OPTISONIC 6400 Handbook

Portable ultrasonic clamp-on flowmeter

Electronic Revision:
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(SW.REV 01.01.01)

KROHNE

IMPRINT

1.1 Intended use

The **OPTISONIC 6400** portable clamp-on flow meter is designed for measurement of liquid flows in full pipes, datalogging and transfer of logged results to the PC. The portable clamp-on flow meter makes it possible to measure the flow on places temporary or you can make use of it if you want to compare the output with other measurement devices. If an inline measurement device is broken and you are in need of the information the OPTISONIC 6400 might be the solution for you.

1.2 Certification

CE

In accordance with the commitment to customer service and safety, the device described in this document meets the following safety requirements:

- EMC Directive 2004/108/EC and 93/68/EEC in conjunction with EN 61326-1 (1997) and A1 (1998), A2 (2001)
- Low-Voltage Directives 73/23/EEC and 93/68/EEC in conjunction with EN 61010-1 (2001)

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

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1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This information refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- HANDLING
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➲ RESULT
This symbol refers to all important consequences of the previous actions.

2.1 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.

CAUTION!
The device arrives in a plastic trunk on wheels.

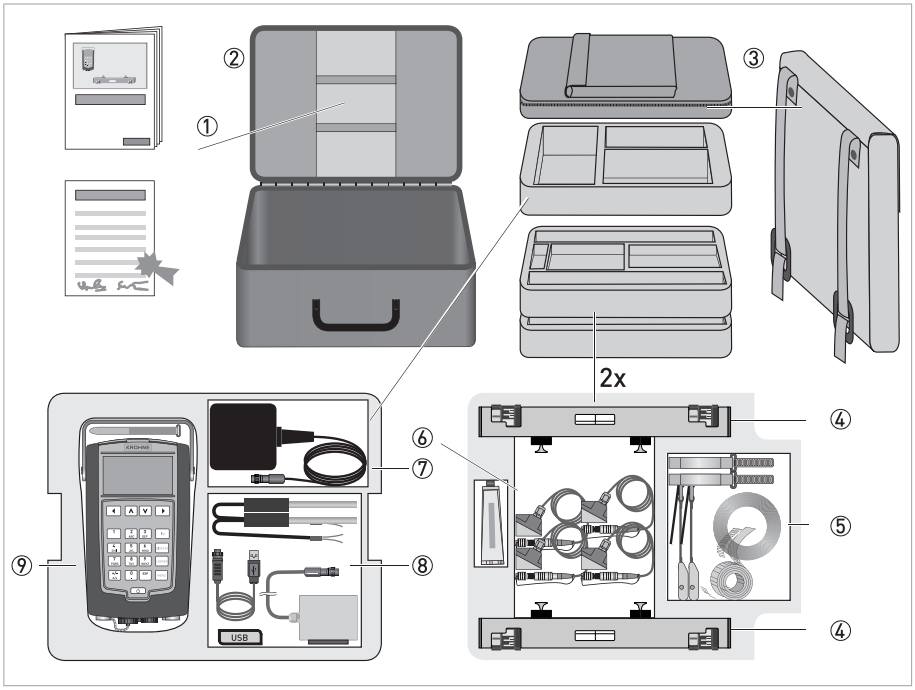


Figure 2-1: Scope of delivery

① Product documentation, factory calibration report
② Trunk on wheels
③ Carrying bag
④ 1 or 2 rail(s) per tray
⑤ Metal / textile straps for mounting rail(s) and converter
⑥ Sensor(s) with fixing units (small version 1, medium version 2 sensors)
2 Transducers (small versions: 2 MHz, medium version: 1 MHz), including 3 m cable, coupling grease
⑦ Power adapter including plugs for EU, UK, US and AUS
⑧ USB memory stick, measure band
optionally I/O box and/or temperature sensors, PC connection cable
⑨ Signal converter UFC 400 P

2.2 Nameplates

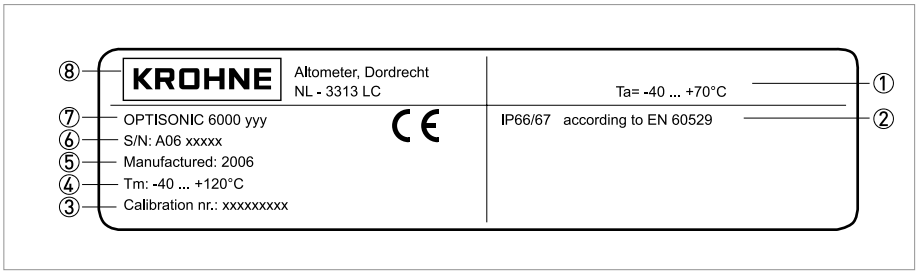


Figure 2-2: Nameplate flow sensor

① Ambient temperature operating range
② Protection category
③ Calibration number
④ Process temperature (-40...+200°C for XT version)
⑤ Manufacturing year
⑥ Serial number
⑦ Device type (yyy = small, medium or large)
⑧ Name and address of the manufacturer

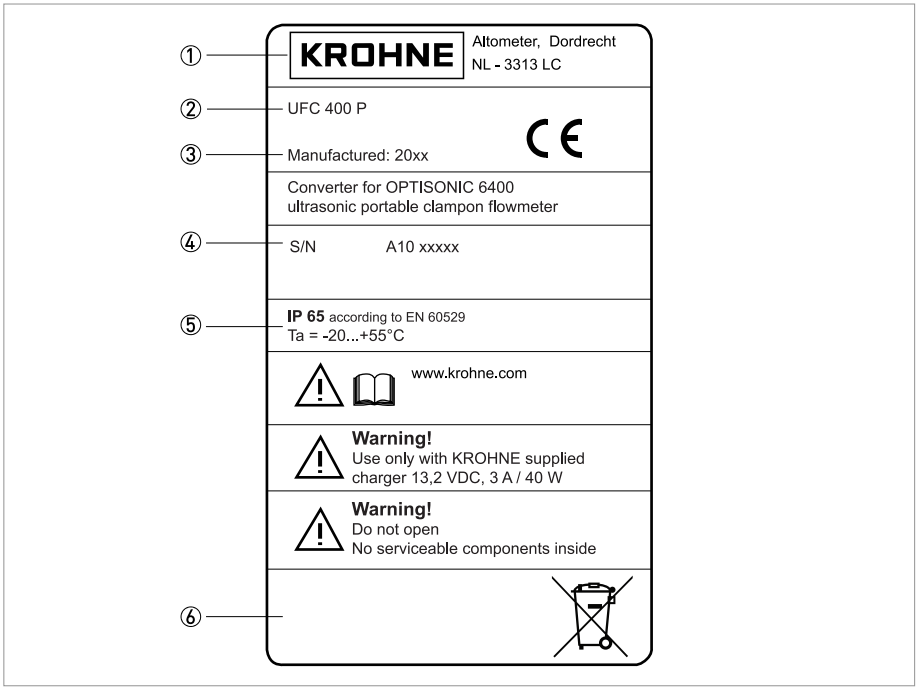


Figure 2-3: Nameplate

① Name and address of the manufacturer
② Device type
③ Manufacturing year
④ Serial number
⑤ Protection class and temperature data
⑥ Treat device as electronic garbage according WEEE rules.

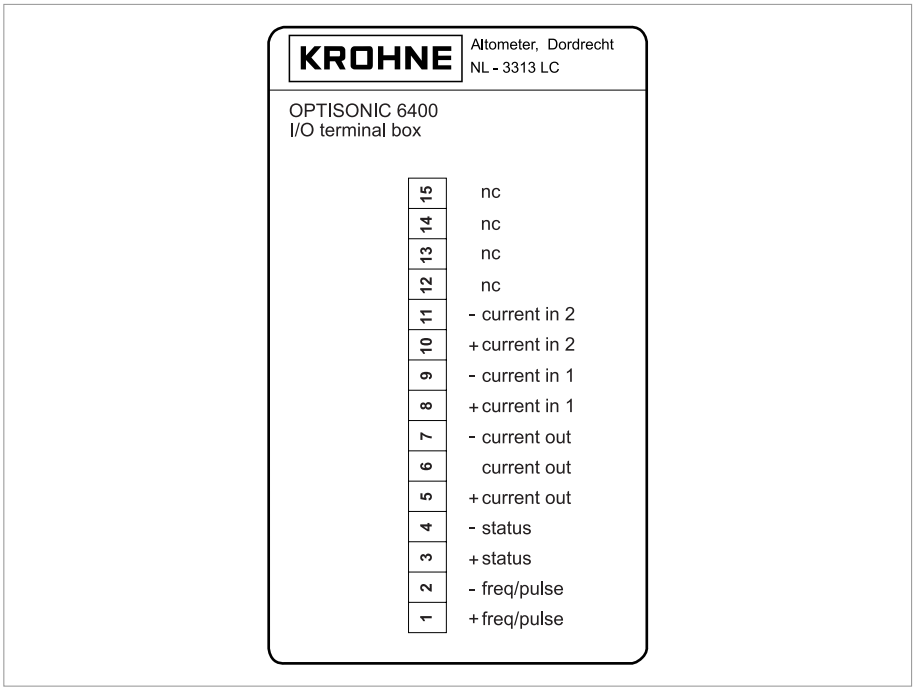


Figure 2-4: I/O box, standard version

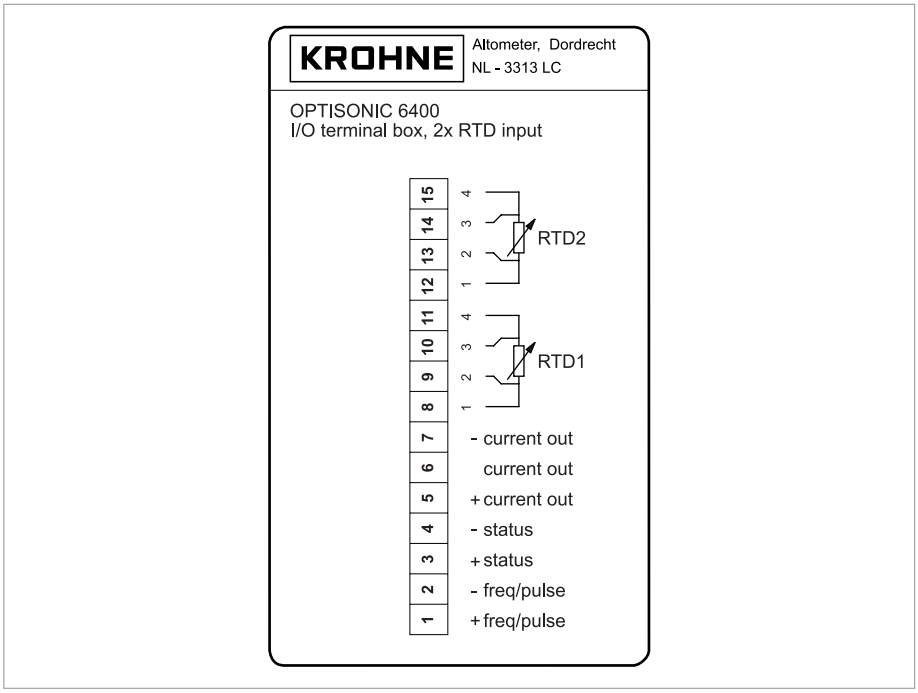


Figure 2-5: I/O box with 2 OPTITEMP TT 30 C included.

3.1 General safety instructions

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

Specific for sensors:

WARNING!
- *Be careful when locking the rail back on to the mounting units as your fingers may get stuck between rail and pipe it is mounted on. This may cause injury.*
- *Be careful when mounting the fixation units using the metal strap. The edge of the strap may cause injury.*

CAUTION!
- *Do not bend the metal mounting strap. This may cause improper mounting of the fixation units of the sensor rails.*
- *Protect the pipe contact side of the transducer. Scratches or other damages may have a negative impact on its proper functioning.*
- *Before fitting the transducer to the transducer knob in the sensor rail, check the connection groove of the transducer cover for damages or dirt. Clean or replace when dirty or damaged.*
- *Check sensor cabling with regular intervals for damages and wear as this may cause improper functioning. Replace when necessary.*
- *Check presence of sufficient grease on the transducer pipe contact side in case of acoustic signal failure.*
- *Check the sensor rail sliding area regularly for dirt or other pollution or excess coupling fat, that may cause improper functioning.*
- *Excess of coupling fat may be removed from the sensor rails and transducers with a dry piece of cloth. Coupling fat on the converter housing may be removed using soapy water.*

Specific for converters:

WARNING!
Be careful moving the handle of the converter, as your fingers may get stuck between the handle and the housing of the converter. This may cause injury.

CAUTION!

- *In order to comply with the EMC directive 2004/108/EC, I/O cables that provide a galvanic connection to the UFC 400 P should have a maximum total length of 3 meter.*
- *When not used, put the connector covers of the connectors on the bottom side of the converter in place. This to prevent improper functioning caused by dust/dirt.*
- *When the sensor cables are connected while the converter is positioned on a flat surface, turn the handle fully backwards (towards the housing) in order to prevent excess stress on the sensor cables.*
- *With an empty main battery, the backup battery of the real time clock may run empty when this is the case for a period longer than one year.*
- *The protection degree of the battery charger / mains adapter is IP 40 / NEMA 1. It should be protected against moisture entering.*
- *To prevent damage due to vibrations, do not firmly attach the converter to or place it on top of a vibrating object.*

3.2 Installation requirements

3.2.1 Inlet, outlet and recommended mounting area

To perform an accurate flow measurement preferably mount the sensor rail at least 10 DN downstream of a flow disturbance like elbow, valve, header or pump. Please follow the installation recommendations in the next installation position examples.

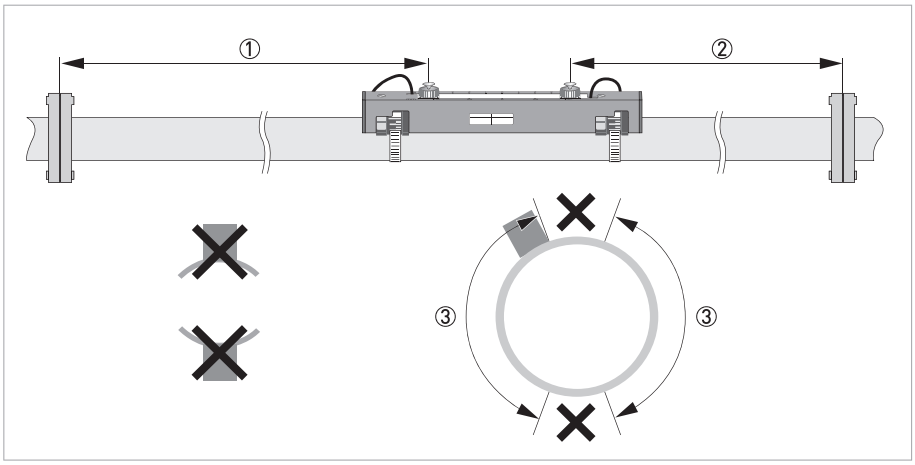


Figure 3-1: Inlet, outlet and recommended mounting area

① Min. 10 DN
② Min. 5 DN
③ OK, 120°

3.2.2 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.

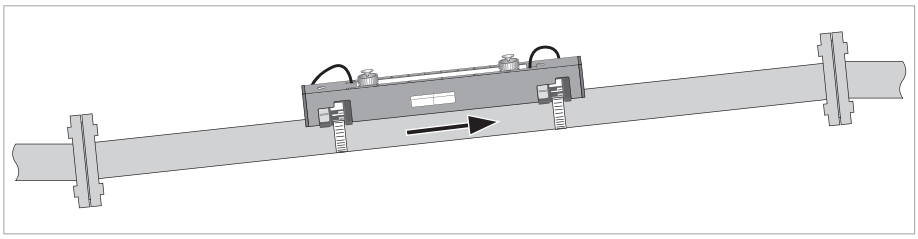


Figure 3-2: Long horizontal pipes

3.2.3 Vertical pipelines

CAUTION!

