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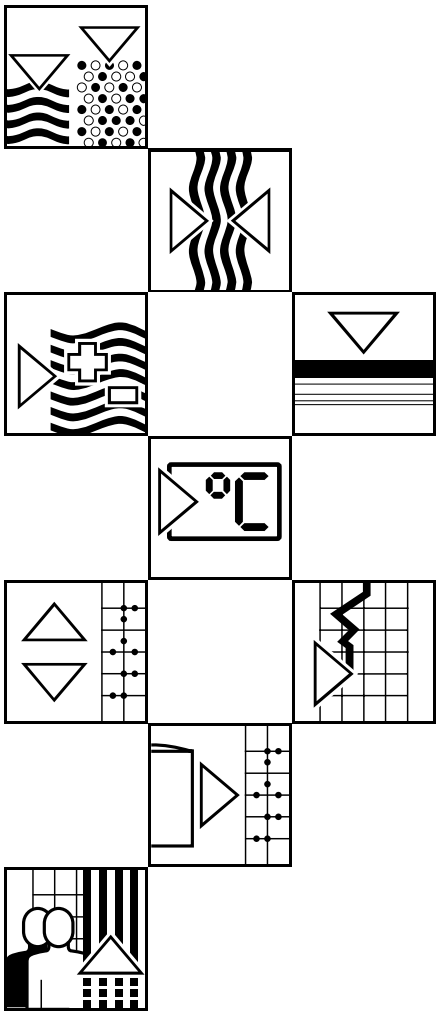
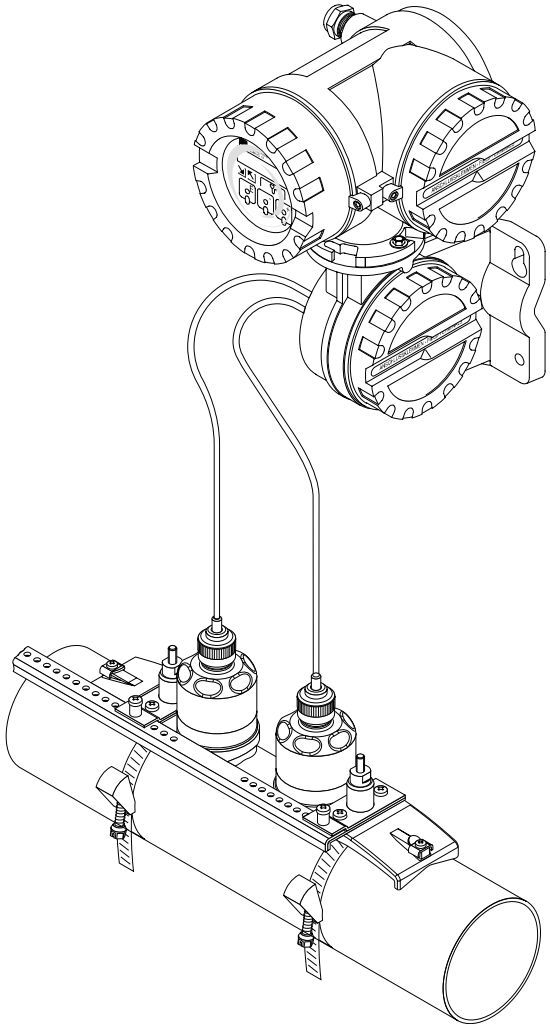
No. 50091472
CV 5.0

Valid as of software version
V01.01.XX (amplifier)
V01.01.XX (communications)

prosonic flow
DMU 93/DDU 10/DDU 18
Ultrasonic Flow Measuring System

Operating Manual





Endress + Hauser

The Power of Know How

Preparation for Quick Setup

Determine measuring point
(Mounting location, inlet length)
Space for measuring point:
= 1 x D (pipe diameter) at 2 traverses,
= 2 x D at 4 traverses
+ 100 mm if D < 100 mm

s. page 11, 12

↓

Get wall thickness and sound velocity
(If not known, measure wall thickness with DDU 19 and sound velocity with sensor DDU 18)

s. page 26
s. page 27

↓

Run Quick Setup
For proceeding with "Quick Setup", the transmitter has to be connected to a power supply!
Result:
Sensor distance Pos. 1 and Pos. 2 for 2 + 4 traverses
Sensor distance (wire length of) for 1 + 3 traverses

s. page 3

↓

Mounting sensors and sensor holders

s. page 14

↓

Electrical installation

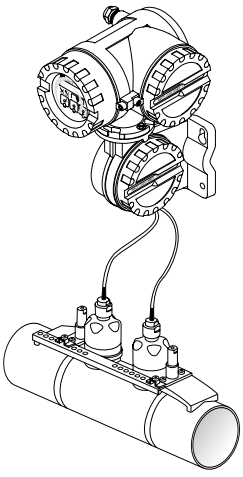
s. page 21

↓

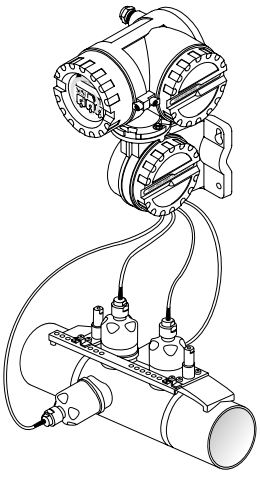
Commissioning

s. page 25

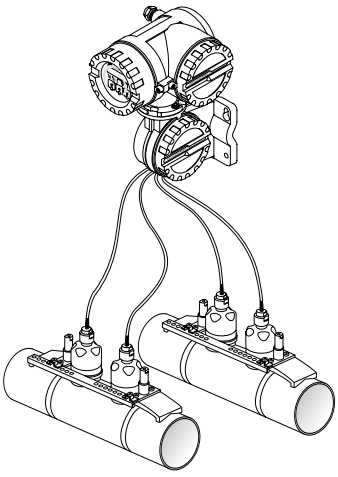
System variations



CLAMP ON single channel meas.
CLAMP ON K1



CLAMP ON dual channel meas.
CL1&2 1M.-POINT

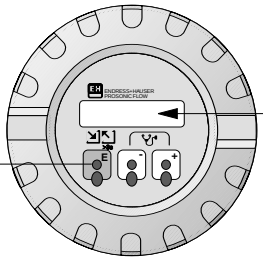


CLAMP ON Single channel meas. at two meas. points
CL1&2 2M.-POINTS

Quick Setup

power supply
s. page 21

POWER ON



You return to the HOME position
by touching the E key for > 3 s

E

QUICK SETUP p. 52 — CANCEL, START → Functions group PROCESS VARIABLE

ACCESS CODE p. 77

LANGUAGE p. 67

SYSTEM UNITS — CANCEL, UNITS SI-SYSTEM, UNITS US-SYSTEM

SENSOR CONFIG. p. 52 — CANCEL

- CLAMP ON CH1 → SETUP SELECTION "PROCESS PARA. CH1"
- CL1&2 1M. POINT → SETUP SELECTION "PROCESS PARA."
- CL 1&2 2M. POINTS → SETUP SELECTION "PROCESS PARA. CH1" and "PROCESS PARA. CH2"
- INSERTION K1 → SETUP SELECTION "PROCESS PARA. CH1"
- IN1&2 1M.POINT → SETUP SELECTION "PROCESS PARA."
- IN 1&2 2M.POINTS → SETUP SELECTION "PROCESS PARA. CH1" and "PROCESS PARA. CH2"

WALL THICKNESS — CANCEL, KNOWN, UNKNOWN

SETUP SELECTION

PROCESS PARA.
PROCESS PARA. CH1
PROCESS PARA. CH2

QUIT

W. THICKNESS CH2

E

SENSOR TYPE p. 72
PIPE MATERIAL p. 70
PIPE DIAMETER p. 70
CIRCUMFERENCE p. 70
WALL THICKNESS p. 70
SOUND VELOC. PIPE p. 70
LIQUID p. 70
TEMPERATURE p. 71
SOUND VELOC. LIQ. p. 71
VISCOSITY p. 71
CABLE LENGTH p. 72
TRAVERSES p. 72
POS. SENSOR 1 p. 72
POS. SENSOR 2 p. 72
WIRE LENGTH p. 72
SENSOR DISTANCE p. 72

BACK TO
SETUP SELECTION

E

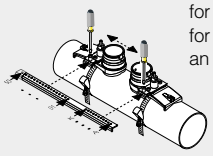
DURING START-UP
CANCEL
LOCK
UNLOCK p. 31

BACK TO
HOME Position

E

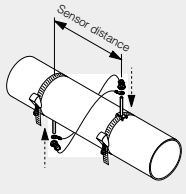
CALIBRATION p. 69
PIPE MATERIAL p. 68
SOUND VEL. LONGI. p. 69
SIG. STRENGTH BAR p. 69
WALL THICKNESS p. 69

BACK TO
SETUP SELECTION



These two results are required
for mounting the two sensors
for pipe diameters ≤ 600 and
an even number of traverses

s. page 15



These two results are required
for mounting the two sensors
for pipe diameters > 600 and
an even number of traverses
or
for all pipe diameters and an odd
number of traverses

s. page 16

The functions in the dotted boxes appear only in the Quick Setup as long as the previous functions fulfil certain conditions.

ba038e40

Contents

Registered Trademarks

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

HASTELLOY ®
Registered trademark of Haynes International, Inc., Kokomo, USA

1 Safety Instructions

1.1 Correct usage

- The manufacturer assumes no liability for damage caused by incorrect use of the instrument.
- Instruments which are used in the explosion hazardous area are supplied with a separate “Ex documentation”, which is an integral part of this Operating Manual. The instructions and connected loads provided in this supplement must absolutely be observed. An appropriate icon is shown on the front of this document according to the approval given and the test center (Ex Europe, FM USA, CSA Canada).

1.2 Dangers and notes

All instruments are designed to meet state-of-the-art safety requirements. They have been tested, and have left the works in an operationally perfectly safe condition. The devices were developed according to EN 61010 “Protection Measures for Electronic Equipment for Measurement, Control, Regulation and Laboratory Procedures”. A hazardous situation may occur if the flowmeter is not used for the purpose it was designed for or is used incorrectly. Please carefully note the information provided in this Operating Manual indicated by the following pictograms:

Warning!
A “Warning” indicates actions or procedures which, if not performed correctly, may lead to personal injury or a safety hazard. Please strictly observe the instructions supplied and proceed carefully.


Warning!

Caution!
A “Caution” indicates actions or procedures which, if not performed correctly, may lead to faulty operations or the destruction of the instrument. Please strictly observe the respective instructions.


Caution!

Note!
A “Note” indicates actions or procedures which, if not performed correctly, may indirectly affect operations or lead to an unexpected instrument response.


Note!

1.3 Personnel for installation, start-up and operation

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must absolutely and without fail read and understand this Operating Manual before carrying out its instructions.
- The instrument may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this Manual are to be observed without fail.
- The installer has to make sure that the measuring system is correctly wired according to the wiring diagrams. The measuring system is to be grounded.
- Please observe all provisions valid for your country and pertaining to the opening and repairing of electrical devices.

Danger from electric shock!
With the housing cover removed, protection against accidental contact is no longer present.


Warning!

1.4 Repairs, dangerous substances

If you send the measuring system for repairs to Endress+Hauser, enclose a note with the following data:
- description of the fault
- description of the application
- description of the use of measuring system within the installation

Remove all material which may adhere to the flow measuring system before returning the instrument to Endress+Hauser for repair. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc. No instrument should be returned to us without first taking all possible safety precautions to ensure that all dangerous materials are removed, e.g. in scratches or diffused through plastic.

Incomplete cleaning of the instrument may result in waste disposal or cause harm to personnel (burns, etc.). Any costs arising from this will be charged to the operator of the instrument.

1.5 Technical improvement

The manufacturer reserves the right to modify technical data without prior notice. Your local Endress+Hauser Sales Office will supply you with all current information and any updates to this Operating Manual.

2 Instrument Identification

The nameplate on the Prosonic Flow DMU 93 transmitter and the Prosonic Flow DDU 10/18/19 ultrasonic sensors has the following information:

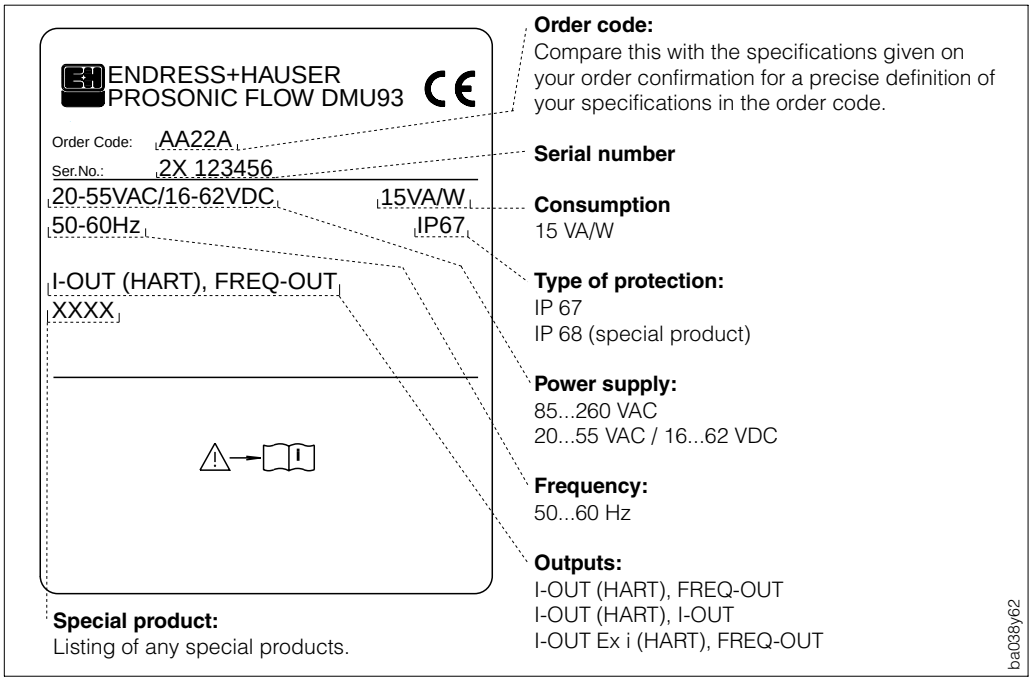


Fig. 1
Nameplate:
DMU 93 transmitter

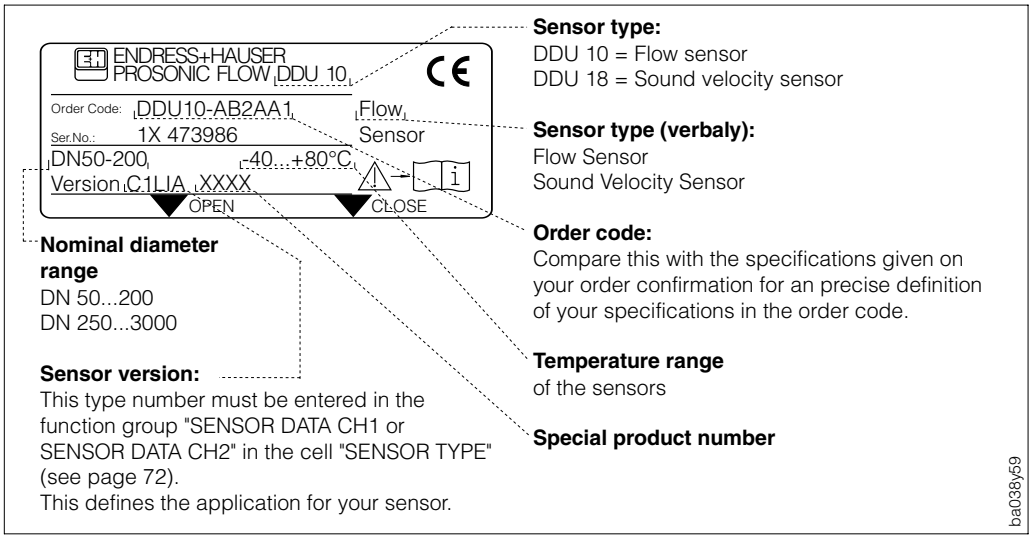


Fig. 2
Nameplate:
DDU 10 Sensors
DDU 18 Sensors

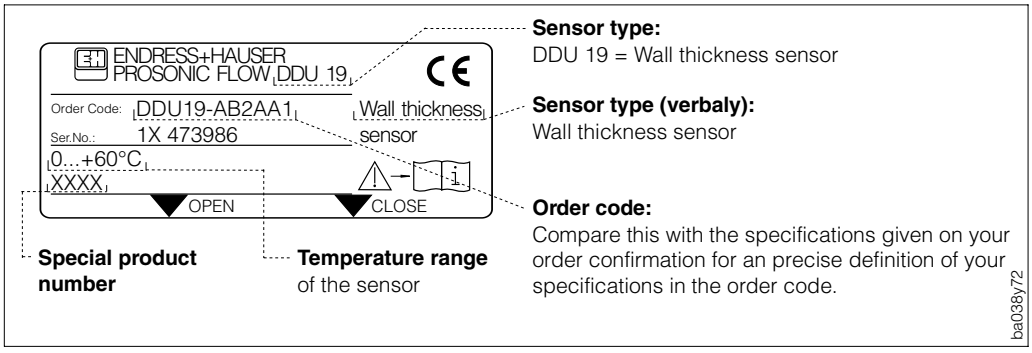


Fig. 3
Nameplate:
DDU 19 Sensors

3 Mounting and Installation

Warning!
- All instructions given in this section are to be observed at all times in order to ensure safe and reliable operation of the measuring system.
- Mounting regulations and technical specifications for Ex-certified instruments may differ from those given below. All mounting regulations and connection values in the Ex documentation must, therefore, be strictly observed.

3.1 Applications for ultrasonic sensors

Note that the properties of the pipe material and the liquid have a direct effect on the ultrasonic measurement (sonic conductivity).

Pipe material

Good results	Care recommended	Not to be used
steel plastic glass enamelled steel	cast iron lined pipes	cement glass-reinforced plastic (GRP)

Properties of the liquid

- Max. 1% air/gas content
- Max. 5% solids content

3.2 Mounting

Vertical
The recommended flow direction in a vertical pipe is upwards. Entrained solids sink downward and gases rise away from the measuring section. This also allows the pipe to be completely drained and protects it from solids build-up.

Horizontal
Sensors are to be mounted on a horizontal pipe in the areas shown in the adjacent figure.
This ensures that gases in the upper or solids in the lower part of the pipe have minimum effect on the measurement.

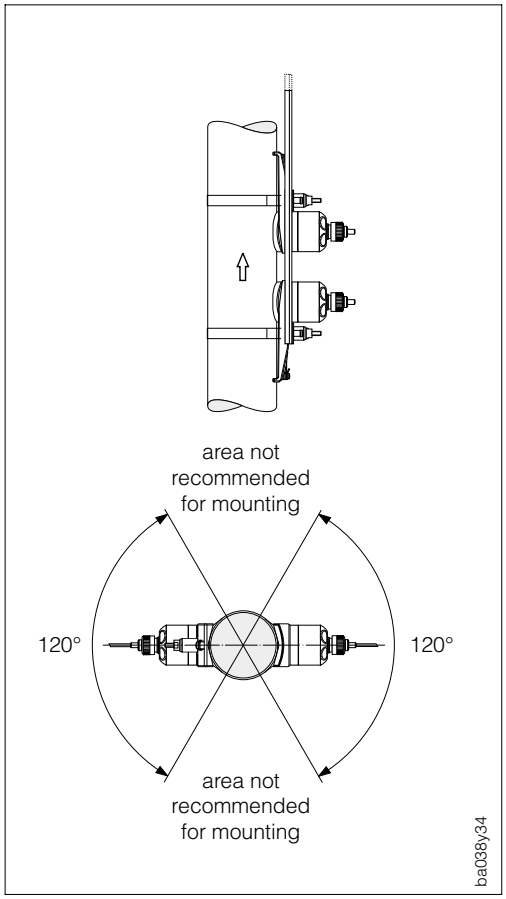


Fig. 4
Positioning

3.3 Insulation

The piping mounted with ultrasonic sensors may at any time be fully insulated whether heated or carrying cryogenics.


Caution!

Caution!
The temperature of insulated sensors and sensor cable may not rise above or fall below the temperature range stated on the nameplate.

3.4 Mounting location

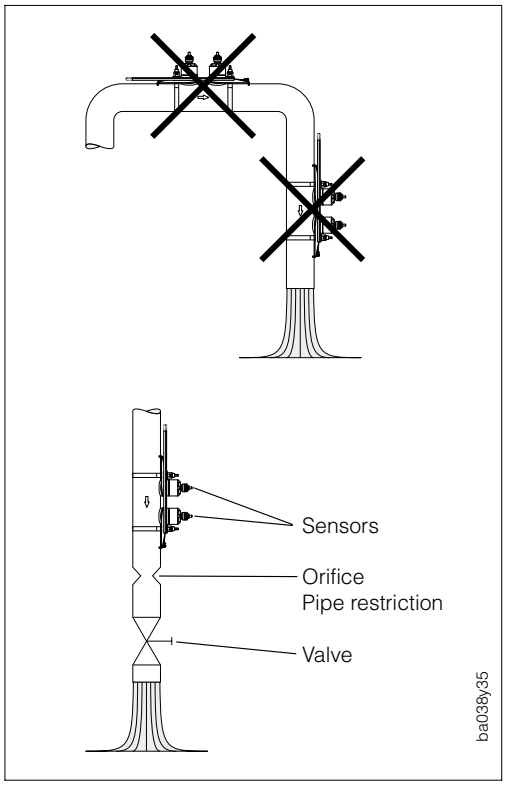


Fig. 5
Mounting location (vertical piping)

Air or entrained gases in the measuring pipe may cause errors. Therefore the following mounting locations are to be avoided:

- Do not install at the highest point of the piping.
- Do not install in a vertical pipeline directly upstream of a free pipe outlet.

Correct installation is still possible in a vertical pipeline using the recommendation in the adjacent figure. Restrictions in the piping or an orifice with a smaller cross section than the nominal diameter can prevent the sensor from running empty during measurement.

3.5 Inlet and outlet run

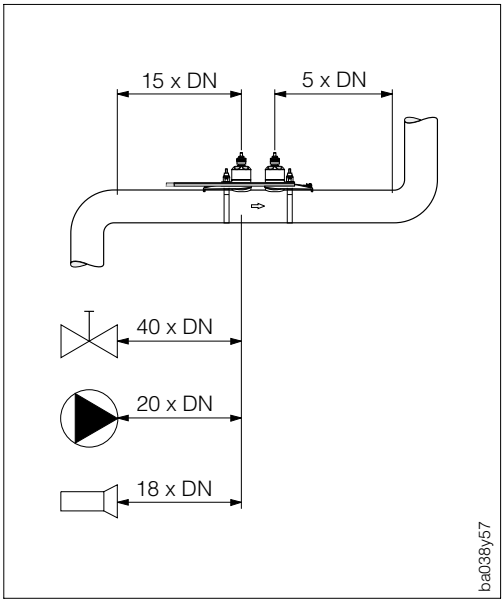


Fig. 6
Example of inlet and outlet run

To ensure a fully developed flow profile, the ultrasonic measuring system should be installed upstream from flow obstacles such as bends, reducers or actuators. It should also be ensured that the longest possible straight pipe should be between the obstacle and the measuring instrument. The adjacent figure shows the minimum length of straight pipe downstream from an obstruction as a multiple of the nominal diameter DN of the pipe. The accuracy of measurement can be affected if these values are lower than those given.
If there are several obstacles to the flow, then the longest inlet or outlet path must always be used.

3.6 Selecting the type of mounting for the ultrasonic sensor

A number of points are to be observed when selecting the type of mounting.

Signal transit time
The ultrasonic signal requires a minimum transit time [t] for optimum measurement.
The time differential is proportional to the flow velocity.

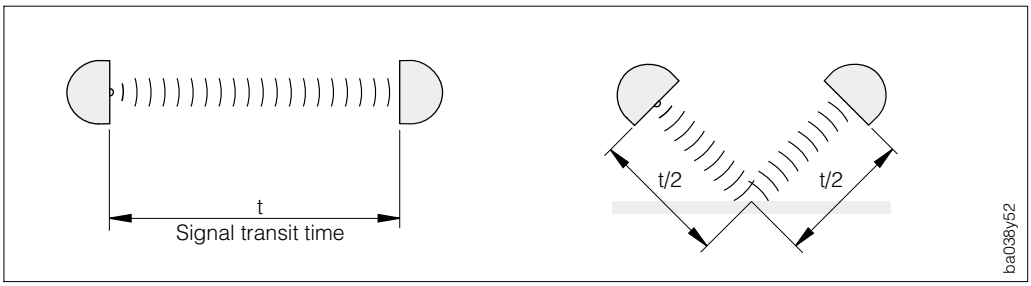


Fig. 7
Example of ultrasonic signal run time

The measurement accuracy, i.e. the actual detected difference in measurement time, increases with the signal transit time [t] in the liquid.
With small pipe sizes it is recommended to use more than one traverse.

Selecting the number of traverses
The transmitter offers 1...4 traverses as standard.

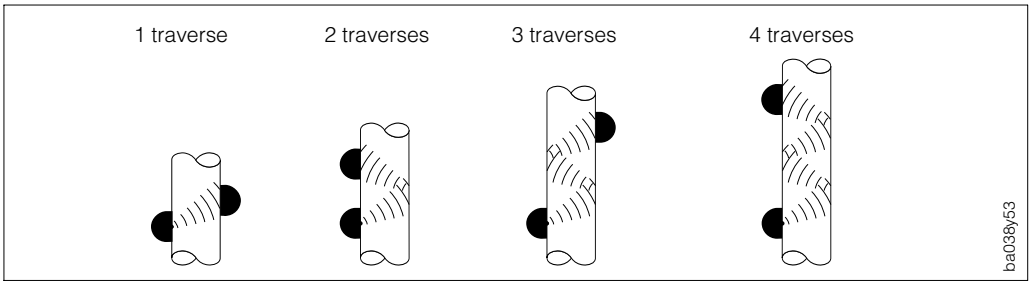


Fig. 8
Number of traverses

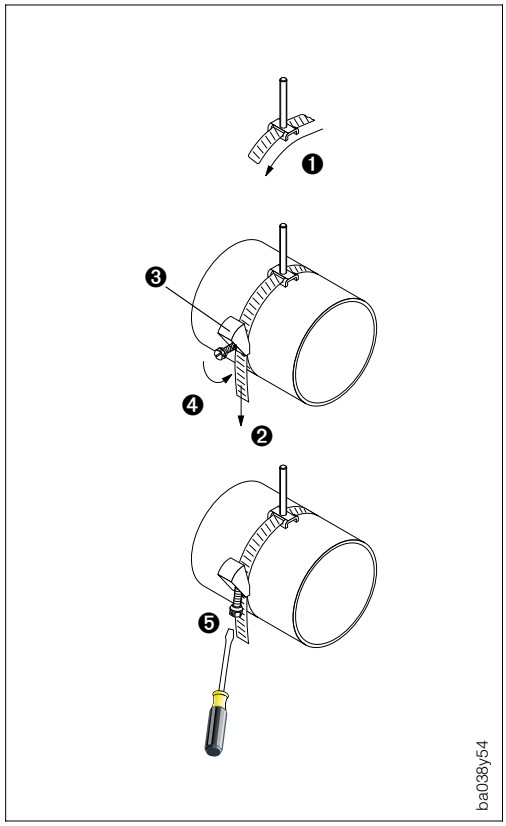
Please note that every additional reflection will reduce the signal strength (2 traverses = 1 reflection point, etc.). To maintain the best possible signal quality, the least possible number of traverses should be used.

Recommendations
To obtain the best possible signal strength and quality, the following options are recommended:

DN 50...65	2...4 traverses
DN 80...600	2 traverses
DN 650...3000	1 traverse

Selecting the sensor bracket
Three ways are offered by E+H for mounting sensors:
- Tensioning bands for nominal diameters DN 50...200 (see page 14).
- Tensioning bands for nominal diameters DN 250...3000 (see page 14).
- Mounting by the customer using welding bolts (see page 17).

3.7 Mounting the tensioning bands for DN 50...200



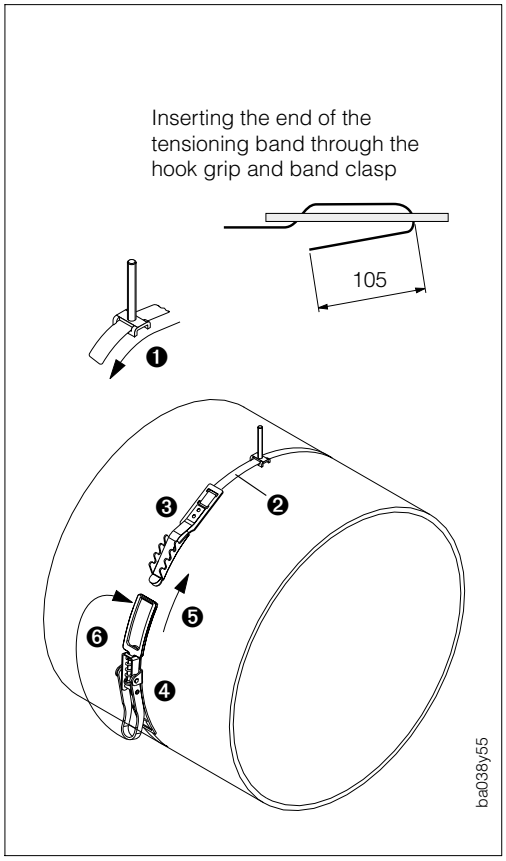
❶ Insert one of the threaded studs (or both threaded studs for sound velocity measurement, see page 17) on the tensioning band.
❷ Place the tensioning band round the pipe and the end through the band clasp ❸ (ensure that the screw is extended). Tighten the tensioning band by hand as far as possible.
Fold in the screw ❹ and tighten the tensioning band with a screwdriver ❺ until it is secure.
If desired the tensioning band can be shortened to a specific length.

Caution!
Risk of injury! Avoid jagged edges when shortening.

Caution!

Fig. 9
Tensioning band for DN 50...200

3.8 Mounting the tensioning bands for DN 250...3000



Measure the actual circumference of the pipe. Shorten the tensioning band accordingly.

Caution!
Risk of injury! Avoid jagged edges when shortening.

Insert one of the threaded studs ❶ (or both threaded studs for sound velocity measurement, see page 17) on the tensioning band. Insert the tensioning band ❷ as shown in the diagram through the holding hook ❸ and the band clasp ❹. Insert the band claps into the holding hook (see adjacent figure) ❺ and tighten until firm using the strap ❻.

Caution!

Fig. 10
Tensioning band for DN 250...3000

3.9 Mounting the sensors (Version 2 or 4 traverses)

Step 1
Tighten a tensioning band ❶ (for small or large nominal diameters) as described on page 14.

Step 2
Put the sensor holder ❷ over the threaded stud on the pipe. Tighten the mounting nuts ❸ using an open-ended spanner (13 AF).

Step 3
Secure the holder of the mounting strip ❹ onto the sensor holder using a Phillips screwdriver.

Intermediate step
Mount the second sensor holder in the same way as Steps 1 to 3 but ensure that the tensioning band is not permanently fixed. The sensor holder can still be slid along the pipe.

