain relief?	–
Are the cables correctly segregated by type? Without loops and crossovers?	–
Are the power supply and sensor 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 equalisation been correctly implemented?	see Page 43 ff.
Are all cable entries installed, firmly tightened and correctly sealed?	see Page 44
Are all the housing covers installed and firmly tightened?	–
Electrical connection - PROFIBUS PA	Notes
Are all the connecting components (T-boxes, junction boxes, connectors, etc.) connected with each other correctly?	–
Has each fieldbus segment been terminated at both ends with a bus terminator?	–
Has the max. length of the fieldbus cable been observed in accordance with the PROFIBUS specifications?	see Page 35
Has the max. length of the spurs been observed in accordance with the PROFIBUS specifications?	see Page 36
Is the fieldbus cable fully shielded and correctly grounded?	see Page 36

5 Operation

5.1 Quick operation guide

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

1. Local operation (optional) → Page 49
The local operation enables you to read the important parameters directly at the measuring point, configure device-specific parameters in the field and commission the instrument.

2. Configuration programs → Page 55
The configuration of profile and device-specific parameters is primarily done via the PROFIBUS PA interface. You can obtain special configuration and operating programs from the various manufacturers for these purposes.

3. Jumpers and miniature switches (for hardware settings) → Page 66
You can make the following hardware settings for the PROFIBUS PA using jumpers or miniature switches on the I/O board:
- Set the device bus address
- Switch the hardware write protection on/off

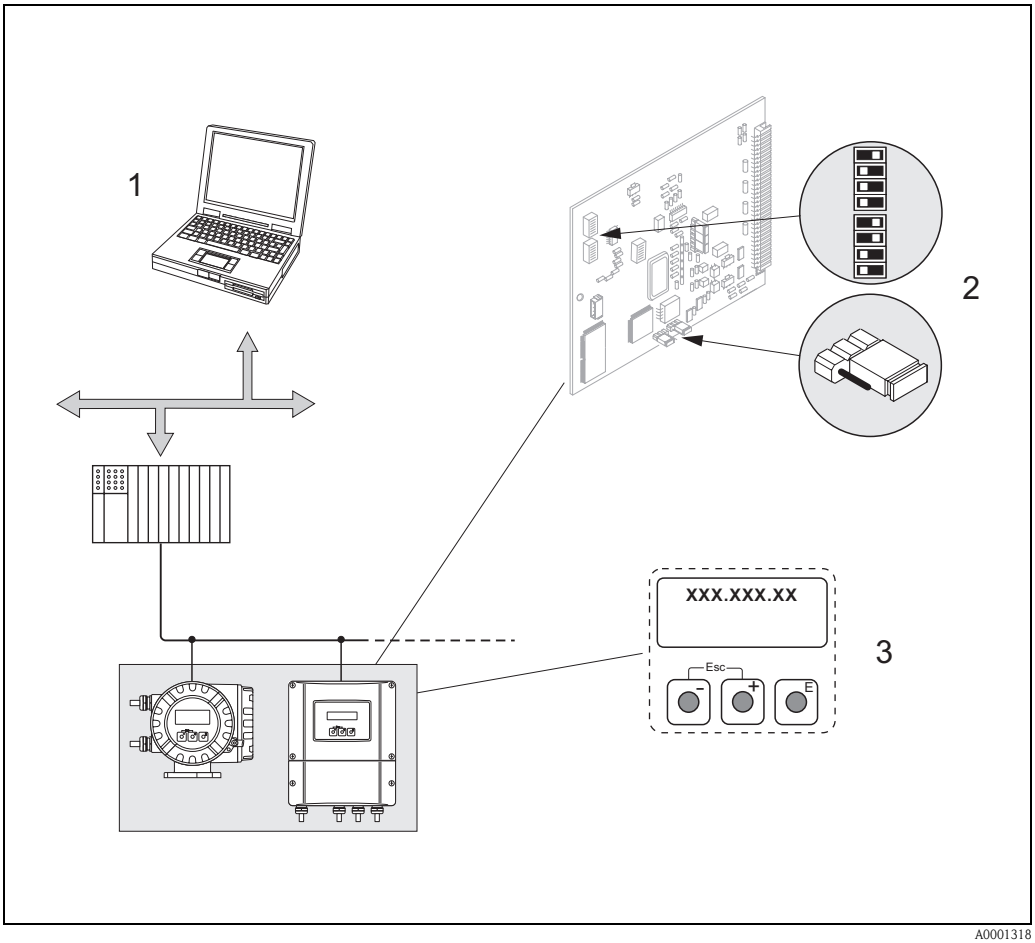


Fig. 40: Options for operating the Prosonic Flow 90 PROFIBUS PA

1 Configuration / operation programs for operating the device via the PROFIBUS PA
2 Jumpers or miniature switch for hardware settings (write protection, device address)
3 Local operation for the operation of the device in the field (optional)

5.2 Display and operating elements

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

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

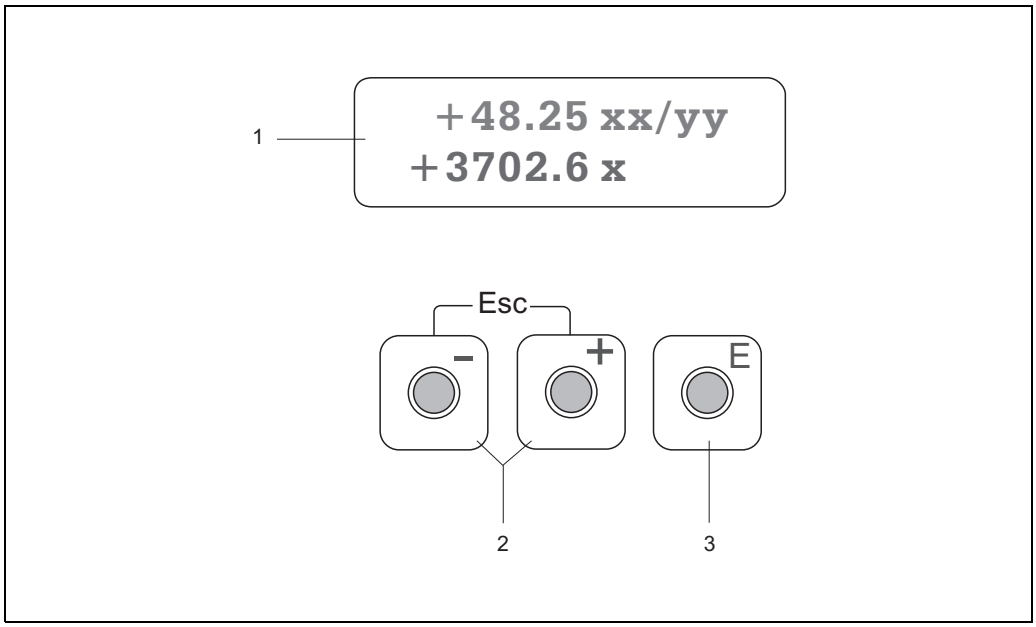


Fig. 41: Display and operating elements

Liquid crystal display (1)
The backlit, two-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. The display as it appears during standard measuring mode is known as the HOME position (operating mode).
- *Top line: shows main measured values, e.g. volume flow in [m³/h] or in [%].*
- *Bottom line: shows additional measured variables and status variables, e.g. totalizer reading in [m³], bar graph representation, tag name.*

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

The following functions are triggered by pressing the [+] [–] keys simultaneously:
- *Exit the function matrix step by step → HOME position*
- *Press and hold down [+] [–] keys for longer than 3 seconds → Return directly to the HOME position*
- *Cancel data entry*

Enter key (3)
- *HOME position → Entry into the function matrix*
- *Save the numerical values you input or settings you change*

5.3 Local operation / Using the function matrix

5.3.1 Brief guide to the function matrix

Note!
- See the general notes on Page 50.
- Function descriptions → "Description of Device Functions" manual.

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

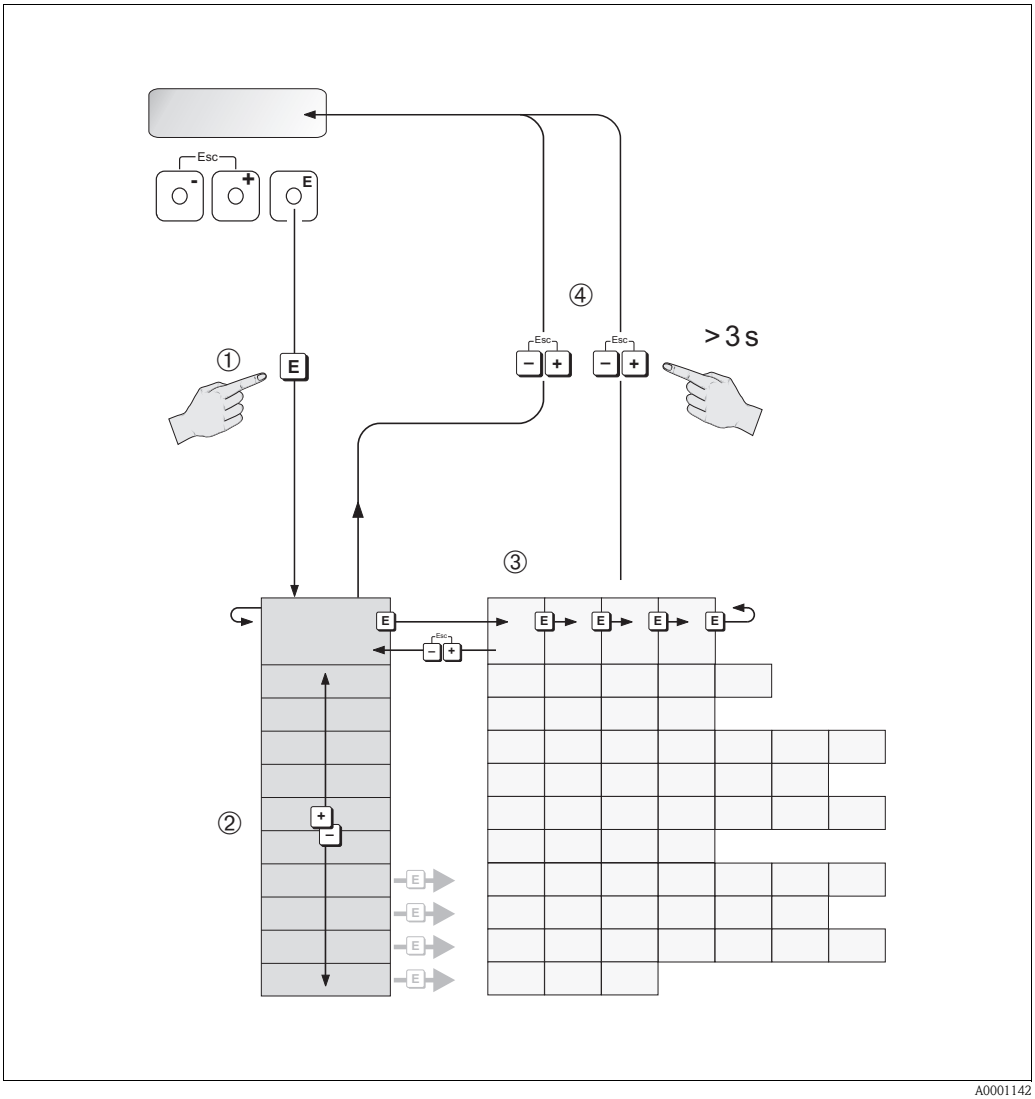


Fig. 42: Selecting functions and configuring parameters (function matrix)

5.3.2 General notes

The "Commisioning" Quick Setup menu (see Page 71) is adequate for commissioning with the necessary standard settings. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customise to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on Page 49.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press ⊞ to select "SURE [YES]" and press E again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

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 parameterised values remain safely stored in the EEPROM.

Caution!
All functions are described in detail, including the function matrix itself, in the **"Description of Device Functions"** manual which is a separate part of these Operating Instructions!

5.3.3 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 = 90) has to be entered before settings can be changed. If you use a code number of your choice, you exclude the possibility of unauthorised persons accessing data (→ see "Description of Device Functions" manual).

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

Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy.
There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the Endress+Hauser service organisation.
Please contact Endress+Hauser if you have any questions.

5.3.4 Disabling the programming mode

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

5.4 Error messages

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

- *System error:* This group comprises all device errors, e.g. communication errors, hardware errors, etc. → Page 103 ff.
- *Process error:* This group comprises all application errors, e.g. "measuring range exceeded" etc. → Page 103 ff.

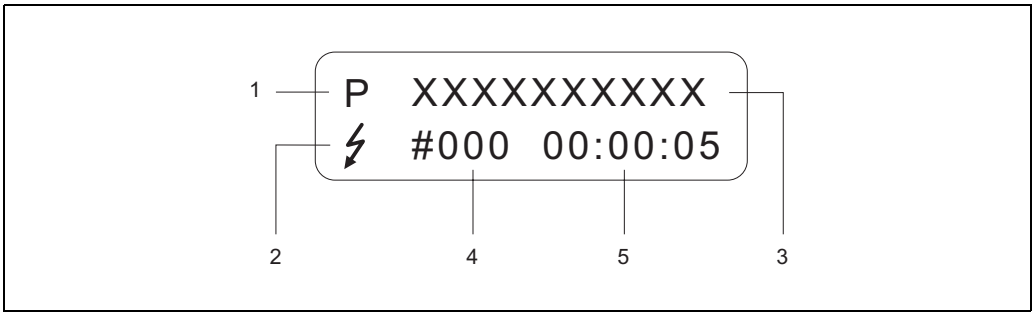


Fig. 43: Error messages on the display (example)

1 Error type: P = Process error, S = System error
2 Error message type: $ = Fault message, ! = Notice message
3 Error designation: e.g. S.VELOC RANGE = Sound velocity outside the measuring range
4 Error number: e.g. #491
5 Duration of most recent error occurrence (in hours, minutes and seconds)

Type of error message
System and process errors are always assigned to two types of error messages (fault and notice messages) and have different weightings → Page 103 ff.
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)
- The error in question has no effect on measurement currently in progress.
- Displayed as → Exclamation mark (!), error group (S: system error, P: process error).
- PROFIBUS → Errors of this type are registered in the manufacturer-specific Transducer Block with the status "UNC(ERTAIN)" for the process variable in question.

Fault message (ϟ)
- The error in question interrupts or stops the measurement currently in progress.
- Displayed as → Lightning flash (ϟ), error designation (S: system error, P: process error)
- PROFIBUS → Errors of this type are registered in the manufacturer-specific Transducer Block with the status "BAD" for the process variable in question.

5.5 Communication: PROFIBUS PA

5.5.1 PROFIBUS PA technology

PROFIBUS (Process Fieldbus) is a standardised bus system based on the European standard EN 50170, Volume 2, which has been successfully used for many years in production and process automation (chemical industry and process engineering).
The PROFIBUS is a multi-master bus system with high performance, which is particularly suitable for medium to large plants.

PROFIBUS PA
PROFIBUS PA expands the PROFIBUS DP by using an optimised transmission technology for field devices while retaining the communication functions of the PROFIBUS DP. With the selected transmission technology, field devices can be connected via the PROFIBUS PA to the automation system over great distances, even in hazardous areas. PROFIBUS PA is the communications compatible extension of PROFIBUS DP.

PROFIBUS PA = PROFIBUS DP + optimised transmission technology for field devices

5.5.2 System architecture

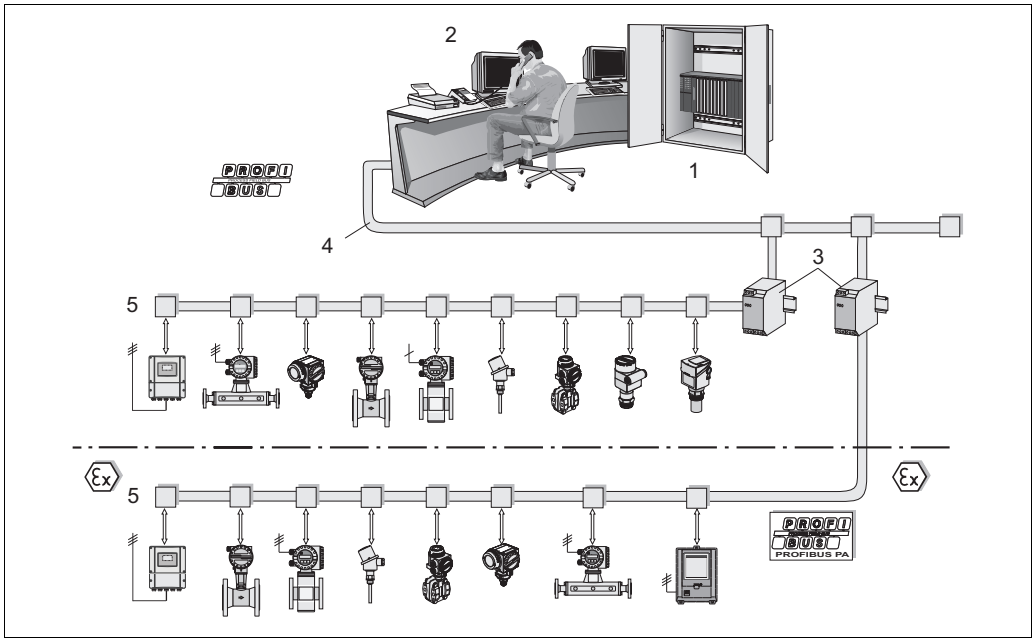


Fig. 44: System architecture PROFIBUS PA

1 Automation system
2 Commuwin II operating program
3 Segment coupler
4 PROFIBUS DP RS 485 (max. 12 MBit/s)
5 PROFIBUS PA IEC 61158-2 (MBP) (max. 31.25 kbit/s)

General information
Prosonic Flow 90 can be equipped with a PROFIBUS PA interface in accordance with the fieldbus standard PROFIBUS DP (EN 50170 Volume 2).
As a consequence, Prosonic Flow 90 can exchange data with automation systems which satisfy this standard. The integration in a control system must be in accordance with the PROFIBUS PA Profile 3.0 Specifications.
The selection of the international IEC 61158-2 (MBP) (International Electrotechnical Commission) transmission standard ensures a future-proof field installation with PROFIBUS PA.

Communications partner
In a control system, the instrument always serves as a slave and can thus, depending on the type of application, exchange data with one or more masters.
The master can be a process control system, a PLC or a PC with a PROFIBUS DP communications adapter card.

Note!
During project planning, please remember that the Prosonic Flow 90 consumes 11 mA.

Caution!
To prevent severe device failures (e.g. short-circuits) from having effect on the PROFIBUS PA segment, the IEC 61158-2 (MBP) interface is equipped with a fuse. If the fuse blows, the device is permanently disconnected from the bus. In this case, the I/O module must be replaced (see Page 111 ff.).

Project planning
For additional project planning information about the PROFIBUS PA fieldbus, see the Operating Instructions BA 198F/00/en “Field Communication - PROFIBUS DP/PA: Guidelines for planning and commissioning”.

Function blocks
The PROFIBUS uses predefined function blocks to describe the function blocks of a device and to specify uniform data access.
The function blocks implemented in the fieldbus devices provide information on the tasks which a device can perform as part of the whole automation strategy.
The following blocks can be implemented in field devices in accordance with Profile 3.0:
- Physical Block:
  The Physical Block comprises all device-specific characteristics.
- Transducer Block (transmission block):
  One or more Transducer Blocks comprise all the device's measurement-related and device-specific parameters. The measuring principles (e.g. flow rate) are mapped in the Transducer Blocks in accordance with the PROFIBUS Specification.
- Function block:
  One or more function blocks comprise the device's automation functions. We distinguish between different function blocks, e.g. Analog Input Block, Analog Output Block, Totalizer Block, etc. Each of these function blocks is used to process different applications.

More information is provided in the “Description of Device Functions” manual.

5.5.3 Acyclic data exchange

The acyclic data transmission is used to transfer parameters during the commissioning, during maintenance or to display other measured variables that are not contained in the cyclic data traffic.

Generally, a distinction is made between Class 1 and Class 2 master connections.
Depending on the implementation of the field device, it is possible to simultaneously establish several Class 2 connections.

- Theoretically, a maximum of 49 Class 2 connections can be established to the same field device.
- Two Class 2 masters are permitted with Prosonic Flow 90. This means that two Class 2 masters can access Prosonic Flow 90 at the same time. However, you must make certain that they do not both attempt to write the same data, since otherwise the data consistency cannot be guaranteed.
- When a Class 2 master reads parameters, it will send an interrogation telegram to the field device specifying the field device address, the slot index and the expected data record length. The field device will answer with the requested data record, if the data record exists and is the correct length (byte).
- When a Class 2 master writes parameters, it will send the address of the field device, the slot index, record length (byte) and the data record. The field device will acknowledge this write job after completion.

A Class 2 master can access the blocks that are shown in the illustration below.
The parameters which can be operated by the Endress+Hauser operating program (Commuwin II) are shown on Page 57 ff. in the form of a matrix.

