

# Operating Instructions



## Hand-held Ultrasonic Flowmeter **KATflow 200**

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**Operating Instructions KATflow 200**

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# KATflow 200

## Operating Instructions

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# 1 Safety instructions, legal requirements, warranty, return policy

## 1.1 Symbols used in these operating instructions



### Danger

This symbol represents an immediate hazardous situation which could result in a **serious injury, death or damage to the equipment**. Where this symbol is shown, do not use the equipment further unless you have fully understood the nature of the hazard and have taken the required precautions.



### Attention

This symbol indicates important instructions which should be respected in order to avoid damage or destroy the equipment. Follow the the precautions given in these instructions to avoid the hazard. Call our service team if necessary.



### Call service

Where this symbol is shown call our service team for advise if necessary.



### Note

This symbol indicates a note or detailed set-up tip.



This symbol represents enumeration.



Operator keys are printed in bold typeface and placed in pointed brackets.

## 1.2 Safety instructions

- Do not install, operate or maintain this flowmeter without reading, understanding and following these operating instructions, otherwise injury or damage may result.
- Study these operating instructions carefully before the installation of the equipment and save them for future reference.
- Observe all warnings, notes and instructions as marked on the packaging, on the equipment and those detailed in the operating instructions.
- Do not use the instrument with removed or opened battery cover under wet conditions.
- Consider the unpacking, storage and preservation instructions to avoid damage to the equipment.
- Install the equipment and cabling securely and safely according to the respective regulations in place.
- If the product does not operate normally, please refer to the service and trouble shooting instructions or contact KATRONIC for help.

### 1.3 Warranty

- Any product purchased from KATRONIC is warranted in accordance with the relevant product documentation and as specified in the sales contract provided it has been used for the purpose for which it has been designed for and operated as outlined in these operating instructions. Misuse of the equipment will immediately revoke any warranty given or implied.
- Responsibility for suitability and intended use of this ultrasonic flowmeter rests solely with the user. Improper installation and operation of the flowmeter may lead to a loss of warranty.
- Please note that there are no operator-serviceable parts inside the equipment. Any unauthorised interference with the product will invalidate the warranty.

### 1.4 Return policy

If the flowmeter has been diagnosed to be faulty, it can be returned to KATRONIC for repair using the Customer Returns Note (CRN) attached to the Appendix of this manual. KATRONIC regret that we cannot accept the return of the equipment unless accompanied by the completed CRN for Health & Safety reasons.

### 1.5 Legislative requirements

#### **CE marking**

The flowmeter is designed to meet the safety requirements in accordance with sound engineering practise. It has been tested and left the factory in a condition in which it is safe to operate. The equipment is in conformity with the statutory requirements of the EC directive and comply with applicable regulations and standards for electrical safety EN 61010 and electro-magnetic compatibility EN 61326. A CE Declaration of Conformity is issued in that respect, a copy of which can be found in the Appendix of these operating instructions.

#### **WEEE Directive**

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) aims to minimise the impact of electrical and electronic goods on the environment, by increasing re-use and recycling and reducing the amount of WEEE going to landfill. It seeks to achieve this by making producers responsible for financing the collection, treatment, and recovery of waste electrical equipment, and by obliging distributors to allow consumers to return their waste equipment free of charge.



KATRONIC offers its customers the possibility of returning unused and obsolete equipment for correct disposal and recycling. The Dustbin Symbol indicates that when the last user wishes to discard this product, it must be sent to appropriate facilities for recovery and recycling. By not discarding this product along with other household-type waste, the volume of waste sent to incinerators or landfills will be reduced and natural resources will be conserved. Please use the Customer Return Note (CRN) in the Appendix for the return to KATRONIC.

#### **RoHS Directive**

The European Union's RoHS ("Restriction of the use of certain Hazardous Substances") Directive (2002/95/EC) goes into effect on July 1, 2006. All of the instrumentation manufactured by KATRONIC falls under Category 9, Measurement and Control Equipment. Currently this category is exempt from RoHS compliance until at least 2010, when it and other exemptions will be reviewed. Regardless of this, all products manufactured by KATRONIC are compliant with the RoHS Directive.

## 2 Introduction

### Clamp-on transit-time flowmeter

The KATflow 200 is a hand-held, battery operated ultrasonic flowmeter utilising clamp-on sensors for the measurement of liquids in full closed pipes. Flow measurements can be undertaken without interrupting of the process or interfering with the integrity of the pipeline. The clamp-on sensors are simply attached to the outside of pipes. The KATflow 200 uses ultrasonic signals for the measurement of the flow, employing the so-called transit-time method.

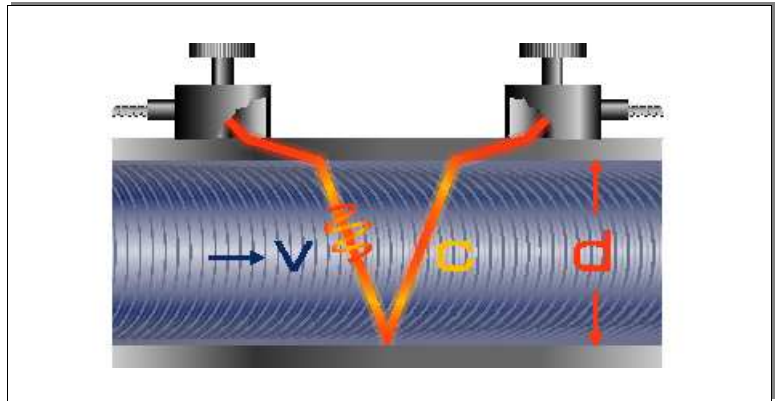


Illustration 1: Clamp-on ultrasonic flowmeter configuration

### Measuring principle

Ultrasonic signals are emitted by a first transducer installed on one side of a pipe, reflected on the opposite side and received by a second transducer. These signals are emitted alternatively in the direction of flow and against it. Because the medium in which the signals propagate is flowing, the transit time of the sound signals propagating in the direction of flow is shorter than the transit time of the signal propagating against the direction of flow. The transit-time difference  $\Delta T$  is measured and allows the determination of the average flow velocity along the path of acoustic propagation. A profile correction is then performed to obtain the average flow velocity over the cross-sectional area of the pipe, which is proportional to the volumetric flow rate.

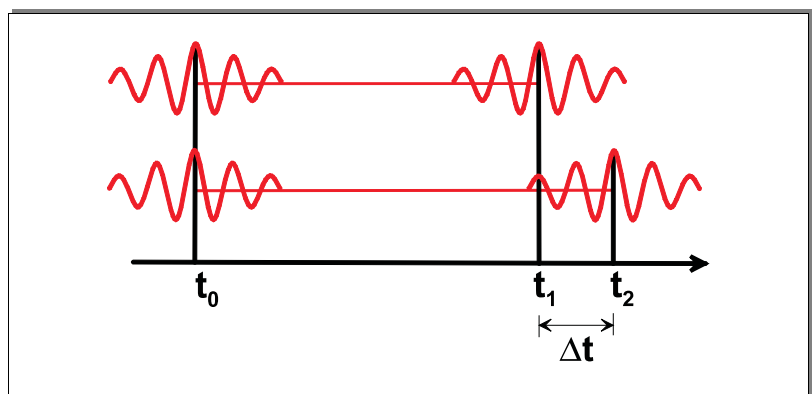


Illustration 2: Transit-time measuring principle

## 2 Installation

### 2.1 Unpacking and storage

#### 2.1.1 Unpacking

Care should be taken when opening the box containing the flowmeter, any markings or warnings shown on the parcel should be observed prior to opening. The following steps should then be taken:

- Unpack the flowmeter in a dry area.
- The flowmeter should be handled with care and not left in an area where it could be subject to physical shocks.
- If using a knife to remove packaging care should be taken not to damage the flowmeter or cables.
- The flowmeter package and contents should be checked for completeness against the delivery note supplied and any missing items reported immediately.
- The flowmeter package and contents should be checked for signs of damage during transport and any problems reported immediately.
- The vendor accepts no responsibility for damage or injury caused during the unpacking of the instrumentation supplied.
- Excess packing materials should be either re-cycled or disposed of in a suitable way.

#### 2.1.2 Storage and preservation

If storage or preservation is necessary, the flowmeter and sensors should be stored:

- in a secure location,
- away from water and harsh environmental conditions,
- in a way as to avoid damage,
- small items should be kept together in the bags and small plastic boxes provided to avoid loss.

#### 2.1.3 Identification of components

The following items are typically supplied (please refer to your delivery note for a detailed description of your scope of supply):

- KATflow 200 hand-held flowmeter
- Clamp-on sensors (usually one or two pairs depending on pipe sizes to be measured)
- Sensor extension cable(s) (optional)
- Sensor mounting accessories
- Coupling component
- Measuring tape
- Operating instructions
- Calibration certificate(s) (optional)

## 2.2 Clamp-on sensor installation

The correct selection of the sensor location is crucial for achieving reliable measurements and a high accuracy. Measurement must take place on a pipe in which sound can propagate (see Acoustic Propagation) and in which a rotationally symmetrical flow profile is fully developed (see Straight Pipe Lengths).

