BA087D/06/en/10.03
50103833

Valid from software version:
V 1.06.XX (measuring amplifier)
V 1.03.XX (communication)

PROline prosonic flow 93 C
Ultrasonic Flow Measuring System

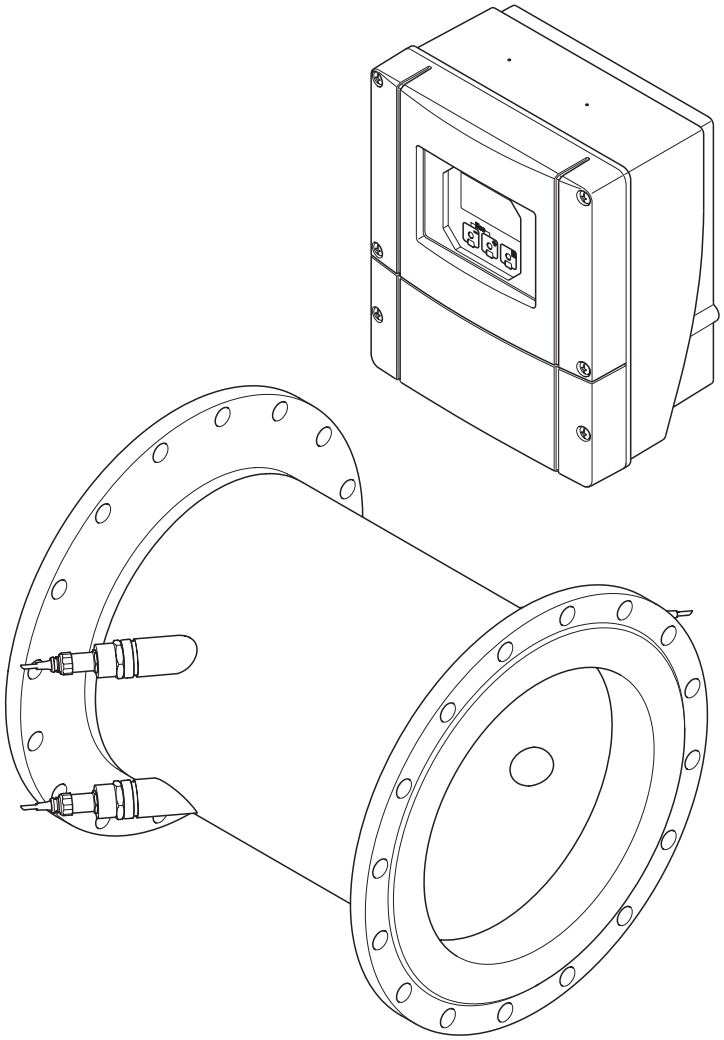








Operating Instructions



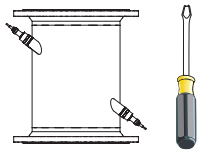
Endress+Hauser
The Power of Know How

Brief operating instructions

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

Designated use	Page 7
Please read the safety instructions through carefully.	

▼

Installing the sensors	Page 20 ff.
Mounting the measuring tube Prosonic Flow C with the flowrate measuring sensors Prosonic Flow W	

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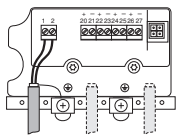
Connecting the transmitter	Page 29
Connect the transmitter to the power supply.	

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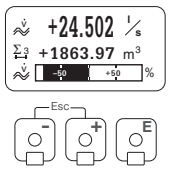
Display and operating elements	Page 36
A short overview of the different display and operating elements to allow you to start quickly.	

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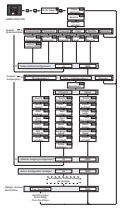
“Commissioning” with QUICK SETUP Commissioning via FieldTool	Page 58
*Measuring devices **with** a local display:* You can commission your measuring device quickly and easily using the special “Quick Setup” menu → Page 58 ff.. This means that important basic functions can be configured directly via the local display, 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** a local display:* No “Commissioning” Quick Setup is available for devices without a local display. The commissioning procedure for such devices is explained on → Page 64 ff.	

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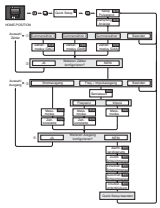
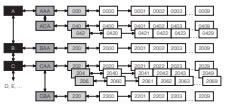
Application-specific QUICK SETUPs	Page 60 ff.
In “Quick Setup” mode you have the option of launching other application-specific Quick Setups, for instance the menu for operation with pulsating flow.	

▼

Customer-specific configuration	Page 39 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: – Setting parameters via the configuration program FieldTool – Setting parameters via the local display (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.	

✎ Note!
Always start trouble-shooting with the checklist on Page 103, if faults occur after startup.

Table of Contents

1 Safety instructions

1.1 Safety instructions

The measuring device described in these Operating Instructions is to be used only for measuring the flow of liquids in closed pipes, e.g.:
- Water and wastewater

In addition to the volume flow, the system measures the sound velocity in the fluid. The sound velocity can be used to distinguish different fluids or as a measure of fluid quality.

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

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 authorised to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions it contains.
- The device must be operated by persons authorised and trained by the facility's owner-operator. Strict compliance with the instructions in these Operating Instructions is mandatory.
- Endress+Hauser will be happy to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning.
- 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 a separate Control Drawing which is an *integral part* of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of the Control Drawing indicates the approval and the certification centre (FM USA, CSA Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of EN 61326/A1.
- The manufacturer reserves the right to modify technical data without prior notice. Your E+H 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 substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

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

Warning!
- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (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. 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". They can, however, be a source of danger if used incorrectly or for use other than that designated.
Consequently, always pay particular attention to the safety instructions indicated in these Operating Instructions by the following symbols:

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

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

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

2 Identification

2.1 Device designation

The “Prosonic Flow 93 C Inline” flow measuring system consists of the following components:
- Transmitter Prosonic Flow 93
- Measuring tube Prosonic Flow C Inline
- Sensors Prosonic Flow W

2.1.1 Nameplate of the transmitter

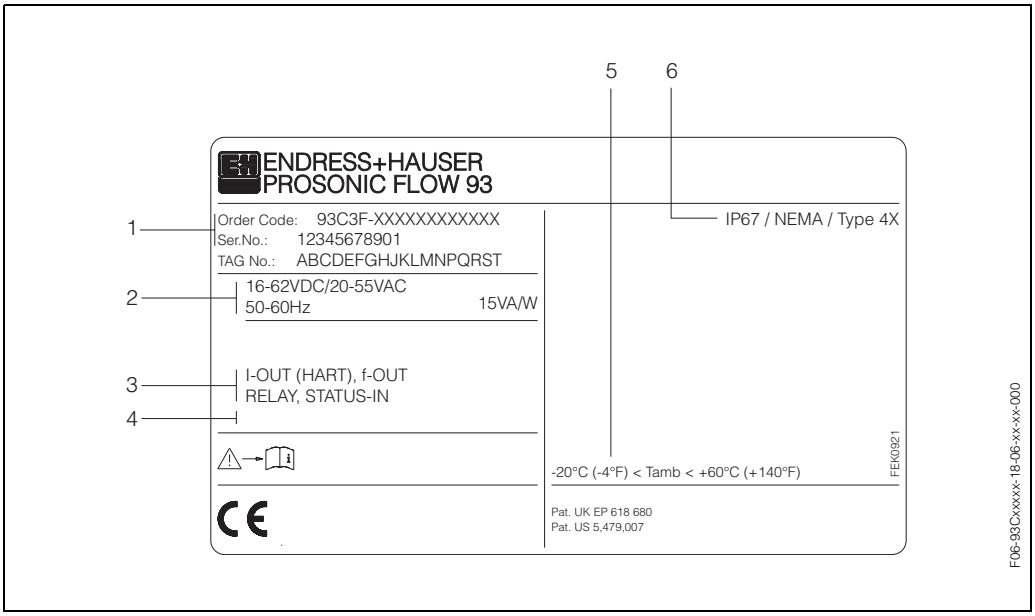


Fig. 1: Nameplate specifications for the “Prosonic Flow 93” transmitter (example)

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 and outputs:
I-OUT (HART): with current output (HART)
f-OUT: with pulse/frequency output
RELAY: with relay output
STATUS-IN: with status input (auxiliary input)
4 Reserved for information on special products
5 Ambient temperature range
6 Degree of protection

2.1.2 Nameplate of the measuring tube

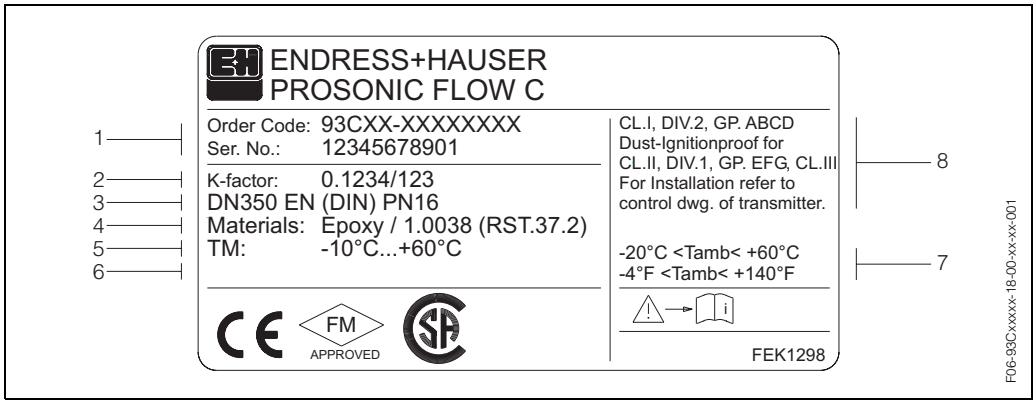


Fig. 2: Nameplate specifications for measuring tube "Prosonic Flow C Inline" (example)

1 *Order code/serial number: see the specifications on the order confirmation for the meanings of the individual letters and digits.*
2 *K-factor of measuring tube*
3 *Range of nominal diameter: DN 300...2000; range of nominal pressure: EN (DIN) PN 6...16*
4 *Measuring tube lining material*
5 *Max. fluid temperature range: –10 °C... +60 °C*
6 *Reserved for information on special products*
7 *Ambient temperature range*
8 *Data on explosion protection*
Refer to the Ex-specific Control Drawing. Please do not hesitate to contact your E+H sales office if you have any questions.

2.1.3 Nameplates of the sensors W

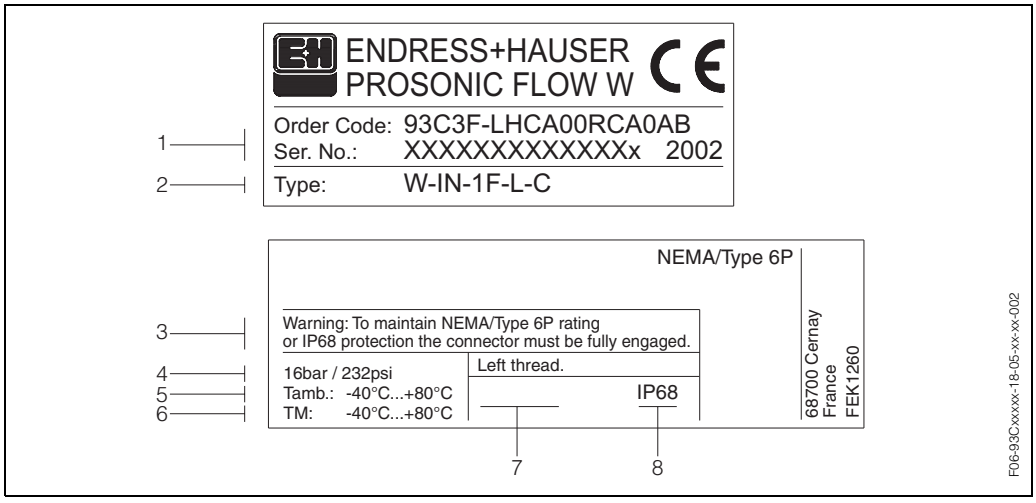


Fig. 3: Nameplate specifications for the "Prosonic Flow W" sensors (example)

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 *Warning notice*
4 *Maximum nominal pressure: 16 bar (232 psi)*
5 *Ambient temperature range: –40 °C...+80 °C*
6 *Medium temperature range: –40 °C...+80 °C*
7 *Note that the sensor holder and sensor nozzle are screwed together with a left thread.*
8 *Degree of protection: IP 68 (NEMA 6P)*

2.1.4 Stick-on label for sensor channel designation on the measuring tube

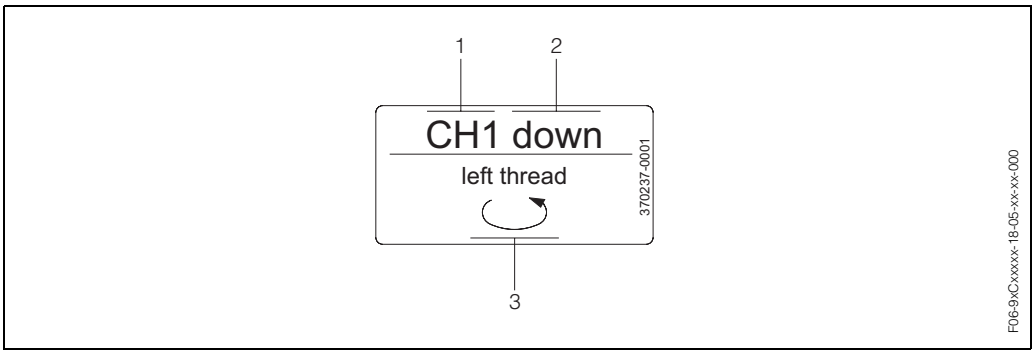


Fig. 4: Stick-on label for sensor channel designation, measuring tube (example)

1 Channel designation CH 1...CH 4
2 Information on flow direction; upstream, downstream
3 Note that the internal thread of the sensor nozzle is a left thread for safety reasons

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

2.3 Registered trademarks

HART®
is a registered trademark of HART Communication Foundation, Austin, USA

S-DAT®, T-DAT™, F-Chip®, FieldTool®, FieldCheck®, Applicator®
are registered trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport, 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.

Caution!
Do not lift flanged devices by the sensor nozzles when transporting. Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

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 97) of the transmitter, the 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 Installation dimensions

Dimensions and fitting lengths of the measuring tube and transmitter are on Page 101 ff.

3.2.2 Installation site

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

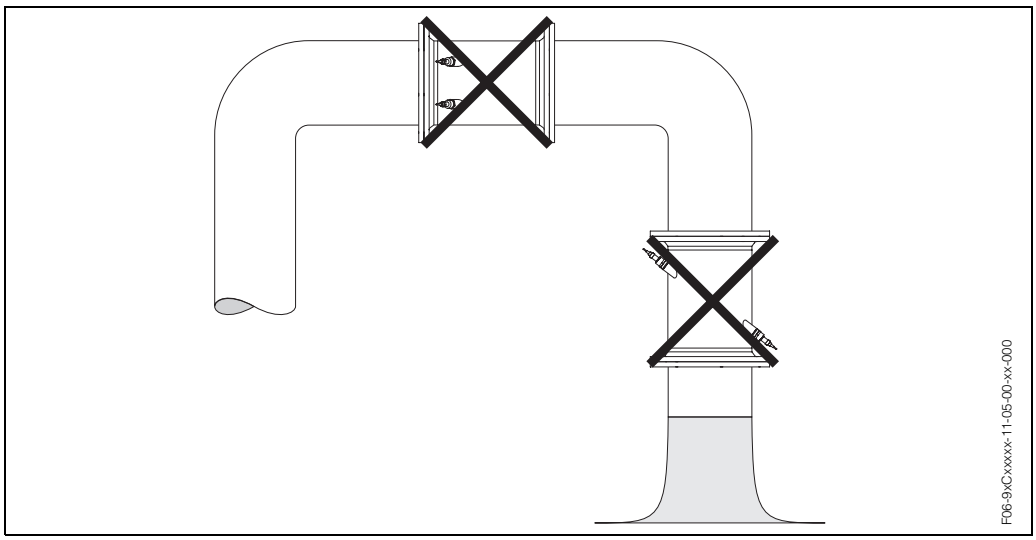


Fig. 5: Installation site

Partially filled pipes
Partially filled pipes with gradients necessitate a drain-type configuration.

Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.

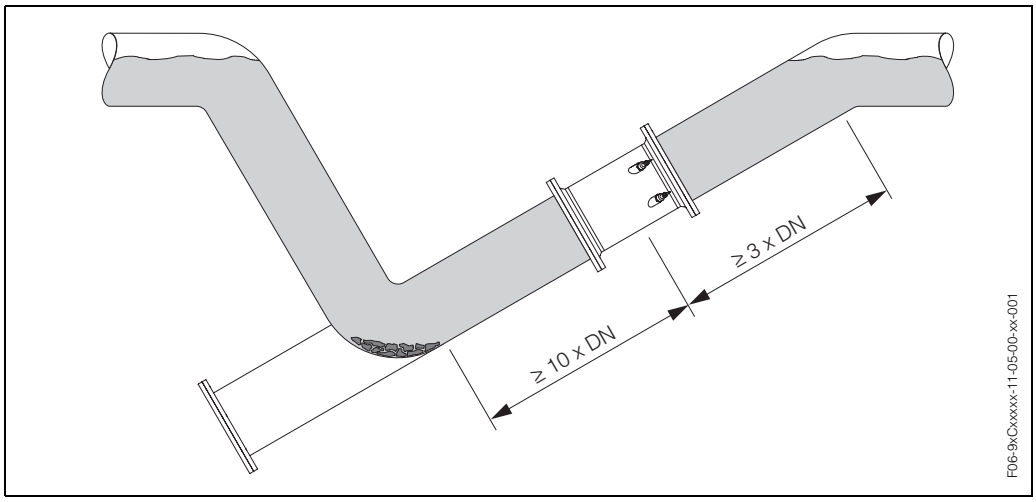


Fig. 6: Installation in partially filled pipe

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.

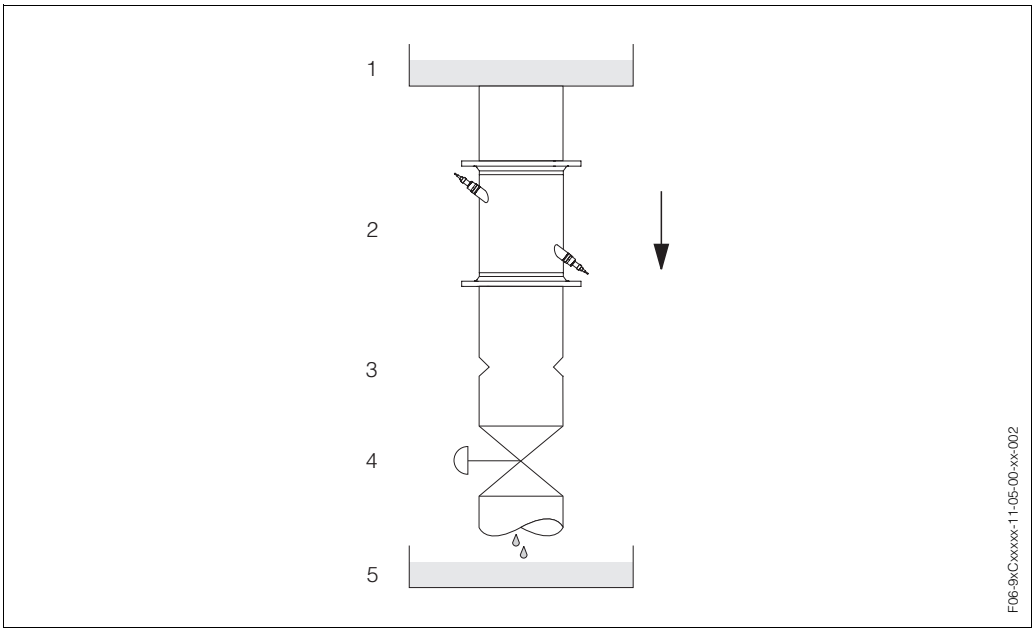


Fig. 7: Installation in a down pipe
1 = Supply tank, 2 = Sensors, 3 = Orifice plate, pipe restriction, 4 = Valve, 5 = Filling tank

3.2.3 Orientation

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

Horizontal orientation
In the recommended installation range (c, max. 120 °) in a horizontal installation position (View B), 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.

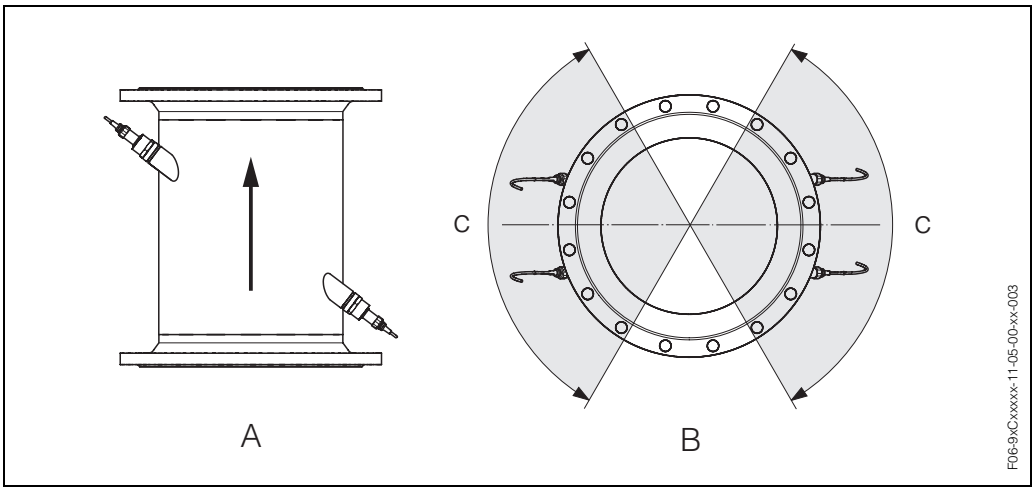


Fig. 8: Installation position (A = Vertical, B = Horizontal, C = Recommended installation range max. 120°)

3.2.4 Inlet and outlet run

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

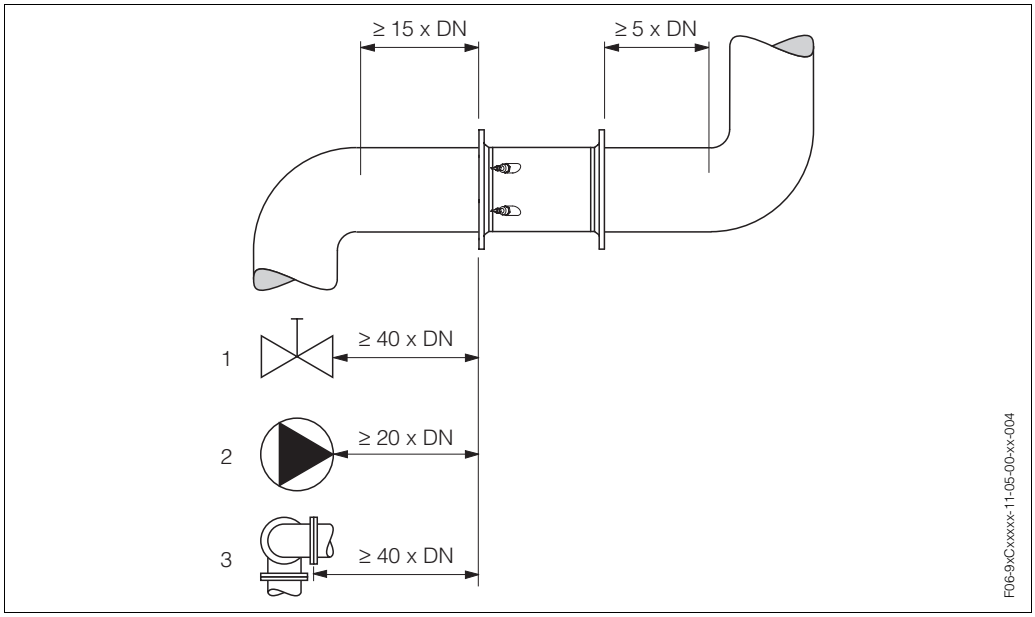


Fig. 9: Inlet and outlet runs
1 = Valve; 2 = Pump; 3 = Two pipe bends in different directions

3.2.5 Vibrations

Secure the piping and the sensor if vibration is severe.
Information on resistance to vibration and shock can be found on → Page 97.