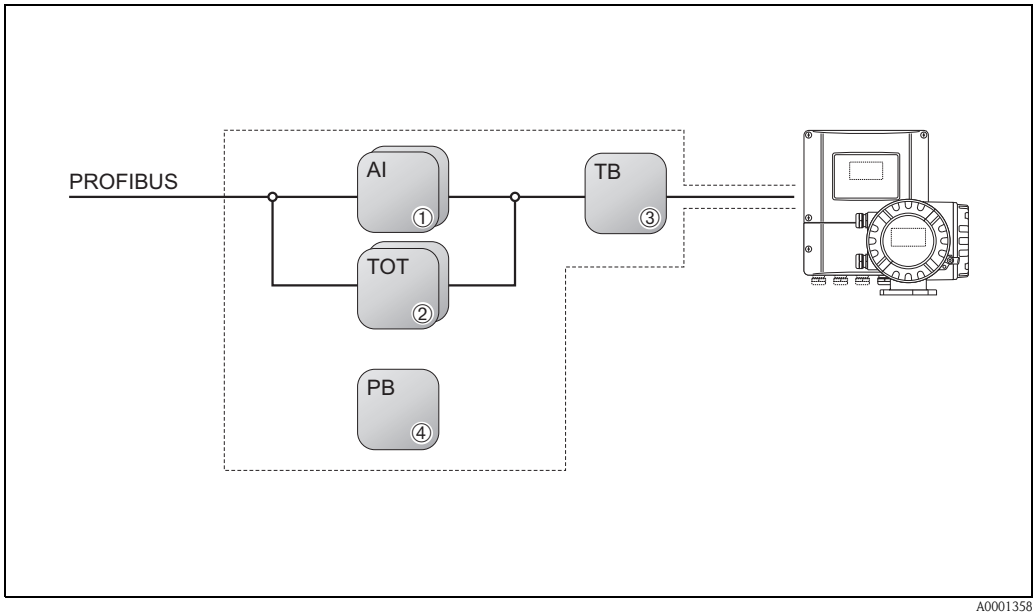


Fig. 45: Function block model for the Prosonic Flow PROFIBUS PA

Automation control system:
AI = Function Block
TOT = Totalizer Function Block
PB = Physical Block
TB = Transducer Block

5.6 PROFIBUS PA communication

For project planning information on the PROFIBUS PA fieldbus, see Operating Instructions BA 198F/00/en “Field Communication – PROFIBUS-DP/-PA: “Guidelines for planning and commissioning”.

5.7 Operation via PROFIBUS configuration programs

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

✎ Note!
A detailed step-by-step description of the procedure for commissioning the PROFIBUS interface is given on Page 70 together with information on configuring device-specific parameters.

Further information is provided in the System Information: SI 031D/06/en “Fieldtool”

Information on acyclic data exchange can be found on Page 95.

5.7.1 Operating program “ToF Tool – Fieldtool Package”

Modular software package consisting of the “ToF Tool” service program for the configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and the “ToF Tool – Fieldtool Package” service program for the configuration and diagnosis of Proline flowmeters. The Proline flowmeters are accessed via a service interface or the FXA 193 service interface.

Contents of the “ToF Tool – Fieldtool Package”:
- Commissioning, maintenance analysis
- Measuring device configuration
- Service functions
- Visualisation of process data
- Trouble-shooting
- Controlling the "Fieldcheck" tester/simulator

Program download: www.ToF-FieldTool.endress.com

5.7.2 “Fieldcare” operating program

Fieldcare is Endress+Hauser’s FDT-based device asset management toolset. It can configure all intelligent field devices in your system and helps you manage them. By using status information, you also have a simple and effective tool for monitoring devices.

For further information, visit www.endress.com

5.7.3 Operating program “SIMATIC PDM” (Siemens)

SIMATIC PDM is a vendor-independent tool for operating, configuring, maintaining and diagnosing intelligent field devices.

For further information, visit www.endress.com

5.7.4 Current device description files

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

PROFIBUS-PA-protocol (IEC 61158-2 (MBP)):

Valid for software:	2.03.XX	→Function "Device software"
Device data PROFIBUS-PA		
Profile version:	3.0	→ Function "Device ID"
Device ID:	$152F_{hex}$	
Profile ID:	9741_{hex}	
GSD Informationen:		
Manufacturer-specific GSD:	Extented	eh3x152F.gsd
	Standard	eh3_152F.gsd
Profil GSD:	PA139742.gsd	
Bitmaps:	EH_152F_d.bmp/.dib EH_152F_n.bmp/.dib EH_152F_s.bmp/.dib	
Software release:	11.2004	

Operating program/device driver:	**Sources for obtaining device descriptions/program updates:**
GSD	■ www.endress.com (→ Download → Software → Device driver) ■ www.profibus.com ■ CD-ROM (Endress+Hauser order number 56003894)
Fieldcare / DTM	■ www.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 56004088)
SIMATIC PDM	■ www.endress.com (→ Download → Software → Device driver) ■ www.feldgeraete.de
ToF Tool - Fieldtool Package (Operation via the service protocol)	■ www.tof-fieldtool.endress.com ■ Update CD-ROM (Endress+Hauser order number 50099820)

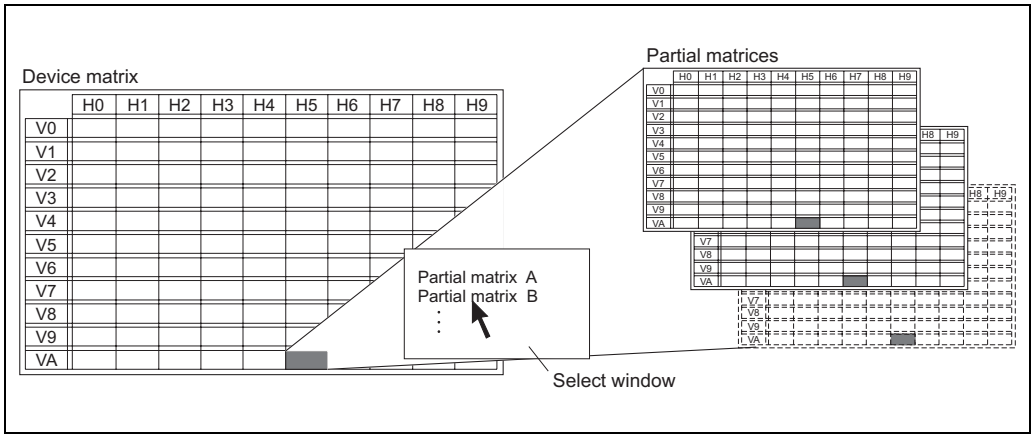
Tester/simulator:	**Sources for obtaining device descriptions:**
Fieldcheck	■ Update by means of ToF Tool - Fieldtool Package via Fieldflash module

5.7.5 Commuwin II operating program

Commuwin II is a program for remote operation of field and control-room equipment. Commuwin II can be used irrespective of the device type and the mode of communication (HART or PROFIBUS standard).

Note!
You can find more information on Commuwin II in the following Endress+Hauser documents:
- System information: SI 018F/00/en “Commuwin II”
- Operating Instructions: BA 124F/00/en “Commuwin II” operating program
- An exact description of the data types can be found in the slot/index lists in the “Description of Device Functions” manual.

All of Prosonic Flow 90's device functions are clearly arranged in a matrix for programming via Commuwin II. Using the MATRIX SELECTION (VAH5) function, you can call up various parts of the matrix.



A0001357-EN

Device matrix

	H0	H1	H2	H3	H4	H5	H6	H7	H8	
V0 MEASURED VARIABLES	VOLUME FLOW (Display)	SOUND VELOCITY (Display)	FLOW VELOCITY (Display)	SIGNAL STRENGTH (Display)						
V1 SYSTEM UNITS	UNIT VOLUME FLOW (Options)	UNIT VELOCITY (Options)			UNIT VISCOSITY (Options)	UNIT TEMPERATURE (Options)	UNIT LENGTH (Options)			
V2 DISPLAY	ACCESS CODE (Input)	DEFINE PRIVATE CODE (Input)	STATUS ACCESS (Display)							
V3 PROCESS PARAMETERS	ASSIGN LOW FLOW CUT OFF (Options)	ON-VALUE LOW FLOW CUT OFF (Input)	OFF-VALUE LOW FLOW CUT OFF (Input)							
V4 PIPE DATA	PIPE STANDARD (Options)	NOMINAL DIAME-TER (Options)	PIPE MATERIAL (Options)		SOUND VELOCITY PIPE (Input)	CIRCUMFERENCE (Input)	PIPE DIAMETER (Input)	WALL THICKNESS (Input)	LINER MATERIAL (Options)	
V5 PIPE ADJUSTMENT	ZEROPOINT ADJUST (Options)	SOUND VELOCITY LINER (Input)	LINER THICKNESS (Options)							
V6 PROFIBUS-PA	WRITE PROTECT (Display)	SELECTION GSD (Options)	SET UNIT TO BUS (Input)	BLOCK SELECTION (Options)	OUT VALUE (Display)	OUT STATUS (Display)	DISPLAY VALUE (Display)	DISPLAY VALUE STATUS (Display)	CYCL. CALC. TOT (Options)	
V7 PROFIBUS INFO	FIELDBUS ADDRESS (Display)	PROFILE VERSION (Display)	ACTUAL BAUDRATE (Display)	DEVICE ID (Display)	CHECK CONFIG (Display)					
V8 SYSTEM PARAME-TERS	MEASURING MODE (Options)	INST. DIR. SENSOR (Options)	FLOW DAMPING (Input)	POSITIVE ZERO RETURN (Input)						
V9 LIQUID DATA	LIQUID (Options)	TEMPERATURE (Input)	SOUND VELOCITY (Input)	VISCOSITY (Input)	SOUND VELOCITY NEGATIVE (Input)	SOUND VELOCITY POSITIVE (Input)				
VA MEASURING POINT	TAG NAME (Input)					MATRIX SELECTION (Options)	DEVICE NAME (Display)			

Sensor data (partial matrix)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0										
V1										
V2 DISPLAY	ACCESS CODE (Input)	DEFINE PRIVATE CODE (Input)	STATUS ACCESS (Display)							
V3 SENSOR PARAME-TERS	MEASUREMENT (Options)	SENSOR TYPE (Options)	SENSOR CONFIG. (Options)	CABLE LENGTH (Options)	POSITION SENSOR (Display)	WIRE LENGTH (Display)	SENSOR DISTANCE (Display)		PATH LENGTH (Display)	
V4 CALIBRATION DATA	CALIB. FACTOR (Input)	ZERO POINT (Input)		CORR. FACTOR (Input)	DEV. SENSOR DIST. (Input)		DEV. PATH LENGTH (Input)			
V5										
V6										
V7										
V8										
V9										
VA MEASURING POINT	TAG NAME (Input)					MATRIX SELECTION (Options)	DEVICE NAME (Display)			

Display functions (partial matrix)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0										
V1										
V2 DISPLAY	ACCESS CODE (Input)	DEFINE PRIVATE CODE (Input)	STATUS ACCESS (Display)							
V3 DISPLAY FUNCTION	LANGUAGE (Options)	DISPLAY DAMPING (Input)	CONTRAST LCD (Input)	BACKLIGHT (Input)						
V4 MAIN LINE	ASSIGN LINE 1 (Options)	100% VALUE (Input)	FORMAT (Options)							
V5										
V6 ADDITIONAL LINE	ASSIGN LINE 2 (Options)									
V7										
V8										
V9										
VA MEASURING POINT	TAG NAME (Input)					MATRIX SELECTION (Options)	DEVICE NAME (Display)			

Version info (partial matrix)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 DIAGNOSIS / ALARM	ACTUAL SYS. COND. (Display)	PREVIOUS SYS. COND. (Display)	SYSTEM RESET (Options)	ALARM DELAY (Input)	TROUBLESHOOTING (Options)					
V!										
V2 DISPLAY	ACCESS CODE (Input)	DEFINE PRIVATE CODE (Input)	STATUS ACCESS (Display)							
V3										
V4 SIMULATION	SIM. MEASURAND (Options)	VALUE SIM. MEASURAND (Input)	SIM. FAILSAFE MODE (Options)							
V5										
V6 SENSOR	SERIAL NUMBER (Display)									
V7 INFO AMPLIFIER			SW-REV. AMPLIFIER (Display)							
V8 A/E MODUL INFO	I/O TYPE (Display)			SW-REV. I/O (Display)						
V9										
VA MEASURING POINT	TAG NAME (Input)					MATRIX SELECTION (Options)	DEVICE NAME (Display)			

Physical Block (operation via profile)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 DEVICE DATA	DEVICE ID (Display)	SERIAL NUMBER (Display)	SOFTWARE VERSION (Display)	HARDWARE VERSION (Display)	MANUFACTURER ID (Display)					
V1 DESCRIPTION	DESCRIPTOR (Input)	INSTALLATION DATE (Display)	MESSAGE (Entry)	DEVICE CERTIFICATE (Display)						
V2 SOFTWRE RESET	SOFTWARE RESET (Input)									
V3 SECURITY LOCKING	WRITE LOCKING (Input)	HW WRITE PROTECTION (Options)	LOCAL OPERATION (Entry)							
V4 DEVICE DATA	IDENT NUMBER (Options)									
V5 DIAGNOSIS MASK	MASK (Display)	MASK 1 (Display)	MASK 2 (Display)	DIAG MASK EXTENS (Display)						
V6 DIAGNOSIS	DIAGNOSIS (Display)	DIAGNOSIS 1 (Display)	DIAGNOSIS 2 (Display)	DIAGNOSIS EXTENS (Display)						
V7										
V8 BLOCK MODE	TARGET MODE (Input)	ACTUAL (Display)	NORMAL (Display)	PERMITTED (Display)						
V9 ALARM CONFIG	CURRENT (Display)	DISABLE (Display)				ST REVISION (Display)				
VA BLOCK PARAMETER	TAG (Input)	STRATEGY (Input)	ALERT KEY (Entry)	PROFILE VERSION (Display)						

Transducer Block Flow (operation via profile)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 VOLUME FLOW	VOLUME FLOW (Display)	STATUS (Display)	UNIT (Options)	LOWER RANGE VAL. (Input)	UPPER RANGE VAL. (Input)					
V1										
V2										
V3										
V4 ULTRASONIC	SOUND VELOCITY (Display)	STATUS (Display)	UNIT (Options)	LOWER RANGE VAL. (Input)	UPPER RANGE VAL. (Input)					
V5										
V6										
V7 SYSTEM PARAMETER	MEASURING MODE (Options)	FLOW DIRECTION (Options)	LOW FLOW CUTOFF (Input)	ZERO POINT (Display)	ZERO POINT ADJUST (Options)	UNIT (Options)	CALIB. FACTOR (Input)	NOMINAL SIZE (Input)	UNIT (Options)	
V8 BLOCK MODE	TARGET MODE (Options)	ACTUAL (Display)	NORMAL (Display)	PERMITTED (Display)				UNIT MODE (Options)		
V9 ALARM CONFIG	CURRENT (Display)	DISABLE (Display)				ST REVISION (Display)				
VA BLOCK PARAMETER	TAG (Input)	STRATEGY (Input)	ALERT KEY (Entry)	PROFILE VERSION (Display)						

Analog Input Block (operation via profile)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 OUT	OUT VALUE (Display)	OUT STATUS (Display)	OUT STATUS (Display)	OUT SUB STATUS (Display)	OUT LIMIT (Display)		FAILSAFE ACTION (Options)	FAILSAFE VALUE (Input)		
V1 SCALING	PV SCALE MIN (Input)	PV SCALE MAX (Input)	TYPE OF LIN (Options)	OUT SCALE MIN (Input)	OUT SCALE MAX (Input)	OUT UNIT (Input)	USER UNIT (Input)	DEC POINT OUT (Input)	RISING TIME (Input)	
V2 ALARM LIMITS	ALARM HYSTERESIS (Input)									
V3 HI HI ALARM	HI HI LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V4 HI ALARM	HI LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V5 LO ALARM	LO LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V6 LO LO ALARM	LO LO LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V7 SIMULATION	SIMULATION VALUE (Input)	SIMULATION STAT. (Options)	SIMULATION MODE (Options)							
V8 BLOCK MODE	TARGET MODE (Input)	ACTUAL (Display)	NORMAL (Display)	PERMITTED (Display)		CHANNEL (Options)		UNIT MODE (Options)		
V9 ALARM CONFIG	CURRENT (Display)	DISABLE (Display)				ST REVISION (Display)				
VA BLOCK PARAMETER	TAG (Input)	STRATEGY (Input)	ALERT KEY (Entry)	PROFILE VERSION (Display)	BATCH ID (Input)	BATCH RUP (Input)	BATCH PHASE (Input)	BATCH OPERATION (Options)		

Totalizer Block (operation via profile)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9
V0 TOTALIZER	TOTAL VALUE (Display)	TOTAL STATUS (Display)	TOTAL STATUS (Display)	TOTAL SUB STATUS (Display)	TOTAL LIMIT (Display)		FAILSAFE MODE (Input)			
V1 CONFIGURATION	TOTAL UNIT (Display)	SET TOTALIZER (Options)	PRESET TOTALIZER (Input)	TOTALIZER MODE (Options)						
V2 ALARM LIMITS	ALARM_HYSTERESIS (Input)									
V3 HI HI ALARM	HI HI LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V4 HI ALARM	HI LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V5 LO ALARM	LO LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V6 LO LO ALARM	LO LO LIM (Input)	VALUE (Display)	ALARM STATE (Display)	SWITCH-ON POINT (Input)	SWITCH-OFF POINT (Input)					
V7										
V8 BLOCK MODE	TARGET MODE (Input)	ACTUAL (Display)	NORMAL (Display)	PERMITTED (Display)		CHANNEL (Input)		UNIT MODE (Options)		
V9 ALARM CONFIG	CURRENT (Display)	DISABLE (Display)				ST REVISION (Display)				
VA BLOCK PARAMETER	TAG (Input)	STRATEGY (Input)	ALERT KEY (Entry)	PRFILE VERSION (Display)	BATCH ID (Input)	BATCH RUP (Input)	BATCH PHASE (Input)	BATCH OPERATION (Options)		

5.8 Hardware configuration

5.8.1 Configuring of write protection

A jumper on the I/O board provides the means of activating or deactivating hardware write protection.

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

1. Switch off power supply.
2. Remove the I/O board → Page 111 ff.
3. Configure hardware write protection appropriately using the jumpers (Fig. 46).
4. Installation of the I/O board is the reverse of the removal procedure.

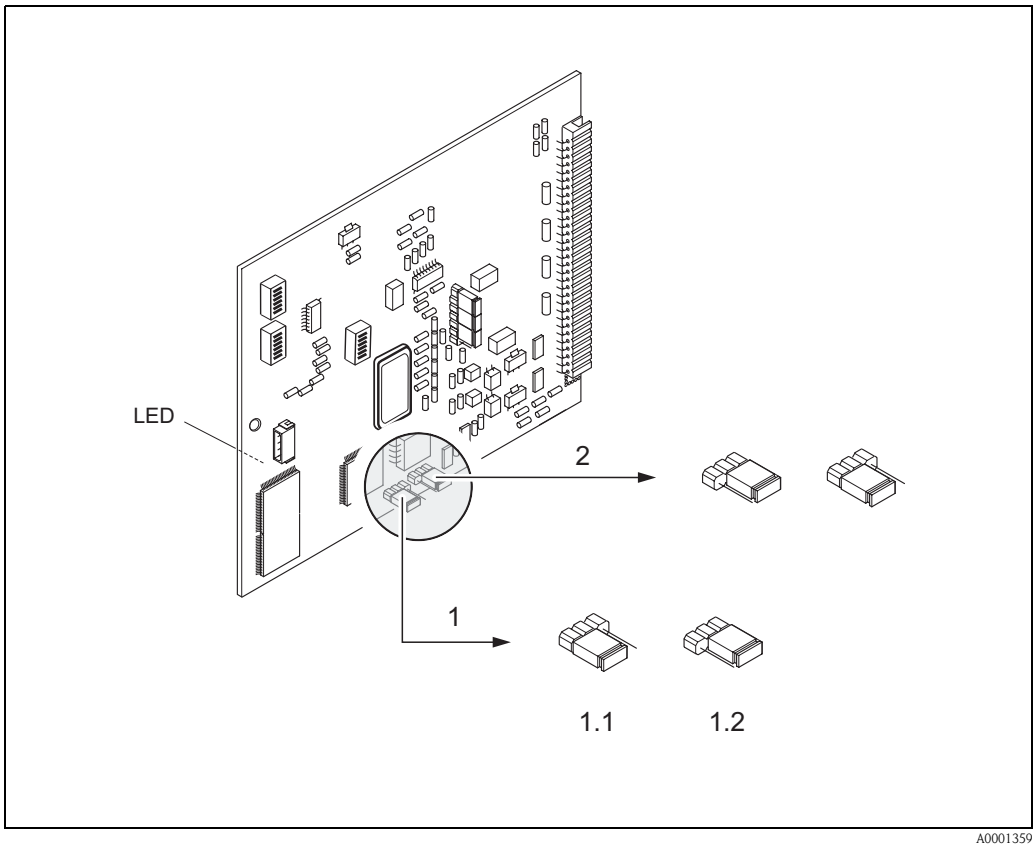


Fig. 46: Hardware configuration (I/O board)

1 Jumper 1 for hardware write protection:
1.1 Deactivated (factory setting) = Access to device parameters via PROFIBUS possible
1.2 Activated = Access to device parameters via PROFIBUS not possible
2 Jumper with no function

LED (light-emitting diode at the back of the board):
– Lit continuously → Ready for operation
– Not lit → Not ready
– Flashing → Critical fault (no connection to measuring amplifier)

5.8.2 Configuration of the device address

Note the following points:
- In the case of a PROFIBUS PA device, the address must always be configured.
  Valid device addresses are in the range 0…125. In a PROFIBUS PA network,
  each address may only be given once. If an address is not configured correctly, the device will not be recognised by the master.
  The address 126 is used for initial commissioning and for service purposes.
- All devices have the address 126 and software addressing on leaving the factory.

Addressing using local operation → Page 70

Addressing using miniature switches

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

1. Remove the screws and open the housing cover (a).
2. Remove the screws securing the electronics module (b). Then push up electronics module and pull it as far as possible out of the wall-mount housing.
3. Unplug ribbon cable connector (c) of the display module.
4. Remove the cover from the electronics compartment by loosening the screws (d).
5. Removing the I/O board (e):
   Insert a thin pin into the opening provided and pull the board out of the holder.
6. Use a pointed object to adjust the positions of the miniature switches on the I/O board.
7. Installation is the reverse of the removal procedure.