The correct positioning of the transducers is an essential condition for error-free measurements. It guarantees that the sound signal will be received under optimal conditions and evaluated correctly. Because of the variety of applications and the different factors influencing the measurement, there can be no standard solution for the positioning of the transducers.

The correct position of the transducers will be influenced by the following factors:

- diameter, material, lining, wall thickness and general condition of the pipe,
- the medium flowing in the pipe,
- and the presence of gas bubbles and solid particles in the medium.

Check that the temperature at the selected location is within the operating temperature range of the transducers (see technical specification in the Appendix).

**Acoustic propagation** Acoustic propagation is given when the flowmeter is able to receive sufficient signal from the transmitted ultrasonic pulses. The signals are attenuated in the pipe material, the medium and at each of the interfaces and reflections. External and internal pipe corrosion, solid particles and gas content in the medium do heavily contribute to signal attenuation.

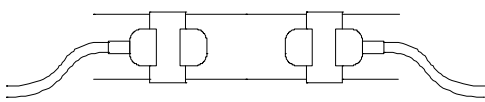
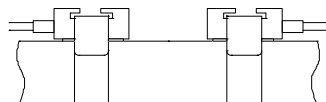
**Straight pipe lengths** Sufficient straight lengths of pipe on the inlet and outlet of the measuring location guarantee an axi-symmetrical flow profile in the pipe for good measurement accuracy. If no sufficient straight lengths of pipe are available for your application, measurements are still obtainable but the uncertainty of the measurement can be compromised.

## 2.3 Installation location

Select an installation location as per recommendations in Table 1 and try to avoid measuring



- in the vicinity of deformations and defects of the pipe,
- near welding seams,
- where deposits could be building up in the pipe.

<p><b>For a horizontal pipe:</b>                  Select a location where the transducers can be mounted on the side of the pipe, so that the sound waves emitted by the transducers propagate horizontally in the pipe. Thus, the solid particles deposited on the bottom of the pipe and the gas pockets developing at the top will not influence the propagation of the signal.</p>	
<p><b>Correct</b></p> 	<p><b>Incorrect</b></p> 
<p><b>For a free inlet or outlet pipe section:</b>                  Select the measuring point at a location where the pipe cannot run empty.</p>	
<p><b>Correct</b></p>	<p><b>Disadvantageous</b></p>



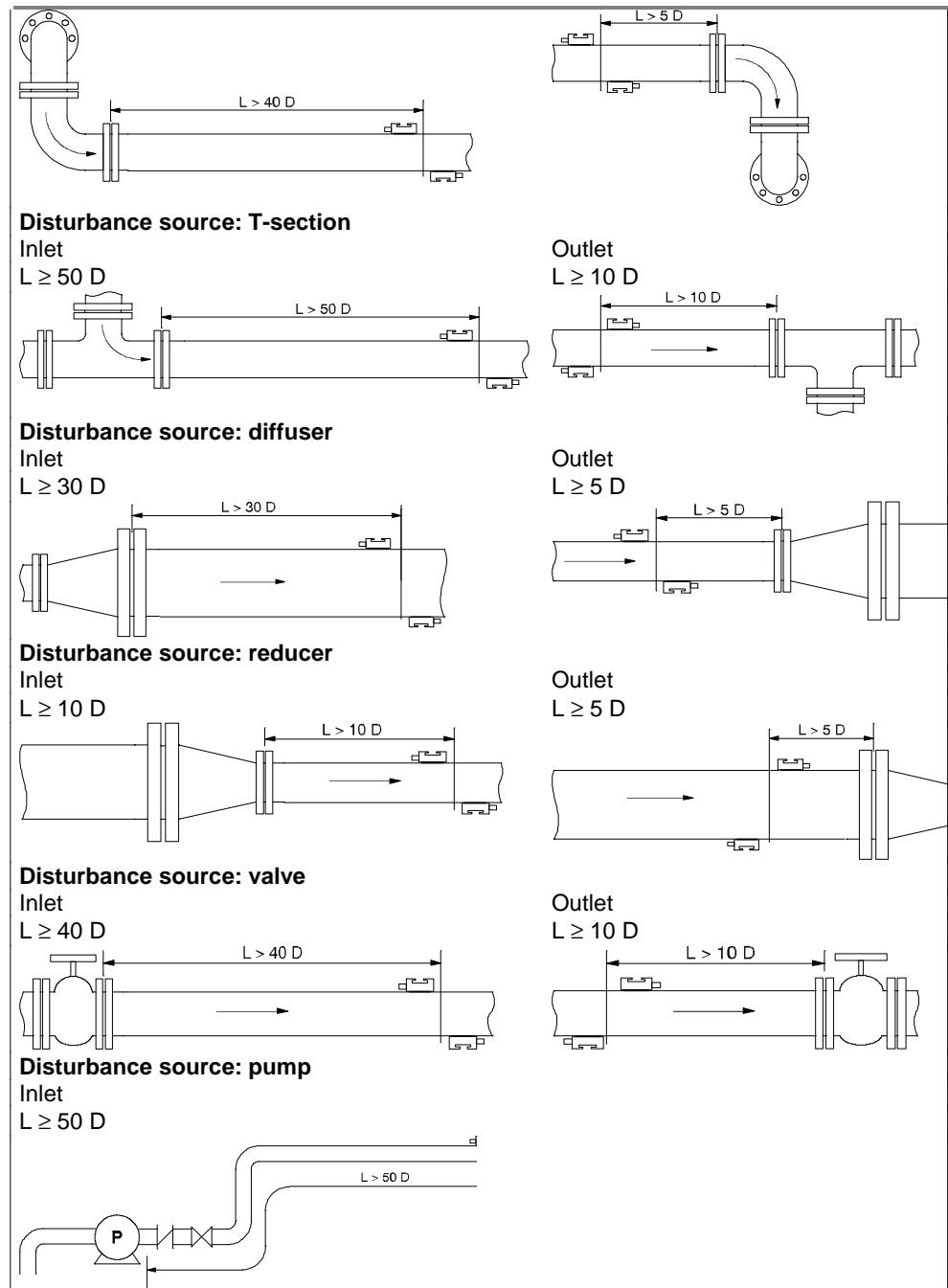


Table 2: Recommended distances from disturbance sources

### 2.4 Pipe preparation



- Clean the pipework from dirt and dust around the area where the sensors shall be placed.
- Remove loose paint and rust with a wire brush or file.

Firmly bonded paint does not necessarily need to be removed down to bare metal provided the flowmeter diagnostics indicate sufficient signal level strength.

## 2.5 Clamp-on sensor mounting configurations and separation distance

### Reflection Mode

The most common clamp-on sensor mounting configuration is the Reflection Mode, also known as V-Mode (see Illustration 3, sketch (1)). Here the ultrasonic signal pass twice through the medium (2 signal passes). The Reflection Mode is the most convenient mounting method as the transducer separation distance can be measured easily and the sensors can be perfectly aligned. This method should be used whenever possible.

### Diagonal Mode

An alternative mounting configuration (Illustration 3, sketch (3)) is the Diagonal mode (Z-Mode). The signals travel here only once through the pipe. This method is often used especially for larger pipes where greater signal attenuation might occur.

Further variation of the Reflection and the Diagonal Mode are possible by altering the number of passes through the pipe. Any even number of passes would require to mount the sensors on the same side of the pipe, whereas with any odd number of passes, the sensors must be mounted on opposite sides of the pipe. Commonly for very small pipes, sensor mounting configurations such as 4 passes (W-mode) or 3 passes (N-mode) are used (Illustration 3, sketch (2)).

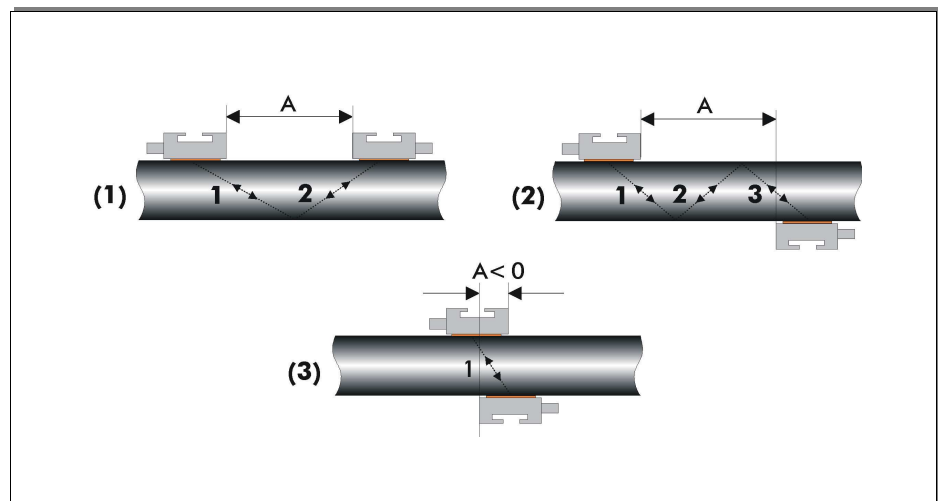


Illustration 3: Clamp-on sensor mounting configurations and separation distances

### Transducer separation distance

The transducer separation distance  $A$  is measured from the edges of the sensor heads facing each other as shown in illustration 3. It is automatically calculated by the flowmeter based on the parameter entries for pipe outside diameter, wall thickness, lining material and thickness, medium, process temperature, the sensor type and the selected number of signal passes.