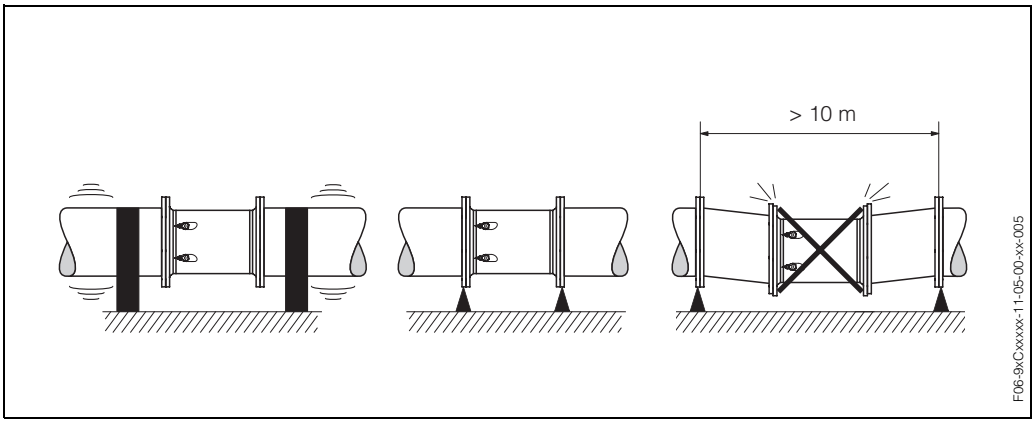


Fig. 10: Measures to prevent vibration of the measuring device

3.2.6 Foundations, supports

For all nominal diameters, mount the sensor on a foundation of adequate load-bearing strength.

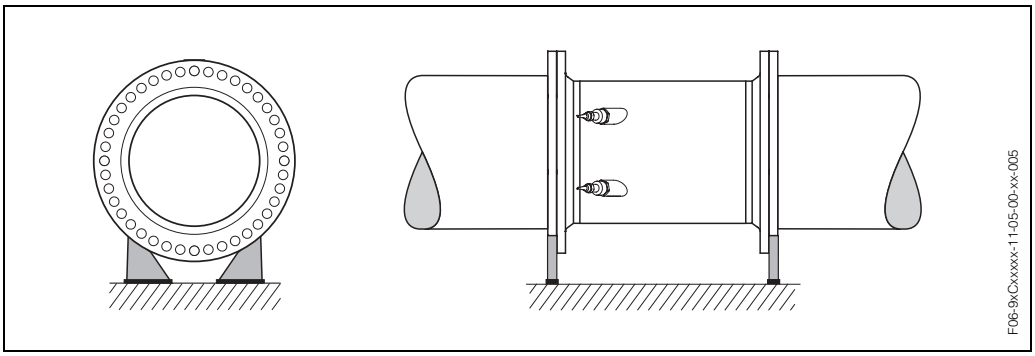


Fig. 11: Correct support for large nominal diameters

3.2.7 Adapters

Suitable adapters to (E) EN (DIN) 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by cross-section reduction:

Note!
The nomogram applies to liquids of viscosity similar to water.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram read off the pressure loss as a function of flow velocity (*downstream* from the reduction) and the d/D ratio.

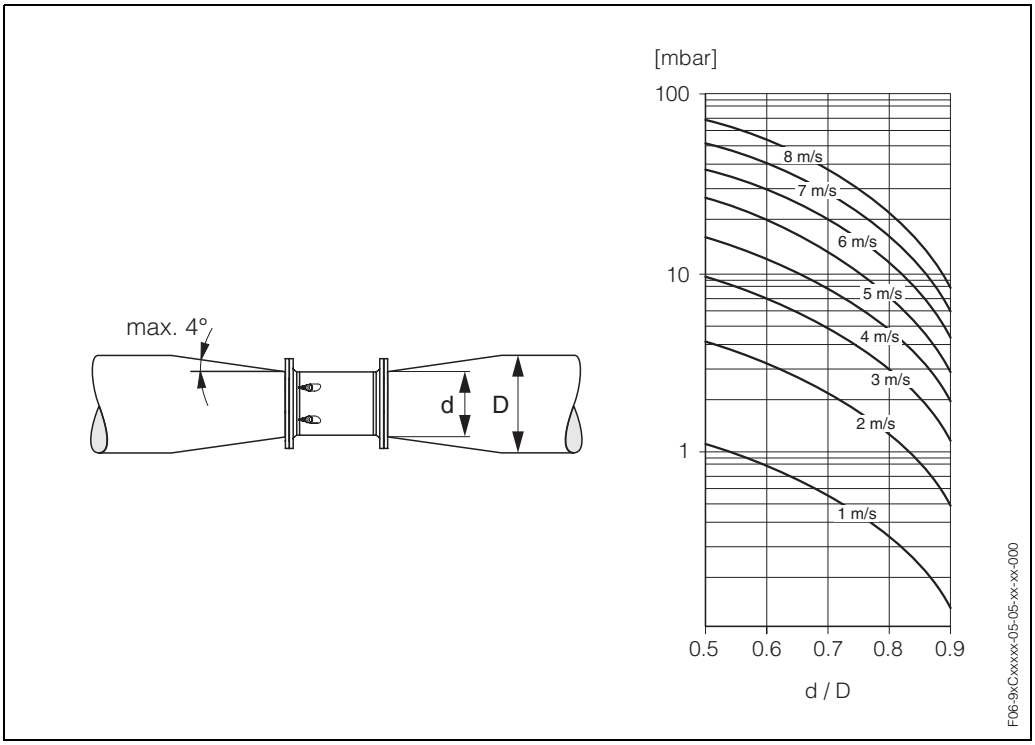


Fig. 12: Pressure loss due to adapters

3.2.8 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum flow velocity is 2…3 m/s. The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:
- v < 2 m/s: for abrasive fluids such as potter's clay, lime milk, ore slurry, etc.
- v > 2 m/s: for fluids producing build-up such as wastewater sludge, etc.

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (see Page 17).

Flow rate characteristic values - Prosonic Flow C (SI units)

Nominal diameter		Recommended flow rate	Factory settings		
[mm]	[inch]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
300	12"	80...2700 m^3/h	700 m^3/h	0.10 m^3	10 m^3/h
350	14"	100...3300 m^3/h	900 m^3/h	0.10 m^3	15 m^3/h
400	16"	130...4400 m^3/h	1100 m^3/h	0.15 m^3	20 m^3/h
450	18"	160...5600 m^3/h	1400 m^3/h	0.25 m^3	20 m^3/h
500	20"	200...6900 m^3/h	1700 m^3/h	0.25 m^3	30 m^3/h
600	24"	300...9900 m^3/h	2500 m^3/h	0.30 m^3	40 m^3/h
700	28"	410...13600 m^3/h	3400 m^3/h	0.50 m^3	55 m^3/h
–	30"	470...15900 m^3/h	4000 m^3/h	0.50 m^3	65 m^3/h
800	32"	540...17900 m^3/h	4500 m^3/h	0.75 m^3	75 m^3/h
900	36"	680...22500 m^3/h	5600 m^3/h	0.75 m^3	90 m^3/h
1000	40"	850…25000 m^3/h	7000 m^3/h	1.00 m^3	115 m^3/h
–	42"	950...27000 m^3/h	7800 m^3/h	1.00 m^3	125 m^3/h
1200	48"	1250…30000 m^3/h	10100 m^3/h	1.50 m^3	160 m^3/h
–	54"	1550...32000 m^3/h	12800 m^3/h	1.50 m^3	205 m^3/h
1400	–	1650...35000 m^3/h	13800 m^3/h	2.00 m^3	220 m^3/h
–	60"	1950...37000 m^3/h	15900 m^3/h	2.00 m^3	255 m^3/h
1600	–	2200...40000 m^3/h	17900 m^3/h	2.50 m^3	285 m^3/h
–	66"	2500...40000 m^3/h	19200 m^3/h	2.50 m^3	305 m^3/h
1800	72"	2800…45000 m^3/h	22600 m^3/h	3.00 m^3	360 m^3/h
2000	78"	3400…50000 m^3/h	27800 m^3/h	3.50 m^3	450 m^3/h

Flow rate characteristic values - Prosonic Flow C (US units)

Nominal diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	Min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
12"	300	350...11900 gal/min	3100 gal/min	25 gal	45 gal/min
14"	350	440...14500 gal/min	4000 gal/min	25 gal	65 gal/min
16"	400	570...19400 gal/min	4800 gal/min	50 gal	90 gal/min
18"	450	700...24700 gal/min	6200 gal/min	65 gal	90 gal/min
20"	500	880...30400 gal/min	7500 gal/min	65 gal	130 gal/min
24"	600	1320...43600 gal/min	11000 gal/min	80 gal	175 gal/min
28"	700	1800...59900 gal/min	15000 gal/min	125 gal	240 gal/min
30"	–	2070...70000 gal/min	17600 gal/min	125 gal	275 gal/min
32"	800	2380...78800 gal/min	19800 gal/min	200 gal	325 gal/min
36"	900	2990...99000 gal/min	24700 gal/min	200 gal	400 gal/min
40"	1000	3740...110000 gal/min	30800 gal/min	275 gal	500 gal/min
42"	–	4180...118900 gal/min	34300 gal/min	275 gal	550 gal/min
48"	1200	5500...132100 gal/min	44500 gal/min	400 gal	700 gal/min
54"	–	9.8...203 Mgal/d	81 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1400	10.5...222 Mgal/d	87 Mgal/d	0.0005 Mgal	1.4 Mgal/d
60"	–	12.4...235 Mgal/d	101 Mgal/d	0.0005 Mgal	1.6 Mgal/d
–	1600	13.9...254 Mgal/d	113 Mgal/d	0.00075 Mgal	1.8 Mgal/d
66"	–	14.6...254 Mgal/d	122 Mgal/d	0.00075 Mgal	1.9 Mgal/d
72"	1800	17.7...285 Mgal/d	143 Mgal/d	0.00075 Mgal	2.3 Mgal/d
78"	2000	21.6...317 Mgal/d	176 Mgal/d	0.001 Mgal	2.9 Mgal/d

3.2.9 Length of connecting cable

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.

3.3 Installation instructions

3.3.1 Installing measuring tube Prosonic Flow C

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the piping flanges.

Caution!
Please pay particular attention to the screw tightening torques required listed on this page and the following pages.

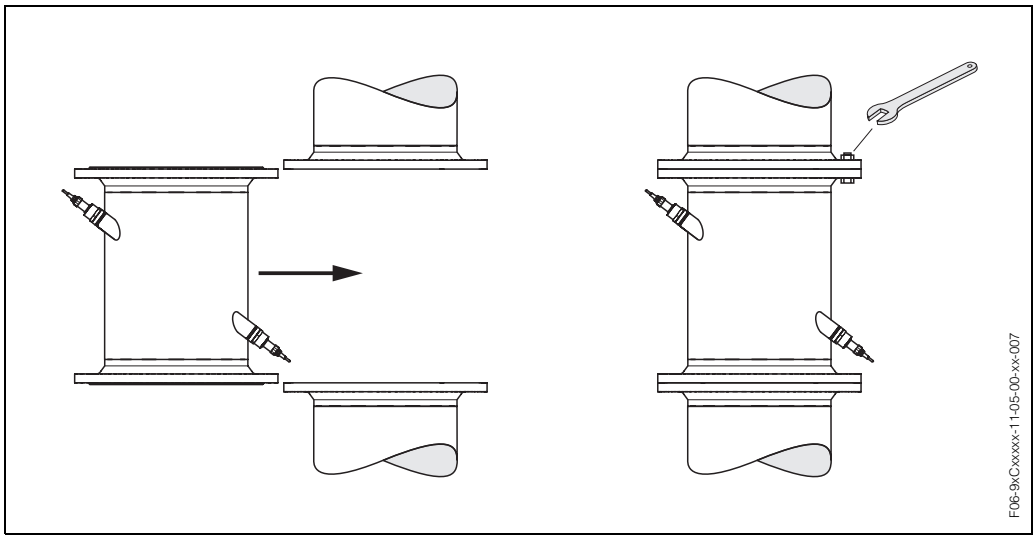


Fig. 13: Mounting measuring tube Prosonic Flow C

Seals
Comply with the following instructions when installing seals:
- For EN (DIN) flanges, use only seals (Iterit) acc. to EN (DIN) 2690.
- Make sure that the seals do not protrude into the piping cross-section.

Screw tightening torques
Note the following points:
- The screw tightening torques listed below are for lubricated threads only.
- Always tighten threaded fasteners uniformly and in diagonally opposite sequence.
- Overtightening the fasteners will deform the sealing faces or damage the seals.
- The screw tightening torques listed below apply only to pipes not subjected to tensile stress.

Prosonic Flow C nominal diameter [mm]	EN (DIN) pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]
300	PN 10	12 x M 20	94
300	PN 16	12 x M 24	134
350	PN 10	16 x M 20	112
350	PN 16	16 x M 24	152
400	PN 10	16 x M 24	151

Prosonic Flow C nominal diameter [mm]	EN (DIN) pressure rating [bar]	Threaded fasteners	Max. tightening torque [Nm]
400	PN 16	16 x M 27	193
450	PN 10	20 x M 24	153
450	PN 16	20 x M 27	198
500	PN 10	20 x M 24	155
500	PN 16	20 x M 30	275
600	PN 10	20 x M 27	206
600	PN 16	20 x M 33	415
700	PN 10	24 x M 27	246
700	PN 16	24 x M 33	278
800	PN 10	24 x M 30	331
800	PN 16	24 x M 36	369
900	PN 10	28 x M 30	316
900	PN 16	28 x M 36	353
1000	PN 10	28 x M 33	402
1000	PN 16	28 x M 39	502
1200	PN 6	32 x M 30	319
1200	PN 10	32 x M 36	564
1200	PN 16	32 x M 45	701
1400	PN 6	36 x M 33	430
1400	PN 10	36 x M 39	654
1400	PN 16	36 x M 45	729
1600	PN 6	40 x M 33	440
1600	PN 10	40 x M 45	946
1600	PN 16	40 x M 52	1007
1800	PN 6	44 x M 36	547
1800	PN 10	44 x M 45	961
1800	PN 16	44 x M 52	1108
2000	PN 6	48 x M 39	629
2000	PN 10	48 x M 45	1047
2000	PN 16	48 x M 56	1324

Prosonic Flow C nominal diameter		AWWA pressure rating	Threaded fasteners	Max. tightening torque
[mm]	[inch]			[Nm]
700	28"	Class D	28 x 1 1/4"	247
-	30"	Class D	28 x 1 1/4"	287
800	32"	Class D	28 x 1 1/2"	394
900	36"	Class D	32 x 1 1/2"	419
1000	40"	Class D	36 x 1 1/2"	420
-	42"	Class D	36 x 1 1/2"	528
1200	48"	Class D	44 x 1 1/2"	552
-	54"	Class D	44 x 1 3/4"	730
-	60"	Class D	52 x 1 3/4"	758
-	66"	Class D	52 x 1 3/4"	946
1800	72"	Class D	60 x 1 3/4"	975
-	78"	Class D	64 x 2"	853

Prosonic Flow C nominal diameter		ANSI pressure rating	Threaded fasteners	Max. tightening torque
[mm]	[inch]	[lbs]		[Nm]
300	12"	Class 150	12 x 7/8"	133
350	14"	Class 150	12 x 1"	135
400	16"	Class 150	16 x 1"	128
-	18"	Class 150	16 x 1 1/8"	204
500	20"	Class 150	20 x 1 1/8"	183
600	24"	Class 150	20 x 1 1/4"	268

3.3.2 Installing wall-mount housing

There are various ways of installing the wall-mount housing:
- Direct wall mounting
- Panel mounting (with separate mounting kit, accessories → Page 73)
- Pipe mounting (with separate mounting kit, accessories → Page 73)

Caution!
- Make sure that ambient temperature does not exceed the permissible range (–20...+60 °C) at the installation site. Install the device at 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. 14.
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.

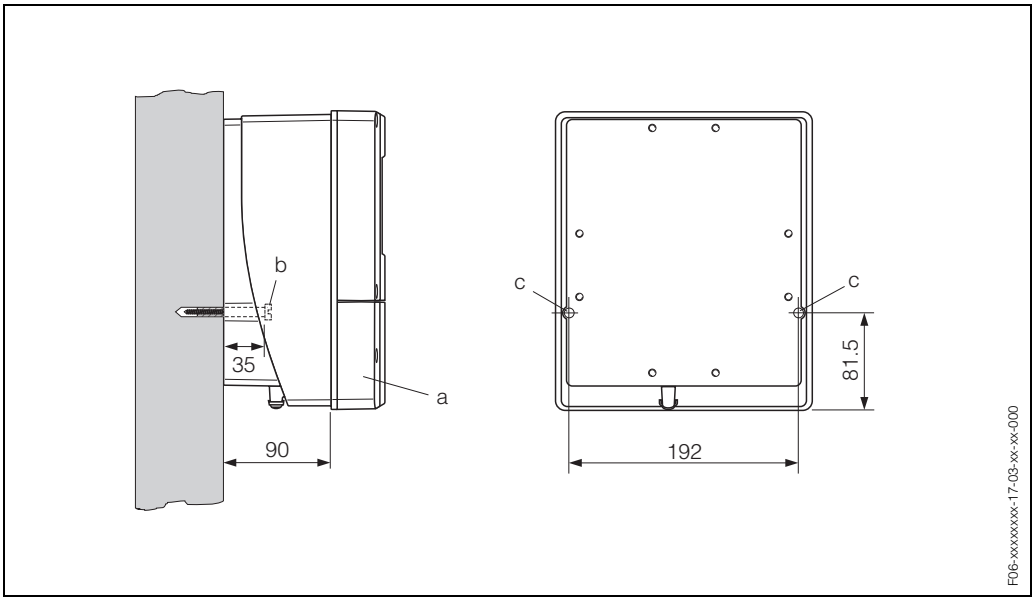


Fig. 14: Mounted directly on the wall

Panel mounting

1. Prepare the opening in the panel (Fig. 15).
2. Slide the housing through the front of the panel cutout.
3. Screw the fasteners to the wall-mount housing.
4. Screw the threaded rods into the brackets and tighten until the housing is firmly fixed to the panel wall. Afterwards, tighten the counter nuts. No further support is necessary.

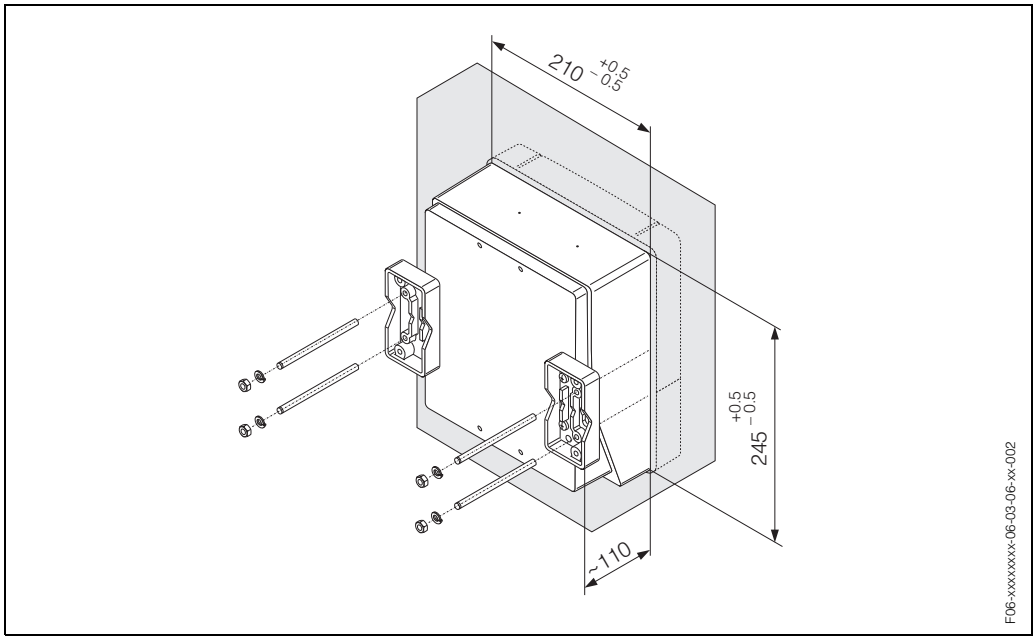


Fig. 15: Panel mounting (wall-mount housing)

Pipe mounting
Installation according to the instructions in Fig. 16.

Caution!
If the device is mounted to a warm pipe, make certain that the housing temperature does not exceed +60 °C, which is the maximum permissible temperature.