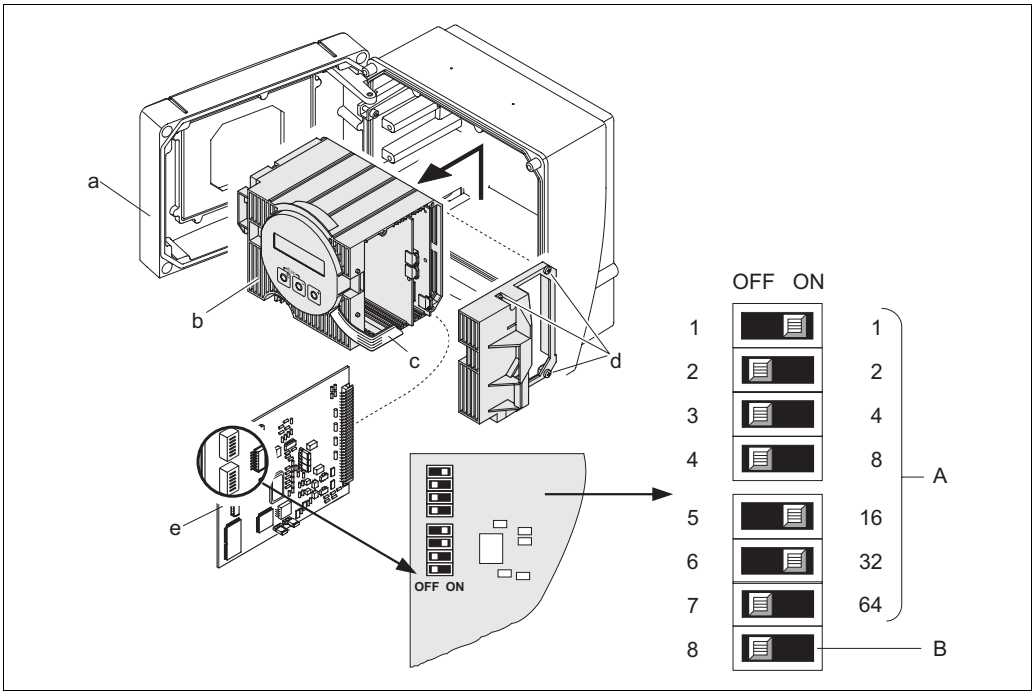


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Fig. 47: Addressing using the miniature switches on the I/O board

a Miniature switches no. 1–7 for defining the bus address (Illustration: 1 + 16 + 32 = 49)
b Switch for the address mode (type of addressing):
OFF = Software addressing using local operation
ON = Software addressing using miniature switches no. 1–7

6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- "Post-installation check" checklist → Page 34
- "Post-connection check" checklist → Page 46

✎ Note!
- The PROFIBUS PA interface's technical data must be maintained in accordance with IEC 61158-2 (FISCO model).
- The bus voltage of 9...32 V and the current consumption of 11 mA at the device can be checked using a normal multimeter.
- Using the LED on the I/O board (see Page 66) it is possible to carry out a simple function check on the fieldbus communication in the non-hazardous area.

Switching on the measuring device
Once the post-connection check (see Page 46) has been successfully completed, it is time to switch on the supply voltage. The device is now operational.
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 90 **START UP ...**	Start-up message
▼	
SW AMPLIFIER **V XX.XX.XX**	Current software version (example)
▼	
SYSTEM OK **→ OPERATION**	Beginning of normal measuring mode

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

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

6.2 Commissioning via local operation

6.2.1 "Sensor Installation" Quick Setup menu

If the measuring device is equipped with a local operation, the sensor distance can be ascertained using the "Sensor Installation" Quick Setup menu (Fig. 48).
If a measuring device does not have a local operation, the individual parameters and functions must be configured via a configuration program, e.g. ToF Tool – Fieldtool Package (see Page 55) or Communwin II (see Page 57).

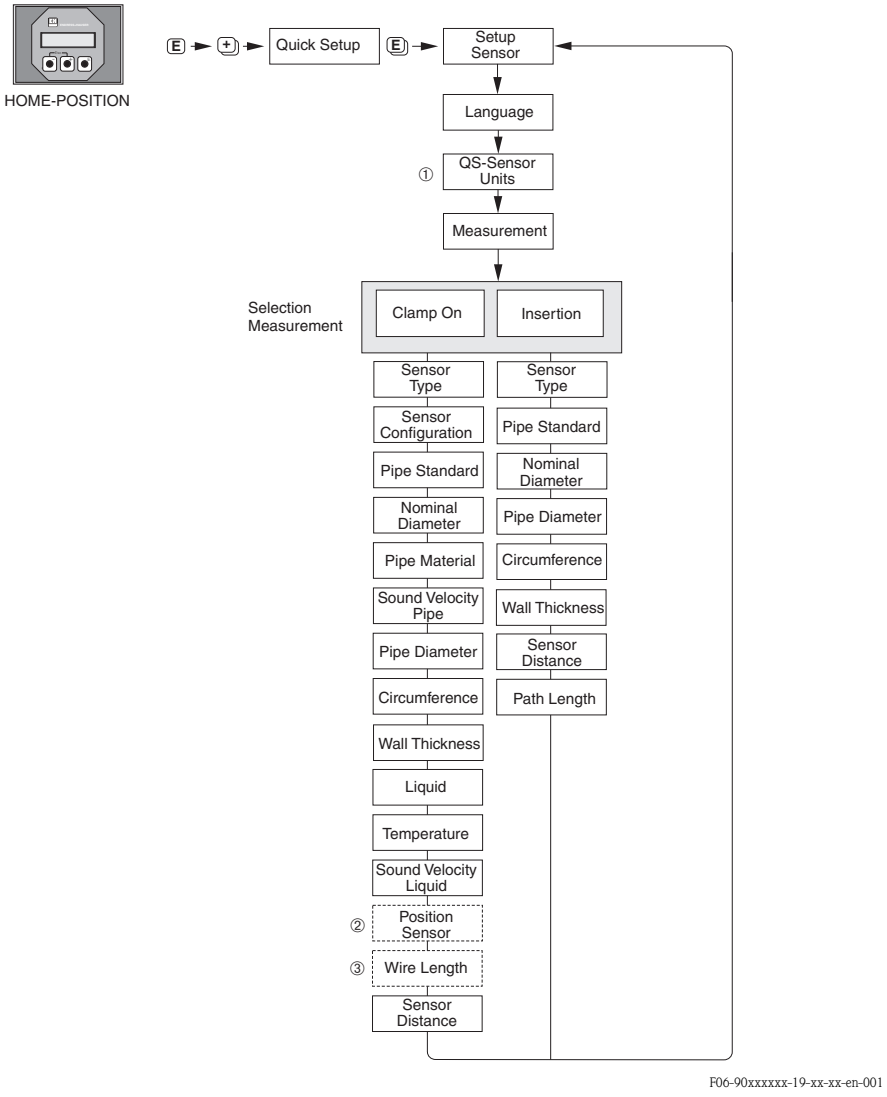

Fig. 48: "Sensor Installation" Quick Setup menu

Note!
The display returns to the COMMISSIONING QUICK SETUP function cell if you press the ESC key (− + ESC) during parameter interrogation.

① Selection of the system units only influences the functions UNIT TEMPERATURE, UNIT LENGTH and UNIT VELOCITY.
② The POSITION SENSOR function only appears when the CLAMP ON option is set in the MEASUREMENT function and the number of traverses is 2 or 4 in the SENSOR CONFIGURATION function.
③ The WIRE LENGTH function only appears when the CLAMP ON option is set in the MEASUREMENT function and the number of traverses is 1 or 3 in the SENSOR CONFIGURATION function.

6.2.2 "Commissioning" Quick Setup menu

If the measuring device is equipped with a local operation, all the device parameters important for standard measuring mode can be configured easily and quickly using the "Commissioning" Quick Setup menu (Fig. 49).
If a measuring device does not have a local operation, the individual parameters and functions must be configured via a configuration program, e.g. ToF Tool – Fieldtool Package (see Page 55) or Communwin II (see Page 57).

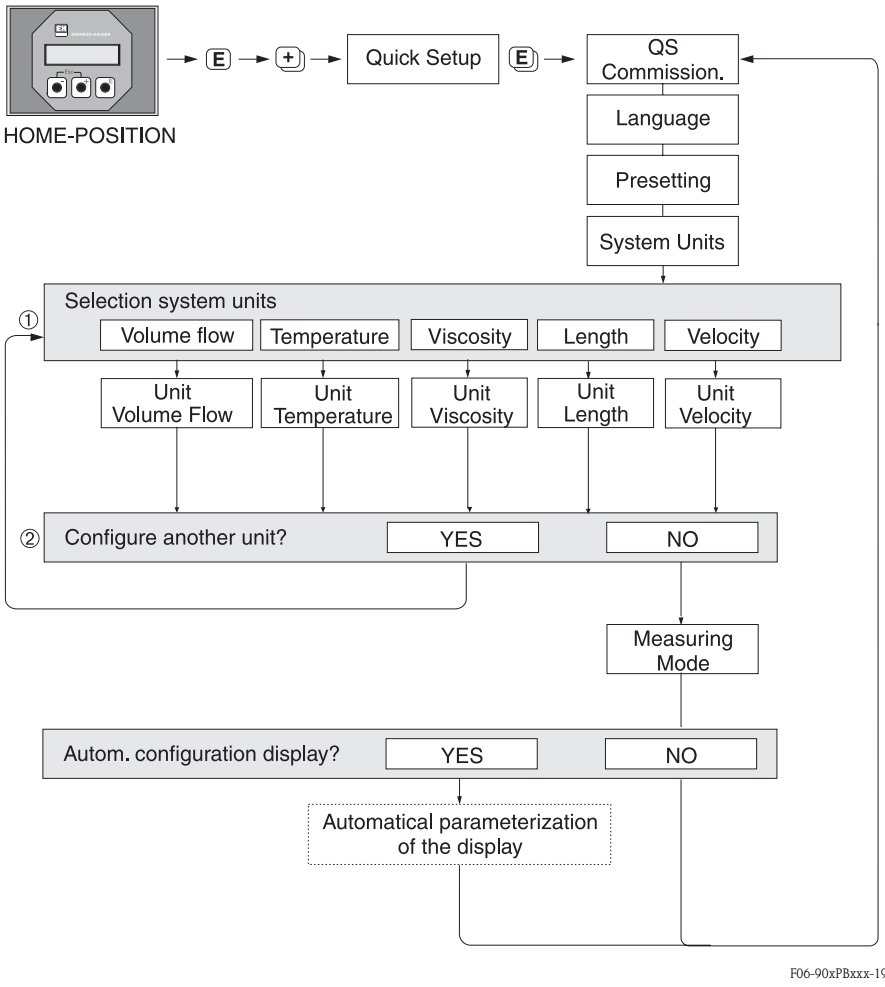

Fig. 49: "Commissioning" Quick Setup (only via local operation)

Note!
The display returns to the COMMISSIONING QUICK SETUP function cell if you press the ESC key (- + ESC) during parameter interrogation.

① Only the units not yet configured in the current Quick Setup are offered for selection in each cycle.
② The "YES" option remains visible until all the units have been parameterised. "NO" is the only option displayed when no further units are available.

6.2.3 Commissioning of the BUS interface

✎ Note!
You must enter a numerical code (factory setting: 90) before altering device functions, numerical values or factory settings (see Page 50).

The following steps have to be carried out one after the other:

1. Check the hardware write protection:
   COMMUNICATION → WRITE PROTECTION
2. Enter the tag name:
   COMMUNICATION → TAG NAME
3. Assign a bus address if this has not already been carried out via the miniature switches on the I/O board (see Page 67):
   COMMUNICATION → BUS ADDRESS
4. Select the system unit for volume flow:
   – Select via the system units group:
     SYSTEM UNITS → UNIT VOLUME FLOW
   – Activate the set system unit in the automation system:
     COMMUNICATION → SET UNIT TO BUS

   ✎ Note!
   The measured values are transmitted in the system units - as described on Page 84 - to the automation system via the cyclic data exchange.
   If the system unit of a measured value is changed using local operation, this will not have an immediate effect on the output of the AI Block (Analog Input Block) and therefore will not influence the measured value which is transmitted to the automation system.
   Once the SET UNIT TO BUS function is activated in the COMMUNICATION group, the modified system unit for the measured value will be transmitted to the automation system.
5. Configuration of the totalizer:
   – Select the process variable, e.g. volume flow:
     TOTALIZER → CHANNEL
   – Enter the totalizer units required:
     TOTALIZER → UNIT TOTALIZER
   – Set the totalizer status, e.g. for totalizing:
     TOTALIZER → SET TOTALIZER
   – Set the totalizer mode, e.g. for balancing:
     TOTALIZER → TOTALIZER MODE
6. Select the GSD file:
   COMMUNICATION → SELECTION GSD

✎ Note!
The range of options and the predefined values/parameters are described in more detail in a separate manual, namely the “Description of Device Functions” manual.

6.3 Commissioning via configuration program

6.3.1 Sensor installation

For sensor installation, the various configuration and operating programs (such as Commuwin II, ToF Tool – Fieldtool Package etc.) do not have any "Quick Setup" menus which correspond to the local operation.
Other methods (see table) are available for determining the relevant values for sensor distance, wire length, etc. The procedure is illustrated in detail on → Page 74.

Sensor type	Required values for the sensor installation	PROFIBUS configuration program [1]	Local operation [2]	ToF Tool – Fieldtool Package [3]	Applicator [4]
Clamp-on version	Sensor position	x	x	x	x
	Wire length	x	x	x	x
	Sensor distance	x	x	x	x
Insertion version	Sensor distance	x	x	x	x
	Arc length	x	x	x	x
	Path length	x	x	x	x

x = possible

1) Conditions that must be met before determining the values via a PROFIBUS configuration program (see Page 74):
- Transmitter installed (see Page 32)
- Transmitter connected to power supply (see Page 40)
- PROFIBUS interface has been commissioned (see Page 72)

2) Conditions that must be met before determining the values via local operation using the "Sensor Installation" Quick Setup (see Page 70):
- Transmitter installed (see Page 32)
- Transmitter connected to power supply (see Page 40)

3) ToF Tool – Fieldtool Package is a configuration and service software for flowmeters in the field. Conditions that must be met before determining the values via the ToF Tool – Fieldtool Package:
- Transmitter installed (see Page 32)
- Transmitter connected to power supply (see Page 40)
- "ToF Tool – Fieldtool Package" configuration and service software installed on a notebook/PC
- Connection made between notebook/PC and device via the FXA 193 service interface (see Page 41)

4) Applicator is a software for selecting and configuring flowmeters. The values required can be determined without having to connect the transmitter beforehand.
The "Applicator" can be downloaded from the Internet (→ *www.applicator.com*) or ordered on CD-ROM for installation on a local PC.

Procedure (determining data for sensor installation)
You can use the following tables to select and configure, in the correct order, the functions required to install the sensor:

- "Clamp-on" sensor installation → Page 74
- "Insertion" sensor installation → Page 75

Note!
- You must enter a valid release code before device parameters can be changed or activated. The code (factory setting = 90) is entered by means of the corresponding matrix cell. This is V2H0 for Commuwin II.
- Commuwin II: You can use the VAH5 matrix cell to select various partial matrixes required for configuration.

"Clamp-on" sensor installation			
Procedure Selection - Input - Display	**Local operation** ▼	**ToF Tool - Fieldtool Package** ▼	**Commuwin II** ▼
▼	→ SENSOR DATA	→ SENSOR DATA	Manufacturer-specific Transducer Block "PROSONIC 90 PBUS": → SENSOR DATA (VAH5) → SENSOR PARAMETERS
Type of measurement	MEASUREMENT	MEASUREMENT	MEASUREMENT (V3H0)
Sensor type	SENSOR TYPE	SENSOR TYPE	SENSOR TYPE (V3H1)
Sensor configuration	SENSOR CONFIGURATION	SENSOR CONFIGURATION	SENSOR CONFIG. (V3H2)
▼	→ PIPE DATA	→ PROCESS PARAMETERS	Manufacturer-specific Transducer Block "PROSONIC 90 PBUS": → DEVICE MATRIX (VAH5) → PIPE DATA
Standard pipe selection	PIPE STANDARD	PIPE STANDARD	PIPE STANDARD (V4H0)
Nominal diameter pipe	NOMINAL DIAMETER	NOMINAL DIAMETER	NOMINAL DIAMETER (V4H1)
Pipe material	PIPE MATERIAL	PIPE MATERIAL	PIPE MATERIAL (V4H2)
Pipe sound velocity	PIPE SOUND VELOCITY	PIPE SOUND VELOCITY	SOUND VELOCITY PIPE (V4H4)
Pipe circumference	PIPE CIRCUMFERENCE	PIPE CIRCUMFERENCE	CIRCUMFERENCE (V4H5)
Pipe diameter	PIPE DIAMETER	PIPE DIAMETER	PIPE DIAMETER (V4H6)
Wall thickness	WALL THICKNESS	WALL THICKNESS	WALL THICKNESS (V4H7)
Liner material	LINER MATERIAL	LINER MATERIAL	LINER MATERIAL (V4H8)
Liner sound velocity	LINER SOUND VELOCITY	LINER SOUND VELOCITY	→ PIPE ADJUSTMENT SOUND VELOCITY LINER (V5H1)
Liner thickness	LINER THICKNESS	LINER THICKNESS	LINER THICKNESS (V5H2)
▼			

"Clamp-on" sensor installation			
Procedure Selection - Input - Display	**Local operation** ▼	**ToF Tool - Fieldtool Package** ▼	**Commuwin II** ▼
▼	→ LIQUID DATA	→ PROCESS PARAMETERS	→ LIQUID DATA
Liquid in the pipe	LIQUID	LIQUID	LIQUID (V9H0)
Liquid temperature	TEMPERATURE	TEMPERATURE	TEMPERATURE (V9H1)
Liquid sound velocity	LIQUID SOUND VELOCITY	LIQUID SOUND VELOCITY	SOUND VELOCITY (V9H2)
▼	→ SENSOR DATA	→ SENSOR DATA	Manufacturer-specific Transducer Block "PROSONIC 90 PBUS": → SENSOR DATA (VAH5) → SENSOR PARAMETERS
Didsplay sensorposition (for sensor installation)	POSITION SENSOR	POSITION SENSOR	POSITION SENSOR (V3H4)
Didsplay wire length (for sensor installation)	WIRE LENGTH	WIRE LENGTH	WIRE LENGTH (V3H5)
Didsplay sensor distance (for sensor installation)	SENSOR DISTANCE	SENSOR DISTANCE	SENSOR DISTANCE (V3H6)
✎ Note! ■ All functions are described in detail in the "**Description of Device Functions**" manual, which is a separate part of these Operating Instructions! ■ The procedure for running through the "Sensor Installation" Quick Setup using the local operation is explained on Page 70.			

"Insertion" sensor installation			
Procedure Selection - Input - Display	**Local operation** ▼	**ToF Tool - Fieldtool Package** ▼	**Commuwin II** ▼
▼	→ SENSOR DATA	→ SENSOR DATA	Manufacturer-specific Transducer Block "PROSONIC 90 PBUS": → SENSOR DATA (VAH5) → SENSOR PARAMETERS
Type of measurement	MEASUREMENT	MEASUREMENT	MEASUREMENT (V3H0)
Sensor type	SENSOR TYPE	SENSOR TYPE	SENSOR TYPE (V3H1)
Sensor configuration	SENSOR CONFIGURATION	SENSOR CONFIGURATION	SENSOR CONFIG. (V3H2)
▼	→ PIPE DATA	→ PROCESS PARAMETERS	Manufacturer-specific Transducer Block "PROSONIC 90 PBUS": → DEVICE MATRIX (VAH5) → PIPE DATA
Standard pipe selection	PIPE STANDARD	PIPE STANDARD	PIPE STANDARD (V4H0)
Nominal diameter pipe	NOMINAL DIAMETER	NOMINAL DIAMETER	NOMINAL DIAMETER (V4H1)
Pipe circumference	PIPE CIRCUMFERENCE	PIPE CIRCUMFERENCE	CIRCUMFERENCE (V4H5)
Pipe diameter	PIPE DIAMETER	PIPE DIAMETER	PIPE DIAMETER (V4H6)
Wall thickness	WALL THICKNESS	WALL THICKNESS	WALL THICKNESS (V4H7)

▼	→ SENSOR DATA	→ SENSOR DATA	Manufacturer-specific Transducer Block “PROSONIC 90 PBUS”: → SENSOR DATA (VAH5) → SENSOR PARAMETERS
Didsplay sensor distance (for sensor installation)	SENSOR DISTANCE	SENSOR DISTANCE	SENSOR DISTANCE (V3H6)
Didsplay path length (for sensor installation)	PATH LENGTH	PATH LENGTH	PATH LENGTH (V3H8)

✎ Note!
- All functions are described in detail in the “**Description of Device Functions**” manual, which is a separate part of these Operating Instructions!
- The procedure for running through the “Sensor Installation” Quick Setup using the local operation is explained on Page 70.

6.3.2 Commissioning

Additionally to the settings for the sensor installation (Chapter 6.3.1) the following functions have to be configured for the standard application:

- System parameters

6.3.3 Commissioning, configuration of the BUS interface

Operation with Commuwin II is described in the Endress+Hauser documentation BA 124F/00/a2. Steps 1–5 can be dealt with in the same order as described in Chap. 6.2.3 “Commissioning of the BUS interface”.
The configuration parameters are found in the following places in the Commuwin II operating matrix:
- In the Physical Block → Page 62
- In the manufacturer-specific device matrix, positions V6 and V7 → Page 58
- In the Analog Input Block → Page 64
- In the Totalizer Block, position V1 → Page 65

1. Parametering the “Physical Block”:
   – Open the Physical Block.
   – Software and hardware write protection is deactivated in Prosonic Flow 90 so that you can access all the write parameters. Check this status with the parameters WRITE LOCKING (V3H0, software write protection) and HW WRITE PROTECT. (V3H1, hardware write protection).
   – Enter the tag name.
2. Parametering the manufacturer-specific device parameters of the Transducer Block “PROSONIC FLOW 90”:
   – Open the manufacturer-specific Transducer Block “PROSONIC FLOW 90”
   – Enter the desired name for the block (tag name).
   Factory setting: No block name (tag name)
   – Now configure the device-specific parameters for flow measurement.