A negative separation distance  $A < 0$  can occur for mounting configurations on small pipes where diagonal mode operation has been selected (see Illustration 3, sketch (3)).

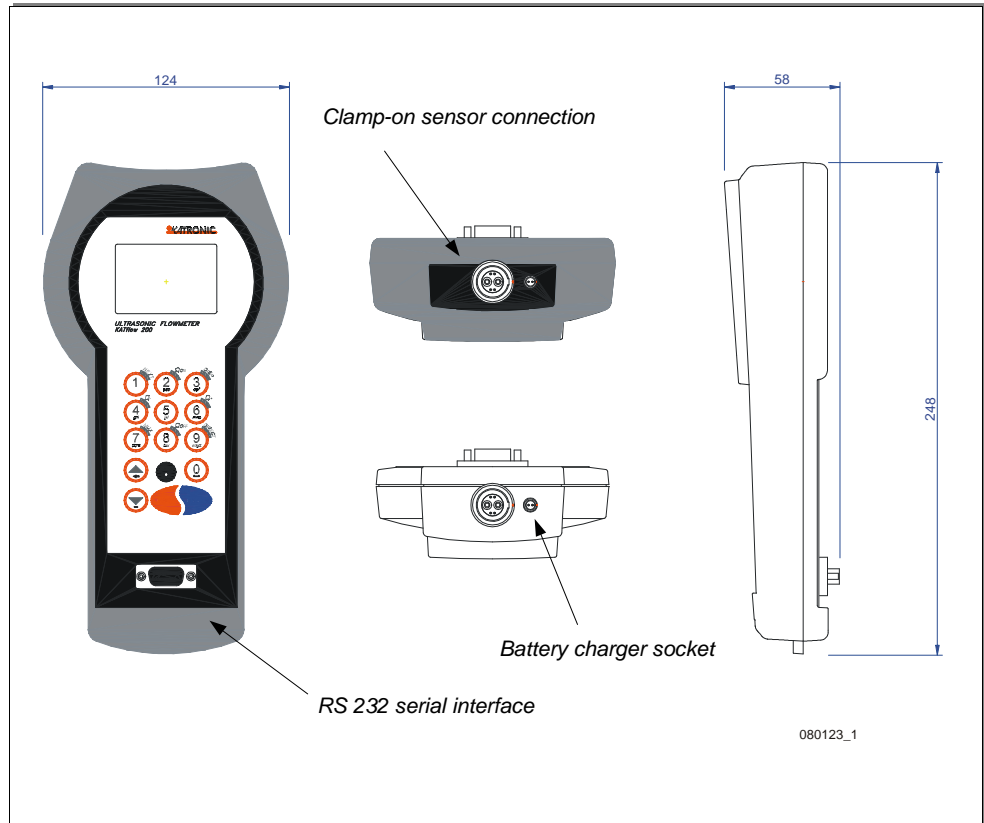


## 2.6 Flowmeter installation

### 2.6.1 Outline dimensions

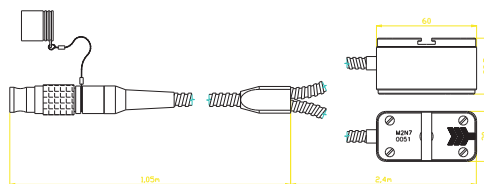
The KATflow 200 is a hand-held, battery operated device with the following outline dimensions.

#### Flowmeter outline dimensions

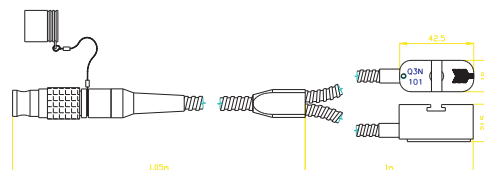


Drawing 1: Outline dimensions KATflow 200

#### K1 type transducer



#### K4 type transducer



Drawing 2: Transducers

### 2.6.2 Electrical interconnections



Drawing 3: Electrical interconnection diagram KATflow 200

### 2.7 Clamp-on sensor mounting

Before the sensors can be mounted

- the installation location should have been determined,
- a sensor mounting method should be chosen,
- the flowmeter batteries must be sufficiently charged,
- the sensors must be connected to the transmitter.

Depending on which sensor mounting method is being used (V or Z-mode), the clamp on sensors are either mounted on the same side of the pipe (Reflection Mode) or on opposite sides of the pipe (Diagonal Mode).

### 2.7.1 Sensor pipe mounting configurations

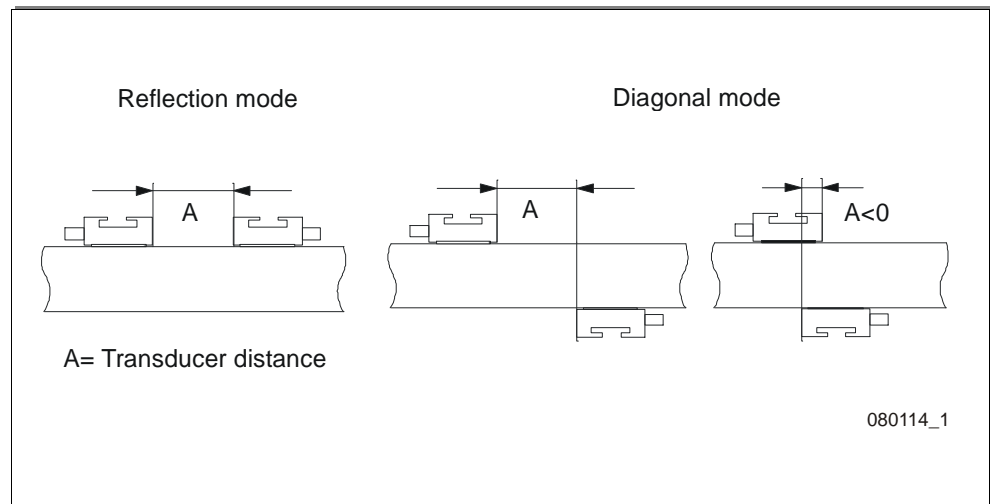


Illustration 4: Sensor pipe mounting configurations

### 2.7.2 Acoustic coupling gel



In order to obtain acoustical contact between the pipe and the sensors, apply a bead of acoustic coupling gel lengthwise down the centre of the contact area of the sensors.

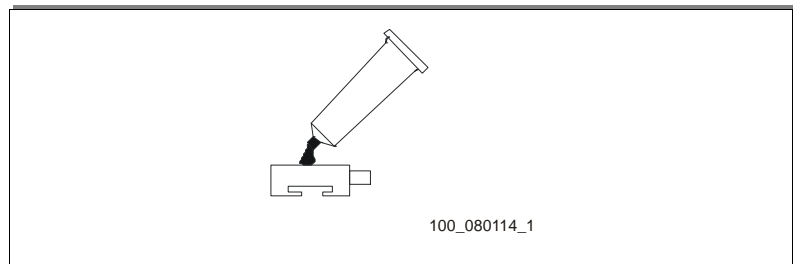


Illustration 5: Application of acoustic coupling gel

2.7.3 Correct positioning of the sensors

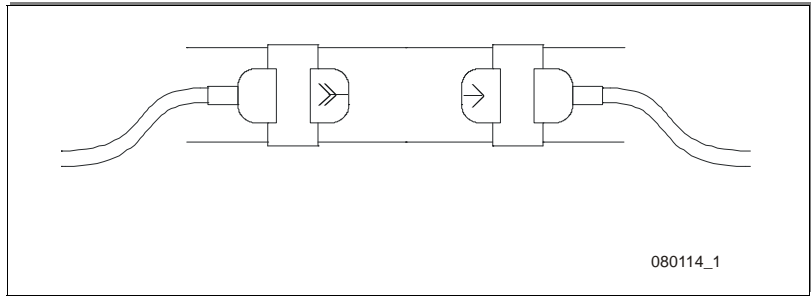


Illustration 6: Correct positioning of the sensors

Always mount the transducer pair such that the free front edges of the sensors face each other.

