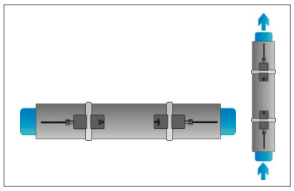
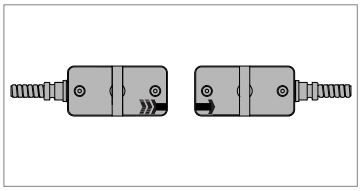
Step 1: Measurement Point and Pipe Preparation

- Avoid installation of sensors in the vicinity of deformations and pipe defects, near welding seams or where deposits could have accumulated.
- Select a measuring point with sufficient straight pipe to obtain accurate measurements, usually a length of 10 x pipe diameter before or 5 x pipe diameter after the measuring point.
- For a horizontal pipe, mount the sensors on the side of the pipe. For a vertical pipe, mount the sensors at a location where the liquid flows upwards (Pic. 1).
- Mount the sensors in the direction of the flow (Pic. 2).
- Clean the pipe at the measurement point. Remove loose paint and rust with a wire brush or file.
- Apply coupling paste to the face of the clamp-on sensors before attaching them to the pipe.

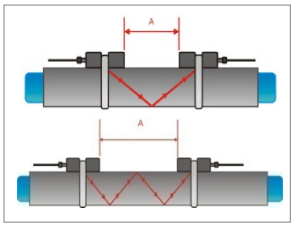


1. Mounting points



2. Flow direction

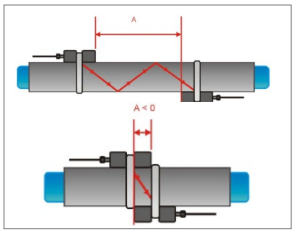
Sensor Mounting Configuration



3. Reflection mode (from above)

Reflection Mode

The flowmeter uses an even number of passes. This is the most convenient mounting arrangement, as the transducer separation distance can be measured very easily and the sensors can be accurately aligned. Use whenever possible (Pic. 3).



4. Diagonal mode (from above)

Diagonal Mode

Signal travels on an odd number of passes through the pipe. A single pass can be used for larger pipes and for dirty/aerated liquids where greater signal attenuation can occur. The sensor distance on this mounting configuration can be negative (sensors overlapping) (Pic. 4).

Step 2: Keyboard Familiarisation

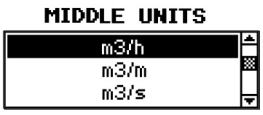
- Show **NEXT** (1) available item
- Q_{on} (2) = Start totaliser function
- Show next **DISP**lay (3)
- Q_{off} (8) = Stop totaliser function
- **DIRECT** (9) access to trend plot
- ▲ = Move menu/selection item up
- ▼ = Move menu/selection item down
- **ESC**ape entry without saving
  Switch device **OFF** (press > 2 sec.)
- **ENTER** selection with saving
  Switch device **ON** (press > 2 sec.)

Step 3: Quick Start Menu and Setup Wizard

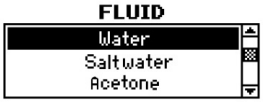
- The flowmeter can be prepared for measurement with the **Setup Wizard** as found in the **Quick Start** menu.

At first power on and the boot sequence, the **Main Menu** is displayed. Use the ▲ and ▼ cursor keys to select **Quick Start** and confirm by pressing **ENTER**.

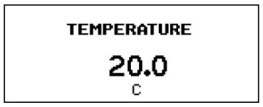
Select the **Setup Wizard** and confirm with **ENTER**. If the sensors are recognised, the serial number will be shown. If not, the type can be selected.



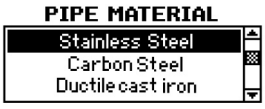
Select the main measurement unit using ▲ and ▼ keys and confirm with **ENTER**. This unit will be diplayed in the middle of the measurement screen.



Select fluid using cursor keys. Confirm by pressing **ENTER**.



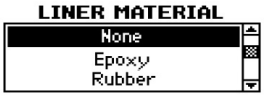
Enter the fluid temperature using the keypad. Confirm by pressing **ENTER**. Use ▲ key as a backspace to correct for entry errors.



Select the pipe material using the ▲ and ▼ keys, confirm with **ENTER**. Selecting **User** will allow manual entry of pipe sound speed.

Enter the outer pipe diameter using the keypad and confirm with **ENTER**. Use ▲ key as backspace to correct for entry errors. If '0' is entered and confirmed, an additional screen appears that allows entry of the circumference. Press **ENTER** to confirm.