   ✎ Note!
   Other matrixes can be selected in the matrix cell VAH5 if you wish to configure other manufacturer-specific parameters.
   Please note that alterations made to device parameters will only be activated once a valid access code has been entered. The release code can be entered in the matrix cell V2H0 (factory setting: 90).
3. Parametering the “Analog Input function block”:
   Prosonic Flow 90 has three Analog Input function blocks (AI 1 = volume flow, AI 2 = sound velocity, AI 3 = flow velocity). These are selected using the connection clearance list.
   – Enter the required name for Analog Input function block 1 (factory setting: VOLUMEFLOW BLOCK).
   – Open the Analog Input function block.
   – In the Analog Input function block, the input value or the input range can be scaled in accordance with the requirements of the automation system (see Page 78).
   – If necessary, set a limit value.
4. Parametering the “Totalizer Block”:
   Prosonic Flow 90 has one Totalizer function block. This is selected using the profile block “Totalizer Block” in the connection clearance list.
   – Enter the required name for the Totalizer function block (factory setting: TOTALIZER BLOCK).
   – Select the process variable, e.g. volume flow, via the CHANNEL (V8H5) parameter.
   – Select the unit required for the totalizer (TOTAL. UNIT, V1HO).
   – Configure the totalizer status (SET TOTALIZER, V1H1), e.g. “TOTALIZE” → totalizing.
   – Configure the totalizer mode (TOTALIZER MODE, V1H3), e.g. “BALANCED” → balancing.

5. Configuration of the cyclic data traffic:
   – All the relevant data are described in the "System Integration" Chapter (see Page 79).
   – We recommend that the "Coupling Documentation" be used for step-by-step configuration. This can be obtained from Endress+Hauser Process Solutions for various automation systems and programmable logic controls.
   – The files required for commissioning and network configuration can be obtained as described on Page 79.

6.3.4 Rescaling the input value

In the Analog Input function block the input value or input range can be scaled in accordance with the automation requirements.

Example:
- The system unit in the Transducer Block is m^3/h.
- The measuring range of the sensor is 0...30 m^3/h.
- The output range to the automation system should be 0...100%.
- The measured value from the Transducer Block (input value) is rescaled linearly via the input scaling SCALING to the desired output range OUT SCALE.

Parameter group PV_SCALE (see "Description of Device Functions" manual)

PV_SCALE_MIN (V1H0)	→ 0
PV_SCALE_MAX (V1H1)	→ 30

Parameter group OUT SCALE (see "Description of Device Functions" manual)

OUT_SCALE_MIN (V1H3)	→ 0
OUT_SCALE_MAX (V1H4)	→ 100
OUT_UNIT (V1H5)	→ %

The result is that with an input value of, for example, 15 m^3/h a value of 50% is output via the OUT parameter.

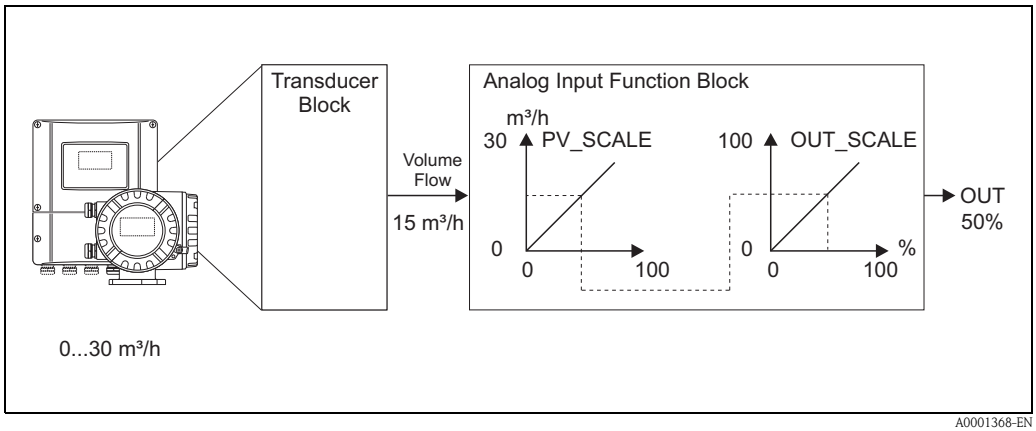

Fig. 50: Scaling the input value for the Analog Input function block

Note!
The OUT_UNIT does not have any effect on the scaling. Nevertheless, it should be set for the purposes of viewing on the local operation, for example.

6.4 System integration

The device will be ready for system integration once commissioning has been effected via local operation or the Class 2 master (Commuwin II). The PROFIBUS PA system will require a description of the device parameters, e.g. output data, input data, data format and supported transmission rate so that it can integrate the field devices into the bus system.
This data is contained in a Device Master File (GSD file) which will be placed at the disposal of the PROFIBUS PA master while the communication system is being commissioned.
Device bitmaps, which appear as symbols in the network tree, can also be integrated.
The Profile 3.0 Device Master File (GSD) allows field devices from various manufacturers to be exchanged without having to reconfigure.

Generally, the Profile 3.0 distinguishes between three different versions of GSD (factory setting: manufacturer-specific GSD)

Manufacturer-specific GSD: This GSD guarantees the unlimited functionality of the field device. Device-specific process parameters and functions are therefore available.

Profile GSD: This GSD is different in terms of the number of Analog Input Blocks (AI) and the measuring principles. If a system is configured with profile GSDs, it will be possible to exchange devices that are supplied by various manufacturers. It is, however, essential that the cyclic process values follow the same sequence.

Example:
Prosonic Flow 90 supports the profile PA139742.gsd (IEC 61158-2 (MBP)). This GSD comprises two AI Blocks and one Totalizer Block. The AI Blocks are assigned to the following measured variables: AI 1 = volume flow, AI 2 = sound velocity.
This guarantees that the first measured variable agrees with the field devices of other manufacturers.

Profile GSD (multi-variable) with the ID number 9760_{Hex}: This GSD contains all function blocks such as AI, DO, DI.... This GSD is not supported by the device.

Note!
- A decision should be made with respect to which GSD is to be used before configuration takes place.
- The configuration can be changed using local operation or a Class 2 master! Configuration using local operation → Page 70 ff.

Prosonic Flow 90 supports the following GSD files:

Name of device	Manufacturer-specific ID No.	Profile 3.0 ID No.	Manufacturer-specific GSD
Prosonic Flow 90 PA PROFIBUS PA (IEC 61158-2 (MBP))	152F (Hex)	9741 (Hex)	EH3_152F.gsd EH3X152F.gsd
	Profile 3.0 GSD	**Type file**	**Bitmaps**
	PA139741.gsd	EH_152F.200	EH_152F_d.bmp/.dib EH_152F_n.bmp/.dib EH_152F_s.bmp/.dib

Each device is assigned an identification number by the Profibus User Organisation (PNO). The name of the Device Master File (GSD) is derived from this.
At Endress+Hauser, this ID No. starts with the manufacturer ID 15xx.
In order to ensure clarity, the GSD names (with the exception of type files) at Endress+Hauser are as follows:

EH3_15xx	EH = Endress + Hauser 3 = Profile 3.0 _ = Standard identification 15xx = ID No.
EH3x15xx	EH = Endress + Hauser 3 = Profile 3.0 x = Extended identification 15xx = ID No.

The GSD files for all Endress+Hauser devices can be acquired in the following manner:
- Internet (Endress+Hauser) → http://www.endress.com (Products → Process Solutions → PROFIBUS → GSD files)
- Internet (PNO) → http://www.profibus.com (GSD library)
- On CD-ROM from Endress+Hauser: order number 50097200

Structure of GSD files from Endress+Hauser
In the case of the Endress+Hauser field devices with PROFIBUS interface, all the files which are needed for configuration are contained in one file. Once unpacked, the file will create the following structure:
- Version #xx stands for the corresponding device version. Device-specific bitmaps can be found in the directories “BMP” and “DIB”. The utilisation of these will depend on the configuration software that is being used.
- The GSD files are saved in the subdirectories “Extended” and “Standard” which can be found in the “GSD” folder. Information relating to the implementation of the field transmitter and any dependencies in the device software can be found in the “Info” folder. Please read this carefully before configuration takes place. The files with the extension .200 have been saved in the “TypDat” folder.

Standard and extended formats
The modules of some GSD files are transmitted with an extended identification (e.g. 0x42, 0x84, 0x08, 0x05). These GSD files can be found in the "Extended" folder.
All GSD files that have a standard identification (e.g. 0x94) can be found in the "Standard" folder. When integrating field transmitters, the GSD files with the extended identification should be used first. If, however, the integration is not successful, the standard GSD should be used. This differentiation is the result of a specific implementation in the master systems.

Contents of the download file from the Internet and the CD-ROM:
- All Endress+Hauser GSD files
- Endress+Hauser type files
- Endress+Hauser bitmap files
- Useful information relating to the devices

Working with GSD / type files
The GSD files must be integrated into the automation system.
Depending on the software that is being used, the GSD files can be copied to the program-specific directory or can be read into the database using the import function within the configuration software.

Example 1:
In the case of the configuration software Siemens STEP 7 (Siemens PLC S7-300 / 400) the files are copied to the subdirectory ...\ siemens \ step7 \ s7data \ gsd.
The GSD files also contain bitmap files. These bitmap files are used to display the measuring points in image form. The bitmap files will have to be saved to the directory ...\ siemens \ step7 \ s7data \ nsbmp.

Example 2:
If you have a PLC Siemens S5 where the PROFIBUS DP network is configured with the configuration software COM ET 200, you will have to use the type files (x.200 files).

If you are using configuration software other than that referred to above, ask your PLC manufacturer which directory you should use.

Compatibility of Profile 2.0 and 3.0 devices
It is possible to operate Profile 2.0 and 3.0 devices with different GSD files in one system using one DP master as the cyclic data for the automation system in both profile versions is compatible.

6.4.1 Cyclic data exchange

In the case of PROFIBUS PA, the cyclic transmission of analog values to the automation system is effected in data blocks of 5 bytes. The measured value is portrayed in the first 4 bytes in the form of floating point numbers in acc. with IEEE 754 standard (see IEEE floating point number). The 5th byte contains status information pertaining to the measured value which is implemented in accordance with the Profile 3.0 Specifications (see Page 79). The status will be indicated on the display of the device (if existing).

Note!
An exact description of the data types can be found in the slot/index lists in the "Description of Device Functions" manual.

IEEE floating point number
Conversion of a hexadecimal value into an IEEE floating point number for measured value detection.
The measured values are shown in numerical format IEEE-754 in the following manner and are transferred to the Class 1 master:

Byte n			**Byte n+1**			**Byte n+2**	**Byte n+3**
Bit 7	Bit 6	Bit 0	Bit 7	Bit 6	Bit 0	Bit 7 Bit 0	Bit 7 Bit 0
Sign	2^7 2^6 2^5 2^4 2^3 2^2 2^1		2^0	2^{-1} 2^{-2} 2^{-3} 2^{-4} 2^{-5} 2^{-6} 2^{-7}		2^{-8} 2^{-9} 2^{-10} 2^{-11} 2^{-12} 2^{-13} 2^{-14} 2^{-15}	2^{-16}...2^{-23}
	Exponents			**Mantissa**		**Mantissa**	**Mantissa**

Formula value = $(-1)^{Sign} * 2^{(exponent\ -127)} * (1 + mantissa)$

Example:
40 F0 00 00 hex = 0100 0000 1111 0000 0000 0000 0000 0000 binary
Value = $(-1)^0 * 2^{(129-127)} * (1 + 2^{-1} + 2^{-2} + 2^{-3})$
= $1 * 2^2 * (1 + 0.5 + 0.25 + 0.125)$
= $1 * 4 * 1.875 = 7.5$

Block model

The analog values transmitted by Prosonic Flow 90 during the cyclic data exchange are:
- Volume flow
- Sound velocity
- Flow velocity
- Totalizer 1 and the corresponding control parameters
- Display value
- Control block for manufacturer-specific functions

Note!
The totalizer can be configured in various combinations with the totalizer controls.
It is possible to configure the totalizer only, or additionally integrate one or two control blocks in order to reset the totalizer or stop totalizing, for example.
The configuration is explained in detail on Page 86.

The block model (Fig. 51) shows which input and output data Prosonic Flow 90 provides for cyclic data exchange.

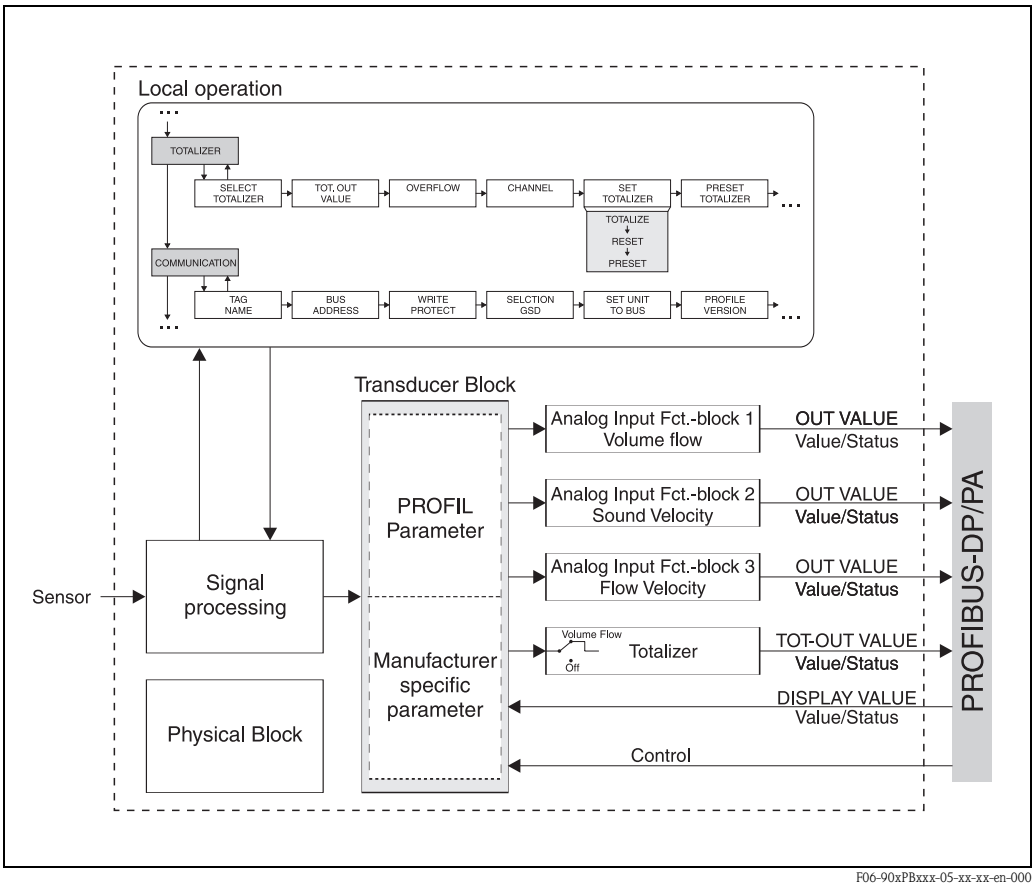

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Fig. 51: Prosonic Flow 90 PROFIBUS PA Profile 3.0 block model

Input data
Input data are:
Volume flow, sound velocity, flow velocity and totalizer.
The current measured value can be transmitted to the automation system using these measured variables.

Data transfer from Prosonic Flow 90 to the automation system
The input and output bytes are structured in a fixed sequence. If addressing is effected automatically using the configuration program, the numerical values of the input and output bytes may deviate from the values in the following table.

Input byte	Process parameter	Access type	Comment / Data format	Factory setting unit
0, 1, 2, 3	Volume flow	read	32-bit floating point number (IEEE-754) Illustrated → Page 82	m^3/h
4	Status Volume flow	read	Status code → Page 92	–
5, 6, 7, 8	Sound velocity	read	32-bit floating point number (IEEE-754) Illustrated → Page 82	m/s
9	Status Sound velocity	read	Status code → Page 92	–
10, 11, 12, 13	Flow velocity	read	32-bit floating point number (IEEE-754) Illustrated → Page 82	m/s
14	Status Flow velocity	read	Status code → Page 92	–
15, 16, 17, 18	Totalizer	read	32-bit floating point number (IEEE-754) Illustrated → Page 82	m^3
19	Status Totalizer	read	Status code → Page 92	–

Note!
- The system units in the table correspond to the predefined scales which are transmitted during the cyclic data exchange.
- The measured variables can be assigned to the totalizer using the CHANNEL function on the local operation or by means of a Class 2 master in the Totalizer Block → CHANNEL (V8H5).
- The following settings are possible for the totalizer (factory setting: volume flow):
  – Off
  – Volume flow

The CHANNEL function is described in more detail in the separate “Description of Device Functions” manual.

Output data display value

The display value allows you to transmit a measured value which has been calculated in the automation system directly to Prosonic Flow 90. This measured value is a display value which can be assigned to line 1 or line 2 of the display. The display value comprises 4 bytes measured value and 1 byte status.

Data transfer from the automation system to Prosonic Flow 90 (display value)

Output byte	Process parameter	Access type	Comment/Data format	Factory setting unit
2, 3, 4, 5	Display value	write	32-bit floating point number (IEEE-754) Illustrated → Page 82	ao
6	Display value status	write	–	–

✎ Note!
The status can be entered manually and is interpreted in accordance with the status coding in Profile Specification 3.0.

Control variables (output data) manufacturer-specific

Prosonic Flow 90 is capable of processing control variables (output data) during cyclic data exchange. An example of this would be activating positive zero return.
The following table shows the control variables that can be transmitted to Prosonic Flow 90.

Data transfer from the automation system to Prosonic Flow 90 (control)

Output byte	Process parameter	Access type	Comment/Control variable	Factory setting unit
7	Control variable	write	This parameter is manufacturer-specific and can process the following control variables: 0 → 1: Reserved 0 → 2: Positive zero return **ON** 0 → 3: Positive zero return **OFF** 0 → 4: Zero point adjustment 0 → 5–7: Reserved 0 → 8: Operation (unidirectional) 0 → 9: Operation (bidirectional)	–

✎ Note!
A control variable can be executed via the cyclic data exchange each time the output byte changes from “0” to another bit pattern. The transition from any bit pattern to “0” will not have any effect.

Control variables for the totalizer (output data)
These functions allow the totalizer to be controlled from the automation system.
The following controls are possible:
- Totalizing
- Resetting
- Activation of a predefined value
- Balancing
- Only positive flow detection
- Only negative flow detection
- Stop totalizing

Data transfer from the automation system to Prosonic Flow 90 (Control variables of totalizer)

Output byte	Process parameter	Access type	Comment/Control variable	Factory setting unit
			The following control variables can be entered for the totalizer using these parameters.	
0	SET TOT	write	**Control variable for SET TOT:** 0: Totalizing 1: Reset totalizer 2: Preset totalizer	–
1	MODE TOT	write	**Control variable for MODE TOT:** 0: Balancing 1: Only pos. flow detection 2: Only neg. flow detection 3: Stop totalizing	–

Note!
- A control variable can be executed through the cyclic data exchange each time the output byte changes from one bit pattern to any other bit pattern. It is not necessary to reset to “0” to execute a control variable.
- It is only possible to preset a predefined totalizer value via the local operation or the Class 2 master!

Example of SET TOT and MODE TOT:
If the control variable SET TOT is set to “1” (1 = reset the totalizer), the value of the totalizer will be set to “0”. The value of the totalizer will now be added up starting from “0”.
If the totalizer is to retain the value “0”, it is necessary to first set the control variable MODE TOT to “3” (3 = stop totalizing). The totalizer will now stop adding up. Then the SET TOT control variable is set to “1” and the value “0” is retained.

Factory settings for the cyclic measured variables
The following measured variables are configured in Prosonic Flow 90 at the factory:
- Volume flow
- Sound velocity
- Flow velocity
- Totalizer (with control variable SET TOT and MODE TOT)
- Display value
- Control (manufacturer-specific control block)

The placeholder “EMPTY_ MODULE” (0x00) is contained in the GSD file. You can use this placeholder to deactivate measured variables not required by using the configuration software of the Class 1 master.
Configuration examples → Page 87

Note!
Only activate the data blocks which are processed in the automation system. This will improve the data throughput rate of the PROFIBUS PA network.

A double-arrow symbol flashes on the display to show that Prosonic Flow 90 is communicating with the automation system.