Step 4
The Quick Setup program of the transmitter (see page 3) provides the spacing holes to your application (i.e. for Sensor 1 a letter A...K and for Sensor 2 a number between 10...76).
Use the mounting strip (small for DN 50...200 or large for DN 50...600) accordingly and tighten the appropriate screws ❺.
Quickly secure the second tensioning band.
The entire unit is now securely attached to the pipe.

Step 5
Coat the contact surfaces ❻ of the sensors with an even layer of the coupling medium approx. 1 mm thick.
Insert the sensors ❼ carefully into the sensor holders. Press down the sensor cover onto the sensor holder until there is an audible click.
Finally insert the sensor cable connector ❽ into the openings provided and screw down tightly by hand until the mechanical stop.

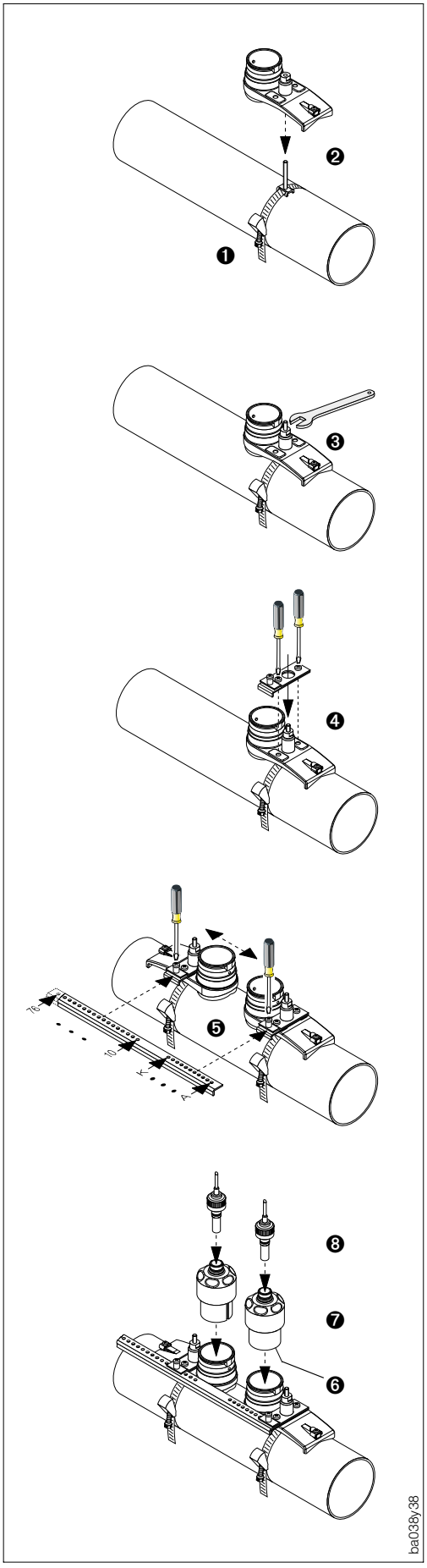


Fig. 11
Mounting the sensors for 2 or 4 traverses

3.10 Mounting the sensors (Version 1 or 3 traverses)

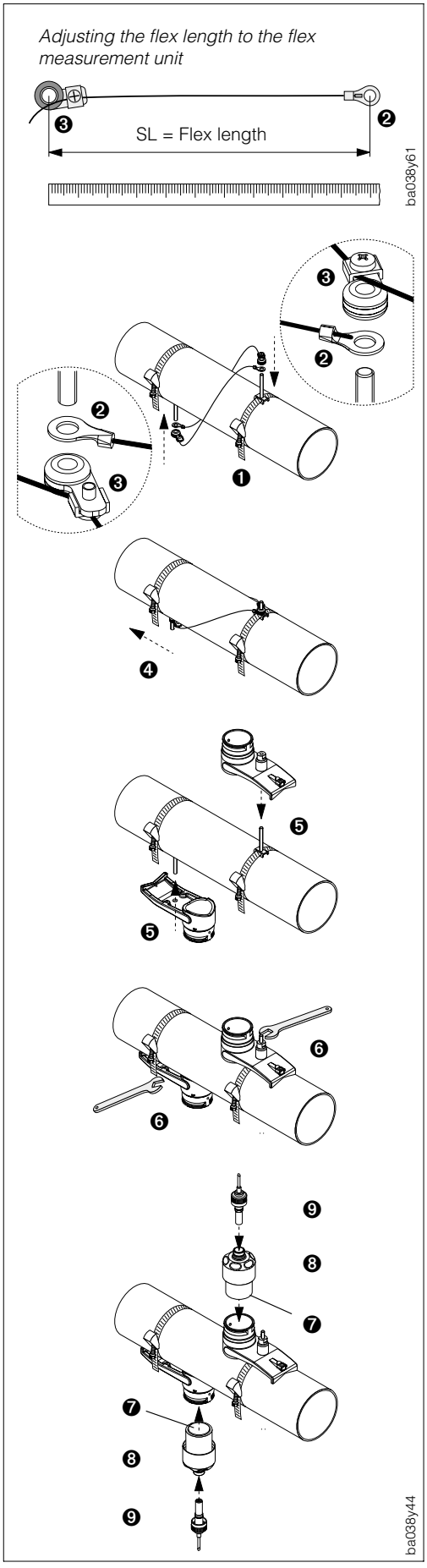


Fig. 12
Mounting the sensors for 1 or 3 traverses

Step 1
Tighten a tensioning band ❶ (for small or large nominal diameters) as described on page 14.
Mount a second tensioning band (with threaded studs on opposite sides). The tensioning band should be loose enough to be moved.

Intermediate step
Use the Quick Setup menu (see page 2) to determine the sensor spacing.

Step 2
Use the following formula to calculate the exact sensor spacing for the wire length:

$$SL = \sqrt{\left(\frac{U}{2}\right)^2 + X^2}$$ see page 72

SL = wire length
U = effective pipe circumference
X = sensor interval (value is determined from the Quick Setup, see page 3)
Enter the wire length for both halves of the wire.

Step 3
Place the cable shoe ❷ and then the fastener ❸ over the 1st threaded stud. Wind a wire round one side of the pipe, place the cable shoe and fixing unit over the 2nd threaded stud. Move the threaded stud ❹ and the tensioning band until both wires are equally under tension. Tighten the tensioning band. Loosen the Philips screws of the fixing part and take off the wires.

Step 4
Insert both sensor holders ❺ over the threaded studs on the pipe and tighten the mounting nut ❻ using a spanner (13 AF).

Step 5
Coat the contact surfaces ❼ of the sensors with an even layer of the coupling medium approx. 1 mm thick.
Insert the sensors ❽ carefully into the sensor holders. Press down the sensor cover onto the sensor holder until there is an audible click.
Finally insert the sensor cable connector ❾ into the openings provided and screw down tightly by hand until the mechanical stop.

3.11 Mounting the ultrasonic velocity sensors (accessory)

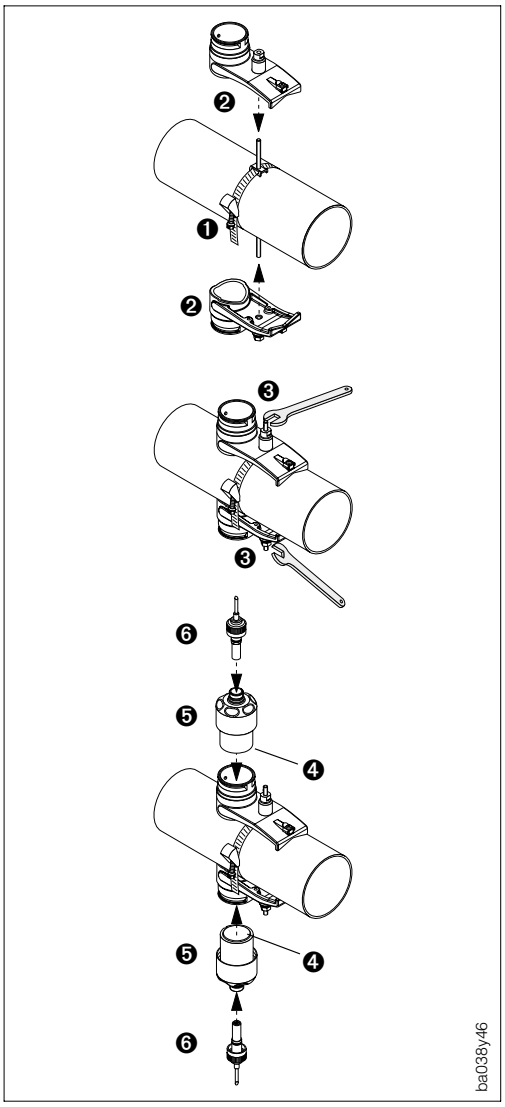
Step 1
Tighten a tensioning band ❶ (for small or large nominal diameters) as described on page 14.

Step 2
Place the sensor holder ❷ over the threaded stud on the pipe. Tighten the mounting nuts ❸ using an open-ended spanner (13 AF).

Step 3
Coat the contact surfaces ❹ of the sensors with an even film of the coupling medium approx. 1 mm thick. Insert the sensors ❺ carefully into the sensor holder. Press down the sensor cover onto the sensor holder until there is an audible click. Finally insert the sensor cable connectors ❻ into the openings provided and then screw down tightly by hand until the mechanical stop.

The tensing bands can be shortened as required after mounting.

Caution!
Risk of injury.
Avoid jagged edges when shortening.



Caution!

Fig. 13
Ultrasonic velocity sensors

3.12 Using welding bolts

Welding bolts can be used instead of tensioning bands for the sensor versions mentioned above.
The program “Quick Set-Up” as described on page 2 should be used to determine the distance between sensors.

Refer to the appropriate pages 15, 16 or 17 for an exact description for mounting the sensor. The same mounting sequence is to be used.
The following must be noted when using a different, non-metric M6-ISO thread:
- Remove the previously mounted holding nuts ❶ of the sensor holder with a metric ISO thread.
- Use a suitable nut for your threaded studs.

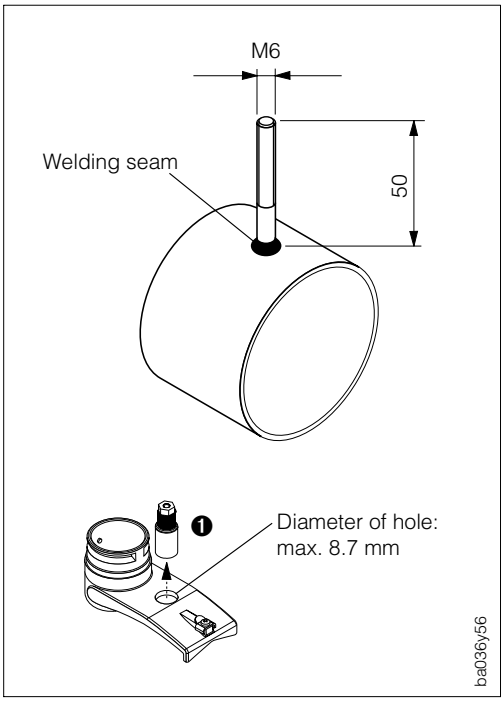


Fig. 14
Inserting welding bolts

3.13 Using the wall thickness sensor (accessory)

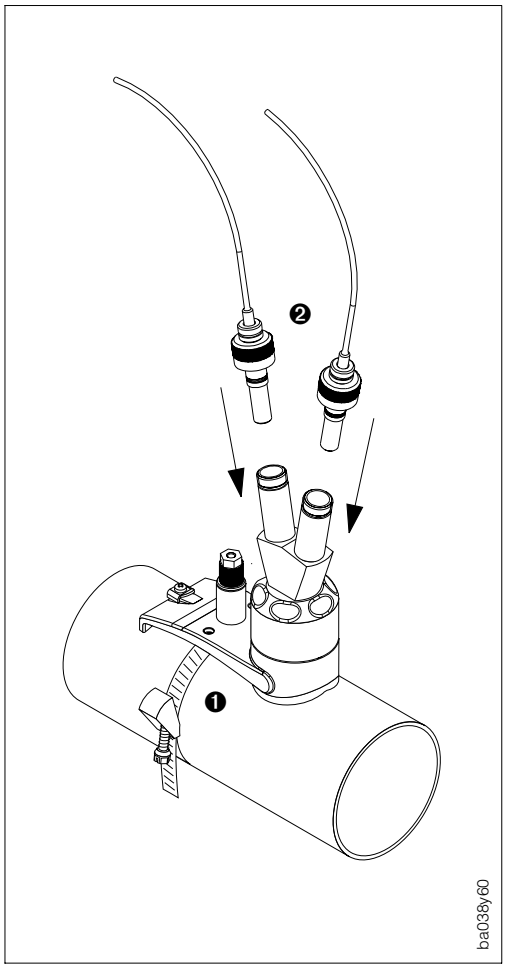


Fig. 15
Wall thickness sensor

Version 1

Secure a tensioning band ❶ (for small or large nominal diameters) as well as a sensor holder as described in Steps 1 and 2 on page 15.
Coat the contact surfaces of the sensor with an even film of appropriate coupling medium approx. 1 mm thick. Insert the sensors carefully into the sensor holder. Press down the sensor cover onto the sensor holder until there is an audible click. Screw down tightly by hand the sensor cable connectors ❷ into the openings provided until the mechanical stop. After determining the thickness of the tube, replace the wall thickness sensor with the appropriate flow sensor. Do not forget to thoroughly clean the coupling point.

Version 2

This is only suitable if the DMU 93 transmitter is within the visible range of the measuring point.
Coat the contact surfaces of the sensors with an even film of appropriate coupling medium approx. 1 mm thick. Then hold the sensor by the hand directly onto the measuring pipe. Use the other hand to carry out local operation.

3.14 Mounting the transmitter

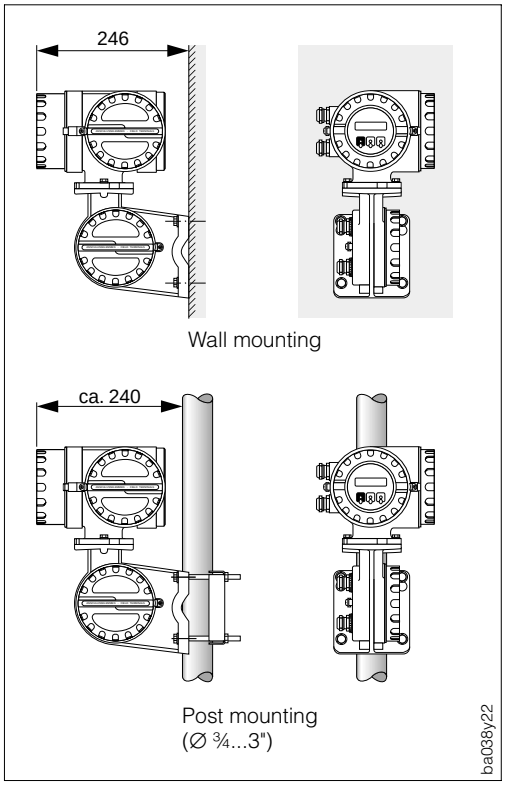


Fig. 16
Mounting versions of the transmitter

The wall mounting set for the transmitter is delivered as standard.
A special mounting set for post mounting can be provided.
(Order No.: 50076905)

Caution!

- Observe carefully the electrical connection diagram on page 23 and 24.
- Fix the cable gland or lay armoured cabling.
- Do not mount cable next to electrical machinery or switching elements.
- The transmitter housing has to be protected from direct sunlight by suitable materials.

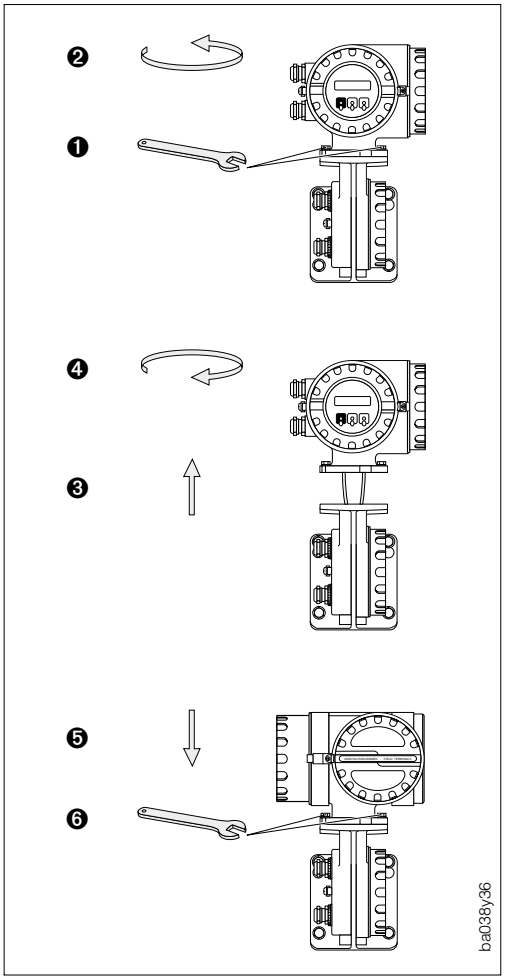
Caution!

3.15 Rotating the transmitter housing

1. Loosen the mounting screws (approx. 2 turns)
2. Rotate the transmitter housing as far as the groove of the nut.
3. Carefully pull out the transmitter housing.

Caution!
Do not damage the connecting cable between the transmitter and wall bracket!

4. Rotate the transmitter housing to the position required.
5. Carefully put the transmitter housing onto the wall bracket
6. Push back the latch again and tighten the two screws securely.



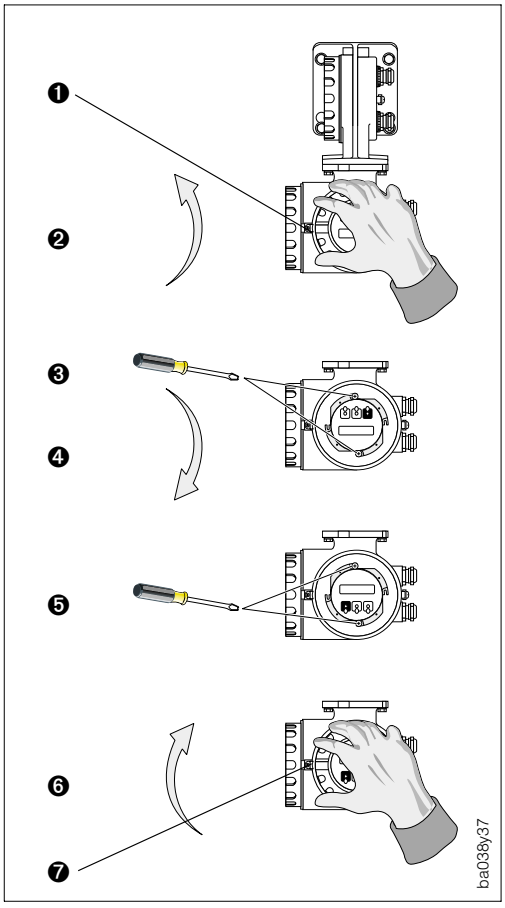
Caution!

Fig. 17
Rotating the transmitter housing

3.16 Rotating the local display

Warning!
Danger from electrical shock! Switch off power supply before opening the housing.

1. Loosen the safety grip. (3 mm Allen key)
2. Unscrew the cover to the electronics area.
3. Undo both Phillips screws.
4. Rotate the display to the position required.
5. Tighten the Phillips screws again.
6. Replace the cover of the electronics area on the transmitter housing.
7. Tighten the Allen screws of the safety grip securely.



Warning!

Fig. 18
Rotating the local display

4 Electrical Connection

Warning!
- For instruments with Ex approval for hazardous areas, the installation regulations and technical data may differ from the information given below. Please refer to the separate supplementary Ex documentation.

4.1 Transmitter protection IP 67

The transmitter fulfils all IP 67 requirements (EN 60529). In order to maintain IP 67 protection after installation in the field or after service, the following points must be observed:

- The housing gaskets must be clean and undamaged before placing in the groove. The gaskets may need to be dried, cleaned or replaced if necessary.
- All housing screws and screw covers must be tightly secured.
- The cables used for the connection must have the specified outer diameter.
- Secure all cable glands ❶ (see diagram on right)
- Lay the cable in a loop ❷ in front of the cable gland. Any moisture forming cannot then reach the entry (see diagram on right).
- Cable glands not used are to be replaced by dummy plugs.
- The protective grommet used may not be removed from the cable entries.

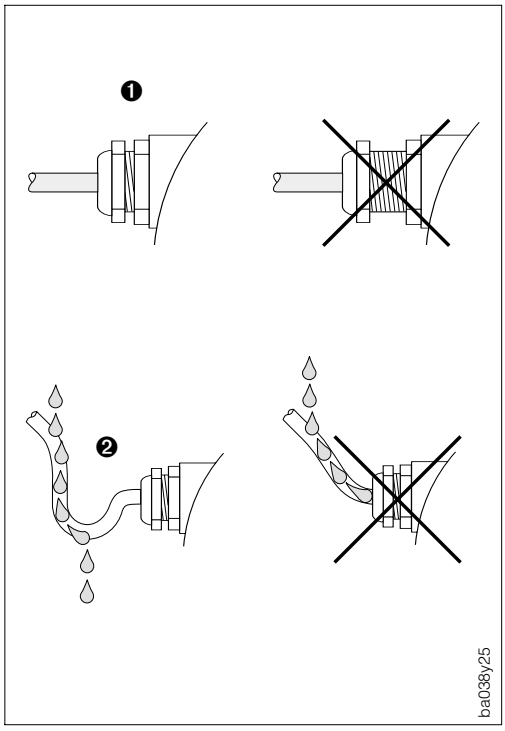


Fig. 19
Protection IP 67

4.2 Sensors protection IP 68

The flow/sonic velocity sensors meet all IP 68 requirements (EN 60529 In order to maintain IP 68 protection after installation in the field or after service, the following points must be observed:

- Only cable and connectors ❶ supplied by E+H may be used for connecting sensors and transmitters.
- The cable connector gaskets ❷ must be clean and undamaged before placing in the groove. The gaskets may need to be dried, cleaned or replaced if necessary.
- Insert the cable connectors so that they do not catch on the side but which finally are securely fixed (to the mechanical stop).
- The sensors ❸ are encapsulated and require no special precautions.

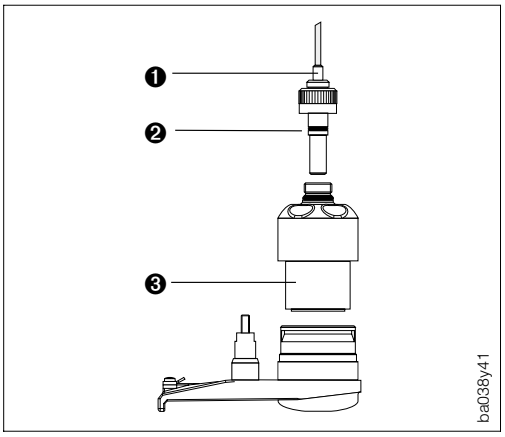


Fig. 20
Protection IP 68

4.3 Connecting the transmitter

Warning!
- Danger from electrical shock! Switch off power supply before opening the instrument.
- Connect the ground wire to the ground terminal on the housing before turning on the power supply.
- Check that the local power supply and frequency agree with the information on the nameplate. All relevant national regulations for mounting must also be observed.

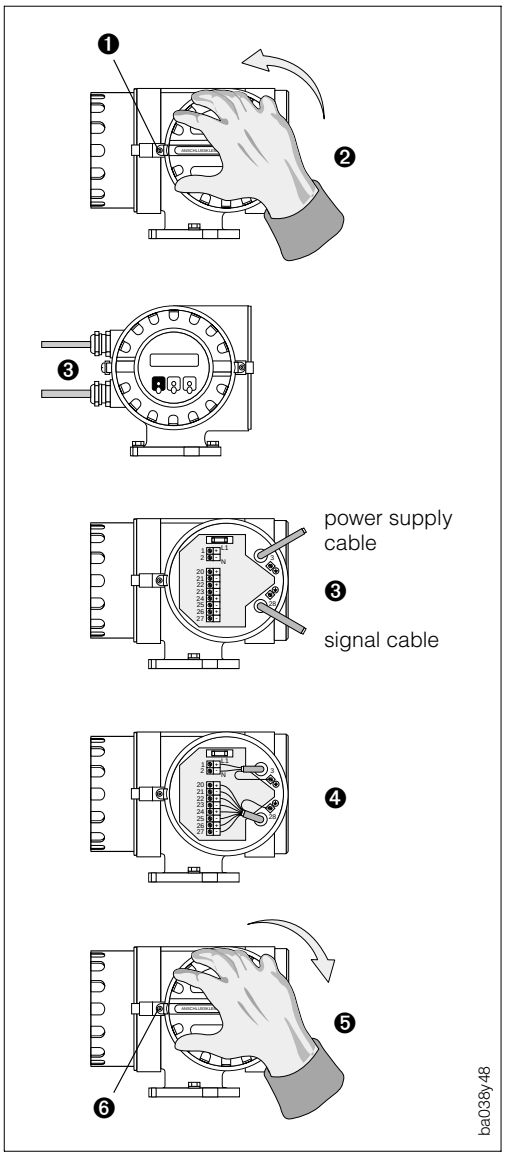


Fig. 21
Connecting the transmitter

1. Loosen the screws of the safety grip (3-mm Allen key).
2. Unscrew the cover of the terminal compartment.
3. Push the power and signal cables through the appropriate cable glands.
4. Wire up according to the connection diagrams on page 21 (see also diagram in the screw cover).

   The power supply is connected to Terminal 1 (L1 or L+), Terminal 2 (N or L-) and ground terminal 3:
   – Stranded-wire cabling: cover with an end sleeve max. 4 mm^2
   – Signal wire cabling max. 6 mm^2
5. Screw the cover of the terminal compartment securely back onto the transmitter housing.
6. Tighten the Allen screws of the safety grip.

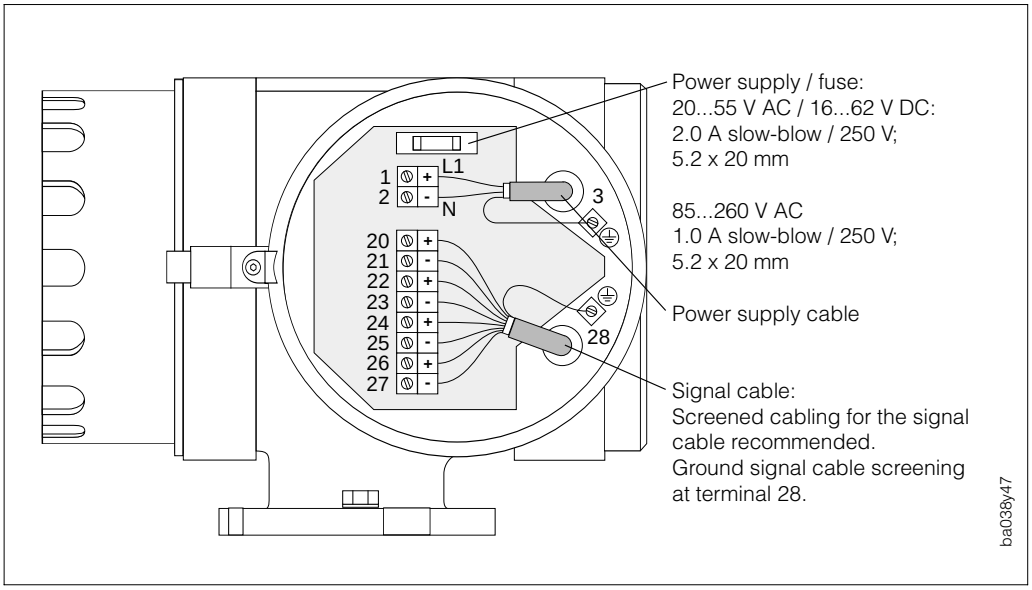


Fig. 22
Wiring the pc boards:
- *HART current output and pulse / frequency output*
- *HART current output and 2nd current output*

"HART" current output and pulse / frequency output		
1 **2**	L1 N for AC power supply	L+ L- for DC power supply
3	Ground connection (ground wire)	
20 **21**	Pulse / frequency output (see page 61)	active/passive, f = 2...10,000 Hz (max. 16383 Hz) active: 24 V DC, 25 mA (250 mA / 20 ms) passive: 30 V DC, 25 mA (250 mA / 20 ms)
22 **23**	Relay 1	max. 60 V AC / 0.5 A max. 30 V DC / 0.1 A can be configured, e.g. for fault
24 **25**	Relay 2	max. 60 V AC / 0.5 A max. 30 V DC / 0.1 A can be configured, e.g. for limit value
26 **27**	Current output 1	active, 0/4...20 mA, R_L < 700 Ω with HART protocol
28	Ground connection (screen of signal cable)	

"HART" current output and 2nd current output		
1 **2**	L1 N for AC power supply	L+ L- for DC power supply
3	Ground connection (ground wire)	
20 **21**	Current output 2	active, 0/4...20 mA, R_L < 700 Ω
22 **23**	Relay 1	max. 60 V AC / 0.5 A max. 30 V DC / 0.1 A can be configured, e.g. for fault
24 **25**	Relay 2	max. 60 V AC / 0.5 A max. 30 V DC / 0.1 A can be configured, e.g. for limit value
26 **27**	Current output 1	active, 0/4...20 mA, R_L < 700 Ω with HART protocol
28	Ground connection (screen of signal cable)	

4.4 Wiring up the connecting cable to the sensors / transmitters

The two sensor cables (including the connectors) from sensors → transmitter are ready to use and supplied in lengths of 5, 10, 15 or 30 meters.

Warning!

Warning!
Danger from electrical shock! Switch off the power supply before unscrewing the terminal compartment cover.

1. Loosen the safety claw Allen screw (3 mm Allen key).
   Unscrew the cover of the sensor cable / terminal compartment.
2. Remove the dummy cover over the cable entries for Channel 1 or 2. Screw in the cable glands.
3. Undo the cable glands (delivered with the sensor).
   - Insert the cable through the cover ❶ of the cable gland.
     A threaded cable entry (e.g. for ½" NPT) can be used instead of a cover.
   - Place the rubber seal ❷ directly up to the contact sleeves ❸ and insert the cables in the holes provided (the seal holes have side slots which can be spread open with a screwdriver).
   - Place the grounding washer ❹ up to the contact sleeves (important for EMC).
   - Insert the rubber gasket, the contact sleeves and the grounding washer into the cable gland.
   - Screw down the cover of the cable gland securely.
4. Plug in the cable connectors as shown in the Figure below, View A
5. Secure the cover of the sensor cable terminal compartment.
   Tighten the safety claw Allen screw securely.