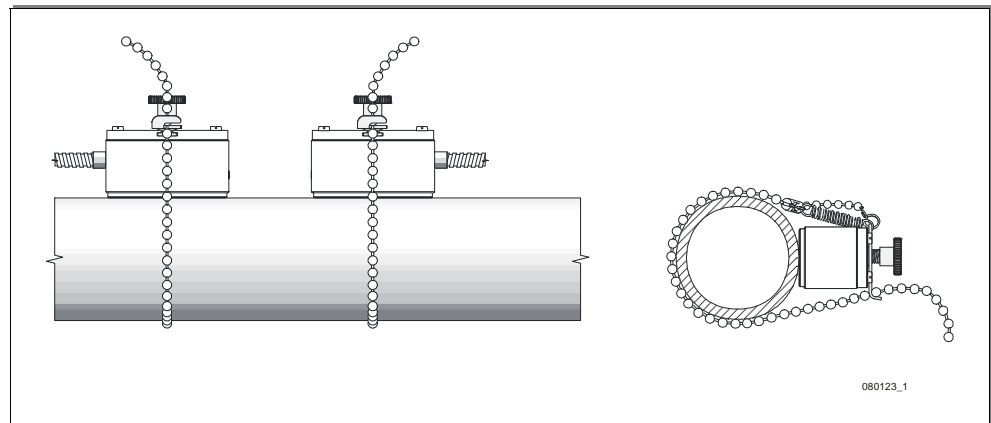


There is a different engraving on the top of each transducer. The transducers are mounted correctly if the engravings on the two transducers are forming an arrow together. The transducer cables should then show in opposite directions.

Later, the arrow, in conjunction with the indicated measured value, will help to determine the direction of flow.

The sensor separation distance is automatically calculated by the flowmeter based on the parameter entries for pipe outside diameter, wall thickness, lining material and thickness, medium, process temperature, the sensor type and the selected number of signal passes.

2.7.4 Sensor mounting with fixtures and chains



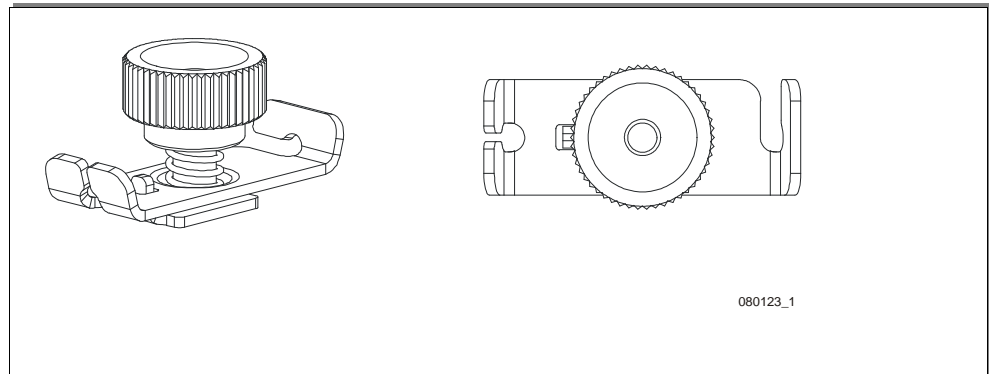
Drawing 4: Sensors mounted with fixtures and chains

- Insert the retaining clip into the groove on the top of the transducer and secure it using the screw knob.
- Apply some acoustic coupling component to the contact surface of the transducer.
- Place the transducer to the side of the pipe or alternatively 45 degrees from the pipe axis.



This is necessary to establish the best acoustic contact since on top of the pipe air pockets could develop and deposits could accumulate at the bottom of the pipe.

- Take the spring end of the chain in one hand and insert the last ball element in the vertical slot of the retaining clip. Mount the chain around the pipe.
- Pull the chain firmly around the pipe and fasten it in the lateral slot of the retaining clip. There should be no air pockets between the transducer surface and the pipe wall.
- Mount the second transducer the same way.
- Using a measuring tape, adjust the sensor separation distance as suggested by the flowmeter.



*Illustration 7: Sensor mounting with fixtures and chains (retaining clip)*

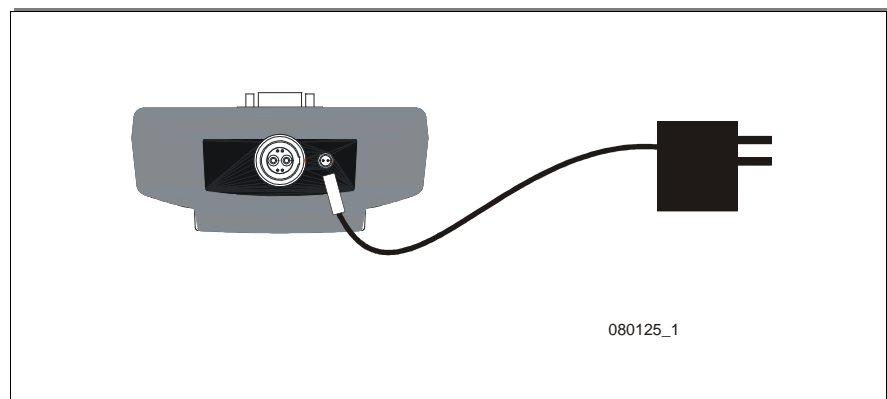
## 3 Operation

### 3.1 Switching On/Off

The flowmeter is switched on by the **<ON>** key for more than 2 seconds continuously. Equally it can be switched off by pressing the **<OFF>** key for more than 2 seconds.

### 3.2 Battery charging

The internal batteries can be recharged with the supplied external battery charger. Simply connect the battery charger to the charging socket of the flowmeter and to the mains supply 100 ... 240 VAC, 50/60 Hz. The battery charger mains plug is supplied country specific as per order code.



*Illustration 8: Battery charging*



During the charging process, the battery icon is blinking. For a fully charged battery all segments of the battery icon are filled.












### 3.3 Keypad and display



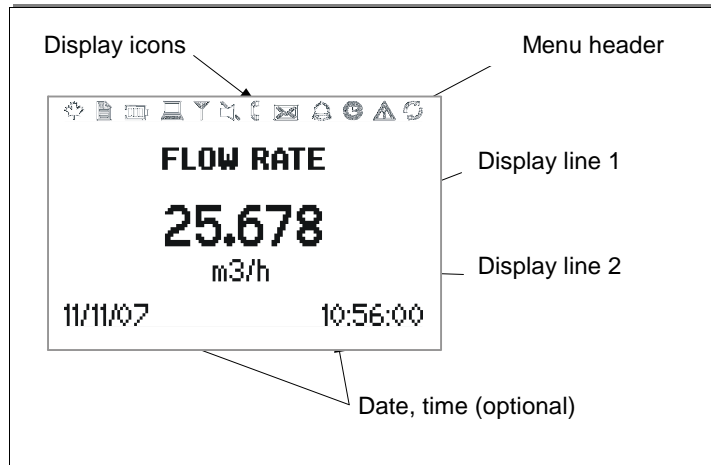
Illustration 9: Keypad and display overview











#### 3.3.1 Keypad key functions



Key	Main function	Secondary function
	Alphanumerical entry: 1 (1 short key stroke) , (2 short key strokes) . (3 short key strokes) _ (4 short key strokes)	Show <b>NEXT</b> available item
	Alphanumerical entry: A B C 2 /	<b>Q<sub>OV</sub></b> = Start totaliser function
	Alphanumerical entry: D E F 3 ?	Show next <b>DISP</b> lay
	Alphanumerical entry: G H I 4	<b>Q</b> = Show negative total value

	<	
	Alphanumeric entry: J K L 5 >	
	Alphanumeric entry: M N O 6 \$	<b>Q+</b> = Show positive total value
	Alphanumeric entry: P Q R S 7	Toggle <b>MULTipleXer</b> (for multi-channel functionalities)
	Alphanumeric entry: T U V 8 *	<b>QOFF</b> = Stop totaliser function
	Alphanumeric entry: W X Y Z 9	<b>DIRECT</b> menu access
	Move menu/list selection item <b>UP</b>	Alphanumeric entry: Character backspace clear
	Numerical entry only: . (decimal point)	Switch LCD backlight on/off
	Alphanumeric entry: 0 <b>Space character</b> + = #	
	Move menu/list selection item <b>DOWN</b>	Numerical entry only: - (minus sign)
	<b>ESC</b> ape menu item	Abort entry without saving  Switches the instrument <b>OFF</b> if pressed for more than 2 s
	<b>ENTER</b> menu item	Confirm entry with saving  Switches the instrument <b>ON</b> if pressed for more than 2 s

3.3.2 Display functions



Display icon	Function
	<b>On</b> Icon not used <b>Off</b> Icon not used
	<b>On</b> Datalogger recording <b>Off</b> Datalogger switched off
	<b>On</b> 1 segment = 33% battery power available 2 segments = 66% battery power available 3 segments = 100% battery power available <b>Off</b> < 5% battery power available <b>Outline blinking</b> Battery charging
	<b>On</b> LCD backlight switched on <b>Off</b> LCD backlight switched off
	<b>On</b> Signal strength sufficient for measurement <b>Off</b> Signal strength insufficient for measurement
	<b>On</b> Speaker on <b>Off</b> Speaker off
	<b>On</b> Call customer service <b>Off</b> No external assistance required
	<b>On</b> Icon not used <b>Off</b> Icon not used
	<b>On</b> <b>Off</b>
	<b>On</b> Time/date display switched on <b>Off</b> Time/date display switched off