- *Ensure that the pipe is fully filled at all times.*
- *Both ascending and descending flow direction is measurable.*
- *Observe the required in- and outlets.*

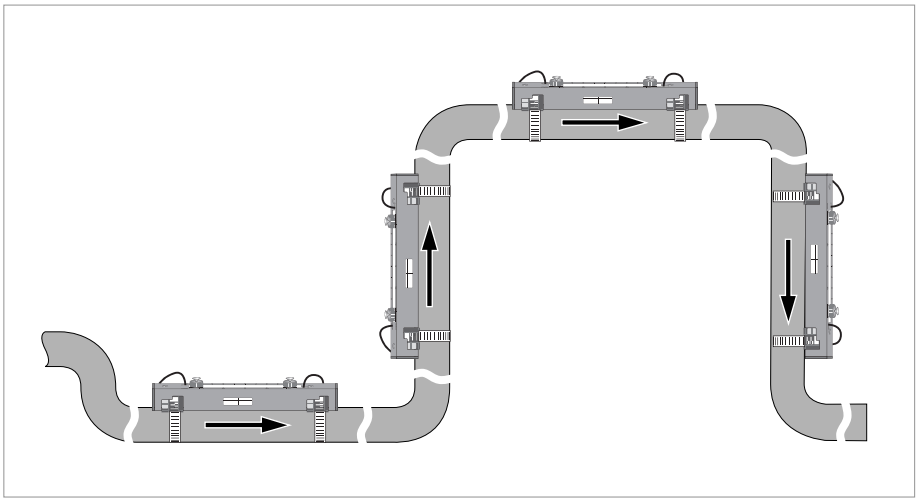


Figure 3-3: Mounting on vertical pipelines is possible

3.2.4 Open feed or discharge

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

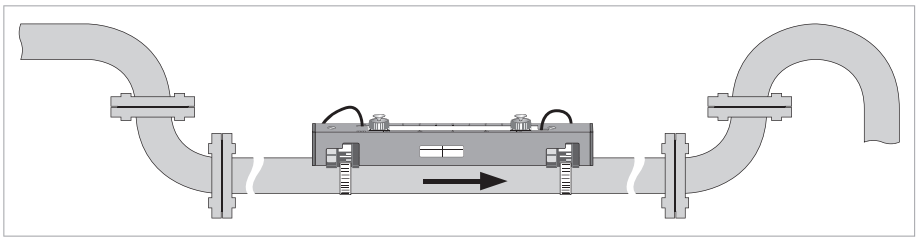


Figure 3-4: Open feed or discharge

3.2.5 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.

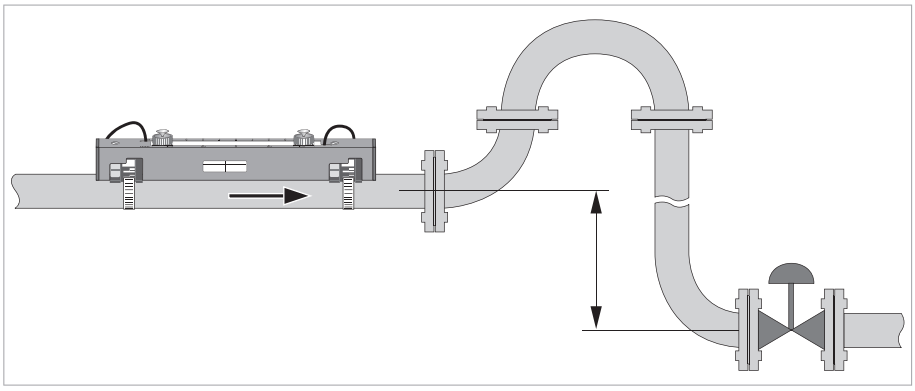


Figure 3-5: Down going pipeline over 5 m / 16 ft length

3.2.6 Position of control valve

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

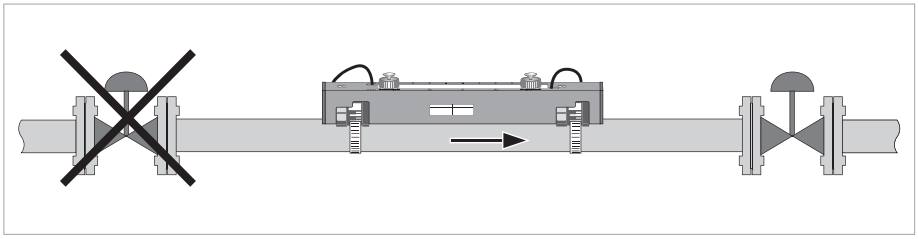


Figure 3-6: Position of control valve

3.2.7 Position of pump

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

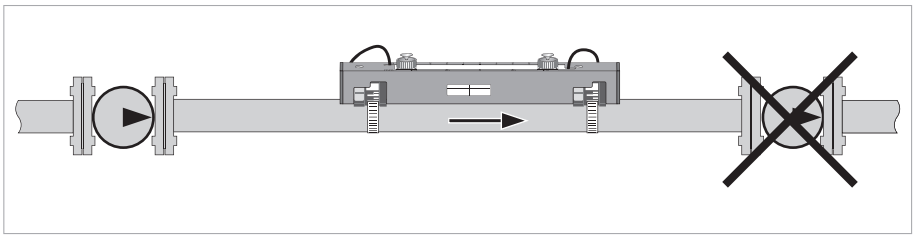


Figure 3-7: Position of pump

3.3 Installation procedure for flow measurement

3.3.1 Step 1: check required parts

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.

CAUTION!
The device arrives in a plastic trunk on wheels.

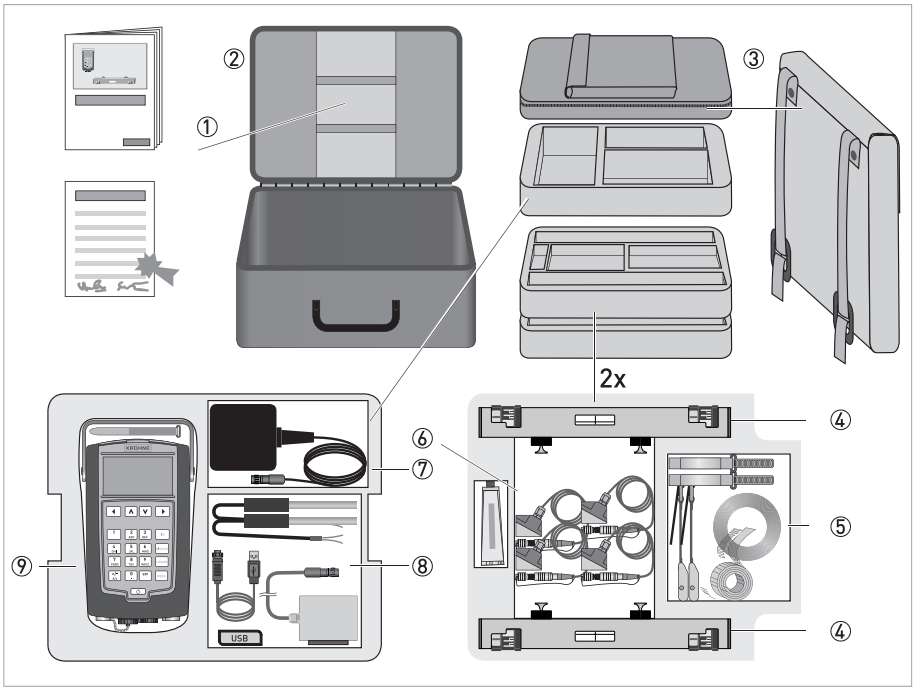


Figure 3-8: Scope of delivery

① Product documentation, factory calibration report
② Trunk on wheels
③ Carrying bag
④ 1 or 2 rail(s) per tray
⑤ Metal / textile straps for mounting rail(s) and converter
⑥ Sensor(s) with fixing units (small version 1, medium version 2 sensors)
2 Transducers (small versions: 2 MHz, medium version: 1 MHz), including 3 m cable, coupling grease
⑦ Power adapter including plugs for EU, UK, US and AUS
⑧ USB memory stick, measure band
optionally I/O box and/or temperature sensors, PC connection cable
⑨ Signal converter UFC 400 P

3.3.2 Step 2: select proper installation position

3.3.3 Step 3: determine dimensions of pipe

- Use the supplied tape measure to find the outside diameter of the pipe.
- Use a pipe wall thickness gauge, or pipe tables to find the pipe wall thickness.
- Establish the pipe material.
- Is the pipe lined, find out what the liner and material thickness is.

3.3.4 Step 4: initialise the UFC 400 P converter

Figure 3-9: Keys UFC 400 P

① TFT Display
② Navigation keys
③ Quick access keys
④ Text and numerical keypad
⑤ On / off button

Turn on the converter by pressing the on / off button for one second. Wait until the menu appears, this will take approximately 30 seconds.
When the UFC 400 P converter is started the first time the startup menu will be shown. In this menu you can set the language, time and date. This menu will be shown only once. You can activate the menu to be shown again at the next startup by selecting "Settings and information ▸ Device ▸ Start-up sequence?".

Menu
Language English Time and date Units Continue
13-04-2010 14:11:09 13 MB free

If the device has been used before, the screen will look like the figure below.

Menu
Installation Measurement View logged data File Management **Settings and information** ▸
13-04-2010 14:11:09 13 MB free

INFORMATION!
You can still change the language, time and date and units from other parts of the menu.

Use the following keys to navigate through the menu:

◂	Back	Back one page
∧	Up	Up one line
∨	Down	Down one line
▸	Forward	Enter item to edit or to select it

When editing only the Back and Forward buttons are functional:

◂	Back	Delete previous character or leave item unchanged when at position one
▸	Forward	Move cursor right, accept item when at last position

3.3.5 Step 5: program the units in the converter

If you use the converter for the first time, it will prompt you for the unit setting automatically. Otherwise go to menu number 2.4.1 ("Measurement ▸ Setup ▸ Units")

Choose in each line the required unit with the buttons as shown in the previous section.

3.3.6 Step 6: program the converter

CAUTION!
Because the converter remember most of its previous settings, you may wish to reset the converter before installing at a new location to prevent unexpected behavior. To reset the converter, enter the "Settings and information" menu and select "Load factory settings".

In the menu "Settings and information ▸ Device ▸ Password" a password can be set. In measuring mode the password blocks the measurement mode after the display sleep time has passed. The measurement mode can only be left after typing the password.

Select "Installation" from the main menu, then press " ▸ " and select the desired configuration.

1.2	
Pipe tag Outer diameter Material Wall thickness Liner material **< Previous | Next > ▸**	Pipe1 100.00 mm Carbon steel 5.00 mm None
13-04-2010 14:11:09 13 MB free	

Pipe tag	Give the pipe a name
Press again " ▸ " and " ▾ ".	
Outer diameter	Use the outside diameter
Material	Choose the right material
Wall thickness	Fill in the pipe wall thickness material
Liner material	Select whether there is a liner or not
Choose next	

CAUTION!
Inaccurate input of the outside diameter will affect the accuracy of the measured flow rate.

1.3	
Fluid VoS Fluid Viscosity **< Previous | Next > ▸**	Water 1485.0 m/s 1 mm^2/s
13-04-2010 14:11:09 13 MB free	

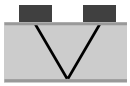
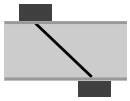
Fluid	Give the right liquid from the table. If the liquid is unknown, choose water. The correct value will be measured.
VoS Fluid	Velocity of Sound. Only change it if it is well known.
Viscosity	Only change it if it is well known.
Choose next	

3.3.7 Step 7: mount the sensor rails

1.7	
Transducer set Calibration number Number of traverses **< Previous | Next >**	Ta 522505050
13-04-2010 14:11:09 13 MB free	

Transducer set	Fill in the value given on the label on the transducer cable
Calibration number	Fill in the value given on the label on the transducer cable
Number of traverses	Z mode = 1 traverse V mode = 2 traverses W mode = 4 traverses

The best suitable sensor is automatically selected from a list of three available sensor types and the appropiate number of traverses is indicated.

Pipe	Available sensor	Traverse mode	
DN15...150	Small 2 MHz, 1 rail		
DN50...250	Medium 1 MHz, 1 rail		
DN200...750	Medium 1 MHz, 2 rails		
DN400...1500	Medium 1 MHz, 2 rails		

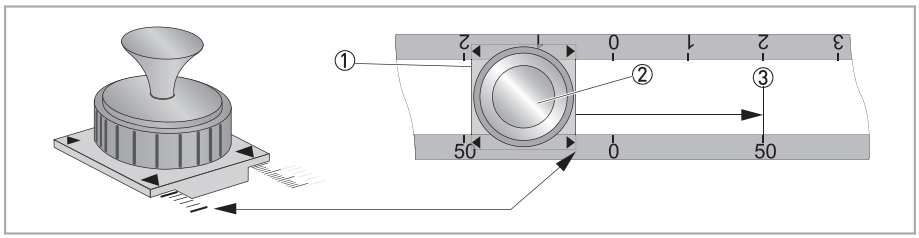
Choose the right traverse mode. For recommendations please see examples above.

V mode;1 rail (DN15...250)

Press " ▸ "
Read from the display of the signal converter what rail configuration is required and what the correct sensor distance is.

1.8		
Advised sensor position 34.30 mm Signal quality		
		78%
< Previous | Next > ▸		
13-04-2010 14:11:09	13 MB free	

Please follow up the instructions for the application.
One rail with 2 transducers in V mode: Put the first transducer at position "0", the other one at the recommended distance, shown on the screen (in this example 34.30 mm).



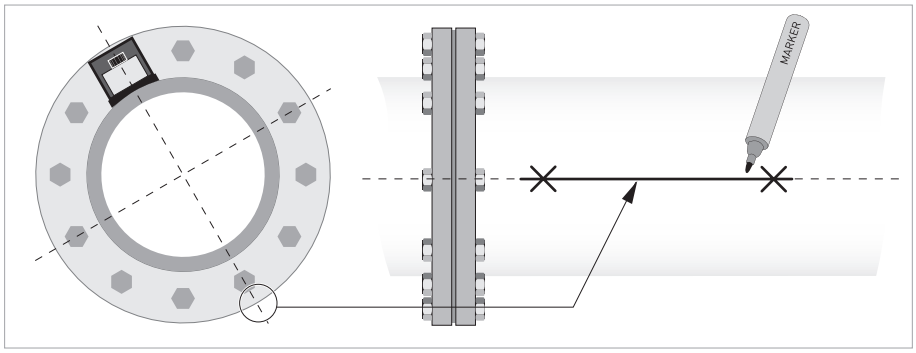
- Unlock the transducer by turning the locking knob ② counter clockwise.
- Slide the transducer ① to the new position ③.
- Lock the transducer by turning the locking knob ② clockwise.

V mode; 2 rails (DN200...750)

INFORMATION!
For V mode with 2 rails you must install the DOWN rail in line with UP rail. It is easier to install than the Z mode, but you need more free pipe length.

Z mode; 2 rails (DN400...1500)

Measure the outer diameter of the pipe with the measuring band. Install the DOWN rail at the opposite location of the pipe.



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

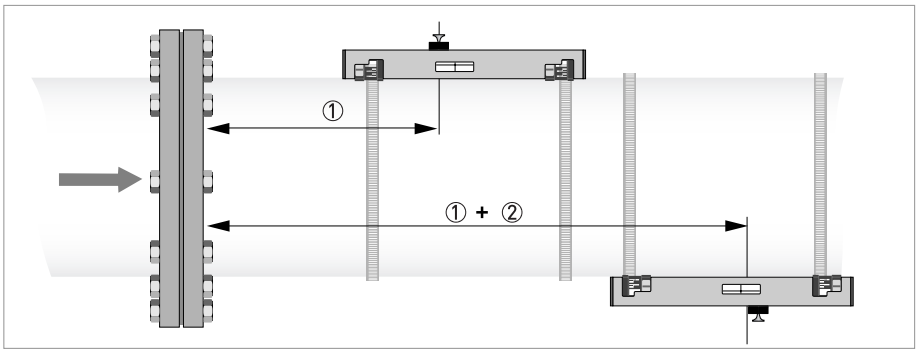


Figure 3-10: Mounting second rail in Z mode (1 traverse) using a reference point

① Measure the distance between the transducer of the UP rail and the reference point.
② Add the advised distance to determine the position of the second transducer.