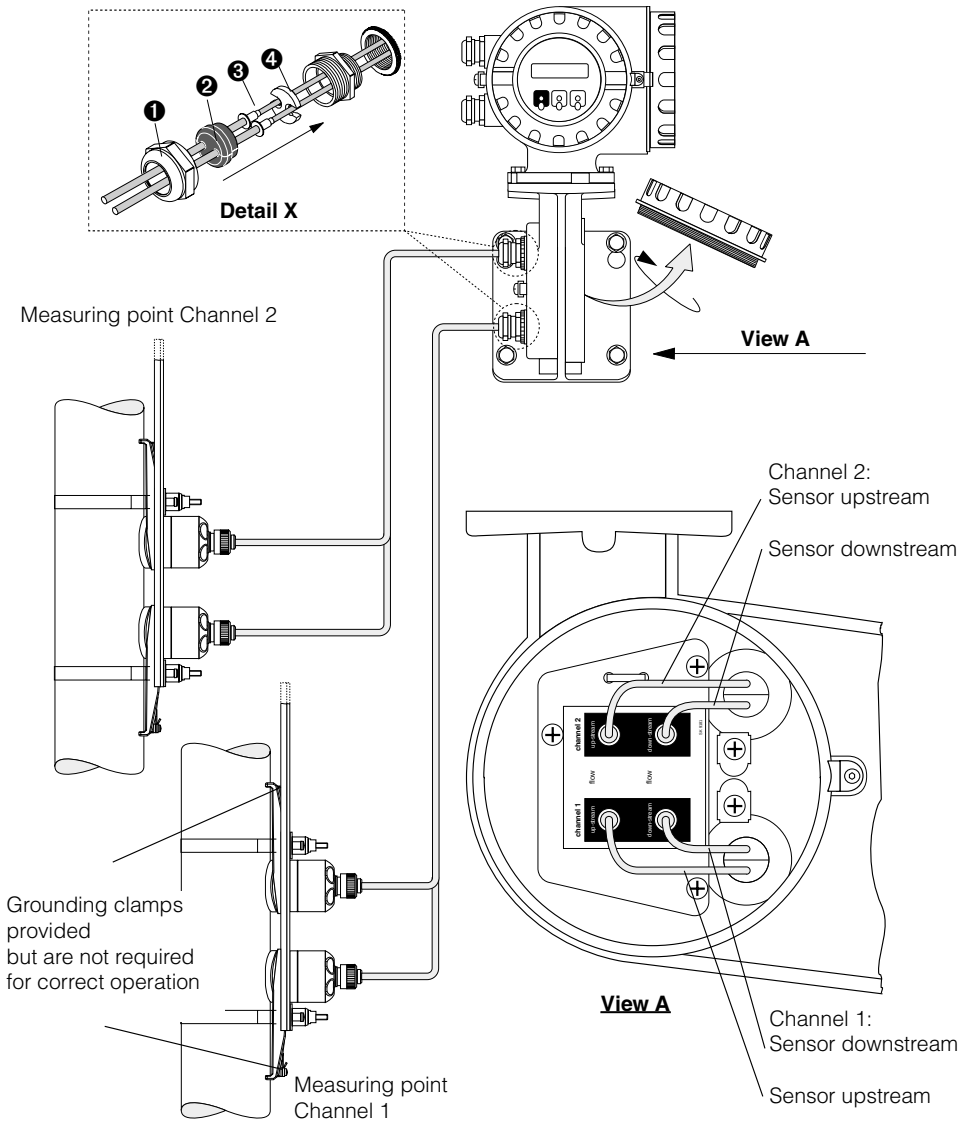


Fig. 23
Signal cable connection sensors / transmitters

5 Commissioning “CLAMP ON”

5.1 Procedure for flow measurement (Quick Setup)

An overview of the Quick Setup program is found on page 3.

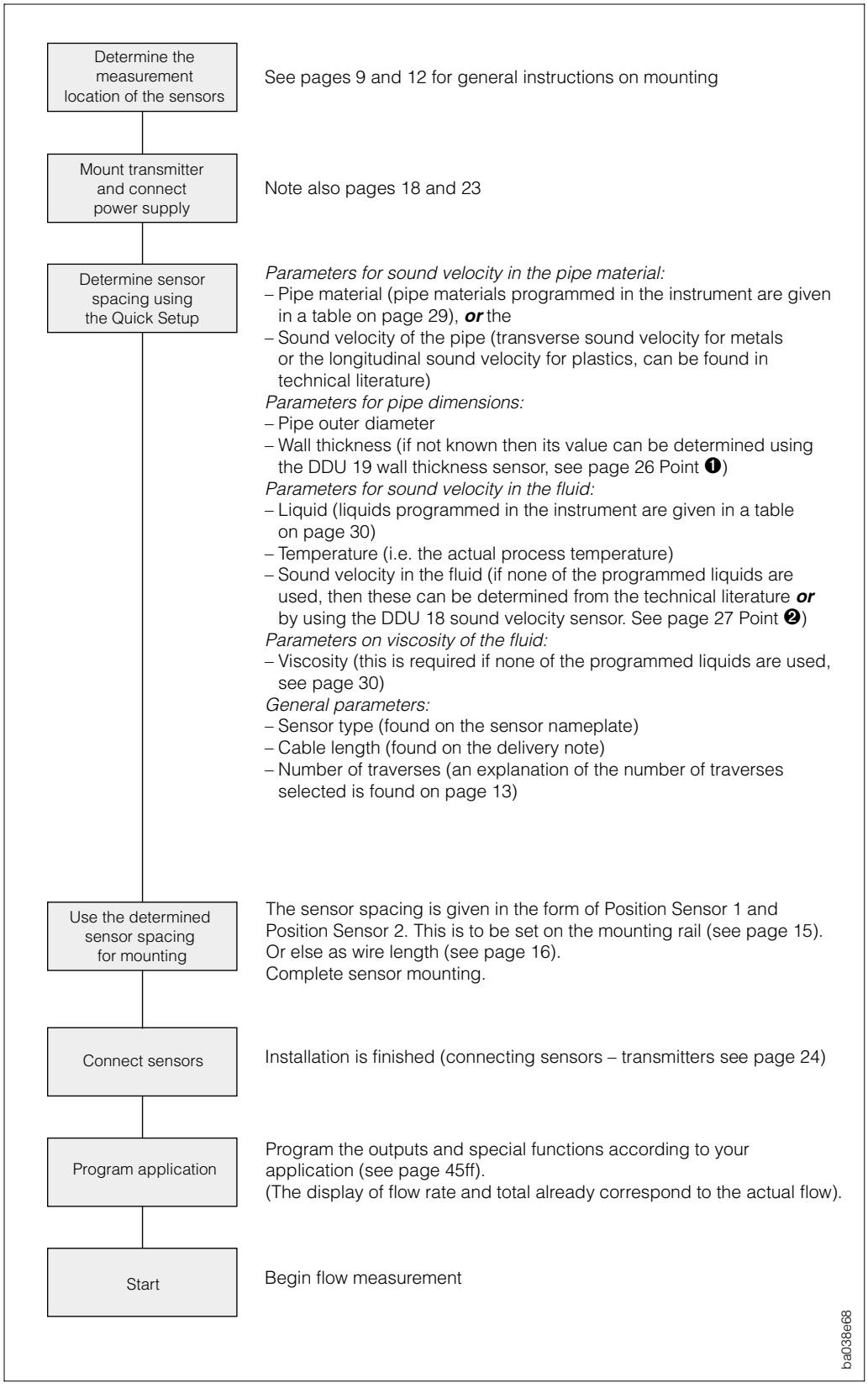


Fig. 24
Flow diagram for flow measurement

5.2 Procedure for wall thickness measurement (Quick Setup)

If the wall thickness is not known or cannot be determined for your particular application (from plant documentation), the value required can be determined using a DDU 19 wall thickness sensor.
The wall thickness sensor DDU 19 is available from E+H as an accessory.
The sensor operates on the ultrasonic transit time measurement principle.

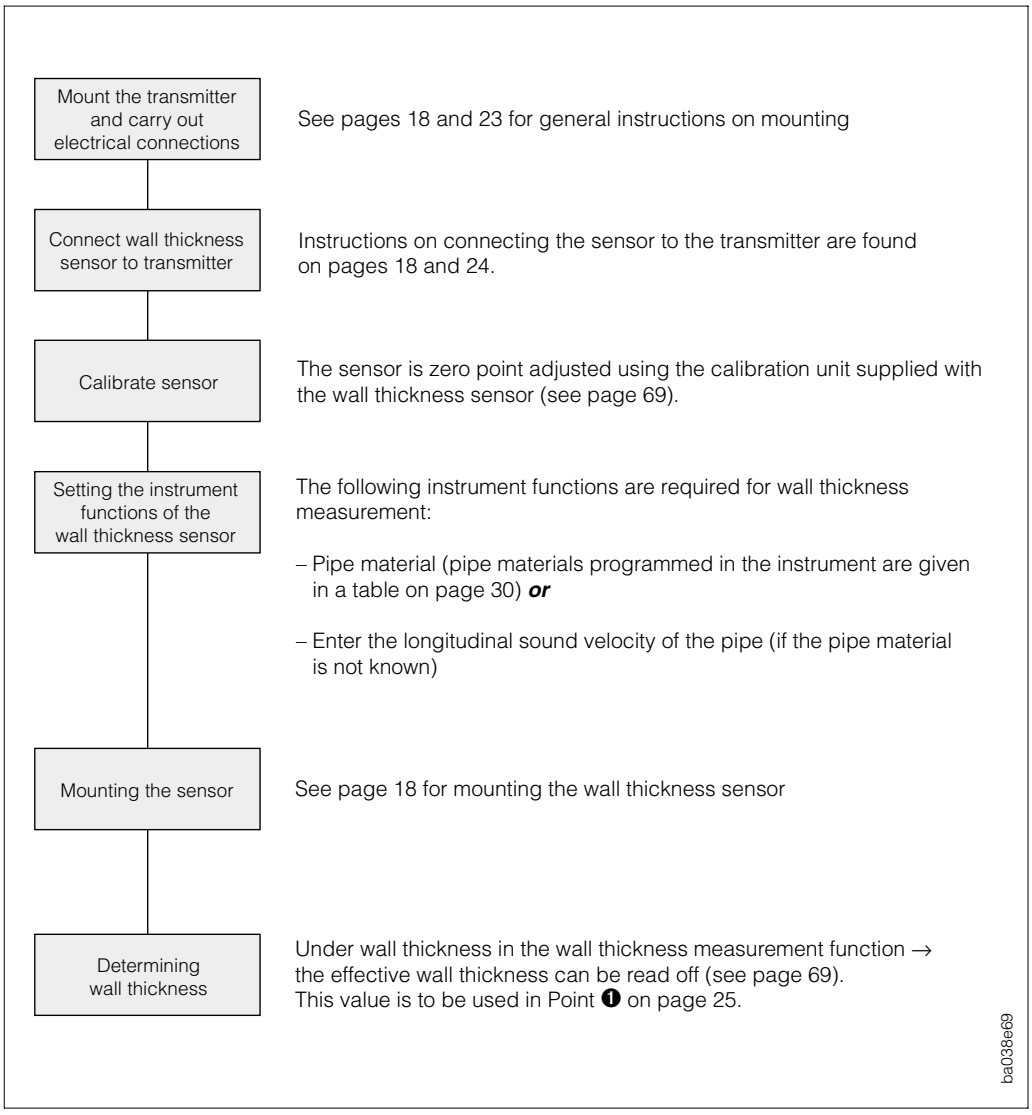


Fig. 25
Flow diagram of wall thickness measurement

5.3 Procedure for sound velocity measurement

If the sound velocity in the fluid to be measured is not known or cannot be determined for commissioning, it can be determined using a DDU 18 sound velocity sensor.
The DDU 18 sound velocity sensors are available from E+H as an accessory.
The sensor operates on the ultrasonic transit time measurement principle.

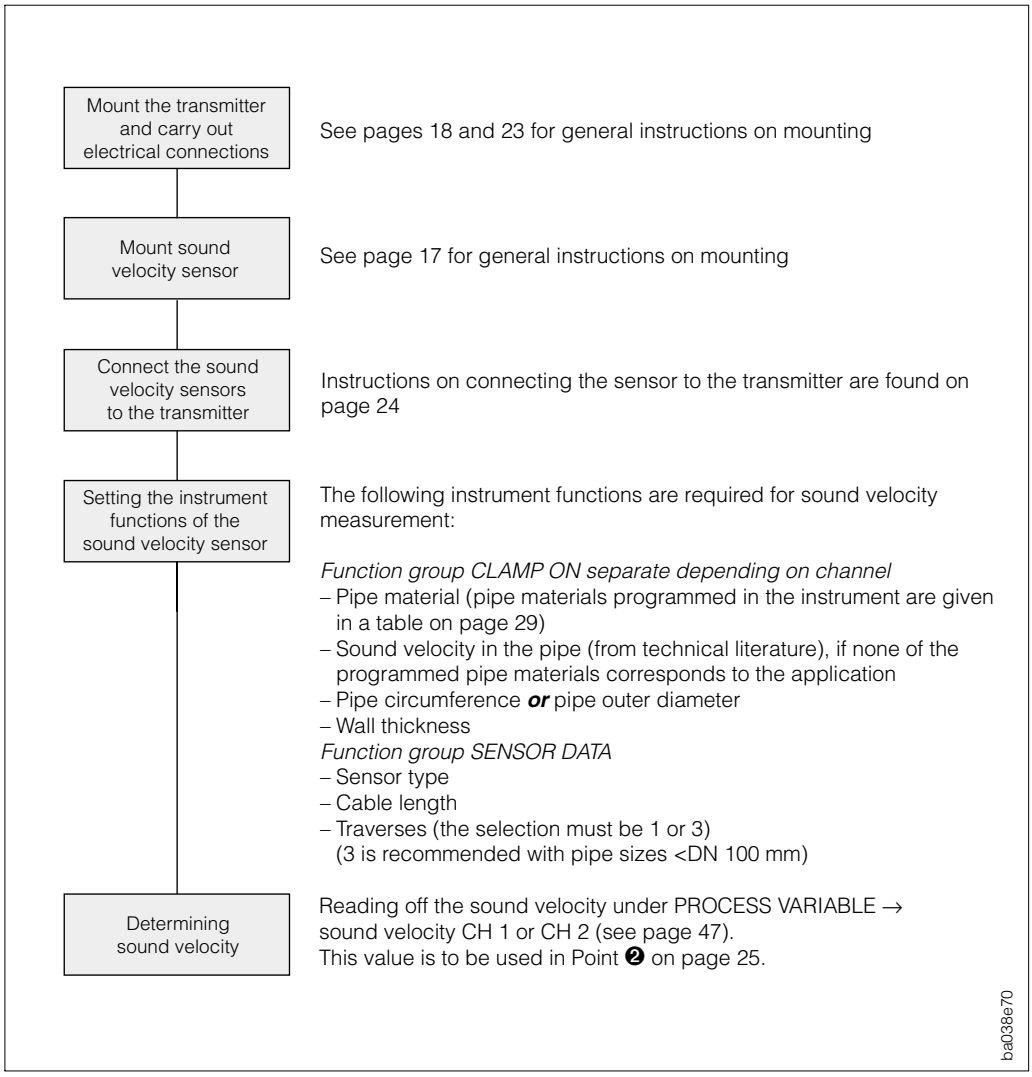


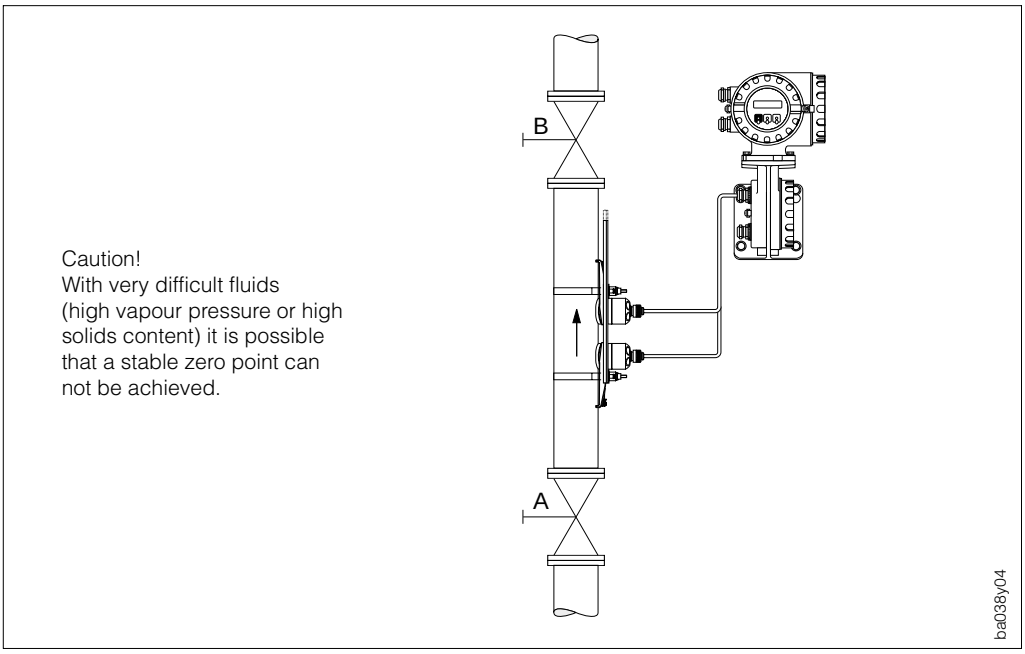
Fig. 26
Flow diagram of sound velocity measurement

5.4 Zero Point Adjustment

Notes on zero point adjustment
A zero point adjustment is ***not*** normally required!

In certain cases, experience has shown that a zero point calibration is recommended especially for very high accuracy in the lower flow measurement range (< 0.5 m/s).

Requirements
Zero point adjustment is carried out using completely filled pipes and a zero flow with e.g. shut-off valves both upstream and downstream. It should be performed with a homogeneous fluid in the pipe.
For this reason, with outgassing liquids the zero point adjustment should be performed at operating pressure.



Caution!

Fig. 27
Mounting for carrying out a zero point adjustment

Carrying out a zero point adjustment

1. Run the plant for as long as necessary until it is operating normally.
2. Stop the flow (v = 0 m/s).
3. Check the shut-off valves (for leaks).
   Check that the operating pressure remain stable during the adjustment.
4. Carry out the adjustment using the local display as follows
   (For zero point adjustment functions see page 75).

Notes!

Note!

- During zero point adjustment the status message “S: ZERO ADJUST. CH1 or CH2 RUNNING” is shown for 30...60 seconds.
- If the flow velocity is >0.1 m/s then the error message “S: ZERO ADJUST. CH1 or CH2 NOT POSSIBLE” is shown on the display and the process is terminated.
- Once the zero point adjustment has been completed, the new zero point value can immediately be called up with the diagnosis function (simultaneously pressing ⊞). The value in the function “ZERO POINT” is overwritten.

5.5 Configuring the relay contacts

Both relays can be configured freely, i.e. both can be either NC contacts or NO contacts by using a plug-in jumper on the communication board.

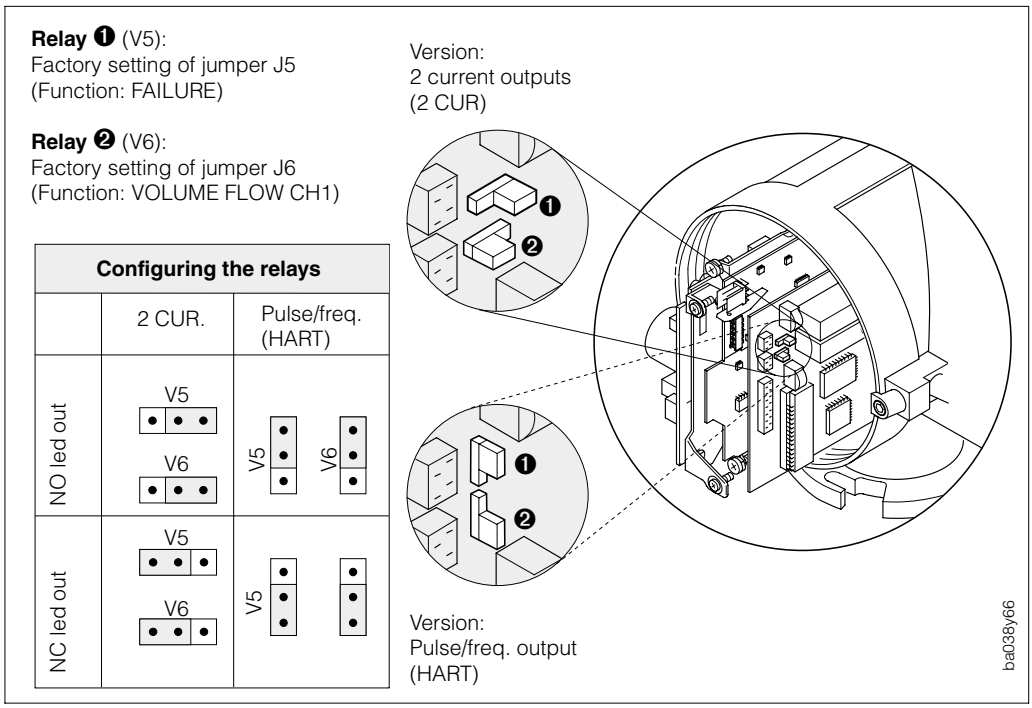


Fig. 28
Configuring the relay contacts (the appropriate functions “RELAY 1 or 2” are found on page 63).

Warning!
If you have a transmitter with Ex approval then please observe the additional separate Ex documentation.

Warning!

5.6 Tables of programmed sound velocities

This table is used in function group “CLAMP ON CH1/CH2”.

Pipe materials to be selected in the program (see page 70 of Functions)	and their permanently programmed **sound velocities** at 20 °C in m/s
Carbon steel	3230
Stainless steel	3120
Hastelloy C	3130
PA (polyamide)	2200
PE (polyethylene)	1950
LDPE (Low Density Polyethylene)	2087
HDPE (High Density Polyethylene)	2404
PP (polypropylene)	2404
PVC (polyvinyl chloride)	2220
PTFE (polytetrafluoroethylene)	1350
PVDF (Polyvinyliden fluoride)	2200
ABS (acrylonitrile-butadiene styrol copolymer)	2020
Flint glass	2560
Pyrex glass	3280
Crown glass	3420

Fig. 29
Pipe materials and their sound velocities

This table is used in function group “CLAMP ON CH1/CH2”.

Pure **Liquids** selected in the program (see page 70 of Functions)	and their permanently programmed **sound velocities** at 20 °C in m/s
Water	1483
Sea water	1522
Ammonia	1729*
Acetone	1197
Alcohol	1180
Benzene	1329
Bromide	904
Ethanol	1227
Glycol	1669
Kerosene	1342
Milk	1501
Methanol	1120
Toluol	1328

Fig. 30
Liquids and their sound velocities

* Ammonia at a temperature of -33 °C

This table is used in function group “W. THICKNESS CH1 or CH2” longitudinal.

Pipe materials to be selected in the program (see page 68 of Functions)	and their permanently programmed **sound velocities** at 20 °C in m/s
Carbon steel	5940
Stainless steel	5660
Hastelloy C	5850
PA (polyamide)	2200
PE (polyethylene)	1950
LDPE (Low Density Polyethylene)	2087
HDPE (High Density Polyethylene)	2404
PP (polypropylene)	2404
PVC (polyvinyl chloride)	2220
PTFE (polytetrafluoroethylene)	1350
PVDF (Polyvinyliden fluoride)	2200
ABS (acrylonitrile-butadiene styrol copolymer)	2020
Flint glass	4230
Pyrex glass	5610
Crown glass	5260

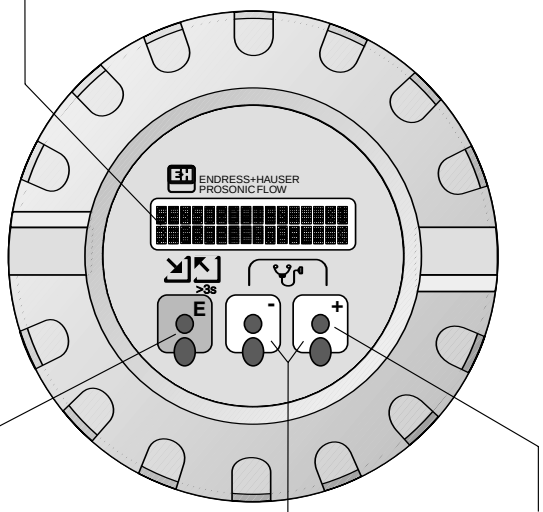
Fig. 31
Pipe materials and their sound velocities

6 Operation

6.1 Display and operating keys

LC display

- Illuminated, double-spaced with 16 characters
- Displayed are menus, texts and numerical values as well as error, alarm and status messages
- HOME Position (display during normal operation):
  Upper line → freely selectable measured variable (Factory setting “mass flow CH1”)
  Lower line → freely selectable measured variable (Factory setting “Total 1”)



3 optical operating keys “Touch Control”

up: infrared transmitter diode
down: infrared receiver diode

+ / – keys

- Select function group
- Select numerical values (if keys are kept pressed the numbers displayed will begin changing at an accelerated rate)
- Select parameters / settings

Diagnostic and help function
(activate +/– operating elements simultaneously)

“ENTER key”

E Direct access to the operating matrix or on first power up via the QUICK SETUP

Note!
This function can be locked when leaving the QUICK SETUP menu.

E Leave operating matrix, return to HOME position
(activate E element for more than 3 seconds)

E Access function,
Save entered figures and settings

ba038y16

Note!

Fig. 32
Display and operating keys

6.2 E+H operating matrix (setting functions)

① Access to the operating matrix

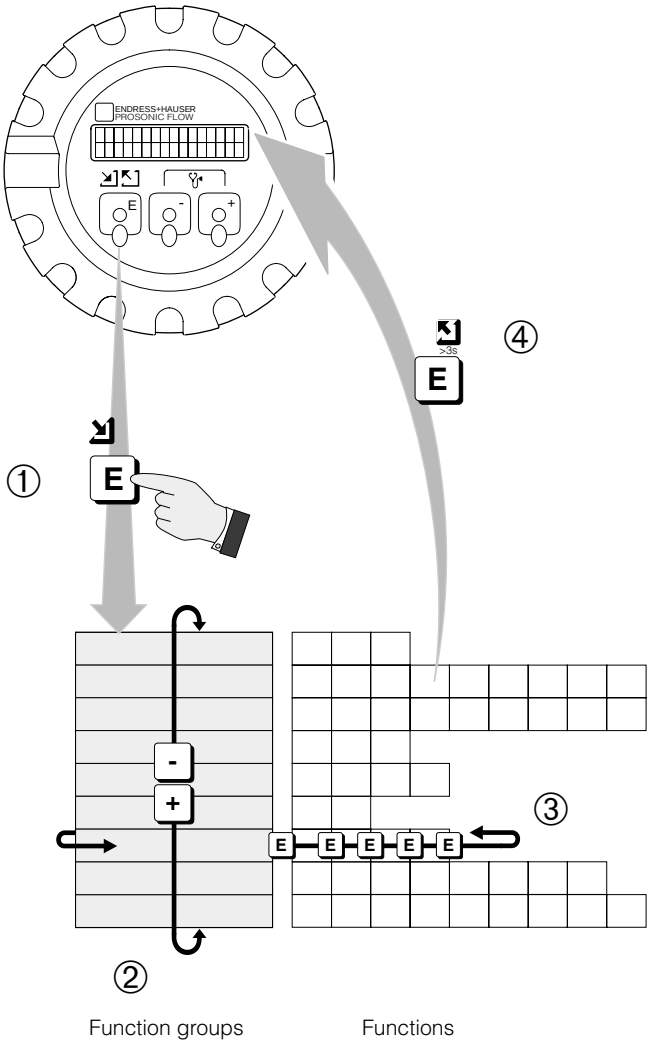
② Select function group (>Group SELECT<)

③ Select function (entering/setting data with ± and saving with E)

④ Leaving operating matrix, return to the HOME position from any matrix position (e.g. after programming)

Note!

Note!
Operating matrix → see page 33
Programming example → see page 35
Function description → see page 45 ff.

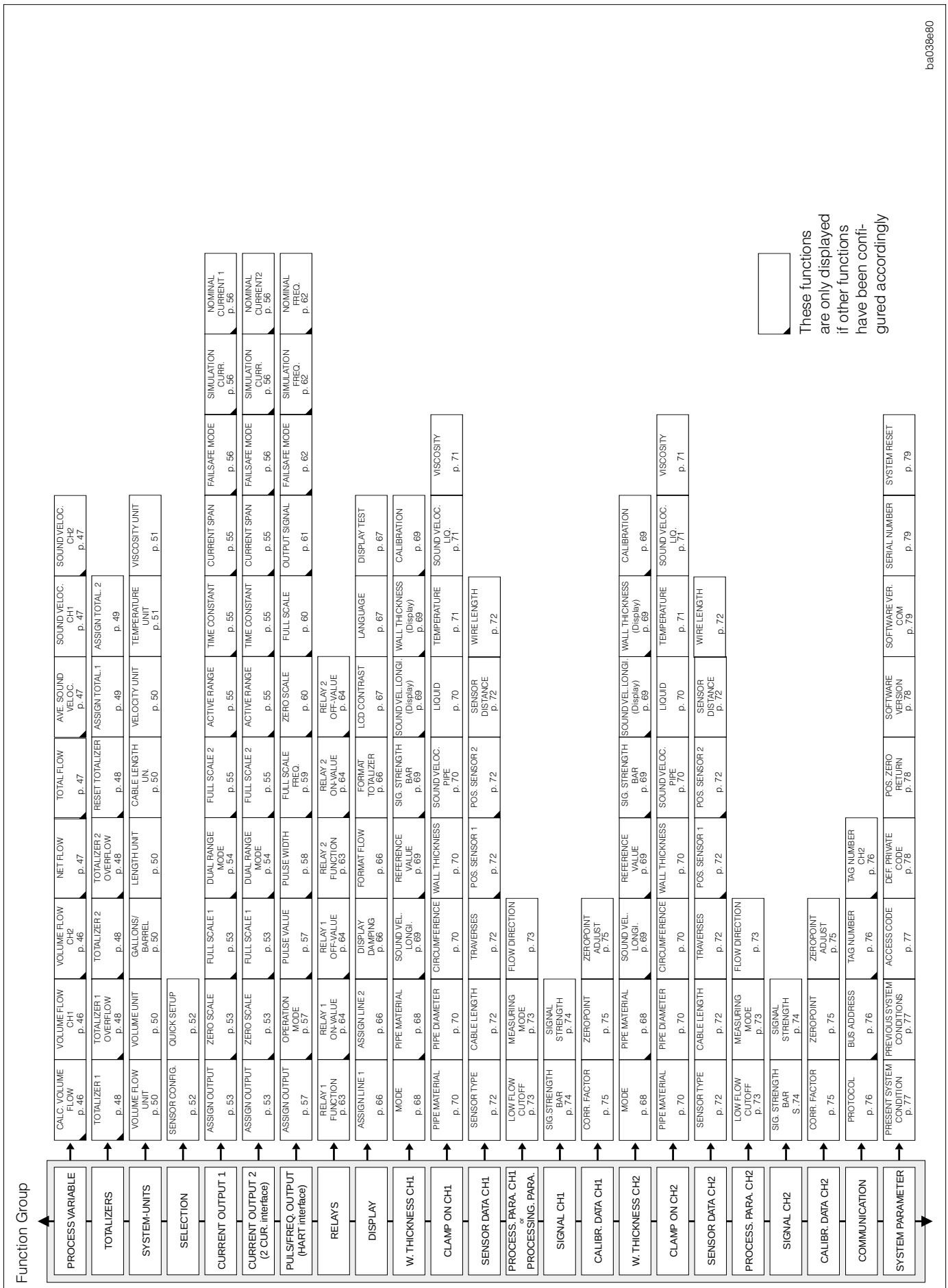


Notes!
- An automatic return to the HOME position will be made if the operating elements are not pressed for 60 seconds (only when the programming is locked).
- If the diagnostic function ± is activated from the HOME position, then an automatic return to HOME position will be made if the operating elements are not pressed within 60 seconds; whether the programming is enabled or locked.

