



VERSAFLOW SONIC 1000/TWS 9000 Quick Start

Ultrasonic clamp-on flowmeter

ER 3.4.0_

Honeywell

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1.1 Intended use

The overall functionality of the clamp-on flowmeter is the continuous measurement of actual volume flow, mass flow, flow speed, velocity of sound, gain, SNR and diagnosis value.

1.2 Scope of delivery



INFORMATION!

Check the packing list to check if you received completely all that you ordered.



INFORMATION!

Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.



INFORMATION!

The device will arrive in two cartons. The square carton contains the converter. The rectangular carton contains the transducer set.

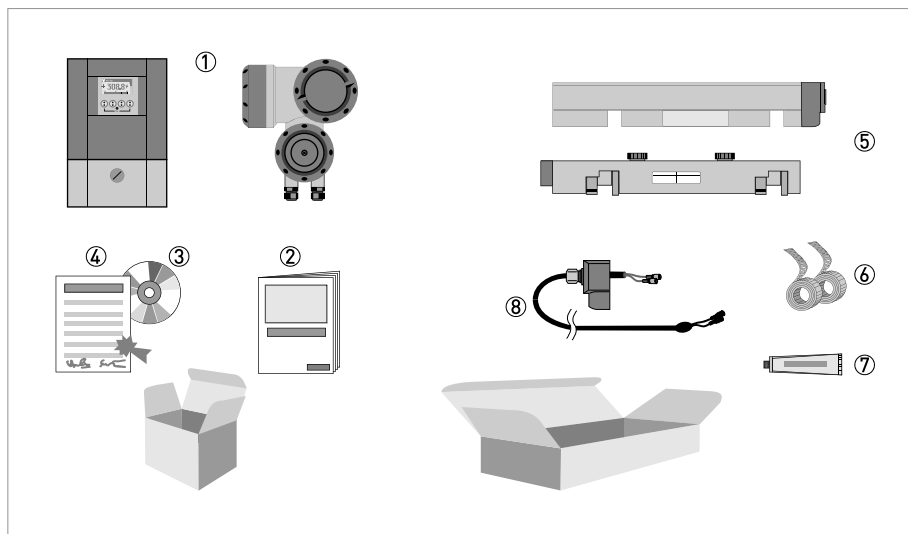
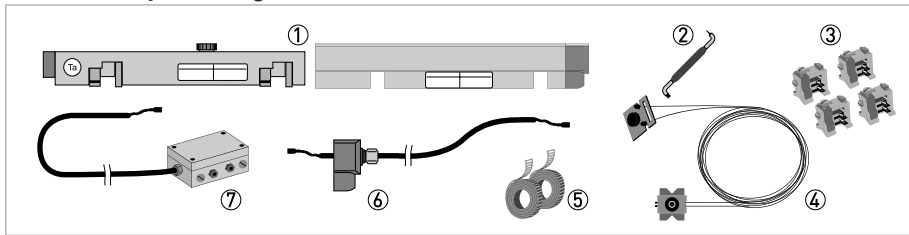


Figure 1-1: Scope of delivery

- ① Signal converter, wall version or field version
- ② Quick Start
- ③ CD-ROM (including Handbook, Quick Start)
- ④ Factory calibration report
- ⑤ Sensor plus cover (stainless steel / XT version without cover)
- ⑥ Metal strap
- ⑦ Mineral coupling grease (standard versions) or high temperature contact gel Pyrogel® (XT versions)
- ⑧ Signal cable plus connector cap (XT versions have a protection sleeve around the signal cable).

Additionally for large version:



- ① 2nd sensor plus cover
- ② 90 degree screw driver
- ③ 4 fixing units
- ④ Positioning tool
- ⑤ 2 metal straps
- ⑥ Signal cable plus connector cap
- ⑦ Cable box plus signal cable



INFORMATION!

No special tools, no training required!

1.3 Overview

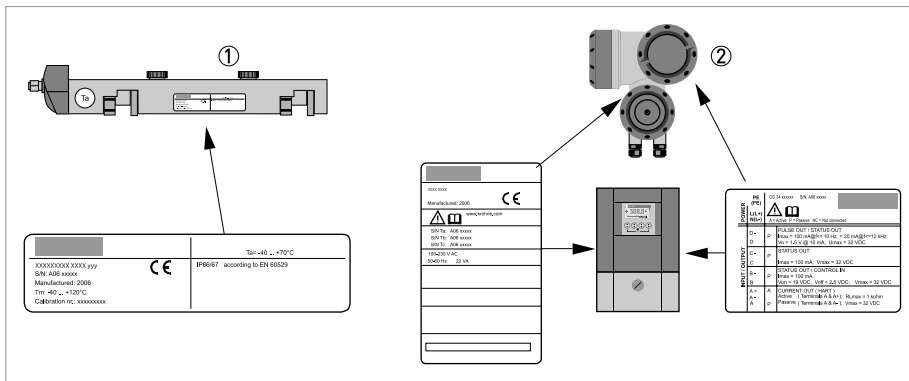


Figure 1-2: Visual check

- ① Flow sensor
- ② Signal converter

1.4 Storage

- Store the flowmeter in a dry and dust-free location.
- Avoid lasting direct exposure to the sun.
- Store the flowmeter in its original packing.

1.5 Transport

No special requirements.

1.6 Pre-installation requirements

**INFORMATION!**

To assure a quick, safe and uncomplicated installation, we kindly request you to make provisions as stated below.

1.6.1 Environmental requirements

- Pollution degree 2
- Protection class I
- Humidity: 5...80 % RH
- Temperature: -40...+60°C / -40...+140°F operating and -50...+70°C / -58...+158°F storage
- Suitable for indoor and outdoor use and certified for operating up to an altitude of 2000 m / 6562 ft
- IP class 66/67

**CAUTION!**

The device should be protected from corrosive chemicals or gases and dust / particles accumulation.

1.6.2 Installation requirements signal converter

- Allow 10...20 cm / 3.9...7.9" of space at the sides and rear of the signal converter to permit free air circulation.
- Protect signal converter against direct solar radiation, install a sunshield if necessary.
- Signal converters installed in switchgear cabinets require adequate cooling, e.g. by fan or heat exchanger.
- Do not expose the signal converter to intense vibration.

1.7 Installation requirements sensor

**INFORMATION!**

To avoid measuring errors and malfunctioning of the flowmeter due to gas or air inclusions or an empty pipe, please observe the following precautions.

**CAUTION!**

Since gas will collect at the highest point of a pipe, installation of the flowmeter at that location should be avoided at all times. Also installation in a down going pipe should be avoided since a completely filled pipe may not be guaranteed due to cascading effects. Additionally flow profile distortion is possible.

**CAUTION!**

If you program the diameter, please note that you use the outer diameter of the pipe.

1.7.1 Inlet, outlet and recommended mounting area

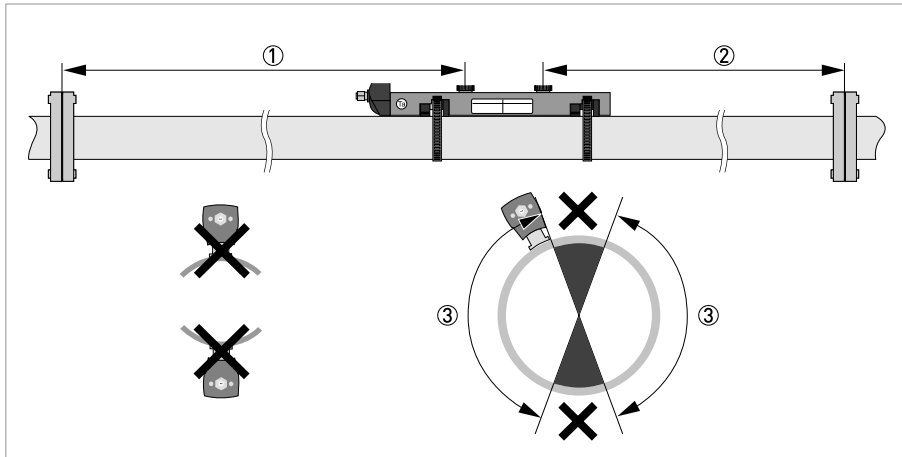


Figure 1-3: Inlet, outlet and recommended mounting area

- ① Min. 10 DN
- ② Min. 5 DN
- ③ OK, 120°



CAUTION!

Especially for XT (eXtended Temperature) versions:

- *Always install the sensor at a non-insulated part of the pipe. Remove any insulation if necessary!*
- *Bend radius of cable plus connection box needs 10 cm / 4" additional non insulated pipe section.*
- *Always wear protections gloves.*

1.7.2 Long horizontal pipes

- Install on slightly ascending pipe section.
- If not possible, ensure adequate velocity to prevent air, gas or vapor from collecting in upper part.
- In partially filled pipes, the clamp-on flowmeter will report incorrect flow rates, or not measure.

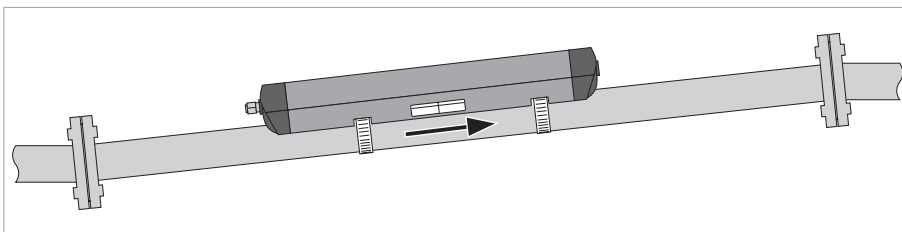


Figure 1-4: Long horizontal pipes

1.7.3 Open feed or discharge

Install meter on a lowered section of the pipe to ensure a full pipe condition through the meter.

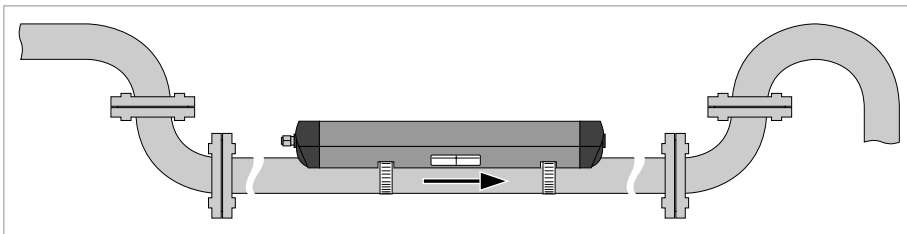


Figure 1-5: Open feed or discharge

1.7.4 Down going pipeline over 5 m /16 ft length

Install air vent downstream of the flow meter to prevent vacuum. Although this will not harm the meter, it may cause gases to come out of solution (cavitate) and interfere with proper measurements.

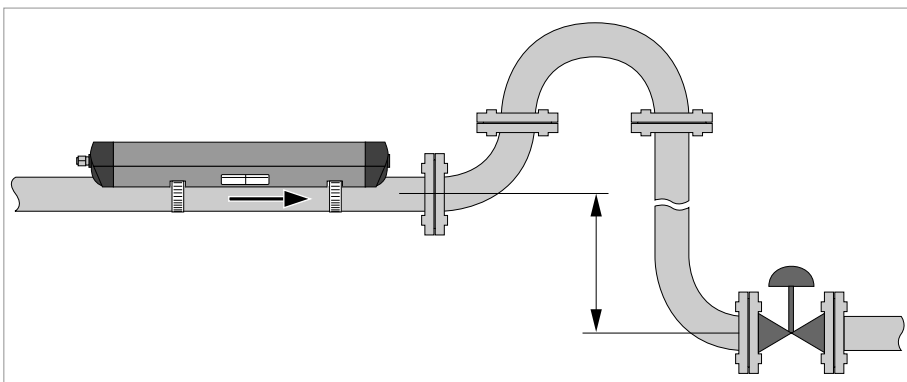


Figure 1-6: Down going pipeline over 5 m /16 ft length

1.7.5 Position of control valve

Always install control valves downstream of flowmeter in order to avoid cavitation or distortion of flow profile.

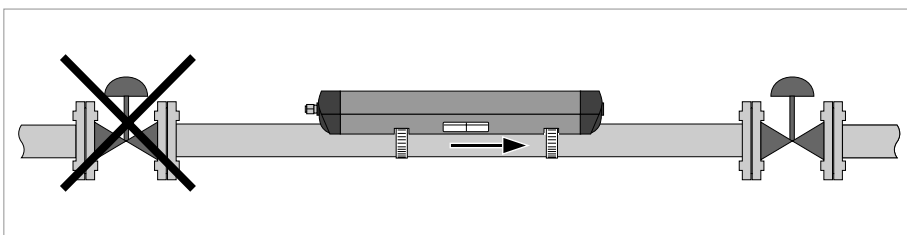


Figure 1-7: Position of control valve

1.7.6 Position of pump



CAUTION!

Never install flowmeter at a pump suction side in order to avoid cavitation or flashing in the flowmeter.