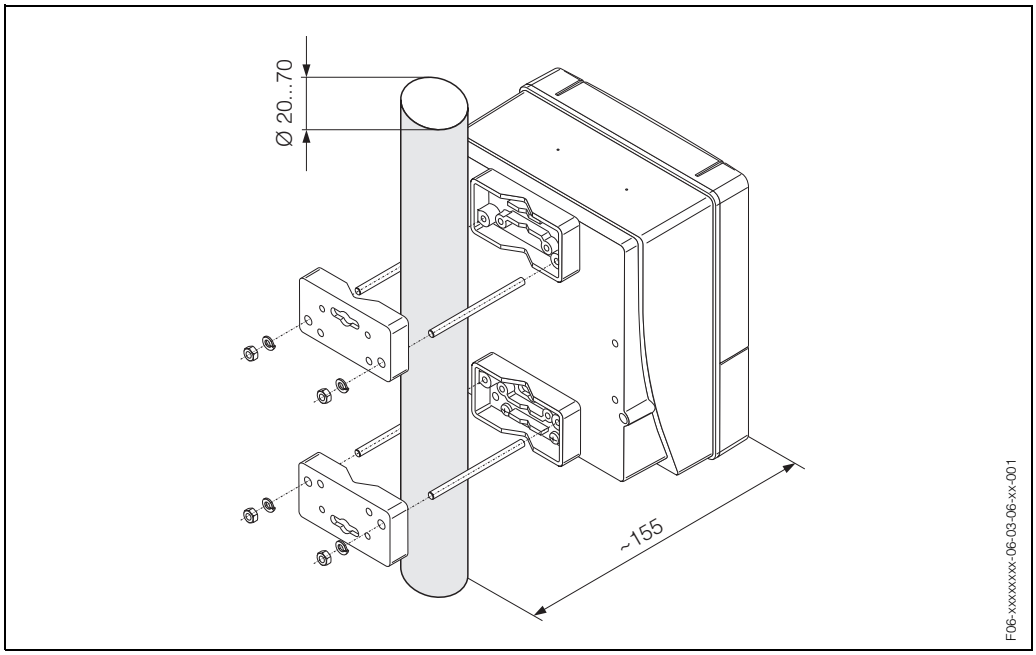


Fig. 16: Pipe mounting (wall-mount housing)

3.4 Post-installation check

Perform the following checks after installing the measuring device on 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 and pressure, ambient temperature, measuring range, etc.?	see Page 93 ff.
Installation	Notes
Are the measuring point number and labelling correct (visual inspection)?	–
Were all threaded fasteners tightened to the specified tightening torques when the measuring tube was installed?	see Page 20 ff.
Process environment / process conditions	Notes
Are the inlet and outlet runs respected?	see Page 16
Is the measuring device protected against moisture and direct sunlight?	–
Is the measuring tube adequately protected against vibration (attachment, support)?	see Page 16, 17

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 E+H sales office if you have any questions.

4.1 Connecting the sensor connecting cable

4.1.1 Connecting the Prosonic Flow W sensors

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 mains voltage. 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

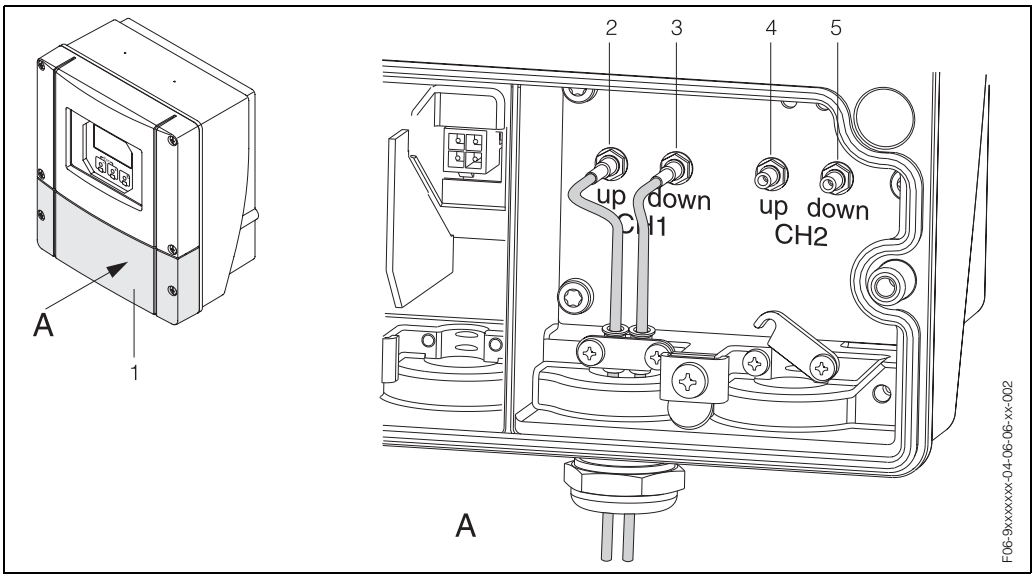


Fig. 17: Connecting the measuring system

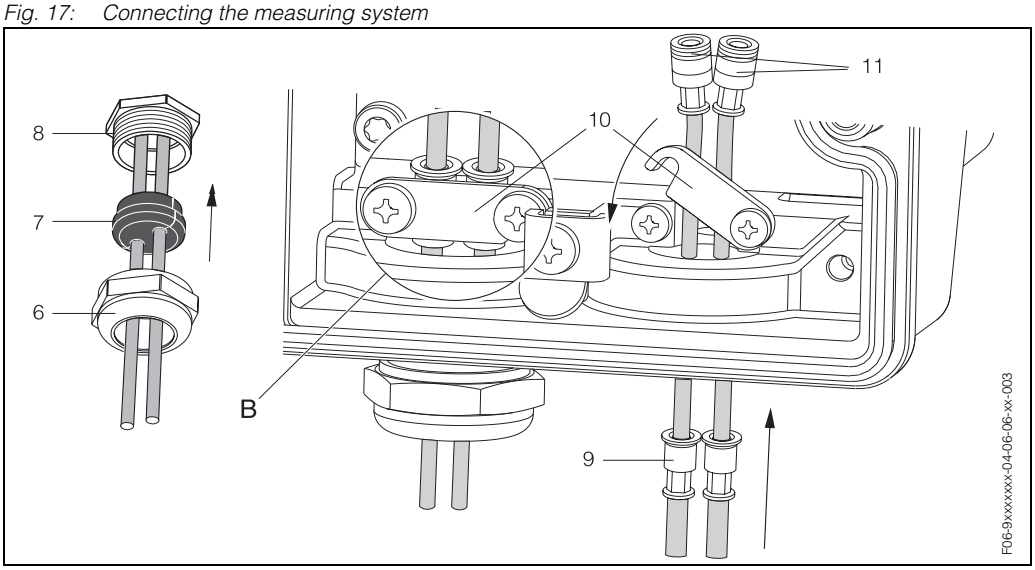


Fig. 18: Connecting the sensor connecting cable

See next page for graphic legend and installation instructions.
Legend:
A View A
B Detail B
1 Connection compartment cover
2 Sensor cable connector, channel 1, upstream
3 Sensor cable connector, channel 1, downstream
4 Sensor cable connector, channel 2 (upstream)
5 Sensor cable connector, channel 2, downstream
6 Cable gland cover
7 Rubber seal
8 Cable gland holder
9 Cable fixing sleeves
10 Earth contact terminals
11 Sensor cable connector

Procedure:

1. Transmitter: Loosen the screws and remove 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 (6) of the cable gland 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 (8). Close the cover of the cable gland (6) so that it is tight.
6. Plug in the sensor cable connectors (11) on the transformer side in the way shown in Fig. 17.
7. Transmitter: Secure cover (1) on the connection compartment.

Note!
To ensure that the sensor plug (sensor side) is correctly connected to the sensor cable connectors (transformer side), stick-on labels on which the corresponding channel designations are printed are affixed to the sensor nozzle of the measuring tube, (example of stick-on label see Page 11).

4.1.2 Cable specifications

Sensor cable
- Use the ready-to-use cables supplied by E+H with each sensor pair.
- The cables are available in lengths of 5 m, 10 m, 15 m and 30 m.
- PVC cable material

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

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

4.2 Connecting the measuring unit

4.2.1 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 mains voltage. 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 signal cables (b) through the appropriate cable entries.
3. Wiring:
   – Wiring diagram (wall-mount housing) → Fig. 19
   – Terminal assignment → Page 30
4. Screw the cover of the connection compartment (f) firmly back onto the transmitter housing.

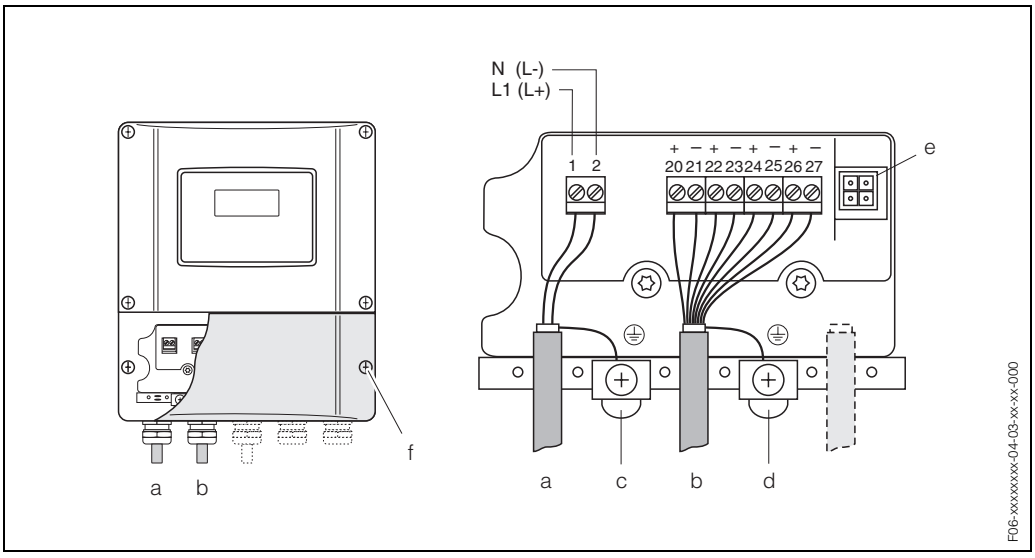


Fig. 19: Connecting the transmitter (wall-mount housing). Cable cross-section: max. 2.5 mm²

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 Signal cable: Terminals **Nos. 20–27** → Page 30*
c Ground terminal for protective earth (PE)
d Ground terminal for signal cable screen
e Service adapter for connecting service interface FXA 193 (FieldCheck, FieldTool)
f Cover of the connection compartment

4.2.2 Terminal assignment

Order variant	Terminal No. (inputs/outputs) 20 (+) / 21 (–)	22 (+) / 23 (–)	24 (+) / 25 (–)	26 (+) / 27 (–)
Fixed communication boards (fixed assignment)				
93***-**********A	–	–	Frequency output	Current output HART
93***-**********B	Relay output	Relay output	Frequency output	Current output HART
93***-**********F	–	–	–	PROFIBUS-PA Ex i
93***-**********G	–	–	–	FOUNDATION Fieldbus, Ex i
93***-**********H	–	–	–	PROFIBUS-PA
93***-**********J	–	–	–	PROFIBUS-DP
93***-**********K	–	–	–	FOUNDATION Fieldbus
93***-**********S	–	–	Frequency output Ex i	Current output Ex i active, HART
93***-**********T	–	–	Frequency output Ex i	Current output Ex i passive, HART
Flexible communication boards				
93***-**********C	Relay output	Relay output	Frequency output	Current output HART
93***-**********D	Status input	Relay output	Frequency output	Current output HART
93***-**********L	Status input	Relay output	Relay output	Current output HART
93***-**********M	Status input	Frequency output	Frequency output	Current output HART
93***-**********W	Relay output	Current output	Current output	Current output HART
93***-**********2	Relay output	Current output	Frequency output	Current output HART

Status input (auxiliary input)
galvanically isolated, 3...30 V DC, R_i = 5 kΩ

Relay output
max. 60 V DC / 0.1 A; max. 30 V AC / 0.5 A; freely configurable

Frequency output (active/passive)
galvanically isolated, active: 24 V DC, 25 mA (max. 250 mA / 20 ms), R_L >100 Ω,
passive: 30 V DC, 250 mA, Open Collector
- frequency output:: full scale frequency 2...10000 Hz (f_{max} = 12500 Hz), on/off ratio ~ 1:1, pulse width 2 s
- pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.05...2000 ms)

Current output (active, passive)
galvanically isolated, active: 0/4...20 mA, R_L <700 Ω (HART: $R_L \geq 250$ Ω),
passive: 4...20 mA, max. 30 V DC, $R_i \leq 150$ Ω,

Ground connection, power supply → Page 29

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26 / 27
- Connection by means of the 4...20 mA circuit.

Note!
- The measuring circuit's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
  – CURRENT SPAN function → "4...20 mA HART" or "4...20 mA (25 mA) HART"
  – Switch HART write protection on or off (see Page 56)
- See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

Connecting the HART handheld communicator

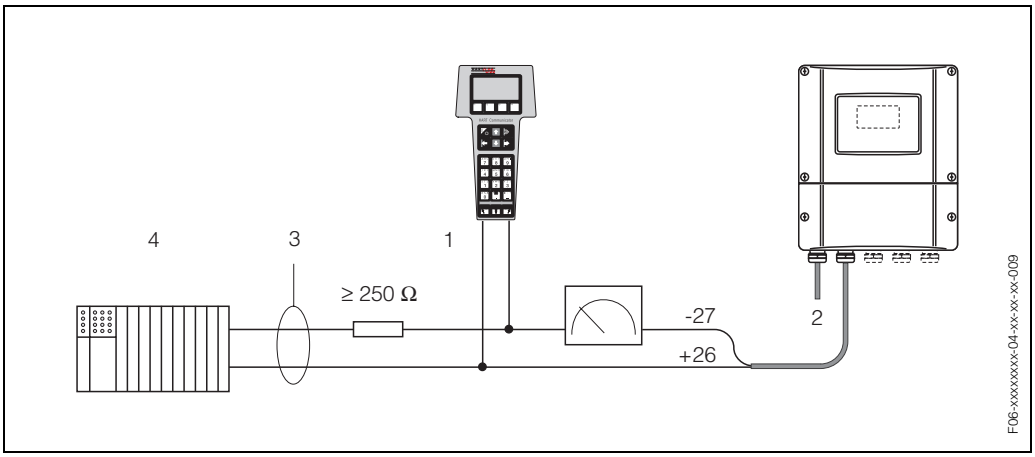


Fig. 20: Electrical connection of the HART handheld communicator:
1 = HART communicator, 2 = Power supply, 3 = Shield, 4 = Other switching units or PLC with passive input

Connecting a PC with operating software
In order to connect a PC with operating software (e.g. "FieldTool"), a HART modem (e.g. "Commubox FXA 191") is needed.

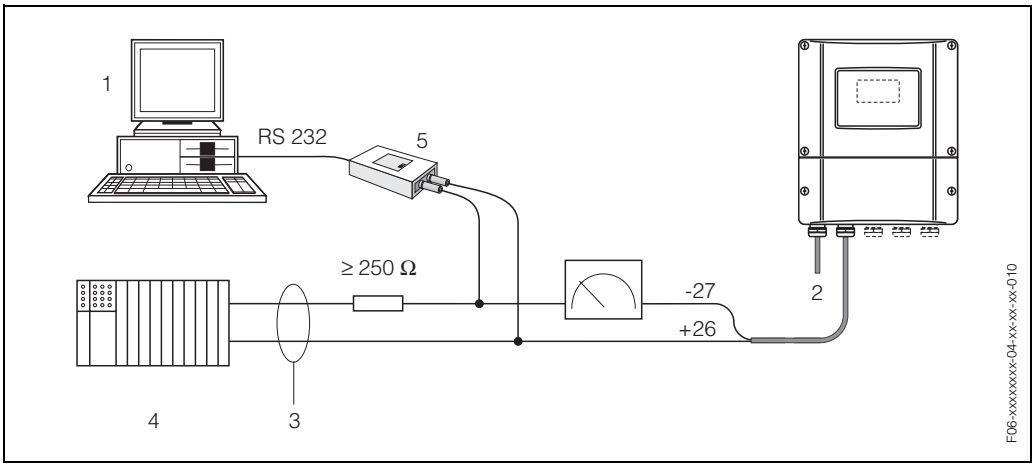


Fig. 21: Electrical connection of a PC with operating software
1 = PC with operating software, 2 = Power supply, 3 = Shield, 4 = Other switching units or PLC with passive input, 5 = HART modem, e.g. Commubox FXA 191

4.3 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.

4.4 Degree of protection

Transmitter (wall-mount 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 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 must be firmly tightened.
- The cables used for connection must be of the specified outside diameter (see Page 95).
- Firmly tighten the cable entries (Fig. 22).
- Remove all unused cable entries and insert dummy plugs instead.
- Do not remove the grommet from the cable entry.

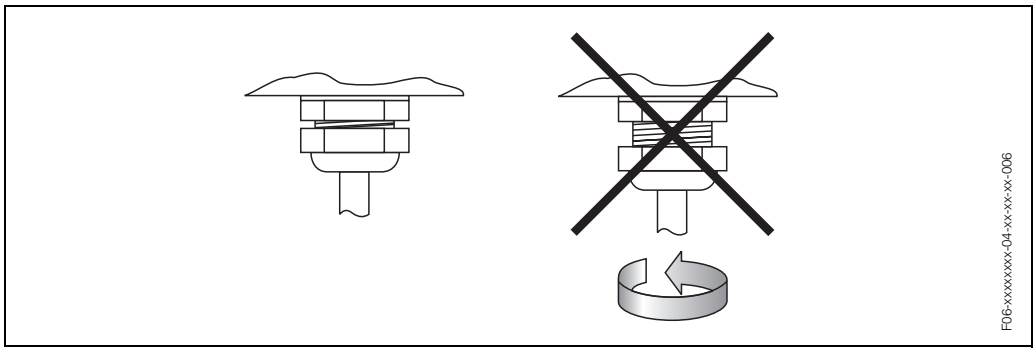


Fig. 22: Installation instructions for cable entries on the transmitter housing

Flowrate measuring sensors Prosonic Flow W

The flowrate measuring sensors W fulfill all the requirements for IP 68 degree of protection. Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 68 protection is maintained:

- Only use cables supplied by E+H with the corresponding sensor connectors.
- The sensor connector seals (1) must be clean, dry and undamaged when inserted in the seal groove. Replace them if necessary.
- Insert the cable connectors, do not cant and then tighten them to the stop.

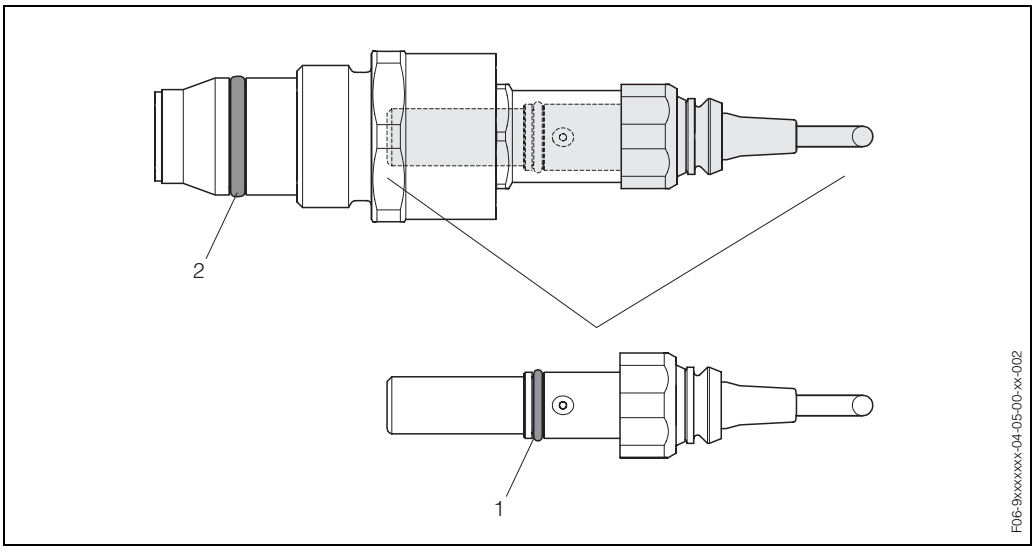


Fig. 23: Installation instructions for IP 68 degree of protection for sensor connectors

1 Sensor connector seal; relevant for IP 68 degree of protection
2 Seal of sensor holder; prevents fluid from exiting the measuring tube

4.5 Post-connection check

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

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85...260 V AC (45...65 Hz) 20...55 V AC (45...65 Hz) 16...62 V DC
Do the cables used comply with the specifications?	see Page 28, 95
Do the cables have adequate strain relief?	–
Is the cable type route completely isolated? 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 been correctly implemented?	see Page 32 ff.
Are all cable entries installed, firmly tightened and correctly sealed?	see Page 32
Are all the housing covers installed and tightened?	–

5 Operation

5.1 Quick operation guide

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

1. Local operation (optional) → Page 36
   The local operation enables you to read all of the important parameters directly at the measuring point, configure device-specific parameters in the field and commission the instrument.

2. Configuration programs → Page 64
   Measuring devices without local operation can be configured by means of the configuration program FieldTool.

5.2 Operation via the local display

5.2.1 Display and operating elements

The local operation enables you to read all important parameters directly at the measuring point and configure the device using the “Quick Setup” or the function matrix.

The display consists of four 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).

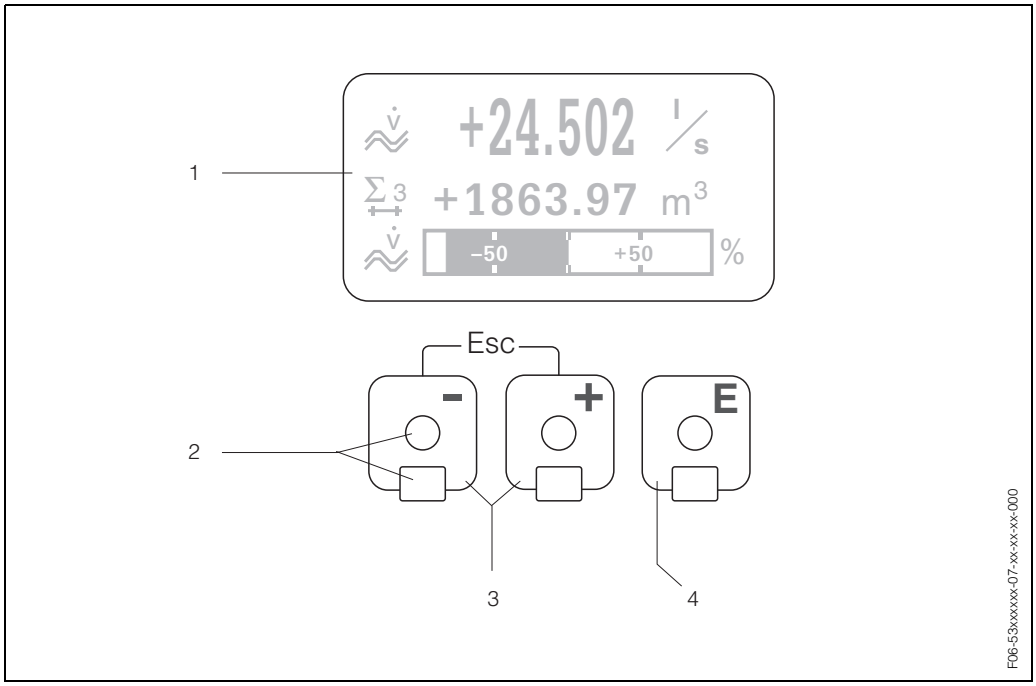


Fig. 24: Display and operating elements

Liquid crystal display (1)
The backlit, four-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).