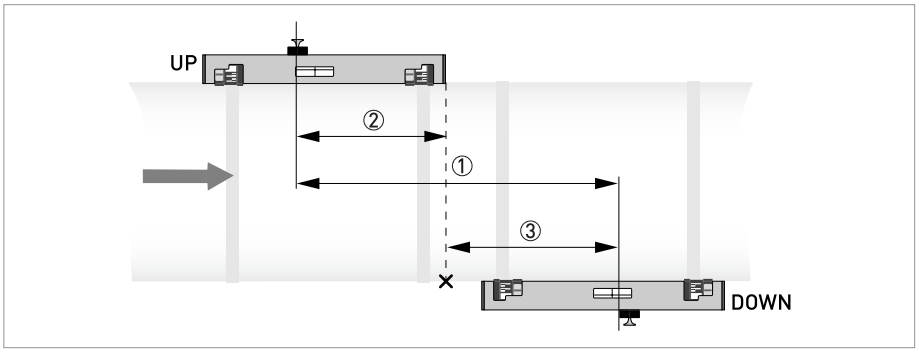


Figure 3-11: Mounting second rail in Z mode (1 traverse) without using a reference point

① Advised distance ① = ② + ③

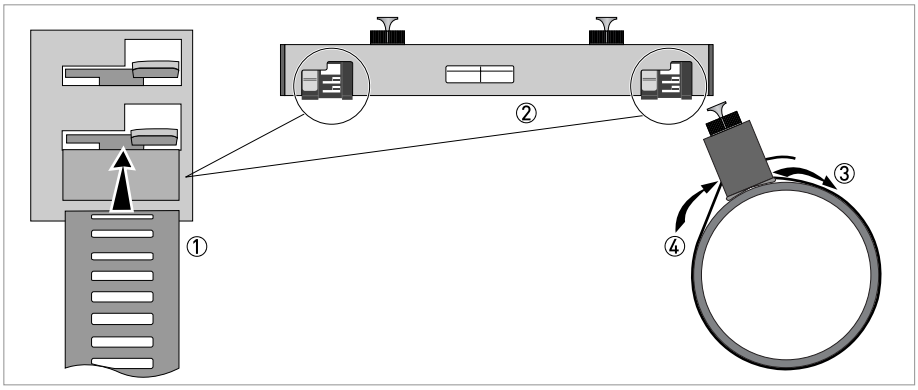
W mode; 1 rail (DN15...150)

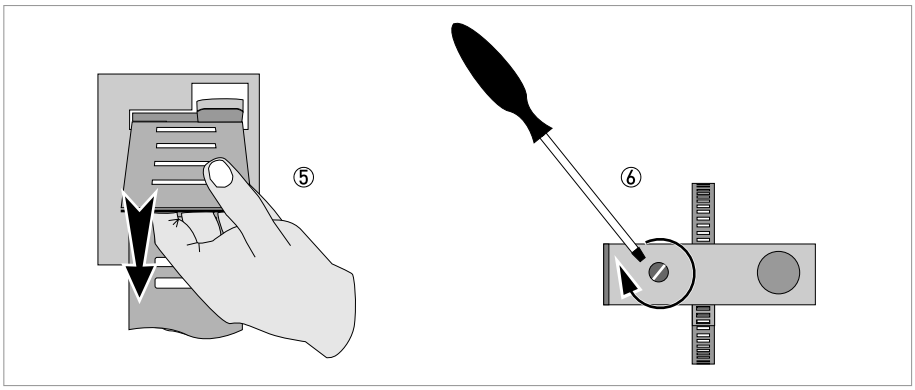
Follow the instructions as given in "**V mode; 1 rail**".

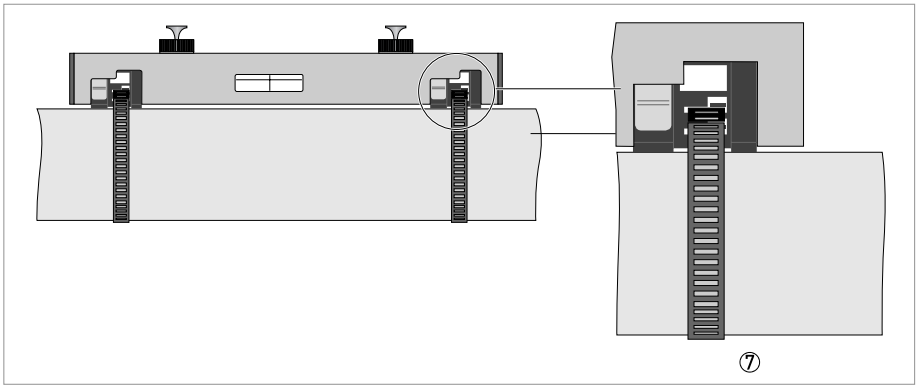
Installation with metal straps (DN15...250)

On request it is possible to use the large rail of the OPTISONIC 6300 with 0,5 MHz transducers. Using this you can measure up to DN4000.

Put the metal straps around the pipe. Put the sensor rail(s) on the pipe including the transducers with fixed cables.

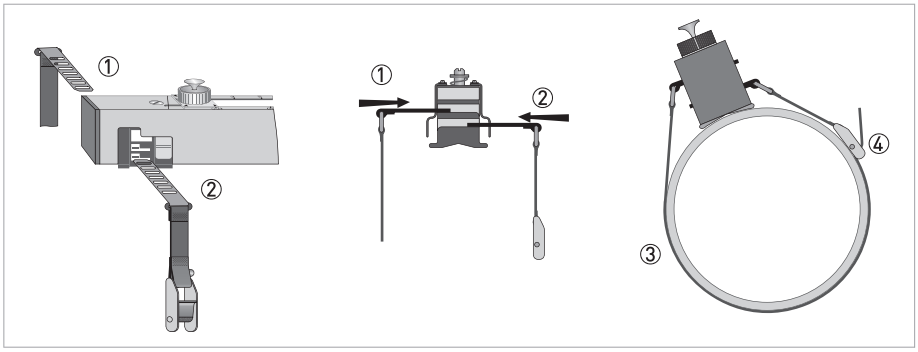


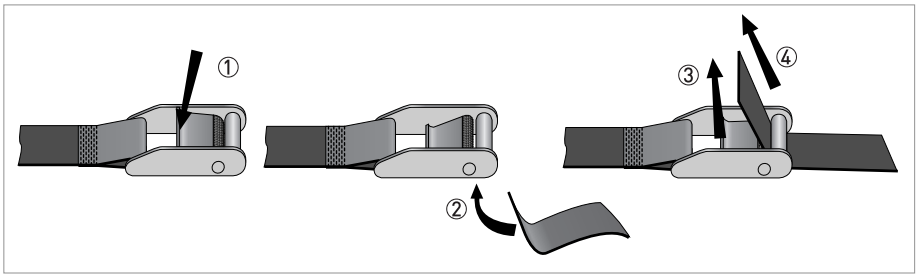




- ⑧: Repeat steps ①...⑦ for the second strap.

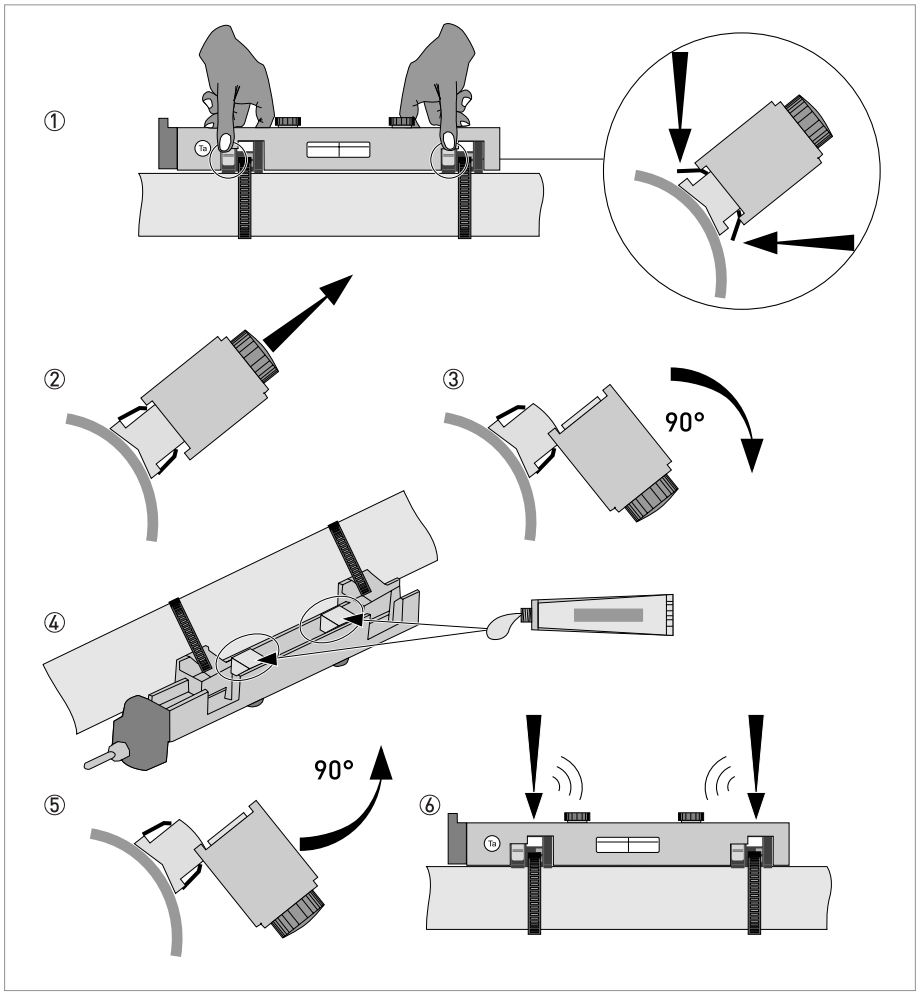
Installation with textile straps (> DN250)





Regreasing of transducers

Set the sensors to the proper sensor distance. Unlock and tilt the rail by pushing the buttons of the fixing units. Then put some coupling fat on the transducers and put the rail back by clicking.



3.3.8 Step 8: connect the sensor cable

CAUTION!
Please look at the labels on the cable of each transducer for the calibration number. All transducers for the same measuring path MUST have the same calibration number!

INFORMATION!
The signal cables are prefixed to the transducers in the factory.

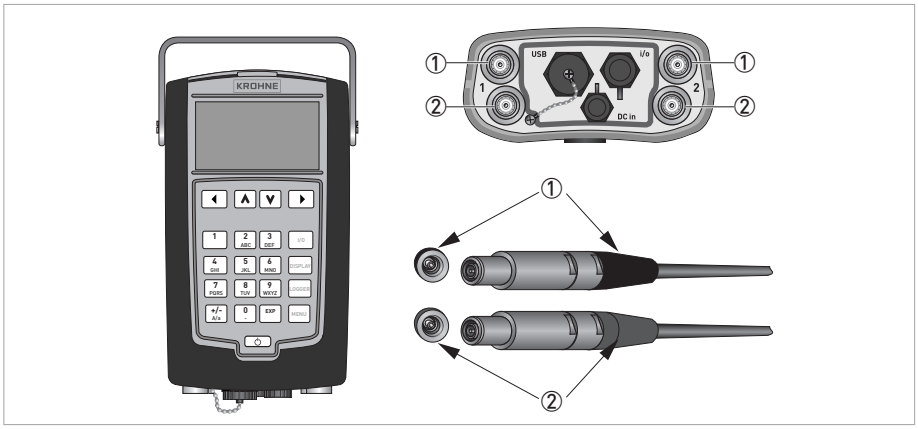
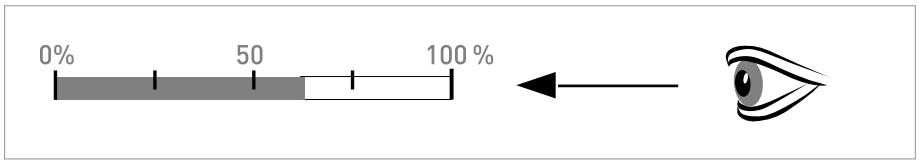


Figure 3-12: Connecting signal cables

① Connector for "UP" transducer (blue)
② Connector for "DOWN" transducer (green)



INFORMATION!
After mounting the transducers in the proper position, it may take 45 seconds before a signal is found.

INFORMATION!
Advice on signal strength:
Signal > 75%: *good signal*
Signal 50...75%: *fairly good signal*
Signal 10...50%: *low signal*
Signal < 10%: *bad or no signal, check settings in menu, change transducer distance until there is at least a low signal*

1.8		
Advised sensor position **52.18 mm** Signal quality		
		78%
< Previous | Next > ▸		
13-04-2010 14:11:09 13 MB free		

Change the right transducer until the signal quality is as high as possible, at least above 75%.
Press " ▸ " and fill in the actual sensor position and press " ▸ " again to confirm the actual sensor position.

CAUTION!
If the actual senor position is not entered accurately, the sound velocity can not be calculated correctly and optimization of the sensor position will fail.

Press " ▸ ".
Display "Installation ▸ Sensor 1 test" appears. We recommend to always optimize the sensor position.
Choose "Optimize position". This will recalculate the sensor position based on the actual (measured) sound velocity. Use this new position. If the shift is more then a few mm, repeat the procedure until the change is small (less then 1 mm or 1% of the distance, whichever is larger).

Once you are satisfied, continue until you are asked for the site name. Enter the name and save the site file with the current configuration. The device is now ready to measure.

3.3.9 Step 9: start flow measurement

Press " ▸ " on the UFC 400 P. The converter checks the received signal and initiates the flow measurement mode.
The display will now show the actual flow.

3.3.10 Error messages

Error code	Group message	Error message	Description	Error handling
F (bold)	error in device		no measurement possible, measured values are not valid	repair or replace device and/or CPU; contact manufacturer service center
F	application error		no measurement possible, but device ok	check parameter settings / power off - wait 5 seconds - power on device
S	out of specification		unreliable measurement	maintenance required, check flowprofile
C	check in progress		test function is active, device is stand-by	wait until finished
I	information		no direct impact on measurements	no action needed
F (bold)		IO 1 (or IO 2)	error or failure of IO Module 1 (or 2)	try to load settings (menu C8.6.3); if error does not disappear, replace electronics unit
F (bold)		parameter	error or failure of data manager, parameter or hardware error	try to load settings (menu C8.6.3); if error does not disappear, replace electronics unit
F (bold)		configuration	incorrect configuration or no confirmation	confirm change of module; if configuration is unchanged, replace electronics unit
F (bold)		display	error of failure of display unit, parameter or hardware error	defect; replace electronics units
F (bold)		current output A (or B, C)	error or failure of the current output A (or B, C), parameter or hardware error	defect; replace electronics units
F (bold)		software user interface		defect; replace electronics units
F (bold)		hardware settings	detected hardware and set hardware settings do not match	follow display instructions
F (bold)		hardware detection	hardware can not be detected	defect; replace electronics units
F (bold)		RAM/ROM error IO 1 (or IO 2)		defect; replace electronics units
F (bold)		communication dsp-up	no communication between DSP and microprocessor PCB	contact manufacturer service center
F (bold)		front end	malfunctioning of front end PCB	contact manufacturer service center
F (bold)		uproc	malfunctioning of microcontroller PCB	contact manufacturer service center
F (bold)		dsp	malfunctioning of DSP	contact manufacturer service center
F		empty pipe	signal lost at two paths	check process conditions
F		flow > max 1	max volume flow exceeded for pipe 1	check parameter in menu C1.7.1
F		flow > max 2	max volume flow exceeded for pipe 2	check parameter in menu C1.7.1
F		open circuit A (or B, C)	current on current output A (or B, C) too low	check cable or reduce resistance (< 1000 Ohm)
F		over range A (or B, C)	current on current output A (or B, C) is limited by parameter setting	extend upper or lower limit for current output in menu C5.2.8
F		over range A (or B, D)	pulse on frequency output A (or B, D) is limited by parameter setting	extend upper or lower limit for frequency output in menu C5.3.7
F		active settings	error during CRC check (Cyclic Redundancy Check) of the active settings	load settings; factory setting, back up 1 or back up 2