Note!

ba038y17

Fig. 33
Selecting functions in the E+H operating matrix


Function Group
PROCESS VARIABLE
TOTALIZERS
SYSTEM-UNITS
SELECTION
CURRENT OUTPUT 1
CURRENT OUTPUT 2 (2 CUR. interface)
PULS/FREQ. OUTPUT (HART interface)
RELAYS
DISPLAY
W. THICKNESS CH1
CLAMP ON CH1
SENSOR DATA CH1
PROCESS. PARA. CH1 or PROCESSING. PARA.
SIGNAL CH1
CALIBR. DATA CH1
W. THICKNESS CH2
CLAMP ON CH2
SENSOR DATA CH2
PROCESS. PARA. CH2
SIGNAL CH2
CALIBR. DATA CH2
COMMUNICATION
SYSTEM PARAMETER
CALC. VOLUME FLOW p. 46
VOLUME FLOW CH1 p. 46
VOLUME FLOW CH2 p. 46
NET FLOW p. 47
TOTAL FLOW p. 47
AVE. SOUND VELOC. p. 47
SOUND VELOC. CH1 p. 47
SOUND VELOC. CH2 p. 47
TOTALIZER 1 p. 48
TOTALIZER 1 OVERFLOW p. 48
TOTALIZER 2 p. 48
TOTALIZER 2 OVERFLOW p. 48
RESET TOTALIZER p. 48
ASSIGN TOTAL.1 p. 49
ASSIGN TOTAL. 2 p. 49
VOLUME FLOW UNIT p. 50
VOLUME UNIT p. 50
GALLONS/ BARREL p. 50
LENGTH UNIT p. 50
CABLE LENGTH UN. p. 50
VELOCITY UNIT p. 50
TEMPERATURE UNIT p. 51
VISCOSITY UNIT p. 51
SENSOR CONFIG. p. 52
QUICK SETUP p. 52
ASSIGN OUTPUT p. 53
ZERO SCALE p. 53
FULL SCALE 1 p. 53
DUAL RANGE MODE p. 54
FULL SCALE 2 p. 55
ACTIVE RANGE p. 55
TIME CONSTANT p. 55
CURRENT SPAN p. 55
FAILSAFE MODE p. 56
SIMULATION CURR. p. 56
NOMINAL CURRENT 1 p. 56
ASSIGN OUTPUT p. 53
ZERO SCALE p. 53
FULL SCALE 1 p. 53
DUAL RANGE MODE p. 54
FULL SCALE 2 p. 55
ACTIVE RANGE p. 55
TIME CONSTANT p. 55
CURRENT SPAN p. 55
FAILSAFE MODE p. 56
SIMULATION CURR. p. 56
NOMINAL CURRENT2 p. 56
ASSIGN OUTPUT p. 57
OPERATION MODE p. 57
PULSE VALUE p. 57
PULSE WIDTH p. 58
FULL SCALE FREQ. p. 59
ZERO SCALE p. 60
FULL SCALE p. 60
OUTPUT SIGNAL p. 61
FAILSAFE MODE p. 62
SIMULATION FREQ. p. 62
NOMINAL FREQ. p. 62
RELAY 1 FUNCTION p. 63
RELAY 1 ON-VALUE p. 64
RELAY 1 OFF-VALUE p. 64
RELAY 1 FUNCTION p. 63
RELAY 2 ON-VALUE p. 64
RELAY 2 OFF-VALUE p. 64
ASSIGN LINE 1 p. 66
ASSIGN LINE 2 p. 66
DISPLAY DAMPING p. 66
FORMAT FLOW p. 66
FORMAT TOTALIZER p. 66
LCD CONTRAST p. 67
LANGUAGE p. 67
DISPLAY TEST p. 67
MODE p. 68
PIPE MATERIAL p. 68
SOUND VEL. LONGI. p. 69
REFERENCE VALUE p. 69
SIG. STRENGTH BAR p. 69
SOUND VEL. LONGI. (Display) p. 69
WALL THICKNESS (Display) p. 69
CALIBRATION p. 69
PIPE MATERIAL p. 70
PIPE DIAMETER p. 70
CIRCUMFERENCE p. 70
WALL THICKNESS p. 70
SOUND VELOC. PIPE p. 70
LIQUID p. 70
TEMPERATURE p. 71
SOUND VELOC. LIQ. p. 71
VISCOSITY p. 71
SENSOR TYPE p. 72
CABLE LENGTH p. 72
TRAVERSES p. 72
POS. SENSOR 1 p. 72
POS. SENSOR 2 p. 72
SENSOR DISTANCE p. 72
WIRE LENGTH p. 72
LOW FLOW CUTOFF p. 73
MEASURING MODE p. 73
FLOW DIRECTION p. 73
SIG.STRENGTH BAR p. 74
SIGNAL STRENGTH p. 74
CORR. FACTOR p. 75
ZEROPOINT p. 75
ZEROPOINT ADJUST p. 75
MODE p. 68
PIPE MATERIAL p. 68
SOUND VEL. LONGI. p. 69
REFERENCE VALUE p. 69
SIG. STRENGTH BAR p. 69
SOUND VEL. LONGI (Display) p. 69
WALL THICKNESS (Display) p. 69
CALIBRATION p. 69
PIPE MATERIAL p. 70
PIPE DIAMETER p. 70
CIRCUMFERENCE p. 70
WALL THICKNESS p. 70
SOUND VELOC. PIPE p. 70
LIQUID p. 70
TEMPERATURE p. 71
SOUND VELOC. LIQ. p. 71
VISCOSITY p. 71
SENSOR TYPE p. 72
CABLE LENGTH p. 72
TRAVERSES p. 72
POS. SENSOR 1 p. 72
POS. SENSOR 2 p. 72
SENSOR DISTANCE p. 72
WIRE LENGTH p. 72
LOW FLOW CUTOFF p. 73
MEASURING MODE p. 73
FLOW DIRECTION p. 73
SIG. STRENGTH BAR S.74
SIGNAL STRENGTH p. 74
CORR. FACTOR p. 75
ZEROPOINT p. 75
ZEROPOINT ADJUST p. 75
PROTOCOL p. 76
BUS ADDRESS p. 76
TAG NUMBER p. 76
TAG NUMBER CH2 p. 76
PRESENT SYSTEM CONDITION p. 77
PREVIOUS SYSTEM CONDITIONS p. 77
ACCESS CODE p. 77
DEF. PRIVATE CODE p. 78
POS. ZERO RETURN p. 78
SOFTWARE VERSION p. 78
SOFTWARE VER. COM p. 79
SERIAL NUMBER p. 79
SYSTEM RESET p. 79
These functions are only displayed if other functions have been configured accordingly
ba038e80

Further information on programming

For the Prosonic Flow measuring system there is a wide choice of functions available which the user can set individually and adapt to the process conditions.
The transmitter is fitted with various electronic modules, depending on the specifications when ordering (communications module “HART”; “2 CUR.”).
Depending on the module, certain functions and function groups are not available or are only available on the display once other functions have been configured.

Please note the following points when programming:
- If the power supply fails, then all calibrated and set values are safely stored in the EEPROM (without requiring batteries).

- Functions which are not required, e.g. current or pulse/frequency output, can be set to “OFF”. The appropriate functions in other function groups then no longer appear on the display.

- If, when programming you wish to undo a setting carried out with ± then select “CANCEL”. This is only possible for settings which have not yet been stored by pressing E .

- In certain functions, for safety reasons a prompt is given after entering data. Select “SURE [YES]” with the keys ± and confirm by pressing E again. The setting is now stored or a function, e.g. zero point adjustment, is activated.

- The Prosonic Flow DMU 93 may not show values with all decimal places as this depends on the unit used and the number of decimal places selected (see function “FORMAT FLOW”, page 66).
  When programming, an arrow is therefore shown between the measured value and the unit (e.g. 1.2 → dm^3/h).

Enable programming (entering the code number)

Normally programming is locked. Any unauthorised changes to the instrument functions, values or factory settings are therefore not possible. Only when a code has been entered (factory setting = 93) can parameters be entered or changed. The use of a personal code number which can be freely chosen prevents unauthorised personnel from gaining access to data (see page 78).

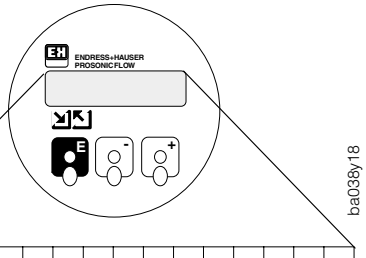

Caution!

Caution!
- If programming is locked and the ± keys are pressed in a given function, then a prompt to enter the code automatically appears on the display.
- With code = 0 the program is always enabled!
- If the personal code number is no longer available, then please contact the Endress+Hauser service organisation for assistance.

Locking programming
- After returning to the HOME position, programming is again locked after 60 seconds if no keypad is pressed.
- Programming can also be locked by entering any number (not the customer code number) in the function ACCESS CODE.

6.3 Example of programming

If you wish to change the factory set current output “4–20 mA” to “0–20 mA”, proceed as shown in:



E	Access to the operating matrix.
	PROCESS VARIABLE > GROUP SELECT. <
+ -	Selecting the desired function group (“CURRENT OUTPUT”)
	CURRENT OUTPUT > GROUP SELECT. <
E	Select function “CURRENT SPAN”
	4 – 20 mA CURRENT SPAN
+ -	On pressing + or – the entry of the code is automatically prompted.
	0 ACCESS CODE
+ -	Enter the code number (Factory setting: 93)
	93 ACCESS CODE
E	Programming is now enabled.
	EDITING ENABLED
	The programmable value flashes.
	4 – 20 mA CURRENT SPAN
+ -	Select the desired current span. The display stops flashing.
	0 – 20 mA CURRENT SPAN
E	Save the input. The display flashes and the value can be changed once again.
	INPUT STORED
	0 – 20 mA CURRENT SPAN
E >3s	Return to the “HOME” position (press the E key for more than 3 sec.). In the “HOME” position the programming level is locked again after 1 minute if none of the operating keys is pressed.
	or
E	Select other functions. Following the last function there is an automatic return to the related function group.
	BACK TO GROUP SELECTION

6.4 Operation with the “HART handheld terminal DXR 275”

Prosonic Flow DMU 93 functions are selected with the “HART handheld terminal” over a number of menu levels as well a special operating matrix for HART handheld terminals (see Fig. 37).

Note!

- All functions are accessible with the HART handheld terminal, i.e. programming is not locked. You can, however, lock the HART operating matrix by entering the value –1 in the function “ACCESS CODE”. The data can then no longer be altered. This is the status even after a power failure. The operating matrix can again be enabled by entering the code 93.

Note!

- The HART protocol requires a 4...20-mA setting of the current output (see page 55). The setting 0...20 mA is then only available if the setting “HART” is switched off in the function “PROTOCOL” (see page 76).
- The Prosonic Flow can only be configured with a DXR 275 HART handheld terminal when it has a minimum 4 MB flash memory module.

Further information on the HART handheld terminal is given in the appropriate operating manual in the carrying case.

Procedure

1. Switch on handheld terminal:
   a. The transmitter is not yet connected → HART main menu is displayed → Continue with “Online”
   b. The transmitter is already connected → The menu level “Online” is displayed

2. “Online” menu level:
   → Actual measurement data including flow, totaliser sum etc.
   → Via “Matrix group sel.” you have access to the HART operating matrix (see page 37), the to the function group (e.g. CURRENT OUTPUT) and finally to the desired function, e.g. “Full scale 1”.

3. Enter values or change the setting.

4. The field “SEND” is shown by pressing the F2 function key. By pressing this key, all values and settings entered with the handheld terminal are registered by the Prosonic measuring system.

5. Press F3 HOME function key to return to the “Online” menu level. The actual values measured by the Prosonic flow measuring system with the new settings can now be read off.

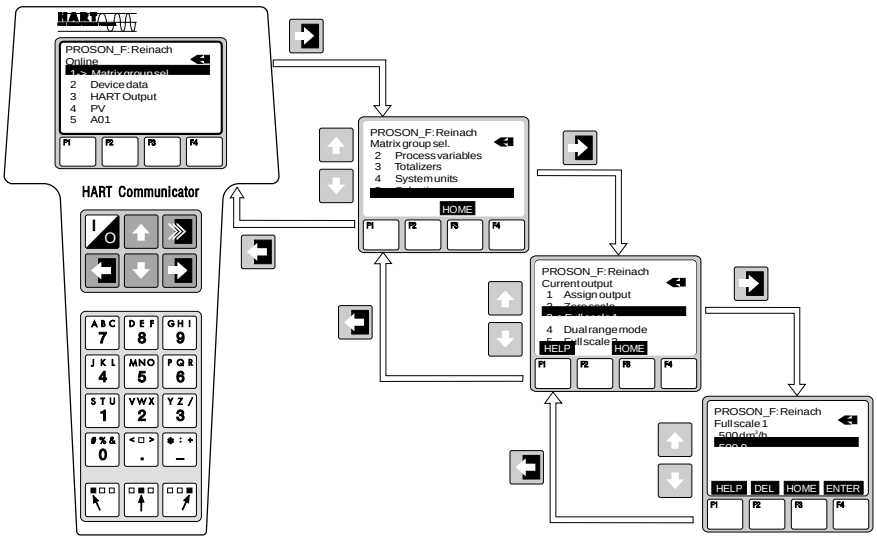


Fig. 34
Operating the HART handheld terminal

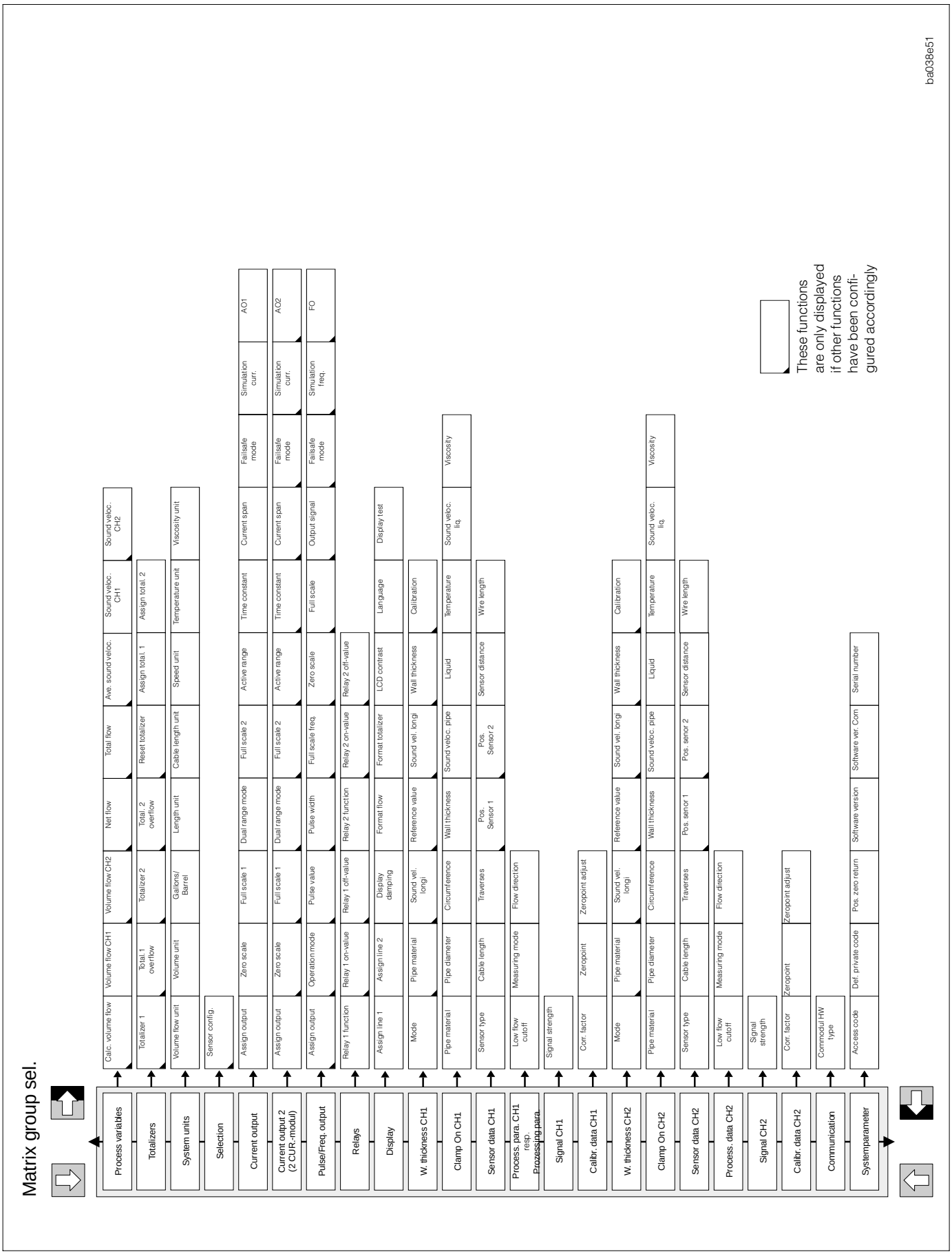


Fig. 35
HART operating matrix Prosonic Flow 93

6.5 Commuwin II via HART protocol

Commuwin II is a universal program for remote operation of field and control room devices. Use of the Commuwin II operating program is possible independent of the type of instrument or communication (HART, PROFIBUS, etc.).
Operation is done over a personal computer using the special Commuwin II program as well as the "Commubox FXA 191" HART modem with the RS 232 C serial interface.

Commuwin II offers the following functions:
- calibration of functions
- visualisation of measured values
- data backup of instrument parameters
- device diagnostics
- measuring point diagnosis

Commuwin II may also be combined with other software packages to visualise processes.

For additional information on Commuwin II, see the following E+H documentation:
- System Information: SI 018F/00/en "Commuwin II"
- Operating manual: BA 124F/00/en "Commuwin II Operating Program"

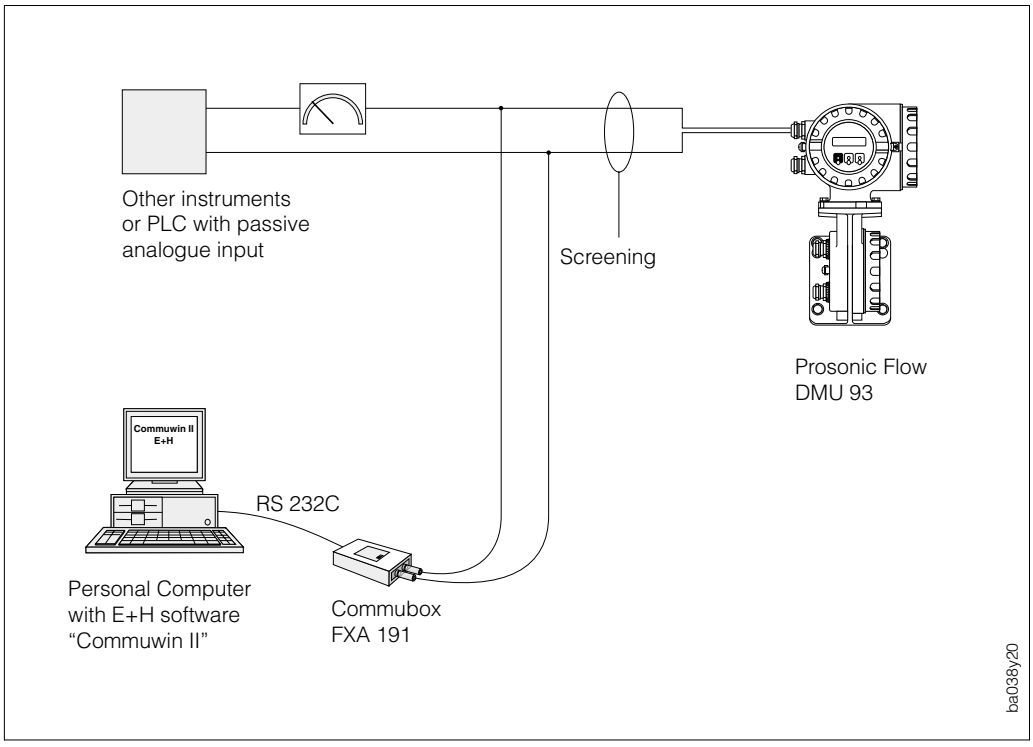


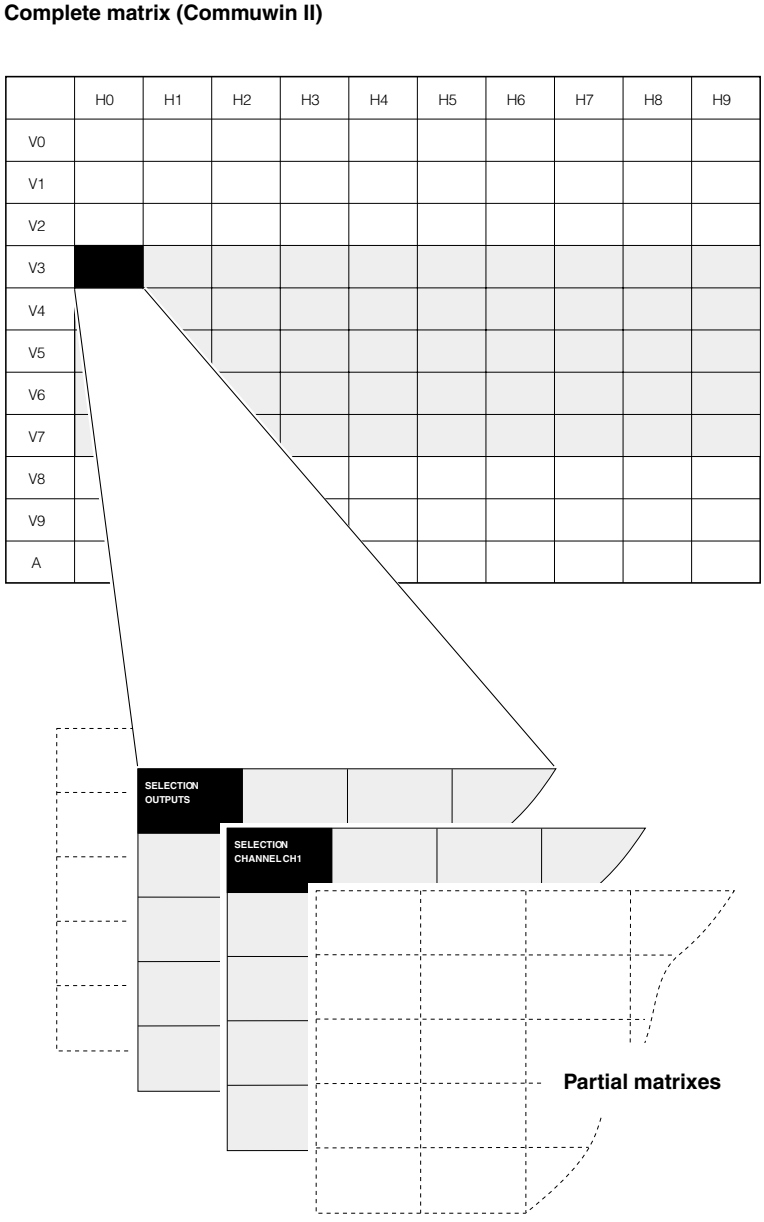
Fig. 36
Operating with "Commuwin II"

The Commuwin II operating matrix for Prosonic Flow DMU 93 is found on the following pages.

6.6 Operation with Commuwin II

For operating Prosonic Flow DMU 93 with the Commuwin II software all instrument functions are clearly organised in a matrix.

Various sections of the complete matrix containing various function groups and functions can be called up using the “SELECTION” (V3H0) function.



Lines V0...V2, and V8...A of the Commuwin II complete matrix are always shown! Six partial matrixes are accessible via the **“SELECTION”** (V3H0) function:

DISPLAY VALUES	→	see page 40/41
OUTPUTS	→	see page 40/41
CHANNEL CH1	→	see page 40/41
SERVICE CH1	→	see page 42/43
CHANNEL CH2	→	see page 42/43
SERVICE CH2	→	see page 42/43

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Fig. 37
Display principle for operating with Commuwin II

Operating matrix for Commuwin II					
		H0	**H1**	**H2**	**H3**
V0	**MEASURED VALUE**	**CALC. VOLUME FLOW** or **VOLUME FLOW CH1**	**VOLUME FLOW CH1** or **VOLUME FLOW CH2**	**VOLUME FLOW CH2** or **NET FLOW**	**AVE. SOUND VELOC.** or **TOTAL FLOW**
V1	**TOTALIZERS**	**TOTALIZER 1**	**TOTAL. 1 OVERFLOW**	**TOTALIZER 2**	**TOTAL. 2 OVERFLOW**
V2	**SYSTEM UNITS**	**VOLUME FLOW UNIT**	**VOLUME UNITS**	**GALLON/BARREL**	**LENGTH UNITS**
V3	**SELECTION**	**SELECTION:** DISPLAY VALUES OUTPUTS CHANNEL CH1 SERVICE CH1 CHANNEL CH2 SERVICE CH2		**SENSOR CONFIG.**	
V4					
V5					
V6					
V7					
V8	**COMMUNICATION**	**PROTOCOL**	**BUS ADDRESS**		
V9	**SYSTEM PARAMETER**	**DIAGNOSTIC CODE**		**ACCESS CODE**	
VA	**TAG NUMBER**	**TAG NUMBER**	**TAG NUMBER CH2**		

V3	**SELECTION**	**SELECTION:** OUTPUTS		**SENSOR CONFIG.**	
V4	**CURRENT OUTPUT** or **CURRENT OUTPUT 1**	**ASSIGN OUTPUT**	**ZERO SCALE**	**FULL SCALE 1**	**DUAL RANGE MODE**
V5	**PULS/FREQ. OUTPUT** or **CURRENT OUTPUT 2**	**ASSIGN PULS/FREQ.**	**OPERATION MODE**	**PULSE VALUE**	**PULSE WIDTH**
V6	**RELAYS**	**RELAY 1 FUNCTION**	**SWITCH-ON PT. RE 1**	**SWITCH-OFF PT. RE 1**	**RELAY 2 FUNCTION**
V7	**DISPLAY**	**DISPLAY LINE 1**	**DISPLAY LINE 2**	**DISPLAY DAMPING**	**FORMAT FLOW**

V3	**SELECTION**	**SELECTION:** CHANNEL CH1		**SENSOR CONFIG.**	
V4	**CLAMP ON CH1**	**PIPE MATERIAL**	**PIPE DIAMETER**	**PIPE CIRCUMFERENCE**	**WALL THICKNESS**
V5					
V6	**SENSOR DATA CH1**	**SENSOR TYPE**		**CABLE LENGTH**	**TRAVERSES**
V7	**PROCESSING PARA. CH1** or **PROCESS PARA.**	**LOW FLOW CUTOFF**	**MEASURING MODE**	**FLOW DIRECTION**	

H4	H5	H6	H7	H8	H9
SOUND VELOC. CH1	SOUND VELOC. CH2		NOMINAL CURRENT 1	NOMINAL CURRENT 2	ACTUAL FREQUENCY
RESET TOTALIZER	ASSIGN TOTAL 1	ASSIGN TOTAL 2			
CABLE LENGTH UN.	VELOCITY UNIT	TEMPERATURE UNIT	VISCOSITY UNIT		
		COMMODUL HW-TYPE			
POS. ZERO RETURN	SOFTWARE VERSION	SOFTWARE VER COM	SERIAL NUMBER		

FULL SCALE 2	ACTIVE RANGE	TIME CONSTANT	CURRENT RANGE	FAILSAFE MODE	SIMULATION CURR.
FULL SCALE FREQ.	ZERO SCALE	FULL SCALE FLOW	OUTPUT SIGNAL	FAILSAFE MODE	SIMULATION FREQ.
SWITCH-ON PT. RE2	SWITCH-OFF PT. RE2				
	FORMAT TOTALIZER	LCD CONTRAST	LANGUAGE	TEST DISPLAY	

	SOUND VELOC. PIPE	LIQUID	TEMPERATURE	SOUND VELOC. LIQ	VISCOSITY
	POS. SENSOR 1	POS. SENSOR 2	SENSOR DISTANCE	WIRE LENGTH	

		H0	H1	H2	H3
V3	SELECTION	SELECTION: SERVICE CH1		SENSOR CONFIG.	
V4					
V5	SIGNAL CH1		SIGNAL STRENGTH		
V6	CALIBR. DATA CH1		CORR. FACTOR	ZERO POINT	
V7	W. THICKNESS CH1	MODE	PIPE MATERIAL*	SOUND VEL. LONGI*	REFERENCE VALUE**

V3	SELECTION	SELECTION: CHANNEL CH2		SENSOR CONFIG.	
V4	CLAMP ON CH2	PIPE MATERIAL	PIPE DIAMETER	PIPE CIRCUMFERENCE	WALL THICKNESS
V5					
V6	SENSOR DATA CH2	SENSOR TYPE		CABLE LENGTH	TRAVERSES
V7	PROCESS PARA CH2	LOW FLOW CUTOFF		MEASURING MODE	FLOW DIRECTION

V3	SELECTION	SELECTION: SERVICE CH2		SENSOR CONFIG.	
V4					
V5	SIGNAL CH2		SIGNAL STRENGTH		
V6	CALIBR. DATA CH2		CORRECTION FACTOR	ZERO POINT	
V7	W. THICKNESS CH2	MODE	PIPE MATERIAL*	SOUND VEL. LONGI*	REFERENCE VALUE**

* Mode = WALL THICKNESS
** Mode = SOUND VEL. LONGI

Commuwin II partial matrix " SERVICE CH1"

H4	H5	H6	H7	H8	H9
STATIC ∅ ADJUST					
	SOUND VEL. LONGI**	WALL THICKNESS*	CALIBRATION*/**		

	SOUND VELOC. PIPE	LIQUID	TEMPERATURE	SOUND VELOC. LIQ	VISCOSITY
	POS. SENSOR 1	POS. SENSOR 2	SENSOR DISTANCE	WIRE LENGTH	

STATIC ∅ ADJUST					
	SOUND VEL. LONGI**	WALL THICKNESS*	CALIBRATION*/**		

* Mode = WALL THICKNESS
** Mode = SOUND VEL. LONGI

7 Functions

This section lists in detail a description as well as all the information required for the individual functions of the Prosonic Flow DMU 93.
Factory settings are shown in ***bold italics***. Factory set values/settings shown here may differ from those instruments with parameters requested by the customer when ordering.

Version: CLAMP ON CH1 CL1&2 1M.POINT CL1&2 2M.POINTS


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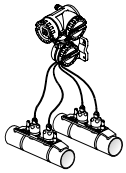
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Note!
If no special reference is made in the cell then it applies to all three versions (CLAMP ON CH1, CL1&2 1M.POINT and CL1&2 2M.POINTS).


Note!

Function group PROCESS VARIABLE

Note!
- The engineering units of all variables shown here can be set in the Function group “SYSTEM UNITS”.
- You may set the maximum number of displayed decimals in function “FORMAT FLOW” (see page 66).
- If the fluid in the piping flows backwards, then the flow rate value is indicated by a negative sign.

