ChronoFLO

Operation Manual

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As part of our policy of continuous development, we reserve the right to alter, without prior notice, all specifications, designs, prices and conditions of supply for all our equipment.

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Revision between L & M

Corrected new small sensor serial / type number. 0400400590422564000.
CHANGED SMALL TRANSIDCER RANGE TO 15 – 75.

Revisions over previous manuals

Corrected MILSPEC connectors, put part number for both Weald and Amphenol.
Added Circumference / Diameter.
Added screen dump of thickness gauge reading a value.
Thickness Gauge image to show correct orientation on pipe.
Added timed log
Added graph display of logged data.
Added latest photos of fixing blocks and rails.
Checked references to other parts of manual.

Revision over version i. Changed small transducer pipe range from 75 to 150 mm (approximately).
Added error codes.
Small Sensor information, as per application note. - BUT needs up to date pictures of mini, the ones here are the prototype rails.

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WARNING

- **Please ensure that the unit is fully charged before operation.**
- **The FLOWMETER is not certified for use in Hazardous Areas.**
- **The FLOWMETER is not certified for use in areas where radio frequency energy in the range of 6 to 12 MHz is present.**
- **Do not leave the battery uncharged for more than six months; this will result in permanent damage to the battery.**

1INTRODUCTION

1.1SYSTEM OVERVIEW

The Rugged Transit Time Ultrasonic Flowmeter uses advanced digital techniques to achieve stable measurements even in difficult conditions. The meter displays volumetric flow rate, in both directions, in all common units. The meter also has a totaliser that displays the net flow in both directions.

Key Features

Clamp-on	Non-invasive, no pressure loss, no leakage risk, no disruption to process during installation, total hygienic integrity and simple installation.
Digital Signal Processing	The flowmeter has excellent signal processing electronics that uses advanced digital techniques. Real time directly measured speed of sound compensation reduces flow error from fluid variations with temperature and pressure.
Wall Thickness	Wall thickness facility (requires optional transducer).
Internal logging	256 kB memory, capable of recording 128,000 data points.
External inputs	Used for thermal energy and external flowmeter logging applications
External outputs	Used for process control.
Large Graphics Display	A large display that provides graphing functions and large character operating modes.
Waterproof	Very rugged electronics and transducers (IP67[1] and IP68[2] respectively), supplied with strong cables, interconnected with military specification connectors.
Very Large internal battery	High capacity rechargeable battery means very extended times.
Remote logging mode	30 day battery life in low power mode.

[1] *IP67 Protected against dust and protected against the effects of temporary immersion in water to a depth of up to 1 metre for 30 minutes.*

[2] *IP68 Protected against dust and the effects of permanent immersion in water to a depth of 3 metres.*

1.2 WHAT IS SUPPLIED

The FLOWMETER is supplied with everything needed to measure flow. The kit includes the electronics, one pair of sensors (to the customer's choice), sensor clamping rail, external power input cable, serial computer cable, a bubble level, a 5m tape measure and a sonically conductive coupling gel (grease may be used if no couplant is available).

Cables for pulse input, pulse output and 4-20 mA current input and output are optional. Other optional equipment includes a thickness gauge and magnetic pipe clamps for use on ferrous metal pipes.

2OPERATING INSTRUCTIONS

2.1FLOWMETER INSTALLATION

The meter will operate on any sonically conductive pipe that contains a sonically conductive liquid such as metals, glass, and most plastics. Low levels of air/gas in the liquid are tolerated and flow the flow velocity remains accurate, but to get an accurate flow rate the fluid must be 100% liquid with no gas/solids present.

2.1.1 SENSOR INSTALLATION

The system works by sending ultrasonic energy pulses between transducers. These signals travel through the pipe at a fixed angle, so the transducers must be positioned such that they are in the signal path. They may be positioned on opposite sides of the pipe so that the signal hits directly (Z mode) or on the same side of the pipe (V mode) so that the signal bounces off the opposite wall and hits the transducer on the return. The separation distance between the transducers must be correct as calculated by the flowmeter based on information you provide (See Section 2.7.2).

2.1.2'V' MODE

This arrangement is suitable for use on pipe sizes up to approximately 400-600mm diameter, using the mounting rail.

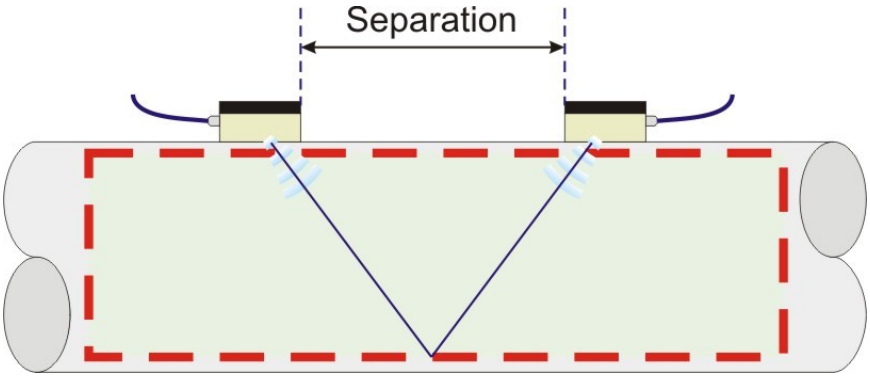


Figure 1. V Mode

2.1.3'Z' MODE

This mode should be used on pipe diameters larger than about 400-600mm, or smaller pipes if difficult conditions mean that a good signal cannot be obtained using V mode. Since the signal only crosses the pipe once, much less energy is lost compared to V mode.

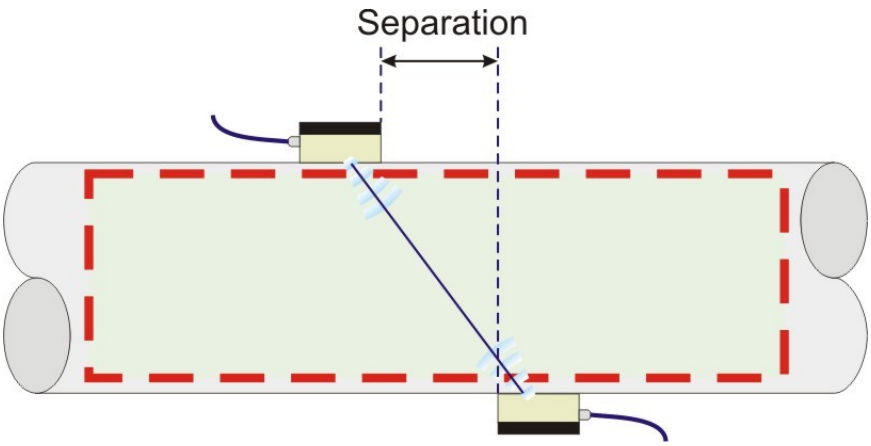


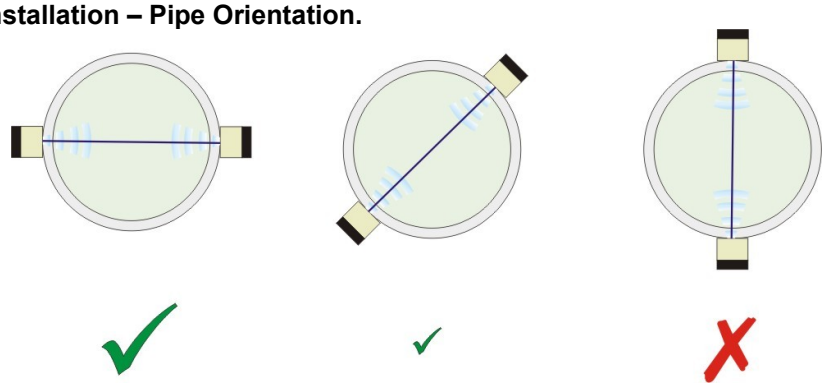
Figure 2. Z Mode

2.1.4 SITE SELECTION

- In a pipe air will collect at the top and solids will collect at the bottom. Since the ultrasonic signal does not travel through air, the transducer should be positioned horizontally.

Ideal ***Acceptable*** ***Risk of no Signal***

Figure 3. Sensor Installation – Pipe Orientation.



Ideal ***Inaccurate Readings*** ***Inaccurate Readings*** ***No Readings*** ***No Readings***

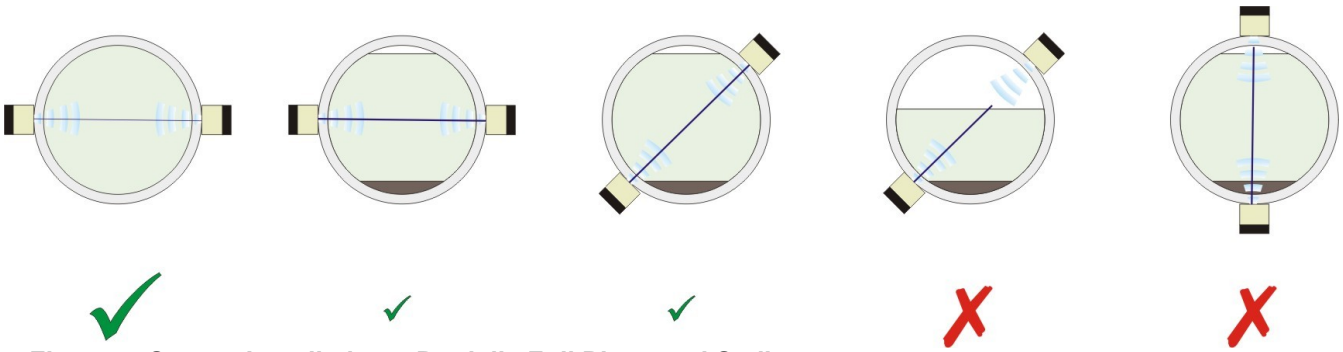


Figure 4. Sensor Installation – Partially Full Pipes and Sediment.