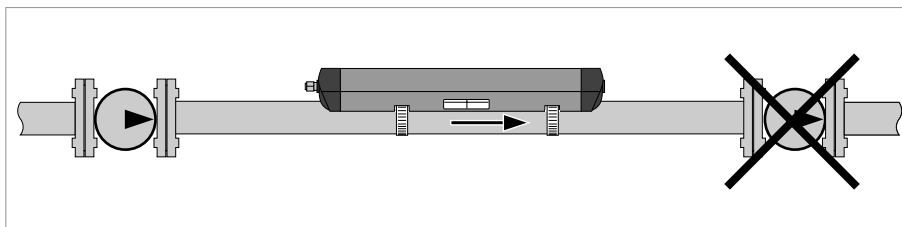


Figure 1-8: Position of pump

1.7.7 Pipe diameters and sensor construction

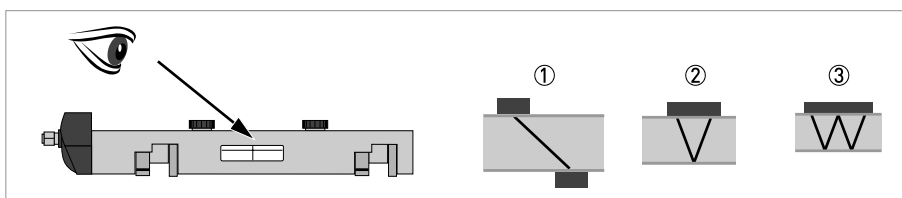


Figure 1-9: Measuring modes

- ① Z-mode
- ② V-mode
- ③ W-mode

Rail version	Diameter range	Preferred measuring modes
Small	DN15...100 / 0.5...4"	< DN25: W-mode (4 traverses)
		≥ DN25: V-mode (2 traverses)
Medium	DN50...400 / 2...16"	V-mode (2 traverses)
Large	DN200...4000 / 8...160"	Z-mode (1 traverse)

1.7.8 Pipe and media parameters



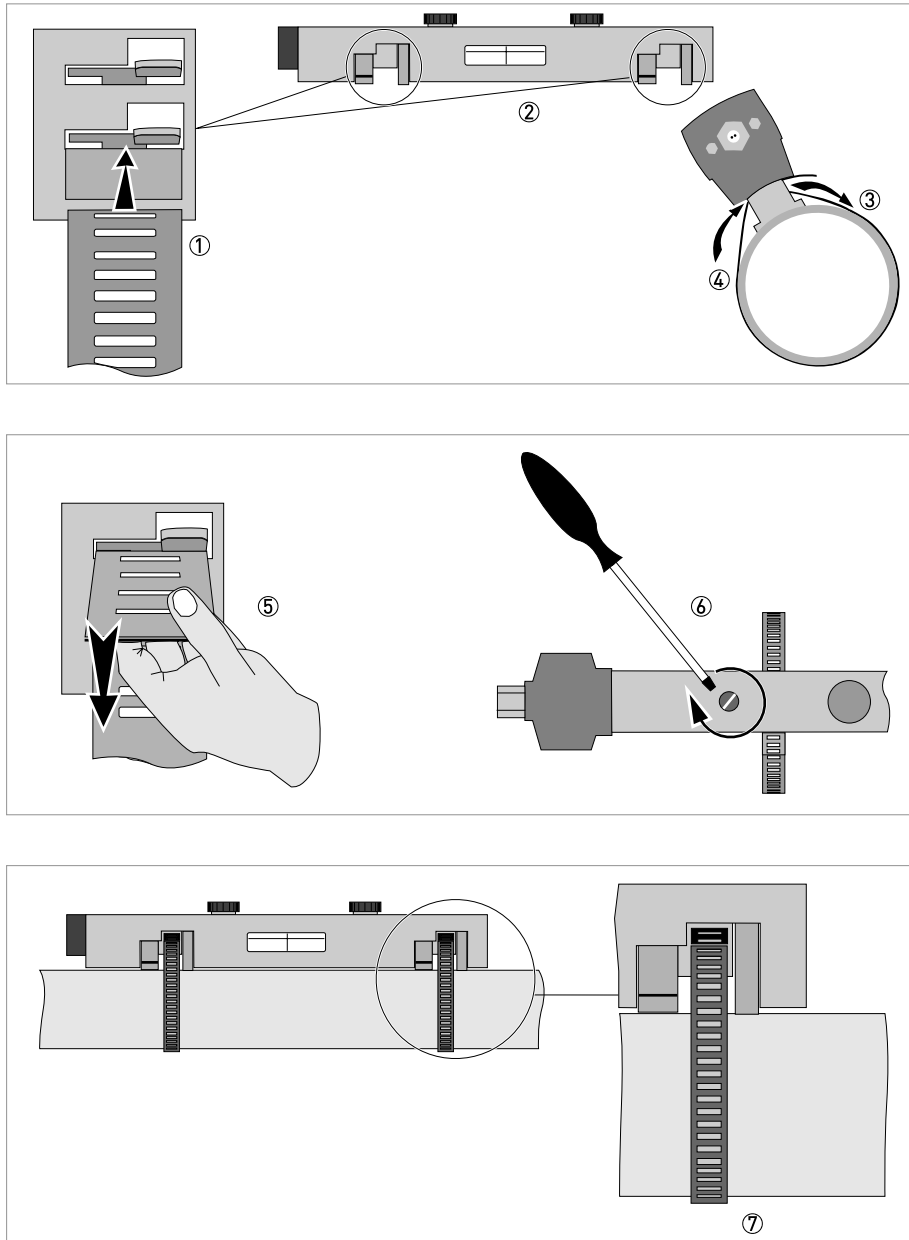
INFORMATION!

Detailed databases of most pipe and media parameters are on the supplied CD.

1.8 Installation of the flowmeter

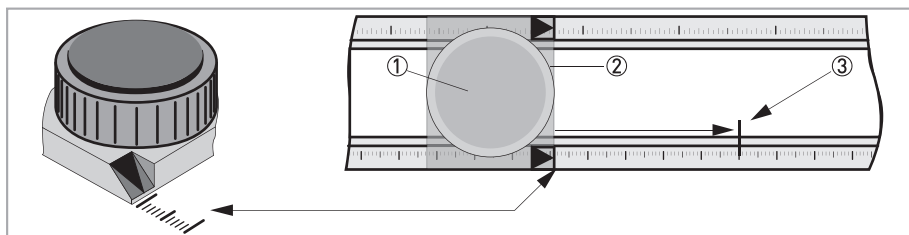
1.8.1 General mechanical installation

Installation of the rails with the metal straps



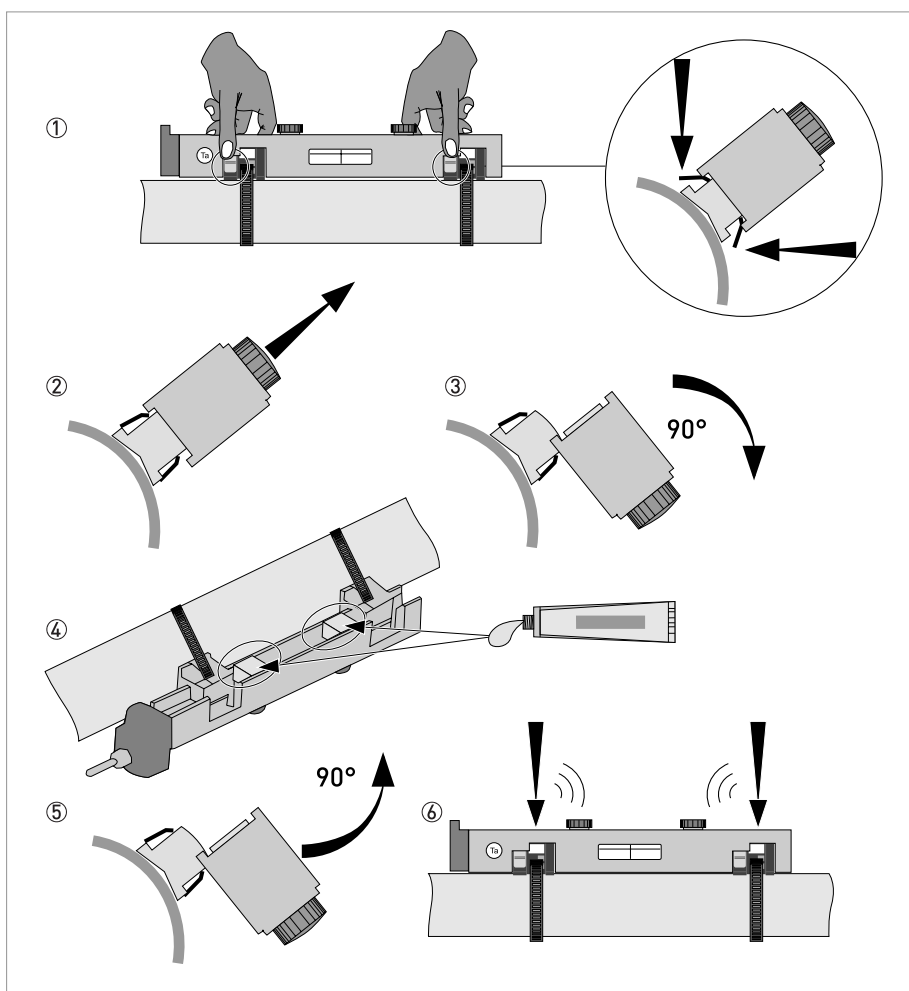
- ⑧: Repeat steps ①...⑦ at the other side of the rail.

Change the position of the transducer



- Unlock the floating transducer ② by turning the locking knob ① counter clockwise.
- Slide the transducer ② to the advised mounting distance ③ (menu X9.4).
- Lock the transducer by turning the locking knob ① clockwise.

Greasing the transducer surfaces



**INFORMATION!**

Not applicable for stainless steel / XT versions. These are delivered without cover.

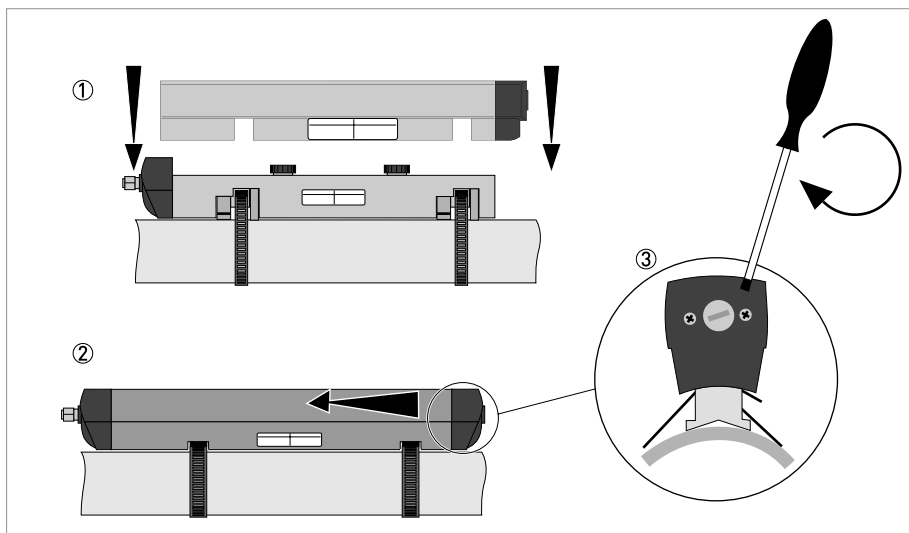
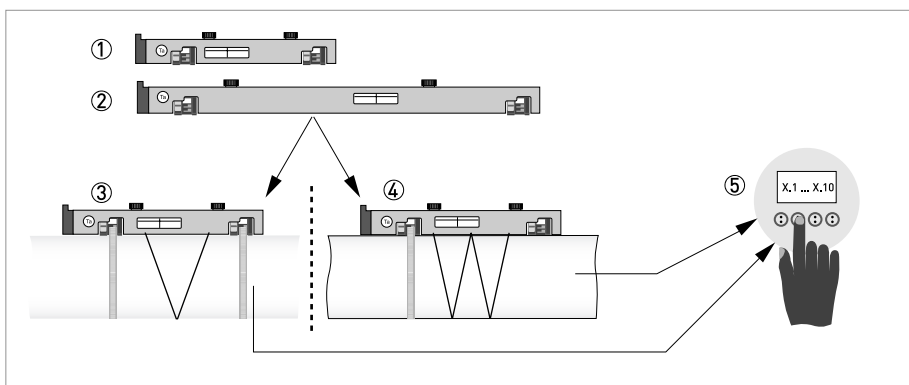
Mounting the cover**1.8.2 Installation instructions for small and medium version**

Figure 1-10: Procedure for installation of small or medium version

- ① Rail, small version
- ② Rail, medium version
- ③ Choose for V-mode or ...
- ④ Choose for W-mode
- ⑤ Make settings in converter

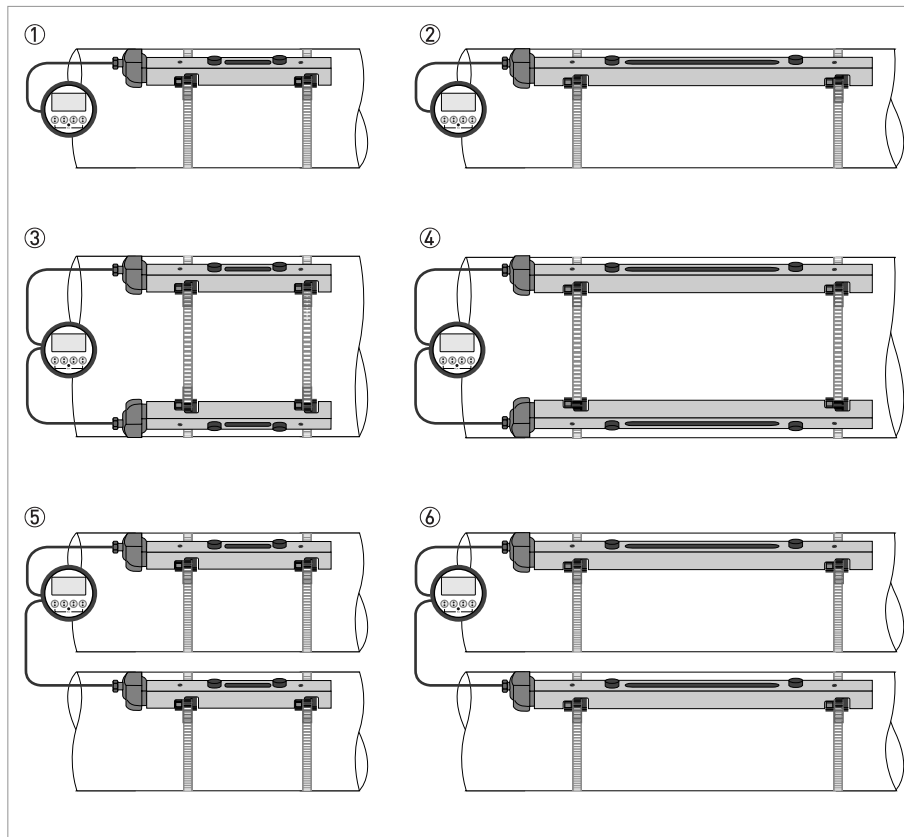


Figure 1-11: Device versions

- ① Small version: single pipe / single path
- ② Medium version: single pipe / single path
- ③ Small version: single pipe / dual path
- ④ Medium version: single pipe / dual path
- ⑤ Small version: dual pipe / single path
- ⑥ Medium version: dual pipe / single path