F		factory settings	error during CRC check of factory settings	
F		back up 1 (or 2) settings	error during CRC check of back up 1 (or 2) settings	
F		signal lost path 1	signal lost at path 1	check signal cable / check for pipe obstructions
F		signal lost path 2	signal lost at path 2	check signal cable / check for pipe obstructions
F		pipe/sens1 param.	unrealistic parameter settings for pipe in combination with path 1	check parameters in menu X6
F		pipe/sens2 param.	unrealistic parameter settings for pipe in combination with path 2	check parameters in menu X6
S		unreliable 1	unreliable measurement at pipe 1	check process conditions for gas bubbles, solids
S		unreliable 2	unreliable measurement at pipe 2	check process conditions for gas bubbles, solids
S		zero converter	invalid value at power up	power off - wait 5 seconds - power on device
S		overflow counter 1 (or 2, 3)	counter is overflowing and will start again at zero	no action needed
S		backplane invalid	error during CRC check of backplane	restore data records on backplane
I		counter 1 (or 2, 3) stopped	counter has stopped	reset counter in menu C8.9.1 (or C8.9.2, C8.9.3)
I		control input A (or B) active	information only	no action needed
I		over range display 1 (or 2)	1^{st} row on 1^{st} (or 2^{nd}) measurement page is limited by parameter setting	extend upper or lower limit for limitation in menu C8.3.4
I		backplane sensor	incompatible data sensor on backplane	
I		backplane settings	incompatible data on backplane	
I		backplane difference	different data on backplane and display	
I		optical interface	optical interface is operational, local display can not be used	
I		softw sync error	incompatible DSP and microprocessor software	

3.4 Installation procedure for energy measurement

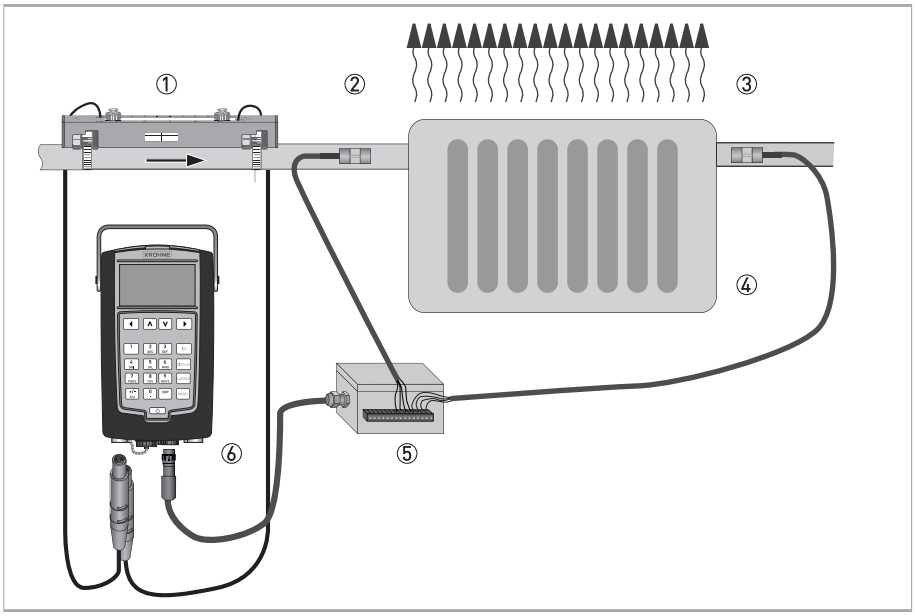


Figure 3-13: Energy measurement

① Mounted rail (in any measuring mode)
② PT 100 temperature sensor on heated pipe
③ PT 100 temperature sensor on cooler pipe
④ Radiator
⑤ Optional I/O box with temperature option
⑥ Converter

The converter calculates the amount of energy, radiated by the radiator. For this, it needs the flow velocity and the difference in temperature between before and after the radiator.

The converter can be placed in different ways. You can use the bracket to hang it or to place it on a desk or you can use the supplied strap to fix it to a pipe.

INFORMATION!
Observe the length of the signal cables.

3.4.1 Step 1: selecting the necessary tools for energy measurement

Besides flow measurement, temperature measurement is also needed. The UFC 400 P has two 4...20 mA inputs for measuring temperature. Temperature transmitters can be connected to the converter using the connection box. Optionally this box can be fitted with temperature transmitters for PT 100 sensors so these can be directly connected to the connection box. In case no temperature sensors are available clamp-on PT 100 sensors can be ordered optionally with the OPTISONIC 6400. In case temperature measurement is not possible there is an option in the UFC 400 P to set the temperature, read from another measurement, manually.

Options for energy measurement:

1. An I/O terminal box with 2 OPTITEMP TT 30 C 4...20 mA, including 2 meter cable. Temperature range 0...120°C / 32...248°F.
2. 2 PT 100's, OPTITEMP TSR-W 30 temperature sensors for tube diameter, max. 300 mm including 2 meter cable

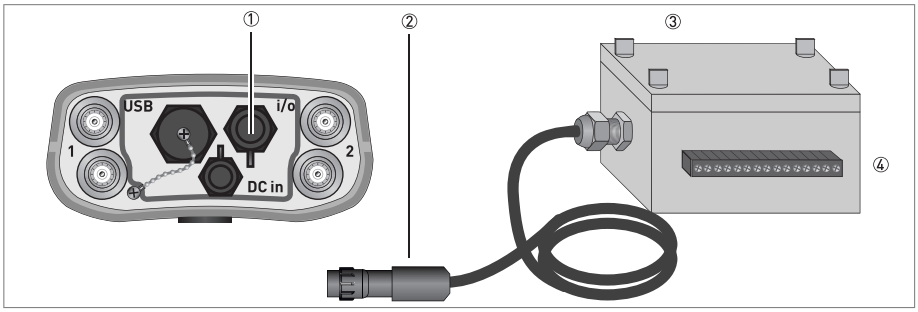


Figure 3-14: Optional I/O box

① I/O connector on converter
② Connector of I/O box
③ I/O box with screw terminals for 1 mm^2 wiring
④ Screw terminal pin 1...15

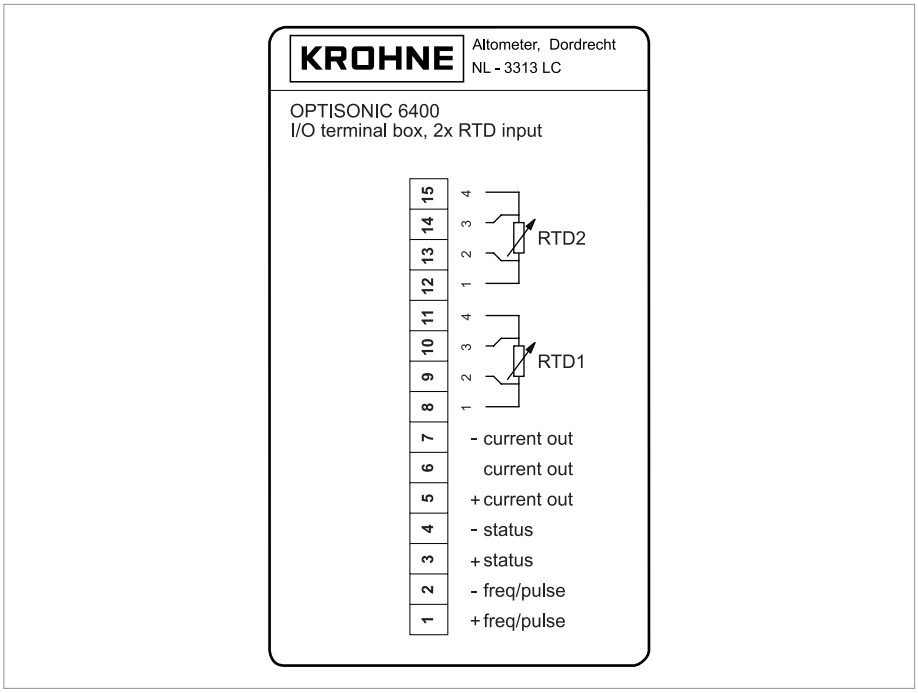


Figure 3-15: I/O box with 2 OPTITEMP TT 30 C included.

Mounting of temperature sensors

You can measure the amount of energy transfered by a system, for instance at heating systems or airconditioning system. You need to use the optional I/O box with PT 100 input option.

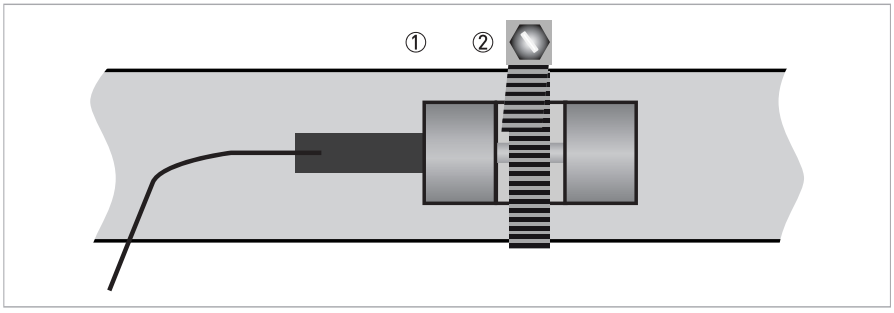


Figure 3-16: Mounting PT 100 with hose clamp

① PT 100 temperature transmitter
② Hose clamp

If the temperature sensors on the pipe have temperature transmitters 4...20 mA it is possible to make use of the standard I/O box.

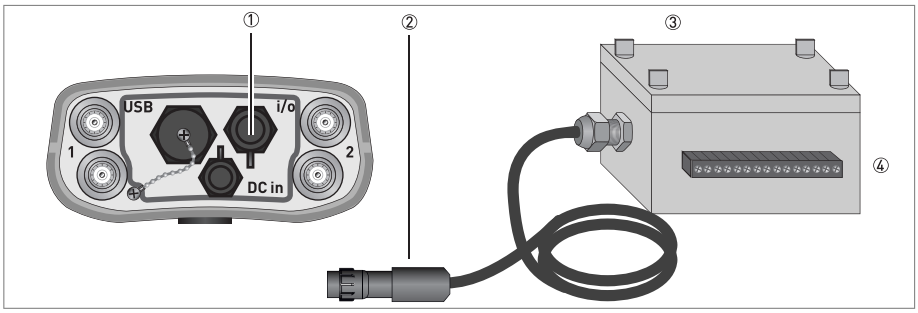


Figure 3-17: Optional I/O box

① I/O connector on converter
② Connector of I/O box
③ I/O box with screw terminals for 1 mm^2 wiring
④ Screw terminal pin 1...15

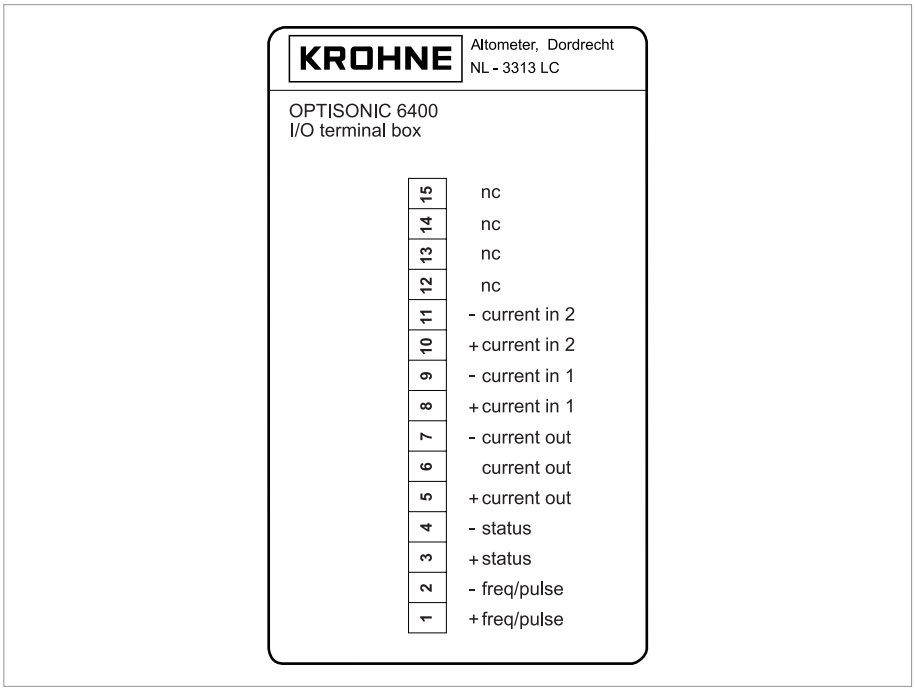


Figure 3-18: I/O box, standard version

Using other temperature sensors or other I/O boxes is possible as long as the output of the transmitters is 4...20 mA.

3.4.2 Step 2: what to do before setting up the energy units

Follow the steps as descriped before, refer to *Installation procedure for flow measurement* on page 17.

3.4.3 Step 3: setting up the units

Connect the cables of the temperature sensors or temperature transmitters with the I/O terminal box. Connect the I/O terminal box with the converter.

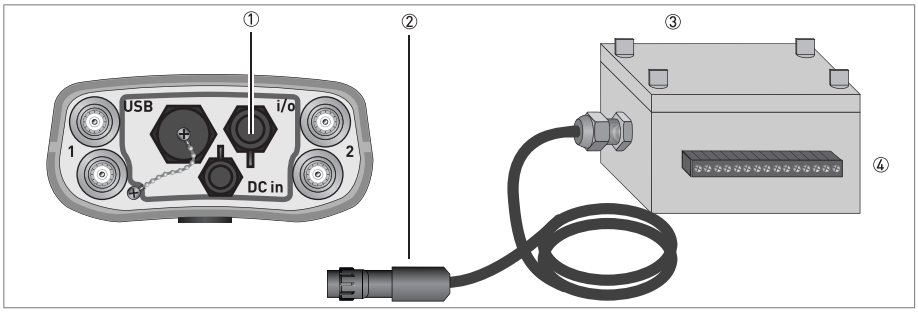


Figure 3-19: Optional I/O box

① I/O connector on converter
② Connector of I/O box
③ I/O box with screw terminals for 1 mm^2 wiring
④ Screw terminal pin 1...15

- Plug the connector ② of the I/O box ③ in the connector ① of the converter. Then use the connector ④ to setup the wanted I/O, as shown in the connection diagrams on the next pages.

3.4.4 Step 4: set up I/O input for energy measurement

Go to menu nr. 2.4.5 via "Measurement ▸ Setup ▸ I/O"

2.4.5
Current output ▸ Current inputs Status output / limit switch Frequency / pulse output Simulation
13-04-2010 14:11:09 13 MB free

If the recommended KROHNE energy set is used, only check the installed values of the "Current inputs". If another energy set is used, teach in the required values. The KROHNE temperature range is 4 mA = 0°C / 32°F and 20 mA = 120°C / 248°F. Extended range min and max is for an alarm function. A value lower than the given minimum value and a value higher than the given maximum will generate a signal that will be logged in the event logger.

3.4.5 Step 5: Set up process input for energy measurement

Go to menu 2.4.2.3.1 via "Measurement ▸ Setup ▸ Process input ▸ Heat ▸ Function off ▸ "

2.4.2.3.1
Heating Cooling **Off ▸**
13-04-2010 14:11:09 13 MB free

Choose "Heating" or "Cooling" to activate energy measurement. The calculation of heating and cooling is the same, except for the polarity of the calculated energy flow.
To measure the correct energy direction set via "Temperature input ▸ " which temperature sensor is at the supply side of the installation

If there are no temperature sensors available for connecting, set the "Temperature input" to "Manual".

2.4.2.3	
Function	Heating
Temperature input ▸	**Manual**
Supply temperature	80.0 °C
Return temperature	120.0 °C
Sensor location	Supply
Fluid	Water
13-04-2010 14:11:09	13 MB free

Set the location of the flow sensor (supply or return side of the installation) in order to calculate the correct specific heat of the liquid. Check whether the shown fluid is correct. The type of fluid is set in the flow sensor installation wizard. In case the fluid is set to water-glycol mixture in the flow sensor installation wizard the concentration of glycol in water can be set in the heating/cooling setup menu.

2.4.2.3	
Function	Heating
Temperature input ▸	**Terminal A at supply**
Sensor location	Supply
Fluid	Water
13-04-2010 14:11:09	13 MB free

3.4.6 Step 6: set up counters for energy

Go to menu 2.4.6 and select a counter for counting energy. Use counter 3 or 4 for energy measurements as they have a higher limit.

2.4.6.1	
Function of counter ▸	**+ counter**
Measurement	Power
Low flow cutoff threshold	0.000 kW
Low flow cutoff hysteresis	0.000 kW
Preset value	0 kJ
Reset counter	
Set counter	
Stop counter	
13-04-2010 14:11:09 13 MB free	

At the "Function of counter", select "Sum" for counting both positive and negative energy flows.
Select "+ counter" for only counting positive energy flows,
Select "- counter" for only counting negative energy flows.
At the "Measurement" option, select "Power". The energy value counter unit is kJ.