	<b>On</b> Error recorded in error log <b>Off</b> No error detected
	<b>On</b> Serial output RS 232 switched on <b>Off</b> Serial output RS 232 switched off

### 3.4 Quick setup wizard

The quick setup wizard allows for a speedy setup of the most important parameters in order to achieve successful measurements in the shortest possible time:



Display screen	Operation
<p style="text-align: center;"><b>MAIN MENU</b></p> <pre> Quick start  System Installation  Diagnostics Output       Datalogger Input        Serial Comm                     </pre>	<p>Upon first power on and the boot-up sequence, the main menu is displayed.</p> <p>Use &lt;UP&gt; and &lt;DOWN&gt; cursor keys to select <b>Quick start</b>. Confirm by pressing &lt;ENTER&gt;.</p>
<p style="text-align: center;"><b>QUICK START MENU</b></p> <pre> Setup Wizard Single Setup Wizard Dual Start Measurement                     </pre>	<p>Use cursor keys to select <b>Setup Wizard</b>. Confirm by pressing &lt;ENTER&gt;.</p>
<p style="text-align: center;"><b>PIPE MATERIAL</b></p> <pre> Stainless Steel Stainless Steel Stainless Steel                     </pre>	<p>Choose pipe material using cursor keys and pressing &lt;ENTER&gt;.</p>
<p style="text-align: center;"><b>OUTSIDE DIAMETER</b></p> <p style="text-align: center;"><b>76.1</b> mm</p>	<p>Enter outside pipe diameter using alphanumerical keys and confirm by pressing &lt;ENTER&gt;.</p> <p>Use key &lt;UP&gt; as character backspace clear to correct for data entry errors.</p>
<p style="text-align: center;"><b>WALL THICKNESS</b></p> <p style="text-align: center;"><b>3.4</b> mm</p>	<p>Enter pipe wall thickness using alphanumerical keys and confirm by pressing &lt;ENTER&gt;.</p> <p>Use key &lt;UP&gt; as character backspace clear to correct for data entry errors.</p>



<p style="text-align: center;"><b>FLUID</b></p> <div style="border: 1px solid black; padding: 5px;"> <p style="background-color: black; color: white; text-align: center;">Water</p> <p style="text-align: center;">Water</p> <p style="text-align: center;">Water</p> </div>	<p>Select fluid using cursor keys.</p> <p>Confirm by pressing &lt;ENTER&gt;.</p>
<p style="text-align: center;"><b>TEMPERATURE</b></p> <p style="text-align: center; font-size: 2em;">20.0</p> <p style="text-align: center;">C</p>	<p>Enter process temperature using alphanumerical keys and confirm by pressing &lt;ENTER&gt;.</p> <p>Use key &lt;UP&gt; as character backspace clear to correct for data entry errors.</p>
<p style="text-align: center;"><b>LINER MATERIAL</b></p> <div style="border: 1px solid black; padding: 5px;"> <p style="background-color: black; color: white; text-align: center;">Rubber</p> <p style="text-align: center;">Rubber</p> <p style="text-align: center;">Rubber</p> </div>	<p>Select pipe lining material using cursor keys.</p> <p>Confirm by pressing &lt;ENTER&gt;.</p>
<p style="text-align: center;"><b>PASSES</b></p> <div style="border: 1px solid black; padding: 5px;"> <p style="background-color: black; color: white; text-align: center;">Auto</p> <p style="text-align: center;">Auto</p> <p style="text-align: center;">Auto</p> </div>	<p>Select transducer configuration (number of passes) using cursor keys.</p> <p><b>Auto</b> Automatically</p> <p><b>Z</b> Z-mode (1 pass), diagonal mode</p> <p><b>V</b> V-mode (2 passes), reflection mode</p> <p><b>N</b> N-mode (3 passes), diagonal mode</p> <p><b>W</b> W-mode (4 passes), reflection mode</p> <p><b>5</b> 5 passes, diagonal mode</p> <p><b>6</b> 6 passes, reflection mode</p> <p>Confirm by pressing &lt;ENTER&gt;.</p>
<p style="text-align: center;"><b>CHNL1 SENSOR</b></p> <p>Spacing 110.5 mm</p> <p>Reflection 6 Mode</p> <p>Signal 26 dB</p>	<p>Sensor placement screen: Mount transducers with suggested spacing. Observe signal strength.</p> <p>Confirm by pressing &lt;ENTER&gt; to obtain measurements.</p>
<p style="text-align: center;"><b>FLOW RATE</b></p> <p style="text-align: center; font-size: 2em;">25.678</p> <p style="text-align: center;">m3/h</p> <p>11/11/07 <span style="float: right;">10:56:00</span></p>	<p><b>Success!</b></p>

### 3.5 Measurements

#### 3.5.1 Main process value (PV) display

The measurements are started either through the Quick Setup Wizard or the menu structure by selecting **Start Measurement** upon first power on. Once all the parameters are programmed, any subsequent power-on sequences will bring up the main PV display immediately.



Display screen	Operation
<p style="text-align: center;"><b>FLOW RATE</b></p> <p style="text-align: center;"><b>25.678</b> m3/h</p> <p>11/11/07 <span style="float: right;">10:56:00</span></p>	<p>The main process value can be changed by accessing the menu structure.</p> <p>Press <b>&lt;ESC&gt;</b> at any time to access the main menu.</p> <p>Change to the 3-line display by pressing <b>&lt;DISP&gt;</b>.</p>

#### 3.5.2 3-line display



Display screen	Operation
<p style="text-align: center;"><b>FLOW</b></p> <p style="text-align: center;">Pump P3A <b>25.678 m3/h</b> 1.370 m/s</p> <p>11/11/07 <span style="float: right;">10:56:00</span></p>	<p>Line 1 shows the Tag ID but is universally configurable through the installation menu.</p> <p>Line 2 displays the main PV.</p> <p>Line 3 displays the flow velocity.</p> <p>Change to diagnostic displays by pressing <b>&lt;DISP&gt;</b>.</p>

#### 3.5.3 Diagnostic displays



Display screen	Operation
<p style="text-align: center;"><b>DIAGNOSTIC 1</b></p> <p style="text-align: center;">55.2 Gain <b>20.5 Sig %</b> 5780.0 Correlation</p> <p>11/11/07 <span style="float: right;">10:56:00</span></p>	<p>Line 1 shows the amplifier gain.</p> <p>Line 2 displays the signal strength.</p> <p>Line 3 indicates the correlation value.</p> <p>Change to more diagnostic displays by pressing <b>&lt;DISP&gt;</b>.</p>

### 3.5.4 Totalisers

The totaliser displays will only be shown when the totalisers are activated.



Display screen	Operation
<p style="text-align: center;"><b>TOTAL+</b></p> <p style="text-align: center;"><b>2580.0</b></p> <p style="text-align: center;">m<sup>3</sup></p> <p>11/11/07 <span style="float: right;">10:56:00</span></p>	<p>The flow totaliser can be started by pressing <b>&lt;Q<sub>ON</sub>&gt;</b>.</p> <p>Pressing <b>&lt;Q<sub>+</sub>&gt;</b> shows the total accumulated flow in positive flow direction.</p> <p>Pressing <b>&lt;Q<sub>-</sub>&gt;</b> shows the total accumulated flow in negative flow direction.</p> <p>The totalisers can be stopped by activating <b>&lt;Q<sub>OFF</sub>&gt;</b>.</p> <p>Change to other displays by pressing <b>&lt;DISP&gt;</b>.</p>

## 4 Commissioning

### 4.1 Menu structure

Main menu	Menu level 1	Menu level 2	Description/settings
<b>Quick Start</b>			
	<b>Setup Wizard</b>		
		Pipe material	Select from list ↑↓ Stainless steel Carbon steel Ductile cast iron Grey cast iron Copper Lead PVC PP PE ABS Glass Cement User (pipe c-speed)
		Pipe c-speed	Only if user pipe material selected 500 ... 5000 m/s
		Outside diameter	10 ... 3000 mm
		Wall thickness	0.5 ... 75 mm
		Fluid	Select from list ↑↓ Water Salt water Acetone Alcohol Ammonia Carbon Tet Ethanol Ethyl alcohol Ethyl ether Ethylene glycol Glycol/water 50% Kerosene Methanol Methyl alcohol