1.8.3 Installation instructions for large version

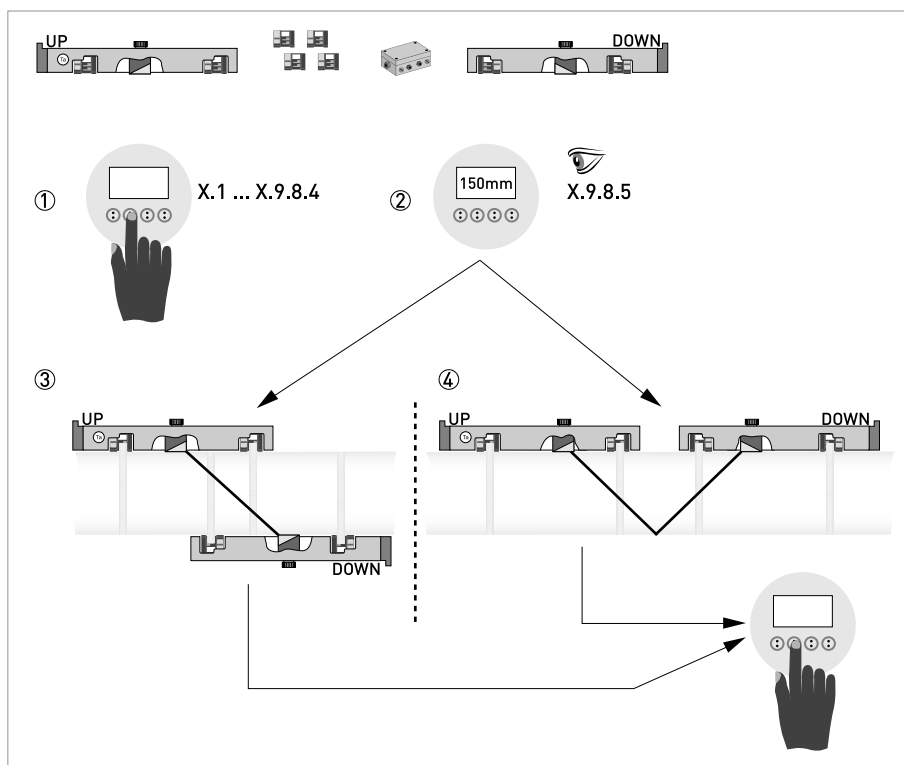


Figure 1-12: Procedure for installation of large version

- ① Enter the values for the installation menu, X1...X9.8.4
- ② Read the advised mounting distance in menu X9.8.5
- ③ Choose for Z-mode (default) or ...
- ④ Choose for V-mode
- ⑤ Finish the installation menu

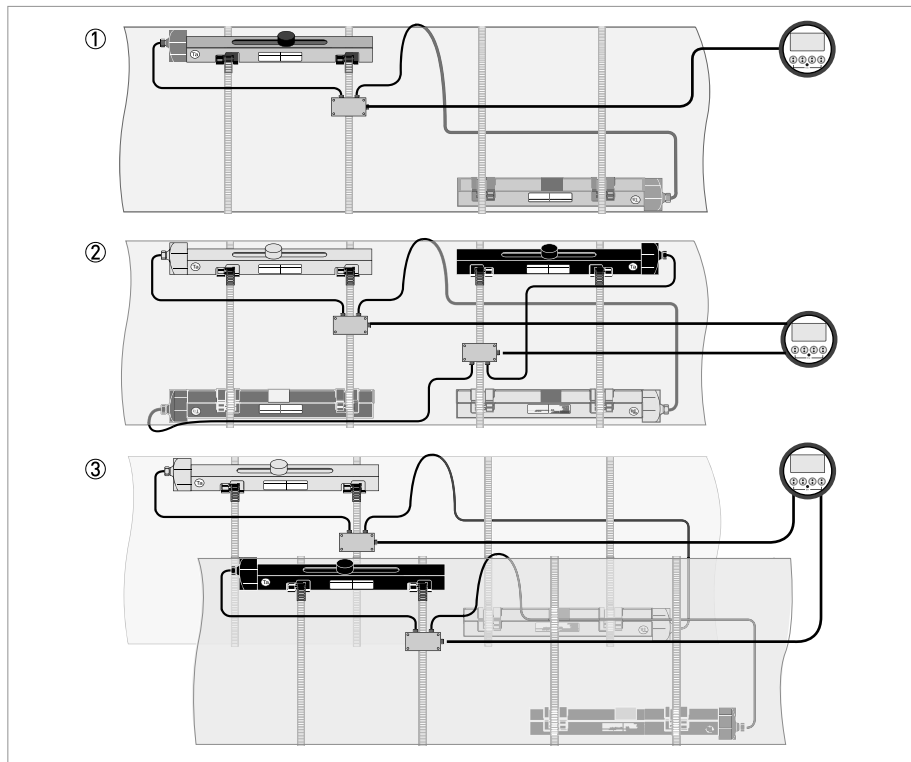


Figure 1-13: Device versions

- ① Single pipe, single path
- ② Single pipe, dual path
- ③ Dual pipe

1.9 Mounting of converter



CAUTION!

Always use the supplied signal cable. Keep the distance between the sensor and the signal converter as short as possible.

1.9.1 Mounting of TWS 9000 F



Perform the following procedures:

- Mount converter with mounting plate on wall or standpipe.
- Observe maximum allowed length of 30 m / 98.4 ft for the signal cable

1.9.2 Turning the display of the field housing version

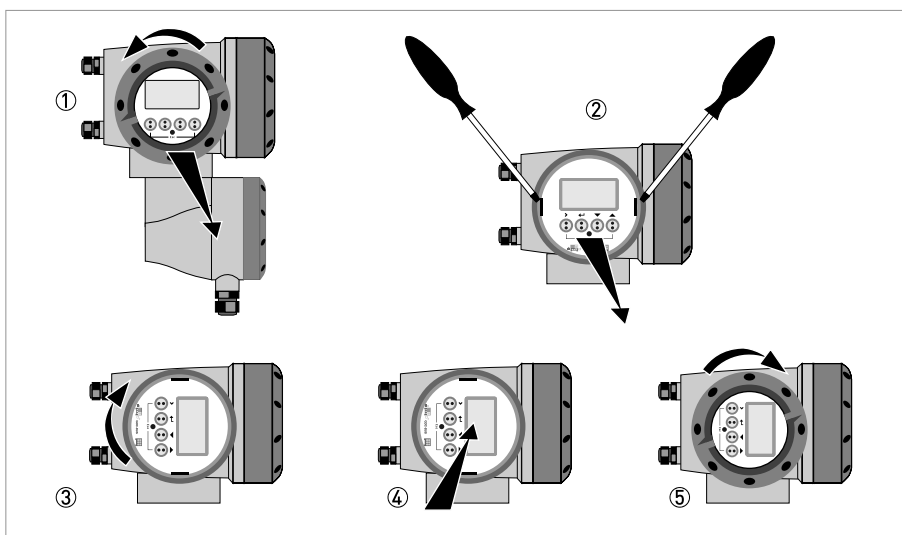


Figure 1-14: Turning the display of the field housing version



The display of the field housing version can be turned in 90° increments.

- ① Unscrew the cover from the display and operation control unit.
- ② Using a suitable tool, pull out the two metal puller devices to the left and right of the display.
- ③ Pull out the display between the two metal puller devices and rotate it to the required position.
- ④ Slide the display and then the metal puller devices back into the housing.
- ⑤ Re-fit the cover and tighten it by hand.



CAUTION!

The ribbon cable of the display must not be folded or twisted repeatedly.



INFORMATION!

Each time a housing cover is opened, the thread should be cleaned and greased. Use only resin-free and acid-free grease.

Ensure that the housing gasket is properly fitted, clean and undamaged.

1.9.3 Mounting of TWS 9000 W



Perform the following procedures:

- Remove aluminium mounting plate from rear of the signal converter, and attach to wall or standpipe.
- Mount signal converter.
- Position lock washers and nuts on the housing bolts, tighten nuts slightly.
- Align housing, tighten nuts firmly.
- Observe max. allowed length of 30 m / 98.4 ft for the signal cable.

2.1 Safety instructions



DANGER!

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!



DANGER!

Observe the national regulations for electrical installations!



DANGER!

For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.



WARNING!

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

2.2 Construction of the various housing versions

2.2.1 TWS 9000 F

The terminal compartments are accessible after unscrewing cover ② and ⑥.

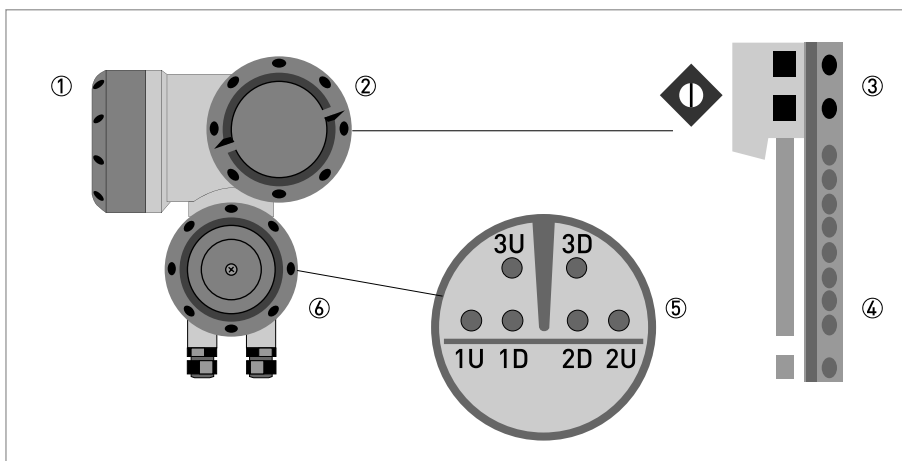


Figure 2-1: Construction (field version)

- ① Cover, electronics compartment
- ② Cover, terminal compartment for power supply and inputs/outputs
- ③ Cable entry for power
- ④ Cable entry for inputs/outputs
- ⑤ Cable entry for sensor cable
- ⑥ Cover, sensor terminal compartment

2.2.2 TWS 9000 W

The terminal compartments are accessible after opening cover ②.

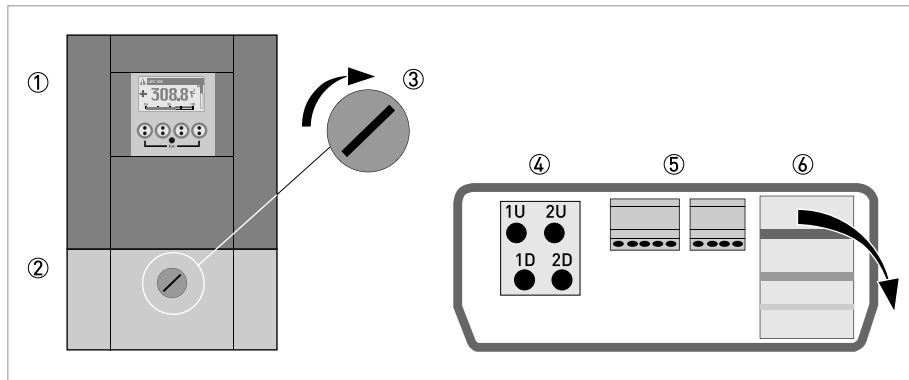


Figure 2-2: Construction of remote version

- ① Cover, electronics compartment
- ② Cover for the three separate terminal compartments for power, sensor connection and inputs/outputs
- ③ Locking screw, 1/2 turn left/right to open/close cover ②
- ④ Sensor terminal compartment
- ⑤ Terminal compartment for inputs/outputs
- ⑥ Power terminal compartment, open separate shock-hazard protection cover

2.3 Electrical connection



CAUTION!

To ensure smooth functioning, always use the signal cables included in the delivery.

The flow sensor is connected to the signal converter via the single signal cable.

2.3.1 Signal cable to flow sensor

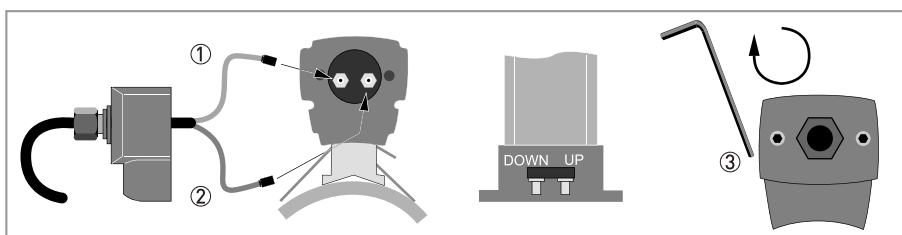


Figure 2-3: Connecting the signal cable to the rail (small and medium version)

- ① Connect the green cable to "DOWN"
- ② Connect the blue cable to "UP"
- ③ Turn the screws clockwise to secure the cap

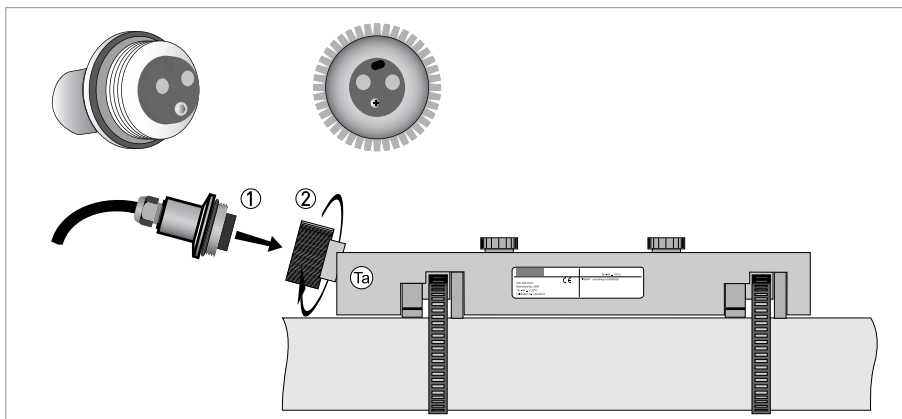


Figure 2-4: Connect the signal cable in case of stainless steel / XT version.