3.4.7 Step 7: How to read energy measurement

The following parameters are available when heating or cooling measurement is switched on:

- Temperature A/B
- Temperature difference
- Themal power (power)
- Thermal energy (totalized power)

To setup the display to view those parameters please refer to the display setup paragraph.

The unit for energy measurement can standard be set to Joule (kilo, mega, giga), Wh (kilo, mega) or BTU (kilo, million (MM)). In case any other unit is required the free unit can be used. To setup the free unit go to "Measurement ▸ Setup ▸ Units ▸ ". Select the power or energy parameter, then select "Free unit". Enter the text for the unit, then the factor for the unit entered.
The factor for energy is the amount of Joules in the free unit. The factor for power is the amount of Watt's in the free unit.
Underneath you find a table with factors for alternative energy units.

Unit of power	Description	W factor (amount of Watt in unit)
Ton (refridgeration)	A ton of refridgeration is defined as the cooling power to melt one short ton (2000 pounds or 907 kg) of ice in a 24 hour period. This is equal to 12000 BTU per hour or 3527 W.	3517
kilo calorie per second	Power required to heat 1 kg of water with 1 degree Celsius in 1 second.	4187

Unit of energy	Description	J factor (amount of Joule in unit)
Ton-hour (refridgeration)	A ton-hour of refridgeration is defined as the energy to melt one short ton (2000 pounds or 907 kg) of ice.	12660000
kilo calorie per second	Amount of heat required to increase 1 kg of water with 1 degree Celsius.	4187
Therm	Equal to 100000 BTU	105506000

4.1 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!

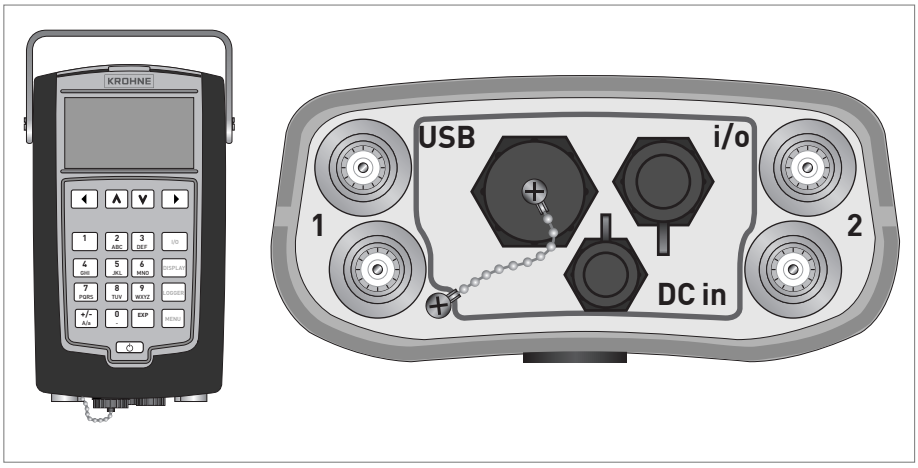
DANGER!
Observe the national regulations for electrical installations!

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.

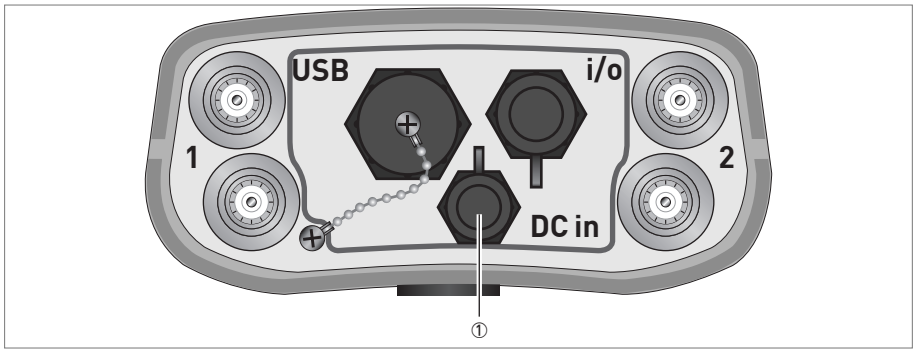
4.2 Location of connectors at the converter

All connectors are located at the bottom side of the converter.



4.3 Power supply

WARNING!
Only use the supplied AC charger to charge the battery of the converter!



Plug in the connector of the supplied charger at the connector ①. Then insert the main power connector into your mains outlet.

4.4 Signal cable

CAUTION!
Please look at the labels on the cable of each transducer for the calibration number. All transducers for the same measuring path MUST have the same calibration number!

INFORMATION!
The signal cables are prefixed to the transducers in the factory.

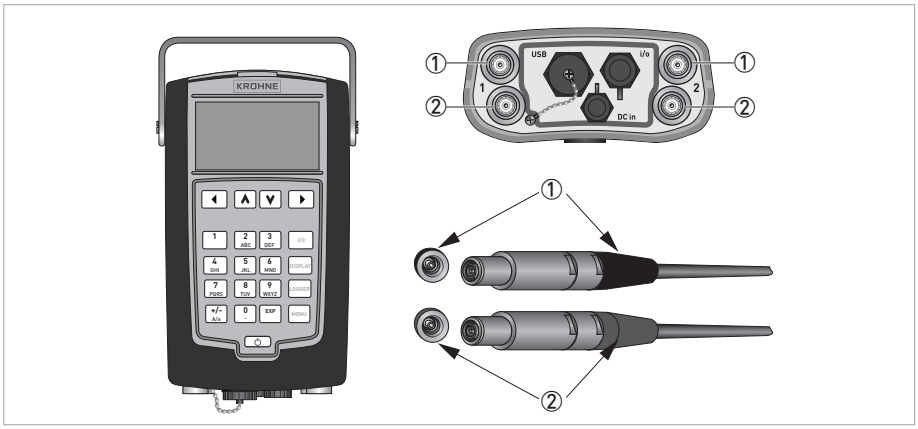


Figure 4-1: Connecting signal cables

① Connector for "UP" transducer (blue)
② Connector for "DOWN" transducer (green)

INFORMATION!
You can measure two paths with this converter simultaneously. Use the left pair of connectors for path 1 and the right pair for path 2.

4.5 USB connector

There are 2 possible USB connections:

1. Reading / writing data to a memory stick, using the USB connector (the converters acts as the master), for transferring data (log files and site files).
2. Controlling the converter with a PC (the converter acts as the slave) for file management. The memory of the converter appears as a memory in your explorer tree view, just like a memory stick.

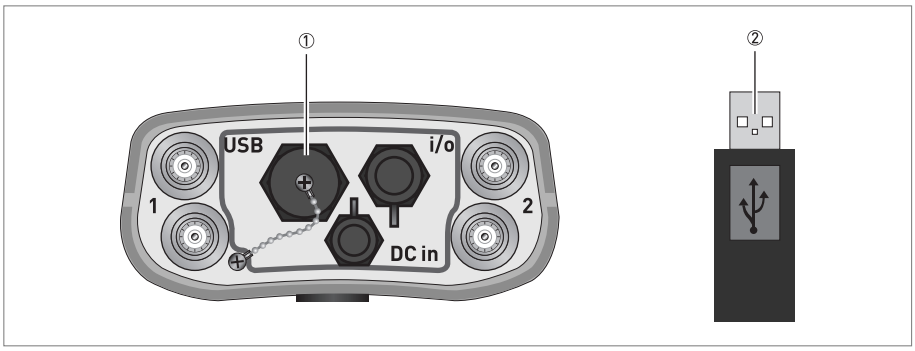


Figure 4-2: Connecting a memory stick to the converter

① Remove the protection cap by turning the knob counter clockwise
② Insert the memory stick

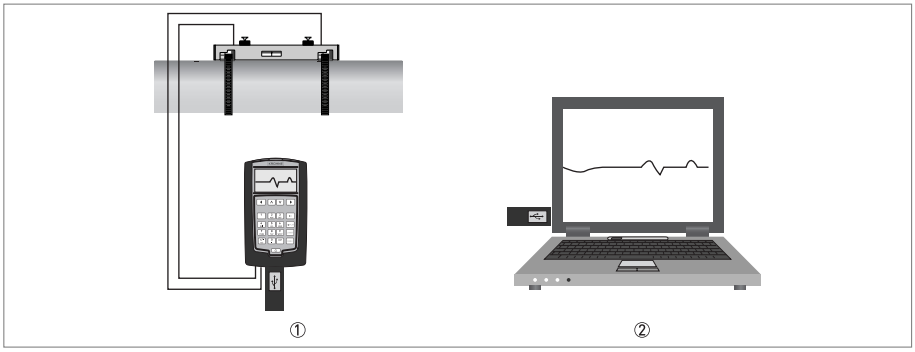


Figure 4-3: Using a memory stick for a measurement

① Perform a measurement on site and log the data to the memorystick
② Put the memory stick in your pc and evaluate the measurement.

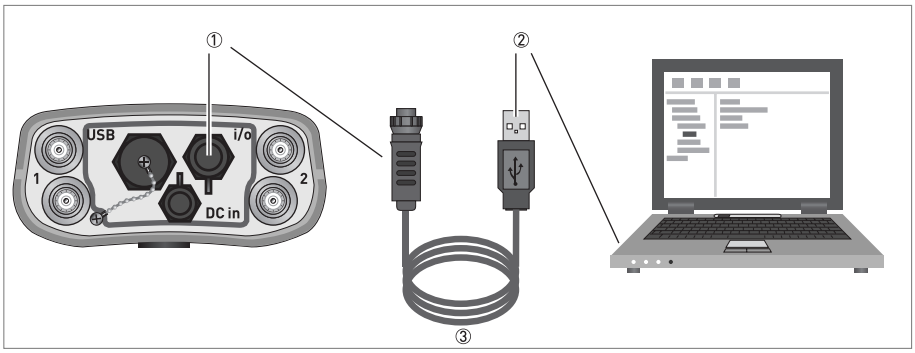


Figure 4-4: Connecting a pc to the converter

① I/O connector
② USB connector
③ optional USB / I/O cable

4.6 I/O cable

To use the available inputs and outputs of the converter, you need an optional I/O box. The I/O box is available in two versions (standard I/O functions and heat measurement version).

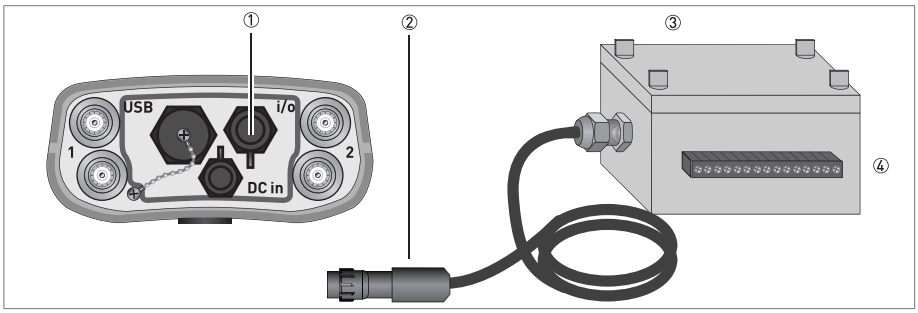


Figure 4-5: Optional I/O box

① I/O connector on converter
② Connector of I/O box
③ I/O box with screw terminals for 1 mm^2 wiring
④ Screw terminal pin 1...15

- Plug the connector ② of the I/O box ③ in the connector ① of the converter. Then use the connectors ④ to setup the wanted I/O, as shown in the connection diagrams on the next pages.

Versions of I/O box

Screw terminal pin	Standard I/O box	I/O box with heat option
1	Frequency / pulse output D	Frequency / pulse output D
2	Frequency / pulse output D-	Frequency / pulse output D-
3	Status output X	Status output X
4	Status output X-	Status output X-
5	Current output C+	Current output C+
6	Current output C	Current output C
7	Current output C-	Current output C-
8	Current input A+	Temperature sensor 1 (PT 100, 4 wire connection)
9	Current input A-	
10	Current input B+	
11	Current input B-	
12	Not connected	Temperature sensor 2 (PT 100, 4 wire connection)
13	Not connected	
14	Not connected	
15	Not connected	

Table 4-1: Terminals of I/O box

4.7 Connection diagrams

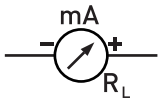
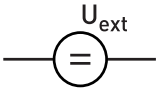
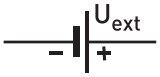
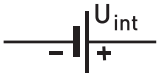
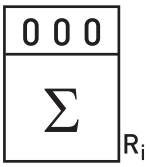
	mA meter 0...20 mA or 4...20 mA and other R_L is the internal resistance of the measuring point including the cable resistance
	DC voltage source (U_{ext}), external power supply, any connection polarity
	DC voltage source (U_{ext}), observe connection polarity according to connection diagrams
	Internal DC voltage source
	Controlled internal power source in the device
	Electronic or electromagnetic counter At frequencies above 100 Hz, shielded cables must be used to connect the counters. R_i Internal resistance of the counter
	Button, NO contact or similar

Table 4-2: Description of symbols

CAUTION!
Observe connection polarity.

4...20 mA current output active (HART®)

- $U_{int,nom}$ = 15 VDC nominal
- I ≤ 22 mA
- R_L ≤ 600 Ω
- Not galvanically isolated.

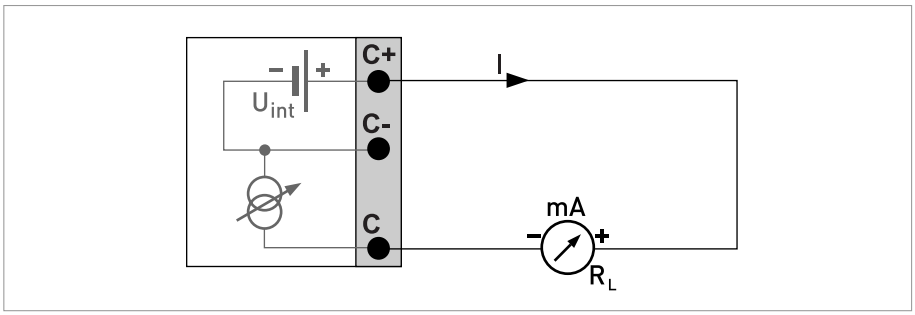


Figure 4-6: Current output active I_a

Current output passive (HART®), basic I/Os

- U_{ext} ≤ 32 VDC
- I ≤ 22 mA
- U_0 ≥ 1.8 V
- $R_L \leq (U_{ext} - U_0) / I_{max}$
- Not galvanically isolated.

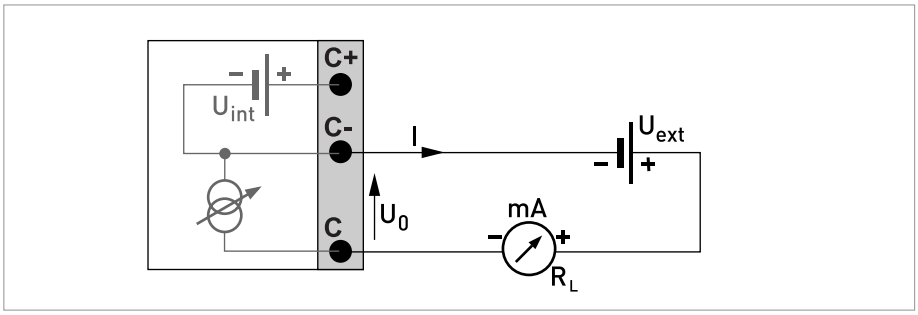


Figure 4-7: Current output passive I_p

INFORMATION!
Pulse / frequency output
- *Any connection polarity.*
- *Galvanically isolated.*

Pulse/frequency output passive

- $U_{ext} \leq 32$ VDC
- f_{max} in operating menu set to $f_{max} \leq 100$ Hz:
  I ≤ 100 mA
  open:
  I ≤ 0.05 mA at U_{ext} = 32 VDC
  closed:
  $U_{0, max}$ = 0.2 V at I ≤ 10 mA
  $U_{0, max}$ = 2 V at I ≤ 100 mA
- f_{max} in the operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:
  I ≤ 20 mA
  open:
  I ≤ 0.05 mA at U_{ext} = 32 VDC
  closed:
  $U_{0, max}$ = 1.5 V at I ≤ 1 mA
  $U_{0, max}$ = 2.5 V at I ≤ 10 mA
  $U_{0, max}$ = 5.0 V at I ≤ 20 mA
- If the following maximum load resistance $R_{L, max}$ is exceeded, the load resistance R_L must be reduced accordingly by parallel connection of R:
  f ≤ 100 Hz: $R_{L, max}$ = 47 kΩ
  f ≤ 1 kHz: $R_{L, max}$ = 10 kΩ
  f ≤ 10 kHz: $R_{L, max}$ = 1 kΩ
- The minimum load resistance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- Can also be set as a status output; for the electrical connection, see status output connection diagram.