- The meter should be installed away from any flow obstructions such as valves and elbows. The meter should be positioned on a straight length with a distance of ***at least*** ten times the internal diameter upstream and ***at least*** five diameters downstream from any flow obstruction.

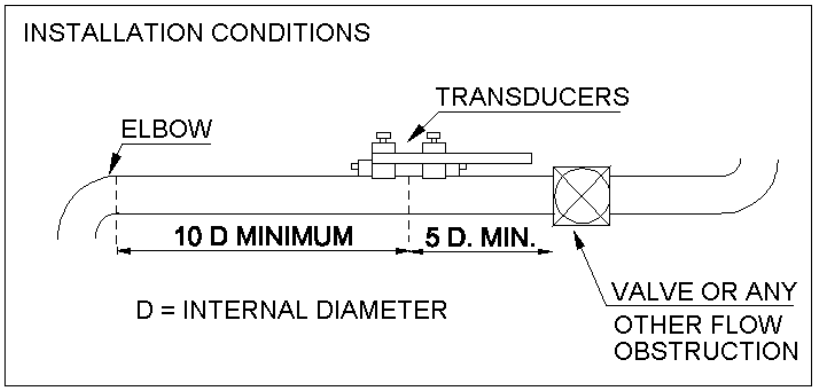


Figure 5. Sensor Installation – Up and downstream obstructions

2.1.5SITE SETUP

Before measuring flow, the meter must be correctly set-up; the following parameters need to be known:

- Pipe Material (including liner if there is one).
- Pipe Dimensions (including diameter (or circumference) and wall thickness). Section 5 contains a table of some standard pipe size dimensions (British Standard Sizes). The use of a separate thickness gauge is recommended if the pipe wall thickness is unknown.

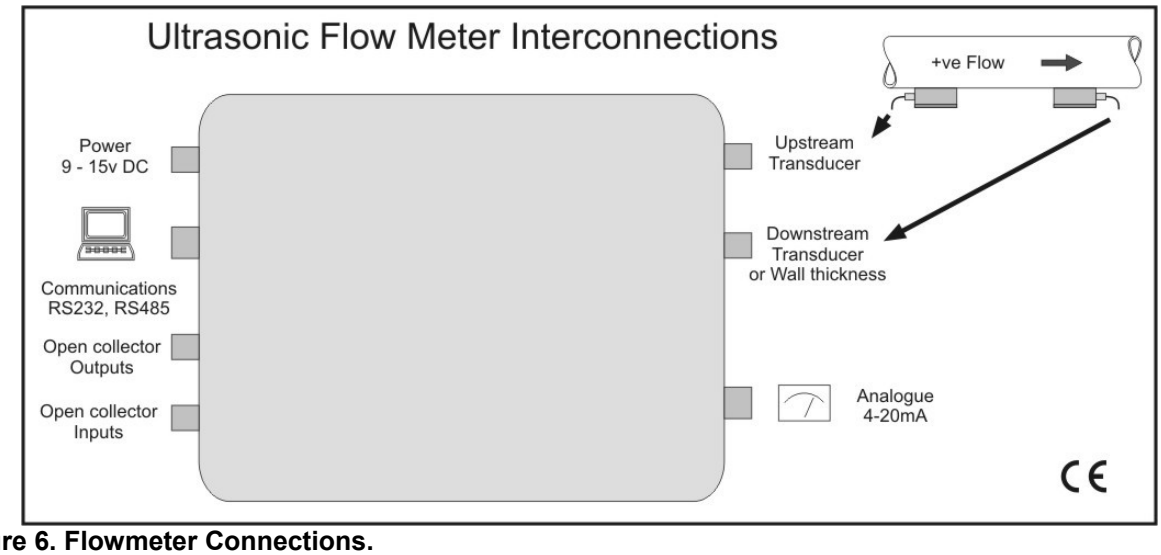
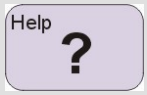


Figure 6. Flowmeter Connections.

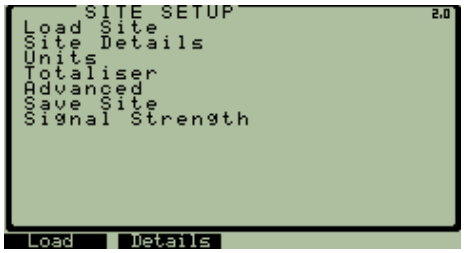
Connect one transducer to each of the “Upstream” and “Downstream” connectors.

- Press the ON key. At this point the meter runs through a series of tests and after 10 seconds the main menu is displayed. The meter uses a logically numbered menu system navigated by use of the cursor keys, and the highlighted text is selected by pressing the Enter key. The basic set-up method is described on the next page.

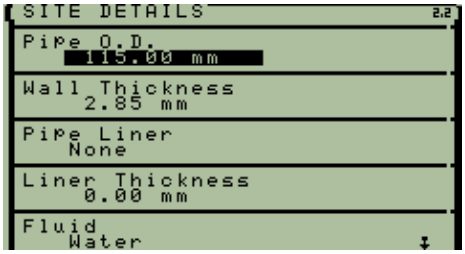
Pressing the Help key will display a Help message on most of the display screens.



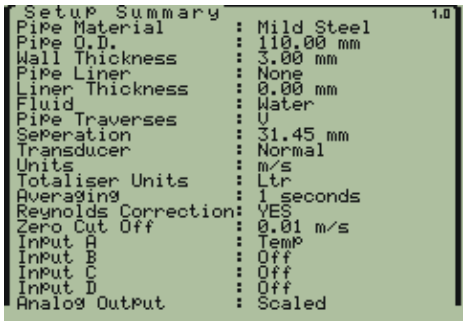
- Select menu 2 (Site Setup)



- Select Site Details.



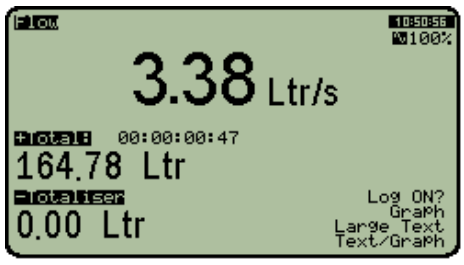
- Enter all the parameters correctly. Check that the transducer serial number.



- Press the back arrow (←) twice to get to the main menu and select Item 7, “Setup Summary”.
- Check the values displayed.

- Use the back arrow (←) to go back to the main menu and select Item 1, “Measure Flow”.

- The meter will prompt the user to set the separation of the transducers. Adjust the transducer rail and set the separation to the value that the meter has calculated. Apply coupling gel to the face of each transducer, and fix the rail onto the pipe.



- The meter takes 10 seconds to initialise and then displays the flow rate. For details of how to change the display units and format, please refer to Section 2.7.3.

2.1.6THE TRANSDUCER FIXING RAIL.