Optical sensors for Touch Control (2)

Plus/minus keys (3)
– HOME position → Direct access to totalizer values and actual values of inputs/outputs
– Enter numerical values, select parameters
– Select different blocks, groups or function groups within the function matrix

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

Enter key (4)
– HOME position → Enter function matrix
– Save the numerical values you input or settings you change

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

Multiplex mode:
A maximum of two different display variables can be assigned to each line. Variables multiplexed in this way alternate every 10 seconds on the display.

Error messages:
The display modes for system and process error messages are described in detail on Page 41 ff.

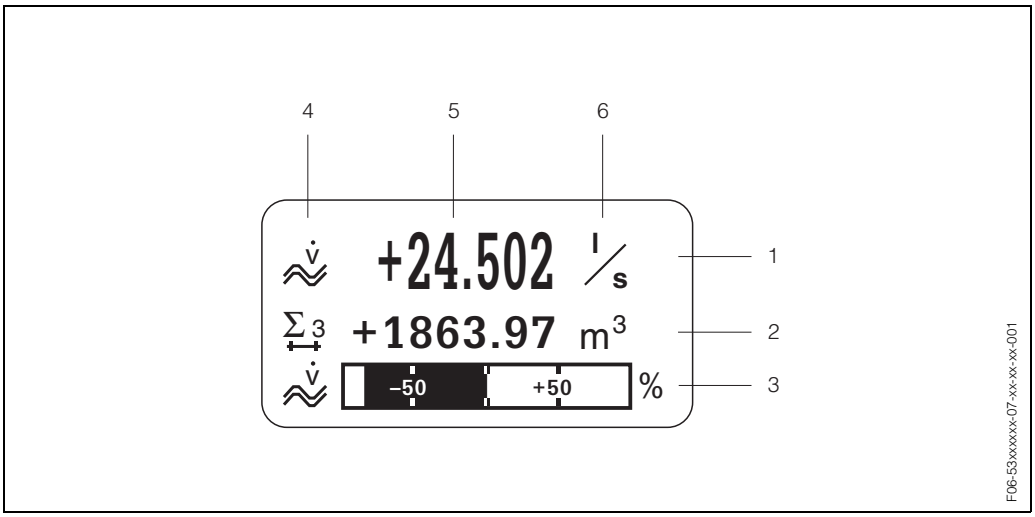


Fig. 25: Typical display for normal operating mode (HOME position)

1 Main line shows primary measured values, e.g. volume flow in [l/s].
2 Additional line shows additional measured variables, e.g. totalizer no. 3 in [m^3]
3 Information line shows additional information on the measured variables, e.g. bar graph of the full scale value reached by the volume flow.
4 "Info icons" field: icons representing additional information on the measured values are shown in this field. See Page 38 for a full list of the icons and their meanings.
5 "Measured values" field: the current measured values appear in this field.
6 "Unit of measure" field: the units of measure and time defined for the current measured values appear in this field.

Note!
From HOME position, use the +/– keys to open an "Info Menu" containing the following information:
- Totalizers (including overflow)
- Actual values or states of the configured inputs/outputs
- Device TAG number (user-definable)

+ – key → Key to request individual values in the list
Esc key (– +) → Return to HOME position

Icons
The icons which appear in the field on the left make it easier to read and recognise measured variables, device status, and error messages.

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
ϟ	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
I 1...n	Current output 1...n	P 1...n	Pulse output 1...n
F 1...n	Frequency output 1...n	S 1...n	Status/relay output 1...n (or status input)
Σ 1...n	Totalizer 1...n		
	Measuring mode = PULSATING FLOW		Measuring mode = SYMMETRY (bidirectional)
	Measuring mode = STANDARD		Counting mode, total. = BALANCE (forwards and reverse flow)
	Counting mode, total. = forwards		Counting mode, totalizer = reverse
	Signal input (current or status input)		Icon for volume flow
	Icon for activated device operation		

5.3 Brief operating instructions to the function matrix

Note!
- See the general notes on Page 40.
- Function descriptions → “Description of Device Functions” manual

1. HOME position → E → Enter the function matrix
2. Select a block (e.g. OUTPUTS)
3. Select a group (e.g. CURRENT OUTPUT 1)
4. Select a function group (e.g. SETTINGS)
5. Select a function (e.g. TIME CONSTANT)

   Change parameter / enter numeric values:
   ± → Select or enter release code, parameters, numerical values
   E → Save the entries

6. Exit the function matrix:
   – Press and hold down the Esc key (Esc ±) for more than 3 seconds → HOME position
   – Repeatedly press Esc key (Esc ±) → Return step by step to HOME position

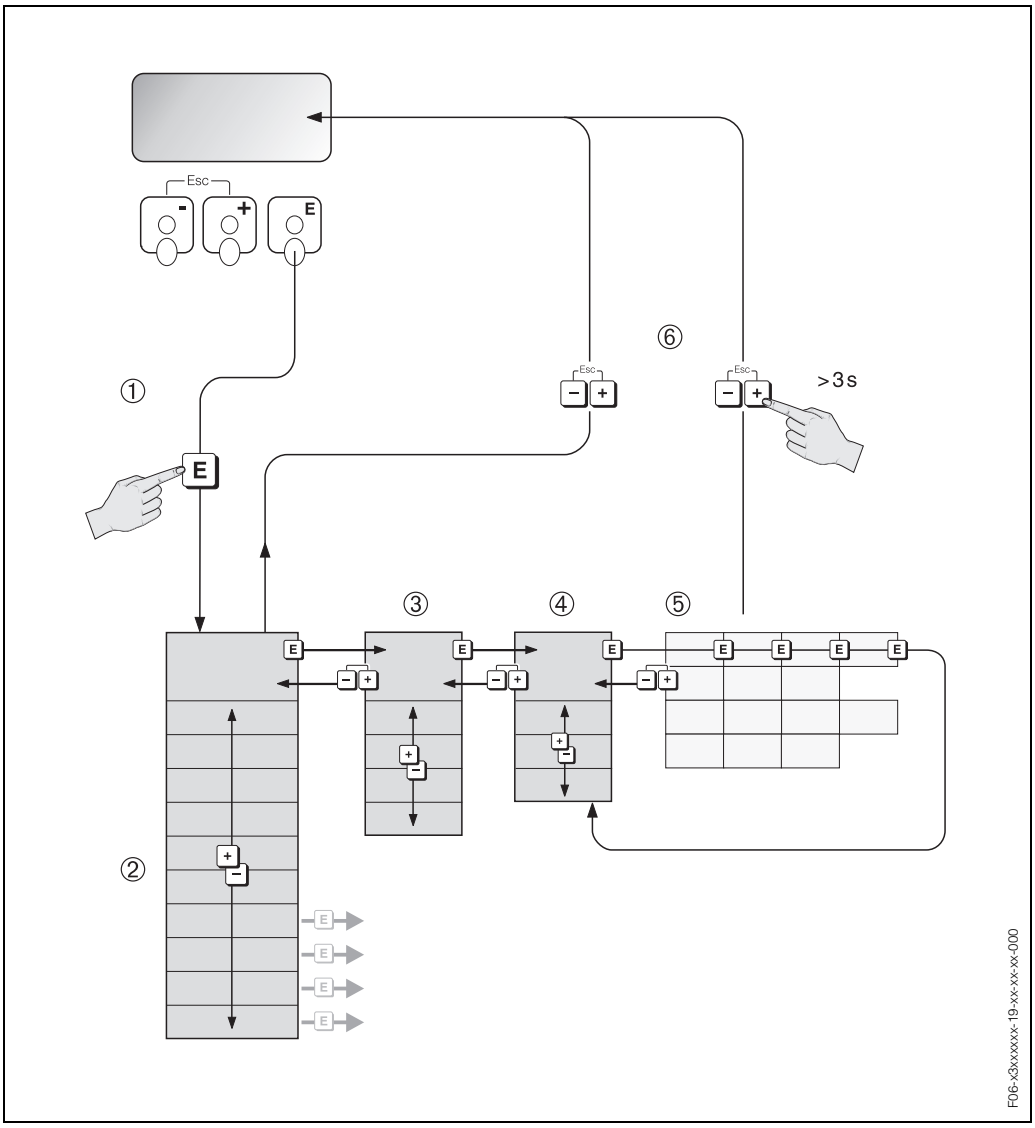


Fig. 26: Selecting functions and configuring parameters (function matrix)

5.3.1 General notes

The Quick Setup menu (see Page 58) is adequate for commissioning in most instances. Complex measurement tasks on the other hand necessitate additional functions that you can configure as necessary and customise to suit your process conditions. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged on a number of menu levels (blocks, groups, and function groups).

Comply with the following instructions when configuring functions:
- You select functions as described on Page 39. Each cell in the function matrix is identified by a numerical or letter code on the display.
- 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, as is the function matrix itself, in the **"Description of Device Functions"** manual which is a separate part of these Operating Instructions.

5.3.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 93) 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 the "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 E+H service organisation can be of assistance if you mislay your personal code.

Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring device, 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 E+H service organisation. Please contact Endress+Hauser if you have any questions.

5.3.3 Disabling the programming mode

Programming mode is disabled if you do not press a key within 60 seconds following automatic return to the HOME position.
You can also disable programming 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 the only one shown on the display.

The measuring system distinguishes between two types of error:
- *System error:* this group includes all device errors, for example communication errors, hardware errors, etc. → Page 76
- *Process error:* this group comprises all application errors, e.g. measuring range exceeded → Page 83

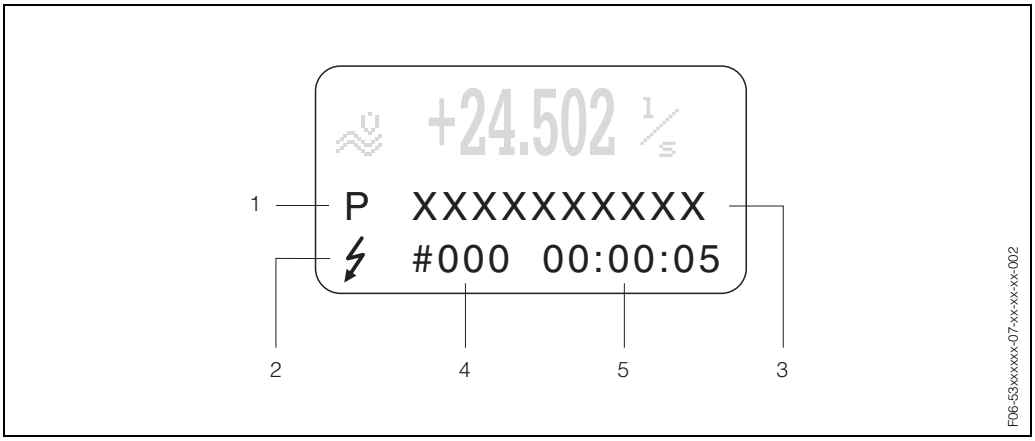


Fig. 27: Error messages on the display (example)

1 Error type: P = process error, S = system error
2 Error message type: ϟ = fault message; ! = notice message (definition: see Page 41)
3 Error designation: e.g. S.V. RANGE CH1 = sound velocity on channel 1 outside measuring range
4 Error number: e.g. #492
5 Duration of most recent error occurrence (in hours, minutes and seconds)

Error message type
Users have the option of weighting system and process errors differently by defining them as **Fault messages** or **Notice messages**. You can define messages in this way with the aid of the function matrix (see the “Description of Device Functions” manual). Serious system errors, e.g. module defects, are always identified and classed as “fault messages” by the measuring device.

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

Fault message (ϟ)
- Displayed as → Lightning flash (ϟ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix (see Page 85).

Note!
- For security reasons, error messages should be output via the relay outputs.
- If an error message is present, an upper or lower signal on alarm level can be output via the current output in accordance with NAMUR NE 43.

Confirming error messages
For the sake of plant and process safety, the measuring device can be configured in such a way that displayed fault messages (ϟ) always have to be rectified and acknowledged locally by pressing E . Only then do the error messages disappear from the display.
This option can be switched on or off by means of the "ACKNOWLEDGE FAULT MESSAGES" function (see the "Description of Device Functions" manual).

Note!
- Fault messages (ϟ) can also be reset and confirmed via the status input.
- Notice messages (!) do not require acknowledgment. Note, however, that they remain visible until the cause of the error has been rectified.

5.5 Communication (HART)

In addition to local operation, the measuring device can also be configured and measured values obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART (see Page 31).

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

Universal commands:
All HART device support and use universal commands. The following functionalities are linked to them:
- Identify HART devices
- Reading digital measured values (volume flow, totalizer, etc.)

Common practice commands:
Common practice commands offer functions which are supported and can be executed by most but not all field devices.

Device-specific commands:
These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cutoff settings, etc.

Note!
The measuring device has access to all three command classes. On Page 45, you will find a list with all the supported "Universal Commands" and "Common Practice Commands".

5.5.1 Operating options

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

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

FieldTool operating program
FieldTool is a universal service and configuration software package designed for the PROline devices. Connection is by means of a HART-Modem, e.g. Commubox FXA 191.

The functionality of FieldTool includes the following:
- Configuration of device functions
- Visualisation of measured values (including data logging)
- Data backup of device parameters
- Advanced device diagnosis
- Measuring-point documentation

You can find more information on FieldTool in the following E+H document: System Information SI 031D/06/en “FieldTool”

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

Note!
- The HART protocol requires the “4...20mA HART” or “4...20 mA (25 mA) HART” setting in the CURRENT SPAN function (current output 1).
- HART write protection can be disabled or enabled by means of a jumper on the I/O board → Page 56.

5.5.2 Device variables and process variables

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

ID (decimal)	Device variable
0	OFF (not assigned)
32	Volume flow average value
42	Sound velocity average value
51	Flow velocity average value
250	Totalizer 1
251	Totalizer 2
252	Totalizer 3

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

- Primary process variable (PV) → Volume flow average value
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → Sound velocity average value
- Fourth process variable (TV) → Flow velocity average value

Note!
You can set or change the assignment of device variables to process variables using Command 51 (see Page 50).

5.5.3 Universal / common practice HART commands

The following table contains all the universal and common practice commands supported by Prosonic Flow 93.

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
Universal Commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: – Byte 0: fixed value 254 – Byte 1: manufacturer ID, 17 = E+H – Byte 2: device type ID , 89 = Prosonic Flow 93 – Byte 3: number of preambles – Byte 4: universal commands rev. no. – Byte 5: rev. no. device-specific commands – Byte 6: software revision – Byte 7: hardware revision – Byte 8: additional device information – Bytes 9-11: device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: primary process variable *Factory setting:* Primary process variable: Volume flow average value ✎ Note! • You can set the assignment of device variables to process variables using Command 51. • Manufacturer-specific units are represented using the HART unit code “240”.
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Byte 0-3: current current of the primary process variable in mA – Bytes 4-7: percentage of the set measuring range *Factory setting:* Primary process variable: Volume flow average value ✎ Note! You can set or change the assignment of device variables to process variables using Command 51.

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
3	Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: fourth process variable *Factory setting:* • Primary process variable = Volume flow average value • Second process variable = Totalizer 1 • Third process variable = Sound velocity average value • Fourth process variable = Flow velocity average value ✎ Note! • You can set the assignment of device variables to process variables using Command 51. • Manufacturer-specific units are represented using the HART unit code “240”.
6	Set HART shortform address Access type = write	Byte 0: desired address (0...15) *Factory setting:* 0 ✎ Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: manufacturer ID, 17 = E+H – Byte 2: device type ID , 89 = Prosonic Flow 93 – Byte 3: number of preambles – Byte 4: universal commands rev. no. – Byte 5: rev. no. device-specific commands – Byte 6: software revision – Byte 7: hardware revision – Byte 8: additional device information – Bytes 9-11: device identification

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
12	Read user message Access type = read	none	Bytes 0-24: user message ✎ Note! You can write the user message using Command 17.
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: date ✎ Note! You can write the TAG, TAG descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: upper sensor limit – Bytes 8-11: lower sensor limit – Bytes 12-15: minimum span ✎ Note! • The data relate to the primary process variable (= Volume flow average value). • Manufacturer-specific units are represented using the HART unit code “240”.
15	Read output information of primary process variable Access type = read	none	– Byte 0: alarm selection ID – Byte 1: transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: end of measuring range, value for 20 mA – Bytes 7-10: start of measuring range, value for 4 mA – Bytes 11-14: attenuation constant in [s] – Byte 15: write protection ID – Byte 16: OEM dealer ID, 17 = E+H *Factory setting:* Primary process variable = Volume flow average value ✎ Note! • You can set the assignment of device variables to process variables using Command 51. • Manufacturer-specific units are represented using the HART unit code “240”.
16	Read the device production number Access type = read	none	Bytes 0-2: production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: desired user message	Displays the current user message in the device: Byte 0-23: current user message in the device

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
18	Write TAG, TAG descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: date
Common Practice Commands			
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable in seconds *Factory setting:* Primary process variable: Volume flow average value	Displays the current damping value in the device: Bytes 0-3: damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: end of measuring range, value for 20 mA – Bytes 5-8: start of measuring range, value for 4 mA *Factory setting:* Primary process variable: Volume flow average value ✎ Note! • You can set the assignment of device variables to process variables using Command 51. • If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit	The currently set measuring range is shown as the response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: end of measuring range, value for 20 mA – Bytes 5-8: start of measuring range, value for 4 mA ✎ Note! Manufacturer-specific units are represented using the HART unit code “240”.
38	Device status reset “configuration changed” Access = write	none	none
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0-3: output current in mA *Factory setting:* Primary process variable: Volume flow average value ✎ Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0-3: output current in mA
42	Perform master reset Access = write	none	none

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable: Volume flow average value ✎ Note! • If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. • If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code “240”.
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table on Page 51
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: device variable code to the primary process variable – Byte 1: device variable code to the second process variable – Byte 2: device variable code to the third process variable – Byte 3: device variable code to the fourth process variable *Factory setting:* • Primary process variable: code 32 for volume flow average value • Second process variable: code 250 for totalizer 1 • Third process variable: code 42 for sound velocity average value • Fourth process variable: code 51 for flow velocity average value ✎ Note! You can set or change the assignment of device variables to process variables using Command 51.

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
51	Write assignments of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: device variable code to the primary process variable – Byte 1: device variable code to the second process variable – Byte 2: device variable code to the third process variable – Byte 3: device variable code to the fourth process variable *Code of the supported device variables:* See data on Page 44 *Factory setting:* • Primary process variable: Volume flow average value • Second process variable = Totalizer 1 • Third process variable = Sound velocity average value • Fourth process variable = Flow velocity average value	The variable assignment of the process variables is displayed as a response: – Byte 0: device variable code to the primary process variable – Byte 1: device variable code to the second process variable – Byte 2: device variable code to the third process variable – Byte 3: device variable code to the fourth process variable
53	Write device variable unit Access = write	This command set the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: device variable code – Byte 1: HART unit code *Code of the supported device variables:* See data on Page 44 ✎ Note! • If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. • If you change the unit of the device variable, this has no impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: device variable code – Byte 1: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code “240”.
59	Set number of preambles in message responses Access = write	This parameter sets the number of preambles which are inserted in the message responses: Byte 0: number of preambles (2...20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: number of preambles

5.5.4 Device status / error messages

You can read the extended device status, in this case, current error messages, via Command “48”. The command delivers information which are partly coded in bits (see table below).

✎ Note!
You can find a detailed explanation of the device status and error messages and their elimination on Page 76 ff.!

Byte	Bit	Error no.	Short error description (→ Page 76 ff.)
0	0	001	Serious device error
	1	011	Measuring amplifier has faulty EEPROM
	2	012	Error when accessing data of the measuring amplifier EEPROM
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–
1	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	041	T-DAT: defective or missing
	4	042	T-DAT: error accessing saved values
	5	051	I/O board and the amplifier board are not compatible.
	6	not assigned	–
	7	not assigned	–
2	0	not assigned	–
	1	not assigned	–
	2	082	Connection (downwards) sensor CH1 / transmitter interrupted
	3	083	Connection (downwards) sensor CH2 / transmitter interrupted
	4	not assigned	–
	5	085	Connection (upwards) sensor CH1 / transmitter interrupted
	6	086	Connection (upwards) sensor CH2 / transmitter interrupted
	7	not assigned	–
3	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	111	Totalizer checksum error
	4	121	The I/O- and the amplifier board are not compatible.
	5	not assigned	–
	6	205	T-DAT: download not successful
	7	206	T-DAT: upload not successful

Byte	Bit	Error no.	Short error description (→ Page 76 ff.)
4	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	261	No data reception between amplifier and I/O board
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–
5	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	339	Current buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6	0	340	
	1	341	
	2	342	
	3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
	4	344	
	5	345	
	6	346	
	7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7	0	348	
	1	349	
	2	350	
	3	351	Current output: flow is out of range.
	4	352	
	5	353	
	6	354	
	7	355	Frequency output: flow is out of range.
8	0	356	
	1	357	
	2	358	
	3	359	Pulse output: the pulse output frequency is out of range.
	4	360	
	5	361	
	6	362	
	7	not assigned	–

Byte	Bit	Error no.	Short error description (→ Page 76 ff.)
9	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–
10	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	392	Attenuation of acoustic measurement section too high (Channel 1)
	6	393	Attenuation of acoustic measurement section too high (Channel 2)
	7	not assigned	–
11	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–
12	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	492	Channel 1 = Sound velocity outside measuring range
	6	493	Channel 2 = Sound velocity outside measuring range
	7	501	New amplifier software version is loaded. No other commands possible at this point.
13	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–

Byte	Bit	Error no.	Short error description (→ Page 76 ff.)
14	0	not assigned	–
	1	592	Channel 1: initialisation running. All outputs set to “0”.
	2	593	Channel 2: initialisation running. All outputs set to “0”.
	3	not assigned	–
	4	602	Positive zero return (CH1 or CH2 or CH1&2)
	5	not assigned	–
	6	not assigned	–
	7	611	Simulation current output active
15	0	612	
	1	613	
	2	614	
	3	621	Simulation frequency output active
	4	622	
	5	623	
	6	624	
	7	631	Simulation pulse output active
16	0	632	
	1	633	
	2	634	
	3	641	Simulation status output active
	4	642	
	5	643	
	6	644	
	7	651	Simulation relay output active
17	0	652	
	1	653	
	2	654	
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	671	Simulation status input active
18	0	672	
	1	673	
	2	674	
	3	691	Simulation of response to error (outputs) active
	4	not assigned	–
	5	not assigned	–
	6	694	Channel 1: volume flow simulation active
	7	695	Channel 2: volume flow simulation active

Byte	Bit	Error no.	Short error description (→ Page 76 ff.)
19	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–
20	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–
21	0	not assigned	–
	1	not assigned	–
	2	743	Channel 1: static zero point adjustment is not possible.
	3	744	Channel 2: static zero point adjustment is not possible.
	4	not assigned	–
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–
22	0	not assigned	–
	1	not assigned	–
	2	not assigned	–
	3	not assigned	–
	4	061	Transmitter F-Chip is defective or missing
	5	not assigned	–
	6	not assigned	–
	7	not assigned	–

5.5.5 Switching HART write protection on and off

A jumper on the I/O board provides the means of activating or deactivating HART 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 88
3. Switch HART write protection on or off, as applicable, by means of the jumper (Fig. 28).
4. Installing the I/O board is the reverse of the removal procedure.