			Milk Naphtha Car oil Freon R134a Freon R22 Hydrochloric acid Sour cream Sulphuric acid Toluene Vinyl chloride User (kinematic viscosity, density, medium c-speed)
		Kinematic viscosity	<i>Only if user fluid selected</i> 0 ... 30000 mm <sup>2</sup> /s
		Density	<i>Only if user fluid selected</i> 100 ... 2000 kg/m <sup>3</sup>
		Medium c-speed	<i>Only if user fluid selected</i> 800 ... 3500 m/s
		Temperature	-30 ... 300 °C
		Liner Material	<i>Select from list</i> ↑↓ None Epoxy Rubber PVDF PP Glass User (liner c-speed)
		Liner c-speed	<i>Only if lining material selected</i> 500 ... 5000 m/s
		Liner thickness	<i>Only if lining material selected</i> 1.0 ... 99.0 mm
		Passes	<i>Select from list</i> ↑↓ Auto Z-mode (1) V-mode (2) 3 W-mode (4) 5 6 Special
		Passes	<i>Only if special passes selected</i> 1 ... 20
		Sensor type	<i>Indication of sensor type and serial number</i>
		SP 1 - Sensor frequency	<i>Only for special, unrecognised sensors</i> 5 ... 80
		SP 2 - Wedge angle	<i>Only for special, unrecognised sensors</i>
		SP3 – Wedge c-speed	<i>Only for special, unrecognised sensors</i>
		SP4 - Crystal offset	<i>Only for special, unrecognised sensors</i>
		SP5 - Spacing offset	<i>Only for special, unrecognised sensors</i>
		SP6 - Zero flow offset	<i>Only for special, unrecognised sensors</i>
		SP7 - Up-stream offset	<i>Only for special, unrecognised sensors</i>
		Sensor placement	
	<b>Start Measurement</b>		
		Sensor type	<i>Indication of sensor type and serial number</i>
		SP 1 ... SP7	<i>Only for special, unrecognised sensors</i>

		Sensor placement	
<b>Installation</b>			
	<b>Pipe</b>		
		Material	<i>Select from pipe material list</i>
		Outside diameter	6 ... 6500 mm
		Wall thickness	0.5 ... 75 mm
		Pipe c-speed	600 ... 6554 m/s
		Pipe circumference	18.8 ... 20420 mm
		Roughness	0.0 ... 10 mm
	<b>Medium</b>		
		Fluid	<i>Select from fluid list</i>
		Kinematic viscosity	0 ... 30000 mm <sup>2</sup> /s
		Density	100 ... 2000 kg/m <sup>3</sup>
		C-speed	800 ... 3500 m/s
		Temperature	-30 ... 300 °C
	<b>Lining</b>		
		Material	<i>Select from material list</i>
		Thickness	0.1 ... 99.9 mm
		C-speed	500 ... 5000 m/s
	<b>Sensor</b>		
		Type	<i>Indication of sensor type and serial number, otherwise select from list</i> ↑↓ K1 K4 Special
		SP 1 ... SP 7	Only if special sensor type was selected
		Passes	<i>Select from list</i>
		Passes	Only if special passes selected 1 ... 20
<b>Output</b>			
	<b>Display</b>		
		Main PV	
		Line 1	
	<b>Damping</b>		<i>Smoothens the display output, the higher the damping factor</i> 1 ... 255 s
	<b>Datalogger</b>		
		Interval	0 ... 255 s
		Overwrite	Yes No
		Low memory	<i>Warning output</i> 0 ... 100 %
	<b>Serial communication</b>		
		Mode	<i>Select from list</i> ↑↓ None Printer Log download

		Baud	Select from list ↑↓ 2400 9600 (Default) 19200
		Parity	Select from list ↑↓ None Even (Default) Odd
<b>System</b>			
	<b>Instrument info</b>		
		Model code	KF200
		Serial number	Example: 20000003
		HW revision	Example: 4.0, 2.0
		SW revision	Example: 1.0, 2.5
	<b>Calculation</b>		
		Low flow cut off	0 ... 0.10 m/s
		Max. flow cut off	0 ... 30 m/s
		Corrected	Yes No
		PV offset	-30 ... 30 units
		PV scaling	0 ... 1000 units
	<b>Zero calibration</b>		This is the 4 <sup>th</sup> menu level, needs changing if possible
		Auto	
		Tracking	
		Delta time	
		Time up	
	<b>User</b>		
		Identifier	Example: Pump P3A
		Tag number	Example: 1FT-3011
	<b>Test</b>		
		Display	
		Analogue output	
		Digital Open-Collector output	
		Digital relay output	
	<b>Settings</b>		
		Date	Example: 03/10/2007
		Time	Example: 09:27:00
		Date format	Select from list ↑↓ dd/mm/yy mm/dd/yy yy/mm/dd
		Language	Select from list ↑↓ English German French Spanish Russian
		Keypad sound	Yes No

	<b>Battery</b>		
		Low warning	Yes No
		Auto off time	1 ... 59 min
	<b>Defaults</b>		Yes No
<b>Diagnostics</b>			
			Tests, Calculated data, diagnostic screens and scope could be shown here
<b>Scope</b>			

## 4.2 Diagnostics

Diagnostic screens can be accessed directly during measurement or through the menu structure.

## 4.3 Display settings

Customer specific settings for data to be displayed can be achieved by accessing the appropriate menu items.

### 4.3.1 Main PV

The main Process Value (PV) is the primary measurement data.

### 4.3.2 Line 1

Display line 1 can be programmed by a list of available items.

## 4.4 Output settings

### 4.4.1 Serial interface RS 232

The RS 232 serial interface can be used to transmit data on-line or to download the integral datalogger content. The settings can be found in submenu **Serial Communication**.

## 4.5 KATdata software

Please consult customer services for assistance.

## 4.6 Wall thickness measurement (WTM)

Future implementation.

## 5 Maintenance

No general maintenance is required for this equipment.

## 6 Troubleshooting

Error message	Group	Description	Error handling
Please refer to customer support.			

## 7 Technical data

Material	Sound Speed* Shear Wave (at 25 °C)	
	m/s	ft/s
Steel, 1% Carbon, hardened	3,150	10,335
Carbon Steel	3,230	10,598
Mild Steel	3,235	10,614
Steel, 1% Carbon	3,220	10,565
302 Stainless Steel	3,120	10,236
303 Stainless Steel	3,120	10,236
304 Stainless Steel	3,141	10,306
304L Stainless Steel	3,070	10,073
316 Stainless Steel	3,272	10,735
347 Stainless Steel	3,095	10,512
Aluminium	3,100	10,171
Aluminium (rolled)	3,040	9,974
Copper	2,260	7,415
Copper (annealed)	2,325	7,628
Copper (rolled)	2,270	7,448
CuNi (70%Cu 30%Ni)	2,540	8,334
CuNi (90%Cu 10%Ni)	2,060	6,759
Brass (Naval)	2,120	6,923
Gold (hard-drawn)	1,200	3,937
Inconel	3,020	9,909
Iron (electrolytic)	3,240	10,630
Iron (Armco)	3,240	10,630
Ductile Iron	3,000	9,843
Cast Iron	2,500	8,203
Monel	2,720	8,924
Nickel	2,960	9,712
Tin (rolled)	1,670	5,479
Titanium	3,125	10,253
Tungsten (annealed)	2,890	9,482
Tungsten (drawn)	2,640	8,661
Tungsten (carbide)	3,980	13,058
Zinc (rolled)	2,440	8,005
Glass (pyrex)	3,280	10,761
Glass (heavy silicant first)	2,380	7,808
Glass (light brate crown)	2,840	9,318
Nylon	1,150	3,772
Nylon, 6-6	1,070	3,510
Polyethylene (LD)	540	1,772
PVC, CPVC	1,060	3,477
Acrylic	1,430	4,690

\* Please note these values are to be considered nominal. Solids may be inhomogeneous and anisotropic. Actual values depend on exact composition, temperature, and to a lesser extent, on pressure and stress.