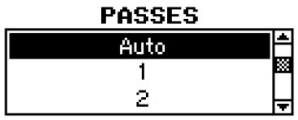
Enter pipe wall thickness using the keypad and confirm with **ENTER**. Use ▲ key as a backspace to correct for entry errors.



Select pipe liner material using cursor keys and confirm by pressing **ENTER**. If a liner material is chosen, an additional screen appears that allows entry of liner thickness.

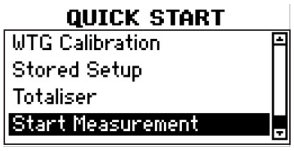
Step 3: Quick Start Menu and Setup Wizard (continued)

- Select number of sound passes (sound paths) using cursor keys.
- **Auto**: Selection by flowmeter according to entered parameters (number of passes shown later on Sensor Positioning Screen).



1 = 1 pass (diagonal mode)
2 = 2 passes (reflection mode)
3 = 3 passes (diagonal mode)
4 = 4 passes (reflection mode) etc.

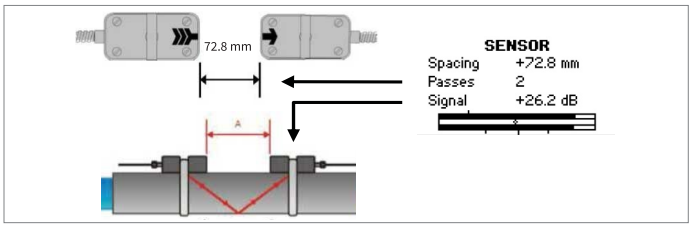
- Even number of passes: Both sensors on same side of pipe (see pic. 3).
- Odd number of passes: Sensors on opposite sides (see pic. 4). Confirm with **ENTER**.



Select **Start Measurement** and confirm with **ENTER** to start the sensor positioning procedure.

Sensor Positioning Screen

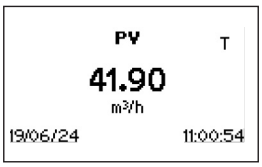
- Mount the transducers with the suggested spacing between the sensor heads. This distance has been determined by the flowmeter on the basis of the entered parameters.
- Use the displayed number of passes to install the sensors on the correct side of the pipe (see pictures 3 and 4).
- Observe the upper bar (signal-to-noise ratio) and lower bar (signal quality). These should be both filled to about the same level with a filling level of around ⅓ or more desired.



5. Sensor positioning screen

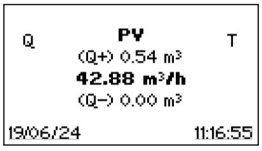
- Use the cursor between the two signal bars for the fine adjustment of the sensor position. With correct pipe parameters entered and the sensors mounted at the suggested spacing, the mark should be near the central indication line (see three lines below the bottom signal bar).
- If the mark is to the left-hand side of the central indication line, the sensors are too close to each other. If the mark is to the right, the sensors are too far apart. Slide one sensor carefully along the pipe to bring the mark into a more central position. Measurements can be obtained when the mark is between the left and right indication line. Press **ENTER** to start measurement.

Measurement Screen



The main measurement unit is displayed when first entering the measurement screen. Press **NEXT** to see up to three units displayed with the main one in the middle. Two further measurement units can be assigned to this screen by going to **Main Menu – Display**.

Totaliser



The totaliser is shown when in measurement mode after pressing **NEXT** twice. It can also be assigned to the three-line display, data logger or process outputs by selecting a quantity as the unit.

- The totaliser function is started with Q_{on} when in measurement mode (measurement screen displayed). Pressing Q_+ resets the total in positive flow direction. Pressing Q_- resets the total in negative flow direction. The totaliser function can be stopped with Q_{off}.
- Pressing Q_{on} again will reset the positive, negative and overall totaliser. Change displays without resetting the totaliser by pressing **DISP** or **NEXT**.

Internal Data Logger

- The data logger is reached via **Main Menu**. It is activated in **Data Logger – Interval** by entering and confirming a non-zero value and selecting units to be recorded.
- Use the cursor keys to highlight a unit and press **ENTER** to select it. Up to twenty measurement units can be selected for logging. Press '0' to deselect it.
- An activated data logger is indicated by a 'document' symbol in the top left corner of the display. On start of measurement (measurement screen displayed) the logger records the selected measurement units.
- A blinking 'document' symbol indicates a recording data logger. Separation markers are set by the data logger whenever a session begins.
- Leave the measurement screen by pressing **ESC** to stop recording.
- The recording interval can be changed in **Data Logger – Interval**. The data logger is cleared using **Data Logger – Log Erase**. Ensure all required data has been downloaded.
- Deactivate the data logger by entering '0' as an interval. Previous measured data remains.