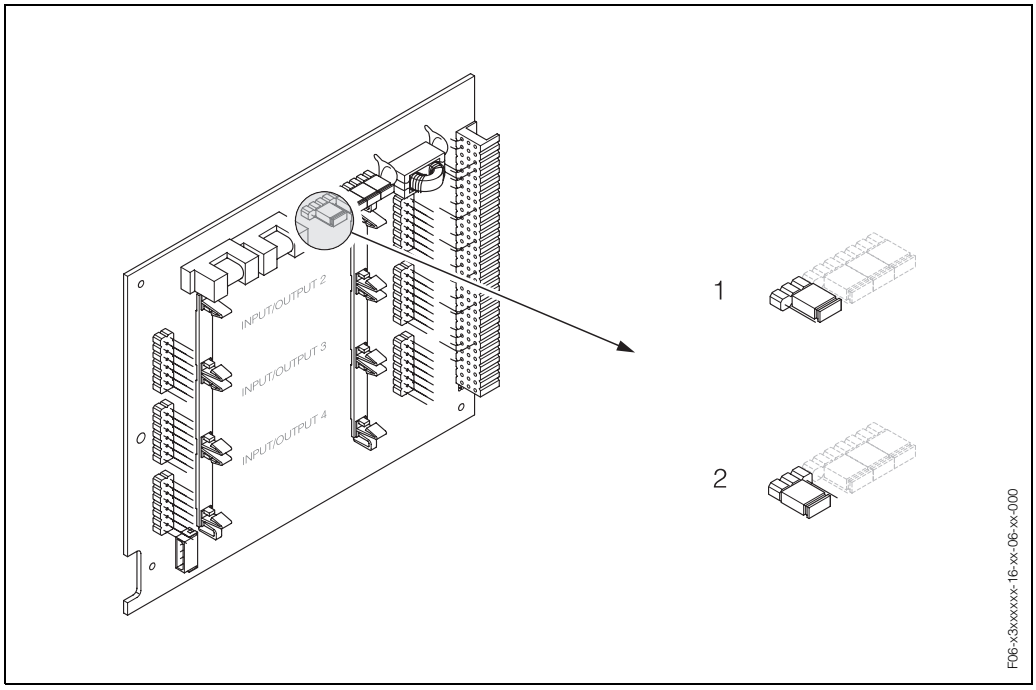


Fig. 28: Switching HART write protection on and off (I/O board)

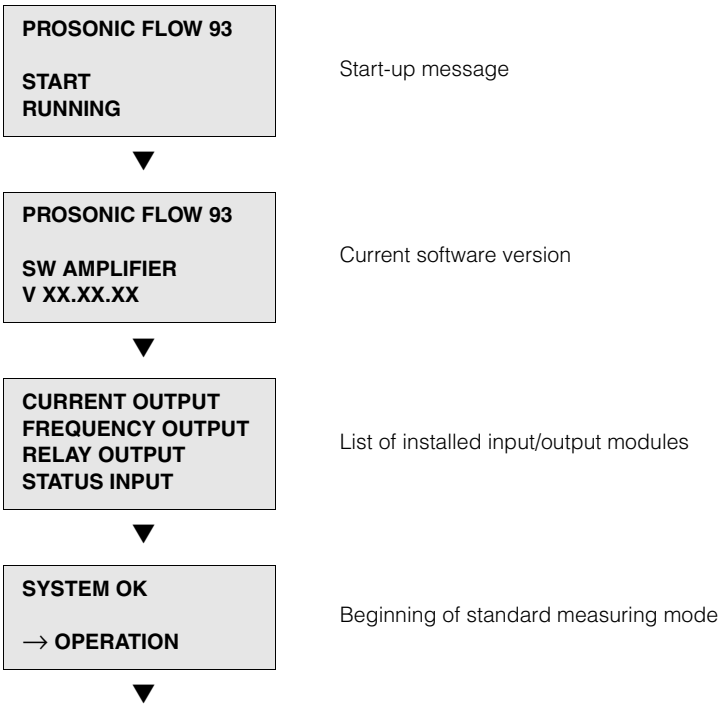
1 Write protection switched off (factory setting), i.e. HART protocol enabled.
2 Write protection switched on, i.e. HART protocol disabled.

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 25
- "Post-connection check" checklist → Page 34

Switching on the measuring device
Once the connection checks (see Page 34) have 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:



Standard measuring mode commences as soon as power-on is completed. Various measured value and/or status variables appear on the display (HOME position).

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

6.2 Commissioning via local display

6.2.1 "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. 29).
If a measuring device does not have a local operation, the individual parameters and functions must be configured via the configuration program FieldTool (see Page 64).

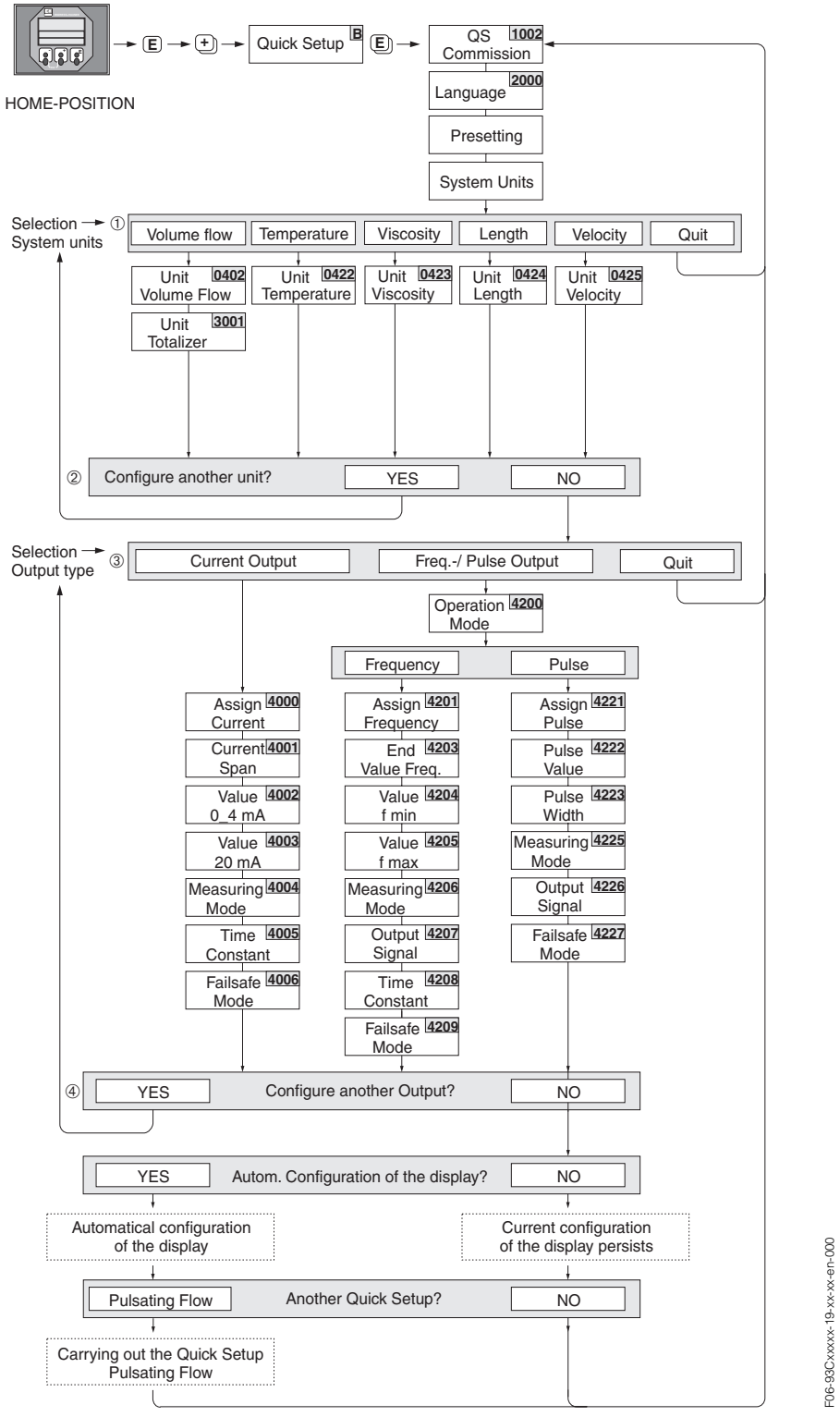


Fig. 29: "Commissioning" Quick Setup (with local operation only)

Note!

- The display returns to the cell QUICK SETUP COMMISSIONING (1002) if you press the ESC key combination (□+□) during interrogation.
- If you confirm the inquiry “Automatic configuration of the display?” as YES, the configuration of the display will be carried out as follows: main line = volume flow, additional line = totalizer 1, information line = operational/system condition.

①
Only the units not yet configured in the current Quick Setup are offered for selection in each cycle. The unit for volume is derived from thevolume flow unit.

②
The “YES” option remains visible until all the units have been configured. “NO” is the only option displayed when no further units are available.

③
Only the outputs not yet configured in the current Quick Setup are offered for selection in each cycle.

④
The “YES” option remains visible until all the outputs have been configured. “NO” is the only option displayed when no further outputs are available.

6.2.2 "Pulsating Flow" Quick Setup menu

Certain types of pump such as piston pumps, peristaltic pumps and cam-type pumps, for example, create a flow characterised by severe periodic fluctuations (Fig. 30). Negative flows can occur with pumps of these types on account of the closing volume of the valves or valve leaks.

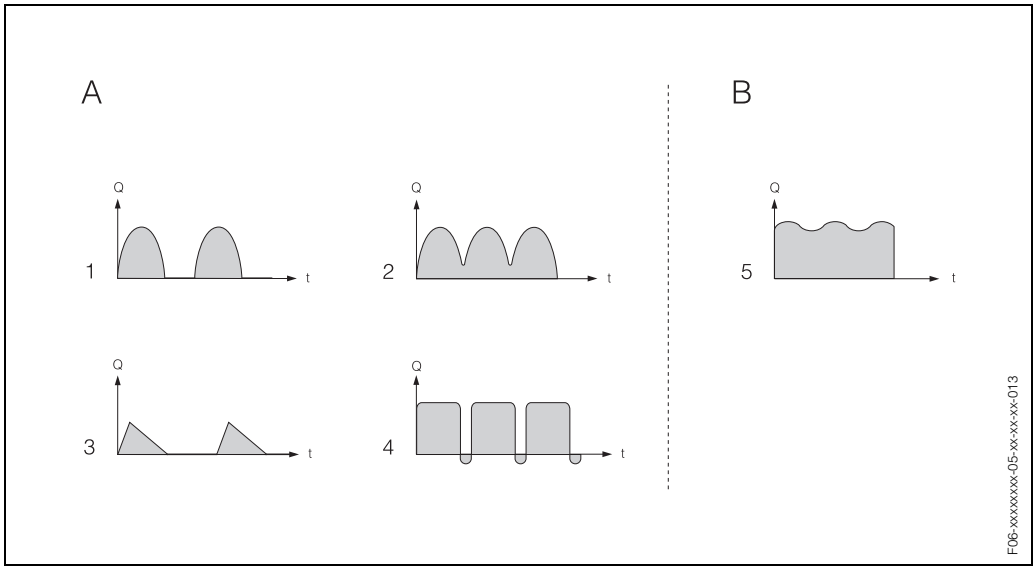


Fig. 30: Flow characteristics of various types of pump

A = With severely pulsating flow
B = With slightly pulsating flow

1 1-cylinder cam pump
2 2-cylinder cam pump
3 Magnetic pump
4 Peristaltic pump, flexible connecting hose
5 Multi-cylinder piston pump

Severely pulsating flow
Once several device functions have been configured in the "Pulsating Flow" Quick Setup menu, flow fluctuations can be compensated over the entire flow range and pulsating liquid flows measured correctly. You will find detailed instructions on how to use this Quick Setup menu on Page 61.

Note!
It is always advisable to work through the "Pulsating Flow" Quick Setup menu if here is any uncertainty about the exact flow characteristic.

Slightly pulsating flow
If flow fluctuations are no more than minor, as is the case, for example with gear-type, three-cylinder or multi-cylinder pumps, it is **not** absolutely necessary to work through the Quick Setup menu.
In cases of this nature, however, it is advisable to adapt the functions listed below in the function matrix (see "Description of Device Functions" manual) to suit local process conditions in order to ensure a stable, unvarying output signal. This applies particularly to the current output:

- Measuring system damping: "FLOW DAMPING" function → Increase value
- Current output damping: "TIME CONSTANT" function → Increase value

Using the "Pulsating Flow" 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 "Pulsating Flow" Quick Setup menu (Fig. 29).

If a measuring device does not have a local operation, the individual parameters and functions must be configured via the configuration program FieldTool (see Page 64).

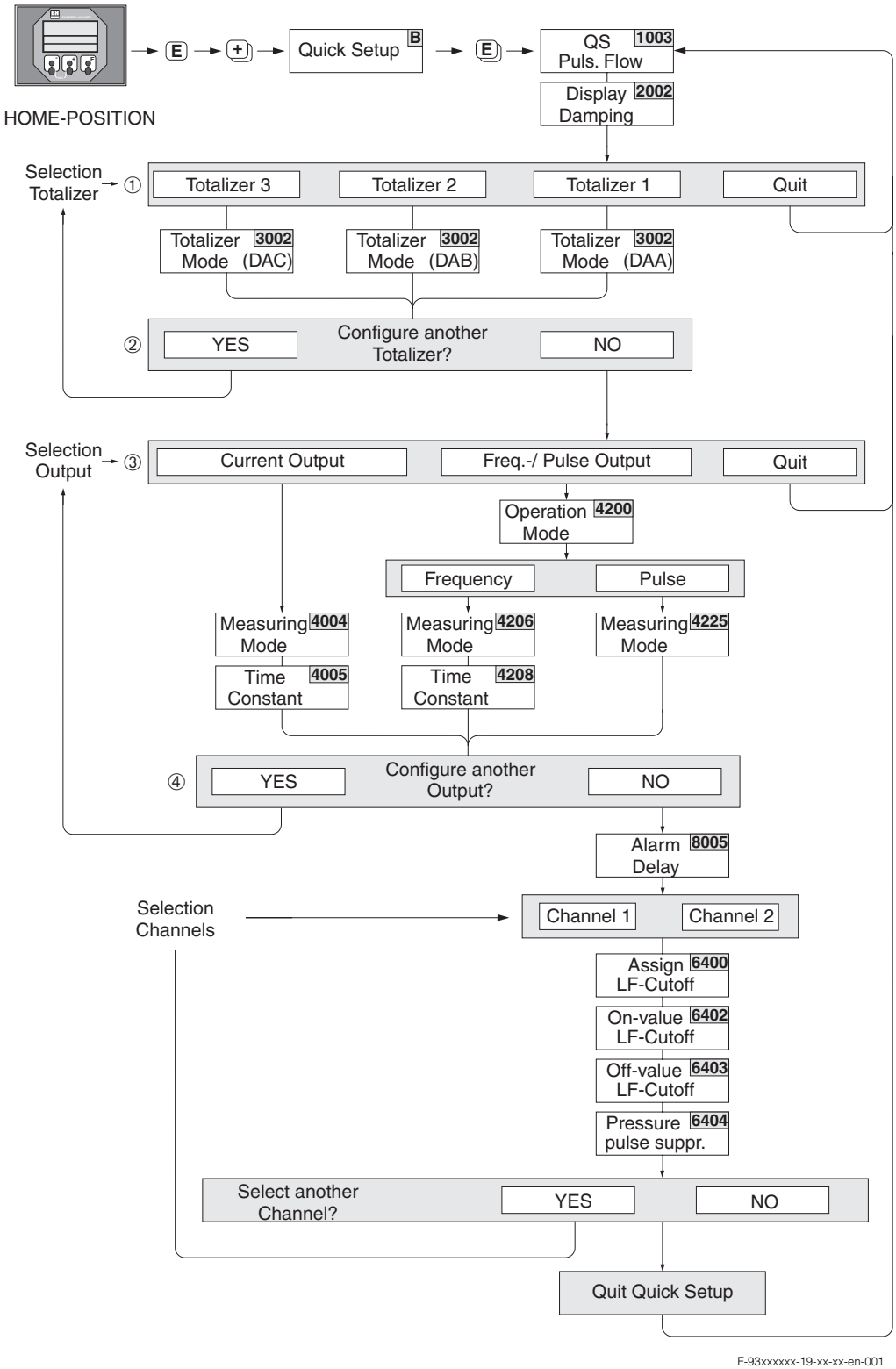


Fig. 31: Quick Setup for measuring severely pulsating flows (with local operation only)
Recommended setting → Page 63

Note!

- The display returns to the cell QUICK SETUP PULSATING FLOW (1003) if you press the ESC key combination (□+□) during interrogation.
- You can call this Quick Setup menu either directly from the “COMMISSIONING” Quick Setup menu or manually by means of the QUICK SETUP PULSATING FLOW function (1003).
- If you confirm the inquiry “Automatic configuration of the display?” as YES, the configuration of the display will be carried out as follows: main line = volume flow, additional line = totalizer 1, information line = operational/system condition.

①
Only the totalizers not yet configured in the current Quick Setup are offered for selection in each cycle.

②
The “YES” option remains visible until all the totalizers have been parameterized. “NO” is the only option displayed when no further totalizers are available.

③
Only the outputs not yet configured in the current Quick Setup are offered for selection in each cycle.

④
The “YES” option remains visible until all the outputs have been parameterized. “NO” is the only option displayed when no further outputs are available.

“Pulsating flow” Quick Setup menu		
HOME position → E → MEASURED VARIABLE (A) MEASURED VARIABLE → + → QUICK SETUP (B) QUICK SETUP → E → QS-PULS. FLOW (1003)		
Function No.	Function name	Setting to select (6)
1003	QS PULS. FLOW	YES After E is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.

▼

Basic configuration		
2002	DISPLAY DAMPING	1 s
3002	TOTALIZER MODE (DAA)	BALANCE (totalizer 1)
3002	TOTALIZER MODE (DAB)	BALANCE (totalizer 2)
3002	TOTALIZER MODE (DAC)	BALANCE (totalizer 3)
Signal type for “CURRENT OUTPUT 1...n”		
4004	MEASURING MODE	PULS. FLOW
4005	TIME CONSTANT	1 s
Signal type for “PULSE/FREQ. OUTPUT 1...n” (for FREQUENCY operating mode)		
4206	MEASURING MODE	PULS. FLOW
4208	TIME CONSTANT	0 s
Signal type for “PULSE/FREQ. OUTPUT 1...n” (for PULSE operating mode)		
4225	MEASURING MODE	PULS. FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LF CUTOFF	VOLUME FLOW
6402	ON-VALUE LOW FLOW CUT OFF	Recommended setting 0.4 l/s
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s

▼

Back to the HOME position
→ Press and hold down Esc key (- + Esc) for longer than three seconds.
→ Repeatedly press and release Esc key (- + Esc) → Exit the function matrix step by step

6.3 Commissioning via a configuration program

6.3.1 Commissioning

The following functions have to be configured for the standard application:

- System parameters
- Outputs

6.4 Application specific commissioning

6.4.1 Zero point adjustment

Zero point adjustment is generally **not** necessary (required after sensor exchange only).

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

Preconditions for a zero point adjustment
Note the following before 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. 32).
  – 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 E+H service center.
- You can view the currently valid zero point value using the “ZERO POINT” function (see the “Description of Device Functions” manual).

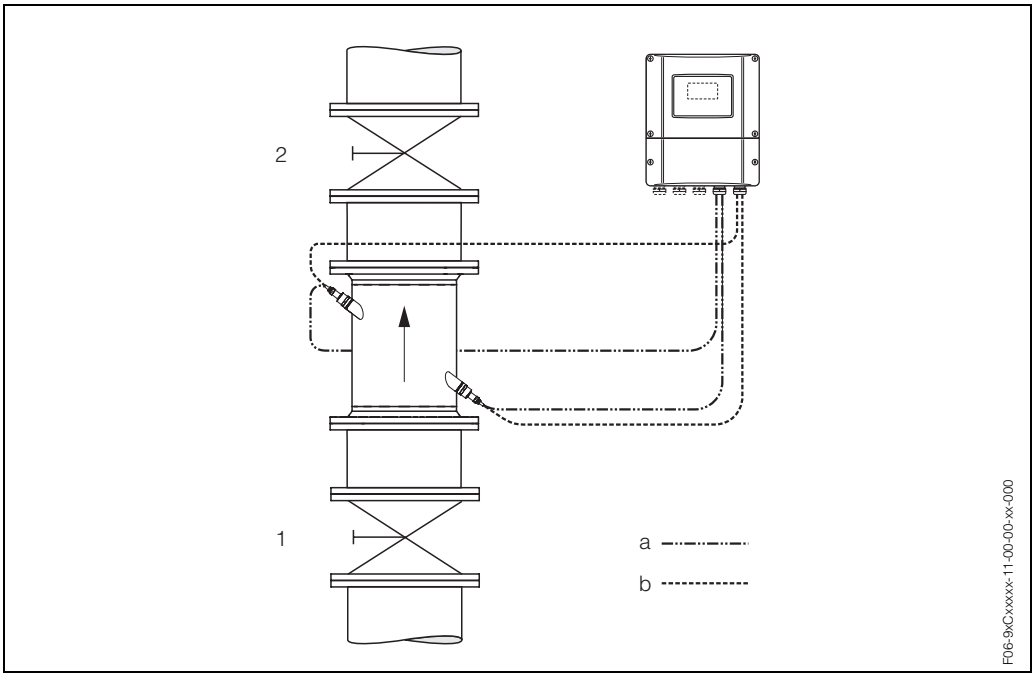


Fig. 32: Zero point adjustment and shut-off valves

1 Shut-off valve upstream before Prosonic Flow C
2 Shut-off valve downstream after Prosonic Flow C
a Sensor cable channel 1
b Sensor cable channel 2

Performing a zero point adjustment

1. Operate the system until normal operating conditions resume.
2. Stop the flow (v = 0 m/s).
3. Check the 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 → E → ± → BASIC FUNCTIONS
   BASIC FUNCTIONS → E → ± → PROCESS PARAMETER CH1/CH2
   PROCESS PARAMETER → E → ± → CALIBRATION
   CALIBRATION → E → 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 “ZERO POINT ADJUST RUNNING” appears on the display for 30...60 seconds while adjustment is in progress.
   – If the fluid velocity in the pipe exceeds 0.1 m/s, the following error message appears on the display: ZERO ADJUST NOT POSSIBLE.
   – When the zero point adjustment is completed, the “ZERO ADJUST.” function reappears on the display.
8. Back to the HOME position
   – Press and hold down Esc key (Esc −+) for longer than three seconds.
   – Repeatedly press and release the Esc key (Esc −+).