Caution!
- It is essential to adhere to the following sequence when configuring the measured variables: volume flow, sound velocity, flow velocity, totalizer, display value, control.
- The device must be reset once a new measured variable configuration has been loaded to the automation system. There are two options here:
  – Commissioning via local operation: HOME → SUPERVISION → SYSTEM RESET
  – Switch supply voltage off and then on again

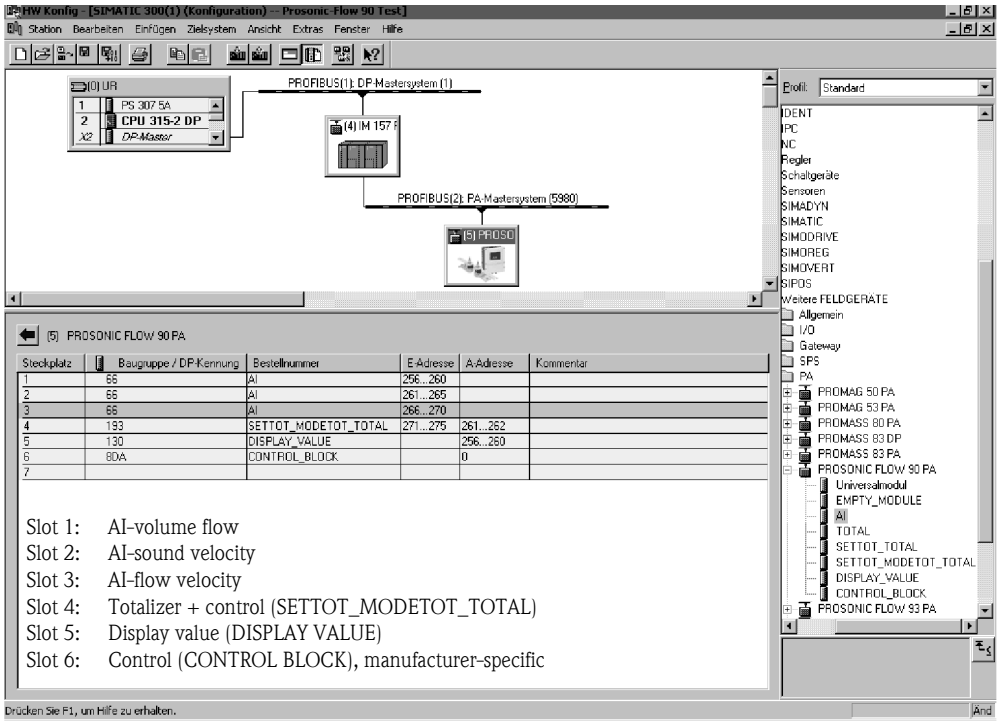
System units
The measured values are transmitted in the system units, as described in the table on Page 84, to the automation system via cyclic data exchange.
If the system unit of a measured value is changed using local operation, this will not have an immediate effect on the output of the AI Block (Analog Input Block) and therefore will not influence the measured value which is transmitted to the automation system.
Once the SET UNIT TO BUS function is activated in the COMMUNICATION group, the modified system unit for the measured value will be transmitted to the automation system. Transmission can also be activated with a Class 2 master (e.g. Commuwin II).

Examples of configuration
The configuration of a PROFIBUS PA system is normally effected in the following manner:

1. The field devices which are to be configured are integrated into the configuration program of the automation system using the GSD file. Measured variables required can be configured “off line” using the configuration software.
2. The automation control system's user program is now programed. On the one hand, the user program controls the input and output data and on the other hand defines the location of the measured variables for further processing.
   An additional measured value configuration module may have to be used in the case of automation systems which do not support the IEEE-754 floating point format.
   It may also be necessary to change the byte sequence (byte swapping) depending on the type of data management employed in the automation system (little-endian format or big-endian format).
3. Once configuration is complete, a binary file is transmitted to the automation system.
4. The system can be started now. The automation system will establish a connection to the configured devices. The device parameters which are relevant for the process can be configured using a Class 2 master, e.g. with Commuwin II (see Page 77).

6.4.2 Configuration examples with Simatic S7 HW-Konfig

Example 1:
Full configuration using the manufacturer-specific GSD file



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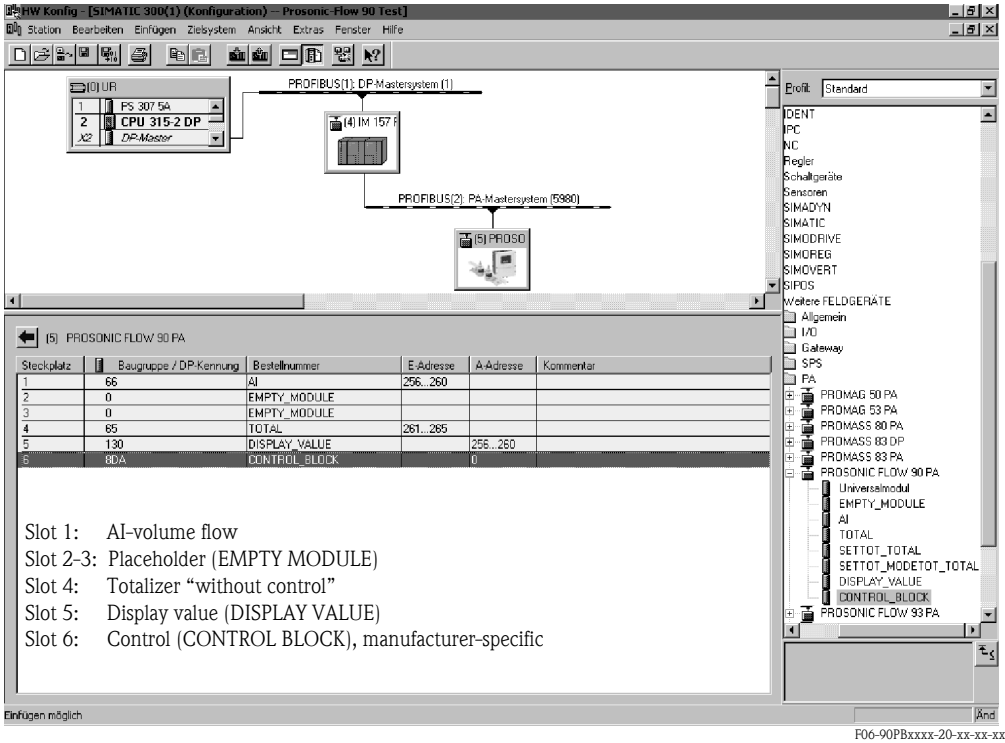
This form of configuration activates all data blocks which are supported by Prosonic Flow 90. The significance of “SET TOT” and “MODE TOT” is described on Page 86.

Configuration data							
Byte length (Input)	Byte length (Output)	Data blocks	Status	Access type	GSD Block designation	GSD Extended block identification	GSD Standard block identification
0...4	–	Volume flow + status	active	read	AI	0x42, 0x84, 0x08, 0x05	0x94
5...9	–	Sound velocity + status	active	read	AI	0x42, 0x84, 0x08, 0x05	0x94
10...14	–	Flow velocity + status	active	read	AI	0x42, 0x84, 0x08, 0x05	0x94
15...19	0...1	Totalizer + status + control	active	read + write	SETTOT_MODETOT_ TOTAL	0xC1, 0x81, 0x84, 0x85	0xC1, 0x81, 0x84, 0x85
–	2...6	Display value	active	write	DISPLAY_VALUE	0x82, 0x84, 0x08, 0x05	0xA4
–	7	Control variable	active	write	CONTROL_BLOCK	0x20	0x20

Example 2:
Replacing measured variables with placeholders (EMPTY_MODULE) using the manufacturer-specific GSD file.



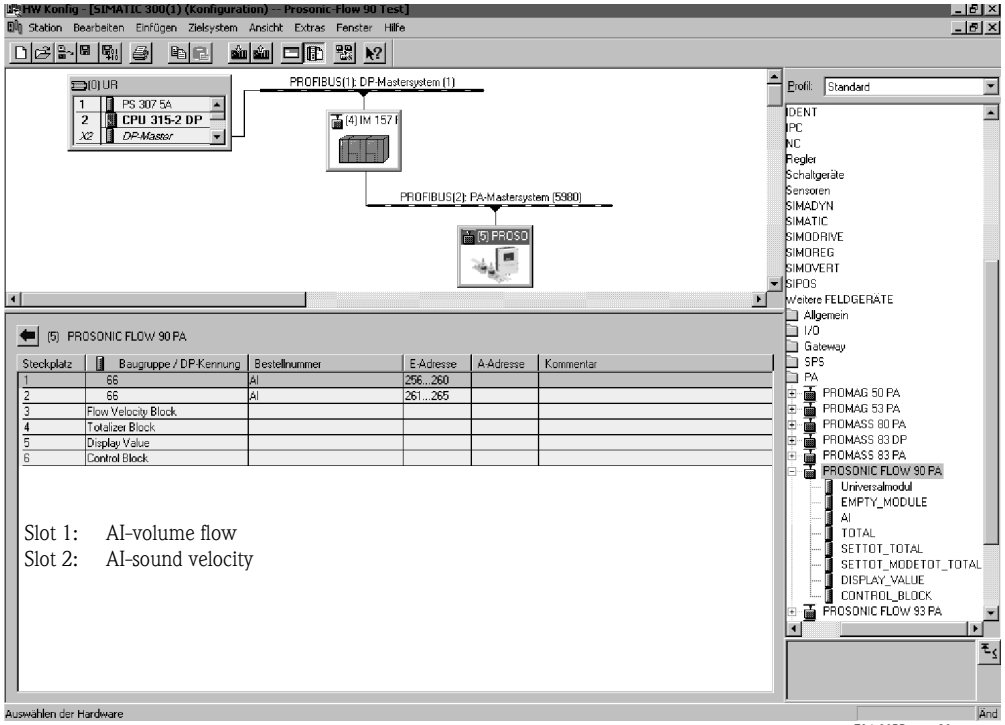
Slot 1: AI-volume flow
Slot 2-3: Placeholder (EMPTY MODULE)
Slot 4: Totalizer "without control"
Slot 5: Display value (DISPLAY VALUE)
Slot 6: Control (CONTROL BLOCK), manufacturer-specific

F06-90PBxxxx-20-xx-xx-xx-001

This form of configuration activates the volume flow, totalizer, display value and manufacturer-specific control.
The totalizer is configured "without control variable". In this example it provides a measured value and cannot be controlled. It is not possible to reset or stop the totalizer.

Configuration data							
Byte length (Input)	Byte length (Output)	Data blocks	Status	Access type	GSD Block designation	GSD Extended block identification	GSD Standard block identification
0...4	–	Volume flow + status	active	read	AI	0x42, 0x84, 0x08, 0x05	0x94
–	–	Placeholder	inactive	–	EMPTY_MODULE	0x00	0x00
–	–	Placeholder	inactive	–	EMPTY_MODULE	0x00	0x00
5...9	–	Totalizer + status	active	read	TOTAL	0x41, 0x84, 0x85	0x41, 0x84, 0x85
–	0...4	Display value	active	write	DISPLAY_VALUE	0x82, 0x84, 0x08, 0x05	0xA4
–	5	Control variable	active	write	CONTROL_BLOCK	0x20	0x20

Example 3:
Configuration of the measured variables without placeholders (EMPTY_MODULE) using the manufacturer-specific GSD file.



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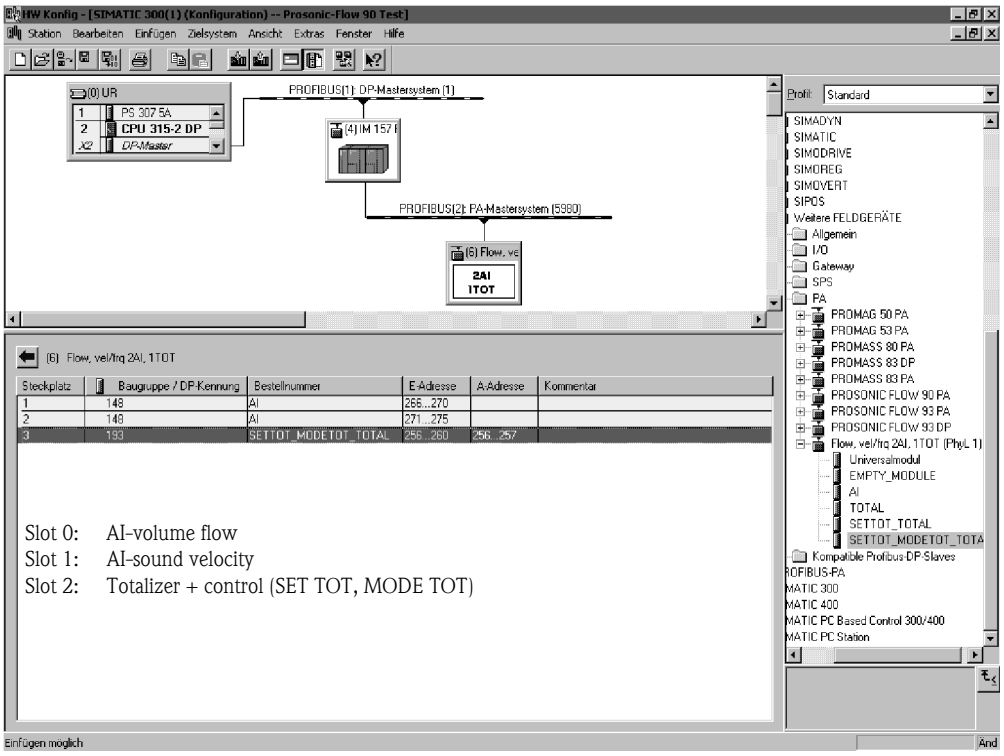
This form of configuration transmits the volume flow and the sound velocity.
If no further measured variables are required, the placeholders (EMPTY_MODULE) will not have to be used.

Note!
This only applies if no manufacturer-specify control blocks are used.

Configuration data							
Byte length (Input)	Byte length (Output)	Data blocks	Status	Access type	GSD Block designation	GSD Extended block identification	GSD Standard block identification
0...4	–	Volume flow + status	active	read	AI	0x42, 0x84, 0x08, 0x05	0x94
5...9	–	Sound velocity + status	active	read	AI	0x42, 0x84, 0x08, 0x05	0x94

Example 4:
Full configuration via profile GSD file PA139741.gsd (IEC 61158-2 (MBP)).



F06-90PBxxxx-20-xx-xx-xx-003

This form of configuration transmits the volume flow, sound velocity and totalizer + control.

Configuration data							
Byte length (Input)	Byte length (Output)	Data blocks	Status	Access type	GSD Block designation	GSD Extended block identification	GSD Standard block identification
0..4	–	Volume flow + status	active	read	AI	–	0x94
5...9	–	Sound velocity + status	active	read	AI	–	0x94
10...14	0...1	Totalizer + status+ control	active	read + write	SETTOT_MODETOT_ TOTAL	–	0xC1, 0x81, 0x84, 0x85

Status code

The status codes which are supported by the blocks AI (Analog Input), TOT (Totalizer) and display value are listed in the following table.
The coding of the status corresponds to the "PROFIBUS PA Profile for Process Control Devices – General Requirements" V 3.0:

Status code	Meaning	Device status	Limits
0x1C 0x1D 0x1E 0x1F	out of operation	bad	OK LOW_LIM HIG_LIM CONST
0x10 0x11 0x12	sensor error below sensor limit sensor limit exceeded	bad	NO_LIMIT LOW_LIM HIG_LIM
0x0C 0x0D 0x0E 0x0F	device failure	bad	OK LOW_LIM HIG_LIM CONST
0x18	no communication	bad	NO_LIMIT
0x08 0x09 0x0A 0x0B	function block not available	bad	OK LOW_LIM HIG_LIM CONST
0x40 0x41 0x42 0x43	non-specific	uncertain	OK LOW_LIM HIG_LIM CONST
0x44 0x45 0x46 0x47	last useable value	uncertain	OK LOW_LIM HIG_LIM CONST
0x48 0x49 0x4A 0x4B	substitute set	uncertain	OK LOW_LIM HIG_LIM CONST
0x4C 0x4D 0x4E 0x4F	values which are not saved after the device or parameters have been reset	uncertain	OK LOW_LIM HIG_LIM CONST
0x50 0x51 0x52 0x53	measured value of sensor inaccurate	uncertain	OK LOW_LIM HIG_LIM CONST
0x60 0x61 0x62 0x63	simulated value	uncertain	OK LOW_LIM HIG_LIM CONST
0x80 0x81 0x82 0x83	measuring system OK	good	OK LOW_LIM HIG_LIM CONST
0x84 0x85 0x86 0x87	change of parameters	good	OK LOW_LIM HIG_LIM CONST
0x8C 0x8D 0x8E 0x8F	critical alarm: alarm limits exceeded	good	OK LOW_LIM HIG_LIM CONST
0x88 0x89 0x8A 0x8B	warning: early warning limit exceeded	good	OK LOW_LIM HIG_LIM CONST

6.5 Application-specific commissioning

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

Preconditions for zero point adjustment
Note the following before you perform 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 shut-off valves upstream and/or downstream of the measuring range or by using existing valves and gates (Fig. 52).
  – 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 centre.
- You can call up the zero point value currently valid via the following function:
  – Local operation: HOME → PROCESS PARAMETERS → ZERO POINT ADJUSTMENT
  – PROFIBUS interface / configuration program:
  Manufacturer-spec. Transducer Block (Prosonic 90 PBUS) → partial matrix “Sensor data” → ZERO POINT (V4H1)

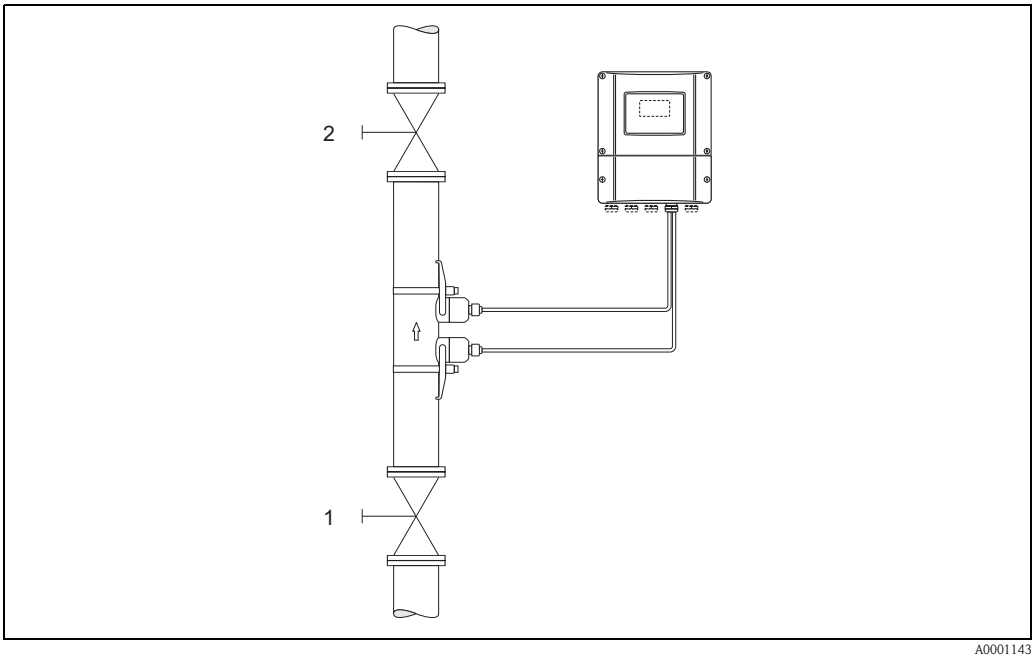


Fig. 52: Zero point adjustment and shut-off valves

Note!
Zero point adjustment can be carried out as follows:
- Via the PROFIBUS configuration program in the manufacturer-specific Transducer Block (Prosonic 90 PBUS → “Device matrix” → ZEROPOINT ADJUST (V5H0))
- Via the local operation (optional)

Performing a zero point adjustment (via local operation)

1. Operate the system until normal operating conditions resume.
2. Stop the flow (v = 0 m/s).
3. Check the shut-off valves for leaks.
4. Check that operating pressure is correct.
5. Using the local operation, select the ZERO POINT ADJUSTMENT function in the function matrix:
   HOME → PROCESS PARAMETERS → ZERO POINT ADJUSTMENT
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...60 seconds while zero point adjustment is in progress.
   – If the fluid velocity 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 POINT ADJUSTMENT function reappears on the display.
8. Back to the HOME position
   – Press and hold down the Esc key (− + Esc) for longer than three seconds.
   – Repeatedly press and release the Esc key (− + Esc).

Performing a zero point adjustment (with configuration program)

1. Operate the system until normal operating conditions resume.
2. Stop the flow (v = 0 m/s).
3. Check the shut-off valves for leaks.
4. Check that operating pressure is correct.
5. Open the configuration program and then the Physical Block.
6. Check whether the write protection for software and hardware is disabled:
   – Software → WRITE LOCKING (V3H0), disabled = 2457, enabled = 0
   – Hardware → HW WRITE PROTEC (V3H1), disabled = 0, enabled = 1
   Disable the write protection, if necessary → Page 66
7. Open the manufacturer-specific Transducer Block (Prosonic 90 PBUS).
8. Enable the programming level:
   – Enter the release code in the ACCESS CODE (V2H0) parameter (factory setting = 90).
   – "DEF. PRIVATE CODE" should now be displayed in the STATUS ACCESS (V2H2) parameter.
9. Start zero point adjustment:
   – Select the "RUN" setting in the ZEROPOINT ADJUST (V5H0) parameter.
   – Start the adjustment by sending this setting to the field device. If the fluid velocity exceeds 0.1 m/s, the error message "ADJUST ZERO FAIL." appears in the "Version info" matrix in the ACTUAL SYS. COND. (V0H0) parameter.
10. Close the configuration program.

6.6 Acyclic data exchange

Acyclic data exchange is used to transfer parameters during commissioning and maintenance or to display other measured variables that are not contained in the useful cyclic data traffic. Thus, parameters for recognising, for controlling or for adjusting can be changed in the various blocks (Physical Block, Transducer Block, function block) while the device is involved in cyclic data exchange with a PLC.

When observing acyclic communication, a distinction must be made between two types:

6.6.1 Class 2 master acyclic (MS2AC)

MS2AC deals with acyclic communication between a field device and a Class 2 master (e.g. Fieldcare, Commuwin, PDM etc., see Page 55). Here, the master opens a communication channel by means of an SAP (service access point) to access the device.

A Class 2 master must be made aware of all the parameters which should be exchanged with a device by means of PROFIBUS. This assignment is made to each individual parameter either in a device description (DD), a DTM (Device Type Manager) or within a software component in the master via slot and index addressing.

The following should be noted with MS2AC communication:
- As already explained, a Class 2 master accesses a device by means of special SAPs. Thus, the number of Class 2 masters that can simultaneously communicate with a device is restricted to the number of SAPs made available for this communication.
- When a Class 2 master is used, the cycle time of the bus system increases.
  This should be taken into account when programming the control system used.