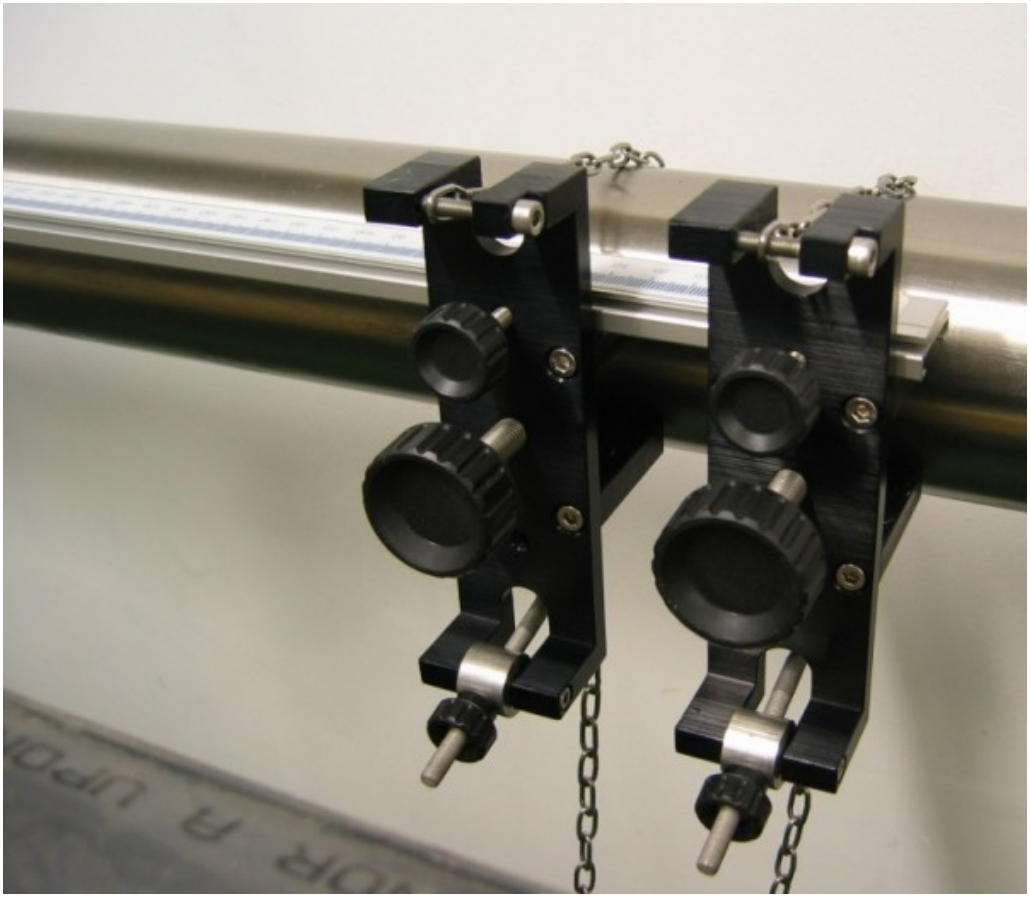


Figure 7. Rail Clamped onto a pipe in Z mode.

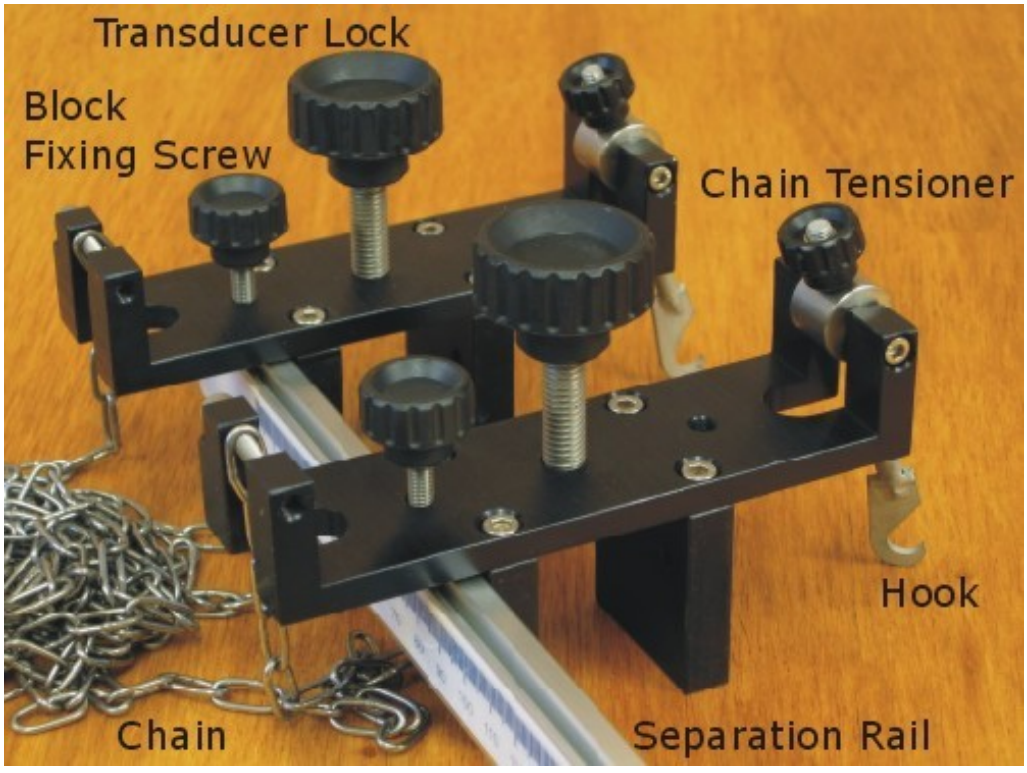
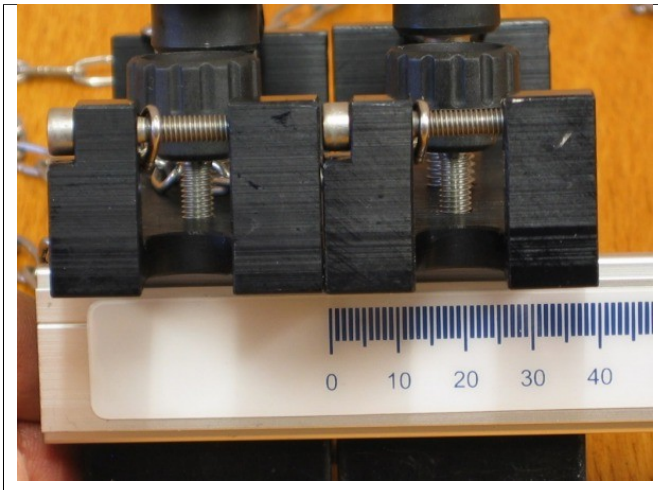


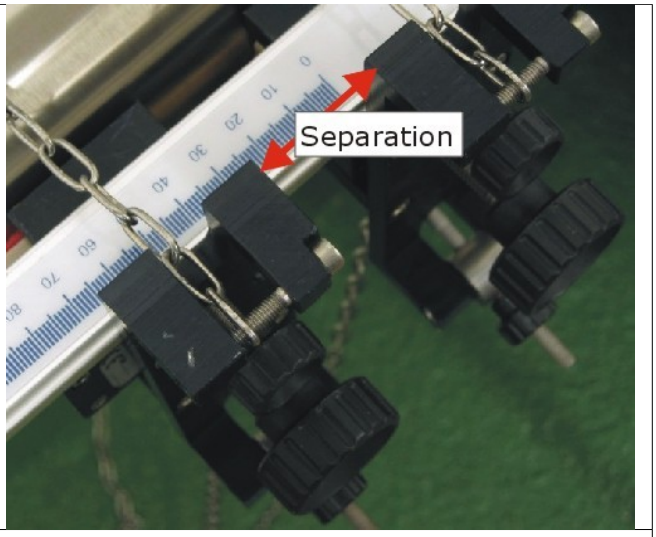
Figure 8. Rail Parts.

2.1.7FIXING THE TRANSDUCERS ONTO THE PIPE.

- Clean the pipe, using a wire brush or file to remove any paint, dirt or corrosion from the area in which the transducers will touch the pipe. A rough uneven surface reduces the signal strength.



Zero (0) separation



Separation on pipe.

Figure 9. Rail Separation.

2.1.7.1 CHOICE OF TRANSDUCER CONFIGURATION – Z OR V MODE.

V mode is used on smaller pipes, with good signal levels. If the pipe is less than 500mm, and it is in reasonable condition, try V mode first. If there is insufficient signal strength in V mode then repeat the set-up in Z mode.

Z mode is used on large pipes greater than 500mm, and in situations where the signal has been degraded. This occurs with pipe material that absorb sound such as cement. Please bear in mind that the figure of 500 mm can vary dependant on pipe conditions.