Note!
Please note that zero point adjustment must be carried out separately for both channels!

6.4.2 Advanced diagnostic functions

Changes to the measuring system can be detected at an early stage by means of the optional software package "Advanced diagnostics" (F-Chip, accessories → Page 73). Normally, these influences reduce the measuring accuracy of the system or may lead to system errors.
By means of the diagnostic functions it is now possible to record various process and device parameters during operation, e.g. volume flow, flow velocity, signal strength, sound velocity, etc.
By analysing the trend of these measured values, deviations of the measuring system from a "reference status" can be detected in good time and corrective measures can be taken.

Reference values as the basis for trend analysis
Reference values of the parameters in question must always be recorded for trend analysis. These reference values are determined under reproducible, constant conditions. Reference data are ascertained under customer-specific process conditions, e.g. during commissioning or during certain processes (cleaning cycles, etc.)
Reference values are recorded and saved in the measuring system always by means of the device function → REFERENCE CONDITION USER (7601).

Caution!
It is not possible to analyse the trend of process/device parameters without reference values! Reference values can only be determined under constant, non-changing process conditions.

Methods of ascertaining data
Process and device parameters can be recorded in two different ways which you can define in the function → ACQUISITION MODE (7610):
- "PERIODICAL" option: measuring device acquires data periodically. Enter the desired time interval by means of the function "ACQUISITION PERIOD (7611)".
- "SINGLE SHOT" option: the user himself acquires the data manually at different, free selectable periods.

Ensure the data are acquired when the process conditions correspond to the reference status. Only in this way can deviations from the reference status be determined reliably and clearly.

Note!
The last ten entries are retained in chronological order in the measuring system.
The "history" of such values can be called up via various functions:

Diagnosis parameters	Data saved (per parameter)
Volume flow Flow velocity Signal strength Sound velocity Actual transit time Acceptance rate	• Reference value → "REFERENCE VALUE" function • Lowest measured value → "MINIMUM VALUE" function • Highest measured value → "MAXIMUM VALUE" function • List of the last ten measured values → "HISTORY 1" function • Deviation measured/reference value → "ACTUAL DEVIATION" function
Note! More detailed information can be found in the "Description of Device Functions" Manual.	

Triggering warning messages
If required, a limit value can be assigned to all the process/device parameters relevant to the diagnostic functions. A warning message is triggered if this limit value is exceeded →"WARNING MODE (7603)" function.
The limit value is entered into the measuring system as a relative deviation from the reference → "WARNING LEVEL (76....)" function.
Deviations can be assigned to and indicated via the current or relay outputs.

Data interpretation
The way the data recorded by the measuring system is interpreted depends largely on the application in question. This means that users must have a very good knowledge of their specific process conditions and the related deviation tolerances in the process, which have to be determined by the users themselves in each individual case.
For example, when using the limit function it is especially important to know the minimum and maximum deviation tolerances allowed. Otherwise there is the danger that a warning message is triggered inadvertently during "normal" process fluctuations.

There can be various reasons for deviating from the reference status. The following table provides examples and pointers for each of the six diagnosis parameters recorded:

Diagnosis parameters	Possible reasons for deviation
Signal strength	A change in the signal strength can be a result of changes in the process, e.g. increased gas or solids content in the liquid, or less optimum signal coupling into the pipe due to drying out or loss of the coupling fluid, for example.
Sound velocity	A change in the sound velocity can be put down to altered process conditions. The most common causes are changes in the temperature or composition of the liquid. Optimum measurement is achieved if the change in sound velocity is smaller than +/- 10%..
Actual transit time Duration of signal to go from transmitter via sensor, through pipe, liquid and back to transmitter. Only the transit time in the liquid is relevant to the flow velocity measurement.	The actual transit time is proportional to the sound velocity.
Acceptance rate: The acceptance rate indicates the proportion of measurements which are applied by the flow calculation.	A reduction in the acceptance rate is caused by a fluctuating signal strength and indicates gas bubbles or solids in the liquid.

6.5 Hardware configuration

6.5.1 Current output: active/passive

The current output can be configured as “active” or “passive” by means of various jumpers on the I/O board or the current submodule.

⚠ 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 88
3. Set the jumpers in accordance with Fig. 33.

☝ Caution!
– Risk of destroying the measuring device. Set the jumpers exactly as shown in Fig. 33. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.
– Note that the position of the current submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → Page 30.

4. Installing the I/O board is the reverse of the removal procedure.

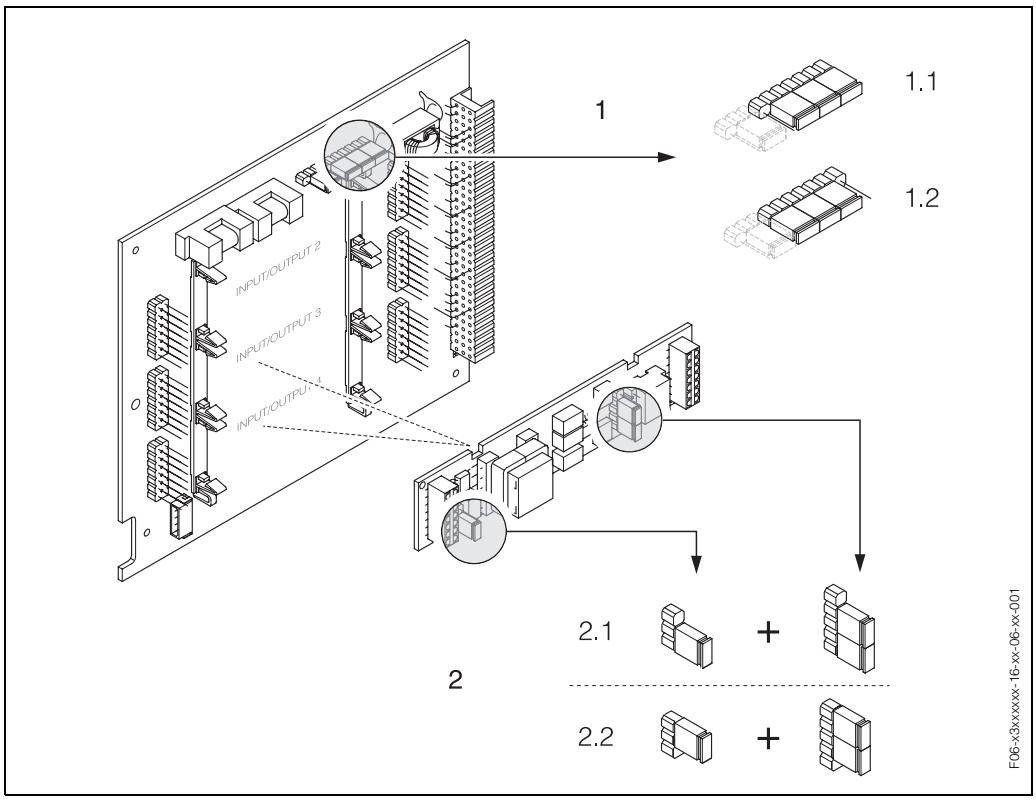


Fig. 33: Configuring current outputs with the aid of jumpers (I/O board)

1 Current output 1 with HART
1.1 Active (default)
1.2 Passive

2 Current output 2 (optional, plug-in module)
2.1 Active (default)
2.2 Passive

6.5.2 Relay contacts: normally closed/normally open

The relay contact can be configured as normally open (NO or make) or normally closed (NC or break) contacts by means of two jumpers on the I/O board or the relay submodule. This configuration can be called up at any time with the “ACTUAL STATUS RELAY” function (No. 4740).

⚠ 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 →see Page 88
3. Set the jumpers in accordance with Fig. 34 or (I/O board upgradable) or Fig. 35 (I/O board not upgradable).

   ☝ Caution!
   – The configuration of the jumpers on the fixed module board is mirrored to that of the flexible module board. Play close attention to the display in the illustrations.
   – Please change the positions of **both** jumpers.
   – Note that the position of the relay submodule on the flexible I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → see Page 30.

4. Installing the I/O board is the reverse of the removal procedure.

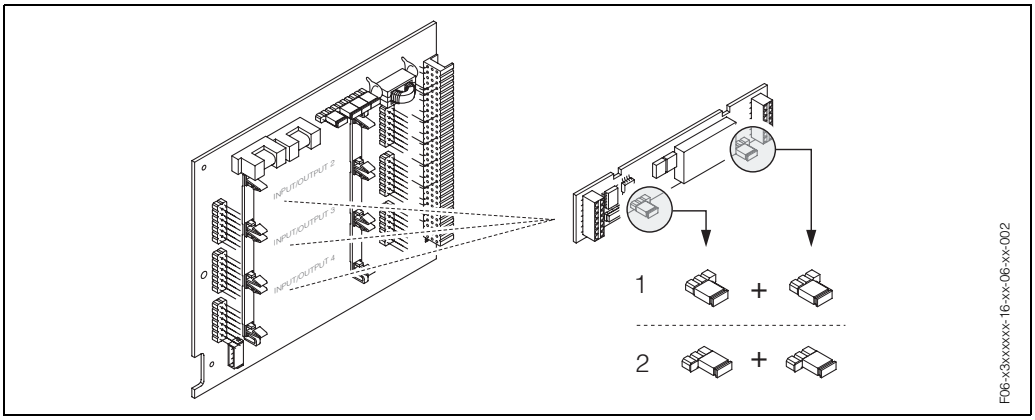


Fig. 34: Configuring relay contacts (NC / NO) for the flexible module board

1 Configured as NO contact (default, relay 1)
2 Configured as NC contact (default, relay 2, if installed)

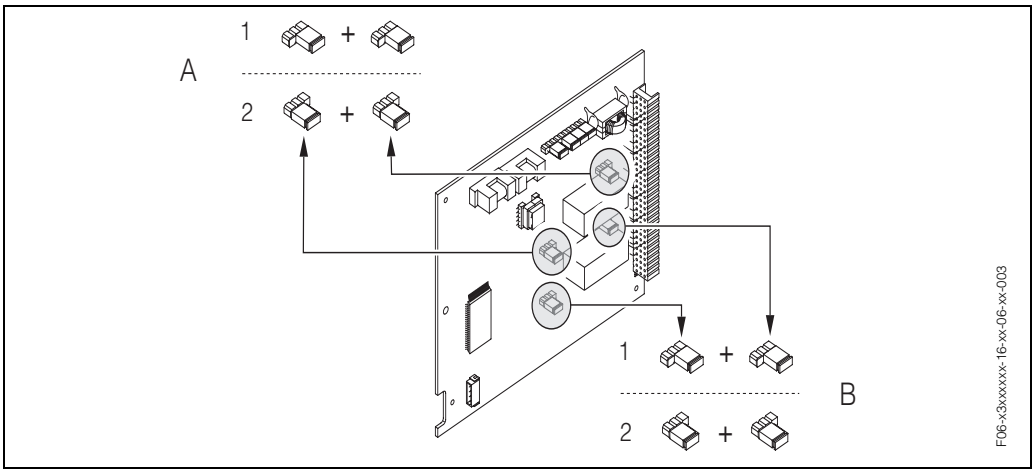


Fig. 35: Configuring relay contacts (NC / NO) for the fixed module board

1 Configured as NO contact (default, relay 1)
2 Configured as NC contact (factory setting, relay 2)

6.6 Data storage device (DAT, F-Chip)

T-DAT (Transmitter-DAT)
The T-DAT is an exchangeable data storage device in which all transmitter parameters and settings are stored.
Storing of specific parameter settings from the EEPROM to the T-DAT and vice versa has to be carried out by the user (= **manual** save function). Detailed instructions regarding this can be found in the "Description of Device Functions" manual (function "T-DAT SAVE/LOAD", No. 1009). In addition, the system calibration data can be restored in the "SYSTEM RESET" function No. 8046 by means of the MEASURING TUBE DATA option. The calibration data of the system are protected and cannot be overwritten or saved with the T-DAT SAVE/LOAD function.

Note!
The T-DAT is connected to the sensor signal cable and should not be removed. The system can only be restored with the original T-DAT or with assistance from the E+H service organisation.

F-Chip (Function-Chip)
The F-Chip is a microprocessor chip that contains additional software packages that extend the functionality and application possibilities of the transmitter.
In the case of a later upgrade, the F-Chip can be ordered as an accessory (see Page 73) and can simply be plugged on to the I/O board (see Page 87). After start up, the software is immediately made available to the transmitter.

Caution!
To ensure an unambiguous assignment, the F-Chip is coded with the transmitter serial number once it is plugged into the I/O board. Thus, it **cannot** be reused with other measuring devices.

7 Maintenance

The Prosonic Flow 93 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.

8 Accessories

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

Accessory	Description	Ordering code
Transmitter wall-mount housing Prosonic Flow 93	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	93–XXXXXXXX ********
Conversion kit Inputs/outputs	Conversion kit includes the necessary submodules for the upgrade of the previous input/output configuration to a new variant.	DK9UI-**
Software package for Prosonic Flow 93	Software add-on on F-Chip, can be ordered individually: – Advanced diagnostics	DK9SO – *
Mounting set for transmitter	Mounting set for wall-mount housing. Suitable for: – Wall mounting – Pipe mounting – Panel mounting Mounting set for alum. field housing Suitable for pipe mounting (3/4"...3")	DK9WM – A DK9WM – B
Flowmeter sensor W	–40...+80 °C; IP 68	DK9WS – L*
Sensor cable set for Prosonic Flow W	– 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	DK9SC – A DK9SC – B DK9SC – C DK9SC – D
Conduit adapter for sensor cable Prosonic Flow W	– 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
HART Communicator DXR 375 handheld communicator	Handheld communicator for remote parameterisation and for fetching measured values via the current output HART (4…20 mA). Contact your E+H representative for more information.	DXR375 –****
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 E+H representative for more information.	DKA80 –*

Accessory	Description	Ordering code
FieldTool	Configuration and service software for flowmeters in the field: – Commissioning, maintenance analysis – Configuring flowmeters – Service functions – Visualisation of process data – Trouble-shooting – Controlling the “FieldCheck” tester/simulator Contact your E+H representative for more information.	DXS10 – *****
FieldCheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the “FieldTool” software package, test results can be imported into a database, printed and used for official certification. Contact your E+H representative for more information.	DXC10 – **

9 Trouble-shooting

9.1 Trouble-shooting instructions

Always start trouble-shooting with the checklist 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.

Check the display	
No display visible and no output signals present.	1. Check supply voltage → Terminal 1, 2 2. Check the power line fuse → Page 91 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. Sensor electronics defective → Order spare part → Page 87
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 89 2. Display module defective → Order spare part → Page 87 3. Sensor electronics defective → Order spare part → Page 87
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ± keys and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Sensor electronics board defective → Order spare part → Page 87

▼

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.V. CH1** = Type of error (e.g. sound velocity channel 1 outside measuring range) – **03:00:05** = Duration of error occurrence (in hours / minutes /seconds) – **# 492** = Error number Caution! • See the information on Page 41 ff.! • The measuring system interprets simulations and positive zero return as system errors, but displays them as notice messages only.	
Error number: No. 001 – 399 No. 501 – 799	System error (device error) has occurred → Page 76
Error number: No. 401 – 499	Process error (application error) has occurred → Page 83

▼

Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → Page 84

9.2 System error messages

Serious system errors are **always** recognised by the instrument as “Fault messages”, and are shown as a lightning flash (ϟ) on the display. Fault messages immediately affect the inputs and outputs. Simulations and positive zero return, on the other hand, are classed and displayed as notice messages.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The procedures on Page 8 must be carried out before you return a flowmeter to Endress+Hauser.
Always enclose a fully completed “Declaration of Contamination” form. A copy of the form can be found at the end of these Operating Instructions.

Note!
The listed error message types below correspond to the factory setting.
Also observe the information on Page 41 ff. and 85.

Type	Error message / No.	Cause	Remedy / spare part
S = System error ϟ = Fault message (*with* an effect on the outputs) ! = Notice message (*without* an effect on the outputs)			
No. # 0xx → Hardware error			
S ϟ	CRITICAL FAIL. **# 001**	Serious device error	Replace the amplifier board. Spare parts → Page 87
S ϟ	AMP HW-EEPROM **# 011**	Amplifier: Defective EEPROM	Replace the amplifier board. Spare parts → Page 87
S ϟ	AMP SW EEPROM **# 012**	Amplifier: Error accessing EEPROM data	The EEPROM data blocks in which an error has occurred are displayed in the “TROUBLESHOOTING” function (No. 8047). Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see also error no. 111 / CHECKSUM TOTAL.).
S ϟ	TRANSM. HW-DAT **# 041**	DAT transmitter: 1. T-DAT is defective 2. T-DAT is not plugged into the amplifier board or is missing.	1. Replace the T-DAT. Spare parts → Page 87. Check the spare part set number to ensure that the new, replacement DAT is compatible with the sensor electronics. 2. Plug the T-DAT into the amplifier board → Page 89

Type	Error message / No.	Cause	Remedy / spare part
S ϟ	TRANSM. SW-DAT **# 042**	Transmitter: Error accessing the calibration values stored in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → Page 89 2. Replace T-DAT if defective. Spare parts → Page 87. Before replacing the DAT, check that the new, replacement DAT is compatible with the sensor electronics. Check the: – Spare part set number – Hardware revision code 3. Replace sensor electronics boards if necessary. Spare parts → Page 87
S ϟ	K-CAL T-DAT **# 043**	Calibration data faulty	1. Check whether the T-DAT is correctly plugged into the amplifier board → Page 89 2. Replace T-DAT if defective. Spare parts → Page 87. Before replacing the DAT, check that the new, replacement DAT is compatible with the sensor electronics. Check the: – Spare part set number – Hardware revision code 3. Replace sensor electronics boards if necessary. Spare parts → Page 87
S ϟ	A / C COMPATIB. **# 051**	The I/O board and the amplifier board are not compatible.	Use only compatible modules and boards. Check the compatibility of the modules used. Check the: – Spare part set number – Hardware revision code
S ϟ	HW F-CHIP **# 061**	Transmitter F-Chip: 1. F-Chip is defective. 2. F-Chip is not plugged into the I/O board or is missing.	1. Replace the F-Chip. Accessories → Page 87 2. Plug the F-Chip into the I/O board → Page 89
S ϟ	SENS. DOWN CH1 **# 082**	Connection between sensor channel 1/2 and transmitter interrupted	– Check the cable connection between the sensor and the transmitter. – Check that the sensor connector is fully screwed in. – The sensor may be defective. – Incorrect sensor connected – The wrong sensor was selected in the SENSOR TYPE (No. 6881) function.
S ϟ	SENS. DOWN CH2 **# 083**		

Type	Error message / No.	Cause	Remedy / spare part
S ϟ	SENSOR UP CH1 **# 085**	Connection between sensor channel 1/2 and transmitter interrupted	– Check the cable connection between the sensor and the transmitter. – Check that the sensor connector is fully screwed in. – The sensor may be defective. – Incorrect sensor connected – The wrong sensor was selected in the SENSOR TYPE (No. 6881) function.
S ϟ	SENSOR UP CH2 **# 086**		
No. # 1xx → Software error			
S ϟ	CHECKSUM TOTAL **# 111**	Totalizer checksum error	1. Restart the measuring device 2. Replace the amplifier board if necessary. Spare parts → Page 87
S !	A / C COMPATIB. **# 121**	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.	Module with lower software version has either to be actualizied by FieldTool with the required software version or the module has to be replaced. Spare parts → Page 87
No. # 2xx → Error in DAT / no data reception			
S !	LOAD T-DAT **# 205**	DAT transmitter: Data backup (download) to T-DAT failed or error when accessing the values stored in the T-DAT (upload).	1. Check whether the T-DAT is correctly plugged into the amplifier board → Page 89 2. Replace T-DAT if defective. Spare parts → Page 87. Before replacing the DAT, check that the new, replacement DAT is compatible with the sensor electronics. Check the: – Spare part set number – Hardware revision code 3. Replace sensor electronics boards if necessary. Spare parts → Page 87
S !	SAVE T-DAT **# 206**		
S ϟ	COMMUNIC. I/O **# 261**	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts

Type	Error message / No.	Cause	Remedy / spare part
No. # 3xx → System limits exceeded			
S !	STACK CUR.OUT n **# 339…342**	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the lower range or full scale value entered. 2. Increase or reduce flow Recommendations in the event of fault category = FAULT MESSAGE (ϟ): – Configure the fault response of the output to "ACTUAL VALUE" (see Page 85), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under item 1.
S !	STACK FRQ.OUT n **# 343…346**		
S !	STACK PULSE n **# 347…350**	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse value 2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses. 3. Increase or reduce flow Recommendations in the event of fault category = FAULT MESSAGE (ϟ): – Configure the fault response of the output to "ACTUAL VALUE" (see Page 85), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under item 1.
S !	RANGE CUR.OUT n **# 351…354**	Current output: Flow is out of range.	– Change the lower range or full scale value entered. – Increase or reduce flow
S !	RANGE FRQ.OUT n **# 355...358**	Frequency output: Flow is out of range.	– Change the lower range or full scale value entered. – Increase or reduce flow

Type	Error message / No.	Cause	Remedy / spare part
S !	PULSE RANGE n **# 359…362**	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse value 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ 3. Reduce flow.
S ↯	SIGNAL LOW CH1 **# 392**	Attenuation of acoustic measurement section too high.	– It is possible that the fluid indicates too much attenuation.
S ↯	SIGNAL LOW CH2 **# 393**		
No. # 5xx → Application error			
S !	SW.-UPDATE ACT. **# 501**	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.
S !	UP-/DOWNLOAD ACT **# 502**	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until the procedure is finished.
S ↯	INIT. RUN CH1 **# 592**	Channel 1/2 initialisation running. All outputs set to 0.	Wait until the procedure is completed.
S ↯	INIT. RUN CH2 **# 593**		