VOLUME FLOW CH1

only for version:
CLAMP ON CH1
CL1&2 2M.POINTS

or

CALC. VOLUME FLOW

only for version:
CL1&2 1M.POINT

Version CLAMP ON CH1 and CL1&2 2M.POINTS:
Display of the current measured volume flow.

Version CL1&2 1M.POINT:
Display of the average volume flow derived from the “VOLUME FLOW CH1” and “VOLUME FLOW CH2”

5-digit number with floating decimal point, incl. units and arithmetical sign (e.g. 5.1145 m^3/h)

For VOLUME FLOW CH1: FLOW VELOCITY from CH1
For CALC. VOL. FLOW: none

Note!
System response in special cases:
In Version CL1&2 1M.POINT a single channel failure response is available.
If one channel fails or wall thickness measurement is activated, then the operating channel is duplicated to the other channel. Only when both channels are defective does the instrument show a fault.

Example 1:
Channel 2 fails due to defective sensor.
- Flashing message: F: SENSOR CURRENT DROP CH2
- Fault relay 1 or 2 does not de-energise
- Current outputs or frequency output do not switch to error response
- The volume flow CH1 replaces Channel 2 for STD.VOL. FLOW → all assigned outputs respond accordingly.
- For Channel 2: Volume flow CH2, sound velocity CH2 as well as signal strength CH2 assume to zero → all assigned outputs assume zero

Example 2:
Channel 1 and Channel 2 fail due to defective sensors
- Flashing message: F: SENSOR CH1 CURRENT DROP and F: SENSOR CH2 CURRENT DROP
- Fault relay 1 or 2 de-energise
- Current outputs or frequency output switch to error response
- Volume flow CH1 or CH2, sound velocity CH1 or CH2, signal strength CH1 or CH2, standard volume FLOW as well as average sound velocity assume zero → all assigned outputs assume zero

VOLUME FLOW CH1

only for version:
CL1&2 1M.POINT

Display of current measured volume flow (Channel 1).

5-digit number with floating decimal point, incl. units and arithmetical sign (e.g. 1.3549 m^3/h)

FLOW VELOCITY of CH1

VOLUME FLOW CH2

only for version:
CL1&2 1M. POINT
CL1&2 2M.POINTS

Display of currently measured volume flow (Channel 2).

5-digit number with floating decimal point, incl. units and arithmetical sign (e.g. 0.7305 m^3/h)

FLOW VELOCITY of CH2

Function group PROCESS VARIABLE	
AVE. SOUND VELOC. only for version: CL1&2 1M.POINT	Display of average, sound velocity (sound velocity in fluids!), derived from "SOUND VELOCITY CH1" and "SOUND VELOCITY CH2". 4-digit number with floating decimal point, incl. units (e.g. 1400 m/s) Note! System response in special cases: In Version CL1&2 1M.POINT a single channel failure response is available. If one channel fails or wall thickness measurement is activated, then the operating channel is duplicated to the other channel. Only when both channels are defective does the instrument show a fault. *Example 1:* Channel 2 fails due to defective sensor. – Flashing message: F: SENSOR CH2 CURRENT DROP – Fault relay 1 or 2 does not de-energise – Current outputs or frequency output do not switch to error response – The sound velocity CH1 replaces Channel 2 for calculating AVERAGE SOUND VELOCITY → all assigned outputs respond accordingly. – For Channel 2: Volume flow CH2, sound velocity CH2 as well as signal strength CH2 assume zero → all assigned outputs assume zero *Example 2:* Channel 1 and Channel 2 fail due to defective sensors – Flashing message: F: SENSOR CH1 CURRENT DROP and F: SENSOR CH2 CURRENT DROP – Fault relay 1 or 2 de-energise – Current outputs or frequency output switch to error response – Volume flow CH1 or CH2, sound velocity CH1 or CH2, signal strength CH1 or CH2, standard volume FLOW as well as average sound velocity assume zero → all assigned outputs assume zero
NET FLOW only for version CL1&2 2M.POINTS	Display of flow as the result of Channel 2 flow rate minus Channel 1 flow rate. 5-digit number, incl. units (e.g. 0,1549 m^3/h) Note! The same value for creep suppression and flow direction must be set on both channels.
TOTAL FLOW only for version CL1&2 2M.POINTS	Display of flow as the result of Channel 2 flow rate plus Channel 1 flow rate. 5-digit number, incl. units (e.g. 1,3549 m3/h) Note! The same value for creep suppression and flow direction must be set on both channels.
SOUND VELOC. CH1	Display of sound velocity for Channel 1: (sound velocity in fluids!) 4-digit number with floating decimal point, incl. units (e.g. 1400 m/s)
SOUND VELOC. CH2 only for version: CL1&2 1M.POINT CL1&2 2M.POINTS	Display of sound velocity for Channel 2: (sound velocity in fluids!) 4-digit number with floating decimal point, incl. units (e.g. 1400 m/s)


Note!


Note!


Note!


Note!

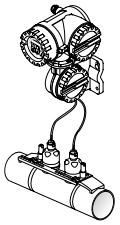
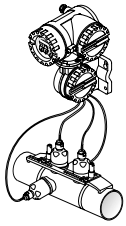
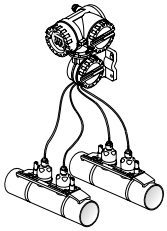
Function group TOTALIZERS	
TOTALIZER 1 **TOTALIZER 2**	Display of the totalised flow quality from when measurement began or since the last totaliser reset. This value is either positive or negative depending on the direction of flow: max. 7-digit number with floating decimal point, incl. arithmetic sign and units Note! • If the count has more figures than can be shown beyond 9'999'999, then the symbol ">" (pos. values) or ">–" (neg. values) are shown before the value. The number of totaliser overflows is shown in the function "TOTAL. OVERFLOW". • If the function "MEASURING MODE" is set to "UNIDIRECTIONAL" (see page 73), then the following applies: *Flow direction function → FORWARD (see page 73):* The totaliser takes into account **positive** flow directions only. *Flow direction function → REVERSE (see page 73):* The totaliser takes into account **negative** flow directions only. • In cases of error the totaliser is coupled to the error response of the pulse/frequency output 1 (see page 56). ASSIGN TOTAL. 1 or 2 Display showing which measuring variable is assigned to the totaliser.
TOTAL. 1 or **2** **OVERFLOW**	Display of totaliser overruns. On the display the totalised flow is shown as a max. 7-digit number with floating decimal point. Larger numbers (>9'999'999) can be read off in this function as overflows. The effective amount is calculated from the sum of the value shown in the function "TOTAL. OVERFLOW" and in the function "TOTALIZER 1, 2". *Example:* Display of 2 overruns: **2 e7 dm^3** = $2 \cdot 10^7$ dm^3 = 20,000,000 dm^3 The value shown in the function "TOTALIZER 1" = 196,845.7 dm^3 Total amount = 20,196,845.7 dm^3 max. 7-digit total ASSIGN TOTAL. or 2 Display showing which measuring variable is assigned to the totaliser.
RESET TOTALIZER	Totaliser 1 or 2 as well as TOTALISERS 1/2 deleted individually (i.e. the values are set to zero). ***CANCEL*** TOTAL. 1 TOTAL. 2 TOTAL. 1 & 2

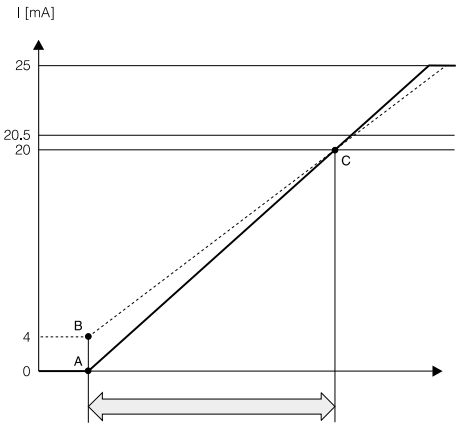
Function group TOTALIZERS	
ASSIGN TOTAL. 1 or **2**	Assigning the totalised flow amount. Totaliser 1 or Totaliser 2 is reset to zero (deleted) if the assignment of this function is changed again. + / - CANCEL ***OFF***** CALC. VOLUME CALC. VOLUME(+) CALC. VOLUME(-) } CL1&2 1M.POINT ***VOLUME CH1**** VOLUME(+) CH1 VOLUME(-) CH1 VOLUME CH2 VOLUME(+) CH2 VOLUME(-) CH2 } CL1&2 1M.POINT and CL1&2 2M.POINTS NET VOLUME TOTAL VOLUME TOTAL VOLUME(+) TOTAL VOLUME(-) } CL1&2 2M.POINTS *Totaliser 1 / ** Totaliser 2 Note! • When selecting NET VOLUME and TOTAL VOLUME functions, it is necessary to set the same values for the creep suppression and the flow direction functions on both channels. • TOTAL VOLUME (+) is the total volume from VOL1 + VOL2 measured in the flow direction. • TOTAL VOLUME (-) is the total volume from VOL1 + VOL2 measured against the flow direction.


Note!

Function group SYSTEM UNITS	
VOLUME FLOW UNIT	In this function the engineering units for volumetric flow rate 1 and volumetric flow rate 2 are selected. CANCEL dm^3/s – dm^3/min – dm^3/h ***l/s*** – l/min – l/h hl/min – hl/h m^3/s – m^3/min – m^3/h gal/min – gal/hr – gal/day gpm – gph – gpd – mgd bbl/min – bbl/hr – bbl/day
VOLUME UNIT	Selecting the engineering units for flow quantity. CANCEL - dm^3 - ***l*** - hl - m^3 - gal - bbl
GALLONS/ BARREL	Selecting between US and IMP units. In the USA and UK, the ratio of barrels (bbl) to gallons (gal) is defined according to the specific industry. CANCEL US: 31.0 gal/bbl — for beer ***US: 31.5 gal/bbl*** — for liquids (used in normal cases) US: 42.0 gal/bbl — for oil (petrochemicals) US: 55.0 gal/bbl — for filling tanks IMP: 36.0 gal/bbl — for beer IMP: 42.0 gal/bb — for oil (petrochemicals) US: 1 gal = 3.785 l IMP: 1 gal = 4.546 l
LENGTH UNIT	Selecting the engineering units for a defined length such as the outer diameter “wall thickness” CANCEL ***mm*** inch
CABLE LENGTH UN.	Selecting the engineering units for a defined length of cable connection from the sensor to the transmitter. CANCEL ***m*** ft
VELOCITY UNIT	Selecting the engineering units for transversal and longitudinal sound velocity as well as the velocity of the fluid to be measured. CANCEL ***m/s*** ft/s

Function group SYSTEM UNITS	
TEMPERATURE UNIT	Selecting the engineering units for the temperature of the medium to be entered. +/- CANCEL ***°C*** (°Celsius) K (Kelvin) °F (°Fahrenheit) °R (°Rankine)
VISCOSITY UNIT	Selecting the units for the kinematic viscosity to be entered. +/- CANCEL ***mm^2/s*** cSt St

Function group SELECTION	
SENSOR CONFIG.	Selecting the sensor configuration. + / - CANCEL ***CLAMP ON CH1***  ba038y63 CL1&2 1M.POINT  ba038y64 CL1&2 2M.POINTS  ba038y65 Note! For the Insertion version the following selctions are available: INSERTION CH1 IN1&2 1M.POINT IN1&2 2M.POINTS Note! CLAMP ON CH1 is not visible in the selection when channel 2 is assigned to either the totalizer, display, current output, frequency/pulse output or relays. The following functions indirectly assign an output to channel 2: NET FLOW, TOTAL FLOW, NET VOLUME, TOTAL VOLUME or AVERAGE SOUND VELOCITY. Remove any reference to channel 2 in all outputs to make the CLAMP ON CH1 visible and selectable in the configuration selection matrix.
QUICK SETUP	Calling up this function enables that distance between sensors to be calculated using the least amount of data for mounting the system for the application. Note! Please closely observe the procedure on page 2. Notes for CL1&2 1M.POINT: After a complete run-through of the set-up selection “PROCESS PARAMETER” (returning to the Setup selection), the parameters shown for Channel 1 and Channel 2 are the same. + / - **CANCEL** START

Function group CURRENT OUTPUT 1 or 2	
ASSIGN OUTPUT	In this function any variable required can be assigned to the current outputs 1 or 2. CANCEL ***OFF***** CALC.VOLUME FLOW ***VOLUME FLOW CH1**** VOLUME FLOW CH2 AVE.SOUND VELOC. SOUND VELOC. CH1 SOUND VELOC. CH2 SIG.STRENGTH CH1 SIG.STRENGTH CH2 NET FLOW TOTAL FLOW *Current output 1 / **Current output 2 In the diagnostic function the following display is shown the flow assignment: MEASUREMENT MODE (see page 73) Note! NET and TOTAL FLOW require that low flow cut off and the flow direction is set to the same value for both channels.
ZERO SCALE or **FULL SCALE 1**	In these two functions define the following values for the variable assigned to the current outputs: • 0/4 mA quiescent current → *zero value of the measured value* • 20 mA → *full scale value of the measured value* These values apply to both flow directions (bi-directional). Note! • The flow direction can be indicated by the configurable relay outputs (see page 63). • The zero value and full range value are freely programmable. • The zero scale value may be higher or lower than the full scale value or can even be negative. • The span between the zero and full scale value should not fall below a set minimum as, otherwise, very small measured value changes may cause large jumps of the output signal:  5-digit number with floating decimal point (e.g. 1.2345 dm^3/h) Display showing which process variable is assigned to the current output.

Note!

Note!

Function group CURRENT OUTPUT 1 or 2

DUAL RANGE MODE

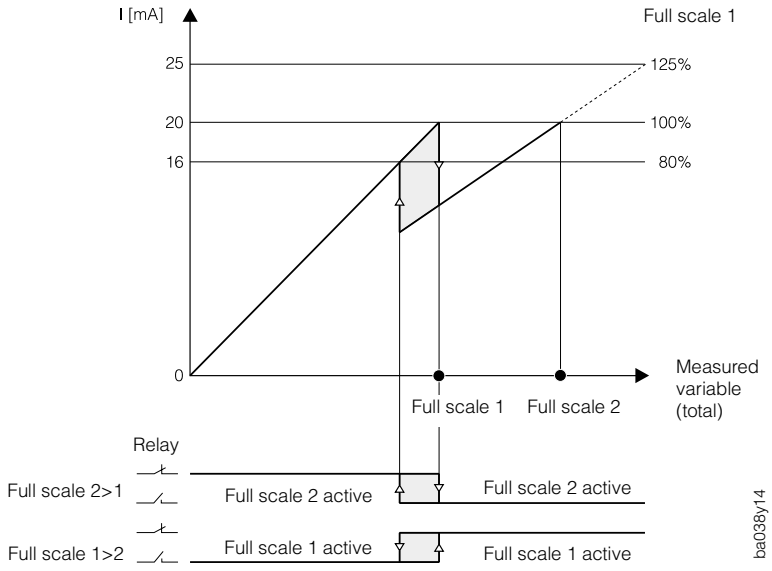
For specific applications the scaling of a second full scale value is useful or possibly required especially with flow rate variables. In this function the two full scale values are selected with which the measuring system operates. The setting “AUTOMATIC” allows the measuring system to switch between two full scale values.

Applications:
- Frequent measurement of two different fluids with widely differing flow velocities. The operator defines a full scale value for each of these two fluids which can. be activated in this function as required.
- Higher resolution of the measuring signal with very small flow velocities. The setting “AUTOMATIC” allows the Prosonic Flow DMU 93 transmitter to switch automatically between two full scale values depending on the flow velocity.

Note!

Note!
The actual full scale value can be supplied by the relay if this is configured accordingly (see figure below as well as page 63).

Example *(0...20 mA; full scale 1 < full scale 2)*



CANCEL

FULL SCALE 1	The measuring system operates with full scale value 1 only
FULL SCALE 2	The measuring system operates with full scale value 2
AUTOMATIC	The measuring system operates with full scale value 1 or 2; Automatic switching between fully scale values 1 and 2

Display showing which process variable is assigned to the current output.

Function group CURRENT OUTPUT 1 or 2	
FULL SCALE 2	For description of function → see "FULL SCALE 1" function (page 53) Note! • This function is only available if Full scale 2 has been activated in the function "DUAL RANGE MODE" (see page 54). • Full scale 2 may be larger or smaller than zero scale or full scale 1.
ACTIVE RANGE	Display of actual full scale from current output 1 or 2 Note! The actual full scale can also be supplied by the relays is they are configured accordingly (see page 63). ***FULL SCALE 1*** FULL SCALE 2 Display showing which process variable is assigned to the current output.
TIME CONSTANT	Selecting the time constant (τ). To determine whether the current output signal reacts quickly (small time constant) or slowly (large time constant) to rapidly fluctuating variables. The time constant does not affect the behaviour of the display. The time constant is activated if the large flow or sound velocity is assigned to the current output. 5-digit number with fixed decimal point (0.5...100.00 s) Factory setting: ***5.00 s*** Display showing which process variable is assigned to the current output.
CURRENT SPAN	Setting the 0/4-mA quiescent current. The current for the scaled full scale volume (= 100%) is always 20 mA. Note! The 0–20 mA current output can only be selected if the HART protocol is inactivated (see page 76). CANCEL 0–20 mA (25 mA) → max. 25 mA 4–20 mA (25 mA) → max. 25 mA 0–20 mA → max. 20.5 mA (NAMUR) ***4–20 mA*** → max. 20.5 mA (NAMUR) Display showing which process variable is assigned to the current output.

Note!

Note!

Note!

Function group CURRENT OUTPUT 1 or 2	
FAILSAFE MODE	It is advisable for safety reasons that the current output in cases of an instrument error assumes a previously defined status which can be set in this function. CANCEL ***MIN. CURRENT*** Current signal is set to 0 mA (0...20 mA) or 2 mA (4...20 mA) on error. MAX. CURRENT Current signal is set to 25 mA for 0/4...20 mA (25 mA) or to 22 mA for 0/4...20 mA. HOLD VALUE Last valid measured value is held ACTUAL VALUE Normal measured value given despite error Display indicates the to the current output, assigned process variable. Note! The setting given here effects only the particular current output. Other outputs as well as the display (e.g. totaliser display) are not affected. The failsafe mode also operates in conjunction with “Assign Output” by the configuration CL1&2 2M.POINTS: CH1: General instrument fault + sensor-specific fault CH1 CH2: General instrument fault + sensor-specific fault CH2
SIMULATION CURR.	Simulation of the output current corresponding to 0%, 50% or 100% of the set current range. Errors may also be simulated. *Application examples:* • Checking instruments connected • Checking the adjustment of the internal current signal Note! • After activating the simulation mode, the message “S: CURRENT OUTPUT SIMUL. ACTIVE” appears on the display (HOME position). • The selected simulation mode affects only the current output. The flowmeter remains fully operational for measurement, i.e. totaliser flow display etc. are operating normally. • Positive zero return to (see page 78) interrupts any simulation being carried out and sets the output current to 0 mA or 4 mA. At 0–20 (25 mA): ***OFF*** – 0 mA – 10 mA – 20 mA – 25 mA – At 4–20 (25 mA): ***OFF*** – 2 mA – 4 mA – 12 mA – 20 mA – 25 mA – CANCEL *Current output acc. to NAMUR* At 0–20 mA: ***OFF*** – 0 mA – 10 mA – 20 mA – 22 mA – At 4–20 mA: ***OFF*** – 2 mA – 4 mA – 12 mA – 20 mA – 22 mA – CANCEL
NOMINAL CURRENT 1 or **2**	In this function the current and calculated target value of the output current is shown. Number with fixed decimal point and one decimal place, incl. unit (e.g. 4.0 mA) Display showing which process variable is assigned to the current output.

Note!

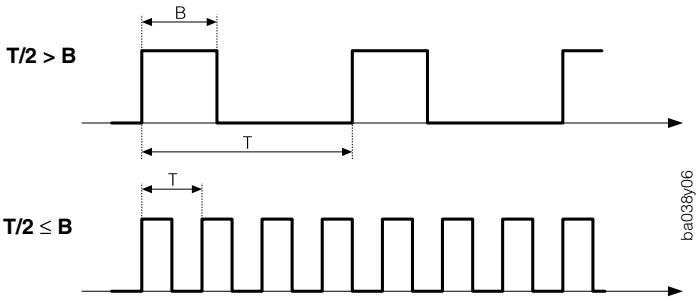
Note!

Function group PULS / FREQ. OUTPUT	
ASSIGN OUTPUT	In this function a particular variable can be assigned to the pulse/frequency output. CANCEL OFF CALC. VOLUME* ***VOLUME CH1**** VOLUME CH2* NET FLOW TOTAL FLOW } (Measurement mode frequency and pulse) AVE.SOUND VELOC. SOUND VELOC. CH1 SOUND VELOC. CH2 SIG.STRENGTH CH1 SIG.STRENGTH CH2 } (Measurement mode frequency only) The diagnosis function only applies to the option marked with *: Display showing whether the flowmeter measures in one or in both flow directions (see function “MEASURING MODE”, page 73). Note! NET FLOW and TOTAL FLOW require that low flow cut off and the flow direction is set to the same value for both channels.
OPERATION MODE	In this function the output is configured as a pulse or frequency output. Various functions are available in this function group depending on the variable selected. CANCEL ***PULSE*** FREQUENCY Display showing which flow variable is assigned to the pulse output.
PULSE VALUE	Every output pulse is assigned a flow quantity. By means of an external counter the sum of these pulses can be totalised and the total quantity determined since the start of measurement. Note! This function is only available if the setting “PULSE” is selected in the function “OPERATION MODE”. 5-digit number with floating decimal point, incl. units (e.g. 240.00 dm^3/p) Display showing which flow variable is assigned to the pulse output.

Note!

Note!

Note!

Function group PULS / FREQ. OUTPUT	
PULSE WIDTH	The maximum pulse width can be set for example for external counter with max. possible input frequency. The pulse width is limited to the set value. Note! This function is only available if the setting “PULSE” is selected in the function “OPERATION MODE”. 3-digit number with fixed decimal point (0.05...2.00 s) Factory setting: ***0.25 s*** Display: T/2 < PULSE ==> PULSE/PAUSE = 1:1 If the frequency resulting from the selected pulse value and current flow rate is too high (T/2 selected pulse width B), the pulses emitted are automatically reduced to half a cycle. The pulse/pause ratio is then 1:1 (see figure below).  B = Pulse width (The above figure applies to positive pulses) *Example:* Pulse width B = 1 second • For T = 3 s → Pulse width = 1 s; pause = 2 s • For T = 1 s → Pulse width = 0.5 s; pause = 0.5 s

Function group PULS / FREQ. OUTPUT

FULL SCALE FREQ.

The full scale frequency (2...10,000 Hz) can be set. The value for this variable is defined in the function “FULL SCALE” (see page 60).

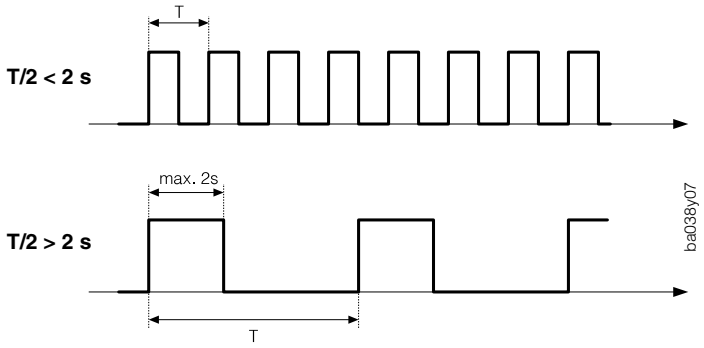
Note!
- This function is only available if the setting “FREQUENCY” is selected in the function “OPERATION MODE” (see page 57).
- An extension up to 163% of the selected full scale frequency is possible.

Note!

max. 5-digit number (2...10,000 Hz)
Factory setting: ***10000 Hz***

Display: T/2 < 2s ==> PULSE/PAUSE = 1:1

In the FREQUENCY mode the output signal is symmetrical (pulse/pause ratio = 1:1). At low frequencies the pulse duration is limited to max. 2 seconds i.e. the pulse/pause ratio is no longer symmetric (see figure below).



The above figure applies to positive pulses.

Function group PULS / FREQ. OUTPUT

ZERO SCALE

or

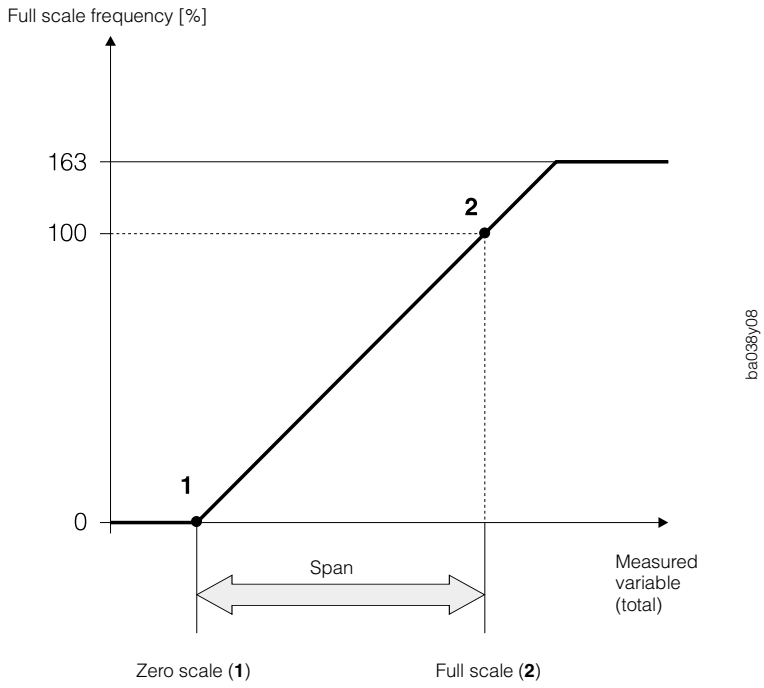
FULL SCALE

Note!

With these two functions the following values can be set for the measured variables assigned to the output:
- 0 Hz → *zero scale value* of the measured variable
- End frequency → *full scale value* of the measured variable

The measuring range required is defined by the zero scale value and full scale value.

Note!
- This function is only available if the setting “FREQUENCY” is selected in the function “OPERATION MODE” (see page 57).
- The zero scale value cannot be larger than the full scale value.
- The full scale value cannot be smaller than the zero scale value.
- The span between the zero and full scale value should not fall below a minimum value.



Zero scale

5-digit number with floating decimal point (e.g. 0.5700 dm^3/s)

Full scale

5-digit number with floating decimal point according to measured variable (e.g. 1.85 dm^3/s)

Display showing which measured variable is assigned to the frequency output.

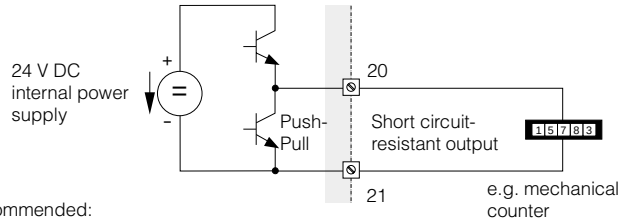
Function group PULS / FREQ. OUTPUT

OUTPUT SIGNAL

The pulse/frequency output can be configured as required, for example for an external counter.

ACTIVE: Internal power supply used (+24 V).
PASSIVE: External power supply required.

ACTIVE

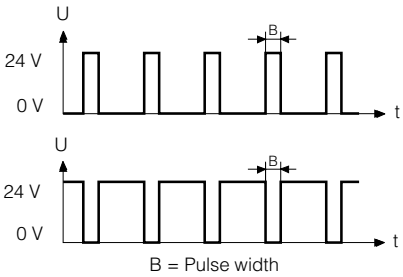


ba038y09

Recommended:
– for high output frequencies and
– a continuous flow up to 25 mA (I_{max} = 250 mA for 20 ms)

ACTIVE POSITIVE pulses

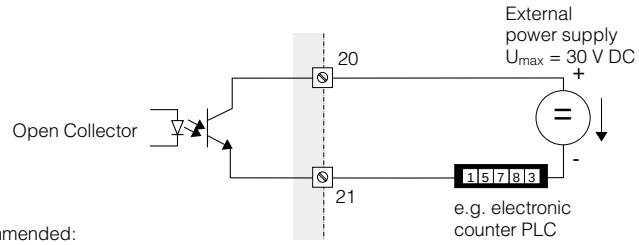
ACTIVE NEGATIVE pulses



B = Pulse width

ba038y11

PASSIVE

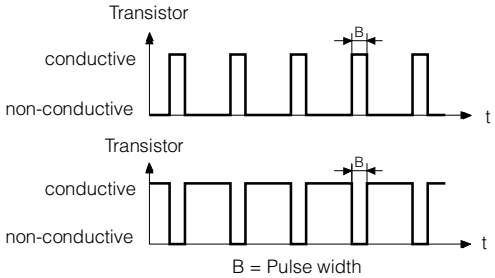


ba038y10

Recommended:
– for low output frequencies or
– a continuous flow up to 25 mA (I_{max} = 250 mA for 20 ms)

PASSIVE NEGATIVE pulses

PASSIVE POSITIVE pulses



B = Pulse width

ba038y11

CANCEL
PASSIVE/POSITIVE
PASSIVE/NEGATIVE
ACTIVE/POSITIVE
ACTIVE/NEGATIVE

Display: PASSIVE = OPEN-COLL or ACTIVE = PUSH-PULL
(see above figures for details)

Function group PULS / FREQ. OUTPUT	
FAILSAFE MODE	In cases of an instrument error it is advisable for safety reasons that the pulse/frequency output assumes a previously defined status which can be set in this function. Note! • The setting chosen only affects the pulse/frequency output and the totaliser. • With unidirectional measuring mode and flow in negative direction (reverse) the measuring system is not having a failsafe response. • The failsafe response of the totalisers depends exclusively on the failsafe response defined here for *pulse/frequency output*! • In version CL1&2 2M.POINTS the failsafe response is also dependent on "Assign Output" (see page 56): CH1: general instrument fault+ sensor-specific fault CH1 CH2: general instrument fault+ sensor-specific fault CH2 CANCEL ***FALLBACK VALUE*** In event of fault, the signal is set to the fall-back value of 0 Hz. HOLD VALUE Last valid measured value is held. ACTUAL VALUE Normal measured value given despite fault Display showing which process variable is assigned to the pulse/frequency output.
SIMULATION FREQ.	With this function present frequency signals can be simulated in order to check, for example, any instruments connected. The simulated signals are always symmetrical (pulse/pause ratio = 1:1). After activating the simulation mode, the display (HOME position) instead shows the message "S: FREQ. OUTPUT SIMULATION ACTIVE". Note! • The flowmeter remains fully operational for measurement during simulation, i.e. totaliser, flow display etc. continue to operate normally. • Positive zero return (see page 78) interrupts a simulation in progress and sets the output signal to the fall-back value. CANCEL – ***OFF*** – 0 Hz – 2 Hz – 10 Hz – 1 kHz – 10 kHz
NOMINAL FREQ.	In this function is shown the calculated target value of the pulse/frequency output. Floating decimal point number with a maximum two decimal place incl. units (e.g.: 7.40 Hz / 811.30 Hz / 12417 Hz) Display showing which process variable is assigned to the pulse/frequency output.