- ① Put in the connector.
- ② Turn knob to secure the connector.



CAUTION!

For XT versions: check if the signal cable is heat protected with the protection sleeve of 1 meter / 40".

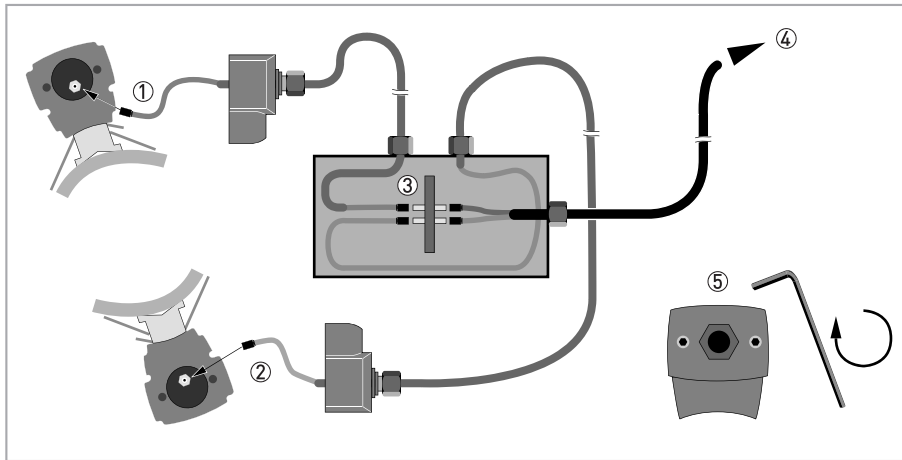


Figure 2-5: Connections in cable box (large version)

- ① Connect the blue cable to the UP rail.
- ② Connect the green cable to the DOWN rail.
- ③ Make connections in cable box.
- ④ Cable to converter
- ⑤ Turn the screws clockwise to secure the caps.

2.3.2 Signal cable and power supply signal converter

**INFORMATION!**

The power terminals in the terminal compartments are equipped with additional hinged lids to prevent accidental contact.

**DANGER!**

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

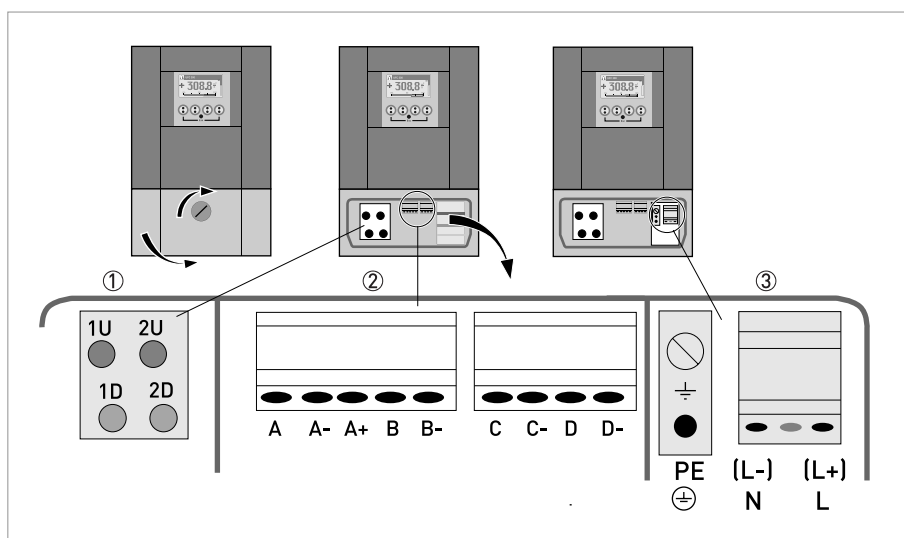


Figure 2-6: Construction of wall version

- ① Connect blue cable to 1U (to 2U for 2nd sensor) and the green cable to 1D (2D for 2nd sensor)
- ② Communication I/O
- ③ Power supply: 24 VAC/DC or 100...240 VAC

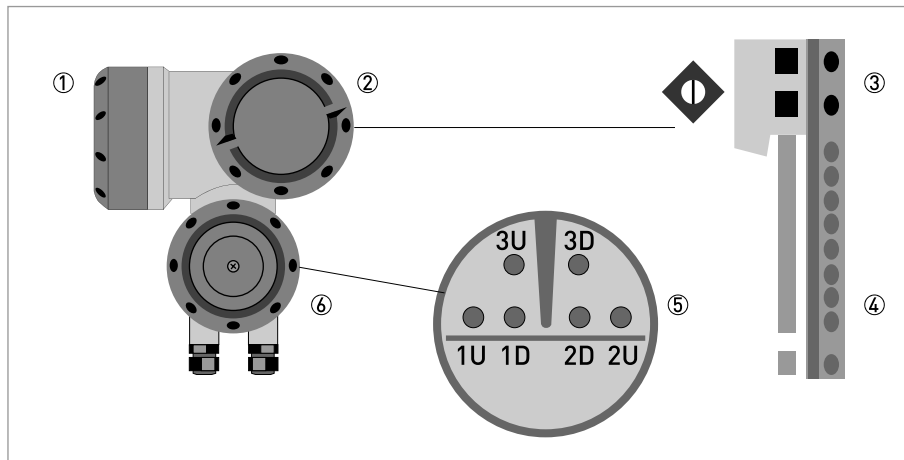


Figure 2-7: Construction (field version)

- ① Cover, electronics compartment
- ② Cover, terminal compartment for power supply and inputs/outputs
- ③ Cable entry for power
- ④ Cable entry for inputs/outputs
- ⑤ Cable entry for sensor cable
- ⑥ Cover, sensor terminal compartment

100...230 VAC (-15% / +10%)

- Connect the protective ground conductor PE of the mains power supply to the separate terminal in the terminal compartment of the signal converter.
- Connect the live conductor to the L terminal and the neutral conductor to the N terminal.

24 VAC/DC (-15% / +10%)

- For reasons to do with the measurement process, connect a functional ground FE to the separate U-clamp terminal in the terminal compartment of the signal converter.
- When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).

2.3.3 Signal cable to converter



CAUTION!

Connect coax cables and follow indications up/down (1U 1D; 2U 2D; 3U 3D).

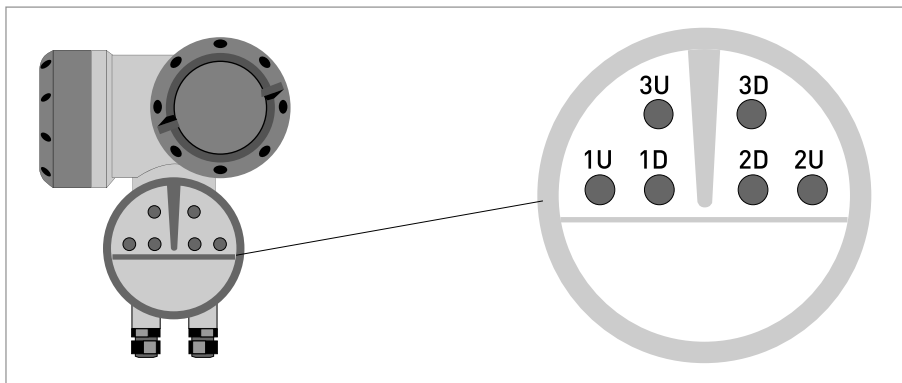


Figure 2-8: Connect signal cable (field version)

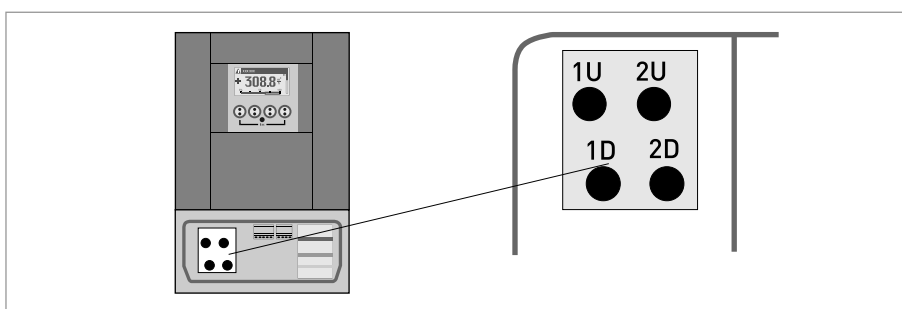


Figure 2-9: Connect signal cable (wall-mounted version)

2.3.4 Laying electrical cables correctly

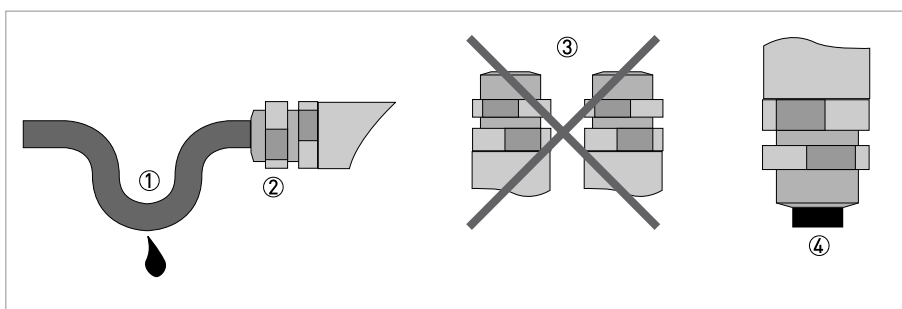


Figure 2-10: Protect housing from dust and water



- ① Lay the cable in a loop just before the housing.
- ② Tighten the screw connection of the cable entry securely.
- ③ Never mount the housing with the cable entries facing upwards.
- ④ Seal cable entries that are not needed with a plug.

2.4 Inputs and outputs, overview

2.4.1 Fixed, non-alterable input/output versions

This measuring transducer is available with various input/output combinations.

CG-No.	Connection terminals								
	A+	A	A-	B	B-	C	C-	D	D-

Basic input/output (I/O) standard

1 0 0		I _p + HART® passive ①	S _p / C _p passive ②	S _p passive	P _p / S _p passive ②
	I _a + HART® active ①				

EEx-i inputs/outputs (I/Os) option

2 0 0				I _a + HART® active	P _N / S _N NAMUR ②
3 0 0				I _p + HART® passive	P _N / S _N NAMUR ②
2 1 0		I _a active	P _N / S _N NAMUR C _p passive ②	I _a + HART® active	P _N / S _N NAMUR ②
3 1 0		I _a active	P _N / S _N NAMUR C _p passive ②	I _p + HART® passive	P _N / S _N NAMUR ②
2 2 0		I _p passive	P _N / S _N NAMUR C _p passive ②	I _a + HART® active	P _N / S _N NAMUR ②
3 2 0		I _p passive	P _N / S _N NAMUR C _p passive ②	I _p + HART® passive	P _N / S _N NAMUR ②

① function changed by reconnection

② changeable

- The grey boxes in the tables denote unassigned or unused connection terminals.
- Connection terminal A+ is only operable in the basic input/output version.

Description of abbreviations and CG identifier for possible optional modules on terminals A and B

Abbreviation	Identifier for CG No.	Description
I _a	A	Active current output (including HART = HART® capability)
I _p	B	Passive current output (including HART = HART® capability)
P _a / S _a	C	Active pulse, frequency, status output or limit switch (changeable)
P _p / S _p	E	Passive pulse, frequency, status output or limit switch (changeable)
P _N / S _N	F	Passive pulse, frequency, status output or limit switch according to NAMUR (changeable)
C _a	G	Active control input
C _p	K	Passive control input
C _N	H	Active control input to NAMUR Signal converter monitors cable breaks and short circuits acc. to EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output.
IIn _a	P	Active current input
IIn _p	R	Passive current input
-	8	No additional module installed
-	0	No further module possible

2.4.2 Alterable input/output versions

The signal converter is available with various input/output combinations.