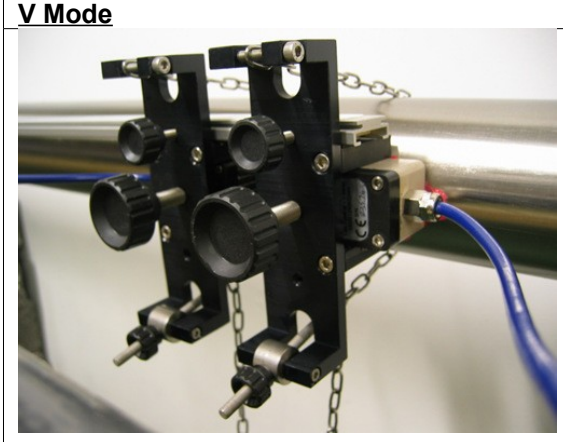
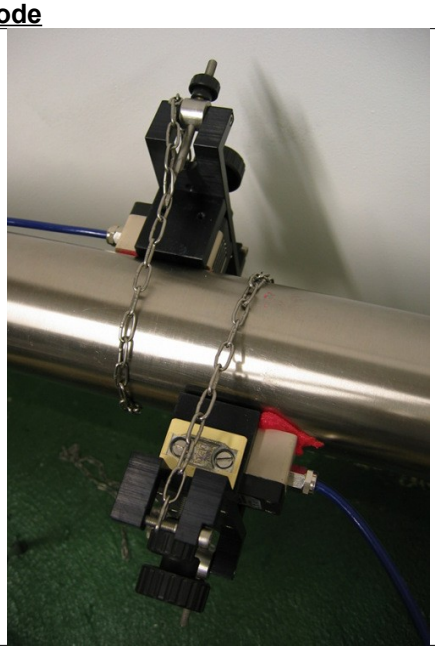
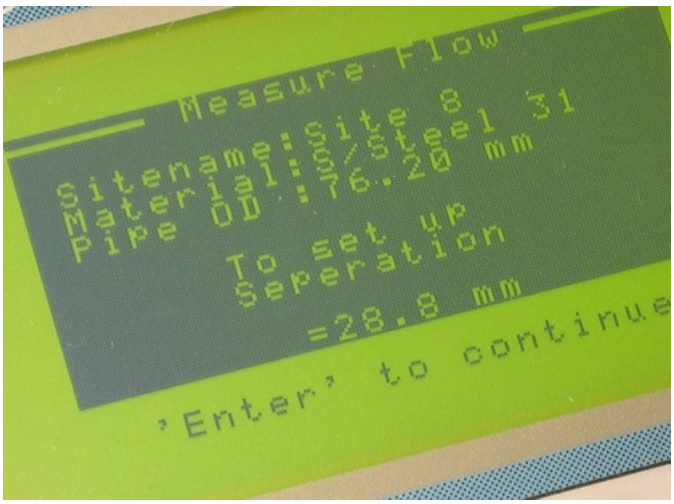
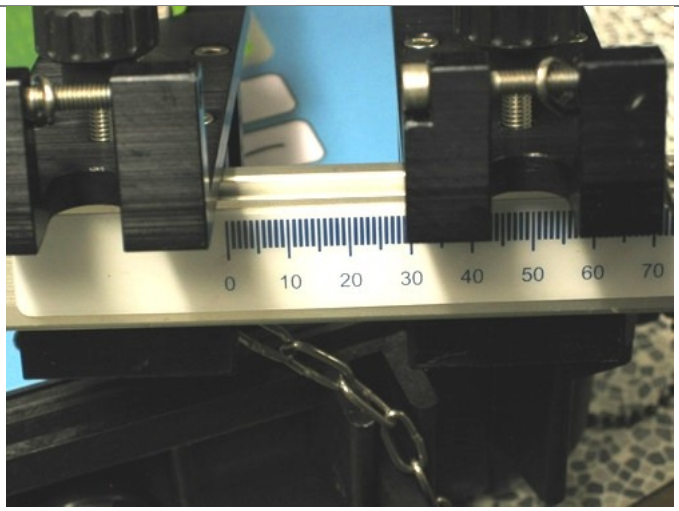
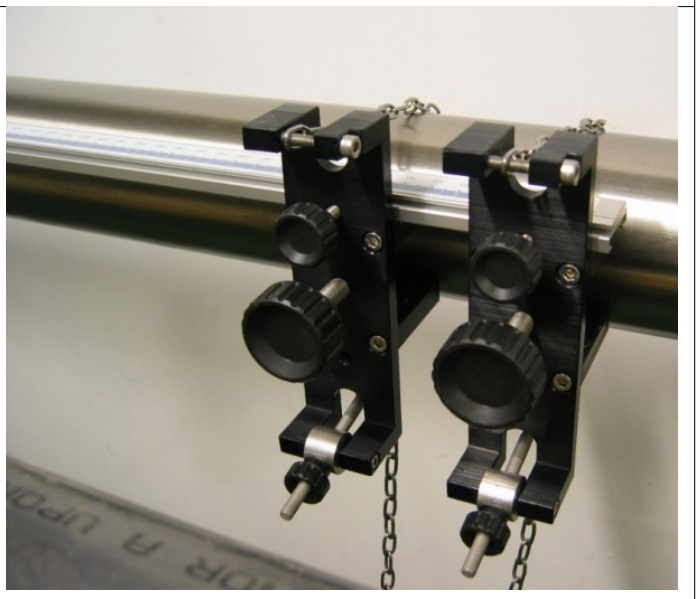
V Mode	Z mode
	

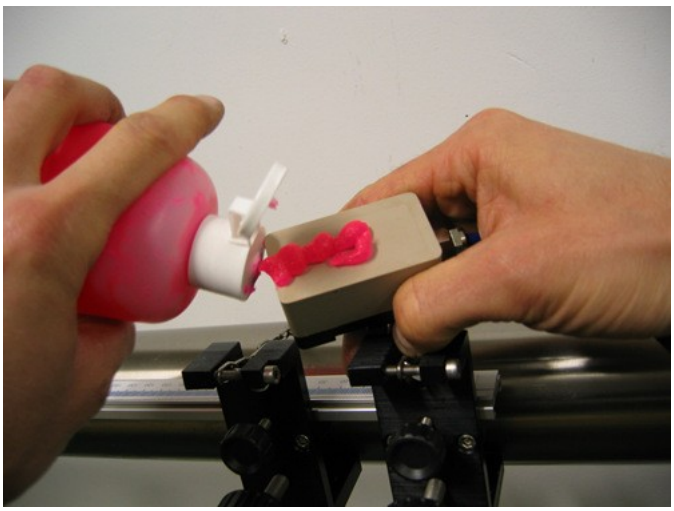
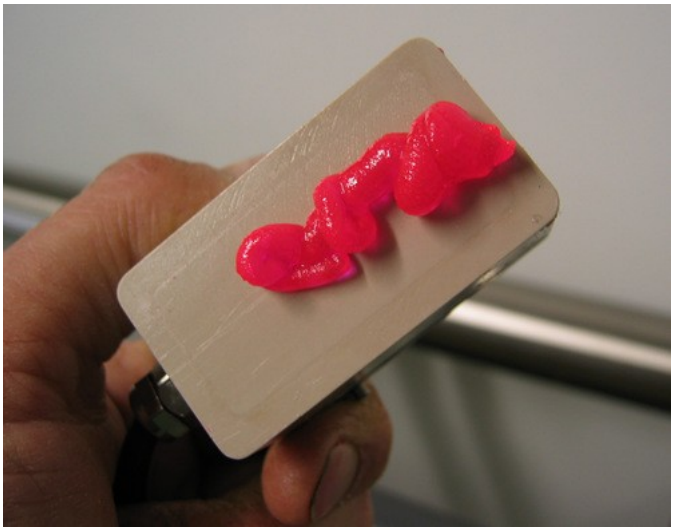
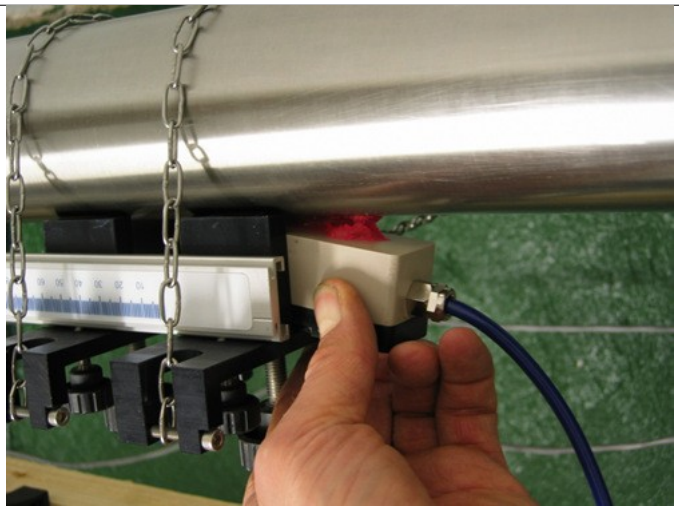
Figure 10. V and Z Modes.

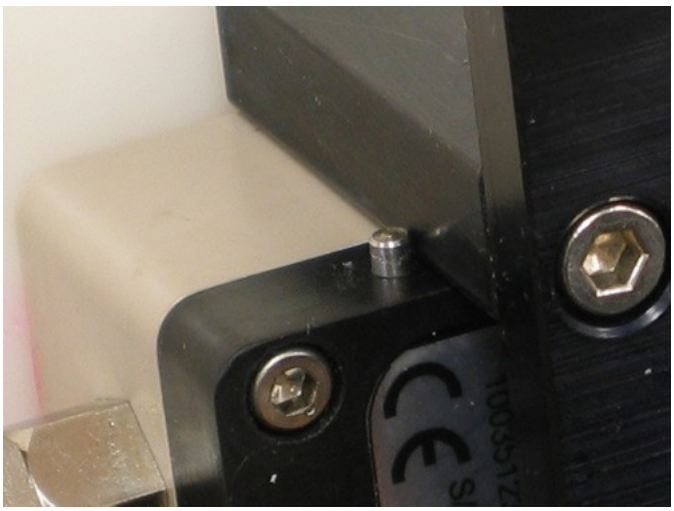
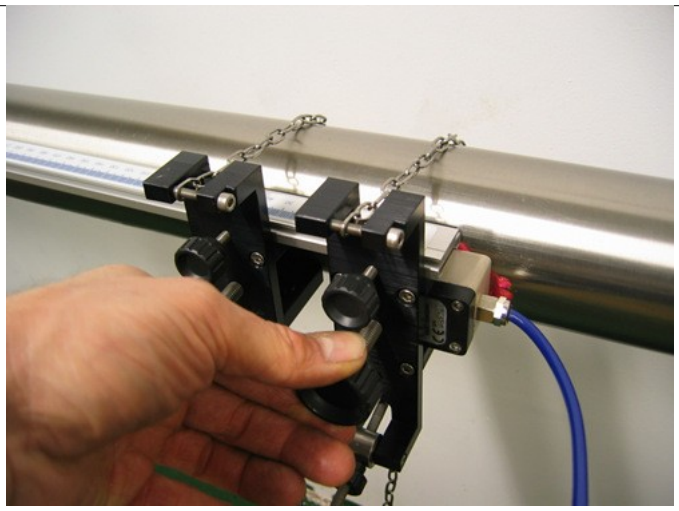
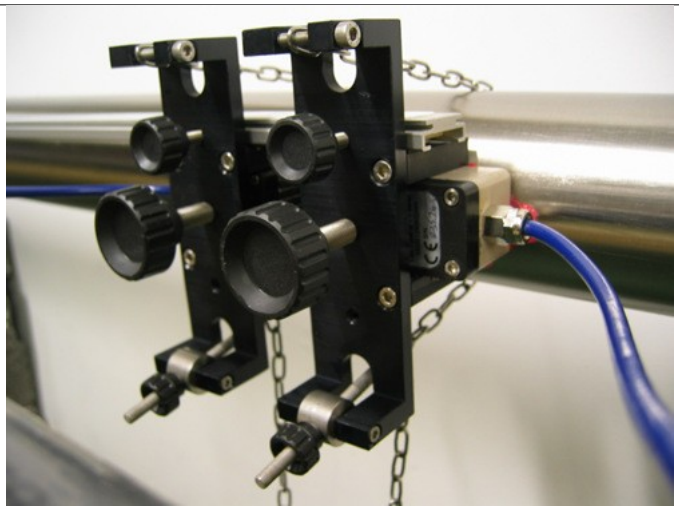
2.1.7.2CLAMPING THE SENSORS IN V MODE.