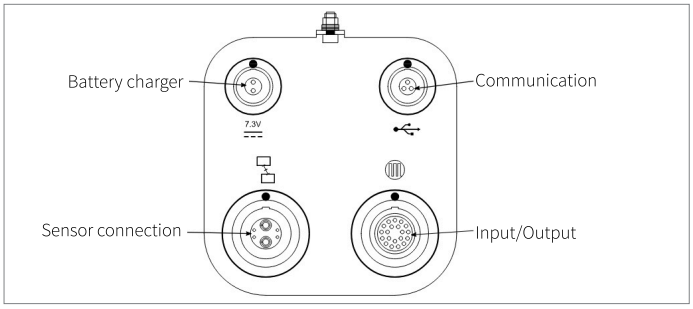
Wall Thickness Gauge (WTG) (optional)

Optional sensor probes to measure pipe wall thickness are available. Ensure the correct pipe material is selected. Connect to the sensor input and select **Start Measurement**.

- The flowmeter will recognise the probe and display the measurement screen. Wall thickness will be shown when the sensor is in good acoustic contact with the pipe.

Heat Quantity Measurement (where specified)

- The KATflow 210 is capable of measuring heat flow and heat quantity.
- To measure heat flow, select a heat flow unit (W, kW, MW) as **Middle Unit** when going through the **Setup Wizard**.
- To measure heat quantity, select a heat quantity unit (J, kJ, MJ).
- On selection of one of these units, the flowmeter requests the entry of the specific heat capacity of the medium in [J/(g*K)]. Enter the value of the fluid and confirm with **ENTER**. Complete the remaining steps of the **Setup Wizard**.
- The temperatures at the inlet and outlet of the monitored system are used to determine heat flow and heat quantity.
- Connect the supplied Pt 100 temperature sensors with the Input/output connector (20-veined cable required, please refer to the operating instructions).



6. KATflow 210 connectors

- In the **Main Menu – Input/Output** use the ▲ and ▼ keys to select **PT100X 4 WIRE** to use the temperature measured on the pipe. To enter a fixed temperature value, select **User** and enter the value.
- Define whether the Pt 100 sensor measures the inlet or outlet temperature. Use ▲ and ▼ keys to select as appropriate and confirm with **ENTER**.
- On the next screen a temperature offset can be applied for the temperature measured on the pipe. After confirming again with **ENTER** the meter returns to the Main Menu.

Medium at 25 °C (unless stated differently)	**Specific Heat Capacity** [J/(g*K]
Ethanol (0 °C)	2.30
Ethylene glycol (100 %)	2.36
25 % Ethylene glycol/75 % water (26.7 °C)	3.85
30 % Ethylene glycol/70 % water (26.7 °C)	3.41
50 % Ethylene glycol/50 % water (26.7 °C)	3.77
65 % Ethylene glycol/35 % water (26.7 °C)	3.11
R22 refrigerant[1)] (30 °C)	6.60
R134a refrigerant[1)]	8.87
Mineral oil	1.67
Water	4.18

[1)] Liquid under pressure

Temperature and Flow Measurement

- For separate measurement of flow and temperature select a flow unit as **Middle Unit** in the **Setup Wizard**. Complete the Wizard and then go to **Main Menu – Inputs/Outputs**.
- In the **Inputs/Outputs** menu assign the temperature input to channel 1, and select **Inlet** or **Outlet** from the menu.
- In the **Display** menu set the **Top Line** or **Bottom Line** to either **T in** or **T out** depending on the previous selection.
- In the **Data Logger** menu select either **T in** or **T out** from the list of variables depending on the previous selection.
- When measuring, the flowmeter will be logging the Pt 100 input and can be viewed by pressing **NEXT** on the keypad.
- This data can also be assigned to a process output in the **Inputs/Outputs** menu following the same process.

Process Outputs: Setup

- Configured process outputs can be set up in **Main Menu** - **Inputs/Outputs**:
  - **RELAY OUT** (relay output)
  - **I OUT ACTIVE** (0/4 … 20 mA)
  - **PULSE OUT** (open-collector)

  Other outputs, depending on which types are available, can be selected.
- After selecting an output, it can be assigned to a measurement channel. Selecting **OFF** disables the output.
- On the next screen, the unit that will appear on the output can be selected.
- The type of output will determine the remaining screens.

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