Pulse/frequency output active

- U_{nom} = 15 VDC
- f_{max} in operating menu set to $f_{max} \leq 100$ Hz:
  I ≤ 20 mA
  open:
  I ≤ 0.05 mA
  closed:
  $U_{0, nom}$ = 15 V at I = 20 mA
- f_{max} in the operating menu set to 100 Hz < $f_{max} \leq 10$ kHz:
  I ≤ 20 mA
  open:
  I ≤ 0.05 mA
  closed:
  $U_{0, nom}$ = 13.5 V at I ≤ 1 mA
  $U_{0, nom}$ = 12.5 V at I ≤ 10 mA
  $U_{0, nom}$ = 9.0 V at I ≤ 20 mA

- If the following maximum load resistance $R_{L, max}$ is exceeded, the load resistance R_L must be reduced accordingly by parallel connection of R:
  $f \leq 100$ Hz: $R_{L, max} = 47$ kΩ
  $f \leq 1$ kHz: $R_{L, max} = 10$ kΩ
  $f \leq 10$ kHz: $R_{L, max} = 1$ kΩ
- The minimum load resistance $R_{L, min}$ is calculated as follows:
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$

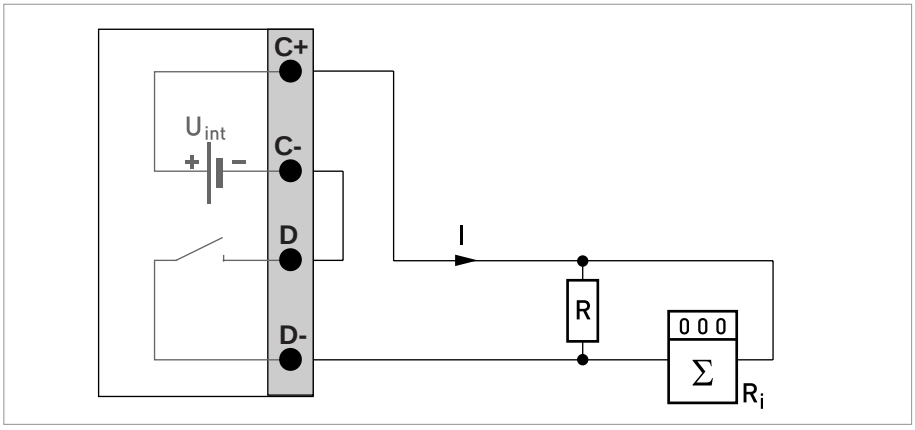


Figure 4-8: Pulse frequency output active P_a

INFORMATION!

- *Any connection polarity.*
- *Galvanically isolated.*

Status output

- $U_{ext} \leq 32$ VDC
- $I \leq 100$ mA
- $R_{L, max} = 47$ kΩ
  $R_{L, min} = (U_{ext} - U_0) / I_{max}$
- open:
  $I \leq 0.05$ mA at $U_{ext} = 32$ VDC
  closed:
  $U_{0, max} = 0.2$ V at $I \leq 10$ mA
  $U_{0, max} = 2$ V at $I \leq 100$ mA
- The output is open when the device is de-energized.

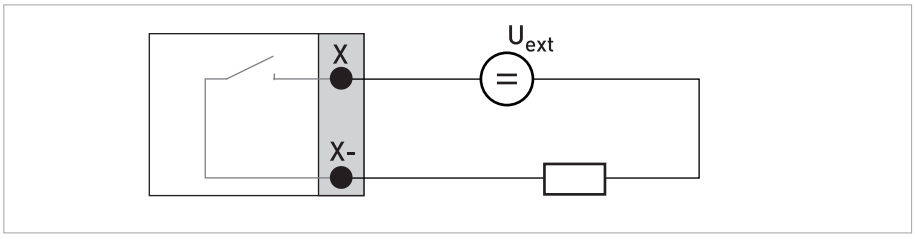


Figure 4-9: Status output / limit switch passive S_p

Current input active

- $U_{int, nom}$ = 15 VDC
- I ≤ 22 mA
- I_{max} ≤ 26 mA (electronically limited)
- $U_{0, min}$ = 19 V at I ≤ 22 mA
- **no** HART®
- Not galvanically isolated
- X designates the connection terminals A or B, depending on the version of the signal converter.

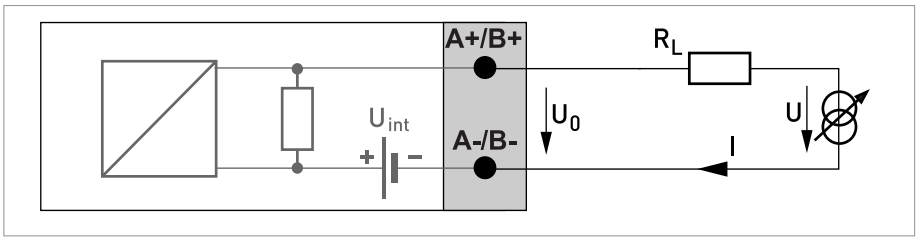


Figure 4-10: Current input active IIn_a

① Signal
② 2-wire transmitter (e.g. temperature)

HART® connection active (point-to-point)

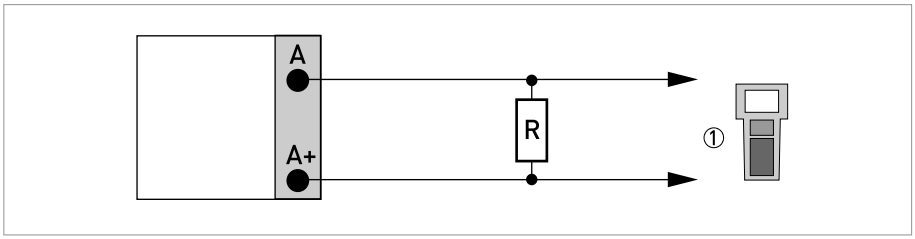


Figure 4-11: HART® connection active (I_a)

① HART® communicator

The parallel resistance to the HART® communicator must be R ≥ 370 Ω.

4.8 I/O configuration

Detailed setup parameters for each I/O port can be set in the measurement menu under setup. Each port should be regarded as independent with its own set of parameters. For more details on parameters for each port, refer to *Menu description* on page 51. The default parameters for a port can be wrong for your application.
A port must be turned on first before any parameters can be set. To ensure that the port is on, we recommend that after turning the port on, you press the "Measure" button and then return using the "Menu" button to continue setting parameters or simulate output.

Current output
The main setting for this is the measurement parameter according to which the mA output will be given and the range for 0% (4 mA) and 100% (20 mA).

Current input
There are 2 current inputs, A and B. The current inputs are meant for temperature measurement. The main setting is the range of the temperature measurement. This is the temperature for 0% scale (= 4 mA) and for 100% (= 20 mA).

Status output
The status output can be used as outputting the status of the device, e.g. Error in device, Application error or other. The status output can also be used as a limit switch. It can be programmed to switch when a measured parameter exceeds a preset value. To achieve the right function a number of parameters can be set. The most important ones are the threshold and hysteresis settings. The threshold is the limit setting, the hysteresis is the change required before the limit event can be logged again.
Example:
Threshold is set to 10 m^3/h, hysteresis set to 1 m^3/h. An event will be logged if the flow exceeds 10 m^3/h. An other event can only be logged after the value has gone under 10 - 1 = 9 m^3/h.
"Polarity"
If the polarity stands on "Normal" the polarity of the parameter is regarded.
If the polarity stands on "Absolute value" the direction of flow is not regarded and events will be logged at for example both positive and negative values.

Pulse / frequency output
A measured value can be output to a pulse frequency output. For the frequency output the frequency at full scale is set. For the pulse output the volume per pulse is set.

I/O simulation
The I/O can also be simulated. This means that a value is set manually. Before simulation of an I/O the following must be done:

- Switch on the I/O first
- Go to the measurement mode to activate the I/O option that was switched on.
- Simulate the required value in the "Simulation" menu.

5.1 Display configuration

5.1.1 Step 1: how to set up the display for showing measured values

There are two ways of setting up screens for showing measured values. Standard 4 information screens can be shown in the measuring mode. Additional screens showing graphs can be added when the datalogger is used. Setting up the display is done in menu nr. 2.4.3.1 via "Measurement ▸ Set up ▸ Display ▸ Screen setup". The following menu will be shown. Page 1 and 2 show parameters in numeric values or bar graphs or both, the graphical page shows trend graphs. The fourth page shows status and error messages.

2.4.3.1	
Page 1 ▸ Page 2 Graphical page Default page	None (cyclic)
13-04-2010 14:11:09 13 MB free	

The appearance of the screens can be set. None (cyclic) means that the screen page will cycle through the 4 screens automatically. It is possible to set it to manual and define the default screen for display.

"Page 1"
"Presentation mode"
Choose the number of lines. This means that one or two parameters can be shown on the display.

"Threshold" and "Hysteresis"
This is for setting the low flow cut off. Normally the default values can be used.

"Time constant"
Use the default unless the signal is very unstable. In that case the time constant can be increased.

"Line 1"
Choose the parameter that is required to be shown. The display format for each parameter can be numerical, bargraph or both. Do the same for the other line when selected.

For page 2 applies the same as for page 1.

"Graphical page"
On this page the actual value of a parameter and a trendgraph is shown. The graph is shown as a percentage of a set scale value. As such the value for 0% and 100% must be set. Also the percentage scale of the graph can be set. Normally this can be left at 0% and 100%. In addition a low flow cutoff and a filter can be set for the displayed parameter. In case a dual path measurement is set, 2 graphs showing both flows are displayed. In case energy measurement is selected, 2 graphs showing both temperatures are shown.

Additional screens showing trend graphs in measuring mode can be setup at the datalogger set up, go to "Measurement ▸ Setup ▸ Logger ▸ Logger setup ▸ View log in screens".

The number of screens can be selected (1 to 4 screens) and the number of graphs per screen (1 to 4). In this way it is possible to show up to 16 trend graphs of parameters. Only one parameter per graph can be shown due to possible difference in unit.

5.1.2 Basic settings of display

If required you can set the backlight brightness of the display. Setting the brightness to 100% instead of 50% decreases the operating time with approximately 5%.

If required change the sleep time. In this example the backlight of the display will be switched off when the keypad is not touched for 60 seconds.

2.4.3.2	
Brightness ▸ Sleep time	**50 %** 60 s
13-04-2010 14:11:09 13 MB free	

5.2 Menu description

Menu Start-up

Menu item			Remarks
Language			Selection of language from list
Time and date			Enter date and time
Units			Selection of units from list
	Size		
	Volume flow		
		Text	Only if free unit is chosen
		m^3/s factor	Only if free unit is chosen
	Velocity		
	Volume		
		Text	Only if free unit is chosen
		m^3 factor	Only if free unit is chosen
	Viscosity		
	Temperature		
	Temperature difference		
	Density		
		Text	Only if free unit is chosen
		kg/m^3 factor	Only if free unit is chosen
	Energy		
		Text	Only if free unit is chosen
		J factor	Only if free unit is chosen
	Power		
		Text	Only if free unit is chosen
		W factor	Only if free unit is chosen
	Specific heat		
Continue			

Menu 1: Installation

Menu nr			Menu item	Remarks
1			Pipe configuration	Selection from list
2			(Pipe 1 data 1)	
	1		Pipe tag	
	2		Outer diameter	
	3		Material	
	4		Wall thickness	
	5		Liner material	
	6		Liner thickness	
3			(Pipe 1 data 2)	
	1		Fluid	
	2		VoS fluid	
	3		Viscosity	
4			(Copy data pipe 1)	
5			(Pipe 2 data 1)	
	1		Pipe tag	
	2		Outer diameter	
	3		Material	
	4		Wall thickness	
	5		Liner material	
	6		Liner thickness	
6			(Pipe 2 data 2)	
	1		Fluid	
	2		VoS fluid	
	3		Viscosity	
7			(Sensor 1 advice)	
	1		Transducer set	
	2		Calibration number	
	3		Number of traverses	
8			(Sensor 1 position)	
	1		Advised Sensor position	
	2		Signal quality	
9			(Sensor 1 warning)	No check
	1		No signal	
	2		Shift sensor position	
		1	Gain	
		2	Signal quality	
	3		Change settings	
	4		Continue	
	5		Abort installation	
10			(Sensor 1 position)	
	1		Advised sensor position	

Menu nr			Menu item	Remarks
	2		Actual sensor position	
11			(Sensor 1 warning)	No check
	1		VoS out of range	
	2		Shift sensor position	
		1	Gain	
		2	Signal quality	
	3		Change settings	
	4		Continue	
	5		Abort installation	
12			(Sensor 1 test)	
	1		Volume flow	
	2		Velocity of sound	
	3		Signal quality	
	4		Optimize position	
13			(Sensor 2 advice)	
	1		Transducer set	
	2		Calibration number	
	3		Number of traverses	
14			(Sensor 2 position)	
	1		Advised transducer position	
	2		Signal quality	
15			(Sensor 2 warning)	No check
	1		No signal	
	2		Shift sensor position	
		1	Gain	
		2	Signal quality	
	3		Change settings	
	4		Continue	
	5		Abort installation	
16			(Sensor 2 position)	
17			(Sensor 2 warning)	No check
	1		VoS out of range	
	2		Shift sensor position	
		1	Gain	
		2	Signal quality	
	3		Change settings	
	4		Continue	
	5		Abort installation	
18			(Sensor 2 test)	
	1		Volume flow	
	2		Velocity of sound	
	3		Signal quality	

Menu nr			Menu item	Remarks
	4		Optimize position	
19			(Status)	
	1		Sensor 1 status	
	2		Signal quality	
	3		Sensor 2 status	
	4		Signal quality	
20			(Save site?)	
	1		Site name	
	2		Cancel	Move to main Menu
	3		Skip saving	Move to Measurement
	4		Save site file	Move to Measurement

Menu 2: Measurement

Menu nr							Menu item	Remarks
X							Site name	
1							Display measurements	
2							Load site	
3							Save current site	
4							Setup	
	1						Units	
		1					Size	
		2					Volume flow	Selection from list
							Text	Only if free unit is chosen
							m^3/s factor	Only if free unit is chosen
		3					Velocity	
		4					Volume	Selection from list
							Text	Only if free unit is chosen
							m^3 factor	Only if free unit is chosen
		5					Viscosity	Selection from list
		6					Temperature	Selection from list
		7					Temperature difference	Selection from list
		8					Density	Selection from list
							Text	Only if free unit is chosen
							kg/m^3 factor	Only if free unit is chosen
		9					Energy	Selection from list
							Text	Only if free unit is chosen
							J factor	Only if free unit is chosen
		10					Power	Selection from list
							Text	Only if free unit is chosen
							W factor	Only if free unit is chosen
		11					Specific heat	Selection from list
	2						Process input	

Menu nr							Menu item	Remarks
		1					Pipe 1	
			1				Calibration	
				1			Zero calibration	Selection from list
				2			Meter factor	
				3			Reynolds correction	Selection from list
			2				Filter	
				1			Limitation minimum	
				2			Limitation maximum	
				3			Flow direction	Selection from list
				4			Time constant	
				5			Low flow cutoff treshold	
				6			Low flow cutoff hysteresis	
			3				Plausibility	
				1			Error limit	
				2			Counter decrease	
				3			Counter limit	
		2					Pipe 2	Same as "Pipe 1"
		3					Heat	
			1				Function	Selection from list
			2				Temperature input	Selection from list
			3				Supply temperature	
			4				Return temperature	
			5				Sensor location	Selection from list
			6				Fluid	
			7				Glycol % volume	(Water/Glycol mixture)
			8				Density	
			9				Specific heat	
		4					Volume flow calculation	Selection from list
	3						Display	
		1					Screen setup	
			1				Page 1	
				1			Presentation mode	Selection from list
				2			Low flow cutoff threshold	
				3			Low flow cutoff hysteresis	
				4			Time constant	
				5			Line 1	
					1		Parameter	Selection from list ①
					2		Presentation format	Selection from list
					3		Range 0%	
					4		Range 100%	
				6			Line 2	