Function group RELAYS

RELAY 1 or **2**
FUNCTION

Selection or assignment of relay function.

Caution!
- Take into account information on pages 64 and 65 on the relay switching response.
- For safety reasons we recommend configuring Relay 1 or relay 2 as the error output and to define the failsafe mode of the outputs (see pages 56 and 62).


Caution!


CANCEL

OFF	Relay switched off
ON	Relay switched on, but without function assignment, e.g. for test purposes
FAILURE *	(Instrument as well as CH1 and CH2)
FAILURE CH1 (applies to CL1&2 2M.POINTS)	(Instrument as well as CH1)
FAILURE CH2 (applies to CL1&2 2M.POINTS)	(Instrument and CH2)
DUAL RANGE MODE. 1 DUAL RANGE MODE. 2	Registering active full scale value (1 / 2) of current output 1 or 2
FLOW DIRECTION (applies to CL1&2 1M.POINT)	Registering flow direction (forward/reverse). On unidirectional measurement the relay also switches in the negative flow direction.
FLOW DIRECT.CH1	Registering flow direction Channel 1
FLOW DIRECT.CH2 (applies to CL1&2 1M.POINT and CL1&2 2M.POINTS)	Registering flow direction Channel 2
CALC.VOLUME FLOW ***VOLUME FLOW CH1***** VOLUME FLOW CH2 AVE. SOUND VELOC. (applies to CL1&2 1M.POINT)	Registrating if preset limit value is outside range.
SOUND VELOC. CH1 SOUND VELOC. CH2 SIGNAL STRENGTH CH1 SIGNAL STRENGTH CH2	
NET FLOW TOTAL FLOW (applies to CL1&2 2M.POINTS)	

* Factory setting Relay 1
** Factory setting Relay 2

Note!
- Specifications such as how the plug-in jumper on the communication board is to be set are found in the Section “Commissioning” on page 29.
- NET FLOW and TOTAL FLOW require that low flow cut off and the flow direction is set to the same value for both channels.


Note!

Function group RELAYS

RELAY 1 or **2**
ON-VALUE

or

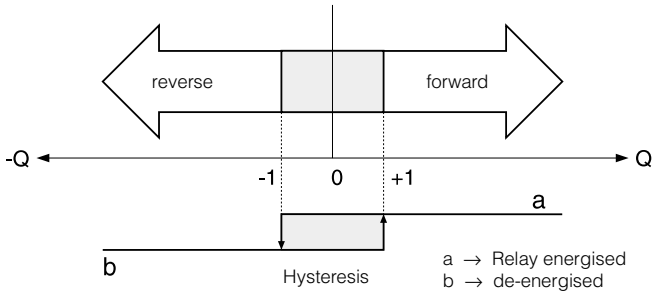
RELAY 1 or **2**
OFF-VALUE

Note!

If you have configured the relay for “LIMIT .....” or “FLOW DIRECTION”, you can define the necessary switching points in this function. If the respective measured value reaches these present values, the relay will switch as shown in the figures below.

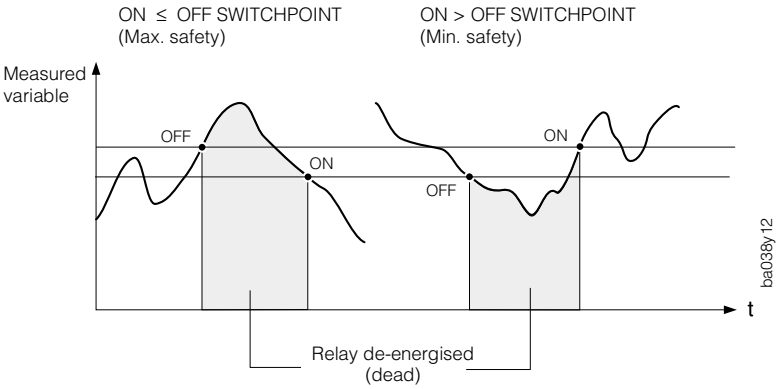
Note!
The value for the switch-on point can be larger or smaller than for the switch-off point.
A negative switch-on or switch-off point may be entered.

Relay → FLOW DIRECTION
The value entered in the function “SWITCH-ON POINT REL” also defines the switch-on point for the positive *and* negative flow direction. If the switching point entered is for example 1 dm^3/s, the relay de-energises at –1 dm^3/s and energises again at +1 dm^3/s. If a direct switchover is required (no hysteresis), then set the switching point to the value “0”.
If creep suppression is activated (see page 73), then it is recommended that the hysteresis is set to a value either larger or the same as the low flow cutofff.



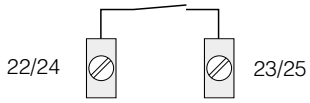
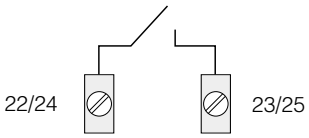
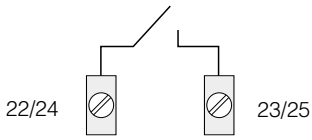
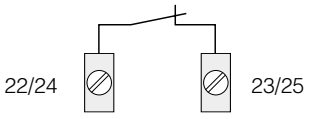
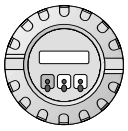
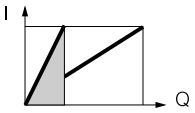
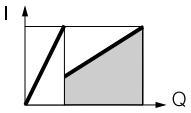
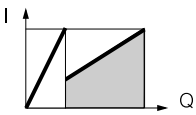
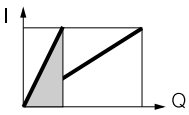
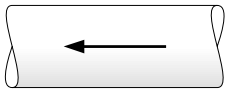
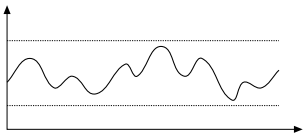
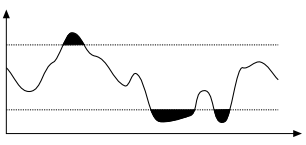
Relay → LIMIT (volumetric flow)
The relay switches as soon as the actual measured variable moves outside the limits of a specific switching point.

Applications: monitoring flow rate.



5-digit number with floating decimal point, incl. units
(e.g. 2.5800 dm^3/s)
Factory settings: at flow direction ***2 l/s***
at volumetric flow ***20 l/s***

Display showing which function is assigned to particular relay.

Assignment relay 1 or 2	Relay contacts	
	Energized	**De-energized**
NO contact (normally open contact)		
NC contact (normally closed contact)		
FAILURE **FAILURE CH1** **FAILURE CH2**	System OK 	 Error: System error, power failure, etc.
DUAL RANGE MODE 1 **DUAL RANGE MODE 2**	Full scale 1 < Full scale 2  Full scale value 1 active Full scale 1 > Full scale 2  Full scale 1 active (larger span)	Full scale 1 < Full scale 2  Full scale value. 2 active (larger span) Full scale 1 > Full scale 2  Full scale 2 active
FLOW DIRECTION **FLOW DIRECT. CH1** **FLOW DIRECT. CH2**	forward 	reverse 
RELAY 1 OFF-VALUE **RELAY 2 OFF-VALUE**	Switch-off point not above or below set value 	Switch-off point above or below set value 

ba038y01

Note!

Note!
This page describes relay configurations produced by the factory setting with the plug-in jumper on page 29.

Function group DISPLAY	
ASSIGN LINE 1 or **2**	Select the measured variables which are to appear during normal measuring operation in the various lines of the display (1 or 2). CANCEL OFF (only ASSIGN LINE 2) CALC.VOLUME FLOW ***VOLUME FLOW CH1**** VOLUME FLOW CH2 AVE.SOUND VELOC. SOUND VELOC. CH1 SOUND VELOC. CH2 SIG.STRENGTH CH1 SIG.STRENGTH CH2 SIGNAL BAR CH1 (Signal strength as bargraph) SIGNAL BAR CH2 (Signal strength as bargraph) ***TOTALIZER 1***** TOTAL.1 OVERFLOW TOTALIZER 2 TOTAL.2 OVERFLOW NET FLOW TOTAL FLOW * Line 1 ** Line 2 Note! NET FLOW and TOTAL FLOW require that low flow cut off and the flow direction is set to the same value for both channels.
DISPLAY DAMPING	Selecting a time constant for damping the display. Selecting a time constant determines whether the display reacts quickly (small time constant τ) or slowly (large time constant τ). Note! Damping is inactivated when set to zero. The time constant does not affect the response of the outputs. max. 2-digit number, incl. units Factory setting: ***5 s***
FORMAT FLOW	Selecting the number of decimal places of all measured variables and parameters of flow rates. The decimal places calculated by the Prosonic Flow DMU 93 cannot always be shown as they depend on the settings and the engineering unit selected. The number of decimal places selected here, however, *only* affects the display, not the internal calculation accuracy of the system! If the measuring system calculates on the basis of more decimal places than are shown, then an arrow symbol is displayed between the numerical value and measuring unit (e.g. 1.2 → m^3/h). CANCEL - XXXXX. - XXXX.X - XXX.XX - ***XX.XXX*** - X.XXXX
FORMAT TOTALIZER	Selecting the number of decimal places of the totaliser displays. The decimal places calculated by the Prosonic Flow DMU 93 cannot always be shown as they depend on the settings and the engineering unit selected. The number of decimal places selected here, however, *only* affects the display, not the internal calculation accuracy of the system! If the measuring system calculates on the basis of more decimal places than are shown, then an arrow symbol is displayed between the numerical value and measuring unit (e.g. 1.2 → m^3/h). CANCEL - XXXXX. - XXXX.X - XXX.XX - ***XX.XXX*** - X.XXXX

Function group DISPLAY	
LCD CONTRAST	The display contrast can be optimally adjusted to match prevailing operating conditions on site, e.g. daylight, ambient temperature (the contrast is dependent on temperature). Caution! In cases of low temperatures the visibility of the LCD is no longer assured. The display contrast is at a maximum if the ± are simultaneously pressed when starting up the flowmeter. ± ▮▮▮▮▮▮▮▮. . . . . . Any change in contrast is immediately seen with the adjustable bar graph.
LANGUAGE	Selecting the appropriate language in which all text, parameters and operating messages are to be displayed. Note! "ENGLISH" is selected if the ± keys are simultaneously pressed when starting up the Prosonic Flow DMU 93. ± CANCEL – ***ENGLISH*** – DEUTSCH – FRANCAIS – ESPANOL – ITALIANO – NEDERLANDS – DANSK – NORSK – SWENSKA – SUOMI – BAHASA INDONESIA – JAPANESE
DISPLAY TEST	Display operations can be certified with this function. The following displays are visible on all lines throughout the test: 1. ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ 2. 8888888888888888 3. ———————————————— 4. 0000000000000000 ± ***CANCEL*** – START


Caution!


Note!

Function group W. THICKNESS CH1 or CH2	
MODE	Selecting whether flow, longitudinal sound velocity, or the wall thickness is to be measured. After determining the wall thickness switch over again to the flow measurement mode (*OFF*). Caution! After a power failure or a restart of the measuring system, flow is always measured. + / - CANCEL ***OFF*** (flow measurement) SOUND VEL. LONGI. WALL THICKNESS Note! During "WALL THICKNESS MEASUREMENT" the longitudinal sound velocity or the wall thickness is shown in the HOME position in the first line and the signal strength is shown as a bar graph in the second line. Signals from the current output, pulse output, frequency output of the totaliser and displays go into the quiescent mode. System responses in special cases: In Version CL1&2 1M.POINT a single channel failure response is available. If one channel fails or wall thickness measurement is activated, then the operating channel is duplicated to the other channel. Only when both channels are defective does the instrument show a fault. For Versions CLAMP ON CH1 and CL1&2 2M.POINTS the output corresponds to the assigned outputs of the appropriate channel: – Current outputs → 0 mA or 4 mA – Pulse / frequency output → fall-back level – Totaliser → stop – Relay 1 or 2 → energise (exceptions Off, Fault, Fault CH1, Fault CH2, i.e. fault detection can still be carried out) With the wall thickness sensor, the wall thickness can be determined if the sound velocity of the pipe is known or the sound velocity of the pipe can be determined if the wall thickness is known.
PIPE MATERIAL (used for the selection WALL THICKNESS)	Selecting the pipe material since ultrasonic waves pass through different pipe materials at different velocities. The longitudinal sound velocities of the most important materials are stored in the communications module and do not have to be entered separately. Select from the following materials. + / - CANCEL – ***CARBON STEEL*** – STAINLESS STEEL – HASTELLOY C – PA – PE – LDPE – HDPE – PP – PVC – PTFE – PVDF – ABS – GLASS FLINT – GLASS PYREX – GLASS CROWN – OTHERS Note! A list of the permanently stored velocities are found on page 30.

Function group W. THICKNESS CH1 or CH2	
SOUND VEL. LONGI. (used for the selection WALL THICKNESS)	Determining the longitudinal sound velocity in the pipe material. If the pipe material does not agree with a previous function field then the sound velocity can be entered here manually (otherwise the corresponding sound velocity will be adopted for the material). max. 4-digit number without decimal point, incl. unit (m/s) Factory setting: ***5900 m/s*** Note! If none of the pipe material corresponds to your application, then by using the wall thickness sensor, the sound velocity of the pipe material can be determined as follows: If the pipe flange is accessible and it is the same as the pipe material, you can determine the value of the pipe material from the thickness of the flange.
REFERENCE VALUE (used for the selection SOUND VEL. LONGI.)	Entering the pipe thickness as basis for measuring the longitudinal sound velocity. max. 2-digit number with two decimal points, incl. unit Factory setting: ***5.00 mm*** Range: lower limit 1.5 mm, upper limit 75.00 mm
SIG. STRENGTH BAR	Display of signal strength as a bar graph. ▮▮▮▮▮▮▮▮. . . . . . Display of longitudinal sound velocity or wall thickness.
SOUND VEL. LONGI. (display only) (used for the selection SOUND VEL. LONGI.)	Display of longitudinal sound velocity in pipe material. 4-digit number, incl. unit
WALL THICKNESS (used for the selection WALL THICKNESS)	Display of the pipe thickness determined through measurement. max. 2-digit number with max. two decimal places, incl. unit
CALIBRATION	Adjusting (calibrating) the sensor for measuring the pipe thickness using the calibration unit supplied. This is carried out as follows: Hold the sensor on the calibration unit, select the function START and then press “Enter”. The procedure is completed as soon as the message “Entry stored” appears for a few seconds. ***CANCEL*** START

Note!

Function group CLAMP ON CH1 or CH2	
PIPE MATERIAL	Selecting the pipe material is necessary because ultrasonic waves pass through the different pipe materials at different velocities. The sound velocities of the most common materials are stored in the communications module and do not have to be entered separately. Select from the following materials. CANCEL – ***CARBON STEEL*** – STAINLESS STEEL – HASTELLOY C – PA – PE – LDPE – HDPE – PP – PVC – PTFE – PVDF – ABS – GLASS FLINT – GLASS PYREX – GLASS CROWN – OTHERS Note! A list of the permanently stored velocities is found on page 29.
PIPE DIAMETER	Entering the outer diameter of the piping. max. 4-digit number with two decimal places, incl. unit Factory setting: ***88.9 mm*** Note! The pipe circumference is automatically calculated by the program when the pipe diameter is entered.
CIRCUMFERENCE	Entering the pipe circumference if the outer diameter of the pipe is not given. max. 4-digit number with max. two decimal places, incl. unit Factory setting: ***279.3 mm*** Displaying the pipe diameter Note! The pipe diameter is automatically calculated by the program when the pipe circumference is entered.
WALL THICKNESS	Entering the wall thickness of the piping. max. 2-digit number with two decimal points, incl. unit Factory setting: ***2.60 mm***
SOUND VELOC. PIPE	Entering the velocity in the pipe (pipe material). Ultrasonic waves travel through the individual pipe materials at different velocities. The sound velocity can be individually given in this function. max. 4-digit number without decimal point, incl. unit Factory setting: ***3230 m/s***
LIQUID	Selecting the fluid to be measured. Ultrasonic waves travel through fluids at different velocities. The sonic velocities of the most important fluids are stored in the communications module and do not have to be entered separately. CANCEL – ***WATER*** – SEAWATER – AMMONIA – ACETONE – ALCOHOL – BENZENE – BROMIDE – ETHANOL – GLYCOL – KEROSENE – MILK – METHANOL – TOLUENE – OTHERS Note! A list of the permanently stored velocities is found on page 30.

Function group CLAMP ON CH1 or CH2	
TEMPERATURE	If the fluid to be measured is known then the operating temperature can be entered to determined the actual sonic velocity. max. 3-digit number with one decimal place, incl. unit Factory setting: ***20.0 °C***
SOUND VELOC. LIQ.	Entering the actual sound velocity in the fluid to be measured. Ultrasonic waves move through the individual fluids at different rates. The sound velocity can be individually given in this function. max. 4-digit number without decimal point, incl. unit Factory setting: ***1481 m/s***
VISCOSITY	By entering the viscosity an improvement of the accuracy / linearity in applications with lower Reynolds Numbers (<10,000) or higher viscosities (>10 cSt) can be achieved. max. 4-digit number with floating decimal point, incl. unit Factory setting: ***1.000 mm^2/s***

Function group SENSOR DATA CH1 or CH2	
SENSOR TYPE	Selecting the sensor type depending on the application. The information is found on the nameplate of the sensors. CANCEL – C1LIA – C2LIA – C1MIA – ***C2MIA*** – C1HIA – C2HIA – C1MPA – C_S08
CABLE LENGTH	Entering the cable length to be used to connect sensors and transmitter. This affects the compensation for data loss. Choose between 5 m, 10 m, 15 m and 30 m max. 3-digit number with one decimal place, incl. unit Factory setting: ***5.0 m***
TRAVERSES	Selecting the Traverses, i.e. how often the sound wave is to pass through the fluid.  1 Traverse 2 Traverses 3 Traverses 4 Traverses CANCEL – 1 – ***2*** – 3 – 4 Note! More information on selection criteria, recommendations etc. can be found on page 13.
POS. SENSOR 1	Display for positioning Sensor 1 (coarse adjustment) of the particular channel. The amplifier proposes where Sensor 1 is to be positioned on the mounting rail. A – B – C – D – E – F – G – H – I – K A diagram is given on page 13 in Section “Mounting and Installation”. Note! This display is only given for even numbers of traverses and with a pipe diameter ≤ DN 650.
POS. SENSOR 2	Display for positioning Sensor 2 (fine adjustment) of the particular channel. The amplifier proposes where Sensor 2 is to be positioned on the mounting rail. 10 – 11 – 12 – ... – 76 A diagram is given on page 13 in Section “Mounting and Installation”. Note! This display is only given for even numbers of traverses and with a pipe diameter ≤ DN 650.
SENSOR DISTANCE	Display of distance from Sensor 1 to Sensor 2 in a unit of length. i.e.: The distance is from the centre of the threaded bolt 1 to the centre of the threaded bolt 2 (see page 16). max. 4-digit number with max. two decimal places, incl. unit
WIRE LENGTH	The display indicates when 1 or 3 traverses is selected the Please refer to page 16 Step 2 and 3. max. 4-digit number with max. two decimal places, incl. unit

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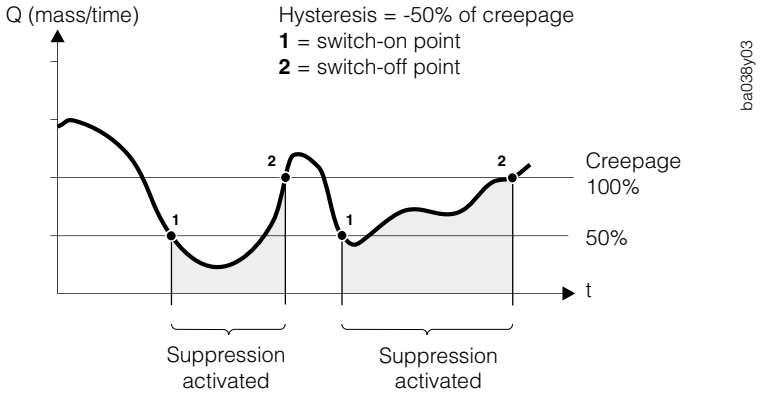
Function group PROCESS. PARA. CH1 (CLAMP ON CH1 and CL1&2 2M.POINTS) Function group PROCESSING PARA. (CL1&2 1M.POINT) Function group PROCESS. PARA. CH2 (CL1&2 2M.POINTS)	
LOW FLOW CUTOFF	Set the desired switching points for creep suppression. The creep suppression prevents the flow rate being registered in the lowest measuring range, e.g. a variable column of liquid at standstill. When creep suppression is active, the sign of the flow appears optically inverted on the display.  5-digit number with floating decimal point (e.g. 25.000 dm^3/min) Factory setting: ***0.4 l/s*** HYSTERESIS = 50% Creep suppression operates with a negative hysteresis of 50% (see above figure).
MEASURING MODE	Selecting whether the system measures in both directions or in one direction only. The measuring can measure in both flow directions, i.e. bi-directional. The signal outputs (current output 1, current output 2, pulse/frequency output, TOTALISERS) can, if assigned for volume units to switch to unidirectional mode; i.e. a signal will only be given if flow is in the positive direction. CANCEL – UNIDIRECTIONAL – ***BIDIRECTIONAL***
FLOW DIRECTION	Selecting the flow direction. The arithmetical sign of the volume flow can be changed. CANCEL – ***FORWARD*** – REVERSE

Function group SIGNAL CH1 or CH2	
SIG. STRENGTH BAR	Display of signal strength as a bar graph. ▮▮▮▮▮▮▮▮.....  Signal strength as a number
SIGNAL STRENGTH	Display of signal strength as a number. Display: 0...100 Prosonic Flow needs a signal strength greater than 35 to achieve a correct measurement.

Function group CALIBR. DATA CH1 or CH2	
CORR. FACTOR	Volumetric flow is corrected in this function. The volumetric flow can be multiplied by a factor for correction purposes. 5-digit number with four decimal places, dimensionless (0.5000...2.0000) Factory setting: ***1.0000***
ZEROPOINT	The actual zero point correction used by the transmitter can be called up or changed manually in this function if required. max. 4-digit number (–1000 ns...+1000 ns) Factory setting: ***depending*** on nominal width of sensor and calibration Display of actual run time difference measured by the system
ZEROPOINT ADJUST	A zero point adjustment can be automatically carried out in this function. The new zero point determined by the measuring system is adopted by the function “ZEROPOINT”. Note! • Programming is locked during zero point adjustment and the display “S: ZERO ADJUST CH1 or CH2 RUNNING”. • If the zero point adjustment is not possible (e.g. with flow velocity v > 0.1 m/s) or has been cancelled, then the alarm message “A: ZERO ADJUST CH1 or CH2 NOT POSSIBLE”. • The selection “UNDO” means that the previously set value before adjustment is again used. • After a successful zero point calibration the new zero point value can immediately be called up with the diagnosis function (press simultaneously). The value in the function “ZERO POINT” is overwritten. ***CANCEL*** – START – UNDO Display showing the zero point used by the measuring system. For a detailed procedure for carrying out zero point adjustment see section Commissioning on page 28.

Note!

Function group COMMUNICATION	
PROTOCOL	Various data transmission protocols are available for digital communication which can be activated or switched off in this function. Note! The HART protocol can only be switched on if the current output current output 1 is set to “4–20 mA or 4–20 mA (25 mA)”. CANCEL – OFF – ***HART***
BUS ADDRESS	Selecting the bus address for data transmission with HART protocol. Note! The current output is set to 4 mA if the address is not set to the value “0”. 2-digit number (HART: 0...15) Factory setting: ***0***
TAG NUMBER	Display of the actual measuring point tag (name, max. 8 places). This can be only entered over the serial interface. Note! This function is only available if the function “PROTOCOL” is set to “HART”. Character field with 8 places Factory setting: ***REINACH***
TAG NUMBER CH2 only for version: CL1&2 2M.POINTS	Display of actual measuring point tag (name, max. 8 places) of Channel 2. This can be only entered over the serial interface. Note! This function is only available if the function “PROTOCOL” is set to “HART”. Character field with 8 places Factory setting: ***REINACH***

Function group SYSTEM PARAMETER	
PRESENT SYSTEM CONDITION	All error and status messages which occur while measurement is in progress can be called up according to their priority. Error and status messages are displayed in the HOME position alternately with the actual measurement variable. Note! • By pressing the diagnosis keys ⊞ in the HOME position there is automatically a jump to this function. • A complete listing of all possible system, process errors and status messages is given on page 83 ff. ⊞ Calling up other current errors or status messages: "+" → messages with higher display priority "–" → messages with lower display priority When the listing is complete the display shows the message "END OF LIST". ⊞ By pressing the diagnosis function again when a system error occurs you can also call up error descriptions. In such cases a diagnosis symbol (stethoscope) is visible.
PREVIOUS SYSTEM CONDITIONS	All process errors and status messages that have occurred so far are listed in chronological order (error history max. 15 entries). Note! • A complete list of all possible error and alarm messages is given on page 83 ff. • If no error or status messages have occurred since the measuring system was last started up then the display shows the message "S: NO ENTRY EXISTING". • With more than 15 entries the oldest is overwritten. • Storage of this list is volatile and is lost if thereis a power failure. ⊞ Calling up other system/process errors and errors and status messages: "+" Listing is done chronologically with the oldest, second oldest ... etc. message. "–" Listing is done chronologically with the latest, second latest ... etc. message. When listing is complete the display shows the message "END OF LIST".
ACCESS CODE	Entering the code number to release the programming via local operation. All data of the Prosonic Flow measuring system are protected against any inadvertent changes. If you press the ⊞ operating keys and the operating matrix is still locked, this function is automatically displayed with the request to enter the code: → Enter code number 93 (factory setting) or → Enter personal code number Note! • After return to the HOME position programming is again locked after 60 seconds if no operating element is pressed during this time. • Programming can also be locked by entering any number in this function but not the customer code. • If you can no longer find your personal code number, then the Endress+Hauser service organisation will be pleased to help you. ⊞ max. 4-digit number (0...9999) Factory setting: ***0***

Note!

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Function group SYSTEM PARAMETER	
DEF. PRIVATE CODE	Entering a personal code number with which programming can be enabled. Note! • Programming is always enabled with the code number 0. • When programming is locked this function is not available and access to the personal code number by third parties is not possible. • The code number can only be altered when programming has been enabled. max. 4-digit number (0...9999) Factory setting: ***93***
POS. ZERO RETURN	This function enables signals to be set from the current, pulse/frequency output to the fallback value, e.g. for interrupting the measurement for cleaning the piping. During this time the following applies: • Current output → set to 0 mA or 4 mA • Pulse/frequency output → at the fallback value • Display flow → 0 • Display totalisers → Remain at the last applicable value. Note! • This function has top priority above all other functions of the instrument. Simulations, for example are suppressed. • After positive zero return is activated, the display shows the message (HOME position) "S: POS. ZERO-RET. ACTIVE" or "S: POS. ZERO-RET. ACTIVE CH1 or CH2". • During positive zero return the relays are energised (except for *OFF*). Any error messages occurring, such as fault or alarm, can then only be called up using the diagnosis function or in the function "PRESENT SYSTEM CONDITION": These do not however affect the outputs. CANCEL – ***OFF*** – ON – CHANNEL CH1* – CHANNEL CH2* *In version CL1&2 2M.POINTS only ALL SIGNALS SET TO ZERO (for description see above)
SOFTWARE VERSION	Display of the current software which is installed in the amplifier. The numbers version have the following meaning: V 1 . 01. 00 (amplifier) Number changes if minor alterations are made to the new software version. Number changes if the new software contains additional functions. Number changes if basic alterations have to be made to the software, e.g. owing to technical modifications to the instrument.

Function group SYSTEM PARAMETER	
SOFTWARE VER. COM	Display of the current software installed in the communications board. The numbers of the software version have the following meaning: V 1 . 01. 00 (communication) Number changes if minor alterations are made to the new software. This also applies to special versions of software. Number changes if the new software contains additional functions. Number changes if basic alterations have to be made to the software, e.g. owing to technical modifications to the instrument.
SERIAL NUMBER	Display of the serial number of the Prosonic Flow measuring system 6-digit number (1...999999)
SYSTEM RESET	The measuring system can be restarted in this function without the power supply being switched off and on again. Note! With a restart all error entries in the function “PREVIOUS SYSTEM CONDITIONS” are deleted. ***CANCEL*** – RESTART SYSTEM


Note!

8 Trouble-shooting, Repairs and Maintenance

8.1 Response of the measuring system on fault or alarm

Error indications which occur during operation are indicated in the HOME position alternately with the measured values. Prosonic Flow DMU 93 recognises two types of error:

Type of error	Response of the instrument
Fault (failure) Errors due to failure of the instrument	• Error message displayed → see page 83 • Relay 1/2 dead (for "FAILURE" and "FAILURE CH1 or CH2") → see page 63 • Signal outputs respond according to the set failsafe mode → see page 56 and 62
Alarm (process error) Errors due to process conditions	• Alarm message displayed → see page 85 • Response of relays according to configuration → see page 63

Redundant response on fault or wall thickness measurement
For two-channel measurement at one measuring point (CL1&2 1M.POINT) the following is to be noted:
- If one channel fails or wall thickness measurement is activated, then the operating channel is duplicated to the other channel (for examples see page 46). The fault message is however shown.
- The instrument enters into fault mode with two defective channels.


Caution!