All data given at 25 °C (77 °F) unless otherwise stated

Substance	Chemical Formula	Specific Gravity	Sound Speed		Change v/°C	Kinematic x10 <sup>-6</sup> m <sup>2</sup> /s	Viscosity ft <sup>2</sup> /s
			m/s	ft/s			
Acetic anhydride	(CH <sub>3</sub> CO) <sub>2</sub> O	1.082 (20 °C)	1,180	3,871.4	2.5	0.769	8.274
Acetic acid, anhydride	(CH <sub>3</sub> CO) <sub>2</sub> O	1.082 (20 °C)	1,180	3,871.4	2.5	0.769	8.274
Acetic acid, nitrile	C <sub>2</sub> H <sub>3</sub> N	0.783	1,290	4,232.3	4.1	0.441	4.745
Acetic acid, ethyl ester	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>	0.901	1,085	3,559.7	4.4	0.467	5.025
Acetic acid, methyl ester	C <sub>3</sub> H <sub>6</sub> O <sub>2</sub>	0.934	1,211	3,973.1		0.407	4.379
Acetone	C <sub>3</sub> H <sub>6</sub> O	0.791	1,174	3,851.7	4.5	0.399	4.293
Acetylene dichloride	C <sub>2</sub> H <sub>2</sub> Cl <sub>2</sub>	1.26	1,015	3,330.1	3.8	0.400	4.304
Alcohol	C <sub>2</sub> H <sub>6</sub> O	0.789	1,207	3,960	4.0	1.396	15.02
Ammonia	NH <sub>3</sub>	0.771	1,729 (-33 °C)	5,672.6 (-27 °C)	6.68	0.292 (-33 °C)	3.141 (-27 °F)
Benzene	C <sub>6</sub> H <sub>6</sub>	0.879	1,306	4,284.8	4.65	0.711	7.65
Benzol	C <sub>6</sub> H <sub>6</sub>	0.879	1,306	4,284.8	4.65	0.711	7.65
Bromine	Br <sub>2</sub>	2.928	889	2,916.7	3.0	0.323	3.475
n-Butane(2)	C <sub>4</sub> H <sub>10</sub>	0.601 (0°C)	1,085 (-5° C)	3,559.7 (23 °C)	5.8		
2-Butanol	C <sub>4</sub> H <sub>10</sub> O	0.81	1,240	4,068.2	3.3	3.239	34.851
sec-Butylalcohol	C <sub>4</sub> H <sub>10</sub> O	0.81	1,240	4,068.2	3.3	3.239	34.851
n-Butyl bromide (46)	C <sub>4</sub> H <sub>9</sub> Br	1.276 (20°C)	1,019 (20°C)	3,343.2 (68°F)		0.49 (15°C)	5.272 (59°C)
n-Butyl chloride (22,46)	C <sub>4</sub> H <sub>9</sub> Cl	0.887	1,140	3,740.2	4.57	0.529 (15°C)	5.692 (59°F)
Carbon tetrachloride	CCl <sub>4</sub>	1.595 (20°C)	926	3038.1	2.48	0.607	6.531
Carbon tetrafluoride (Freon 14)	CF <sub>4</sub>	1.75 (-150 °C)	875.2 (-150 °C)	2,871.5 (-238 °F)	6.61		
Chloroform	CHCl <sub>3</sub>	1.489	979	3,211.9	3.4	0.55	5.918
Dichlorodifluoromethane (Freon 12)	CCl <sub>2</sub> F <sub>2</sub>	1.516 (40 °C)	774.1	2,539.7	4.24		
Ethanol	C <sub>2</sub> H <sub>6</sub> O	0.789	1,207	3,960	4.0	1.39	14.956
Ethyl acetate	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>	0.901	1,085	3,559.7	4.4	0.489	5.263
Ethyl alcohol	C <sub>2</sub> H <sub>6</sub> O	0.789	1,207	3,960	4.0	1.396	15.020
Ethyl benzene	C <sub>8</sub> H <sub>10</sub>	0.867 (20 °C)	1,338 (20 °C)	4,89.8 (68 °F)		0.797 (17 °C)	8.575 (63 °F)
Ether	C <sub>4</sub> H <sub>10</sub> O	0.713	985	3231.6	4.87	0.311	3.346
Ethyl ether	C <sub>4</sub> H <sub>10</sub> O	0.713	985	3231.6	4.87	0.311	3.346
Ethylene bromide	C <sub>2</sub> H <sub>4</sub> Br <sub>2</sub>	2.18	995	3264.4		0.79	8.5
Ethylene chloride	C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>	1.253	1,193	3,914		0.61	6.563
Ethylene glycol	C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>	1.113	1,658	5439.6	2.1	17,208 (20°C)	185.158 (68°F)
Fluorine	F	0.545 (-143 °C)	403 (-143 °C)	1322.2 (-225 °F)	11.31		
Formaldehyde, methyl ester	C <sub>2</sub> H <sub>4</sub> O <sub>2</sub>	0.974	1,127	3697.5	4.02		
Freon R12			774.2	2540			
Glycol	C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>	1.113	1658	5439.6	2.1		
50% Glycol/50% H <sub>2</sub> O			1,578	5,177			
Isopropanol	C <sub>3</sub> H <sub>8</sub> O	0.785 (20 °C)	1,170 (20 °C)	3,838.6 (68 °F)		2.718	29.245
Isopropyl alcohol (46)	C <sub>3</sub> H <sub>8</sub> O	0.785 (20 °C)	1,170 (20 °C)	3,838.6 (68 °F)		2.718	29.245
Kerosene		0.81	1,324	4,343.8	3.6		
Methane	CH <sub>4</sub>	0.162 (-89 °C)	405	1,328.7	17.5		

			(-89 °C)	(-128 °F)			
Methanol	CH4O	0.791 (20 °C)	1,076	3,530.2	292	0.695	7.478
Methyl acetate	C3H6O2	0.934	1,211	3,973.1		0.407	4.379
Methyl alcohol	CH4O	0.791	1,076	3,530.2	292	0.695	7.478
Methyl benzene	C7H8	0.867	1,328 (20 °C)	4,357 (68 °F)	4.27	0.644	7.144
Milk, homogenized			1,548	5,080			
Naphtha		0.76	1,225	4,019			
Natural Gas		0.316 (-103 °C)	753 (-103 °C)	2,470.5 (-153 °F)			
Nitrogen	N2	0.808 (-199 °C)	962 (-199 °C)	3,156.2 (-326 °F)		0.217 (-199 °C)	2.334 (-326 °F)
Oil, Car (SAE 20a.30)		1.74	870	2,854.3		190	2,045.093
Oil, Castor	C11H10O0	0.969	1,477	4,845.8	3.6	0.670	7.209
Oil, Diesel		0.80	1,250	4,101			
Oil, Fuel AA gravity		0.99	1,485	4,872	3.7		
Oil (Lubricating X200)			1,530	5,019.9			
Oil (Olive)		0.912	1,431	4,694.9	2.75	100	1,076.365
Oil (Peanut)		0.936	1,458	4,738.5			
Propane (-45 to -130 °C)	C3H8	0.585 (-45 °C)	1,003 (-45 °C)	3,290.6 (-49 °F)	5.7		
1-Propanol	C3H8O	0.78 (20 °C)	1,222 (20 °C)	4,009.2 (68 °F)			
2-Propanol	C3H8O	0.785 (20 °C)	1,170 (20 °C)	3,838.6 (68 °F)		2.718	29.245
Propene	C3H6	0.563 (-13 °C)	963 (-13 °C)	3,159.4 (9 °F)	6.32		
n-Propyl-alcohol	C3H8O	0.78 (20 °C)	1,222 (20 °C)	4,009.2 (68 °F)		2.549	27.427
Propylene	C3H6	0.563 (-13 °C)	963 (-13 °C)	3,159.4 (9 °F)	6.32		
Refrigerant 11	CCl3F	1.49	828.3 (0 °C)	2,717.5 (32 °F)	3.56		
Refrigerant 12	CCl2F2	1.516 (-40 °C)	774.1 (-40 °C)	2,539.7 (-40 °C)	4.24		
Refrigerant 14	CF4	1.75 (-150 °C)	875.24 (-150 °C)	2,871.6 (-268 °F)	6.61		
Refrigerant 21	CHCl2F	1.426 (0 °C)	891 (0 °C)	2,923.2 (32 °F)	3.97		
Refrigerant 22	CHClF2	1.491 (-69 °C)	893.9 (50 °C)	2,932.7 (122 °F)	4.79		
Refrigerant 113	CCl2F-CClF2	1.563	783.7 (0 °C)	2,571.2 (32 °F)	3.44		
Refrigerant 114	CClF2-CClF2	1.455	665.3 (-10 °C)	2,182.7 (14 °F)	3.73		
Refrigerant 115	C2ClF5		656.4 (-50 °C)	2,153.5 (-58 °F)	4.42		
Refrigerant C318	C4F8	1.62 (-20 °C)	574 (-10 °C)	1,883.2 (14 °F)	3.88		
Sodium nitrate	NoNO3	1.884 (336 °C)	1,763.3 (336 °C)	5,785.1 (637 °F)	0.74	1.37 (336 °C)	14.74 (637 °F)
Sodium nitrite	NoNO2	1.805 (292 °C)	1876.8 (292 °C)	6157.5 (558 °F)			
Sulphur	S		1177 (250 °C)	3861.5 (482 °F)	-1.13		
Sulphuric Acid	H2SO4	1.841	1,257.6	4,126	1.43	11.16	120.081
Tetrachloroethane	C2H2Cl4	1553 (20 °C)	1,170 (20 °C)	3,838.6 (68 °F)		1.19	12.804
Tetrachloro-ethene	C2Cl4	1.632	1,036	3,399			