Menu nr							Menu item	Remarks
					1		Parameter	Selection from list ①
					2		Presentation format	Selection from list
					3		Range 0%	
					4		Range 100%	
			2				Page 2	Same as "Page 1"
			3				Graphical page	
				1			Parameter	Selection from list ①
				2			Range 0%	
				3			Range 100%	
				4			Minimum scale	
				5			Maximum scale	
				6			Low flow cutoff threshold	
				7			Low flow cutoff hysteresis	
				8			Time constant	
				9			Time scale	
			4				Default page	Selection from list
		2					Display settings	
			1				Brightness	
			2				Sleep time	
	4						Logger	
		1					Start/stop logger now	Selection from list
		2					Set start time	
		3					Set stop time	
		4					Arm/disarm logger	Selection from list
		5					Logger setup	
			1				Filename	
			2				Parameters	
				1			All	
				2			Flow	
				3			Energy	
				4			Analysis	
				5			Custom	Selection from list ①
			3				Sample interval	
			4				Event logging	
				1			Function	Selection from list
				2			Status	Selection from list
				3			Limit	
					1		Measurement	Selection from list ①
							Threshold	
							Hysteresis	
					2		Polarity	Selection from list
					3		Direction	Selection from list

Menu nr							Menu item	Remarks
			5				View log in screens	
				1			number of screens	Selection from list
				2			Screen 1	
					1		Time scale	
					2		Layout	Selection from list
					3		Graph 1	
						1	Parameter	List acc. To "logger setup - Parameters selection"
						2	Minimum scale	
						3	Maximum scale	
					4		Graph 2	Same as "Graph 1"
					5		Graph 3	Same as "Graph 1"
					6		Graph 4	Same as "Graph 1"
				3			Screen 2	as Screen 1
				4			Screen 3	as Screen 1
				5			Screen 4	as Screen 1
	5						I/O	
		1					Current output	
			1				Function	Selection from list
			2				Range 0%	
			3				Range 100%	
			4				Extended range min	
			5				Extended range max	
			6				Error current	
			7				Error condition	
			8				Measurement	Selection from list ①
			9				Range 0%	
			10				Range 100%	
			11				Polarity	Selection from list
			12				Limitation minimum	
			13				Limitation maximum	
			14				Low flow cutoff threshold	
			15				Low flow cutoff hysteresis	
			16				Time constant	
			17				4mA trimming	
			18				20mA trimming	
		2					Current inputs	
			1				Function	Selection from list
			2				Extended range A 0%	
			3				Extended range A 100%	
			4				Extended range B 0%	
			5				Extended range B 100%	

Menu nr							Menu item	Remarks
			6				Temperature range A 0%	
			7				Temperature range A 100%	
			8				Temperature range B 0%	
			9				Temperature range B 100%	
			10				Time constant A	
			11				Time constant B	
			12				4mA trimming A	
			13				20mA trimming A	
			14				4mA trimming B	
			15				20mA trimming B	
		3					Status output / limit switch	
			1				Function	Selection from list
			2				Status output	
				1			mode	Selection from list ①
				2			invert signal	Selection from list
			3				Limit switch	
				1			Measurement	Selection from list ①
				2			Threshold	
				3			Hysteresis	
				4			Polarity	Selection from list
				5			Time constant	
				6			Invert signal	Selection from list
		4					Frequency / pulse output	
			1				Function	Selection from list
			2				Frequency output	
				1			Pulse shape	Selection from list
				2			Pulse width	
				3			100% pulse rate	
				4			Measurement	Selection from list ①
				5			Range 0%	
				6			Range 100%	
				7			Polarity	Selection from list
				8			Limitation minimum	
				9			Limitation maximum	
				10			Low flow cutoff threshold	
				11			Low flow cutoff hysteresis	
				12			Time constant	
				13			Invert signal	Selection from list
			3				Pulse output	
				1			Pulse shape	Selection from list

Menu nr							Menu item	Remarks
				2			Pulse width	
				3			Maximum pulse rate	
				4			Measurement	Selection from list ①
				5			Pulse value unit	Selection from list
				6			Value per pulse	
				7			Polarity	Selection from list
				8			Low flow cutoff threshold	
				9			Low flow cutoff hysteresis	
				10			Time constant	
				11			Invert signal	Selection from list
		5					Simulation	
			1				Output	Selection from list
			2				Set simulation value	
	6						Counters	
		1					Counter 1	
			1				Function of counter	Selection from list
			2				Measurement	Selection from list ①
			3				Low flow cutoff treshold	
			4				Low flow cutoff hysteresis	
			5				Preset value	
			6				Reset counter	Selection from list
			7				Set counter	
				1			Value	
				2			Set counter	Selection from list
			8				Stop counter	Selection from list
			9				Start counter	Selection from list
		2					Counter 2	Same as "Counter 1"
		3					Counter 3	Same as "Counter 1"
		4					Counter 4	Same as "Counter 1"
	7						Reset errors	Selection from list

① Items shown are dependent on settings in other menu items, e.g. 1 pipe / 2 pipes, 1 path / 2 paths, energy on / off, flow calculation on / off etc.

Menu 3: View logged data

Menu nr			Menu item	Remarks
3			View logged data	
	1		Select log file	
	2		Select parameter	configured list
	3		(Range setting)	
		1	Offset	
		2	Limit	

Menu nr			Menu item	Remarks
		3	Next	
	4	3	Next	

Menu 4: File management

Menu nr		Menu item	Remarks
1		Site files	Selection from list
	1	Import	
	2	Rename	
	3	Copy	
	4	Export	
	5	Delete	
2		Log files	
	1	Import	
	2	Rename	
	3	Copy	
	4	Export	
	5	Delete	
	6	Export to CSV	

Menu 5: Settings and information

Menu number				Menu item	Remarks
1				Load factory settings	Selection from list
2				Device	
	1			Tag	
	2			Language	
	3			Time and date	
	4			Start-up sequence ?	Selection from list
	5			Password	
3				Transducer sets	
	1			Ta serial number	
	2			Ta calibration number	
	3			Tb serial number	
	4			Tb calibration number	
	5			Tc serial number	
	6			Tc calibration number	
4				Information	Information on hardware and software versions and serial numbers. Not required for day to day use but may be asked for when support from the supplier is required.
	1			General	
		1		Identification number	
		2		Device serial number	

Menu number				Menu item	Remarks
		3		Electronic serial number	
	2			Components	
		1		Device	
		2		Sensor CPU	Same as "Device"
		3		Sensor DSP	Same as "Device"
		4		Sensor driver	Same as "Device"
		5		Current output	Same as "Device"
		6		Current input A	Same as "Device"
		7		Current input B	Same as "Device"
		8		UI controller	Same as "Device"
	3			Operating hours	
5				Service	These settings are specific for the ultrasonic measurement operation. Changing service settings may affect proper operation of the instrument. It is advised that changing of these parameters is performed by qualified engineers only.
	1			Signal data	
		1		Signal path 1	Selection from list
		2		Signal path 2	Selection from list
		3		Window path 1	
			1	Method	Selection from list
			2	Window size	
			3	Window weight	
			4	Window minimum	
			5	Window start	
			6	Window end	
		4		Window path 2	Same as "Window path 1"
		5		Detection path 1	
			1	Method	Selection from list
			2	Trigger level	
			3	Trigger margin	
			4	Dead time	
		6		Detection path 2	Same as "Detection path 1"
	2			Service calibration	
		1		zero device	
			1	path 1	
			2	path 2	
		2		zero converter	
			1	path 1	
			2	path 2	
	3			Reset to defaults	Selection from list

5.3 How to set up data logging

5.3.1 Step 1: how to set up the data logger

Go to menu 2.4.4.5 via "Measurement ▸ Setup ▸ Logger ▸ Logger setup". The data logging can be stored in "Filename", with a maximum of eight characters. The name of the data logging file is free to be chosen. Behind the name of the saved data logging will be three numbers that start with 000. Each time a data logging will be filed again the numbers will be increased by one.

INFORMATION!
We recommend to use the same name for the site file as for the data logger file.

2.4.4.5	
Filename ▸	**12345678**
Parameters	All
Sample interval	60 s
Event logging	
View log in screens	
13-04-2010 14:11:09	13 MB free

In "Parameters", it is possible to save all parameters or to choose a predefined set of parameters ("Flow", "Energy" or "Analysis")

2.4.4.5.2
All ▸
Flow
Energy
Analysis
Custom
13-04-2010 14:11:09 13 MB free

By choosing "Custom" you can select your own set of parameters by setting each individual available parameter on or off. Those parameters which are set to on will be logged.

2.4.4.5.2.5	
Volume flow ▸	**On**
Velocity of sound	on
Flow speed	on
Gain	on
SNR	on
Reynolds nr	on
Signal quality	on
Counter 1	on
13-04-2010 14:11:09	13 MB free

"Sample interval"
The standard sample interval is 60 s this means that once a minute it creates 1 data point. Change the sample interval in a frequency that is wise. Data logging 3 minutes long with one data point per minute means not too much information. 60 data points per minute 3 days long is a lot of information. Maximum number in one file is 150000 data points. If this number is exceeded during logging, the oldest datapoints are overwritten. The memory size for data logging is sufficient for 50 x 150000 data points.

Calculation examples:
Velocity of sound, supply temperature and flow speed are turned on. This means 150000 data points / 3 = 50000 data points per subject. Required is 1 data point per minute, maximum time would be 50000 minutes = 833 hours.

Another example:
Volume flow and velocity of sound are turned on. This means 150000 data points /2 = 75000 data point per subject. Required is 1 data point per 5 seconds = 12 data points per minute. 75000 / 12 / 60 = 104 hours.

2.4.4.5	
Filename Parameters **Sample interval** Event logging View log in screens	log Custom **60 s ▸**
13-04-2010 14:11:09 13 MB free	

"Event logging" to log parameters exceeding pre-set limits and errors. To make use of event logging, data logging must be on. The event logging can be filled in fully independent from the data logging. The event logging will be logged on event regardless of the interval set.

The event logging can be set to "Status", the occurence of a pre-defined event will be logged with time and date. The pre-defined events are "Error in device", "Application error", "Out of specification". for more information, refer to *Error messages* on page 29.

2.4.4.5	
Filename Parameters Sample interval **Event logging ▸** View log in screens	log Custom 60 s
13-04-2010 14:11:09 13 MB free	

"Limit"
If the event logger is set to "Limit" the event of a parameter exceeding a pre-set limit can be logged.

"Measurement"
Choose the parameter for which the events should be logged.

"Threshold" and "Hysteresis"
The threshold is the limit setting. The hysteresis is the change required before the limit event can be logged again.
Example: Threshold is set to 10 m^3/h, hysteresis to 1 m^3/h. An event will be logged if the flow exceeds 10 m^3/h. Another event can only be logged after the value has gone under 10 - 1= 9 m^3/h.

"Polarity"
If the polarity stands on "Normal" the polarity of the parameter is regarded. If the polarity stands on "Absolute value" the direction of flow is not regarded and events will be logged at for example both negative and positive values.

"Direction"
"Normal" or "Inverse" shows the direction of exceeding the threshold setting in order to log an event. Normal is when the threshold value is passed by an increasing value of the parameter.

2.4.4.5.4.3	
Measurement ▸	**Volume flow**
Threshold	180.0 m^3/h
Hysteresis	3.600 m^3/h
Polarity	Normal
Direction	Normal
13-04-2010 14:11:09	13 MB free

5.3.2 Step 2: how to start data logging

2.4.4
Start/stop logger now ▸
Set start time
Set stop time
Arm/disarm logger
Logger setup ▸
13-04-2010 14:11:09 13 MB free

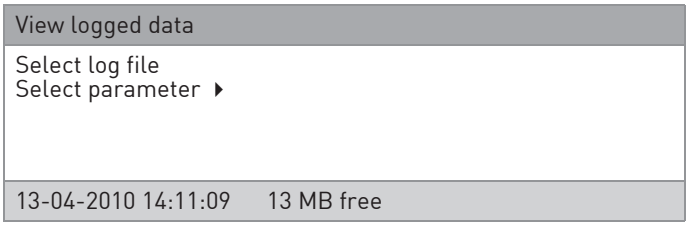
Data logging can only be done in the measurement mode. This will happen after the logger is armed (activated) in the above menu. In addition this may depend on time and date if a start/stop time/date for the logger is set.
"Start/stop logger now" "Yes" "Logger armed" will appear in the bottom blue line, pressing it again will make it disappear. If the "Logger armed" is on, data will be logged in accordance with the settings filled in "Logger setup" when the measuring mode is entered. When the measuring mode is left, datalogging will stop. When the logger is armed it is not possible to change settings of the logger.

If required, a start stop time and date for the logger can be set. After arming the logger the set date and time will be considered for starting and stopping the datalogger.

2.4.4
Start/stop logger now ▸
Set start time ▸
Set stop time
Arm/disarm logger
Logger setup
13-04-2010 14:11:09 13 MB free

5.3.3 Step 3: how to view logged data

With the UFC 400 P it is possible to view logged data. This is only possible for one logged parameter at the time.
"View logged data", ▸, choose saved file. Press ▸



Choose a parameter and change the percent of the scale for viewing as required. Press "Next". A graph is displayed.

With the keys ▲ and ▼ zooming on the time scale axis is possible. The actual level of zooming is shown in the upper left corner as a percentage and through the bar on the time scale. After zooming in the 4 and 6 keys can be used to step to the beginning or the end of the data. The 1 and 3 key can be used to step backwards and forwards through the data.

5.4 How to transfer data to a PC

5.4.1 Site files

When you use the converter for the first time only a default site file is available. This will be loaded. If you used the converter before, the same site file will be loaded that was loaded when you switched off the converter the last time.
When you start with the installation of a flow sensor the settings from this file are used. You can save the site file under an appropiate name after the flow sensor installation procedure.

By saving the default site file the parameters settings of the factory are overwritten. To restore the factory default settings, select "Settings and information ▸ Load factory settings". If the default site file is deleted the converter will create a new one at the next startup of the device.

Site files can be saved and loaded in the "Measurement" menu. When a parameter setting is changed and not saved in the site file the converter will ask if you want to save it when you enter the measuring mode. You can skip this. By using the function keys on the right side of the keypad you can jump from the measurement menu to the setup menu or options without being asked to save changed parameter settings.
It is recommended to save the site file regularly in order to not loose work. The site files are not stored automatically also not when the converter is switched off.

In the menu "File management ▸ Site files" you can manage your site files. You can copy, rename or delete site files.
With the "Import" or "Export" option you can copy site files from/to a memory stick connected to the USB port.
It is highly recommended to backup your site files on a memory stick or on your pc in order not to loose work.
The site files are XML files. You can store, copy or rename the site files on your pc, however if you edit a site file on your pc the site file might not have the correct format anymore and may give an error when reading it on the converter.

File management ▸ Site files
Import ▸ Rename Copy Export Delete
13-04-2010 14:11:09 13 MB free

5.4.2 Log files

On the converter you can rename, copy or delete log files. Log files are related to site. Renaming log file may disturb this relation. This may give wrong results when viewing the logged data. With the "Import" or "Export" option you can copy site files from/to a memorystick connected to the USB port

The file format of the log files is binary and the format is propriety. However you can backup log files on your pc and import them back to the converter to view logged data on the converter. If you want to view the logged data on your pc it can be converted to CSV format. Before this is done the site file related to the logged data must be made the current site file. This is done by opening it in the measuring mode. The CSV (Comma Separated Values) format can be imported into Excel by using the menu "Data ▸ Import external data". The values are separated by a ";". The data is stored in columns, the first column is the time/date tag. Please note that numbers in the CSV file are stored without a thousands separator and with a decimal point (".") as decimal separator. If this is not your standard setting in Excel, go to "Advanced" during the import to make these settings accordingly. In following columns measured values of each logged parameter are stored. The data is stored in ISO units only. The parameter name and unit is stored in the first row.

Export to CSV can be done when a memory stick is connected to the converter.

File management ▸ Log files
Import ▸ Rename Copy Export Delete Export to CSV
13-04-2010 14:11:09 13 MB free

5.4.3 Managing your files from your pc

The converter can be connected to a pc with a USB cable (option). The memory of the converter is shown in the explorer treeview on your pc in a similar way as a memory stick.
The site files are stored in \pcf\data\configuration (as .XML files).
The log files are stored in \pcf\data\log (as .log files).
You can copy the configuration and log files to your pc for backup and storage. You can copy configuration files that were created with the UFC 400 P emulation software on your pc. You can copy log files that were created during earlier data logging sessions on a UFC 400 P to the UFC 400 P.