CG-No.	Connection terminals								
	A+	A	A-	B	B-	C	C-	D	D-

Modular inputs/outputs option

4 _ _		max. 2 option modules for term. A + B	I _a + HART® active	P _a / S _a active ①
8 _ _		max. 2 option modules for term. A + B	I _p + HART® passive	P _a / S _a active ①
6 _ _		max. 2 option modules for term. A + B	I _a + HART® active	P _p / S _p passive ①
B _ _		max. 2 option modules for term. A + B	I _p + HART® passive	P _p / S _p passive ①
7 _ _		max. 2 option modules for term. A + B	I _a + HART® active	P _N / S _N NAMUR ①
C _ _		max. 2 option modules for term. A + B	I _p + HART® passive	P _N / S _N NAMUR ①

① changeable

Description of abbreviations and CG identifier for possible optional modules on terminals A and B

Abbreviation	Identifier for CG No.	Description
I _a	A	Active current output (including HART = HART® capability)
I _p	B	Passive current output (including HART = HART® capability)
P _a / S _a	C	Active pulse, frequency, status output or limit switch (changeable)
P _p / S _p	E	Passive pulse, frequency, status output or limit switch (changeable)
P _N / S _N	F	Passive pulse, frequency, status output or limit switch according to NAMUR (changeable)
C _a	G	Active control input
C _p	K	Passive control input
C _N	H	Active control input to NAMUR Signal converter monitors cable breaks and short circuits acc. to EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output.
IIn _a	P	Active current input
IIn _p	R	Passive current input
-	8	No additional module installed
-	0	No further module possible

3.1 General instructions for programming

Human machine interface (HMI)

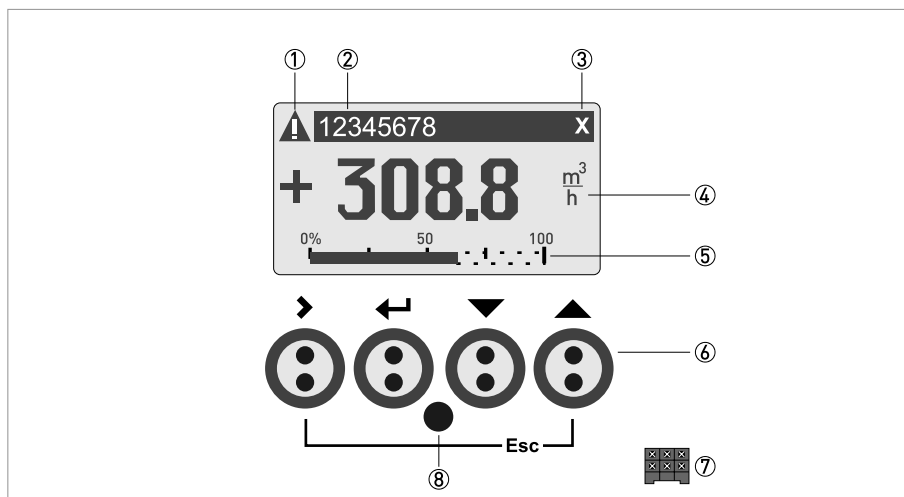


Figure 3-1: Display and operating elements (Example: flow indication with 2 measuring values)

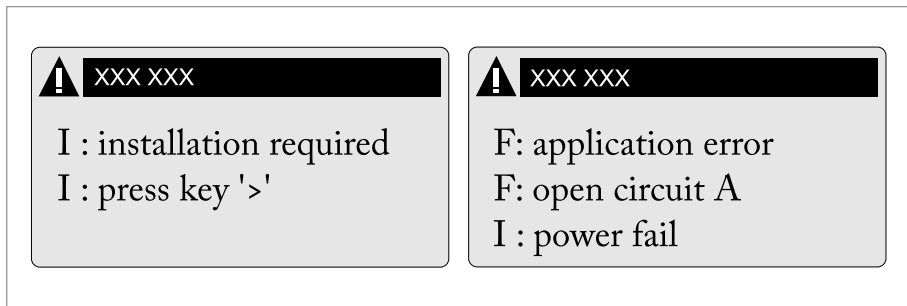
- ① Indicates a possible status message in the status list
- ② Tag number (is only indicated if this number was entered previously by the operator)
- ③ Indicates when a key has been pressed
- ④ 1st measured variable in large representation
- ⑤ Bargraph indication
- ⑥ Keys (see table below for function and representation in text)
- ⑦ Interface to the GDC bus (not present in all signal converter versions)
- ⑧ Infrared sensor (not present in all signal converter versions)

Key	Measuring mode	Menu mode	Sub-menu or function mode	Parameter and data mode
>	Switch from measuring mode to menu mode; press key for 2.5 s, "Quick Start" menu is then displayed	Access to displayed menu, then 1st submenu is displayed	Access to displayed sub-menu or function	For numerical values, move cursor (highlighted in blue) one position to the right
←	-	Return to measuring mode but prompt whether the data should be saved	Press 1 to 3 times, return to menu mode, data saved	Return to sub-menu or function, data saved
↓ or ↑	Switch between display pages: measured value 1 + 2, trend page and status page(s)	Select menu	Select sub-menu or function	Use cursor highlighted in blue to change number, unit, setting and to move the decimal point
Esc (> + ↑)	-	-	Return to menu mode without acceptance of data	Return to sub-menu or function without acceptance of data

Start installation menu



- Connect converter to power supply and power up converter.



First and second page appear intermittently



- Keep left button ">" pressed, until in display appears "release key now".

Installation menu

**CAUTION!**

- If you program the diameter, use the outer diameter of the pipe.
- For improved accuracy fill in as much details as possible.
- Fill in the actual transducer distance at menu X9.7
- Run the optimization loop until the transducer distance changes no more than 0.5%.



- > ↓ ↑ ←

X1...X7

X1	language	>	select from list using ↑ ↓ >	←
X2	GDC IR interface	>	activate / cancel	←
X3	units	>	X3.1, X3.2, ...	↑ ↓
	X3.1 size	>	select from list using ↑ ↓ >	←
	X3.2 volume flow	>	select from list using ↑ ↓ >	←
	X3.3 velocity	>	select from list using ↑ ↓ >	←
	X3.4 density	>	select from list using ↑ ↓ >	←
	X3.5 viscosity	>	select from list using ↑ ↓ >	←
X4	number of pipes	>	1 pipe / 2 pipes	↑ ↓
[X5 becomes active if one pipe is selected in X4]				
X5	number of paths	>	1 path / 2 paths	↑ ↓
[underneath X6 becomes active if one pipe is selected in X4]				
[Note: the measurement results of path 1 and path 2 are averaged !]				
[underneath X6 and X7 become active if two pipes are selected in X4]				
X6	pipe data / pipe data 1	>	X6.2, X6.3, ...	↑ ↓
	X6.2 pipe tag	>	fill in 12 pos using ↑ ↓ >	←
	X6.3 diameter	>	fill in using ↑ ↓ >	←
	X6.4 pipe material	>	select from list using ↑ ↓ >	←
	X6.5 VoS pipe material	>	read advise or fill in using ↑ ↓ >	←
	X6.6 wall thickness	>	fill in using ↑ ↓ >	←
	X6.7 liner material	>	select from list using ↑ ↓ >	←
	X6.8 VoS liner material	>	read advise or fill in using ↑ ↓ >	←
	X6.9 liner thickness	>	fill in using ↑ ↓ >	←
	X6.10 fluid	>	select from list using ↑ ↓ >	←
	X6.11 VoS fluid	>	read advise or fill in using ↑ ↓ >	←
	X6.12 density	>	read advise or fill in using ↑ ↓ >	←
	X6.13 viscosity	>	fill in using ↑ ↓ >	←
X7	pipe data 2	>		↑ ↓
	X7.1 copy pipe 1 data	>	start to copy ?	↑ ↓

			if no:	copy pipe 1 data appears Go to X7 Fill in menu X7.2 up to X7.13: is similar to X6.2 up to X6.13	←
			if yes:	copy pipe 1 data appears after copy process	←

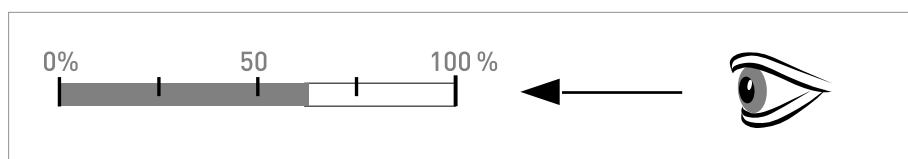
X9...X10

X9	install transd. 1	>	X9.1, X9.2,...	↑ ↓	
	X9.1	transducer set	> read preset Ta,Tb,Tc / confirm or overrule using ↑ ↓ >		
	X9.2	calibration number	read		←
	X9.3	number of traverses	> read preset 1,2,4 / confirm or overrule using ↑ ↓ >		
	X9.4	mount transducers at	read advise		←
		please wait: decounting 30 seconds			
	X9.5	act. flow, preliminary	read		←
	X9.6	check signal	read (0 - 100 %)		←
	X9.7	actual distance	> fill in using ↑ ↓ >		←
	[start optimization loop]				
	X9.8.1	optimize distance ?	yes/no		←
			if no:	go to X9.9	
			if yes:	continue with X9.8.2	
	X9.8.2	act. VoS fluid	read		←
	X9.8.3	continue ?	yes/no		←
			if no:	go to X9.9	
			if yes:	continue with X9.8.4	
	X9.8.4	VoS fluid	read / confirm or overrule using ↑ ↓ >		←
	X9.8.5	mount transducers at	read advise		←
	[end optimization loop; next menu appearing is X9.8.1]				
	(underneath X10 becomes active if two pipes or two paths are selected in X4 or X5)				
X10	install transd. 2	>		↑ ↓	
			submenus identical to X9.1 up to X9.12		
					←

3.2 Start measurement of small / medium version



- Power up the converter (do not mount and/or connect the rails yet)
- Fill in menu X1...X7 (see section "Installation menu" in chapter "General instructions for programming")
- X9.1: Check the reading with the sensor code (Ta/Tb) on rail. Press enter
- X9.2: Check the reading with the calibration number on the nameplate. Press enter
- X9.3: Check the factory preset number of traverses (default: 2, for DN<25: 4)
- X9.4: Read the advised mounting distance and position the transducer at that distance . Press enter
- X9.5: Read the preliminary volume flow. Press enter
- X9.6: Read the actual signal strength



INFORMATION!

Advice on signal strength:

Signal > 75%: good signal, optimization loop not needed

Signal 50...75%: fairly good signal, optimization loop can improve the signal

Signal 10...50%: low signal, optimization loop needed

Signal < 10%: bad or no signal, check settings in menu X6, increase transducer distance and/or go into the optimization loop.



- X9.7: Confirm or adjust the reading with the actual distance on the rail.
- X9.8: Optimization loop. Repeat steps X9.8.1...X9.8.5 until the advised mounting distance does not change more than 0.5%.
 - X9.8.1: Optimise distance?
 - X9.8.2: Read the velocity of sound of the fluid
 - X9.8.3: Continue?
 - X9.8.4: Confirm or adjust the velocity of sound
 - X9.8.5: Read the advised mounting distance and reposition the transducer
- X9.9: Read the preliminary volume flow
- X9.10: Path ready? Enter "Yes". If you have:
 - 1 path or pipe: you are finished, proceed with X9.12
 - 2 paths: go to X9 for the 2nd path
 - 2 pipes: go to X10 for the 2nd pipe
- X9.12: End Installation? Enter "Yes" to save the installation. The measurement screen will appear.
- Mount the cover (see the section "mounting the cover" in chapter "General mechanical installation")

3.3 Start measurement of large version

Prepare installation

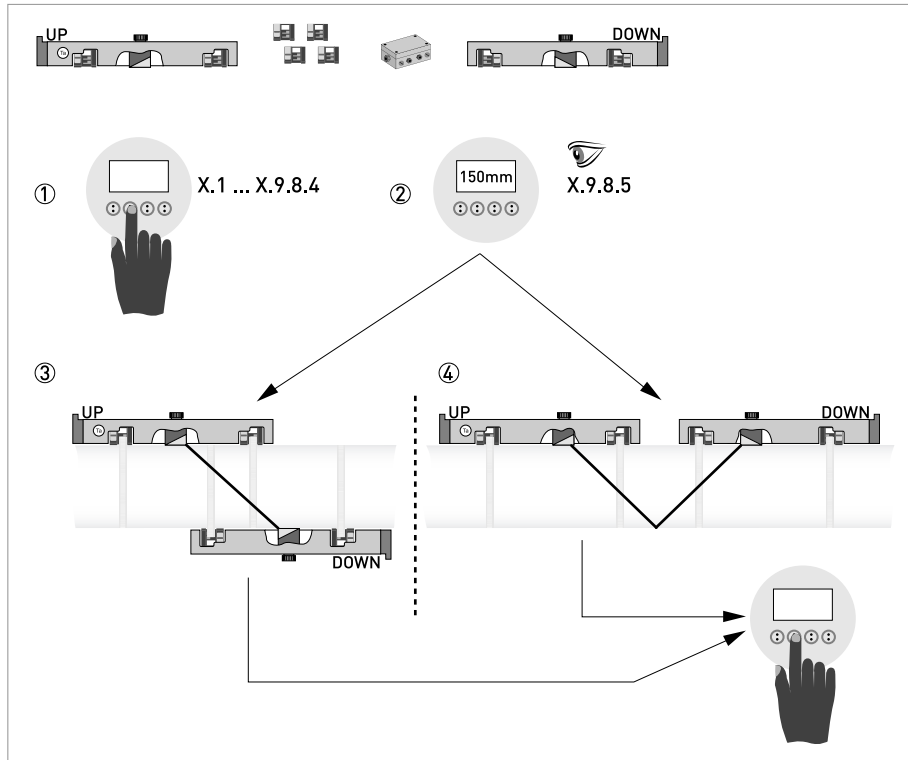


Figure 3-2: Procedure for installation of large version

- ① Enter the values for the installation menu, X1...X9.8.4
- ② Read the advised mounting distance in menu X9.8.5
- ③ Choose for Z-mode (default) or ...
- ④ Choose for V-mode
- ⑤ Finish the installation menu



- Power up the converter (do not mount and/or connect the rails yet)
- Fill in menu X1...X7 as described in section "Installation menu" in chapter "General instructions for programming". Select "1 path" initially in X5
- X9.1: Check the reading with the sensor code (Ta/Tb) on rail
- X9.2: Check the reading with the calibration number on the nameplate
- X9.3: Check the factory preset number of traverses (default: 1 for Z-mode)
- X9.4: Read the advised mounting distance. Write it down, you need it later
- X9.5: Press enter
- X9.6: Press enter. Wait for 30 seconds
- X9.7: Press enter
- X9.8: Optimization loop. Enter "No" in X9.8.1
- X9.9: Press enter. Wait for 30 seconds
- X9.10: Path ready? Enter "Yes"
- X9.12: End Installation? Enter "Yes"

**CAUTION!**

Choose between Z and V mode before you proceed. The Advised Distance (menu X9.4) must be > 246 mm / 9,7" for V-mode.

Set transducer positions for both rails according to the table below.