6.6.2 Class 1 master acyclic (MS1AC)

In the case of MS1AC, a cyclic master, which is already reading the cyclic data from the device or writing the data to the device, opens the communication channel via the SAP 0x33 (special service access point for MS1AC) and can then, like a Class 2 master, acyclically read or write a parameter by means of the slot and the index (if supported).

The following should be noted with MS1AC communication:
- At present, there are very few PROFIBUS masters on the market that support this kind of communication.
- Not all PROFIBUS devices support MS1AC.
- In the user program, you must be aware that constant parameter writing (e.g. with every program cycle) can drastically reduce the operating life of a device. Parameters written acyclically are written to memory modules (EEPROM, Flash, etc.). These are resistant to voltage. These memory modules are only designed for a limited number of writes. This number of writes is not even nearly reached in normal operation without MS1AC (during configuration). This maximum figure can be quickly reached as a result of incorrect programming and thus the operating time of a device can be drastically reduced.

The measuring device supports MS2AC communication with 2 available SAPs.
MS1AC communication is supported in this device.
The memory module is designed for 10^6 writes

7 .Maintenance

The Prosonic Flow 90 flow measuring system requires no special maintenance.

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

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.

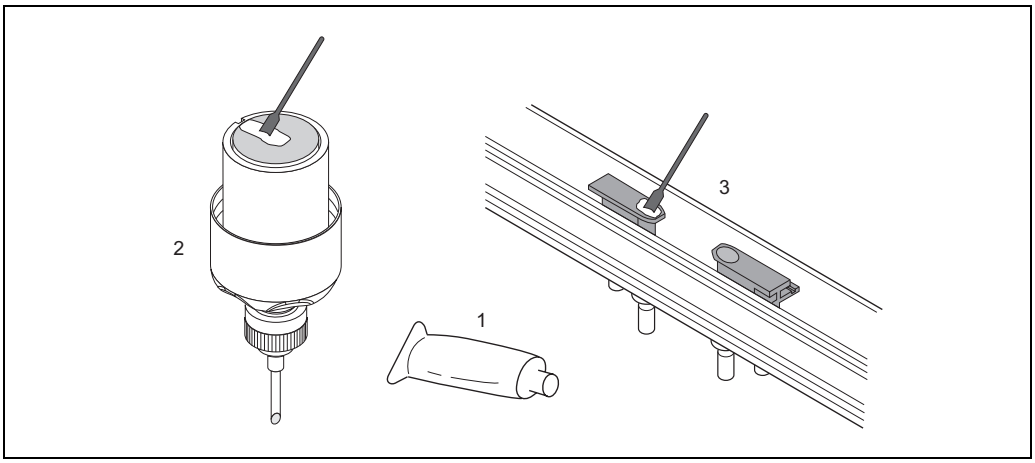


Fig. 53: Application of the coupling fluid

1 Coupling fluid
2 Sensor surface Prosonic Flow W/P
3 Sensor surface Prosonic Flow U

8 Accessories

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

Accessory	Description	Order Code
Transmitter Prosonic Flow 90 PROFIBUS PA	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable entries – Display / power supply / operation – Software – Outputs / inputs	90XXX – XXXXXX*****H
Mounting set for transmitter 90	Mounting set for wall-mount housing. Suitable for: – Wall mounting – Pipe mounting – Panel mounting	DK9WM – A
Flowmeter sensor W	Clamp-on Sensor: –20...+80 °C; DN 100...4000; IP67 –20...+80 °C; DN 50...300; IP67 –20...+80 °C; DN 100...4000; IP68 –20...+80 °C; DN 50...300; IP68 Installation sensor –40...+80 °C; DN 200...4000; IP68	 DK9WS – A* DK9WS – B* DK9WS – M* DK9WS – N* DK9WF – K*
Flowmeter sensor P	Clamp-on Sensor: –40...+80 °C; DN 100...4000 –40...+80 °C; DN 50...300 Clamp-on Sensor: 0...+170 °C; DN 100...4000 0...+170 °C; DN 50...300	 DK9PS – A* DK9PS – B* DK9PS – E* DK9PS – F*
Flowmeter sensor U	Clamp-on Sensor: –20...+80 °C; DN 15...100	 DK9UF – A
Sensor holder set for Prosonic Flow W/P sensors	– Sensor holder, fixed retaining nut, Clamp On version – Sensor holder, removable retaining nut, clamp-on version – Sensor holder, welding type, DN 200...300, Insertion version, single channel – Sensor holder, welding type, DN 300...400, Insertion version, single channel – Sensor holder, welding type, DN 400...4000, Insertion version, single channel – Sensor holder, welding type, DN 400...4000, Insertion version, dual channel	 DK9SH – A DK9SH – B DK9SH – C DK9SH – D DK9SH – E DK9SH – F
Installation set clamp-on sensor fastening for Prosonic Flow W/P Installation set clamp-on Installation aids for Prosonic Flow W/P	– Without sensor fastening – Tensioning bands DN 50...200 – Tensioning bands DN 200...600 – Tensioning bands DN 600...2000 – Tensioning bands DN 2000...4000 – Without mounting support tool – Spacing ruler DN 50...200 – Spacing ruler DN 200...600 – Mounting rail DN 50...200 – Mounting rail DN 200...600	DK9IC – A* DK9IC – B* DK9IC – C* DK9IC – D* DK9IC – E* DK9IC – *1 DK9IC – *2 DK9IC – *3 DK9IC – *4 DK9IC – *5

Accessory	Description	Order Code
Installation set clamp-on sensor fastening for Prosonic Flow U	Installation set DN 15...40 Tensioning bands DN 32...65 Tensioning bands DN 50...100	DK9IS – A DK9IS – B DK9IS – C
Installation set Insertion	Installation set DN 200...1800, Insertion Installation set DN 1800...4000, Insertion	DK9II – A DK9II – B
Sensor cable set for Prosonic Flow W/P sensors	– 5 m sensor cable, PVC, –20...+70 °C – 10 m sensor cable, PVC, –20...+70 °C – 15 m sensor cable, PVC, –20...+70 °C – 30 m sensor cable, PVC, –20...+70 °C – 5 m sensor cable, PTFE, –40...+170 °C – 10 m sensor cable, PTFE, –40...+170 °C – 15 m sensor cable, PTFE, –40...+170 °C – 30 m sensor cable, PTFE, –40...+170 °C	DK9SC – A DK9SC – B DK9SC – C DK9SC – D DK9SC – E DK9SC – F DK9SC – G DK9SC – H
Sensor cable set for Prosonic Flow U sensors	– 5 m sensor cable, PVC, –20...+70 °C – 10 m sensor cable, PVC, –20...+70 °C – 15 m sensor cable, PVC, –20...+70 °C – 30 m sensor cable, PVC, –20...+70 °C – 5 m sensor cable, PTFE, –40...+170 °C – 10 m sensor cable, PTFE, –40...+170 °C – 15 m sensor cable, PTFE, –40...+170 °C – 30 m sensor cable, PTFE, –40...+170 °C	DK9SK – A DK9SK – B DK9SK – C DK9SK – D DK9SK – E DK9SK – F DK9SK – G DK9SK – H
Sensor cable conduit adapter for Prosonic Flow W/P	– Sensor cable conduit adapter incl. sensor cable glands M20x1.5 – Sensor cable conduit adapter incl. sensor cable glands ½" NPT – Sensor cable conduit adapter incl. sensor cable glands G½"	DK9CA – 1 DK9CA – 2 DK9CA – 3
Acoustic coupling medium	– Wacker P –40...+80 °C – Coupling medium 0...170 °C, standard – Adhesive coupling medium –40...+80 °C – Water-soluble coupling medium –20...+80 °C – SilGel –40...+130 °C – Coupling medium DDU 19 –20...+60 °C – Coupling medium –40...+80 °C, standard, typ MBG2000	DK9CM – 1 DK9CM – 2 DK9CM – 3 DK9CM – 4 DK9CM – 5 DK9CM – 6 DK9CM – 7
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 – *
ToF Tool - Fieldtool Package	Configuration and service software for flowmeters in the field: – Commissioning, maintenance analysis – Configuring measuring devices – Service functions – Visualisation of process data – Trouble-shooting – Controlling the Fieldcheck tester/simulator Contact your Endress+Hauser representative for more information.	DXS10 – *****

Accessory	Description	Order Code
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the ToF Tool - Fieldtool Package software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	DXC10 – **

9 Trouble-shooting

9.1 Trouble-shooting instructions

Always start trouble-shooting with the checklists below, if faults occur after start-up or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Caution!
In the event of a serious fault, a measuring device might have to be returned to the manufacturer for repair. The procedures on Page 8 must be carried out before you return a measuring device to Endress+Hauser.
Always enclose a duly completed "Declaration of Contamination" form. You will find a preprinted form at the back of this manual!

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → Terminal 1, 2 2. Check the device fuse → Page 114 85...260 V AC: 0.8 A slow-blow / 250 V 20...55 V AC and 16...62 V DC: 2 A slow-blow / 250 V 3. Electronics defective → Order spare part → Page 110
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 110, 112 2. Display module defective → Order spare part → Page 110 3. Electronics defective → Order spare part → Page 110
Display texts are in a foreign language.	Switch off the power supply. Press the ⊟+ key combination and switch on the power supply again at the same time. The display text will appear in English (default) and is displayed at maximum contrast.

▼

Error messages on display	
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example): – Error type: **S** = System error, **P** = Process error – Error message type: ϟ = Fault message, **!** = Notice message – **S.VELOC RANGE** = Error designation (e.g. sound velocity outside measuring range) – **03:00:05** = Duration of error occurrence (in hours / minutes / seconds) – **# 491** = Error number Caution! ■ See the information on Page 51 ff.! ■ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.	
Error number: No. 001 – 391 No. 501 – 692	System error (device failure) has occurred → Page 103 ff.
Error number: No. 491 No. 731	Process error (application error) has occurred → Page 103 ff.

▼

Faulty connection to control system	
No connection can be made between the control system and the device. Check the following points:	
Supply voltage Transmitter	Check the supply voltage → Terminal 1, 2
Device fuse	Check the device fuse → Page 114 85...260 V AC: 0.8 A slow-blow / 250 V 20...55 V AC and 16...62 V DC: 2 A slow-blow / 250 V
Fieldbus connection	Check the data lines.
Fieldbus connector	– Check the pin assignment / wiring → Page 46 – Check the connection between connector / fieldbus port. Is the coupling ring tightened correctly?
Fieldbus voltage	Check that a min. bus voltage of 9 V DC is present at terminals 26/27. Permissible range: 9 ... 32 V DC
Network structure	Check the permissible fieldbus length and number of spurs → Page 36
Basic current	Is there a basic current of min. 11 mA?
Bus address	Check the bus address: Make sure there are no double assignments!
Terminators	Has the PROFIBUS network been terminated correctly? Each bus segment must always be terminated with a bus terminator at both ends (start and finish). Otherwise interference may affect communication.
Current consumption Permissible feed current	Check the current consumption of the bus segment. The current consumption of the bus segment in question (= total of basic currents of all fieldbus stations) must not exceed the max. permitted feed current of the fieldbus power supply.

▼

System or process error messages
System or process errors which occur during commissioning or operation can also be displayed in the manufacturer-specific device controls using an operating program, such as Commuwin II → Page 103 ff.

▼

Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → Page 109

9.2 System and process error messages

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

Error message type "Fault message":
- If this message occurs, measuring operation is immediately interrupted or stopped!
- Display on the PROFIBUS → Fault messages are relayed to downstream function blocks or higher-level process control systems with the status "BAD" of the corresponding process variable.
- Local operation → A lightning symbol (ϟ) flashes on the display.

Error message type "Notice message":
- Normal measuring operation continues despite this message!
- Display on the PROFIBUS → Notice messages are relayed to downstream function blocks or higher-level process control systems with the status "UNC(ERTAIN)" of the corresponding process variable.
- Local operation → An exclamation mark (!) flashes on the display.

Serious system errors, e.g. electronic module defects, are always categorised and displayed as "Fault messages" by the measuring device. On the other hand, the measuring system interprets simulations and positive zero return as "Notice messages".

Error messages in the configuration program (cl. 2 master) → see table
In Prosonic Flow 90, system and process errors are interpreted and reported in the manufacturer-specific Transducer Block (Prosonic 90 PBUS) → partial matrix "Version info" → ACTUAL SYS. COND.(V0H0) and Analog Input Block. The following table contains a list of device status messages pertaining to the Analog Input Blocks (PROFIBUS Profile 3.0) as well as a description of the possible device status messages on the display (measured value Q = measured value quality).

Error messages on the local operation → see table

Device status message Diagnosis message (Control system)	Device status message (Display)	No.	Output status Analog Input Block / Totalizer Block	Measured value Q/ Substatus/ alarm limit	Cause / remedy
ROM / RAM Failure	S CRITICAL FAILURE ϟ # 001	1	device failure	BAD 0x0F constant	*Cause:* System error. ROM / RAM error. Error when accessing the program memory (ROM) or random access memory (RAM) of the processor. *Remedy:* Replace the amplifier board. Spare parts → Page 110
Amplifier EEPROM failure	S AMP HW EEPROM ϟ # 011	11	device failure	BAD 0x0F constant	*Cause:* System error. Measuring amplifier has faulty EEPROM *Remedy:* Replace the amplifier board. Spare parts → Page 110

Device status message Diagnosis message (Control system)	Device status message (Display)	No.	Output status Analog Input Block / Totalizer Block	Measured value Q/ Substatus/ alarm limit	Cause / remedy
Amplifier EEPROM data inconsistent	S AMP SW-EEPROM ϟ # 012	12	device failure	BAD 0x0F constant	*Cause:* System error. Error when accessing data of the measuring amplifier EEPROM *Remedy:* Execute a warm start (= start up the measuring system without network interruption). ■ PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → Version info → SYSTEM RESET (V0H2) ■ Local operation: SUPERVISION → SYSTEM RESET → "RESTART SYSTEM"
Compatibility Amp. - I/O module	S A / C COMPATIB. ϟ # 051	51	device failure	BAD 0x0F constant	*Cause:* The I/O board and the amplifier board are not compatible. *Remedy* Use only compatible assemblies and boards. Use the following to check the compatibility of the assemblies used: – Spare part set number – Hardware revision code
Interruption between sensor and transmitter	S SENSOR DOWN ϟ # 081	81	sensor failure	BAD 0x13 constant	*Cause:* System error. The connection between sensor and transmitter is interrupted. *Remedy* – Check the cable connection between the sensor and the transmitter. – Check that the sensor connector is fully screwed in. – The sensor may be defective. – An incorrect sensor is connected. – An incorrect sensor is selected: ■ PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → partial matrix "Sensor data" → SENSOR TYPE (V3H1) ■ SENSOR DATA → SENSOR TYPE Local operation:

Device status message Diagnosis message (Control system)	Device status message (Display)	No.	Output status Analog Input Block / Totalizer Block	Measured value Q/ Substatus/ alarm limit	Cause / remedy
Interruption between sensor and transmitter	S SENSOR UP ϟ # 084	84	sensor failure	BAD 0x13 constant	*Cause:* System error. The connection between sensor and transmitter is interrupted. *Remedy* – Check the cable connection between the sensor and the transmitter. – Check that the sensor connector is fully screwed in. – The sensor may be defective. – An incorrect sensor is connected. – An incorrect sensor is selected: ▪ PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → partial matrix "Sensor data" → SENSOR TYPE (V3H1) ▪ SENSOR DATA → SENSOR TYPE Local operation:
Totalizer checksum error	S CHECKSUM. TOT. ϟ # 111	111	device failure	BAD 0x0F constant	*Cause:* System error. Totalizer checksum error. *Remedy:* 1. Restart the device. 2. If necessary, replace the amplifier board. Spare parts → Page 110
Amplifier and I/O board only partially compatible	S A / C COMPATIB. ϟ # 121	121	device failure	BAD 0x0F constant	*Cause:* Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality). ✎ Note! – The indication on the display as notice message appears only for 30 seconds (with listing in "Previous system condition" function). – This condition can occur if only one electronics board has been exchanged; the extended software functionality is not available. The previously existing software functionality is still working and the measurement possible. *Remedy:* Module with lower software version has either to be actualizied by ToF Tool - Fieldtool Package with the required software version or the module has to be replaced. Spare parts → Page 110

Device status message Diagnosis message (Control system)	Device status message (Display)	No.	Output status Analog Input Block / Totalizer Block	Measured value Q/ Substatus/ alarm limit	Cause / remedy
Communication failure	S COMMUNICAT. I/O ϟ # 261	261	no communication	BAD 0x18 no limits	*Cause:* System error. Communication error. No data reception between amplifier and I/O board or faulty internal data transfer. *Remedy:* Check whether the electronics boards are correctly inserted in their holders, see Page 111, 112.
Attenuation of acoustic measurement section too high	S SIGNAL TOO LOW ϟ # 391	391	device failure	BAD 0x0F constant	*Cause:* System error. Attenuation of acoustic measurement section too high. *Remedy:* – 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 distance (installation dimensions). – Reduce the number of traverses if possible.
Pipe data	P PIPE DATA ϟ # 468	468	device failure	BAD 0x0F constant	*Cause:* The inner diameter is negative. *Remedy:* – In the function group PIPE DATA check the values of the functions CIRCUMFERENCE and WALL THICKNESS resp. LINER THICKNESS.
Sound velocity outside the range	P S. VELOC RANGE ϟ # 491	491	non specific	BAD 0x03 constant	*Cause:* Process error. Sound velocity is outside the search range of the transmitter. *Remedy:* – 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. Detailed information on this topic is provided in the Description of Device Functions Prosonic Flow 90 (BA 075D/06/en) manual under the SOUND VELOCITY LIQUID function or under Commuwin II → Parameter SOUND VELOCITY LIQUID

Device status message Diagnosis message (Control system)	Device status message (Display)	No.	Output status Analog Input Block / Totalizer Block	Measured value Q/ Substatus/ alarm limit	Cause / remedy
Interference	P INTERFERENCE ! # 494	494	non specific	UNCERTAIN 0x43 constant	Cause: 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. *Remedy:* – In the SENSOR CONFIGURATION function, change the number of traverses from 2 or 4 to 1 or 3 and mount the sensors accordingly.
New amplifier software loaded	S SW.-UPDATE ACT. ! # 501	501	substitute set	UNCERTAIN 0x48 no limits	*Cause:* New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible. *Remedy:* Wait until the procedure has finished. The device will restart automatically.
Up- or downloading via configuration program	S UP-/DOWNLOAD ACT ! # 502	502	substitute set	UNCERTAIN 0x48 no limits	*Cause:* Up- or downloading the device data via configuration program. Currently no other functions are possible. *Remedy:* Wait until the procedure has finished.
Positive zero return active	S POS ZERO RETURN ! # 601	601	sensor conversion not accurate	UNCERTAIN 0x53 constant	*Cause:* System error. Positive zero return is activated *Remedy:* Switch off positive zero return: ■ PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → Device matrix → POSITIVE ZERO RETURN (V8H3) ■ Local operation: SYSTEM PARAMETERS → POSITIVE ZERO RETURN
Simulation of response to error	S SIM. FAILSAFE ! # 691	691	substitute set	UNCERTAIN 0x48...0x4B low/high constant	*Cause:* System error. Simulation of response to error is active. *Remedy:* Switch off the simulation: ■ PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → Version info → SIM. FAILSAFE MODE (V4H2) ■ Local operation: SIMULATION SYSTEM → SIM. FAILSAFE

Device status message Diagnosis message (Control system)	Device status message (Display)	No.	Output status Analog Input Block / Totalizer Block	Measured value Q/ Substatus/ alarm limit	Cause / remedy
Simulation of measuring active	S SIM. MEASURAND ! # 692	692	simulated value	UNCERTAIN 0x60...0x63 low/high constant	*Cause:* System error. Simulation of volume flow active. *Remedy:* Switch off the simulation: ■ PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → Version info → SIM. MEASURAND (V4H0) ■ Local operation: SIMULATION SYSTEM → SIM. MEASURAND
Device test via Fieldcheck active	S DEV. TEST ACT. ! # 698	698	simulated value	UNCERTAIN 0x60...0x63 low / high constant	*Cause:* System error. The measuring device is being checked on site via the test and simulation device. *Remedy:* Wait until the procedure has finished.
Zeropoint adjustment failure	P ADJ. ZERO FAIL ϟ # 731	731	non specific	UNCERTAIN 0x40 no limits	*Cause:* Static zero point adjustment is not possible or was cancelled. *Remedy:* Make sure that zero point adjustment is carried out at zero flow → Page 93
No communication to amplifier	–	–	device failure	BAD 0x0F constant	*Cause:* Communication error. No communication to the amplifier. *Remedy:* 1. Switch power supply off and then on again. 2. Check whether the electronics boards are correctly inserted in their holders, see Page 111, 112.