Tetrachloro-Methane	CCl4	1.595 (20 °C)	926	3,038.1		0.607	6.531
Tetrafluoro-methane (Freon 14)	CF4	1.75 (-150 °C)	875.24 (-150 °C)	2,871.5 (-283 °F)	6.61		
Toluene	C7H8	0.867 (20 °C)	1,328 (20 °C)	4,357 (68 °F)	4.27	0.644	6.929
Toluol	C7H8	0.866	1,308	4,291.3	4.2	0.58	6.24
Trichloro-fluoromethane (Freon 11)	CCl3F	1.49	828.3 (0 °C)	2,717.5 (32 °F)	3.56		
Turpentine		0.88	1,255	4,117.5		1.4	15.064
Water, distilled	H2O	0.996	1,498	4,914.7	-2.4	1.00	10.76
Water, heavy	D2O		1,400	4,593			
Water, sea		1.025	1531	5023	-2.4	1.00	10.76

Temperature		Sound Speed in Water	
° C	° F	m/s	ft/s
0	32.0	1402	4600
1	33.8	1407	4616
2	35.6	1412	4633
3	37.4	1417	4649
4	39.2	1421	4662
5	41.0	1426	4679
6	42.8	1430	4692
7	44.6	1434	4705
8	46.4	1439	4721
9	48.2	1443	4734
10	50.0	1447	4748
11	51.8	1451	4761
12	53.6	1455	4774
13	55.4	1458	4784
14	57.2	1462	4797
15	59.0	1465	4807
16	60.8	1469	4820
17	62.6	1475	4830
18	64.4	1476	4843
19	66.2	1479	4853
20	68.0	1482	4862
21	69.8	1485	4872
22	71.6	1488	4882
23	73.4	1491	4892
24	75.2	1493	4899
25	77.0	1496	4908
26	78.8	1499	4918
27	80.6	1501	4925
28	82.4	1504	4935
29	84.2	1506	4941
30	86.0	1509	4951
31	87.8	1511	4958
32	89.6	1513	4964
33	91.4	1515	4971
34	93.2	1517	4977
35	95.0	1519	4984
36	96.8	1521	4984

37	98.6	1523	4990
38	100.4	1525	4997
39	102.2	1527	5010
40	104.0	1528	5013
41	105.8	1530	5020
42	107.6	1532	5026
43	109.4	1534	5033
44	111.2	1535	5036
45	113.0	1536	5040
46	114.8	1538	5046
47	116.6	1538	5049
48	118.4	1540	5053
49	120.2	1541	5056
50	122.0	1543	5063
51	123.8	1543	5063
52	125.6	1544	5066
53	127.4	1545	5069
54	129.2	1546	5072
55	131.0	1547	5076
56	132.8	1548	5079
57	134.6	1548	5079
58	136.4	1548	5079
59	138.2	1550	5086
60	140.0	1550	5086
61	141.8	1551	5089
62	143.6	1552	5092
63	145.4	1552	5092
64	147.2	1553	5092
65	149.0	1553	5095
66	150.8	1553	5095
67	152.6	1554	5099
68	154.4	1554	5099
69	156.2	1554	5099
70	158.0	1554	5099
71	159.8	1554	5099
72	161.6	1555	5102
73	163.4	1555	5102
74	165.2	1555	5102
75	167.0	1555	5102
76	167.0	1555	5102
77	170.6	1554	5099
78	172.4	1554	5099
79	174.2	1554	5099
80	176.0	1554	5099
81	177.8	1554	5099
82	179.6	1553	5095
83	181.4	1553	5095
84	183.2	1553	5095
85	185.0	1552	5092
86	186.8	1552	5092
87	188.6	1552	5092
88	190.4	1551	5089
89	192.2	1551	5089
90	194.0	1550	5086

91	195.8	1549	5082
92	197.6	1549	5082
93	199.4	1548	5079
94	201.2	1547	5076
95	203.0	1547	5076
96	204.8	1546	5072
97	206.6	1545	5069
98	208.4	1544	5066
99	210.2	1543	5063
100	212.0	1543	5063
104	220.0	1538	5046
110	230.0	1532	5026
116	240.0	1524	5000
121	250.0	1526	5007
127	260.0	1507	4944
132	270.0	1497	4912
138	280.0	1487	4879
143	290.0	1476	4843
149	300.0	1465	4807
154	310.0	1453	4767
160	320.0	1440	4725
166	330.0	1426	4679
171	340.0	1412	4633
177	350.0	1398	4587
182	360.0	1383	4538
188	370.0	1368	4488
193	380.0	1353	4439
199	390.0	1337	4387
204	400.0	1320	4331
210	410.0	1302	4272
216	420.0	1283	4210
221	430.0	1264	4147
227	440.0	1244	4082
232	450.0	1220	4003
238	460.0	1200	3937
243	470.0	1180	3872
249	480.0	1160	3806
254	490.0	1140	3740
260	500.0	1110	3642

## 8 Specification



### Hand-held Ultrasonic Flowmeter KATflow 200

- Transit-time correlation measurement
- Dual DSP-technology, coded signals for better measurement accuracy
- Light-weight, hand-held unit with graphic display
- Easy to install clamp-on sensors with no process interruption
- Non-invasive flow measurement of liquids or liquified gases
- Suitable for all commonly used pipe materials with pipe diameters from 10 mm (4/10") to 3 m (118")
- Two types of sensors to cover complete pipe range
- Battery life > 24 hours



#### Description

The KATflow range of non-invasive flowmeters utilises ultrasonic technology for the accurate flow measurement of liquids and liquified gases in full pipes.

The KATflow 200 is a hand-held device designed for quick non-invasive spot measurements throughout plants, buildings and pipe systems. The set-up of the unit is simple through a wizard-like guided menu structure. Therefore flow measurements can be obtained quickly. This flowmeter is light-weight and can be carried to inaccessible locations easily.

The measurement of flow is based on the principle that sound waves are influenced by a flowing medium. Measurements are made by penetrating the pipe with ultrasound and subsequently time differences, frequency variations and phase shifts of the ultrasonic signals are evaluated. This measuring technique has no effect on the flowing medium. There is no pressure loss in the pipe and no wear on components of the measuring device.

The ultrasonic sensors are clamped onto the outside of the pipe, thus eliminating the need to dismantle the pipework and interrupt the process. The KATflow 200 can be applied to any type of standard pipe carrying clean or dirty liquids and liquified gases.

#### Advantages

- Quick and easy installation
- Light-weight, hand-held device
- No cutting of pipes necessary, no interruption of process, no plant shut down
- Robust instrument with IP 65 housing shock-protected by rubber protector
- Integral data logger for comprehensive data analysis

#### Specification

##### General

Measuring principle:	Ultrasonic time difference correlation principle
Flow velocity range:	0.01 ... 25 m/s
Resolution:	0.25 mm/s
Repeatability:	0.15 % of measured value $\pm$ 0.015 m/s
Accuracy:	Volume flow $\pm$ 1 ... 3 % of measured value depending on application, $\pm$ 0.5 % of measured value with process calibration Flow velocity $\pm$ 0.5 % of measured value
Turn down ratio:	1/100
Gaseous and solid content of liquid media:	< 10 % of volume

##### Flowmeter

Enclosure:	Hand-held
Degree of protection:	IP 65 according EN 60529
Operating temperature:	-10 ... 60 °C (14 ... 140 °F)
Housing material:	ABS (UL 94 HB)
Flow channels:	1
Power supply:	Internal rechargeable batteries 4 x NiMH AA Sanyo 2500 mAh or external power supply 9 V DC
Operating time:	> 24 h with fully charged batteries

**Flowmeter (cont.)**

Display : LCD graphic display, 128 x 64 dots,  
backlit  
Dimensions : H 228 x W 72/117 x D 47 mm  
Weight : Approx. 650 g  
Power  
consumption : < 1 W in measurement mode  
Signal damping : 0 ... 99 s  
Measurement rate : 10 ... 100 s<sup>-1</sup>  
Operating  
languages : English, German, French, Spanish,  
Russian  
Response time : 1 s

**Quantity and units of measurement**

Volumetric flow  
rate : m<sup>3</sup>/h, m<sup>3</sup>/min, m<sup>3</sup>/s, l/h, l/min, l/s,  
USgal/h (US gallons per hour),  
USgal/min, USgal/s, bbl/d (barrels  
per day), bbl/h, bbl/min, bbl/s  
Flow velocity : m/s, cm/s, ft/s, inch/s  
Mass flow rate : g/s, t/h, kg/h, kg/min  
Volume : m<sup>3</sup>, l, gal (US gallons), bbl  
Mass : g, kg, t

**Internal data logger**

Storage capacity : approx. 30,000 samples (128  
kByte), optional > 100,000 samples  
(512 kByte)  
Logging data : All measured and totalised values,  
parameter sets

**Communication**

Serial interface : RS 232, RS 485 (optional)  
Data : Instantaneous measured value,  
parameter set and configuration,  
logged data

**Software KATdata**

Functionality : Downloading of measured  
values/parameter set, graphical  
presentation, list format, export to  
third party software, on-line transfer  
of measured data  
Operating systems : Windows 2000, NT, XP

## 9 Index

To be added.