Advised distance [mm]	Transducer position [mm]
100...250	-65
>250	0

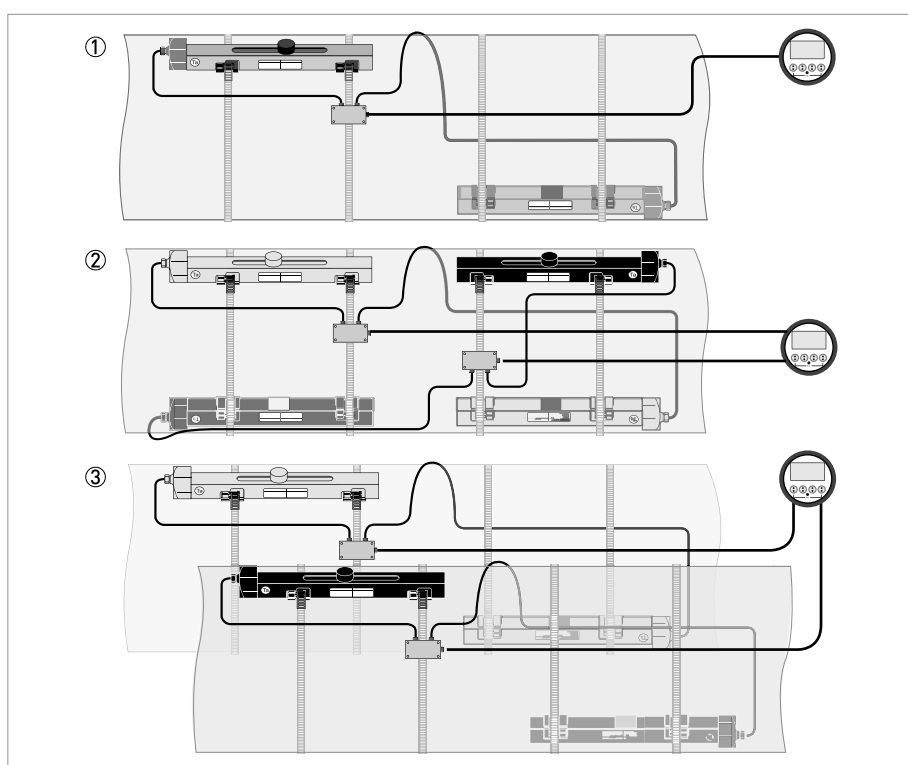


Figure 3-3: Device versions

- ① Single pipe, single path
- ② Single pipe, dual path
- ③ Dual pipe

3.4 Mechanical installation for large version



INFORMATION!

You need a calculator, measuring band and pen & paper to install a large version.

Mounting the UP rail



CAUTION!

Make sure that you mount the rail parallel to the pipe. Mount the fixing units and the cable box as shown below.

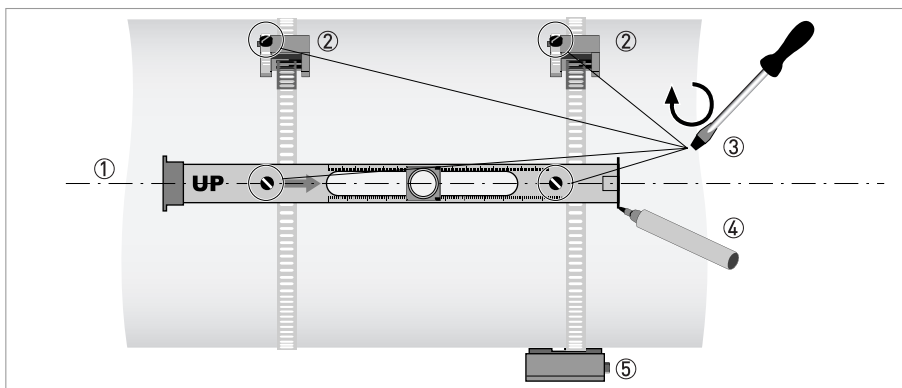


Figure 3-4: Mounting the large rail

- ① Align the UP rail with the pipeline.
- ② Fixing units
- ③ Turn screws clockwise to secure.
- ④ Mark the position.
- ⑤ Cable box

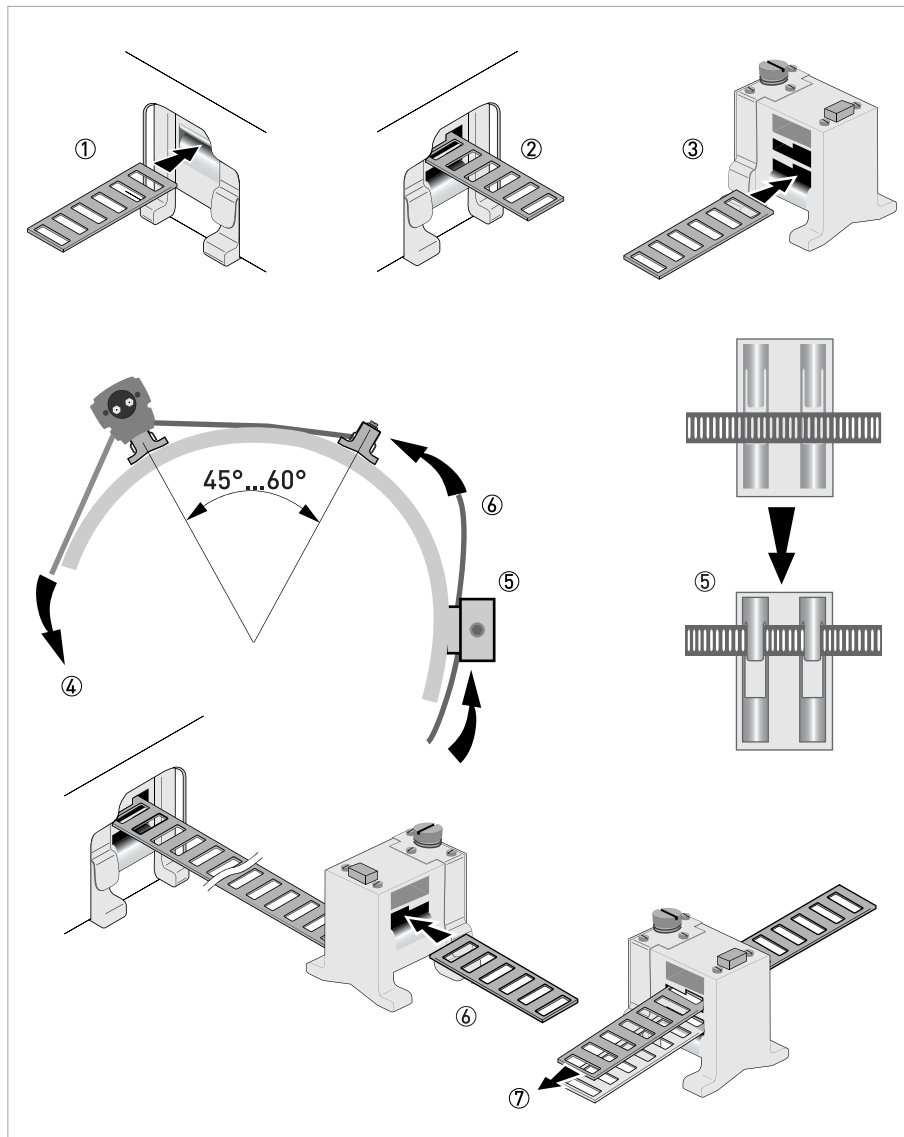


Figure 3-5: Mounting large version rail

- ① Pull the metal strap through the upper slit of the UP rail.
- ② Take the metal strap around the pipe (45°...60°).
- ③ Push the end of the metal strap in the lower slit of the fixing unit.
- ④ Take the other side of the metal strap around the pipe to the fixing unit.
- ⑤ Mount the cable box (only for downstream metal strap).
- ⑥ Push the metal strap through the upper slit of the fixing unit.
- ⑦ Pull the metal strap moderately tight by hand.



- Secure by turning screws clockwise.

Mounting the DOWN rail in Z-mode

Set transducer positions for both rails according to the table below.

Advised distance [mm]	Transducer position [mm]
100...250	-65
>250	0

Measure the outer diameter of the pipe with a measuring band.

For Z-mode, you must install the DOWN rail at the opposite location at the pipe. There are two possible ways to find the exact location:

1. FIND THE LOCATION WITH A FIXED REFERENCE POINT

Calculate the half of the outer diameter. Mark this 180° alignment line on the pipe.

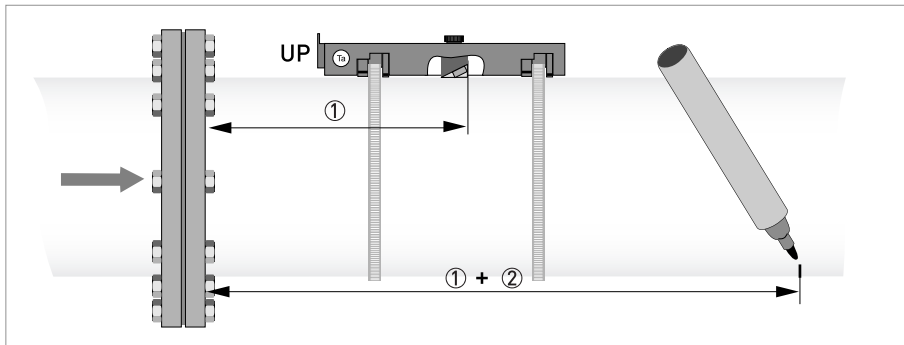
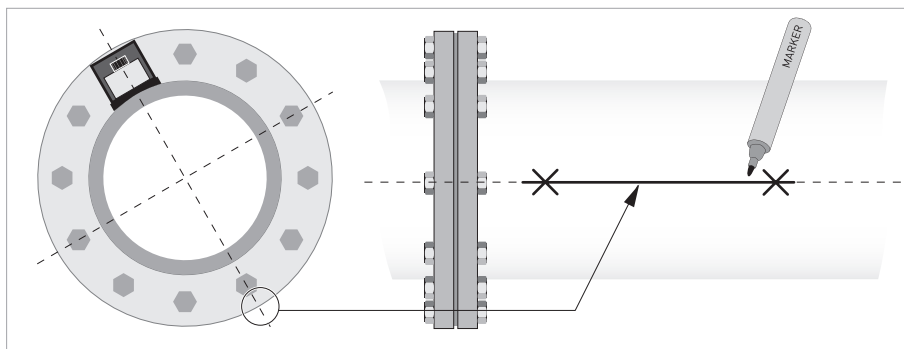


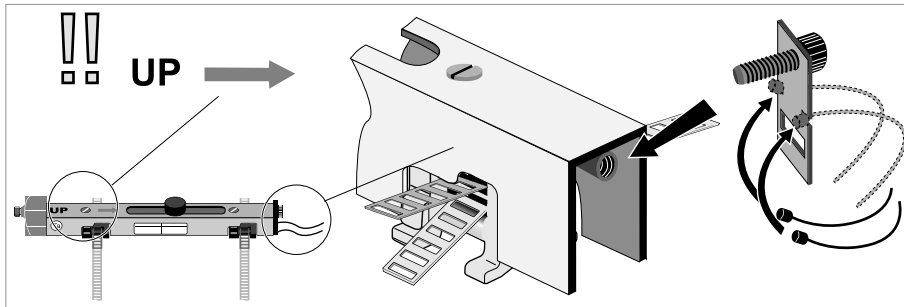
Figure 3-6: Find the opposite location with a reference point

- ① Measure the distance between the transducer of the UP rail and the reference point.
- ② Add the Advised Distance and mark the location on the alignment line.

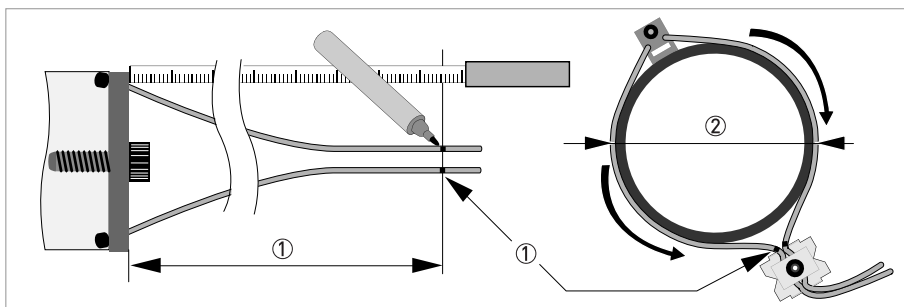


- Mount the DOWN rail in such a way that the transducer is at the marked location.

2. FIND THE LOCATION WITH THE SUPPLIED POSITIONING TOOL



Mount the positioning tool to the UP rail as shown.



- ① Mark the cables at a distance of $1.63 \times$ outer diameter.
- ② Outer diameter of pipeline



INFORMATION!

For large diameters you can use the weight of the metal plates to throw the cable around the pipe. First release one of the cables in that case!

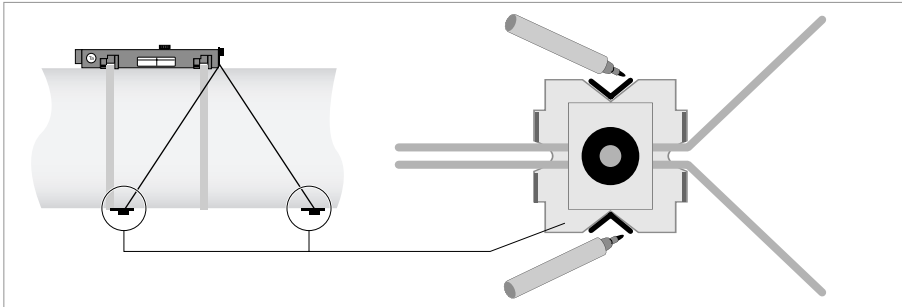


Figure 3-7: Mark the pipelines with the V-mark

Pull the V-shaped plate in the downstream direction as much as possible. Pay attention that the cables are not obstructed.
Put the two V-marks on the pipeline.
Do the same in the upstream direction.