1	Choose the best place to fit the sensors	Refer to figure 6.
2	Measure the pipe circumference, or diameter.	 **Figure 11 Circumference Measurement**
3	Measure the wall thickness using a thickness gauge (or enter it if known)	 **Figure 12. Using the Thickness Gauge**

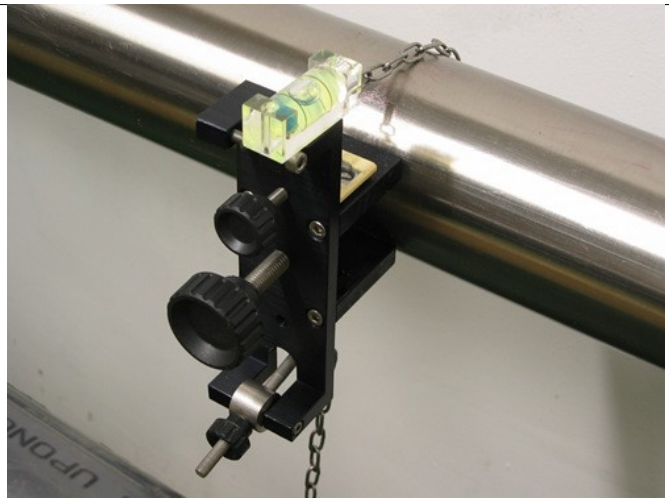
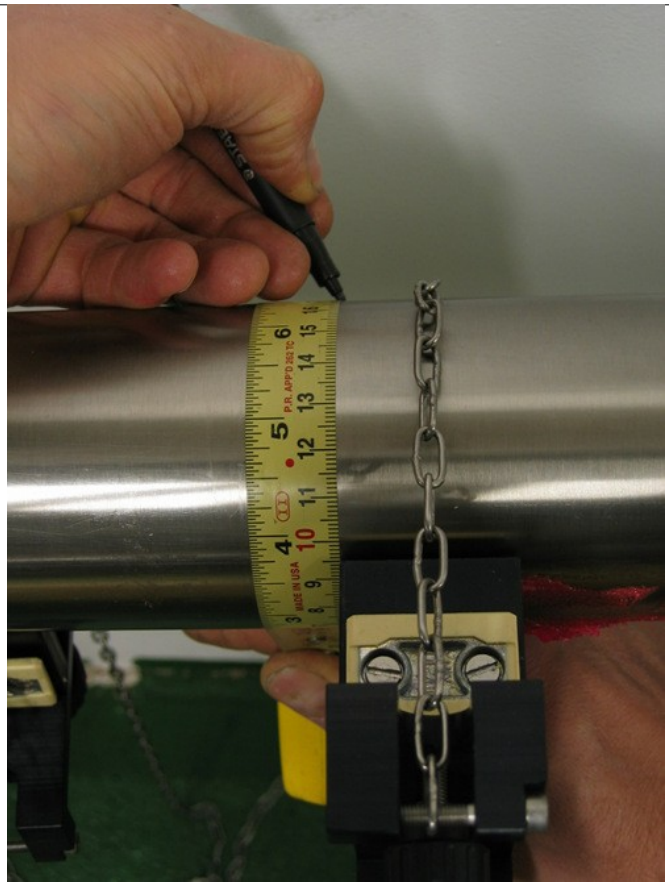
4	Enter pipe parameters in site details in flowmeter menu 2 to show separation.	 **Figure 13. Setting up the flowmeter in V mode.**
5	Set the sensor separation. Use the block fixing screws to adjust the position of the blocks on the measurement rail.	 **Figure 14. Setting the separation in V mode.**

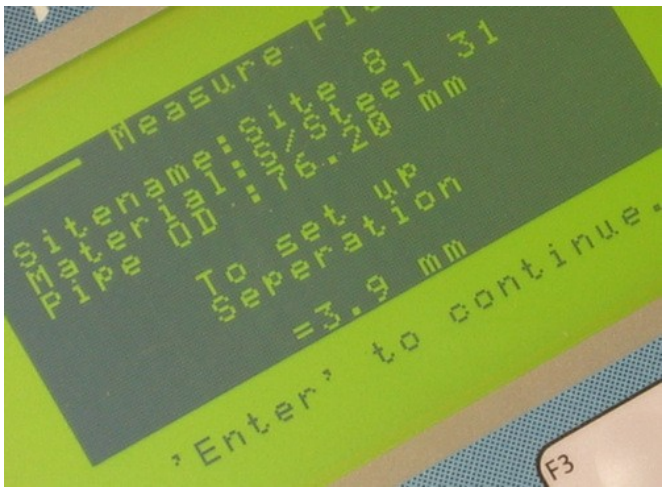
6	Attach both chains and tighten. DO NOT OVER TIGHTEN!	 **Figure 15. Tighten the Hooks.**
7	Fit rail in horizontal plane.	 **Figure 16. Rail mounted in V mode, proir to sensor installation.**

8	**Fit the sensors.** Apply couplant gel. Particularly to the front of the sensor.	 **Figure 17. Applying Sonically conductive couplant gel.**  **Figure 18. Couplant Gel, close up.**
9	Slide each transducer into the rail. Hold the sensor away from the pipe until in place so that the gel remains intact.	 **Figure 19. Inserting the sensors into the rail.**

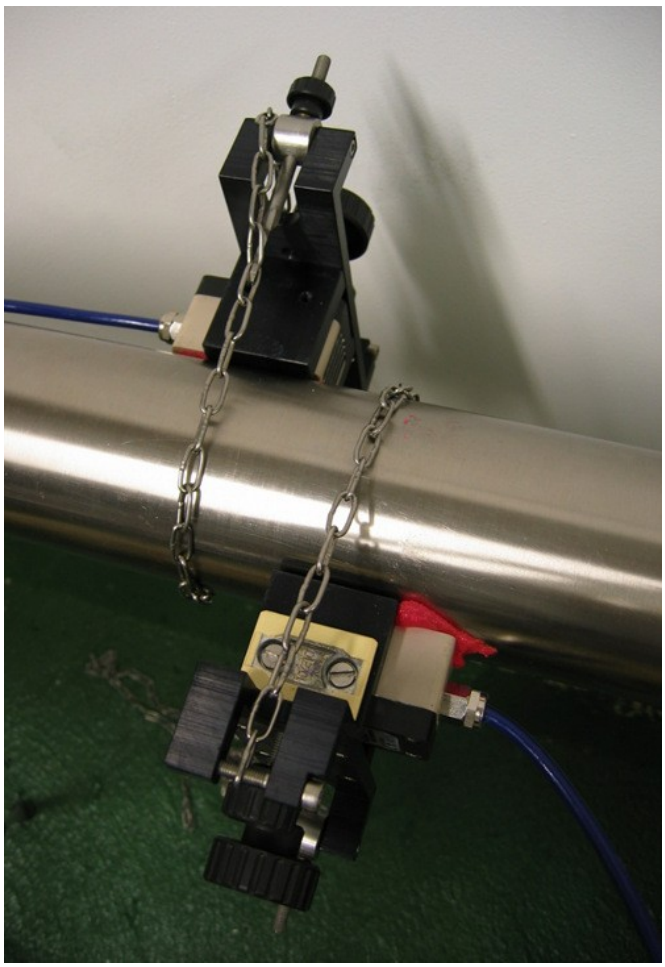
9a	Transducer in place.	 **Figure 20. Sensor Stop.**
10	Tighten lock screws equally. Do not over-tighten but do ensure that the sensor is fully pressed down onto the pipe.	 **Figure 21. Inserting sensors into rail (V Mode)**
11	That completes the sensor mounting in V mode, you are ready to measure the flow.	 **Figure 22. V mode sensor installation complete.**

2.1.7.3CLAMPING THE SENSORS IN Z MODE.