9.3 Process errors without message

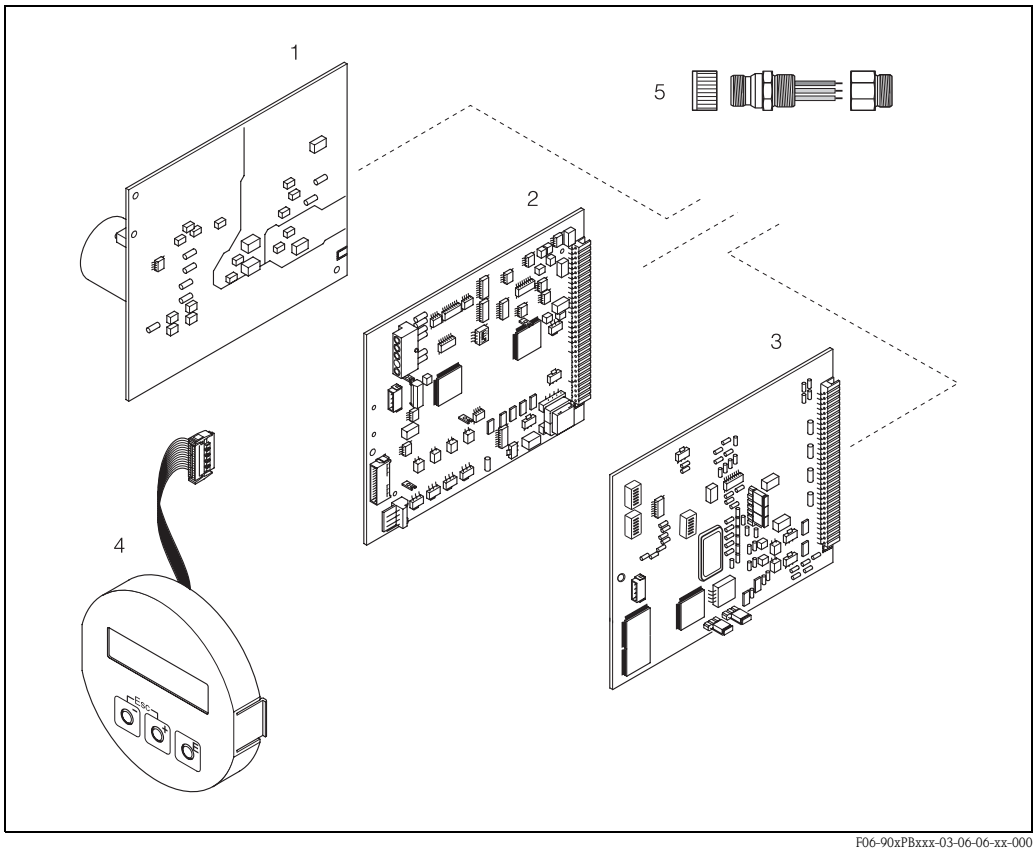
Symptoms	Rectification
Remark: You may have to change or correct settings in certain functions of the function matrix in order to eliminate faults. The following parameters and functions are described in detail in the "Description of Device Functions" manual.	
Measured value display fluctuates even though flow is steady	1. Check the fluid for presence of gas bubbles. 2. Increase the following values: – PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → Device matrix → FLOW DAMPING (V8H2); Analog Input function block → RISING TIME (V1H8) – Local operation: HOME → SYSTEM PARAMETERS → FLOW DAMPING 3. Increase the value for the display damping: – PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → Device matrix → DISPLAY DAMPING (V3H1) – Local operation: HOME → DISPLAY → DISPLAY DAMPING
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. Enter a value for the low flow cutoff or increase this value: – PROFIBUS (Commuwin II): Manufacturer-specific Transducer Block → Device matrix → ON-VALUE LOW FLOW CUT OFF (V3H1) – Local operation: HOME → PROCESS PARAMETERS → ON-VALUE LOW FLOW CUT OFF
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your Endress+Hauser service organisation.	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 organisation to have a service technician sent out, please be ready with the following information: – Brief description of the fault – Nameplate specifications (Page 9 ff.): order code and serial number **Returning devices to Endress+Hauser** The procedures on Page 8 must be carried out before you return a measuring device requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of Contamination" form with the device. You will find a preprinted form at the back of these Operating Instructions. **Replace transmitter electronics** Components in the measuring electronics defective → Order spare part → Page 110

9.4 Spare parts

Chap. 9.1 contains detailed trouble-shooting instructions. The measuring device, more over, provides additional support in the form of continuous self-diagnosis and error messages. Trouble-shooting can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.

Note!
You can order spare parts directly from your Endress+Hauser service organisation by providing the serial number printed on the transmitter nameplate (see Page 9).

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



F06-90xPBxxx-03-06-06-xx-000

Fig. 54: Spare parts for Proline Prosonic Flow 90 PROFIBUS PA transmitter (field and wall-mount housing)

1 Power unit board (85...260 V AC, 20...55 V AC, 16...62 V DC)
2 Amplifier board
3 I/O board type PROFIBUS PA (Com module)
4 Display module
5 Fieldbus connectors comprising protection cap, connector, adapter piece PG 13.5/M20.5 (Order no. 50098037)

9.5 Removing and installing electronics boards

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, purposely built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.

Procedure (Fig. 55):

1. Switch off the power supply.
2. Loosen the screws and open the housing cover (1).
3. Loosen the screws of the electronics module (2). Push the electronic module upwards. Pull the module out of the wall-mount housing as far as possible.
4. Now disconnect the following cable plugs from amplifier board (7):
   – Sensor signal cable (7.1) plug
   – Ribbon cable (3) plug of the display module
5. Loosen the screws of the electronics compartment cover (4) and remove the cover.
6. Remove the boards (6, 7, 8) as follows:
   Insert a thin pin into the hole provided (5) and pull the board clear of its holder.
7. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser replacement parts.

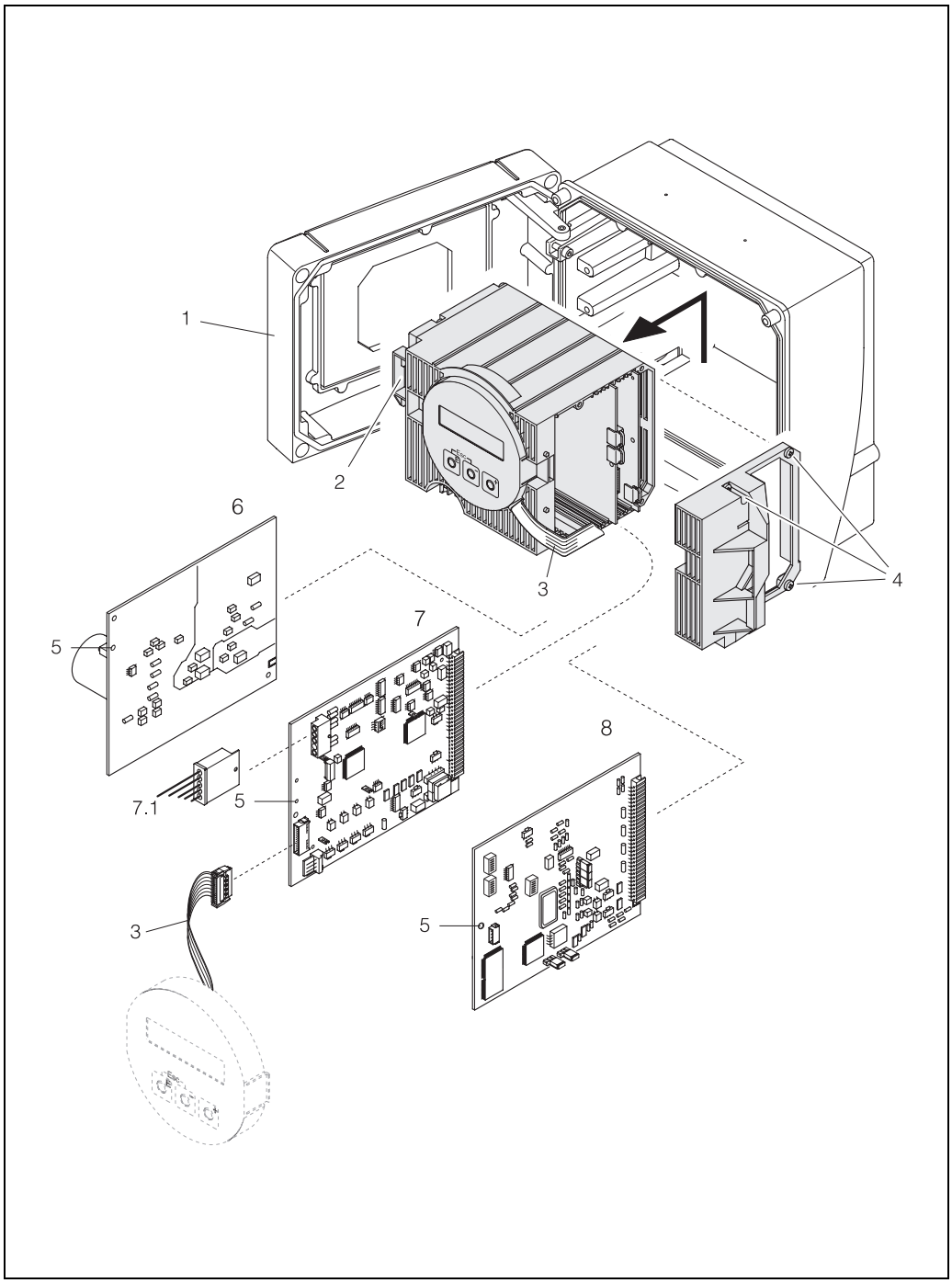


Fig. 55: Wall-mount housing: removing and installing electronics boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Screws of electronics compartment cover
5 Hole for installing/removing boards
6 Power unit board
7 Amplifier board
7.1 Sensor signal cable
8 I/O board type PROFIBUS PA

9.6 Removing and installing flowrate measuring sensors W “Insertion”

The active part of the flowrate measuring sensor W “Insertion” can be replaced without interrupting the process.

1. Pull the sensor connector (1) out of the sensor cover (3).
2. Remove the small retainer ring (2). This is located on the top of the sensor neck and keeps the sensor cover in place.
3. Remove the sensor cover (3) and spring (4).
4. Remove the large retainer ring (5). This keeps the sensor neck (6) in place.
5. Now remove the sensor neck. Note that you must reckon with a certain amount of resistance.
6. Pull the sensor element (7) out of the sensor holder (8) and replace it with a new one.
7. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser replacement parts.

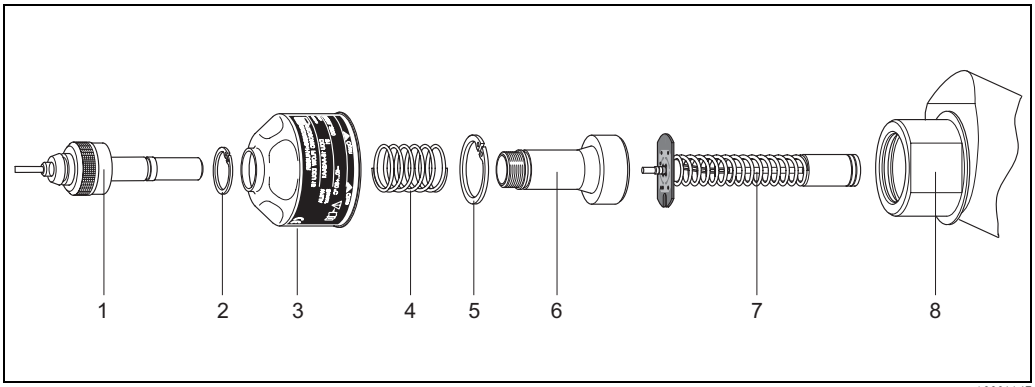


Fig. 56: Flowrate measuring sensor W “Insertion”: installation and removal

1 Sensor connector
2 Small retainer ring
3 Sensor cover
4 Spring
5 Large retainer ring
6 Sensor neck
7 Sensor element
8 Sensor holder

9.7 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 power unit board (Fig. 57).

The procedure for replacing the fuse is as follows:

1. Switch off the power supply.
2. Remove the power unit board → Page 111, 112
3. Remove the protection cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – Power supply 20...55 V AC / 16...62 V DC → 2.0 A slow-blow / 250 V; 5.2 x 20 mm
   – Power supply 85...260 V AC → 0.8 A slow-blow / 250 V; 5.2 x 20 mm
   – Ex-systems → See appropriate Ex documentation
4. Installation is the reverse of the removal procedure.

☝ Caution!
Use only original Endress+Hauser replacement parts.

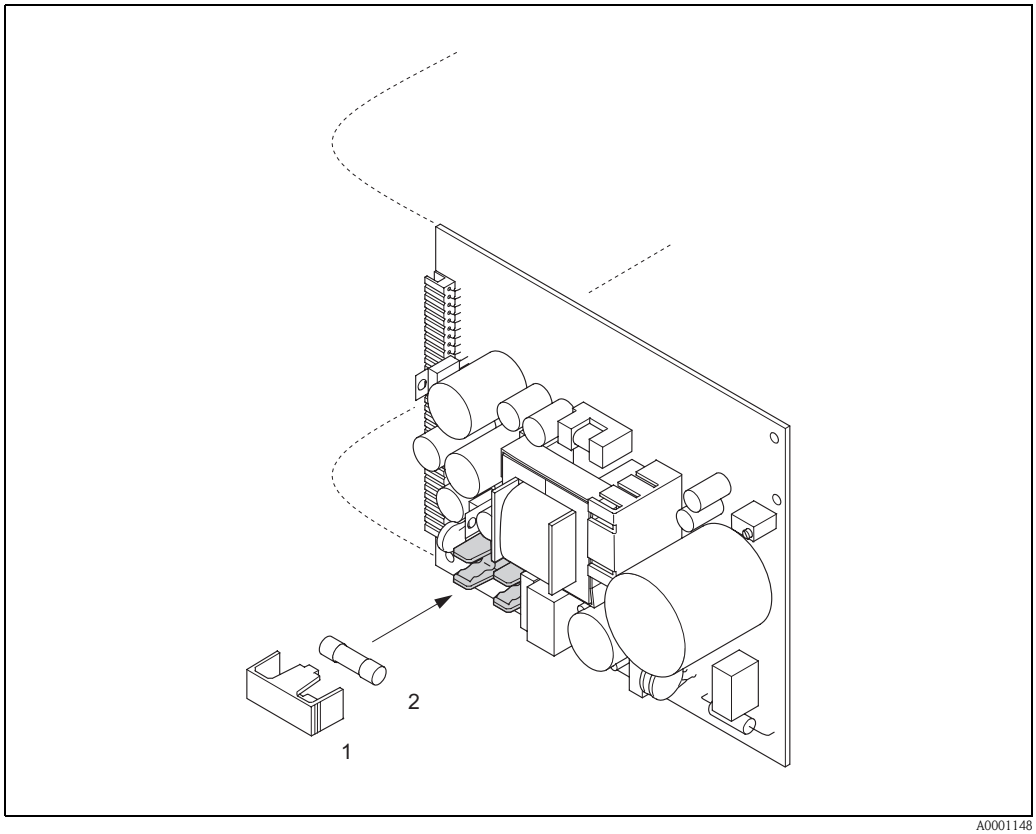


Fig. 57: Replacing the device fuse on the power unit board

1 Protection cap
2 Device fuse

9.8 Software history

Date	Software version	Changes to software	Operating Instructions
11.2004	2.03.XX	Software expansion: – Prosonic Flow P sensor – Language group (contains the language Chinese and English) New functionalities: – DEVICE SOFTWARE → Device software displayed (NAMUR-recommendation 53)	50101779/11.04
10.2003	Amplifier: 1.06.XX Communication module: 2.03.XX	Software expansion: – Language groups New functionalities: – Operation hours counter – Adjustable backlight – Access code counter – Reset function fault history – Up-/download with Fieldtool in preparation	50101779/10.03
12.2002	Amplifier: 1.05.00 Communication module: 2.02.00	Software expansion: – Prosonic Flow U sensor – New error messages: PIPE DATA INTERFERENCE – Update Commuwin II Matrix – Update GSD	50101779/12.02
05.2002	Amplifier: 1.01.00 Communication module: 2.00.01	Original software. Compatible with: – Fieldtool – Commuwin II (version 2.07.02 and higher) – PROFIBUS DP/PA version 3.0	50101779/05.02

✎ Note!
Usually, an upload or download between the different software versions is only possible with a special service software.

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

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

10.1.2 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 measuring sensors. The following version is available: ■ Version for installing in safe area *Transmitter:* ■ Prosonic Flow 90 PROFIBUS PA *Measuring sensors:* ■ Prosonic Flow P clamp-on version (for chemical and process applications) for nominal diameters DN 50...4000 ■ Prosonic Flow W clamp-on version (water/wastewater applications) for nominal diameters DN 50...4000 ■ Prosonic Flow U clamp-on version (water/ultra pure water applications) for nominal diameters DN 15...100 dedicated for plastic pipes ■ Prosonic Flow W Insertion version (water/wastewater applications) for nominal diameters DN 200...4000

10.1.3 Input

Measured variable	Flow velocity (Transit time difference proportional to flow velocity)
Measuring range	Typically v = 0...15 m/s with the specified measuring accuracy for Prosonic Flow W/P Typically v = 0...10 m/s with the specified measuring accuracy for Prosonic Flow U
Operable flow range	Over 150 : 1

10.1.4 Output PROFIBUS PA

Output signal	PROFIBUS PA interface: PROFIBUS PA in accordance with EN 50170 Volume 2, IEC 61158-2 (MBP), Profile Version 3.0, galvanically insulated.
Signal on alarm	PROFIBUS PA interface: Status and alarm messages in accordance with PROFIBUS PA Profile Version 3.0.
Current consumption	11 mA
Permissible feed voltage	9...32 V, not intrinsically safe
FDE (Fault Disconnection Electronic)	0 mA
Data transmission rate	PROFIBUS PA: Supported baud rate = 31.25 kBaud
Signal coding	PROFIBUS PA: Manchester II
Acyclic communication	■ Supports Class 2 master acyclic (MS2AC) communication with 2 available service access points. ■ Supports Class 1 master acyclic (MS1AC) communication with approx. 10^6 writes.

10.1.5 Power supply

Electrical connection	see Page 35 ff.
Potential equalisation	For instruments for use in hazardous areas, observe the corresponding guidelines in the Ex-specific supplementary documentation.
Cable entries	Power supply and signal cables (inputs/outputs): ■ Cable entry M20 x 1.5 or ■ Cable gland for cables with Ø 6...12 mm ■ Threaded adapter 1/2" NPT, G 1/2" Sensor cable connection (see Fig. 34 on Page 38): A special cable gland allows you to insert both sensor cables into the connection compartment simultaneously. ■ Cable gland M20 x1.5 for 2 x Ø 4 mm or ■ Threaded adapter 1/2" NPT, G 1/2"
Cable specifications	see Page 39

Supply voltage	Transmitter: ■ 85...260 V AC, 45...65 Hz ■ 20...55 V AC, 45...65 Hz ■ 16...62 V DC Measuring sensors: powered by the transmitter
Power consumption	AC: <18 VA (incl. measuring sensors) DC: <10 W (incl. measuring sensors) Switch-on current: ■ Max. 13.5 A (< 50 ms) at 24 V DC ■ Max. 3 A (< 5 ms) at 260 V AC
Power supply failure	Lasting min. 1 power cycle: EEPROM saves measuring system data if power supply fails.

10.1.6 Performance characteristics

Reference operating conditions	■ Fluid temperature: +28 °C ± 2 K ■ Ambient temperature: +22 °C ± 2 K ■ Warm-up period: 30 minutes Installation: ■ Inlet run >10 x DN ■ Outlet run > 5 x DN ■ Sensor and transmitter grounded.
Maximum measured error	For flow velocities of > 0.3 m/s and a Reynolds number of >10000, the system accuracy is: ■ Pipe diameter DN < 50: ± 0,5% o.r. ± 0,1 % o.f.s. * ■ Pipe diameter 50 < DN < 200: ± 0.5% o.r. ± 0.05% o.f.s. ■ Pipe diameter > DN 200: ± 0.5% o.r. ± 0.02% o.f.s. o.r. = of reading o.f.s. = of full scale value * plastic pipes only As standard, the system is dry-calibrated. The dry calibration procedure results in an additional uncertainty of measurement. This measuring uncertainty is better than 1.5% typically. During dry calibration, the characteristics of the pipe and the fluid are derived to calculate the calibration factor. As verification of the accuracy, an accuracy report is offered as an option. Accuracy is verified using a stainless steel pipe.

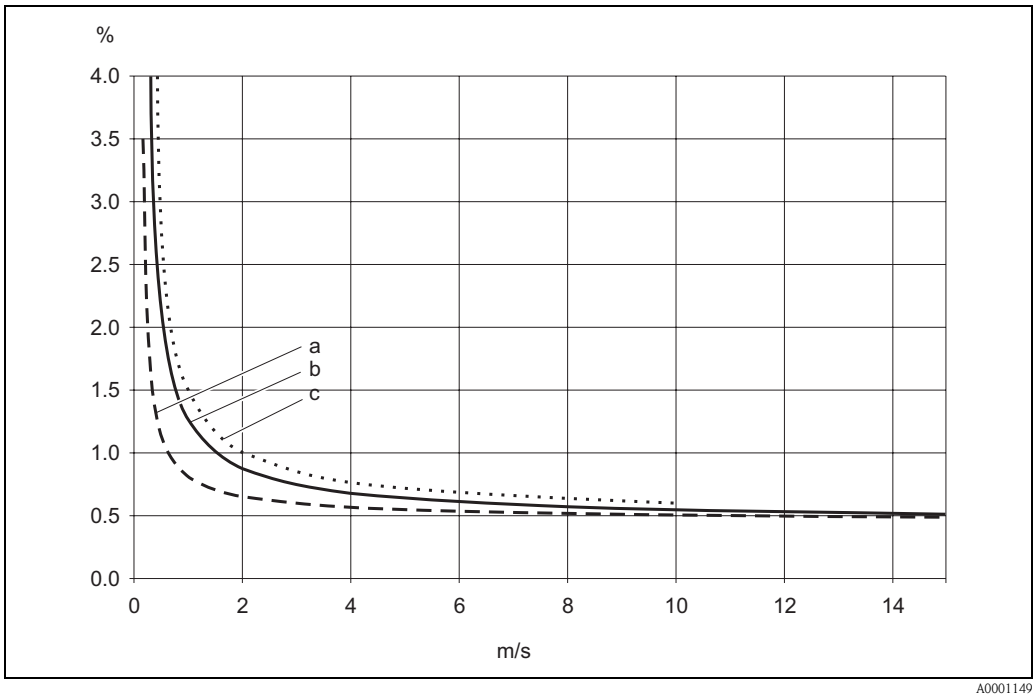


Fig. 58: Max. measured error (wet calibration) in % of measured value

a = Pipe diameter > DN 200
b = Pipe diameter 50 < DN < 200
c = Pipe diameter DN < 50

Repeatability	Max. ± 0.3% for flow velocities > 0.3 m/s

10.1.7 Operating conditions

Installation

Installation instructions	Any orientation (vertical, horizontal) Restrictions and additional installation instructions → Page 14 ff.
Inlet and outlet runs	Clamp-on version → Page 15 Insertion version → Page 16
Length of connecting cable	Shielded cables are offered in the following lengths: 5 m, 10 m, 15 m and 30 m Route the cable well clear of electrical machines and switching elements.