CAUTION!

Repeat above steps to check if you find the same points.

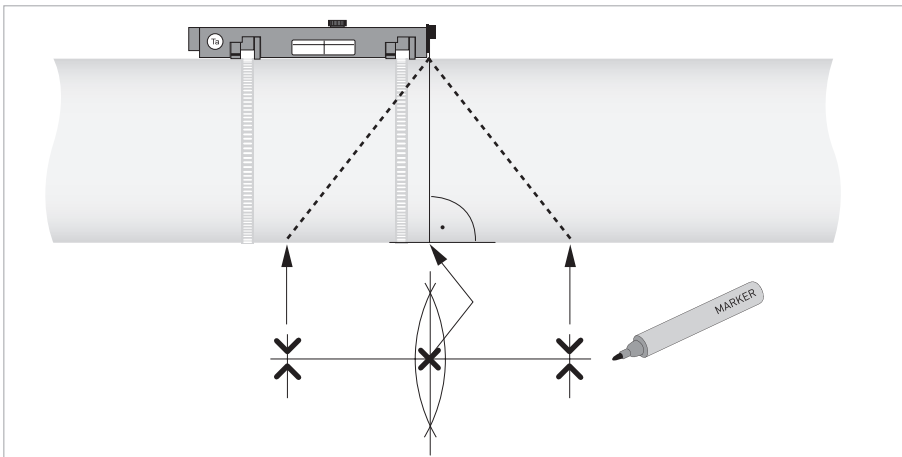


Figure 3-8: Marking the opposite location

Calculate the middle of the alignment line between the 4 V-marks as shown.

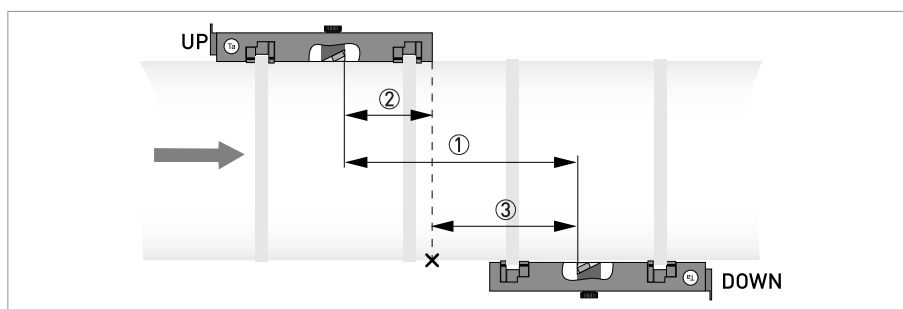


Figure 3-9: Finding the location for the DOWN rail

- ① Advised Distance as shown in menu X9.4
- ② Measure the distance between the transducer and the end of the UP rail.
- ③ Determine and mark the location of the transducer of the DOWN rail: $\textcircled{3} = \textcircled{1} - \textcircled{2}$

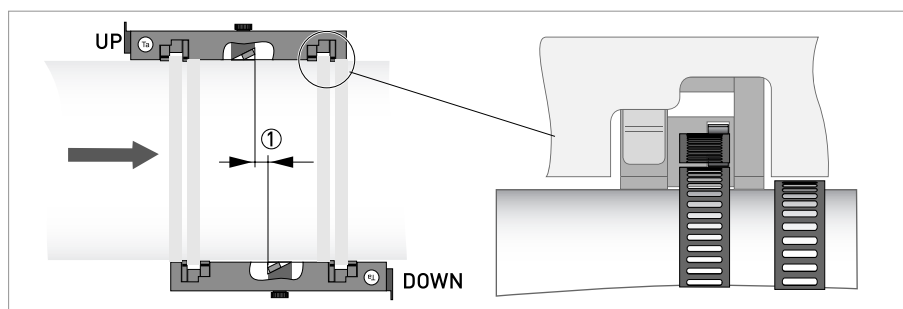


- Mount the DOWN rail in such a way that the transducer is at the marked location.
- Grease all transducers, see "General mechanical installation".



INFORMATION!

It can be necessary to install the DOWN rail as shown below.



Mounting the DOWN rail in V-mode

For V-mode, you must install the DOWN rail in line with the UP rail. It is easier to install than the Z-mode, but you need more free pipe length. V-mode is possible for DN450/600...2000 (minimum depends on application).

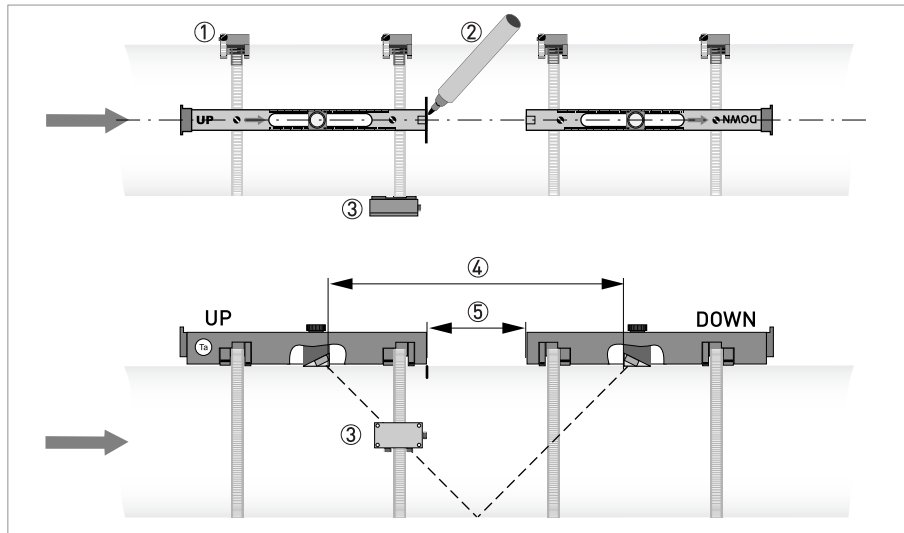


Figure 3-10: Mounting large version in V-mode

- ① Fixing units
- ② Reference marking
- ③ Cable box
- ④ Advised Distance, X9.4
- ⑤ Minimum distance between UP and DOWN rail: 110 mm / 4.3"

Electrical connections

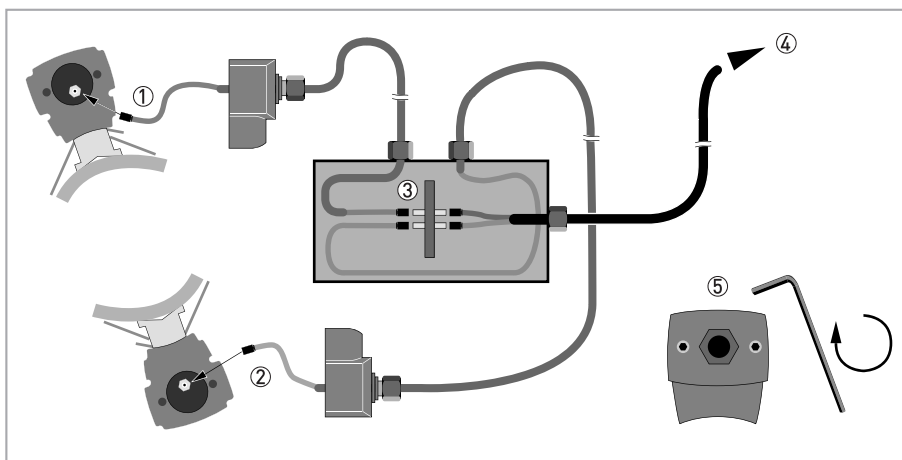


Figure 3-11: Connections in cable box (large version)

- ① Connect the blue cable to the UP rail.
- ② Connect the green cable to the DOWN rail.
- ③ Make connections in cable box.
- ④ Cable to converter
- ⑤ Turn the screws clockwise to secure the caps.

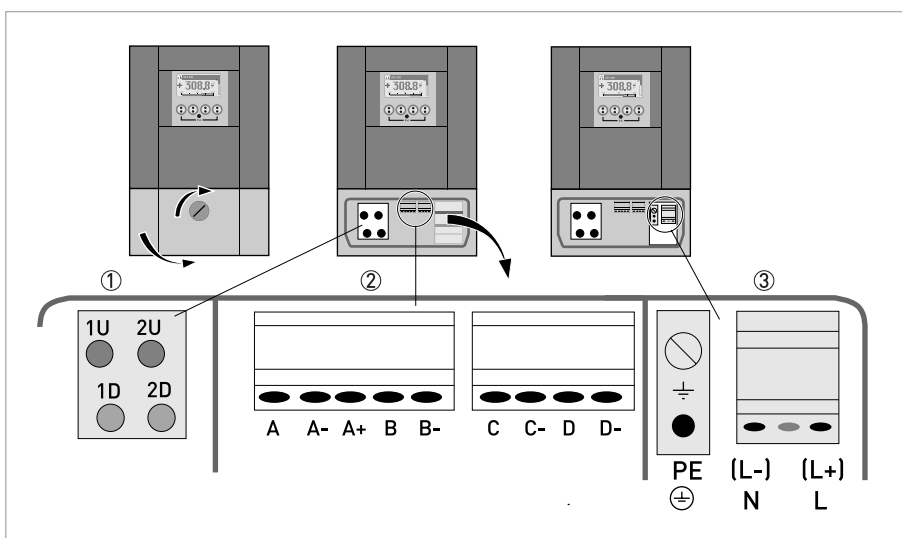


Figure 3-12: Construction of wall version

- ① Connect blue cable to 1U (to 2U for 2nd sensor) and the green cable to 1D (2D for 2nd sensor)
- ② Communication I/O
- ③ Power supply: 24 VAC/DC or 100...240 VAC

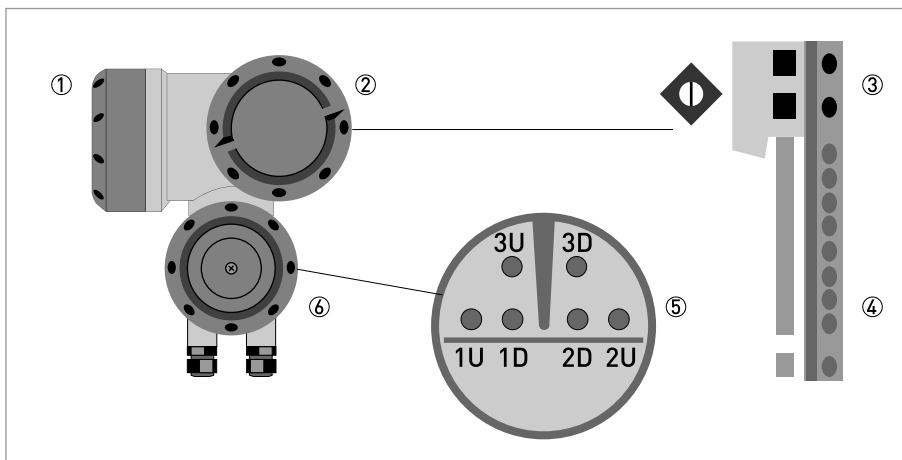


Figure 3-13: Construction (field version)

- ① Cover, electronics compartment
- ② Cover, terminal compartment for power supply and inputs/outputs
- ③ Cable entry for power
- ④ Cable entry for inputs/outputs
- ⑤ Cable entry for sensor cable
- ⑥ Cover, sensor terminal compartment

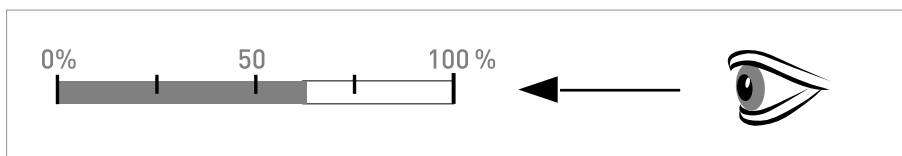


INFORMATION!

See also the section "Installation menu" in chapter "General instructions for programming".



- Go through menu X1...X7 as described in section "Installation menu" in chapter "General instructions for programming". Correct X5 if needed.
- X9.1: Press enter
- X9.2: Press enter
- X9.3: Press enter
- X9.4: Press enter
- X9.5: Read the preliminary volume flow. Press enter
- X9.6: Check signal



CAUTION!

Advice on signal strength:

Signal > 75%: good signal, optimization loop not needed

Signal 50...75%: fairly good signal, optimization loop can improve the signal

Signal 10...50%: low signal, optimization loop needed

Signal < 10%: bad or no signal, check settings in menu X6, increase transducer distance and/or go into the optimization loop.



- X9.7: Confirm or adjust the reading with the actual distance on the rail.
- X9.8: Optimization loop. Repeat steps X9.8.1...X9.8.5 until the advised mounting distance does not change more than 0.5%.
 - X9.8.1: Optimise distance?
 - X9.8.2: Read the velocity of sound of the fluid
 - X9.8.3: Continue?
 - X9.8.4: Confirm or adjust the velocity of sound
 - X9.8.5: Read the advised mounting distance and reposition the transducer
- X9.9: Read the preliminary volume flow
- X9.10: Path ready? Enter "Yes". If you have:
 - 1 path or pipe: you are finished, proceed with X9.12
 - 2 paths: go to X9 for the 2nd path
 - 2 pipes: go to X10 for the 2nd pipe
- X9.12: End Installation? If you enter "No" the installation is not saved, go to X9. If you enter "Yes" the installation is saved and the measurement screen will appear.
- Mount the cover (see section "mounting the cover" in chapter "General mechanical installation")

4.1 Technical data



INFORMATION!

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local representative.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website .