1-3	Choose site location, measure circumference and pipe wall	As V mode
4	Clamp on first block – use level to get in horizontal plane.	 **Figure 23. Z Mode, using the bubble level.**
5	Use tape to get opposite position.	 **Figure 24. Z mode setup, using tape measure.**

6	Enter pipe parameters in site details in flowmeter menu 2 to show separation.	 **Figure 25. Flowmeter separation in Z mode.**
7	Measure along this separation on opposite side of the pipe.	 **Figure 26. Using the tape to mark separation in Z mode.**

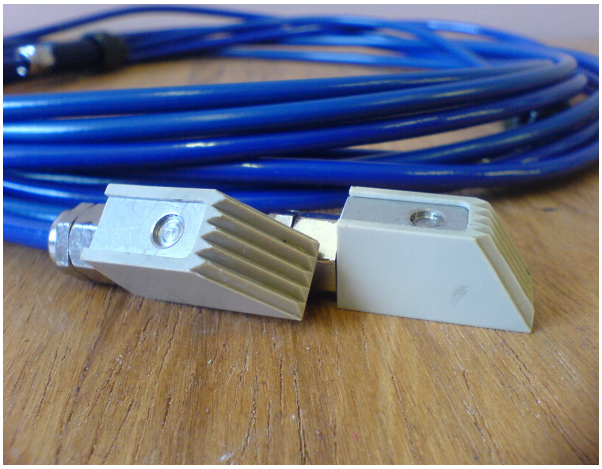
8	Attach second transducer using bubble level to ensure the second sensor is also in the horizontal plane.	 **Figure 27. Alignment blocks clamped to pipe, Z mode.**

9	Insert sensors (as V mode) and you are ready to measure the flow.	 **Figure 28. Z mode sensor installation complete.**

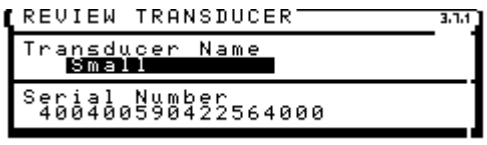
2.1.8 SMALL SENSORS.

The small transducers are intended for use on pipes from 15 – 150 mm (150 mm is approximate, it depends very much on pipe and fluid condition). Due to their small size and higher operating frequency they are good for use on small pipes, with low flows. They will not, however have as much signal strength as the larger standard sensors, so on the larger pipe the signal strength may be low. As a guide, a 100 mm mild steel pipe, in good condition will give good signal levels. These sensors work well in both Z and V mode only. If there is insufficient signal in V mode switch to Z mode.

Make sure that the type/serial number is 400400590422564000. The new sensors can be identified from the picture below. **<A label should be printed on the side of the sensor>**



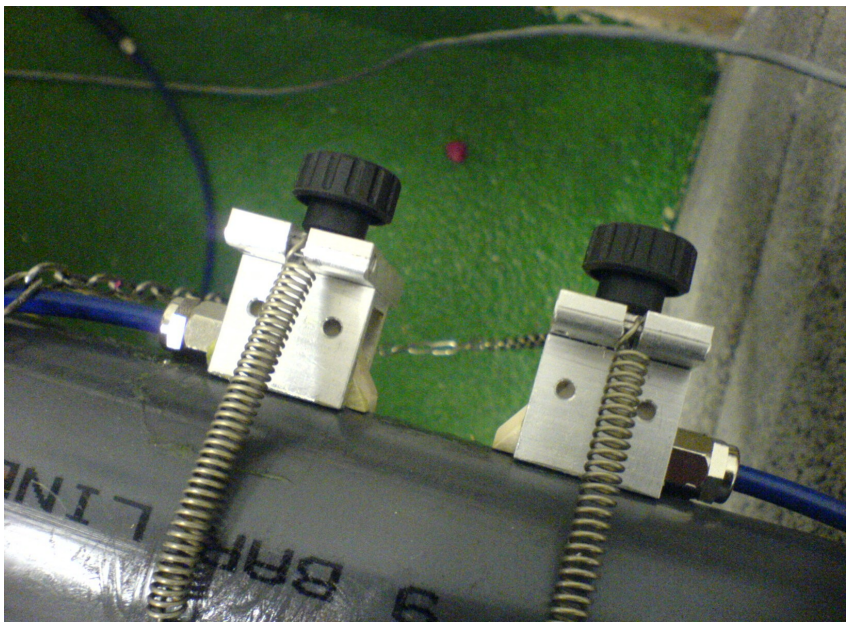
The Type/Serial Number for these MUST be entered in menu 3.7.



The clamp has a simple spring mechanism and should be applied to the pipe as shown below.

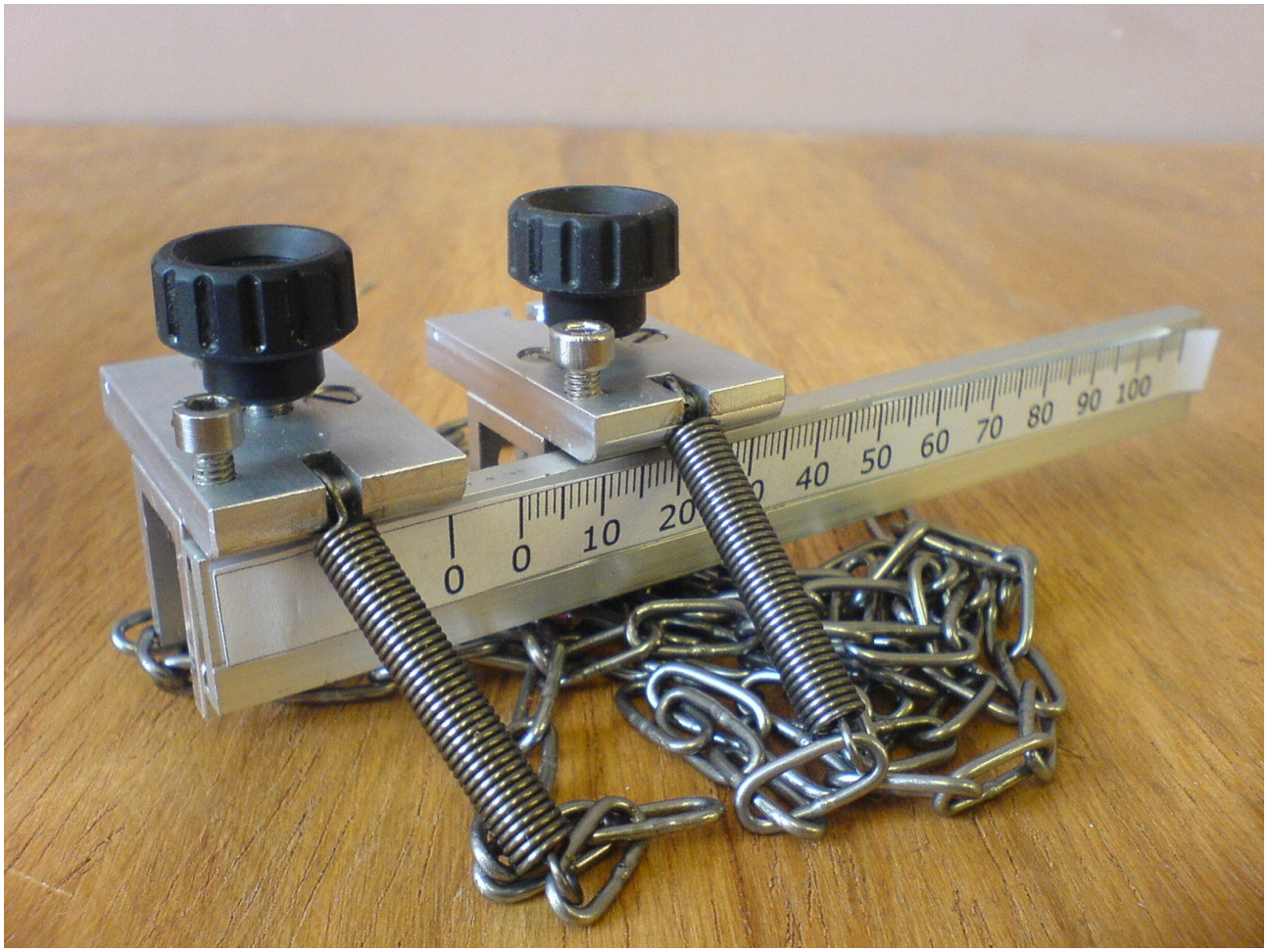
When you wrap the chain around a pipe, apply enough force to extend the spring a few chain links. The chain will locate in the top of the fixture block.

With the sensors installed, the fixtures look like this (V mode).



Note that the alignment rail and ruler is not shown here. The sensors can be used with or without the use of the alignment rail, in V mode, and the alignment rail is not used in Z mode.

View of mini rail with rule.



2.1.9MAGNETIC CLAMPS

If the pipe is magnetic (i.e. mild steel, cast iron, ductile iron) then it is possible to use the optional magnetic mounting blocks, in either Z or V modes. A Z mode installation is described here. The procedure is the same for V mode, but the two blocks are fitted to the same side of the pipe. The bubble level is essential for getting the sensors in the horizontal plane.