CAUTION!
Do not create / change other files than the ones mentioned. Do not delete other files or folders from the signal converter.

When the converter is connected to your pc you can not convert log files to CSV format on the converter. This will only work with a memory stick connected to the converter.

Emulation of the signal converter operation on a pc

On the memory stick provided with the OPTISONIC 6400 a file "win32.zip" is provided. If you unzip this file to the harddisk of your pc you can run the signal converter user interface on your pc. To start this program select \win32\pcf.exe. With this program you can load site files, change settings and store them. You can also convert logged data to CSV format. The CSV file will be stored in the \win32 folder. With this program of course there is no measurement function available.

6.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local representative.

6.3 Returning the device to the manufacturer

6.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

CAUTION!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

CAUTION!
If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

6.3.2 Form (for copying) to accompany a returned device

Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:	☐	water-hazardous
	☐	toxic
	☐	caustic
	☐	flammable
	☐	We checked that all cavities in the device are free from such substances.
	☐	We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

6.4 Disposal

CAUTION!
Disposal must be carried out in accordance with legislation applicable in your country.

7.1 Measuring principle

- Like canoes crossing a river, acoustic signals are transmitted and received along a diagonal measuring path.
- A sound wave going downstream with the flow travels faster than a sound wave going upstream against the flow.
- The difference in transit time is directly proportional to the mean flow velocity of the medium.

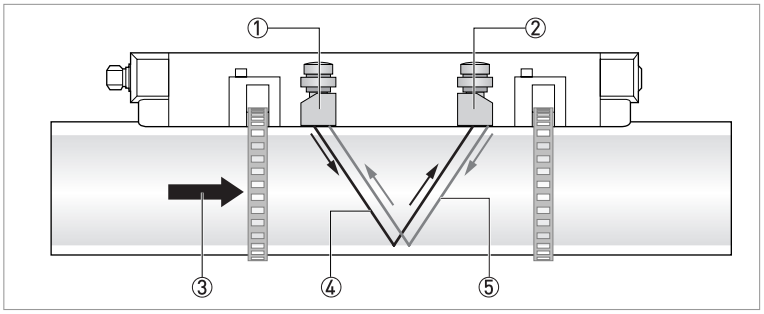


Figure 7-1: Measuring principle

① Transducer A
② Transducer B
③ Flow velocity
④ Transit time from transducer A to B
⑤ Transit time from transducer B to A

7.2 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 (Download Center).*

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, thermal energy (requires input of temperature (2x)).

Design

	The measurement system consists of one or two measuring sensors and a portable signal converter.
Signal converter	
Portable housing	UFC 400 P
Measuring sensor	
Standard	Single or dual rail sensors with 1 or 2 MHz transducers
Optional	OPTISONIC 6300 flow sensors using cable adapters
Diameter ranges	
DN15...150 / ½...6"	One rail, 2 MHz transducers
	Outer diameter must be at least 20 mm / ¾".
DN50...250 / 2...10"	One rail, 1 MHz transducers
DN200...1500 / 8...60"	Two rails, 1 MHz transducers
Options	
Outputs	0(4)...20 mA, pulse, frequency and/or status output
Inputs	0(4)...20 mA (2x) with optional I/O box.
Counters	4 internal counters with a maximum of 8 counter places, for counting volume, energy and/or mass units.
USB	1x host port (PC can use OPTISONIC 6400 as a removable media device)
	1x slave (memory stick can be written by converter)
Self diagnostics	Integrated verification, diagnostic functions: flowmeter, process, measured value, empty pipe detection, bar graph.

Display and user interface	
Graphic display	4.3" TFT with LED backlight, daylight readable
	272x480 dots resolution
	The readability of the display could be reduced at ambient temperatures below -25°C / -13°F.
Operator input elements	21 Key tactile keypad:
	1 on/off key
	4 cursor keys for menu operation
	12 keys for alpha / numerical input (SMS style)
	4 function keys for direct access to main functions
Display functions	
Menu	Wizard for setup and configuration of measurements.
	Support for the configuration of 2 path / 2 pipe or 2 path / 1 pipe measurement.
	Averaging, adding or subtracting of measurement results of 2 path measurements.
	Storage of measurement configurations as site file. Maximum of site files is 100.
	Measurement data can be displayed as value or as bar or trend graph.
Thermal energy measurement	By input of 2 temperature sensors providing a temperature difference, thermal energy can be calculated.
Data logger	Logging of selected measured / calculated values. Data to be logged and time interval can be set. A maximum number of 150000 values / 50 files can be stored. Display of logged data through line graphs.
Language of display texts	English, French, German, Italian, Spanish.
	Other languages on request.
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
Ambient temperature	Sensor: -40...+70°C / -40...+158°F
	Signal converter: -20...+55°C / -4...+131°F (Humidity: 5...80%, non condensing).
Storage temperature	-30...+80°C / -22...+176°F (Humidity: 5...80%, non condensing).
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

Installation condititions

Measurement configuration	Single pipe, single path
	Single pipe, dual path
	Dual pipe, dual path
Inlet run	≥ 10 DN straight length
Outlet run	≥ 5 DN straight length
Dimensions and weights	For information refer to *Dimensions and weights* on page 77.

Materials

Sensor	Anodized aluminum (rail)
Converter	Polyamide PA12, covered with TPE soft touch layer on the sides
Trunk on wheels	Polypropylene

Electrical connections

Power supply	Adapter for 100…240 VAC (-10% / +10%), 47...63 Hz
	Adapter voltage: 13.2 V
	Maximum power consumption: 10 W (25 W during charging)
	Charging time: 8 hours
	Battery type: Lithium polymer
	Battery lifetime:
	Measuring operation (display at 50% brightness): 14 hours
Signal cable	double shielded, internal triax, length: 3 m / 15 ft
USB ports	1x for PC, 1x for memorystick
Inputs / outputs	15 pin connector for I/O interfacing with optional I/O box
	Optional: PT100 input:
	Function: PT 100 temperature input by 2x KROHNE TT30C temperature transmitters build into an I/O box
	For specifications see TT30C datasheet.
	Optional: temperature input:
	Function: temperature input by 2x KROHNE TSR-W 30 clamp-on temperature sensors only in combination with I/O box with temperature transmitters.
	For specifications see TSR-W 30 datasheet.

Inputs and outputs

Connections	Inputs and outputs can only be connected using the optional I/O box.
Description of used abbreviations	U_{ext} = external voltage R_L = load + resistance U_o = terminal voltage I_{nom} = nominal current
Current output	
Isolation	The output is not galvanically isolated from the other circuits.
Output data	All analog measurement parameters like volume and mass flow (at constant density), flow speed, speed of sound, gain, signal to noise ratio, reliability of flow measurement, quality of acoustic signal, thermal energy (requires input of temperature (2x)).
Settings	Q = 0%: 0…20 mA; Q = 100%: 10…21.5 mA
	Error identification: 0…22 mA
Operating data	
Active	$U_{int,nom}$ = 15 VDC $I \leq 22$ mA $R_L \leq 450\ \Omega$
Passive	$U_{ext} \leq 32$ VDC $I \leq 22$ mA $U_0 \geq 1.8$ V at I = 22 mA

Pulse or frequency output	
Isolation	The output is galvanically isolated from the other circuits.
Output data	For pulse counting and/or analog output: Volume flow, mass flow, thermal energy (requires input of temperature (2x)
	As analog output: Flow speed, speed of sound, gain, signal to noise ratio, reliability of flow measurement, quality of acoustic signal
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	
Active	U_{nom} = 15 VDC
	$f_{max} \leq$ 100 Hz: I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0,nom}$ = 15 V at I = 20 mA
	100 Hz < $f_{max} \leq$ 10 kHz: I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0,nom}$ = 13.5 V at I = 1 mA $U_{0,nom}$ = 12.5 V at I = 10 mA $U_{0,nom}$ = 9 V at I = 20 mA
Passive	$U_{ext} \leq$ 32 VDC
	$f_{max} \leq$ 100 Hz: I ≤ 100 mA open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 0.2 V at I ≤ 10 mA $U_{0, max}$ = 2 V at I ≤ 100 mA
	100 Hz < $f_{max} \leq$ 10 kHz: I ≤ 20 mA open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 1.5 V at I ≤ 1 mA $U_{0, max}$ = 2.5 V at I ≤ 10 mA $U_{0, max}$ = 5.0 V at I ≤ 20 mA

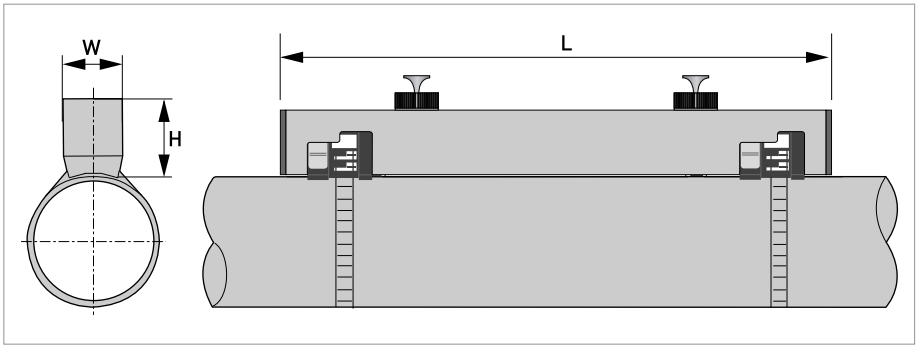
Status output	
Isolation	The output is galvanically isolated from the other circuits.
Function and settings	Settable as automatic measuring range change, indicator for direction of flow, overflow, error, operating point or empty pipe detection
	Status and/or control: ON or OFF
Operating data	
Active	U_{int} = 15 VDC I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 15 V at I = 20 mA
Passive	U_{ext} ≤ 32 VDC I ≤ 100 mA open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 0.2 V at I ≤ 10 mA $U_{0, max}$ = 2 V at I ≤ 100 mA
Current inputs	
Isolation	The inputs are not galvanically isolated from the other circuits.
Function	Input of temperature, used for energy calculation in combination with flow measurement
	Range: -50...500°C / -58...932°F (default: 0...120°C / -32...248°F)
Operating data	
Active	U_{int} = 15 VDC I ≤ 22 mA I_{max} = 26 mA (electronically limited) $U_{0, min}$ = 9 V with I ≤ 22 mA No HART®
Passive	U_{ext} ≤ 32 VDC I ≤ 22 mA I_{max} = 26 mA (electronically limited) $U_{0, max}$ = 5 V with I ≤ 22 mA No HART®

Approvals and certificates

CE	
	This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Electromagnetic compatibility	Directive: 2004/108/EC
	Harmonized standard: EN 61326-1: 2006
Low voltage directive	Directive: 2006/95/EC
	Harmonized standard: EN 61010: 2001
Other approvals and standards	
Protection category acc. to IEC 529 / EN 60529 / NEMA 250/2003	Sensor: IP 67 / NEMA 6
	Converter: IP 65 / NEMA 4
	Trunk on wheels: IP 67 / NEMA 6
	Power adapter: IP 40 / NEMA 1
Shock test sensor	IEC 60068-2-27
Vibration test sensor	IEC 68-2-64

7.3 Dimensions and weights

7.3.1 Clamp-on sensor



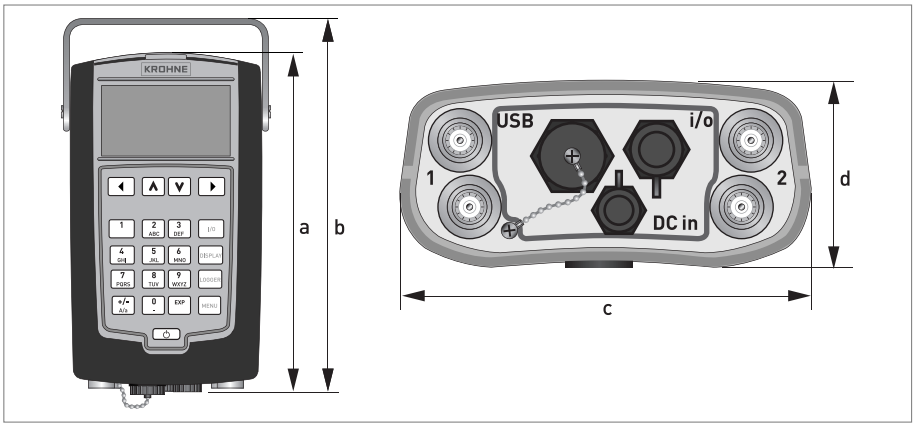
Dimensions [mm]			Approx. weight [kg]
L	H	W	
406	76	39.2	2.1 ①

① with transducers / cable, without mounting strap

Dimensions [inches]			Approx. weight [lb]
L	H	W	
16.0	3.0	2.5	4.6 ①

① with transducers / cable, without mounting strap

7.3.2 Converter

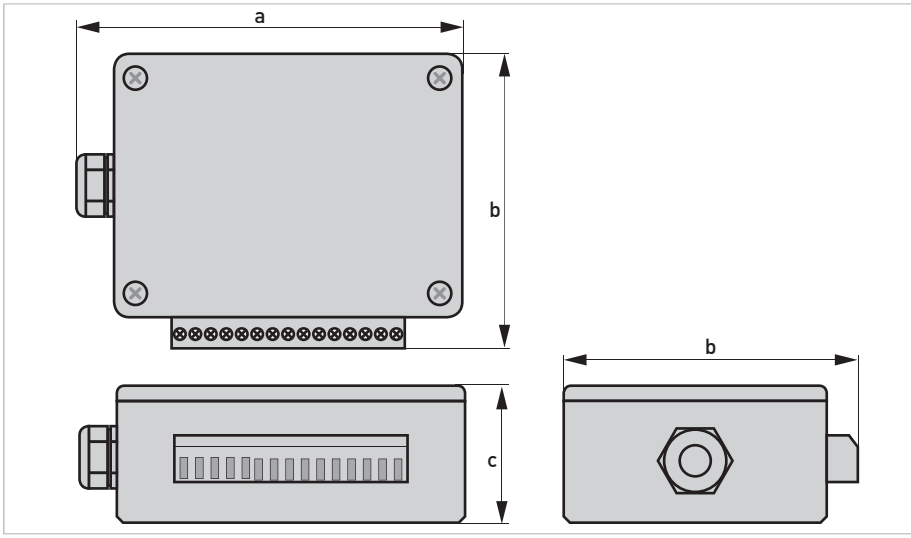


Dimensions UFC 400 converter

Dimensions [mm]				Approx. weight [kg]
a	b	c	d	
247	289	168	66	1.6

Dimensions [inch]				Approx. weight [lb]
a	b	c	d	
9.7	11.4	6.6	2.6	3.5

7.3.3 I/O box

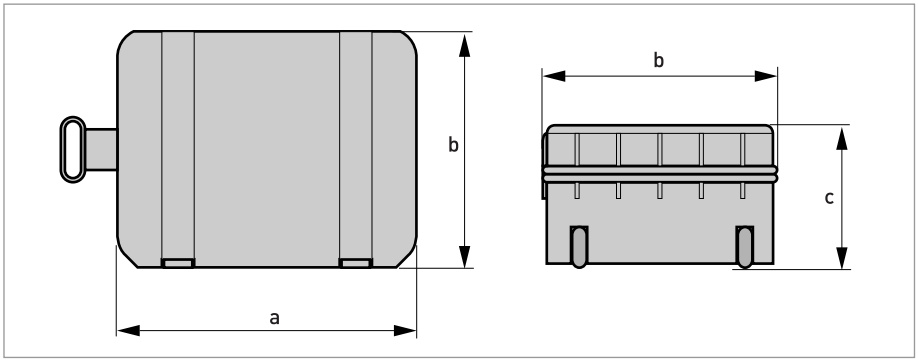


Dimensions I/O box

Dimensions [mm]			Approx. weight [kg]
a	b	c	
112.5	84.6	41.3	0.2

Dimensions [inch]			Approx. weight [lb]
a	b	c	
4.4	3.3	1.6	0.44

7.3.4 Trunk on wheels



Dimensions trunk on wheels

Dimensions [mm]			Approx. weight [kg]
a	b	c	
565	374	241	6.2

Dimensions [inch]			Approx. weight [lb]
a	b	c	
22.2	14.7	9.5	13.7

KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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