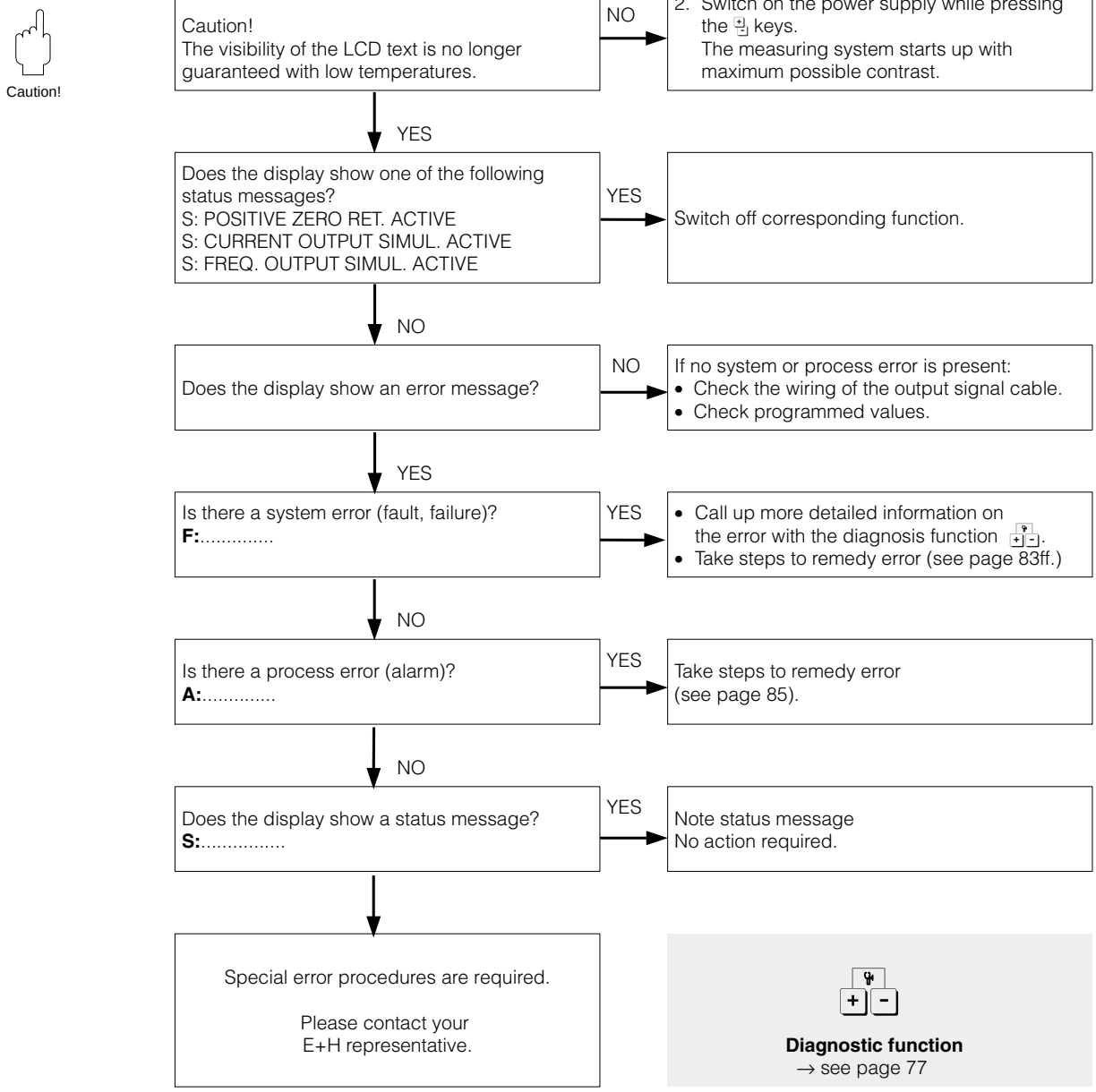
Caution!
Please note the following points on active **positive zero return** or active **simulation**:

Positive zero return (PZR)
- This function has top priority above all other instrument functions. Simulations, for example, are suppressed.
- After activating PZR the display shows the message "S: POS. ZERO-RET. ACTIVE".
- During positive zero return all relays are energised, except in the option "OFF". Any error messages occurring (fault, alarm) can then only be called up using the diagnostic function or in the function "PRESENT SYSTEM CONDITION". These do not, however, affect the outputs.
- Positive zero return (CL1&2 2M.POINTS) is possible for separate channels.

Simulation
- This function has the second highest priority, just as the related status messages. Any error messages occurring during this time can only be called up and shown using the diagnostic function.
- Normal output of system error if Relay 1 is configured for fault output. Normal function of the remaining relays (according to configuration).

8.2 Diagnosis flow chart and trouble-shooting

All instruments undergo various stages of quality control during production. However should an error or fault occur during set-up or operation, then refer to the flow chart below to identify possible causes.



8.3 Error and alarm messages

Error message **F: . . . . .** (System error)	**Cause** Call up by ⊞	**Remedy**
F: SYSTEM ERROR AMPLIFIER	**: EEPROM FAILURE** Error on access to EEPROM data.	Replace amplifier board, see Chap. 8.6.
	: RAM FAILURE Error on access to working memory (RAM) of the processor.	Replace amplifier board, see Chap. 8.6.
	: ASIC FAILURE Error on access to ASIC of amplifier.	Replace amplifier board, see Chap. 8.6.
F: SIGNAL CH1 or **CH2 TOO LOW**	**NO DIAGNOSIS** Damping of the acoustic measuring path too large.	• Check whether the coupling medium should be renewed. • The product possibly has a too high a damping effect. • The pipe possibly has a too a damping effect. • Check the distance between sensors.
F: SOUND VELOCITY K1 OR K2 OUT OF RANGE	**NO DIAGNOSIS** The sound velocities lie outside the measuring range.	• Check the distance between sensors. • Check - if possible - the sound velocity of the liquid or see for specific literature. If the actual sound velocity is greater than 1800 contact E+H service.
F: SENSOR CH1 or **CH2 UPSTREAM**	**NO DIAGNOSIS** Connection between sensor and transmitter broken.	• Check the cable connection between sensor and transmitter. • Check whether the plug has been inserted right to the mechanical stop. • The sensor is possibly defective. • Wrong sensor connected.
F: SENSOR CH1 or **CH2 DOWNSTREAM**	**NO DIAGNOSIS** Connection between sensor and transmitter broken.	• Check the cable connection between sensor and transmitter. • Check whether the plug has been inserted right to the mechanical stop. • The sensor is possibly defective. • Wrong sensor connected.
F: SYSTEM ERROR POWER SUPPLY	**: LOW VOLTAGE DETECTED** The power supply board is supplying a too low a voltage.	Replace power supply board, see Chap. 8.6.

(continued next page)

Error message **F: . . . . .** (System error)	**Cause** Call up by ⊞	**Remedy**
F: NO AMPLIFIER RESPONSE	**: NO DIAGNOSIS** Data transfer between amplifier and communications module not possible.	Restarting the measuring system may be required (switch off power supply and then switch it on again) Otherwise change electronics module, see chap. 8.6.
F: VALUE NOT ACCEPTED	**: NO DIAGNOSIS** An internally stored value cannot be read by the communications module.	Restarting the measuring system may be required (switch off power supply and then switch it on again) Otherwise change electronics module, see chap. 8.6.
F: SYSTEM ERROR COM-MODUL	**: EEPROM FAILURE** Error on access to EEPROM data (process and calibration data of communications module).	Replace Com-module, see chap. 8.6.
	: RAM FAILURE Error on access to the working memory (RAM).	Replace Com-module, see chap. 8.6.
	: ROM FAILURE Error on access to the program memory (ROM).	Replace Com-module, see chap. 8.6.
	: LOW VOLTAGE DETECTED DC/DC converter on the communications module is supplying a power voltage which is too low.	Replace Com-module, see chap. 8.6.
	: VOLTAGE REFERENCE Reference voltage of the communications module outside tolerance, i.e. correct functioning of the current output is no longer guaranteed.	Replace Com-module, see chap. 8.6.
	: EEPROM HW DATA ERROR A part of the EEPROM data of the communications module is damaged or has been overwritten. Default values from the ROM are written in. The measuring system can still operate on a makeshift basis using these values.	Replace Com-module, see chap. 8.6.
	: SENSOR CONFIGURATION NOT POSSIBLE Incompatibility of Com-modules by mixing V1.01.00 with amplifier board V1.00.00.	This configuration operates Clamp On sensors only.

(continued on next page)

Error message **F: . . . . .** (System error)	**Cause** Call up by ±	**Remedy**
F: SYSTEM ERROR COM-MODUL (continued)	**: EEPROM PARA. DATA ERR** A part of the EEPROM data of the communications module is damaged or has been overwritten. Default values from the ROM are written in. The measuring system can still operate on a makeshift basis using these values. **: EEPROM TOT. DATA ERROR** A part of the EEPROM data of the communications module (totaliser-block) is damaged or is overwritten.	Replace Com-module, see chap. 8.6. Replace Com-module, see chap. 8.6.
Alarm messages A: .... (Process error)	**Cause**	**Remedy**
A: CURRENT OUTP. OVERFLOW	The actual measured value is outside the range preset by the scaled zero and full scale values.	Change scaled zero and full scale values (see page 53 ff) or change measured variable.
A: FREQ. OUTPUT 1 OVERFLOW	The actual measured value is outside the range preset by the scaled zero and full scale values.	Change scaled zero and full scale values (see page 60) or change measured variable.
A: ZERO ADJT. CH1 or **CH2 NOT POSSIBLE**	The static zero point calibration is not possible or has been cancelled.	Check if flow velocity = 0 m/s (see page 75)

Status messages S:.....	Cause	Remedy
S: POS. ZERO-RET. ACTIVE	Positive zero return is activated. This message has highest priority for the Prosonic Flow DMU 93.	Not required
S: POS. ZERO-RET. ACTIVE CH1	Positive zero return is active for Channel 1. This only applies to configuration CI1&2 2M.POINTS.	Not required
S: POS. ZERO-RET. ACTIVE CH2	Positive zero return is active for Channel 2. This only applies to configuration CI1&2 2M.POINTS.	Not required
S: SENSOR CH1 INCOMPATIBLE	Incorrectly, the flow sensor was installed for measuring wall thickness.	Change round the flowmeter and wall thickness sensor.
S: SENSOR CH2 INCOMPATIBLE	Incorrectly, the flow sensor was installed for measuring wall thickness.	Change round the flowmeter and wall thickness sensor.
S: CURRENT OUTPUT SIMUL. ACTIVE	Current simulation is activated	Not required
S: FREQ. OUTPUT SIMUL. ACTIVE	Frequency simulation is activated	Not required
S: ZERO ADJT. CH1 or **CH2 RUNNING**	Static zero point calibration is running	Not required
S: W. THICKN. CH1 or **CH2 RUNNING**	Wall thickness measurement activated	Not required
S: CALIBR. CH1 or . **CH2 RUNNING**	Calibration of wall thickness sensor is activated	Not required
S: CALIBR. CH1 or **CH2 NOT POSSIBLE**	Calibration of wall thickness sensor not possible	Sensor connection Calibration unit Coupling medium

8.4 Repair

Repairs can only be carried out on the transmitter. For exchange of the electronics module or other components, see page 88 or the spare parts catalog.
No repairs can be carried out on the sensors (the sensors are potted). The sensors can be ordered in pairs from Endress+Hauser. (For Order No. see Technical Data page 96).

8.5 Exchange the instrument fuses

Warning!
- Danger of electric shock! Turn off the power supply before the transmitter housing is opened.
- For instruments with Ex approvals, instructions according to the separate Ex documentation is to be observed.

There are two instrument fuses:
- The first can be found on the wiring terminal board in the terminal compartment of the DMU 93 transmitter housing (see page 23).
- The second can be found on the electronic module power supply board in the electronics compartment (behind the local display) of the DMU 93 transmitter housing.

Procedure:
1. Turn off the power supply.
2. Remove the electronic module as described on page 88.
   Use only the following fuse types:
   – For 20...55 V AC / 20...62 V DC power supply:
     2 A slow-blow/250 V, switching capacity 1500 A; 5 x 20 mm
   – For 85...260 V AC:
     1 A slow-blow/250 V, switching capacity 1500 A; 5 x 20 mm
3. Slide the electronic module back into the transmitter housing and fasten.
4. Turn on power supply.

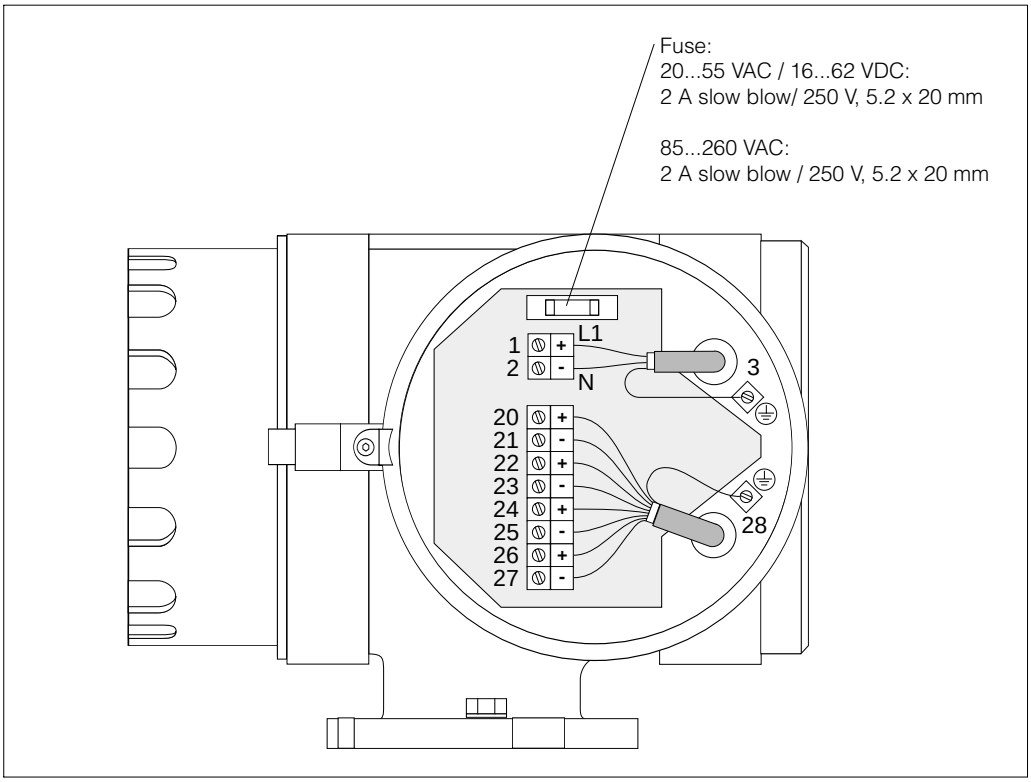


Fig. 38
Wiring compartment with location of the fuse

8.6 Exchange of transmitter electronics


Warning!

Warning!
- Danger of electric shock! Turn off the power supply before the electronics module is removed.
- Danger of electronics component damage (ESD protection)! Use an anti-static work area with a grounded work surface.
- The local power voltage and frequency must correspond to the technical data of the power supply board in question. For Ex instruments, instructions according to the separate Ex documentation are to be observed.

❶ Turn off power supply.
❷ Loosen the Allen head screw holding the safety claw (3mm Allen key).
❸ Unscrew the electronic compartment cover (glass cover) from the transmitter housing.
❹ Remove the local display:
a) Loosen the display module fastening screws.
b) Disconnect the display module flat cable from the communications module.
❺ Disconnect the power supply cables 2-pole connector from the power supply PCB (while simultaneously depressing the connector locking mechanism).
❻ Disconnect the sensor cable connector from the amplifier PCB (while simultaneously depressing the connector locking mechanism).
❼ Remove the two PCB carrier plate screws. Carefully pull the carrier plate approx. 4...5 mm out of the transmitter housing. The complete transmitter electronics can now, together with the PCB carrier plate, be pulled completely out of the housing.
❽ The electronics module can now be separated (unscrewed) into the three components (power supply A, preamplifier B and Com-module C).
Exchange the necessary components and reassemble the module.


Note!

Note!
When ordering PCBs, observe the order code in the form of a 500xxxxx number written on a label. Use only those PCBs with the same order number.
After exchanging the transmitter electronics, reassembly is in reverse order.

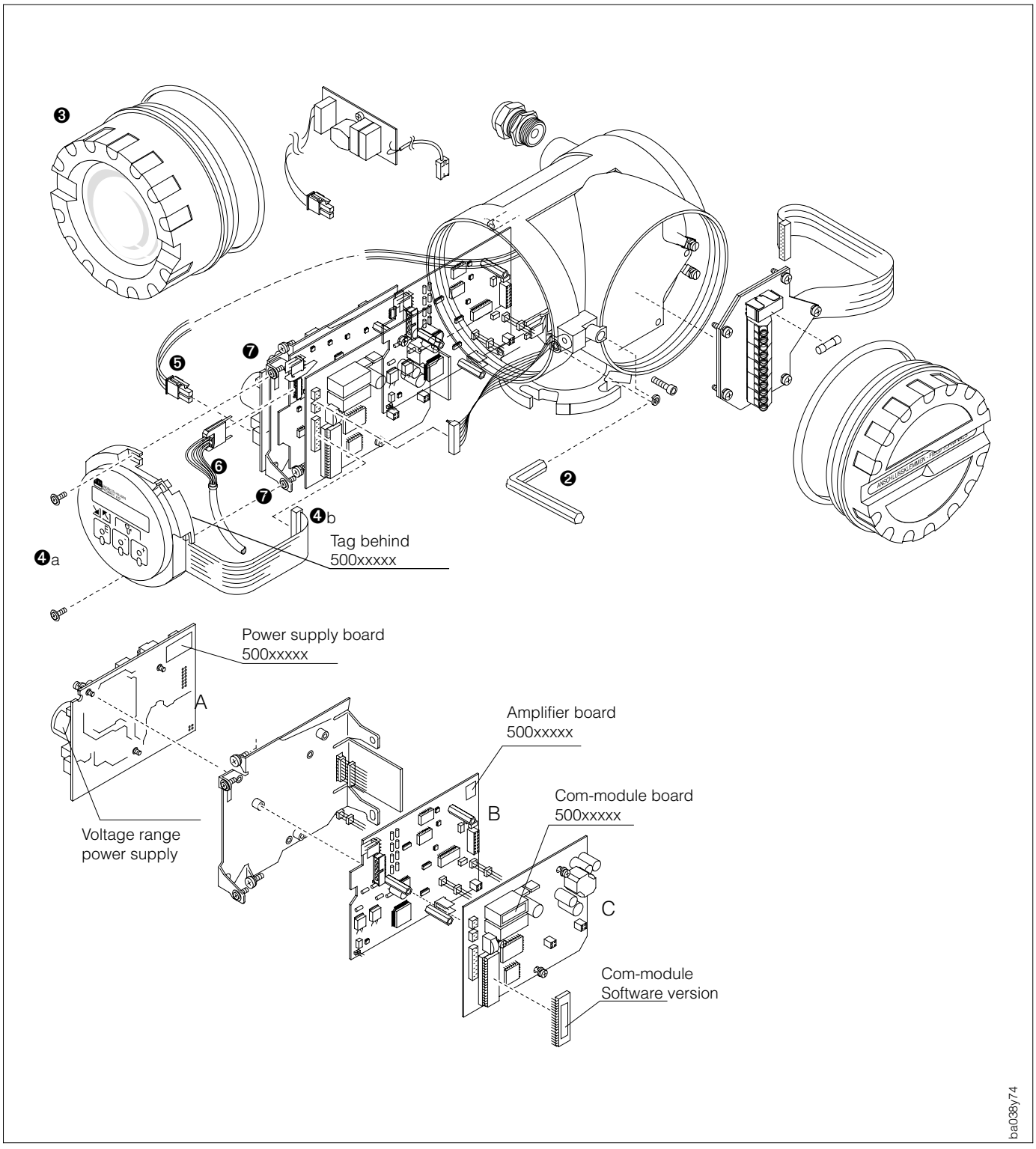
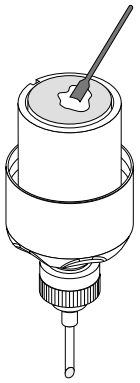


Fig. 39
Exchange of the Prosonic Flow DMU 93 transmitter electronics

8.7 Maintenance

The Prosonic Flow system is largely maintenance-free.
A coupling medium is required in order to ensure a good acoustic connection between the sensor and piping.
Poor coupling may result due to external conditions. This is indicated by very low signal strength or unstable measurement. The signal strength can be read from the display or from an output.
If the signal strength sinks more than 30% when the medium is stationary and measurement is stable, then the coupling medium should be replaced.
Under normal conditions (room temperature and product temperature not higher than 60 °C), regular replacement of the coupling medium is usually not required.



Procedure:

1. Unscrew sensor.
2. Clean all sensor surface by wiping with a soft cloth (do not use abrasive scouring agents or corrosive cleaning liquids).
3. Apply a new layer of coupling agent (approx. 1 mm) and spread it evenly over the sensor surface.
4. If necessary remove any residue on the surface of the pipe in the sensor holder.
5 Replace the original sensor.
6. Check signal strength

ba038y58

Fig. 40
Applying the coupling medium

9 Dimensions

Note!
Dimensions and weights given for the transmitter with Ex approvals may differ from those given in the specifications.
Please note therefore the separate Ex documentation.

Note!

Dimensions of versions for 2 and 4 traverses

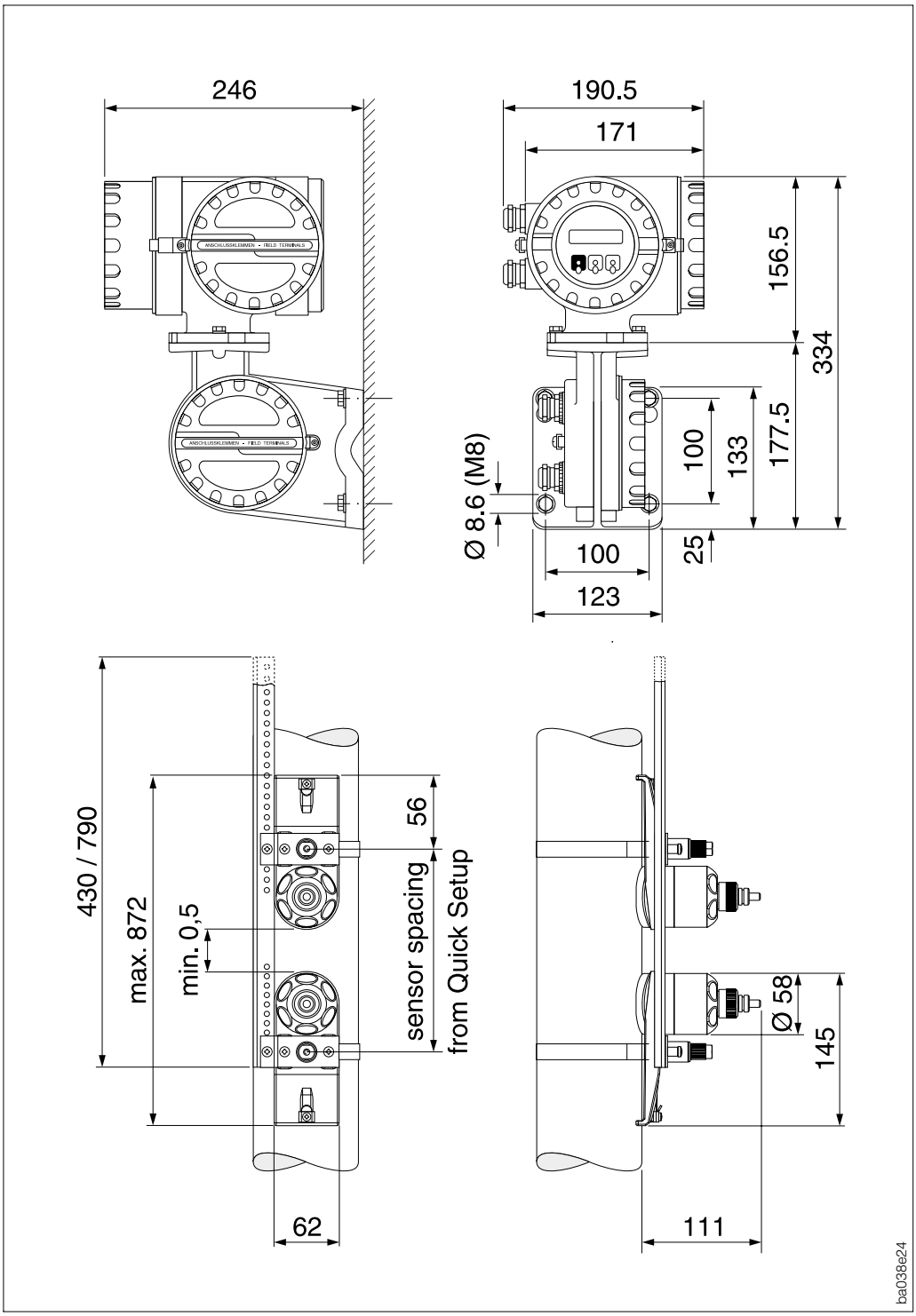


Fig. 41
Dimensions Prosonic Flow versions for 2 and 4 traverses

Dimensions of versions for 1 and 3 traverses

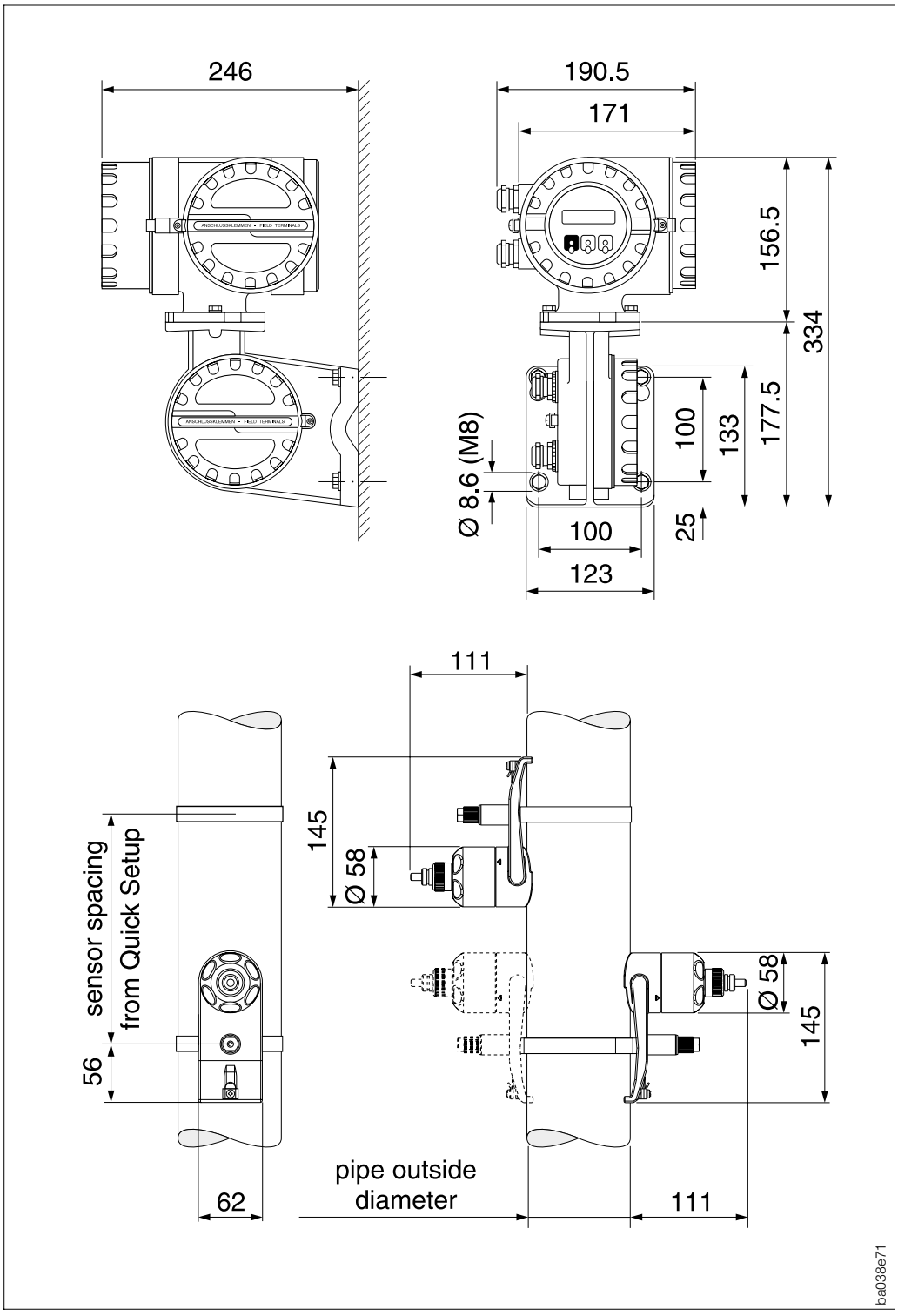


Fig. 42
Dimensions Prosonic Flow versions for 1 and 3 traverses

Weight:

Transmitter DMU 93	=	4.7 kg
Sensors DDU 10 incl. mounting rails and tensioning bands	=	2.8 kg
Sensors DDU 18 incl. tensioning band	=	2.4 kg
Sensor DDU 19 incl. tensioning band	=	1.5 kg

10 Technical Data

Application	
Instrument name	Ultrasonic measuring system “Prosonic Flow”
Instrument function	Prosonic Flow DMU 93 transmitter to process and display measuring data supplied by the Prosonic Flow sensors DDU 10/18/19.
Function and system design	
Measuring principle	Measuring system according to the ultrasonic run time difference
Measuring system	The complete measuring system consists of: • Transmitter Prosonic Flow DMU 93 • Sensors Prosonic Flow DDU 10 Flow sensors DDU 18 Sound velocity sensors (accessory) DDU 19 Wall thickness sensor (accessory)
Input variables	
Measured variables	• Volumetric flow (proportional to ultrasonic run time difference) • Sound velocity • Signale strength
Measuring range	Freely adjustable from 0...1 m/s to 0...15 m/s. DN [mm] Maximum measuring range 50 0...118 m^3/h 100 0...420 m^3/h 1000 0...42.400 m^3/h 2000 0...169.600 m^3/h 2500 0...265.000 m^3/h 3000 0...380.000 m^3/h
Operable flow range	150 : 1
Output variables	
Output signal	• *Relay output 1* max. 60 V AC / 0.5 A or max. 30 V DC / 0.1 A NC or NO contact available Configurable for: fault, full scale switching, flow direction, limit values • *Relay output 2* max. 60 V AC / 0.5 A or max. 30 V DC / 0.1 A; NC or NO contact available Configurable for fault, full scale switching, flow direction, limit values • *Current output 1* 0/4...20 mA (also acc. to NAMUR recommendations), R_L <700 Ω (R_L >250 Ω with HART), freely assignable to different measured values (see page 53), time constant freely selectable (0.5...100.00 s), full scale value selectable, with HART protocol. • *Current output 2* 0/4...20 mA (also acc. to NAMUR recommendations), R_L <700 Ω, freely assignable to different measured values (see page 53), time constant freely selectable (0.5...100.00 s), full scale value selectable. (continued next page)

Output variables (continued)	
Output signal (continued)	• *Pulse / frequency output* active / passive selectable, one measured variable freely assignable (see page 57) active: 24 V DC, 25 mA (250 mA for 20 ms), R_L >100 Ω, passive: 30 V DC, 25 mA (250 mA for 20 ms) – *Frequency output:* f_{End} selectable up to 10000 Hz, On/off ratio 1:1, pulse width max. 2 s – *Pulse output:* pulse weighting adjustable, pulse polarity adjustable, pulse width adjustable (50 ms...2 s). above a frequency of $^1/_{(2 \times \text{pulse width})}$ the on/off ratio is 1:1
Signal on alarm	The following applies until the fault has been cleared: • Current output → failure mode selectable • Pulse/frequency output → failure mode selectable (coupled with totalisers) • Relay 1 or 2 → de-energised, if configured to fault detection (failure mode selectable)
Load	R_L <700 Ω (current output) R_L >250 Ω (current output with HART)
Creep suppression	Switch points for low flow selectable (see page 73). Hysteresis: –50 %
Accuracy (process data)	
Reference conditions	Error limits based on ISO/DIN 11631 • +20...+30 °C, 2...4 bar • Calibration rig based on national standards
Measured error	For flow velocities >0.3 m/s and a Reynolds number >10000 Dry calibration better than ±2% o.r. typical. • Accuracy: ±0.5% o.r. plus ±0.05% o.f.s under reference conditions • Reference conditions: Pipe DN 100; Pipe material Stainless steel; Fluid Water; Fluid temperature +30 °C o.r. = of reading o.f.s. = of full scale (15 m/s) • Repeatability: ±0.4%
Operating conditions	
Installation conditions	
Installation instructions	For further details see page 11 ff
Sensor cable length	max. 30 m between sensors / transmitter, screened cable is to be used
Ambient conditions	
Ambient temperature (transmitter)	DMU 93 –20...+60 °C (An all-weather cover should be used to protect the housing from direct sunlight when mounting in the open. This is especially important in warmer climates and with high ambient temperatures).
Ambient temperature (sensors incl. cable)	DDU 10 –40...+80 °C / 0...+170 °C DDU 18 –40...+80 °C / 0...+170 °C DDU 19 0...+60 °C

Operating conditions (continued)			
Storage temperature	Transmitter Sensors (incl. cable)	DMU 93 DDU 10 DDU 18 DDU 19	–40...+80 °C –40...+80 °C / 0...+170 °C –40...+80 °C / 0...+170 °C 0...+60 °C
Degree of protection (EN 60529)	Transmitter Sensors	DMU 93 DDU 10 DDU 18 DDU 19	IP 67 / (NEMA 4X) IP 68 / (NEMA 6P) IP 68 / (NEMA 6P) IP 67 / (NEMA 4X)
Shock resistance	according to IEC 68-2-31		
Vibrational resistance	up to 1 g, 10...150 Hz according to IEC 68-2-6		
Electromagnetic compatibility	According to EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 as well as to NAMUR recommendations. Interference resistance to EN 61000-4-6; 3 V for sensor cable ≥ 30 m.		
Product conditions			
Fluid temperature	Sensors	DDU 10 DDU 18 DDU 19	–40...+80 °C / 0...+170 °C –40...+80 °C / 0...+170 °C 0...+60 °C
Nominal pressure	Independent		
Pressure drop	Independent		
Mechanical construction			
Design, dimensions (L x W x H)	Dimensional drawings → see page 91		
Weights	see page 91		
Materials	• *Transmitter Housing DMU 93:* – Powder-coated die-cast aluminium • *Sensor DDU 10/18/19:* – Sensor holder – Sensor housing – Cable plug – Tension band – Wetted parts of sensor – Sensor cable		 W1.4301 (AISI 304) W1.4301 (AISI 304) W1.4301 (AISI 304) W1.4310 (AISI 301) chemically resistant plastic PVC or PTFE
Electrical connection	• *Wiring diagrams:* see page 23 *Transmitter:* PG 13.5 (5...15 mm) or thread for cable glands $^1/_2$" NPT, M20 x 1.5 (8...15 mm), G $^1/_2$" • *Galvanic isolation:* All circuits for inputs, outputs, power supply and sensors are galvanically isolated from one another. • *Cable specifications:* The ready-to-use cables supplied from the factory at E+H are to be used for every pair of sensors. Connection of sensors / transmitter see page 24.		