- Clean the pipe and remove any paint, dirt or corrosion from the area in which the transducers and the magnetic clamp will touch the pipe.
- An uneven surface will cause signal loss and reduce the magnetic clamping force.
- Avoid any weld seams on the pipe that could interfere with the ultrasonic beam. Although weld seams are on the inside of the pipe, it is usually possible to see where they are from the outside of the pipe.

- Each magnetic mounting block has a switch that turns the magnet on and off. Take the first block, and switch the magnet to the OFF position; this will be the Upstream Block. Place the block against the

side of the pipe, with the switch pointing downstream. The base of the block is grooved to ensure that it will automatically align along the length of the pipe.

- Use the bubble level supplied to position the block so that it is in the horizontal plane.

Figure 29. Sensor Installation – Magnetic clamp.

- When the block is correctly positioned with the level horizontal, turn the magnet switch ON so that the magnet clamps to the pipe.

- Pass the tape measure around the circumference of the pipe, making a note of the circumference (in order to allow calculation of the diameter). Slide the tape along the pipe so that it passes through the small gap between the block and the pipe, as illustrated. This point is the zero for measuring the transducer separation.

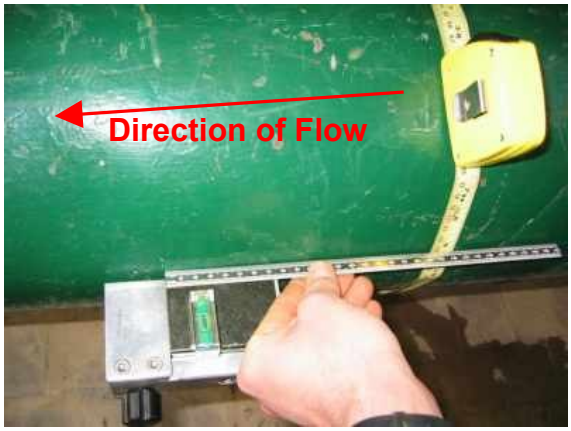
- Pull the tape together so that it is tight around the pipe.

Figure 30. Sensor Installation – Using a tape to get opposite position on pipe.

- Make a mark on the opposite side of the pipe to this transducer, using the tape as a guide to get the opposite point.

- Set up the pipe dimensions in flowmeter menu 2.2. Select Set up Summary (menu 7) to show the transducer separation.

- Measure the transducer separation distance along the pipe, downstream from the tape measure or mark. This indicates the required position for the second transducer block.



- Take the second magnetic block (the Downstream Block), and position it on the pipe with the magnetic switch pointing Upstream. It should be placed so that the far edge of the magnet is at the transducer separation distance, as illustrated. **Use the bubble level to ensure that the block is horizontal** and switch the magnet on.

Figure 31. Sensor Installation – Measuring position of the second magnetic block (Z Mode).

- Apply couplant to the sensors and slide them into the mounting blocks as far as they will go.

- Tighten the screws on the magnetic blocks, such that the transducers are fixed securely against the pipe, but not so tightly that they begin to lift the magnetic blocks from the pipe wall.

- You are now ready to measure flow. Select measure flow from the flowmeter menu and wait for the meter to set itself up and measure the flow.

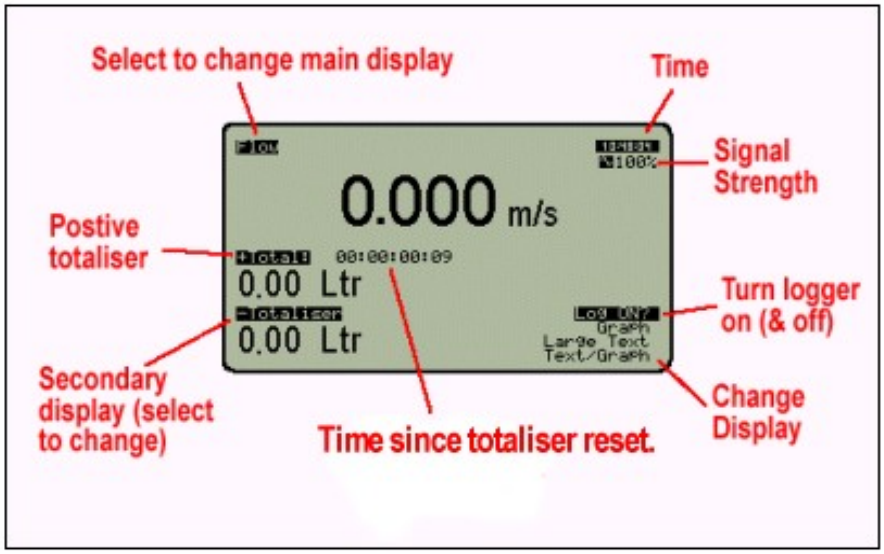
2.2 THICKNESS GAUGE

The thickness gauge is used to measure the pipe wall thickness. Connect the gauge to the correct connector as shown 2.1.5. The thickness gauge has two sensors in it, and it is important that a signal can travel between them, therefore, you must use couplant and apply FIRM pressure to hold it securely onto the pipe.

Figure 32. Thickness Gauge showing correct orientation on pipe.

The thickness gauge menu is found in Site Setup.

Wall Thickness 2.84 mm	• **Make sure the pipe material has been correctly entered in Site Details (2.7.2 manual, menu 2.2 flowmeter).** • The range of the gauge is between 2 and 25 mm. • 'Signal !' means that the transducer has not got a good. • Make a note of the value and input it into the site details (menu 2.2)



2.3 THE FLOW MEASUREMENT SCREEN

The flow measurement screen is displayed after pressing '1. Measure Flow'.

You can control several important functions from the flow measurement screen.

Figure 33. The main flow measurement screen.

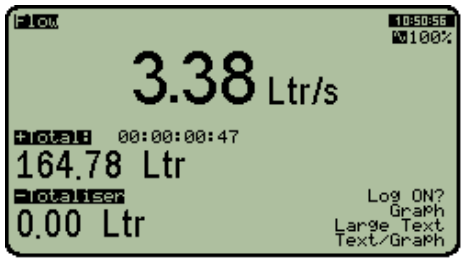
2.4 INPUT CONTROL

When the flow measurement starts, notice a flashing cursor over the LOG ON? The up and down arrow keys move the cursor around the screen and certain functions of the meter can be adjusted directly from this screen. For example pressing Enter, with the flashing cursor over LOG ON? enables logging (the text changes to LOG OFF?) and a logging symbol is displayed.

2.5 MAIN DISPLAY - ADJUSTABLE PARAMETERS

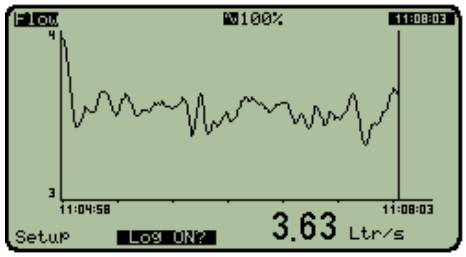
Main Display Reading	In the illustration above, the main display shows flow speed, in m/s. This can be changed to any of the available parameters by moving the flashing cursor to the top left corner of the screen (Flow) and pressing Enter.
Time	Time is displayed on the screen.
Signal Strength	Signal quality is always displayed as a percentage. A perfect signal is 100%. The meter will function accurately down to a signal strength of approximately 30 - 35% and will show an error if the signal is less than this.
LOG ON? / LOG OFF?	This item switches the logger on and off. Log ON? means that logging is currently OFF, and you are being asked if you would like to turn it ON. When the logger is on a LOGGING symbol is displayed next to the time. If the log becomes full, LOG FULL is displayed.
Change Display	As well as the main display, other options are a graph screen, a large text screen and a text / graph screen, all illustrated on the next page.

Standard Flow Measurement Screen



- This is the normal display, showing flow, totaliser, secondary reading, the time and the signal strength.

Graph Screen

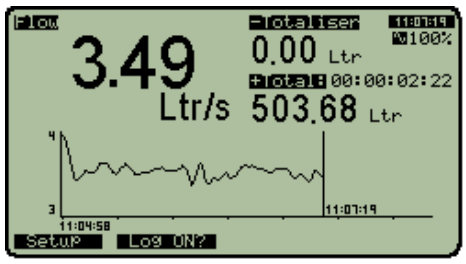


- Time is shown along the X-axis and the measurement selected is plotted on the Y-axis. Setup (F1) is used to adjust the X and Y-axis values. The start time is displayed and as the graph scrolls to the right, the real time is displayed. The elapsed time is displayed on the left and the real time is on the right.
- In this mode, F2 switches the logger on and off.

Large Text Screen.

- This is used to read the display from a distance.

Graph / Text Screen



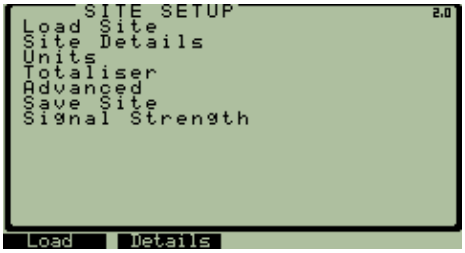
- View everything and show flow trends.