Type	Error message / No.	Cause	Remedy / spare part
No. # 6xx → Simulation mode active			
S !	POS.0-RET.CH1 **# 602**	Positive zero return channel CH1 / CH2 / CH1&2 active. Caution! This is the highest priority notice message.	Switch off positive zero return
S !	POS.0-RET.CH2 **# 603**		
S !	POS.0-RT.CH1&2 **# 604**		
S !	SIM. CURR. OUT. n **# 611...614**	Simulation current output active	Switch off simulation
S !	SIM. FREQ. OUT. n **# 621…624**	Simulation frequency output active	Switch off simulation
S !	SIM. PULSE n **# 631...634**	Simulation pulse output active	Switch off simulation
S !	SIM. STAT. OUT n **# 641...644**	Simulation status output active	Switch off simulation
S !	SIM. REL. OUT n **# 651…654**	Simulation relay output active	Switch off simulation
S !	SIM. STATUS IN n **# 671…674**	Simulation status input active	Switch off simulation
S !	SIM. FAILSAFE **# 691**	Simulation of response to error (outputs) active	Switch off simulation
S !	SIM.MEASUR.CH1 **# 694**	Channel 1/2: volume flow simulation active	Switch off simulation
S !	SIM.MEASUR.CH2 **# 695**		
S !	DEV. TEST ACT. **# 698**	The measuring device is being checked on site via the test and simulation device.	–
No. # 7xx → Calibration or action errors			
S !	0-ADJ.FAIL CH1 **# 743**	The static zero point calibration of Channel 1/2 is not possible or was interrupted.	Check that the flow velocity is = 0 m/s.
S !	0-ADJ.FAIL CH2 **# 744**		
No. # 8xx → Other error messages with software options (ultrasonic flowmeter)			
S !	D VOL. FLOW CH1 **# 810**	Advanced diagnostics: The volume flow is outside the limit value, set in the corresponding diagnosis function.	–
S !	D. VOL. FLOW CH2 **# 820**		
S !	D FLOW CH1 **# 811**	Advanced diagnostics: The flow velocity is outside the limit value, set in the corresponding diagnosis function.	–
S !	D FLOW CH2 **# 821**		

Type	Error message / No.	Cause	Remedy / spare part
S !	D SIGNAL CH1 **# 812**	Advanced diagnostics: The signal strength is outside the limit value, set in the corresponding diagnosis function.	–
S !	D SIGNAL CH2 **# 822**		
S !	D SOUND V. CH1 **# 813**	Advanced diagnostics: The sound velocity is outside the limit value, set in the corresponding diagnosis function.	–
S !	D SOUND V. CH2 **# 823**		
S !	D T. TIME CH1 **# 814**	Advanced diagnostics: The actual transit time is outside the limit value, set in the corresponding diagnosis function.	–
S !	D T. TIME CH2 **# 824**		
S !	D ACC.RATE CH1 **# 815**	Advanced diagnostics: The acceptance rate is outside the limit value, set in the corresponding diagnosis function.	–
S !	D ACC.RATE CH2 **# 825**		
S !	D VOL.FL AVG **# 830**	Advanced diagnostics: The average volume flow is outside the limit value, set in the corresponding diagnosis function.	–
S !	D FLOW VEL.AVG **# 831**	Advanced diagnostics: The average flow velocity is outside the limit value, set in the corresponding diagnosis function.	–
S !	D SOUND V. AVG **# 833**	Advanced diagnostics: The average sound velocity is outside the limit value, set in the corresponding diagnosis function.	–

9.3 Process error messages

Process errors can be defined as either “Fault” or “Notice” messages and can thereby be weighted differently. Determination of this is done via the function matrix (→ see the “Description of Device Functions” Manual).

✎ Note!
The error types listed in the following correspond to the factory settings.
Also observe the information on Page 41 ff. and 85

Type	Error message / No.	Cause	Remedy
P = Process error ϟ = Fault message (*with* an effect on the inputs and outputs) ! = Notice message (*without* an effect on the inputs and outputs)			
P ϟ	S.V. RANGE CH1 **# 492**	The sound velocity channel 1/2 is outside the search range of the transmitter.	– Check the installation dimensions. – If possible, check the sound velocity of the liquid, 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 93 (BA 071D/06/en)* manual under the SOUND VELOCITY LIQUID (6542) function.
P ϟ	S.V. RANGE CH2 **# 493**		

9.4 Process errors without messages

Symptoms	Rectification
N.B.: You may have to change or correct settings in certain functions in the function matrix in order to rectify the fault. The functions outlined below, such as DISPLAY DAMPING, for example, are described in detail in the “Description of Device Functions” manual.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Check wiring → Page 27. If necessary, reverse the connections at terminals “up” and “down”. 2. Change the “INSTALLATION DIRECTION SENSOR” function accordingly
Measured value reading fluctuates even though flow is steady.	1. Check the fluid for presence of gas bubbles. 2. “TIME CONSTANT” function (current output) → Increase value 3. “DISPLAY DAMPING” function → Increase value
Measured-value reading or measured-value output pulsates or fluctuates, e.g. because of piston pump, peristaltic pump, diaphragm pump or pump with similar delivery characteristics.	Run the “Pulsating Flow” Quick Setup → Page 61 ff. If the problem persists despite these measures, a pulsation damper will have to be installed between pump and flowmeter.
There are differences between the flowmeter's internal totalizer and the external metering device.	This symptom is due primarily to backflow in the piping, because the pulse output cannot subtract in the “STANDARD or SYMMETRY” measuring modes. The following solution is possible: Allow for flow in both directions. Set the “MEASURING MODE” function to “Pulsating Flow” for the pulse output in question.
Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check the fluid for presence of gas bubbles. 2. Activate the “LOW FLOW CUTOFF” function, i.e. enter or increase the value for the switching point.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Select the “BUS ADDRESS” function and change the setting to “0”. 2. Value for creepage too high. Reduce the corresponding values in the “Low flow cutoff” functions (ON-/OFF VALUE).
The fault cannot be rectified or some other fault not described above has occurred. In these instances, please contact your E+H service organisation.	The following options are available for tackling problems of this nature: **Request the services of an E+H service technician** If you contact our service organisation to have a service technician sent out, please be ready with the following information: – Brief description of the fault – Nameplate specifications (Page 9 ff.): order code, serial number **Return devices to E+H** The procedures on Page 8 must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed “Declaration of Contamination” form with the flowmeter. You will find a preprinted form at the end of these Operating Instructions. **Replace transmitter electronics** Components in the sensor electronics defective → Order spare part → Page 87

9.5 Response of outputs to errors

Note!
The failsafe mode of totalizers, current, pulse and frequency outputs can be customised by means of various functions in the function matrix. You will find detailed information on these procedures in the “Description of Device Functions” manual.

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

Failsafe mode of outputs and totalizers		
	Process/system error is present	Positive zero return is activated
Caution! System or process errors defined as “Notice messages” have no effect whatsoever on the inputs and outputs. See the information on Page 41 ff.		
Current output	*MINIMUMCURRENT* The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN function (see the “Description of Device Functions” manual). *MAXIMUMCURRENT* The current output will be set to the higher value of the signal on alarm level depending on the setting selected in the CURRENT SPAN function (see the “Description of Device Functions” manual). *HOLD VALUE (not recommended)* Measured value display on the basis of the last saved value preceding occurrence of the fault. *ACTUAL VALUE* Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to “zero flow”
Pulse output	*FALLBACK VALUE* Signal output → No pulses *HOLD VALUE (not recommended)* Last valid value (preceding occurrence of the fault) is output. *ACTUAL VALUE* Fault is ignored, i.e. standard measured value output on the basis of ongoing flow measurement.	Output signal corresponds to “zero flow”

Failsafe mode of outputs and totalizers		
	Process/system error is present	Positive zero return is activated
Frequency output	*FALLBACK VALUE* Signal output → 0 Hz *FAILSAFE LEVEL* Output of the frequency specified in the FAILSAFE VALUE function (No. 4211). *HOLD VALUE (not recommended)* Last valid value (preceding occurrence of the fault) is output. *ACTUAL VALUE* Fault is ignored, i.e. standard measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer	*STOP* The totalizers are paused until the error is rectified. *ACTUAL VALUE* The fault is ignored. The totalizers continue to count in accordance with the current flow value. *HOLD VALUE (not recommended)* The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Relay output	In the case of faults or failure in the power supply: Relay → Voltage-free In the "Description of Device Functions" manual you can find detailed information concerning the switching behaviour of the relay in different configurations such as fault message, flow direction, limit value, etc.	No effect on relay output

9.6 Spare parts

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

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

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

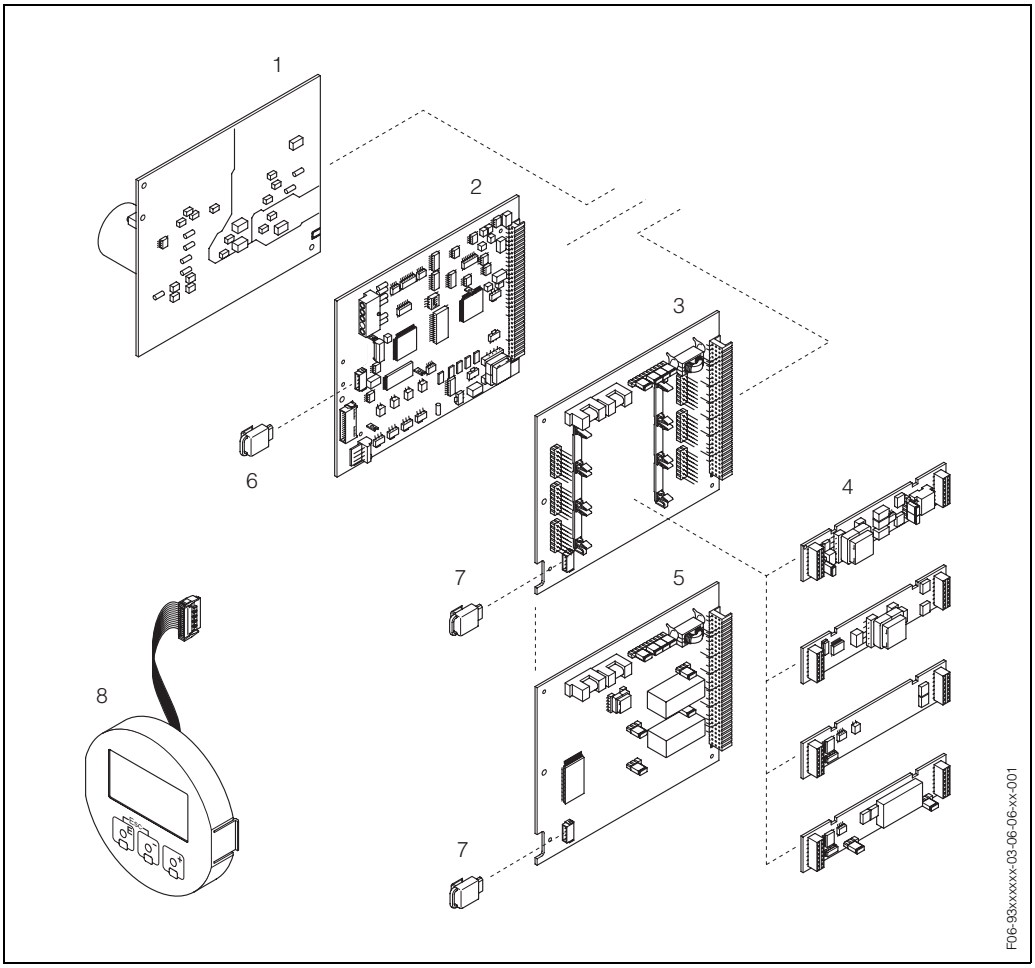


Fig. 36: Spare parts for Prosonic Flow 93 transmitter (wall-mount housing)

1 Power unit board (85...260 V AC, 20...55 V AC, 16...62 V DC)
2 Amplifier board
3 I/O board (flexible assignment)
4 Pluggable input/output submodules (product structure → Page 73)
5 I/O board (permanent assignment)
6 T-DAT (transmitter data memory)
7 F-Chip (function chip for optional software)
8 Display module

9.7 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, purpose-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 (see Fig. 37):

1. Remove the screws and open the hinged cover (1) of the housing.

2. Remove the screws securing the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mount housing.

3. Disconnect the following cable plugs from amplifier board (7):
   – Unplug sensor signal cable (7.1)
   – Ribbon cable plug (3) of the display module

4. Remove the cover (4) from the electronics compartment by loosening the screws.

5. Removal of boards (6, 7, 8, 9):
   Insert a thin pin into the hole (5) provided for the purpose and pull the board clear of its holder.

6. Removal of submodules (8.1):
   No tools are required for removing the submodules (inputs/outputs) from the I/O board. Installation is also a no-tools operation.

    Caution!
   Only certain combinations of submodules on the I/O board are permissible (see Page 30). The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

   "INPUT / OUTPUT 2" slot = terminals 24 / 25
   "INPUT / OUTPUT 3" slot = terminals 22 / 23
   "INPUT / OUTPUT 4" slot = terminals 20 / 21

7. Installation is the reverse of the removal procedure.

    Caution!
   Use only original Endress+Hauser parts.

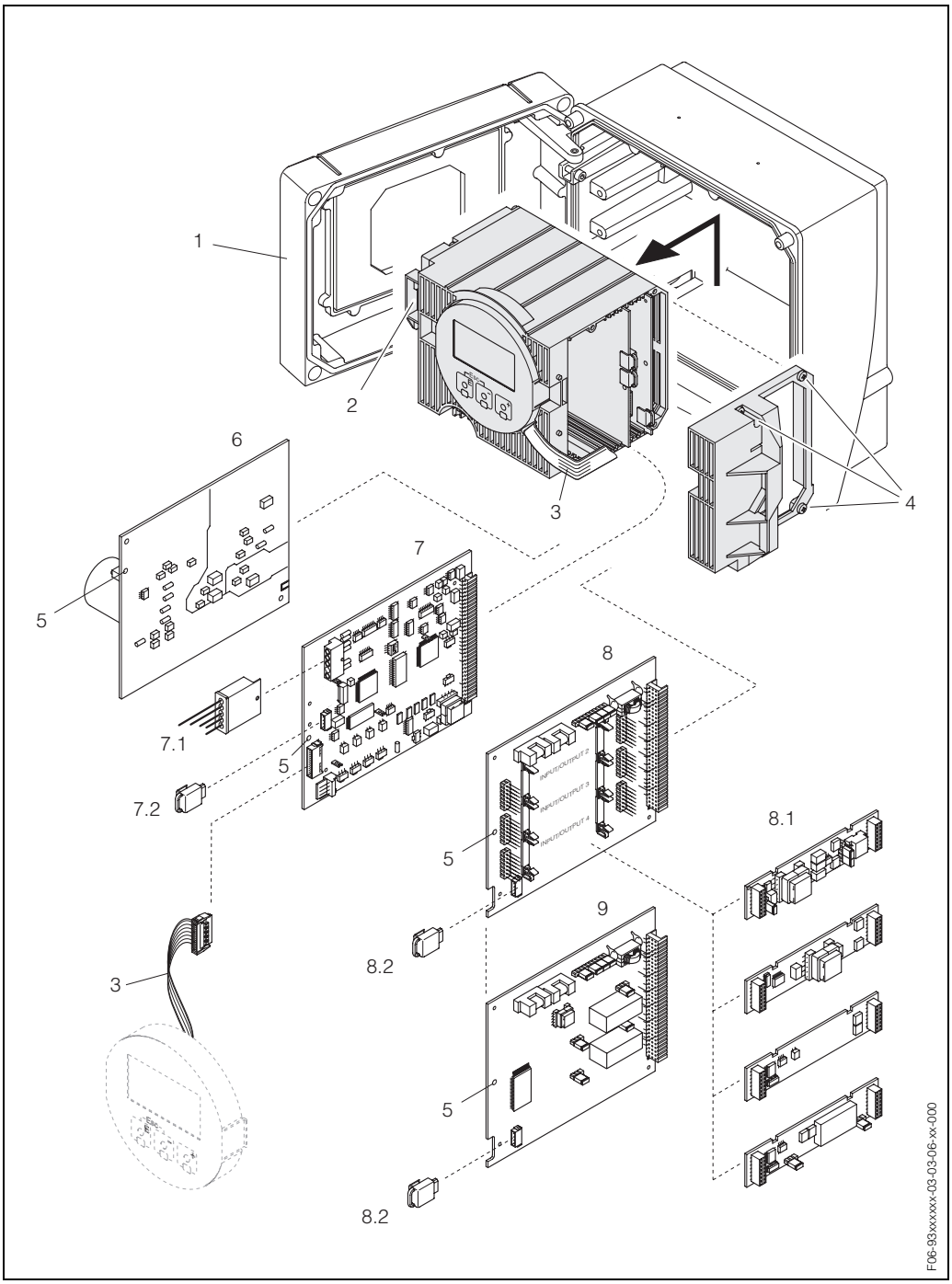


Fig. 37: Wall-mount housing: removing and installing electronics boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Screws of electronics compartment cover
5 Aperture for installing/removing boards
6 Power unit board
7 Amplifier board
7.1 Sensor signal cable
7.2 T-DAT (transmitter data memory); the T-DAT is connected with the sensor signal cable (Pos. 7.1); you will find additionally important informations on T-DAT on Page 70
8 I/O board (flexible assignment)
8.1 Pluggable submodules (status input, current output, frequency output, relay output)
8.2 F-Chip (function chip for optional software)
9 I/O board (permanent assignment)

9.8 Removing and installing flowrate measuring sensors W

The active part of the flowmeter sensor W can be replaced without interrupting the process.

1. Release the sensor connector (1) from the sensor neck (2) and pull out.
2. Release the sensor neck (2) from the sensor holder (5). Note that you must reckon with a certain amount of resistance.

Note!
During this removal work and subsequent mounting task, the sensor holder (5) must be fixed with a wrench (AF 36). For safety reasons, the sensor holder (5) and sensor nozzle (6) are screwed together with a left thread.

3. Pull out the sensor neck.
4. Pull the sensor element (4) out of the sensor holder (5) and replace it with a new one.
5. Check whether the O-ring (3) is intact and replace it with a new one if necessary.
6. Installation is the reverse of the removal procedure.

Warning!
Risk of accident! During operation, do **not** unscrew the sensor holder (5) from the sensor nozzle (6) of the measuring tube Prosonic Flow C as fluid may seep out!

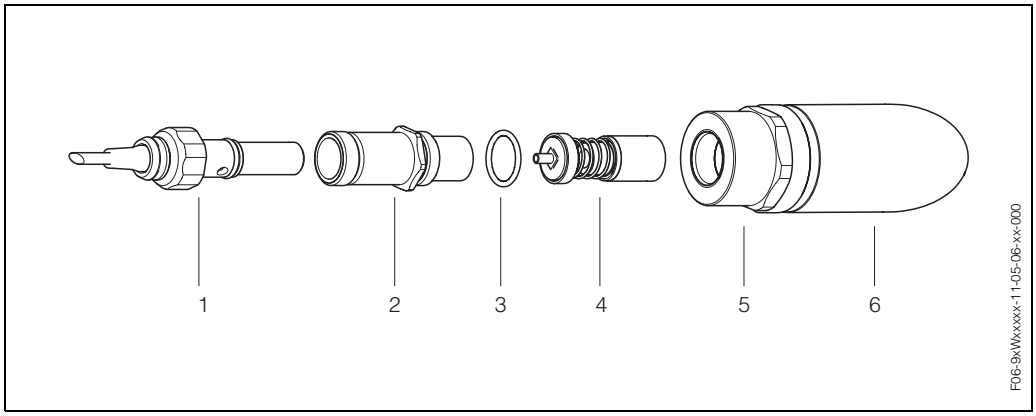


Fig. 38: Flowmeter sensor W: installation/removal

1 Sensor connector
2 Sensor neck
3 O-ring
4 Sensor element
5 Sensor holder
6 Sensor nozzle, measuring tube Prosonic Flow C

9.9 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 main fuse is on the power unit board (Fig. 39).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove power unit board →Page 88
3. Remove protective 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-rated devices → see the Ex documentation.
4. Assembly is the reverse of the disassembly procedure.

☝ Caution!
Use only original Endress+Hauser parts.