Environment

Ambient temperature	■ Transmitter Prosonic Flow 90: –20...+60 °C optionally: –40...+60°C ✎ Note! At ambient temperatures below –20°C the readability of the display may be impaired. ■ Flowrate measuring sensors Prosonic Flow P (clamp-on): –40...+80 °C / 0...+170 °C ■ Flowrate measuring sensors Prosonic Flow W (clamp-on): –20...+80 °C ■ Flowrate measuring sensors Prosonic Flow U (clamp-on): –20...+60 °C ■ Flowrate measuring sensors Prosonic Flow W (Insertion version): –40...+80 °C ■ Sensor cable PTFE: –40...+170 °C; Sensor cable PVC: –20...+70 °C ■ In heated piping or piping conveying cold fluids, it is always permissible to insulate the piping completely with the mounted ultrasonic sensors. ■ Install the transmitter at a shady location. 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	■ Prosonic Flow 90 transmitter: IP 67 (NEMA 4X) ■ Flowrate measuring sensors Prosonic Flow P (clamp-on): IP 68 (NEMA 6P) ■ Flowrate measuring sensors Prosonic Flow W (clamp-on): IP 67 (NEMA 4X) ■ Flowrate measuring sensors Prosonic Flow U (clamp-on): IP 54 ■ Flowrate measuring sensors Prosonic Flow W (Insertion version): IP 68 (NEMA 6P)
Shock and vibration resistance	According to IEC 68-2-6
Electromagnetic compatibility (EMC)	To EN 61326/A1 (IEC 1326) “Emission to class A requirements” and NAMUR Recommendations NE 21

Process

Medium temperature range	■ Flowrate measuring sensors Prosonic Flow P (clamp-on): –40...+80 °C / 0...+170°C ■ Flowrate measuring sensors Prosonic Flow W (clamp-on): –20...+80 °C ■ Flowrate measuring sensors Prosonic Flow U (clamp-on): –20...+80 °C ■ Flowrate measuring sensors Prosonic Flow W (Insertion version): –40...+80 °C

Medium pressure range (nominal pressure)

Perfect measurement requires that the static fluid pressure is higher than vapour pressure.

Max. nominal pressure, flowrate measuring sensors W (Insertion vers.): PN16 (PSI 232)

Pressure loss

There is no pressure loss.

10.1.8 Mechanical construction

Design, dimensions

see Page 125 ff.

Weight

Transmitter housing:
Wall-mount housing: 6.0 kg

Measuring sensors:
- Flowrate measuring sensors P (clamp-on) incl. mounting rail and tensioning bands: 2.8 kg
- Flowrate measuring sensors W (clamp-on) incl. mounting rail and tensioning bands: 2.8 kg
- Flowrate measuring sensors U (clamp-on): 1 kg
- Flowrate measuring sensors W (Insertion): 4.5 kg

Material

Transmitter housing 90 (wall-mount housing):
Powder-coated die-cast aluminum

Standard designations of the materials (measuring sensors W/P/U)

	DIN 17660	**UNS**
Standard sensor cable – Cable connector (nickled brass) – Cable sheath	 2.0401 PVC	 C38500 PVC
	DIN 17440	**AISI**
Sensor housing W/P (clamp-on)	1.4301	304
Sensor holder W/P (clamp-on)	1.4308	CF-8
Sensor housing U (clamp-on)	Plastic	
Frame end-piece for U sensor – Cast steel	 1.4308	 CF-8
Welding parts for W sensors (Insertion version)	1.4301	304
Sensor contact surface	Chemical resistant plastic	
Tensioning bands	1.4301	304
High temperature sensor cable – Cable connector (stainless steel) – Cable sheath	 1.4301 PTFE	 304 PTFE
	DIN EN 573-3	**ASTM B3221**
U sensor fixation bar – Cast aluminum	 EN AW-6063	 AA 6063

10.1.9 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 with three keys (−, +, E) ■ "Quick Setup" for quick and easy commissioning
Remote operation	Operation via PROFIBUS PA
Language group	Language groups available for operation in different countries: ■ Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese ■ Eastern Europe and Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish and Czech ■ South and east Asia (SEA): English, Japanese, Indonesian ■ China (CIN): English, Chinese You can change the language group via the operating program "ToF Tool – Fieldtool Package."

10.1.10 Certificates and approvals

Ex approval	The transmitter housing (wall-mount housing) is suitable for use in ATEX II3G (Ex Zone 2). Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your Endress+Hauser Sales Centre on request. All explosion protection data are given in a separate documentation which is available upon request.
CE approval	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.
Certification PROFIBUS PA	The Prosonic Flow 90 flowmeter has successfully passed all the test procedures implemented and has been certified and registered by the PNO (PROFIBUS User Organisation). The device thus meets all the requirements of the specifications listed below: ■ Certified for PROFIBUS 3.0 Device certification number: available upon request ■ The instrument meets all of the PROFIBUS 3.0 specifications. ■ The device may also be operated using certified devices from other manufacturers (interoperability).
Other standards and guidelines	EN 60529: Degrees of protection by housing (IP code) EN 61010 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures. EN 61326/A1 (IEC 1326) "Emission to class A requirements" Electromagnetic compatibility (EMC requirements) NAMUR NE 21 Electromagnetic compatibility (EMC) of imdustrial process and laboratory control equipment.

10.1.11 Ordering information

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

10.1.12 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor (see Page 98). The Endress+Hauser service organisation can provide detailed information on the order codes of your choice.

10.1.13 Documentation

- System Information Prosonic Flow 90/93 (SI 034D/06/en)
- Technical Information Prosonic Flow 90/93 W/U/C (TI 057D/06/en)
- Description of Device Functions Prosonic Flow 90 PROFIBUS PA (BA 075D/06/en)
- Supplementary Ex documentation: ATEX, FM, CSA, etc.

10.2 Dimensions of wall-mount housing

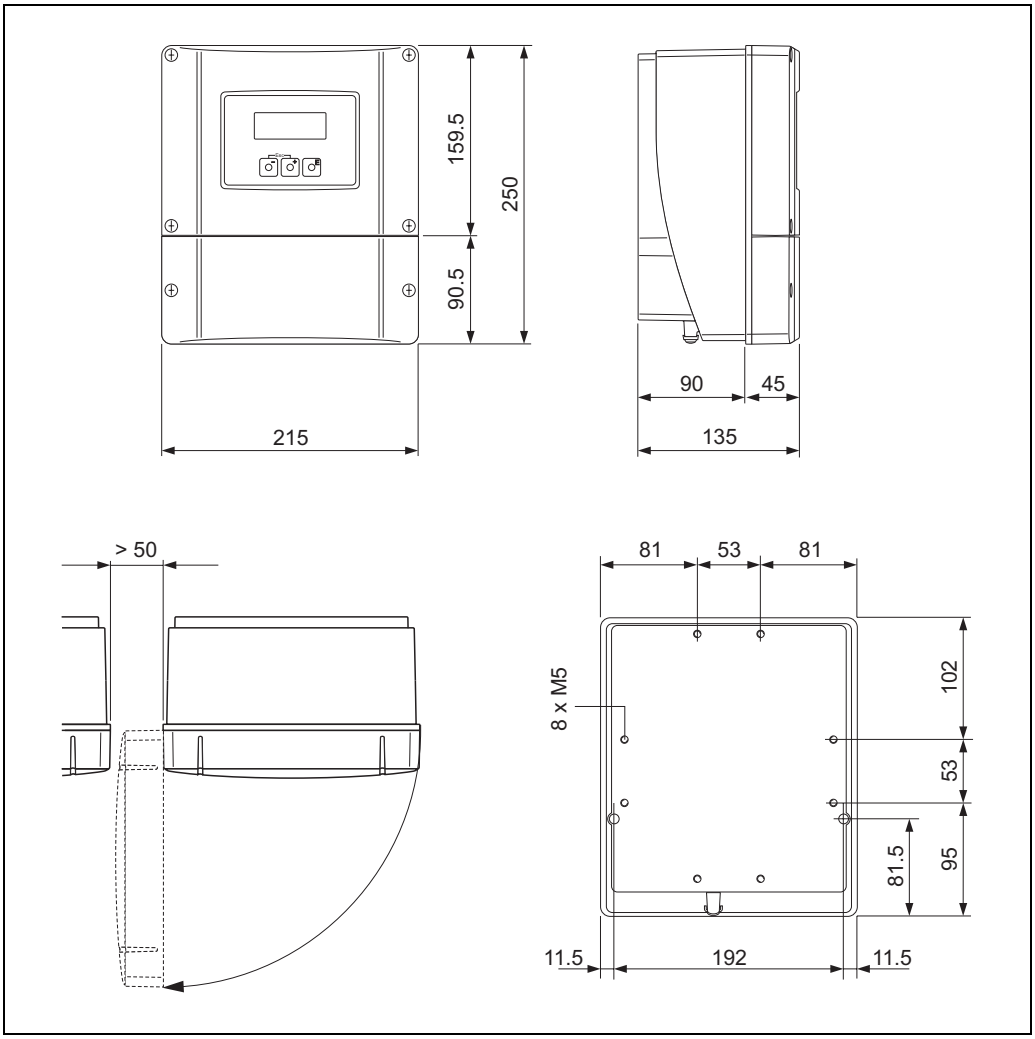


Fig. 59: Dimensions of wall-mount housing (panel mounting and pipe installation) → *Page 33*

10.3 Dimensions of P sensors (clamp-on)

2 or 4 traverses version

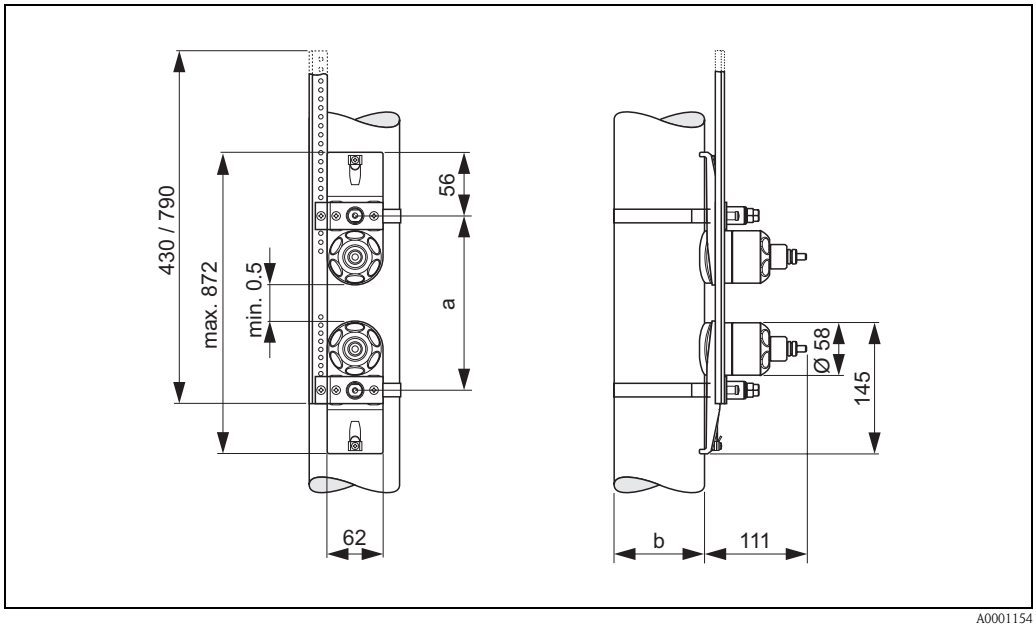


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Fig. 60: Dimensions of P sensor (clamp-on) / (version: 2 or 4 traverses)

a = Sensor spacing can be determined using Quick Setup
b = Pipe outer diameter (defined by the application)

1 traverse version

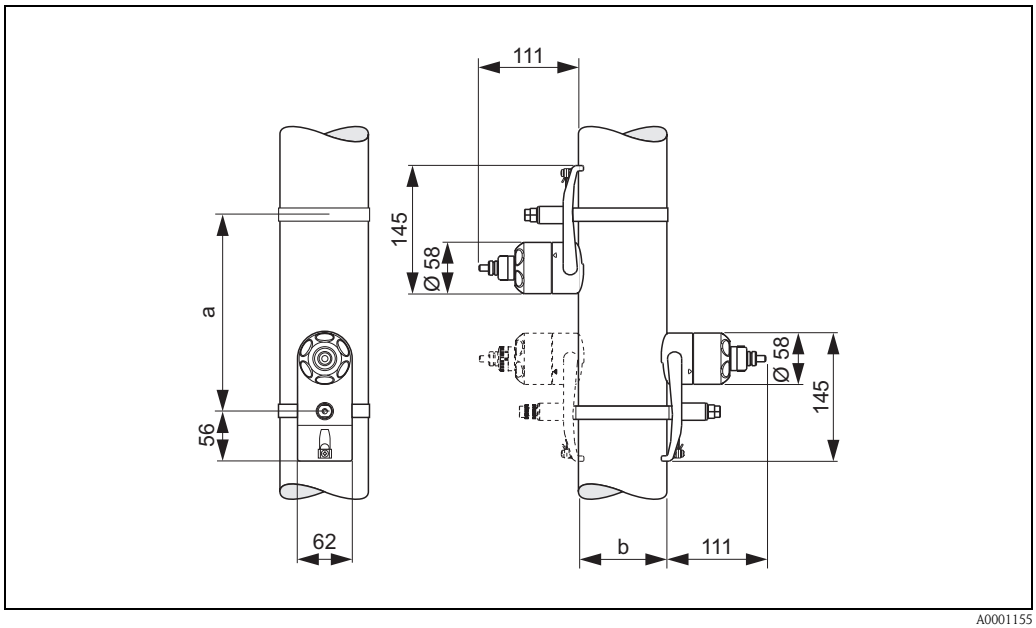

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Fig. 61: Dimensions of P sensor (clamp-on) / (version: 1 traverse)

a = Sensor spacing can be determined using Quick Setup
b = Pipe outer diameter (defined by the application)

10.4 Dimensions of W sensors (clamp-on)

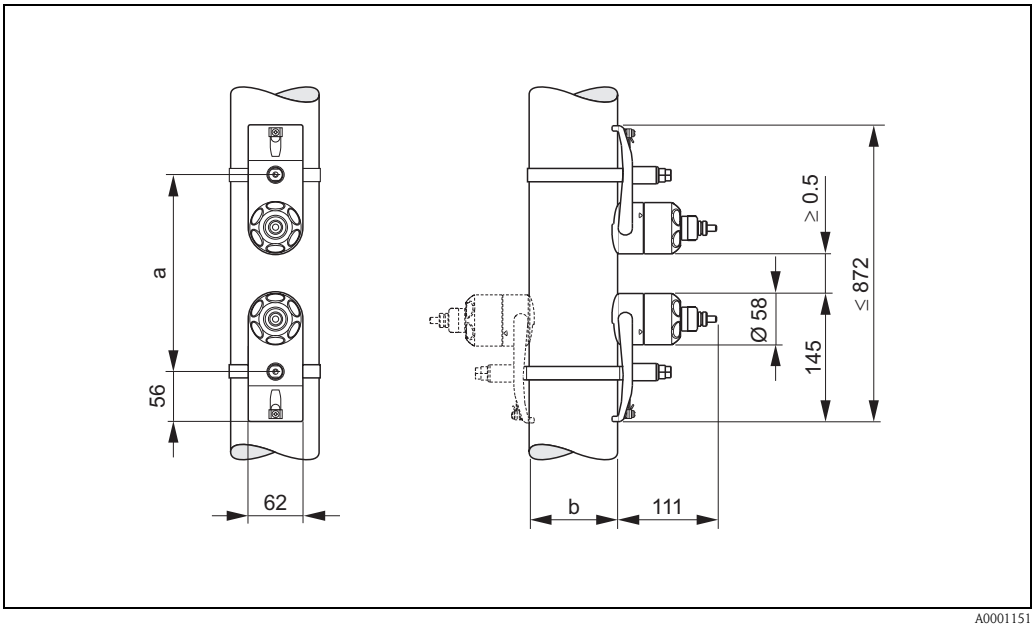

Fig. 62: Dimensions of W sensor (clamp-on)

a = Sensor distance can be determined using Quick Setup or a configuration program
b = Pipe outer diameter (determined by application)

10.5 Dimensions of U sensors (clamp-on)

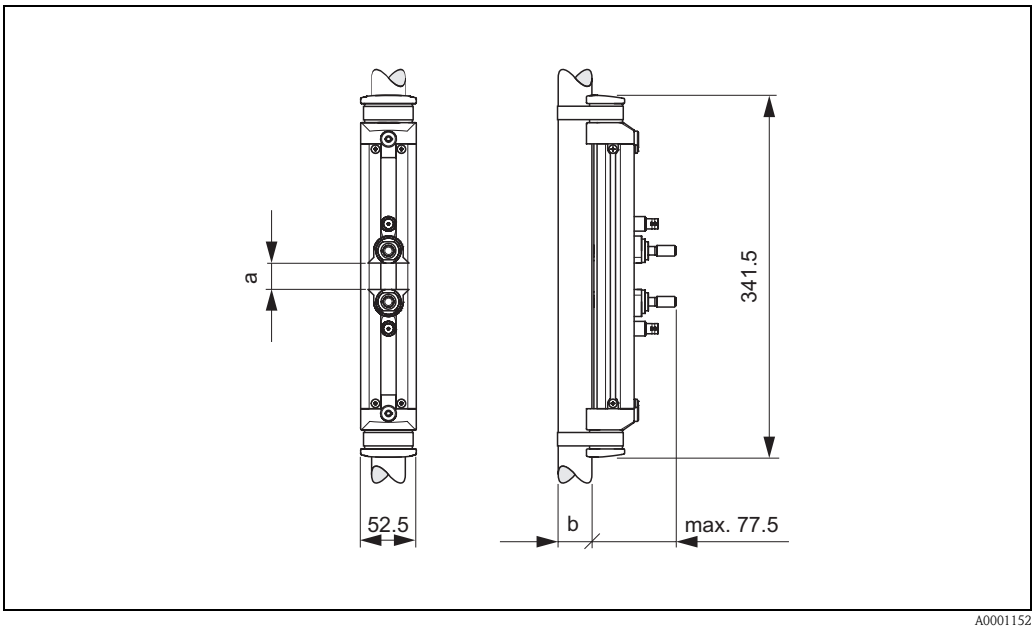

Fig. 63: Dimensions of U sensor (clamp-on)

a = Sensor spacing can be determined using Quick Setup
b = Pipe outer diameter (defined by the application)

10.6 Dimensions of W sensors (Insertion version)

Single path version

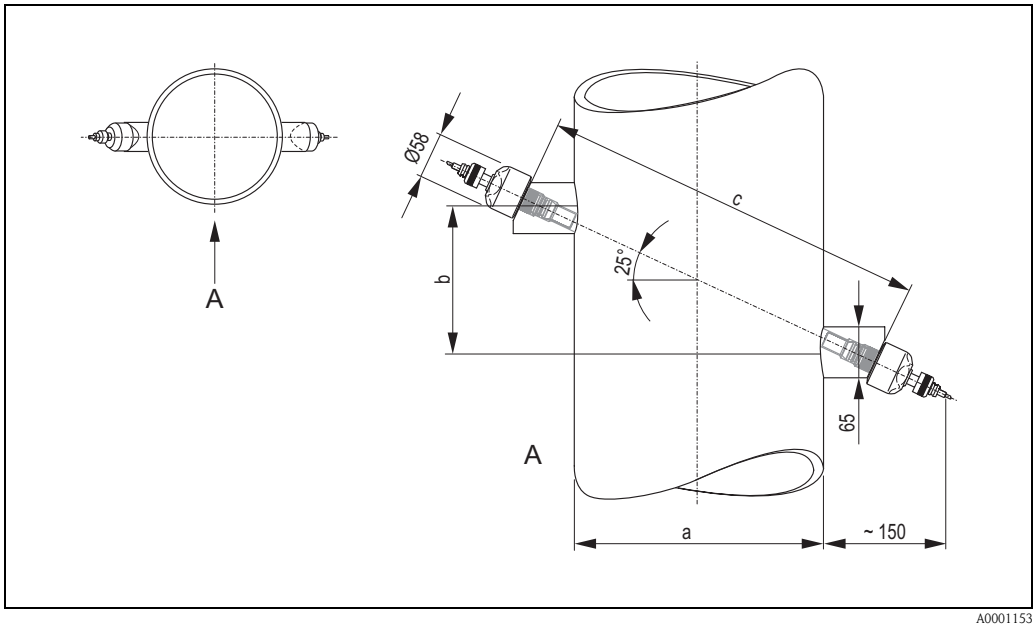

Fig. 64: Dimensions of W sensor (Insertion version, single path)

A = View A
a = Pipe outer diameter (defined by the application)
b = Sensor spacing determinable using Quick Setup
c = Path length determinable using Quick Setup

11 Index

Declaration of contamination

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

Type of device / sensor:		Serial no.:			
Medium / concentration:		Temperature:		Pressure:	
Cleaned with:		Conductivity:		Viscosity:	

Warning hints for medium used (mark the appropriate hints)

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

Reason for return

Company data

Company:		Contact person:	
		Department:	
Address:		Phone:	
		Fax / e-mail:	
		Your order no.:	

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

(Place, date)

(Company stamp and legally binding signature)

More information about services and repairs:
www.services.endress.com

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People for Process Automation

BA074D/06/en/11.04
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FM+SGML6.0