User interface	
Operation	On-site operation: • 3 operating keys for interactive programming of all instrument functions in the instrument operating matrix (see page 31). • Diagnosis and help function (⊞).
Display	LC display, illuminated, two-lines each with 16 characters
Communication	• E+H Commuwin II (via HART protocol over a communications box, e.g. Commubox FXA 191 from E+H) • HART protocol via current output
Power supply	
Supply voltage *Frequency*	*Transmitter:* 20... 55 V AC (50...60 Hz), 16...62 V DC 85...260 V AC (50...60 Hz) *Sensor:* • supplied by the transmitter
Power consumption	AC: <15 VA (incl. sensors) DC: <15 W (incl. sensors)
Power supply failure	Bridges min. 1 power cycle (22 ms). • EEPROM saves measuring system data on power failure (no batteries required).
Certificates and approvals	
Ex approvals	Information on presently available Ex versions (e.g. ATEX, CENELEC, FM, CSA) can be supplied by your E+H Sales Centre on request. All explosion protection data are given in separate documentation available on request.
CE mark	By attaching the CE mark, Endress+Hauser confirms that the instrument has been successfully tested and fulfils all legal requirements of the relevant EC directives.
Ordering	
Accessories	• Post mounting set for transmitter housing (Order No. 50076905) • Coupling material –40...+80 °C (Order No. 50091705) • Coupling material 0...+170 °C (Order No. 50091706) • Coupling material DDU 19 (Order No. 50093015) • Tensioning bands for DN 50... 200 (Order No. 50091709) • Tensioning bands for DN 200... 600 (Order No. 50091710) • Tensioning bands for DN 600...1200 (Order No. 50091711) • Tensioning bands for DN 600...3000 (Order No. 50091712)
Supplementary documentation Prosonic Flow	System Information SI 025D/06/en Technical Information TI 042D/06/en Operating manual Insertion version BA 044D/06/en Ex documentation: ATEX/CENELEC XA 001D/06/a3 (II2G/Zone 1) ATEX XA 002D/06/a3 (II3G/Zone 2) FM EX 042D/06/a2 CSA EX 043D/06/d2
Other standards and guidelines	
EN 60529	Degree of protection by housing (IP code)
EN 61010	Protection Measures for Electronic Equipment for Measurement, Control, Regulation and Laboratory Procedures
EN 50081	Part 1 and 2 (interference emission)
EN 50082	Part 1 and 2 (interference immunity)
NAMUR	Association of Standards for Control and Regulation in the Chemical Industry

11 Functions at a Glance

PROCESS VARIABLE	
VOLUME FLOW CH1 (p. 46) only for version: CLAMP ON CH1 CL1&2 2M.POINTS *or* **CALC. VOLUME FLOW** (p. 46) only for version: CL1&2 1M.POINT	Display: 5-digit number with decimal point (e.g. 5.1145 m^3/h)
VOLUME FLOW CH1 (p. 46) only for version: CL1&2 1M.POINT	Display: 5-digit number with decimal point (e.g. 1.3549 m^3/h)
VOLUME FLOW CH2 (p. 46) only for version: CL1&2 1M.POINT CL1&2 2M.POINTS	Display: 5-digit number with decimal point (e.g. 0.7305 m^3/h)
AVE. SOUND VELOC. (p. 47) only for version: CL1&2 1M.POINT	Display: 4-digit number (e.g. 1300 m/s)
NET FLOW (p. 47) only for version: CL1&2 1M.POINT	Display: 5-digit number with decimal point (e.g. 1.4505 m^3/h)
TOTAL FLOW (p. 47) only for version: CL1&2 1M.POINT	Display: 5-digit number with decimal point (e.g. 1.7305 m^3/h)
SOUND VELOC. CH2 (p. 47)	Display: 4-digit number (e.g. 1200 m/s)
SOUND VELOC. CH2 (p. 47) only for version: CL1&2 1M.PONT CL1&2 2M.POINTS	Display: 4-digit number (e.g. 1400 m/s)
TOTALIZERS	
TOTALIZER 1 TOTALIZER 2 (p. 48)	Display: 7-digit number with floating decimal point
TOTAL 1 or **2 OVERFLOW** (p. 48)	Display: max. 7-digit total
RESET TOTALIZER (p. 48)	***CANCEL*** – TOTAL. 1 – TOTAL. 2 – TOTAL. 1 & 2

ASSIGN TOTAL. 1 or **2** (p. 49)	CANCEL ***OFF***** CALC. VOLUME CALC. VOLUME(+) CALC. VOLUME(-) } CL1&2 1M.POINT ***VOLUME CH1**** VOLUME(+)CH1 VOLUME(-)CH1 VOLUME CH2 VOLUME(+)CH2 } CL1&2 1M.POINT VOLUME(-)CH2 } CL1&2 2M.STELLEN NET VOLUMEN TOTAL VOLUME TOTAL VOLUME(+) TOTAL VOLUME(-) } CL1&2 2M.POINTS *Totalizer 1 / ** Totalizer 2 Client setting:.....
SYSTEM UNITS	
VOLUME FLOW UNIT (p. 50)	CANCEL dm^3/s – dm^3/min – dm^3/h ***l/s*** – l/min – l/h hl/min – hl/h m^3/s – m^3/min – m^3/h gal/min – gal/hr – gal/day gpm – gph – gpd – mgd bbl/min – bbl/hr – bbl/day Client setting:.....
VOLUME UNIT (p. 50)	CANCEL – dm^3 – ***l*** – hl – m^3 – gal – bbl Client setting:.....
GALLONS/BARREL (p. 50)	CANCEL – US: 31.0 gal/bbl - ***US: 31.5 gal/bbl*** – US: 42.0 gal/bbl – US: 55.0 gal/bbl – IMP: 36.0 gal/bbl – IMP: 42.0 gal/bb Client setting:.....
LENGTH UNIT (p. 50)	CANCEL – ***mm*** – inch Client setting:.....
CABLE LENGTH UN. (p. 50)	CANCEL – ***m*** – ft Client setting:.....
VELOCITY UNIT (p. 50)	CANCEL – ***m/s*** – ft/s Client setting:.....
TEMPERATURE UNIT (p. 51)	CANCEL – ***°C*** – K – °F – °R Client setting:.....
VISCOSITY UNIT (p. 51)	CANCEL – ***mm^2/s*** – cSt – St Client setting:.....
SELECTION	
SENSOR CONFIG. (p. 52)	CANCEL – ***CLAMP ON CH1*** – CL1&2 1M.POINT – CL1&2 2M.POINTS Client setting:.....
QUICK SETUP (p. 52)	***CANCEL*** – START

CURRENT OUTPUT 1 or 2	
ASSIGN OUTPUT (p. 53)	CANCEL ***OFF***** CALC.VOLUME FLOW ***VOLUME FLOW CH1**** VOLUME FLOW CH2 AVE.SOUND VELOC. SOUND VELOC. CH1 SOUND VELOC. CH2 SIG.STRENGTH CH1 SIG.STRENGTH CH2 NET FLOW TOTAL FLOW *Current output 1 / **Current output 2 Client setting:.....
ZERO SCALE or **ZERO SCALE 1** (p.53)	5-digit number with floating decimal point (e.g. 1.2345 dm^3/h) Client setting:.....
DUAL RANGE MODE (p. 54)	CANCEL – ***FULL SCALE 1*** – FULL SCALE 2 – AUTOMATIC Client setting:.....
FULL SCALE 2 (p. 55)	5-digit number with floating decimal point (e.g. 1.2345 dm^3/h) Client setting:.....
ACTIVE RANGE (p. 55)	***FULL SCALE 1*** FULL SCALE 2
TIME CONSTANT (p. 55)	5-digit number with fixed decimal point (0.5...100.00 s) Factory setting: ***5.00 s*** Client setting:.....
CURRENT SPAN (p. 55)	CANCEL 0–20 mA (25 mA) → max. 25 mA 4–20 mA (25 mA) → max. 25 mA 0–20 mA → max. 20.5 mA (NAMUR) ***4–20 mA*** → max. 20.5 mA (NAMUR) Client setting:.....
FAILSAFE MODE (p. 56)	CANCEL – ***MIN. CURRENT*** – MAX. CURRENT – HOLD VALUE – ACTUAL VALUE Client setting:.....
SIMULATION CURR. (p. 56)	At 0–20 (25 mA): ***OFF*** – 0 mA – 10 mA – 20 mA – 25 mA At 4–20 (25 mA): ***OFF*** – 2 mA – 4 mA – 12 mA – 20 mA – 25 mA CANCEL *Current output acc. to NAMUR* At 0–20 mA: ***OFF*** – 0 mA – 10 mA – 20 mA – 22 mA At 4–20 mA: ***OFF*** – 2 mA – 4 mA – 12 mA – 20 mA – 22 mA – CANCEL
NOMINAL CURRENT 1 or **2** (p. 56)	Number with fixed decimal point and one decimal place, incl. unit (e.g. 4.0 mA)

PULS / FREQ. OUTPUT	
ASSIGN OUTPUT (p. 57)	CANCEL OFF CALC. VOLUME ***VOLUME CH1*** VOLUME CH2 NET VOLUME TOTAL VOLUME } (Meas. mode freq. and pulse) AVE.SOUND VELOC. SOUND VELOC. CH1 SOUND VELOC. CH2 SIG.STRENGTH CH1 SIG.STRENGTH CH2 } (Meas. mode freq. only) Client setting:.....
OPERATION MODE (p. 57)	CANCEL – ***PULSE*** – FREQUENCY Client setting:.....
PULSE VALUE (p. 57)	5-digit number with floating decimal point, incl. units (e.g. 240.00 dm^3/p) Client setting:.....
PULSE WIDTH (p. 58)	3-digit number with fixed decimal point (0.05...2.00 s) Factory setting: ***0.25 s*** Client setting:.....
FULL SCALE FREQ. (p. 59)	max. 5-digit number (2...10,000 Hz) Factory setting: ***10000 Hz*** Client setting:.....
ZERO SCALE or **FULL SCALE** (p. 60)	5-digit number with floating decimal point (e.g. 0.5700 dm^3/s) Client setting:.....
OUTPUT SIGNAL (p. 61)	CANCEL – ***PASSIVE-POSITIVE*** – PASSIVE-NEGATIVE – ACTIVE-POSITIVE – ACTIVE-NEGATIVE Client setting:.....
FAILSAFE MODE (p. 62)	CANCEL – ***FALLBACK VALUE*** – HOLD VALUE – ACTUAL VALUE Client setting:.....
SIMULATION FREQ. (p. 62)	CANCEL – ***OFF*** – 0 Hz – 2 Hz – 10 Hz – 1 kHz – 10 kHz
NOMINAL FREQ. (p. 62)	Display: floating decimal point number (e.g.: 811.30 Hz)

RELAYS	
RELAY 1 or **2 FUNCTION** (p. 63)	CANCEL OFF ON ***FAILURE **** FAILURE CH1 (applies to CL1&2 2M.POINTS) FAILURE CH2 (applies to CL1&2 2M.POINTS) DUAL RANGE MODE 1 DUAL RANGE MODE 2 FLOW DIRECTION (applies to CL1&2 1M.POINT) FLOW DIRECT.CH1 FLOW DIRECT.CH2 (applies to CL1&2 1M.POINT and CL1&2 2M.POINTS) CALC. VOLUME FLOW ***VOLUME FLOW CH1***** VOLUME FLOW CH2 AVE. SOUND VELOC. (applies to CL1&2 1M.POINT) SOUND VELOC.CH1 SOUND VELOC.CH2 NET FLOW TOTAL FLOW * Factory setting Relay 1 ** Factory setting Relay 2 Client setting:.....
RELAY 1 or **2 ON-VALUE** or **RELAY 1** or **2 OFF-VALUE** (p. 64)	5-digit number with floating decimal point (e.g. 2.5800 dm^3/s) Client setting:.....
DISPLAY	
ASSIGN LINE 1 or **2** (p. 66)	CANCEL OFF (only line 2) CALC.VOLUME FLOW ***VOLUME FLOW CH1**** VOLUME FLOW CH2 AVE.SOUND VELOC. SOUND VELOC. CH1 SOUND VELOC. CH2 SIG.STRENGTH CH1 SIG.STRENGTH CH2 SIGNAL BAR CH1 SIGNAL BAR CH2 ***TOTALIZER 1****** TOTAL.1 OVERFLOW TOTALIZER 2 TOTAL.2 OVERFLOW NET FLOW TOTAL FLOW * Line 1 ** Line 2 Client setting:.....
DISPLAY DAMPING (p. 66)	max. 2-digit number, incl. units Factory setting: ***5 s*** Client setting:.....

FORMAT FLOW (p. 66)	CANCEL – XXXXX. – XXXX.X – XXX.XX – ***XX.XXX*** – X.XXXX Client setting:.....
FORMAT TOTALIZER (p. 66)	CANCEL – XXXXX. – XXXX.X – XXX.XX – ***XX.XXX*** – X.XXXX Client setting:.....
LCD CONTRAST (p. 67)	▮▮▮▮▮▮▮▮. . . . .
LANGUAGE (p. 67)	CANCEL – ***ENGLISH*** – DEUTSCH – FRANCAIS – ESPANOL – ITALIANO – NEDERLANDS – DANSK – NORSK – SWENSKA – SUOMI – BAHASA INDONESIA – JAPANESE Client setting:.....
DISPLAY TEST (p. 67)	1. ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ 2. 8888888888888888 3. ———————— 4. 0000000000000000
W. THICKNESS CH1 or CH2	
MODE (p. 68)	CANCEL – ***OFF*** – SOUND VEL. LONGI. – WALL THICKNESS
PIPE MATERIAL (p. 68)	CANCEL – ***CARBON STEEL*** – STAINLESS STEEL – HASTELLOY C – PA PE – LDPE – HDPE – PP – PVC – PTFE – PVDF – ABS – GLASS FLINT – CLASS PYREX – GLASS CROWN – OTHERS Client setting:.....
SOUND VEL. LONGI (p. 69)	max. 4-digit number Factory setting: ***5900 m/s*** Client setting:.....
REFERENCE VALUE (p. 69)	max. 2-digit number Factory setting: ***5.00 mm*** Client setting:.....
SIG. STRENGTH BAR (p. 69)	▮▮▮▮▮▮▮. . . . .
SOUND VEL. LONGI (p. 69)	Display: 4-digit number
WALL THICKNESS (p. 69)	Display: max. 2-digit number
CALIBRATION (p. 69)	***CANCEL*** – START
CLAMP ON CH1 or CH2	
PIPE MATERIAL (p. 70)	CANCEL – ***CARBON STEEL*** – STAINLESS STEEL – HASTELLOY C – PA – PE – LDPE – HDPE – PP – PVC – PTFE – PVDF – ABS – GLASS FLINT – GLASS PYREX – GLASS CROWN–- OTHERS Client setting:.....

PIPE DIAMETER (p. 70)	max. 4-digit number Factory setting: ***88.9 mm*** Client setting:.....
CIRCUMFERENCE (p. 70)	max. 4-digit number Factory setting: ***279.3 mm*** Client setting:.....
WALL THICKNESS (p. 70)	max. 2-digit number Factory setting: ***2.60 mm*** Client setting:.....
SOUND VELOC. PIPE (p. 70)	max. 4-digit number Factory setting: ***3230 m/s*** Client setting:.....
LIQUID (p. 70)	CANCEL – ***WATER*** – SEAWATER - AMMONIA – ACETONE – ALCOHOL – BENZENE – BROMIDE – ETHANOL – GLYCOL – KEROSENE – MILK – METHANOL – TOLUENE – OTHERS Client setting:.....
TEMPERATURE (p. 71)	max. 3-digit number Factory setting: ***20.0 °C*** Client setting:.....
SOUND VELOC. LIQ. (p. 71)	max. 4stellige Zahl Werkeinstellung: ***1481 m/s*** Client setting:.....
VISCOSITY (p. 71)	max. 4-digit number with floating decimal point Factory setting: ***1.000 mm²/s*** Client setting:.....
SENSOR DATA CH1 or CH2	
SENSOR TYPE (p. 72)	CANCEL – C1LIA – C2LIA – C1MIA – ***C2MIA*** – C1HIA – C2HIA – C1MPA – C_S08 Client setting:.....
CABLE LENGTH (p. 72)	max. 3-digit number Factory setting: ***5.0 m*** Client setting:.....
TRAVERSES (p. 72)	CANCEL – 1 – ***2*** – 3 – 4 Client setting:.....
POS. SENSOR 1 (p. 72)	Display: A – B – C – D – E – F – G – H – I – K
POS. SENSOR 2 (p. 72)	Display: 10 – 11 – 12 – ... – 76
SENSOR DISTANCE (p. 72)	Display: max. 4-digit number
WIRE LENGTH (p. 72)	Display: max. 4-digit number

PROCESS. PARA. CH1 PROCESSING PARA. PROCESS. PARA. CH2	
LOW FLOW CUTOFF (p. 73)	5-digit number with floating decimal point (e.g. 25.000 dm³/min) Factory setting: ***0.4 l/s*** Client setting:.....
MEASURING MODE (p. 73)	CANCEL – UNIDIRECTIONAL – ***BIDIRECTIONAL*** Client setting:.....
FLOW DIRECTION (p. 73)	CANCEL – ***FORWARD*** – REVERSE Client setting:.....
SIGNAL CH1 or CH2	
SIG. STRENGTH BAR (p. 74)	▮▮▮▮▮▮▮▮. . . . .
SIGNAL STRENGTH (p. 74)	Display: 0...100
CALIBR. DATA CH1 or CH2	
CORR. FACTOR (p. 75)	5-digit number with four decimal places Factory setting: ***1.0000*** Client setting:.....
ZEROPOINT (p. 75)	max. 4-digit number Client setting:.....
ZEROPOINT ADJUST (p. 75)	***CANCEL*** – START – UNDO
COMMUNICATION	
PROTOCOL (p. 76)	OFF - HART Client setting:.....
BUS ADDRESS (p. 76)	2-digit number Factory setting: ***0*** Client setting:.....
TAG NUMBER (p. 76)	8-digit character field Factory setting: ***REINACH***
TAG NUMBER CH2 (p. 76)	8-digit character field Factory setting: ***REINACH***
SYSTEM PARAMETER	
PRESENT SYSTEM CONDITION (p. 77)	Calling up other current errors or status messages: "+"→ messages with higher display priority "–"→ messages with lower display priority
PREVIOUS SYSTEM CONDITIONS (p. 77)	Calling up other system/process errors and errors and status messages: "+" Listing is done chronologically with the oldest, second oldest ... etc. message "–" Listing is done chronologically with the latest, second latest ... etc. message.

ACCESS CODE (p. 77)	max. 4-digit number (0...9999) Factory setting: ***0***
DEF. PRIVATE CODE (p. 78)	max. 4-digit number (0...9999) Factory setting: ***93*** Client setting:.....
POS. ZERO RETURN (p. 78)	CANCEL – ***OFF*** – ON – CHANNEL CH1* – CHANNEL CH2* *In version CL1&2 2M.POINTS only
SOFTWARE VERSION (p. 78)	Display: Software Version amplifier
SOFTWARE VER. COM (p. 79)	Display: Software Version Com (communications board)
SERIAL NUMBER (p. 79)	Display: 6-digit number (1...999999)
SYSTEM RESET (p. 79)	***CANCEL*** – RESTART SYSTEM

Index

Europe

Austria
❑ Endress+Hauser Ges.m.b.H.
Wien
Tel. (01) 88056-0, Fax (01) 88056-35

Belarus
❑ Belorgsintez
Minsk
Tel. (0172) 508473, Fax (0172) 508583

Belgium / Luxembourg
❑ Endress+Hauser N.V.
Brussels
Tel. (02) 2480600, Fax (02) 2480553

Bulgaria
INTERTECH-AUTOMATION
Sofia
Tel. (02) 664869, Fax (02) 9631389

Croatia
❑ Endress+Hauser GmbH+Co.
Zagreb
Tel. (01) 6637785, Fax (01) 6637823

Cyprus
I+G Electrical Services Co. Ltd.
Nicosia
Tel. (02) 484788, Fax (02) 484690

Czech Republic
❑ Endress+Hauser GmbH+Co.
Praha
Tel. (026) 6784200, Fax (026) 6784179

Denmark
❑ Endress+Hauser A/S
Søborg
Tel. (70) 131132, Fax (70) 132133

Estonia
ELVI-Aqua
Tartu
Tel. (7) 441638, Fax (7) 441582

Finland
❑ Endress+Hauser Oy
Helsinki
Tel. (0204) 83160, Fax (0204) 83161

France
❑ Endress+Hauser S.A.
Huningue
Tel. (389) 696768, Fax (389) 694802

Germany
❑ Endress+Hauser Messtechnik GmbH+Co.
Weil am Rhein
Tel. (07621) 975-01, Fax (07621) 975-555

Great Britain
❑ Endress+Hauser Ltd.
Manchester
Tel. (0161) 2865000, Fax (0161) 9981841

Greece
I & G Building Services Automation S.A.
Athens
Tel. (01) 9241500, Fax (01) 9221714

Hungary
Mile Ipari-Elektro
Budapest
Tel. (01) 4319800, Fax (01) 4319817

Iceland
BIL ehf
Reykjavik
Tel. (05) 619616, Fax (05) 619617

Ireland
Flomeaco Company Ltd.
Kildare
Tel. (045) 868615, Fax (045) 868182

Italy
❑ Endress+Hauser S.p.A.
Cernusco s/N Milano
Tel. (02) 921921, Fax (02) 92107153

Latvia
Rino TK
Riga
Tel. (07) 315087, Fax (07) 315084

Lithuania
UAB "Agava"
Kaunas
Tel. (07) 202410, Fax (07) 207414

Netherland
❑ Endress+Hauser B.V.
Naarden
Tel. (035) 6958611, Fax (035) 6958825

Norway
❑ Endress+Hauser A/S
Tranby
Tel. (032) 859850, Fax (032) 859851

Poland
❑ Endress+Hauser Polska Sp. z o.o.
Warszawy
Tel. (022) 7201090, Fax (022) 7201085

Portugal
Tecnisis, Lda
Cacém
Tel. (21) 4267290, Fax (21) 4267299

Romania
Romconseng S.R.L.
Bucharest
Tel. (01) 4101634, Fax (01) 4112501

Russia
❑ Endress+Hauser Moscow Office
Moscow
Tel. (095) 1587564, Fax (095) 1589871

Slovakia
Transcom Technik s.r.o.
Bratislava
Tel. (7) 44888684, Fax (7) 44887112

Slovenia
❑ Endress+Hauser D.O.O.
Ljubljana
Tel. (061) 5192217, Fax (061) 5192298

Spain
❑ Endress+Hauser S.A.
Sant Just Desvern
Tel. (93) 4803366, Fax (93) 4733839

Sweden
❑ Endress+Hauser AB
Sollentuna
Tel. (08) 55511600, Fax (08) 55511655

Switzerland
❑ Endress+Hauser AG
Reinach/BL 1
Tel. (061) 7157575, Fax (061) 7111650

Turkey
Intek Endüstriyel Ölcü ve Kontrol Sistemleriİstanbul
Tel. (0212) 2751355, Fax (0212) 2662775

Ukraine
Photonika GmbH
Kiev
Tel. (44) 26881, Fax (44) 26908

Yugoslavia Rep.
Meris d.o.o.
Beograd
Tel. (11) 4441966, Fax (11) 4441966

Africa

Egypt
Anasia
Heliopolis/Cairo
Tel. (02) 4179007, Fax (02) 4179008

Morocco
Oussama S.A.
Casablanca
Tel. (02) 241338, Fax (02) 402657

South Africa
❑ Endress+Hauser Pty. Ltd.
Sandton
Tel. (011) 4441386, Fax (011) 4441977

Tunisia
Controle, Maintenance et Regulation
Tunis
Tel. (01) 793077, Fax (01) 788595

America

Argentina
❑ Endress+Hauser Argentina S.A.
Buenos Aires
Tel. (01) 145227970, Fax (01) 145227909

Bolivia
Tritec S.R.L.
Cochabamba
Tel. (042) 56993, Fax (042) 50981

Brazil
❑ Samson Endress+Hauser Ltda.
Sao Paulo
Tel. (011) 50313455, Fax (011) 50313067

Canada
❑ Endress+Hauser Ltd.
Burlington, Ontario
Tel. (905) 6819292, Fax (905) 6819444

Chile
❑ Endress+Hauser Chile Ltd.
Santiago
Tel. (02) 3213009, Fax (02) 3213025

Colombia
Colsein Ltda.
Bogota D.C.
Tel. (01) 2367659, Fax (01) 6104186

Costa Rica
EURO-TEC S.A.
San Jose
Tel. (02) 961542, Fax (02) 961542

Ecuador
Insetec Cia. Ltda.
Quito
Tel. (02) 269148, Fax (02) 461833

Guatemala
ACISA Automatizacion Y Control Industrial S.A.
Ciudad de Guatemala, C.A.
Tel. (03) 345985, Fax (03) 327431

Mexico
❑ Endress+Hauser S.A. de C.V.
Mexico City
Tel. (5) 5682405, Fax (5) 5687459

Paraguay
Incoel S.R.L.
Asuncion
Tel. (021) 213989, Fax (021) 226583

Uruguay
Circular S.A.
Montevideo
Tel. (02) 925785, Fax (02) 929151

USA
❑ Endress+Hauser Inc.
Greenwood, Indiana
Tel. (317) 535-7138, Fax (317) 535-8498

Venezuela
Controval C.A.
Caracas
Tel. (02) 9440966, Fax (02) 9444554

Asia

China
❑ Endress+Hauser Shanghai Instrumentation Co. Ltd.
Shanghai
Tel. (021) 54902300, Fax (021) 54902303

❑ Endress+Hauser Beijing Office
Beijing
Tel. (010) 68344058, Fax (010) 68344068

Hong Kong
❑ Endress+Hauser HK Ltd.
Hong Kong
Tel. 25283120, Fax 28654171

India
❑ Endress+Hauser (India) Pvt Ltd.
Mumbai
Tel. (022) 8521458, Fax (022) 8521927

Indonesia
PT Grama Bazita
Jakarta
Tel. (21) 7975083, Fax (21) 7975089

Japan
❑ Sakura Endress Co. Ltd.
Tokyo
Tel. (0422) 540613, Fax (0422) 550275

Malaysia
❑ Endress+Hauser (M) Sdn. Bhd.
Petaling Jaya, Selangor Darul Ehsan
Tel. (03) 7334848, Fax (03) 7338800

Pakistan
Speedy Automation
Karachi
Tel. (021) 7722953, Fax (021) 7736884

Papua-Neuguinea
SBS Electrical Pty Limited
Port Moresby
Tel. 3251188, Fax 3259556

Philippines
❑ Endress+Hauser Philippines Inc.
Metro Manila
Tel. (2) 3723601-05, Fax (2) 4121944

Singapore
❑ Endress+Hauser (S.E.A.) Pte., Ltd.
Singapore
Tel. 5668222, Fax 5666848

South Korea
❑ Endress+Hauser (Korea) Co., Ltd.
Seoul
Tel. (02) 6587200, Fax (02) 6592838

Taiwan
Kingjarl Corporation
Taipei R.O.C.
Tel. (02) 27183938, Fax (02) 27134190

Thailand
❑ Endress+Hauser Ltd.
Bangkok
Tel. (2) 9967811-20, Fax (2) 9967810

Vietnam
Tan Viet Bao Co. Ltd.
Ho Chi Minh City
Tel. (08) 8335225, Fax (08) 8335227

Iran
PATSA Co.
Tehran
Tel. (021) 8754748, Fax (021) 8747761

Israel
Instrumetrics Industrial Control Ltd.
Netanya
Tel. (09) 8357090, Fax (09) 8350619

Jordan
A.P. Parpas Engineering S.A.
Amman
Tel. (06) 4643246, Fax (06) 4645707

Kingdom of Saudi Arabia
Anasia Ind. Agencies
Jeddah
Tel. (02) 6710014, Fax (02) 6725929

Lebanon
Network Engineering
Jbeil
Tel. (3) 944080, Fax (9) 548038

Sultanate of Oman
Mustafa Sultan Science & Industry Co. LLC.
Ruwi
Tel. 602009, Fax 607066

United Arab Emirates
Descon Trading EST.
Dubai
Tel. (04) 2653651, Fax (04) 2653264

Yemen
Yemen Company for Ghee and Soap Industry
Taiz
Tel. (04) 230664, Fax (04) 212338

Australia + New Zealand

Australia
ALSTOM Australia Limited
Milperra
Tel. (02) 97747444, Fax (02) 97744667

New Zealand
EMC Industrial Group Limited
Auckland
Tel. (09) 4155110, Fax (09) 4155115

All other countries

❑ Endress+Hauser GmbH+Co.
Instruments International
D-Weil am Rhein
Germany
Tel. (07621) 975-02, Fax (07621) 975345