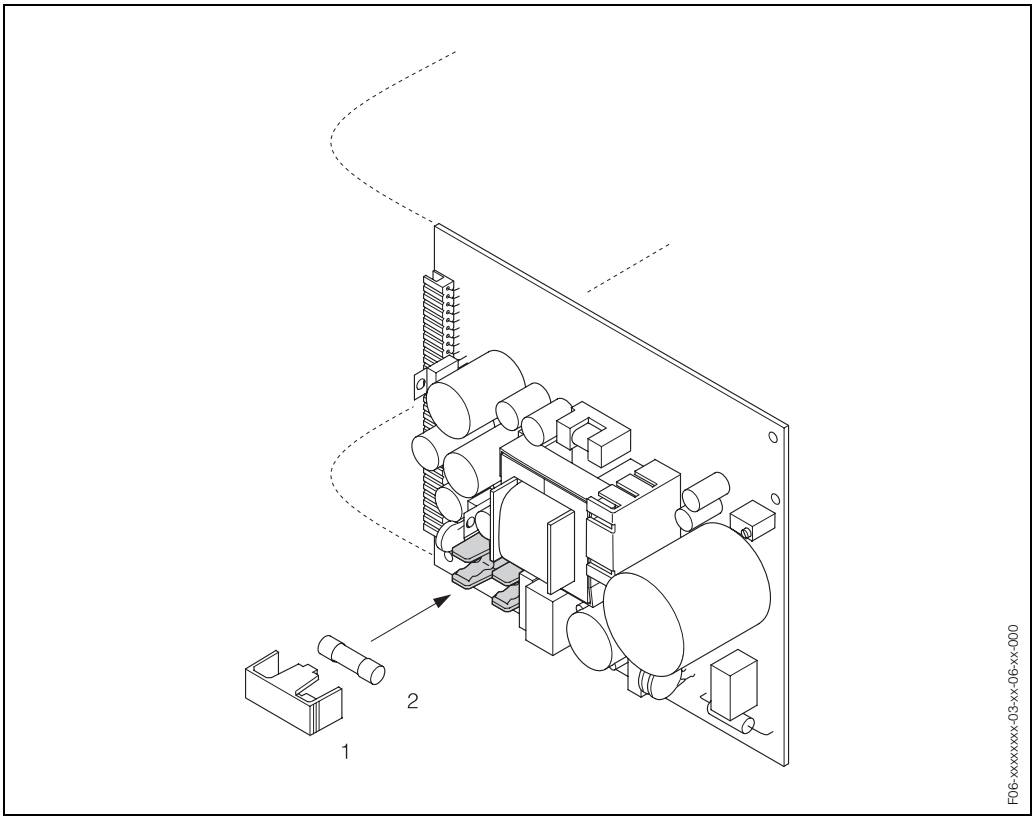


Fig. 39: Replacing the device fuse on the power unit board

1 Protective cap
2 Device fuse

9.10 Software history

Software version / date	Changes to software	Documentation Changes/Additions
Amplifier		
V 1.00.00 / 06.2001	Original software. Compatible with: – FieldTool – HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD 1.	–
V 1.04.00 /07.2002	Software expansion: New functionalities	• "Advanced diagnostics" software function • Device functions: new definition of search range "sound velocity liquid" • New error messages: – PIPE DATA? – INTERFERENCE • Minimum sensor distance 180 mm for P and W sensor • CURRENT SPAN function: additional options
V 1.05.00 / 12.2002	Software expansion: New functionalities	• Implement U sensor • Prosonic Flow C Inline
V 1.06.XX / 10.2003	Software expansion: New/revised functionalities	• Device functions in general • Language groups • Simulation function for pulse output • Flow direction pulse output selectable • Adjustable backlight • Operation hours counter • Access code counter • Reset function fault history • Up-/download with FieldTool in preparation • Advanced diagnostics: acquisiton start via status input
Communication module (Inputs/Outputs)		
V 1.02.00 / 06.2001	Original software	–
V 1.02.01 / 07.2002	Software adaptation	–
V 1.03.XX / 10.2003	Software expansion: New/revised functionalities	• Device functions in general • Simulation function for pulse output • Flow direction pulse output selectable

✎ 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 liquids 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 sensors. *Transmitter:* • Prosonic Flow 93 *Measuring tube Prosonic Flow C with sensors Prosonic Flow W:* • Prosonic Flow C (for water and wastewater applications) for nominal diameters DN 300...2000

10.1.3 Input

Measured variable	Flow velocity (transit time difference proportional to flow velocity)
Measuring range	Typically v = 0...10 m/s with the specified measuring accuracy for Prosonic Flow C
Operable flow range	Over 150 : 1
Input signals	Status input (auxiliary input): U = 3...30 V DC, R_i = 5 kΩ, galvanically isolated. Configurable for: totalizer(s) reset, positive zero return, error message reset.

10.1.4 Output

Output signal	Current output: Active/passive selectable, galvanically isolated, time constant selectable (0.05...100 s), full scale value selectable, temperature coefficient: typically 0.005% o.r./°C, resolution: 0.5 µA • Active: 0/4...20 mA, R_L < 700 Ω (for HART: R_L ≥ 250 Ω) • Passive: 4...20 mA, operating voltage 18...30 V DC, R_L < 700 Ω Pulse / frequency output: Active/passive selectable, galvanically isolated • Active: 24 V DC, 25 mA (max. 250 mA/20 ms), R_L > 100 Ω • Passive: open collector, 30 V DC, 250 mA • Frequency output: full scale frequency 2...10000 Hz (f_{max} = 12500 Hz), on/off ratio 1:1, pulse width max. 10 s • Pulse output: pulse weighting and pulse polarity selectable, pulse width adjustable (0.05...2000 ms), above a frequency of 1 / (2x pulse width) the on/off ratio is 1:1.
Signal on alarm	• Current output → Failsafe mode selectable (e.g. in accordance with NAMUR Recommendation NE 43) • Pulse/frequency output → Failsafe mode selectable • Relay output → "De-energised" by fault or power supply failure Details → Page 85
Load	See "Output signal"
Switching output	Relay output (relay 1, relay 2): Normally closed (NC or break) or normally open (NO or make) contacts available (factory setting: relay 1 = NO, relay 2 = NC), max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated. Configurable for: error messages, flow direction, limit values
Low flow cutoff	Switch points for low flow cutoff are selectable
Galvanic isolation	All circuits for inputs, outputs and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connections	See Page 27 ff.
Potential equalisation	See Page 32 ff.
Cable entry	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 • Threaded adapter G 1/2" Sensor cable connection (see Fig. 18 on Page 27): A special cable gland allows you to insert both sensor cables (per channel) into the connection compartment simultaneously. • Cable gland M20 x 1.5 for 2 x Ø 4 mm • Threaded adapter 1/2" NPT • Threaded adapter G 1/2"
Cable specification	See Page 28 ff.
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. sensors) DC: < 10 W (incl. 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. • T-DAT saves the configuration/setting values of the transmitter. If necessary, the T-DAT data can be loaded into the EEPROM (manual save function).

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:

Standard:
The system is supplied with calibration confirmation. The certification guarantees an accuracy of 1.5% o.r. in the flow velocity range of 0.3...10 m/s.

Option:
The system can be optionally provided with a calibration protocol. This guarantees an accuracy of 0.5% o.r. + 0.02 o.f.s in the flow velocity range of 0.3...10 m/s.

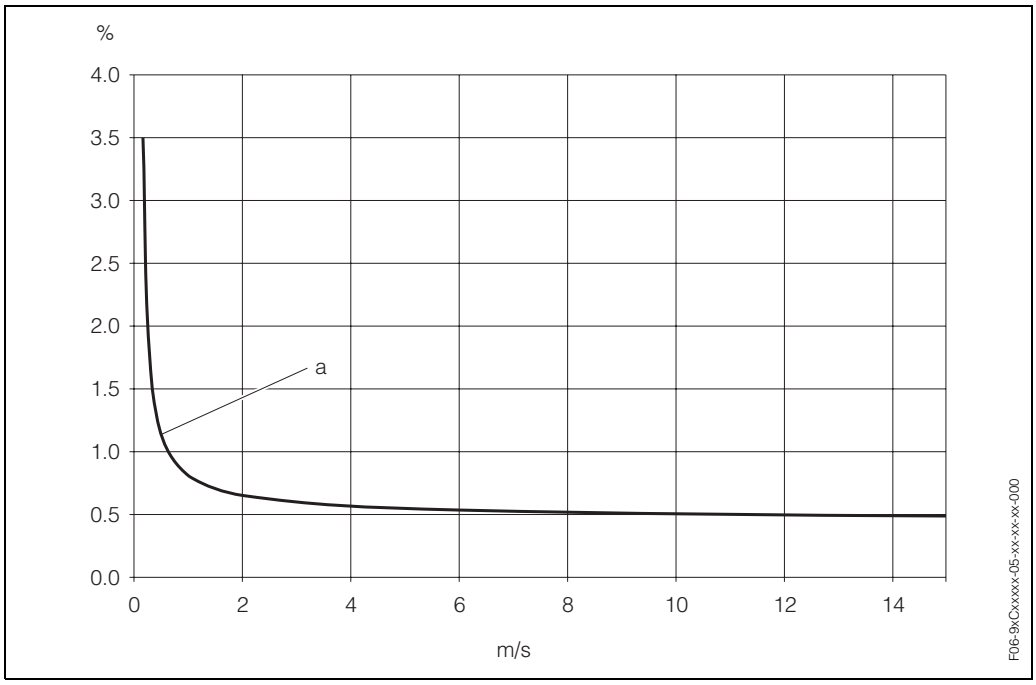


Fig. 40: Max. measured error (wet calibration) in % of reading

a = pipe diameter > DN 300

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 run	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 range	• Transmitter Prosonic Flow 93: –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 W: –20...+80 °C • Measuring tube Prosonic Flow C: –10...+60 °C • Sensor cable PVC: –20...+70 °C • In heated piping or piping conveying cold fluids, it is always permissible to insulate the measuring tube 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	• Transmitter Prosonic Flow 93: IP 67 (NEMA 4X) • Flowrate measuring sensors Prosonic Flow W: IP 68 (NEMA 6P)
Vibration and shock resistance	According to IEC 68–2–-6
Electromagnetic compatibility (EMC)	EN 61326/A1 (IEC 1326): “Emission to class A requirements”. Electromagnetic compatibility (EMC requirements) and NAMUR recommendations NE 21/43

Process

Medium temperature range

- Flowrate measuring sensors Prosonic Flow W:
  –20...+80 °C
- Measuring tube Prosonic Flow C:
  –10...+60 °C (Epoxy coated)

Medium pressure range (nominal pressure)

- Perfect measurement requires that the static fluid pressure is higher than vapor pressure.
- Max. nominal pressure Prosonic Flow W (insertion): PN 16 (232 psi).

Pressure loss

The installation of Prosonic Flow C does not result in any pressure loss.

A pressure loss arises from using adapters before and after the Prosonic Flow C. Refer to the nomogram on Page 17 for the relevant values.

10.1.8 Mechanical construction

Design, dimensions

See Page 101 ff.

Weight

Prosonic Flow 93 C weight data in kg

Nominal diameter		Measuring tube incl. sensors					Wall housing
[mm]	[inch]	EN (DIN) PN 6	EN (DIN) PN 10	EN (DIN) PN 16	ANSI Class 150	AWWA Class D	
300	12"	–	41.8	59.6	77.2	–	6.0
350	14"	–	54.7	70.1	111.2	–	6.0
400	16"	–	66.4	90.3	139.6	–	6.0
–	18"	–	–	–	162.7	–	6.0
500	20"	–	96.8	145.9	197.8	–	6.0
600	24"	–	120.4	196.6	287.9	–	6.0
700	28"	–	183.6	251.3	–	229.9	6.0
–	30"	–	–	–	–	265.1	6.0
800	32"	–	245.0	327.0	–	323.9	6.0
900	36"	–	313.7	456.3	–	455.6	6.0
1000	40"	–	379.0	587.3	–	552.6	6.0
–	42"	–	–	–	–	626.1	6.0
1200	48"	434.6	678.6	941.7	–	894.7	6.0
–	54"	–	–	–	–	1280.2	6.0
1400	–	569.2	907.6	1267.6	–	–	6.0
–	60"	–	–	–	–	1584.5	6.0
1600	–	818.7	1381.4	2012.0	–	–	6.0
–	66"	–	–	–	–	2268.0	6.0
1800	72"	993.5	1726.7	2608.2	–	2707.0	6.0
2000	78"	1508.2	2393.6	3601.3	–	3073.9	6.0

(Weight data valid for standard pressure ratings and without packaging material)

Material

Transmitter housing 93 (wall-mount housing):
Powder-coated die-cast aluminum

Standard designations of the materials (measuring tube and sensors W):

	DIN 17660	UNS
Measuring tube Prosonic Flow C	ST 37.2 (carbon steel)	
Standard sensor cable – Cable connector (nickled brass) – Cable sheath	2.0401 PVC	C38500 PVC
	DIN 17440	**AISI**
Sensor housing W	1.4404	316L
Sensor nozzle	1.4404	316L

10.1.9 Human interface

Display elements

- Liquid crystal display: illuminated, four lines with 16 characters per line
- Custom configurations for presenting different measured value and status variables
- 3 totalizers

Operating elements

- Local operation with three optical keys (–, +, E)
- Application-specific Quick Setups for quick and easy commissioning

Remote operation

Operation via HART protocol

Language group

- Language group for western Europe and America, contains the languages English, German, Spanish, Italian, French, Dutch and Portuguese
- Language group for northern Europe/Scand., contains the languages English, Russian, Polish, Norwegian, Finnish, Swedish and Czech
- Language group for southern/eastern Asia, contains the languages English, Japanese and Indonesian

10.1.10 Certificates and approvals

Ex approval

- The transmitter housing (wall-mount housing) is suitable for use in Class I Div. 2 (Ex zone 2 to FM, CSA).
- Please also consult the separate Control Drawing.
- Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H 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.

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 industrial process and laboratory control equipment.

NAMUR NE 43
Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal.

10.1.11 Ordering information

The E+H service organisation can provide detailed ordering information and information on specific 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 73). The E+H 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/de)
- ❑ Technical Information Prosonic Flow 93 P (TI 056D/06/de)
- ❑ Technical Information Prosonic Flow 90/93 W/U/C (TI 057D/06/de)
- ❑ Description of Device Functions Prosonic Flow 93 C Inline (BA 088D/06/de)
- ❑ Operating Instructions Prosonic Flow 93 (BA 070D/06/de and BA 071D/06/de)
- ❑ Operating Instructions Prosonic Flow 93 PROFIBUS-DP/-PA (BA 076D/06/de and BA 077D/06/de)
- ❑ Operating Instructions Prosonic Flow 93 FOUNDATION Fieldbus (BA 078D/06/de and BA 079D/06/de)
- ❑ Operating Instructions Prosonic Flow 93 C Inline PROFIBUS-PA (BA 089D/06/de and BA 090D/06/de)
- ❑ Operating Instructions Prosonic Flow 93 C Inline FOUNDATION Fieldbus (BA 091D/06/de and BA 092D/06/de)
- ❑ Control-Drawing for FM, CSA

You can order the documentation from your E+H service organisation or download it from the Internet under *http://www.endress.com*.

10.2 Dimensions of wall-mount housing

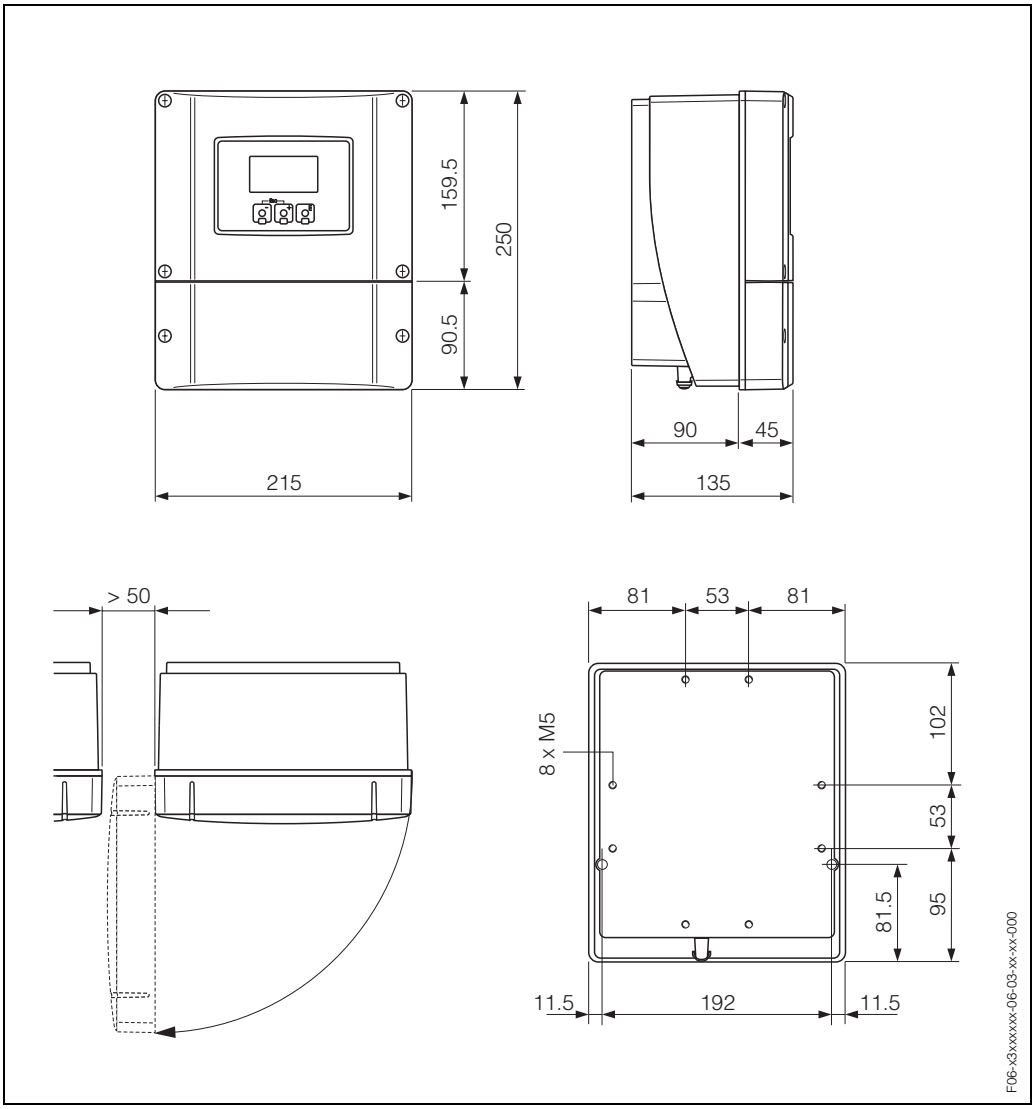


Fig. 41: Dimensions of wall-mount housing (for panel mounting and pipe mounting → Page 24)

10.3 Dimensions of measuring tube with sensors W

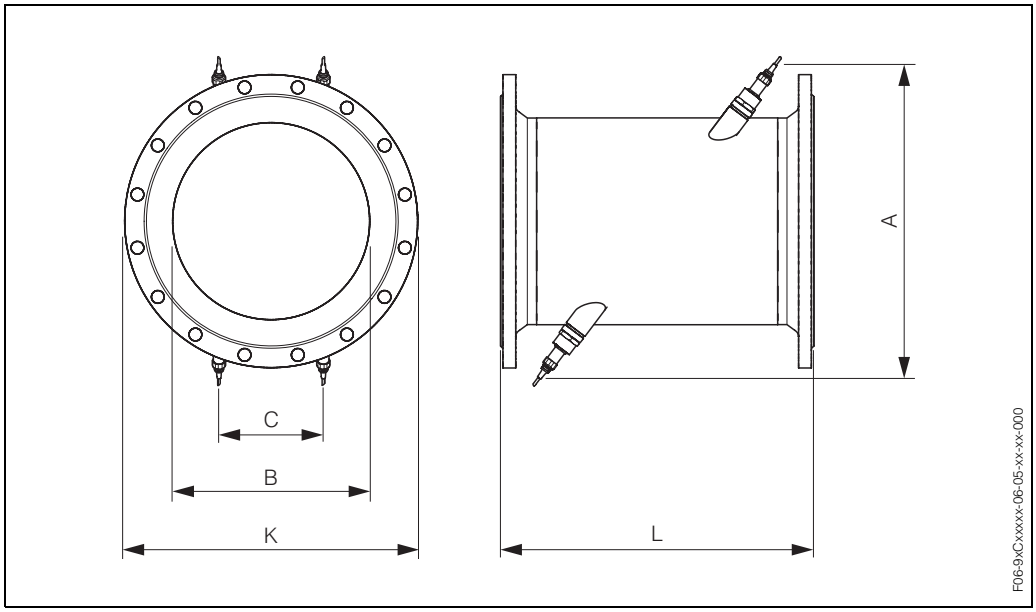


Fig. 42: Dimensions of measuring tube with installed sensors

DN				A	B	C	L	K
EN (DIN) PN 6 [mm]	EN (DIN) PN 10 [mm]	EN (DIN) PN 16 [mm]	ANSI/ AWWA [inch]	[mm]	[mm]	[mm]	[mm]	[mm]
–	300	–	–	520	317.5	165.1	500	445
–	–	300	–	517	313.9	163.2	500	460
–	–	–	12"	517	313.9	163.2	500	482.6
–	350	–	–	548	350	182	550	505
–	–	350	–	546	348	181	550	520
–	–	–	14"	544	346	179.9	550	533.4
–	400	–	–	590	400	208	600	565
–	–	400	–	589	398	207	600	580
–	–	–	16"	587	396	205.9	600	596.9
–	–	–	18"	629	445	231.4	650	635
–	500	–	–	676	500	260	650	670
–	–	500	–	674	498	259	650	715
–	–	–	20"	672	496	257.9	650	699
–	600	–	–	763	602	313	780	780
–	–	600	–	760	598	311	780	840
–	–	–	24"	756	594	308.9	780	813
–	700	–	–	848	701	364.5	910	895
–	–	700	–	842	695	361.4	910	910
–	–	–	28"	846	699	363.5	910	927.1
–	–	–	30"	889	750	390	975	984.25
–	800	–	–	935	803	417.6	1040	1015

DN				A	B	C	L	K
EN (DIN) PN 6 [mm]	EN (DIN) PN 10 [mm]	EN (DIN) PN 16 [mm]	ANSI/ AWWA [inch]	[mm]	[mm]	[mm]	[mm]	[mm]
–	–	800	–	930	797	414.4	1040	1025
–	–	–	32"	933	801	416.5	1040	1060.45
–	900	–	-	1019	902	469	1170	1115
–	–	900	–	1012	894	464.9	1170	1125
–	–	–	36"	1016	898	467	1170	1168.4
–	1000	–	–	1106	1004	522.1	1300	1230
–	–	1000	–	1100	996	517.9	1300	1255
–	–	–	40"	1103	1000	520	1300	1289.05
–	–	–	42"	1147	1051	546.5	1365	1346.2
1200	–	–	–	1282	1210	629.2	1560	1405
–	1200	–	–	1277	1204	626.1	1560	1455
–	–	1200	–	1270	1196	621.9	1560	1485
–	–	–	48"	1274	1200	624	1560	1511.3
–	–	–	54"	1399	1347	700.4	1755	1682.75
1400	–	–	–	1453	1410	733.2	1820	1630
–	1400	–	–	1448	1404	730.1	1820	1675
–	–	1400	–	1441	1396	725.9	1820	1685
–	–	–	60"	1530	1500	780	1950	1854.2
1600	–	–	–	1622	1608	836.2	2080	1830
–	1600	–	–	1615	1600	832	2080	1915
–	–	1600	–	1607	1590	826.8	2080	1930
–	–	–	66"	1655	1646	855.9	2145	2032
1800	–	–	–	1793	1808	940.2	2340	2045
–	1800	–	–	1786	1800	936	2340	2115
–	–	1800	–	1776	1788	929.8	2340	2130
–	–	–	72"	1778	1790	930.8	2340	2197.1
2000	–	–	–	1961	2004	1042.1	2600	2265
–	2000	–	–	1954	1996	1037.9	2600	2325
–	–	2000	–	1943	1984	1031.7	2600	2345
–	–	–	78"	1949	1990	1034.8	2600	2362.2
The fitting length (L) is always the same, regardless of the pressure rating.								

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 put the completely filled in declaration to the instrument and to the shipping documents in any case. Add also safety sheets and/or specific handling instructions if necessary.

type of instrument / sensor: _____ serial number: _____

medium / concentration: _____ temperature: _____ pressure: _____

cleaned with: _____ conductivity: _____ viscosity: _____

Warning hints for medium used:

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

Please mark the appropriate warning hints.

Reason for return:

_____

_____

Company data:

company: _____ contact person: _____

_____ _____

_____ department: _____

address: _____ phone number: _____

_____ fax / e-mail: _____

_____ your order no.: _____

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

_____ _____

(Date) (company stamp and legally binding signature)

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