Measuring system

Measuring principle	Ultrasonic transit time
Application range	Flow measurement of liquids
Measured value	
Primary measured value	Transit time
Secondary measured value	Volume flow, mass flow, flow speed, flow direction, speed of sound, gain, signal to noise ratio, diagnosis value, reliability of flow measurement, quality of acoustic signal

Design

	The measurement system consists of a measuring sensor and a signal converter. It is only available as separate version.
Signal converter	
Wall-mounted housing (W) - remote version	TWS 9000 W (general purpose)
Field housing (F) - remote version	TWS 9000 F (Option: Ex version)
Measuring sensor	
Standard	Small, medium or large version in aluminum
Optional	Small / medium stainless steel version
	Small / medium XT (eXtended Temperature).
Diameter ranges	
Small	DN15...100 / ½...4"
	Outer diameter must be at least 20 mm / 0.79".
Medium	DN50...400 / 2...16"
Large	DN200...4000 / 8...160"
	Outer diameter must be smaller than 4300 mm / 169.29".
Options	
Inputs / outputs	Current (incl. HART®), pulse, frequency and/or status output, limit switch and/or control input (depending on the I/O version)
Counters	2 internal counters with a max. of 8 counter places (e.g. for counting volume and/or mass units)
Self diagnostics	Integrated verification, diagnosis functions: flowmeter, process, measured value, empty pipe detection, bargraph

Display and user interface	
Graphic display	LC display, backlit white
	Size: 128x64 pixels, corresponds to 59x31 mm = 2.32"x1.22"
	Display turnable in 90° steps
	The readability of the display could be reduced at ambient temperatures below -25°C / -13°F.
Operator input elements	4 optical keys for operator control of the signal converter without opening the housing.
	Option: Infrared interface (GDC)
Remote control	PACTware® including Device Type Manager (DTM)
	All DTM's and drivers are available at the internet homepage of the manufacturer.
Display functions	
Menu	Programming of parameters at 2 measured value pages, 1 status page, 1 graphic page (measured values and descriptions adjustable as required)
Language of display texts	English, French, German
Units	Metric, British and US units selectable from list / free unit

Measuring accuracy

Reference conditions	Medium: water
	Temperature: 20°C / 68°F
	Straight inlet section: 10 DN
Maximum measuring error	±1% of the measured value for DN≥50 mm / 2" and v > 0.5 m/s / 1.5 ft/s
	±3% of the measured value for DN<50 mm / 2" and v > 0.5 m/s / 1.5 ft/s
Repeatability	<±0.2%

Operating conditions

Temperature	
Process temperature	Standard version: -40...+120°C / -40...+248°F
	XT version: -40...+200°C / -40...+392°F
Ambient temperature	Sensor: -40...+70°C / -40...+158°F
	Signal converter: -40...+60°C / -40...+140°F (ambient temperature 55°C / 131°F and higher: protect electronics against self-heating, because an increase in the electronics temperature in 10°C / 50°F steps leads to a corresponding reduction of the electronics' service life by a factor of two).
Storage temperature	-50...+70°C / -58...+158°F
Pipe specifications	
Material	Metal, plastic, ceramic, asbestos cement, internal / external coated pipes (coatings and liners fully bonded to pipe wall)
Pipewall thickness	< 200 mm / 7.87"
Liner thickness	< 20 mm / 0.79"

Media properties	
Physical condition	Liquids
Viscosity	< 100 cSt (general guideline)
	For detailed information please contact your local representative.
Permissible gas content (volume)	≤ 2%
Permissible solid content (volume)	≤ 5%
Recommended flow velocity	0.5...20 m/s
Other conditions	
Protection category acc. to IEC 529 / EN 60529	W (Wall) version signal converter: IP 65 (acc. to NEMA 4/4x)
	F (Field) version signal converter: IP 66/67 (acc. to NEMA 4x/6)
	All sensors: IP 67 (acc. to NEMA 6)
Vibration resistance	IEC 68-2-64
Shock resistance	IEC 60068-2-27

Installation conditions

Measurement configuration	Single path, single pipe or dual path / dual pipe
Inlet run	≥ 10 DN straight length
Outlet run	≥ 5 DN straight length
Dimensions and weights	See chapter "Dimensions and weights"

Materials

Sensor	Standard
	Anodised aluminum
	Option stainless steel / eXtended Temperature (small / medium version)
	Rail construction: 1.4404 (AISI 316L) Cable connection: 1.4404, PSU with FKM O-ring
Converter	Standard
	F version: die-cast aluminum, polyurethane coated
	W version: polyamide-polycarbonate
	Option
	F version: stainless steel 316 L (1.4408)

Electrical connections

Voltage	Standard: 100...230 VAC [-15% / +10%], 50/60 Hz
	Option: 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%)
Power consumption	AC: 22 VA
	DC: 12 W
Signal cable	double shielded, 2 internal triax, available lengths:
	5 m / 15 ft (standard), maximum length 30 m / 90 ft
Cable entries	Standard: M20 x 1.5
	Option: ½" NPT, PF ½

Inputs and outputs

General	All in- and outputs are galvanically isolated from each other and from all other circuits		
Description of used abbreviations	U_{ext} = external voltage; R_L = load + resistance; U_o = terminal voltage; I_{nom} = nominal current		
Current output			
Output data	Measurement of volume and mass (at constant density), HART [®] communication		
Settings	Without HART [®]		
	Q = 0%: 0...20 mA; Q = 100%: 10...21.5 mA		
	Error identification: 0...22 mA		
	With HART [®]		
	Q = 0%: 4...20 mA; Q = 100%: 10...21.5 mA		
	Error identification: 3.5...22 mA		
Operating data	Basic I/Os	Modular I/Os	Ex-i
Active	$U_{\text{int,nom}} = 24 \text{ VDC}$ $I \leq 22 \text{ mA}$ $R_L \leq 1 \text{ k}\Omega$		$U_{\text{int,nom}} = 20 \text{ VDC}$ $I \leq 22 \text{ mA}$ $R_L \leq 450 \Omega$
			$U_o = 21 \text{ V}$ $I_o = 90 \text{ mA}$ $P_o = 0.5\text{W}$ $C_o = 90 \text{ nF} /$ $L_o = 2 \text{ mH}$ $C_o = 110 \text{ nF} /$ $L_o = 0.5 \text{ mH}$
Passive	$U_{\text{ext}} \leq 32 \text{ VDC}$ $I \leq 22 \text{ mA}$ $U_o \geq 1.8 \text{ V at } I = 22 \text{ mA}$		$U_{\text{ext}} \leq 32 \text{ VDC}$ $I \leq 22 \text{ mA}$ $U_o \geq 4 \text{ V}$ $R_L \leq (U_{\text{ext}} - U_o) / I_{\text{max}}$
			$U_I = 30 \text{ V}$ $I_I = 100 \text{ mA}$ $P_I = 1 \text{ W}$ $C_I = 10 \text{ nF}$ $L_I \sim 0 \text{ mH}$
HART [®]			
Description	HART [®] protocol at active and passive current output		
	HART [®] version: V5		
	Universal HART [®] parameter fully integrated		
Load	$\geq 250 \Omega$ Please observe maximum value for current output		
Multidrop	Yes, current output = 4 mA		
	Multidrop addresses programmable in menu 1...15		
Device drivers	FDT/DTM		

Pulse or frequency output			
Output data	Volume or mass counting		
Function	Can be set as a pulse output or frequency output		
Settings	For Q = 100%: 0.01...10000 pulses per second or pulses per unit volume		
	Pulse width: setting automatic, symmetric or fixed (0.05...2000 ms)		
Operating data	Basic I/Os	Modular I/Os	Ex-i
Active	-	$U_{nom} = 24 \text{ VDC}$	-
		$f_{max} \leq 100 \text{ Hz}$: $I \leq 20 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ closed: $U_{0,nom} = 24 \text{ V}$ at $I = 20 \text{ mA}$	
		$100 \text{ Hz} < f_{max} \leq 10 \text{ kHz}$: $I \leq 20 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ closed: $U_{0,nom} = 22.5 \text{ V}$ at $I = 1 \text{ mA}$ $U_{0,nom} = 21.5 \text{ V}$ at $I = 10 \text{ mA}$ $U_{0,nom} = 19 \text{ V}$ at $I = 20 \text{ mA}$	
Passive	$U_{ext} \leq 32 \text{ VDC}$		-
	$f_{max} \leq 100 \text{ Hz}$: $I \leq 100 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ closed: $U_{0,max} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0,max} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$		
	$100 \text{ Hz} < f_{max} \leq 10 \text{ kHz}$: $I \leq 20 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ closed: $U_{0,max} = 1.5 \text{ V}$ at $I \leq 1 \text{ mA}$ $U_{0,max} = 2.5 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0,max} = 5.0 \text{ V}$ at $I \leq 20 \text{ mA}$		
NAMUR	-	Passive to EN 60947-5-6 open: $I_{nom} = 0.6 \text{ mA}$ closed: $I_{nom} = 3.8 \text{ mA}$	Passive to EN 60947-5-6 open: $I_{nom} = 0.43 \text{ mA}$ closed: $I_{nom} = 4.5 \text{ mA}$
			$U_I = 30 \text{ V}$ $I_I = 100 \text{ mA}$ $P_I = 1 \text{ W}$ $C_I = 10 \text{ nF}$ $L_I \sim 0 \text{ mH}$

Status output / limit switch			
Function and settings	Settable as automatic measuring range change, indicator for direction of flow, overflow, error, operating point or empty pipe detection		
	Valve control with activated dosing function		
	Status and/or control: ON or OFF		
Operating data	Basic I/Os	Modular I/Os	Ex-i
Active	-	$U_{int} = 24 \text{ VDC}$ $I \leq 20 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ closed: $U_{0, nom} = 24 \text{ V}$ at $I = 20 \text{ mA}$	-
Passive	$U_{ext} \leq 32 \text{ VDC}$ $I \leq 100 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ closed: $U_{0, max} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$	$U_{ext} = 32 \text{ VDC}$ $I \leq 100 \text{ mA}$ $R_{L, max} = 47 \text{ k}\Omega$ open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ closed: $U_{0, max} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$	-
NAMUR	-	Passive to EN 60947-5-6 open: $I_{nom} = 0.6 \text{ mA}$ closed: $I_{nom} = 3.8 \text{ mA}$	Passive to EN 60947-5-6 open: $I_{nom} = 0.43 \text{ mA}$ closed: $I_{nom} = 4.5 \text{ mA}$
			$U_I = 30 \text{ V}$ $I_I = 100 \text{ mA}$ $P_I = 1 \text{ W}$ $C_I = 10 \text{ nF}$ $L_I = 0 \text{ mH}$

Control input			
Function	Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, range change.		
	Start of dosing when dosing function is activated.		
Operating data	Basic I/Os	Modular I/Os	Ex-i
Active	-	U _{int} = 24 VDC Terminals open: U _{0, nom} = 22 V Terminals bridged: I _{nom} = 4 mA On: U ₀ ≥ 12 V with I _{nom} = 1.9 mA Off: U ₀ ≤ 10 V with I _{nom} = 1.9 mA	-
Passive	8 V ≤ U _{ext} ≤ 32 VDC I _{max} = 6.5 mA at U _{ext} ≤ 24 VDC I _{max} = 8.2 mA at U _{ext} ≤ 32 VDC Contact closed (On): U ₀ ≥ 8 V with I _{nom} = 2.8 mA Contact open (Off): U ₀ ≤ 2.5 V with I _{nom} = 0.4 mA	3 V ≤ U _{ext} ≤ 32 VDC I _{max} = 9.5 mA at U _{ext} ≤ 24 V I _{max} = 9.5 mA at U _{ext} ≤ 32 V Contact closed (On): U ₀ ≥ 3 V with I _{nom} = 1.9 mA Contact open (Off): U ₀ ≤ 2.5 V with I _{nom} = 1.9 mA	U _{ext} ≤ 32 VDC I ≤ 6 mA at U _{ext} = 24 V I ≤ 6.6 mA at U _{ext} = 32 V On: U ₀ ≥ 5.5 V or I ≥ 4 mA Off: U ₀ ≤ 3.5 V or I ≤ 0.5 mA
			U _I = 30 V I _I = 100 mA P _I = 1 W C _I = 10 nF L _I = 0 mH
NAMUR	-	Active to EN 60947-5-6 Contact open: U _{0, nom} = 8.7 V Contact closed (On): I _{nom} = 7.8 mA Contact open (off): U _{0, nom} = 6.3 V with I _{nom} = 1.9 mA Identification for open terminals: U ₀ ≥ 8.1 V with I ≤ 0.1 mA Identification for short circuited terminals: U ₀ ≤ 1.2 V with I ≥ 6.7 mA	-
Low-flow cutoff			
On	0...±9.999 m/s; 0...20.0%, settable in 0.1% steps, separately for each current and pulse output		
Off	0...±9.999 m/s; 0...19.0%, settable in 0.1% steps, separately for each current and pulse output		
Time constant			
Function	Can be set together for all flow indicators and outputs, or separately for: current, pulse and frequency output, and for limit switches and the 3 internal counters		
Time setting	0...100 seconds, settable in 0.1 second steps		

Approvals and certificates

Hazardous areas	
ATEX	Sensor:
	PTB 06 ATEX 2045 X
	II 2 G Ex ia IIC T6...T4 (XT Version: II 2 G Ex ia IIC T6...T2)
	Converter (F version only):
	PTB 06 ATEX 2046 X
	II 2(1) G Ex de [ia] IIC T6 or II 2 G Ex de [ia] IIC T6 II 2(1) G Ex d [ia] IIC T6 or II 2 G Ex d [ia] IIC T6
FM - Class I, DIV 1/2	Option (F version): approval ID = 3029326
	Pending for stainless steel / eXtended Temperature version.
CSA - GP / Class I, DIV 1/2	Option (F version): approval certificate = 1956404 (LR 105802)
	Pending for stainless steel / eXtended Temperature version.
Other approvals and standards	
Electromagnetic compatibility	Directive: 2004/108/EC, NAMUR NE21/04
	Harmonized standard: EN 61326-1: 2006
Low Voltage Directive	Directive: 2006/95/EC
	Harmonized standard: EN 61010: 2001

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