2.6MENU 1 – MAIN MENU

- **Measure Flow** – Measure Flow now
- **Site Setup** – Enter site parameters
- **System Setup** – Your meter preferences
- **Data Management** – File and Logging options
- **Diagnostics** – Advanced functions
- **Charge Battery** – Charge battery
- **Setup Summary** – View important settings

Before measuring flow, the site details have to be correctly entered. This is done in menu 2, Site Setup.

2.7 MENU 2 – SITE SETUP

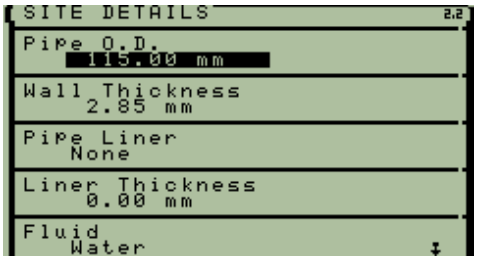


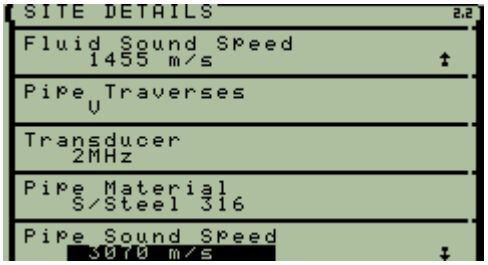
- **Load Site** – Recall stored sites
- **Site Details** – Enter details of current site
- **Units** – Select the flow units for this site
- **Totaliser** – Set up the flow totaliser function
- **Save Site** – Store site details
- **Signal Strength** – Signal Quality Check.

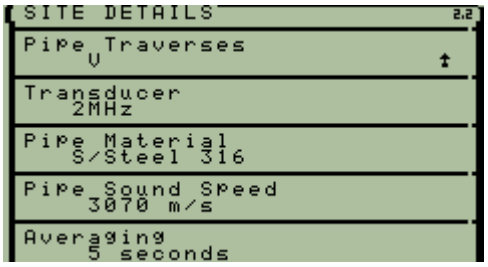
2.7.1 MENU 2.1 – LOAD SITE.

- If a site has been saved in menu 2.6, then it can be loaded.

2.7.2 MENU 2.2 – SITE DETAILS







- **Pipe O.D.** – Enter pipe outside diameter.
- **Wall thickness** – Enter wall thickness.
- **Pipe Liner** – Select material of Liner from a list*.
- **Liner Thickness** – Enter Liner thickness or None
- **Fluid** – Select the fluid from a list*
- **Fluid Sound Speed** – No need to input anything.
- **Pipe Traverses** – Select Z, V or W** mode.
- **Transducer** – Select transducer from list***
- **Pipe Material** – Select Pipe Material from a list*
- **Pipe Sound Speed** - No need to input anything.
- **Averaging** - The data display will always update at a 1 second interval. However, each updated value is an average of the last 'n' readings, as set here (5 in this example). This acts as a filter on noisy data – the higher the averaging period the less noisy the data. Minimum is 1 second, where every reading is displayed with no averaging. Features intelligent start-up, so the first few readings are correctly averaged until the first averaging period is complete.

* Pressing Enter displays a list of materials or fluids from which to make a selection.

** The meter can measure flow using three ultrasonic beam configurations:
'Z' Sensors are clamped on opposite sides of a pipe. Used mainly pipes greater than about 600mm Ø.
'V' Sensors are clamped onto the same side of the pipe. Used for pipe from 15 to about 600mm Ø.
'W' A double V bounce. Not recommended.

V mode is the preferred mode as it gives good timing resolution and it is easy to use the rail with both sensors on the same side of the pipe. If a weak signal is detected in V mode then change to Z mode and reposition the sensors accordingly. W mode is not generally used with small or standard sensors.

*** Transducers are defined in the table below.

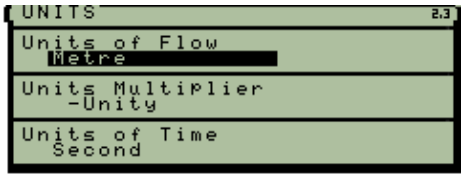
Transducer	Approx. Pipe Diameter (mm)	Frequency (MHz)	Sensor Code Number
Normal (1MHz)	50 – 2000	1	100351230932564000
Small (4MHz)	15 – 75 (approximately)	4	400370590422564000
Custom (?MHz)	Refer to Sensor Label	Refer to Sensor Label	Refer to Sensor Label

All sensors are supplied with a code number on them, on the label on top of the sensor.
This 18 digit number contains important information about the sensor.

The meter must have the correct sensor code number for correct operation.

Custom sensors have a custom code that must be entered and selected at set-up.

2.7.3MENU 2.3 – UNITS.



- Units of Flow – Select from a list[1]
- Units of Multiplier – Select from a list[2]
- Units of time – Select from a list[3]

[1] Metre, Litre, Cubic Metre, U.S. Gallon, Imperial Gallon, Million Litres, Million Cubic Metres, Million U.S. Gallons, Million Imperial Gallons, Feet, User1, User 2 and User 3.

[2] The multiplier enables the user to select the unit multiplier. For example if you wanted to measure every one hundred litres, then selecting the multiplier to be hundreds (h) would display 1 hLtr = 100 Litres.

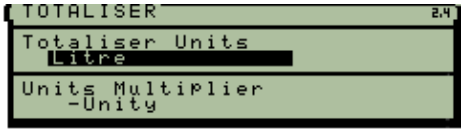
Example flow rate = 1 Litre.

Unit Multiplier	Label	Real Quantity = Displayed Value
Unity	-	1Ltr = 1Ltr
Thousandths	m	1Ltr = 1000 mLtr
Hundredths	c	1Ltr = 100 cLtr
Hundreds	H	1Ltr = 0.01 HLtr
Millions	M	1Ltr = 0.000001MLtr

The multiplier should be left as Unity, but sometimes multipliers are useful for high and low flows.

[3] Units of time can be selected from Seconds, Minutes, Hours and Days.

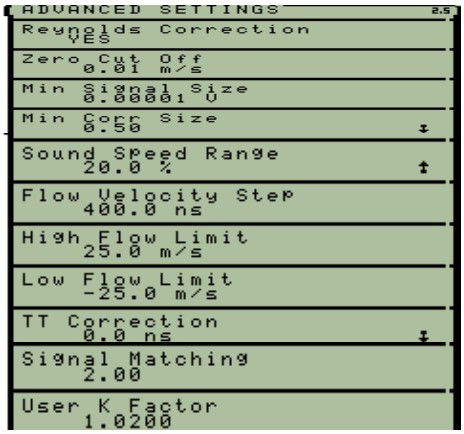
2.7.4MENU 2.4 – TOTALISER



- Totaliser Units
- Multiplier Units

The totaliser and totaliser multiplier units do not have to be equal to the flow and flow multiplier units.

2.8MENU 2.5 – ADVANCED SETTINGS



Reynolds Correction Almost all fluids are 'Newtonian' (including water and all petrochemicals). Unless it is specifically known that the fluid is not Newtonian, leave this set to YES.

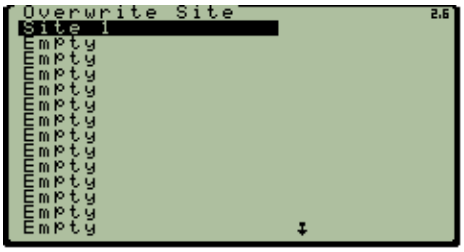
Zero Cut Off A very small flow rate, below the flowmeter accuracy can be forced to zero.

TT Correction Transit Time correction. Sometimes a small bias error may occur. When the flow can be stopped, then this small offset value can be removed. Go to the main flow measurement screen to set the display parameter to "Time Diff" (this means time difference). This displays the time difference of an ultrasonic transmission with the flow (from upstream to downstream sensor) and against the flow in nano seconds (1x10^-9 seconds). At zero flow, it should read 0.0, but if it does not, then make a note of the value, and enter it into the TT correction box under this menu. Note, if the value reads –0.7 then enter –0.7.

User K Factor This is a multiplier adjustment of the measured flow value, which may be used to adjust the instrument performance against a calibration standard. It should not be altered under normal circumstances, as the flowmeter will have had a calibration check when it was originally delivered. This value is displayed on the calibration certificate. Please note that the performance of the instrument will vary under different installation conditions.

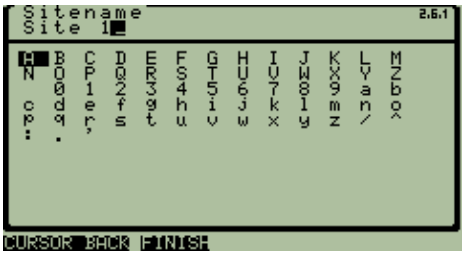
Signal Matching, Min Signal size, Min Corr Size, Sound Speed Range, Flow Velocity Step, High Flow Limit & Low Flow Limit set error levels that define the normal characteristics of the meter. **DO NOT ADJUST** unless under the specific guidance of the manufacturer.

2.9MENU 2.6 – SAVE SITE



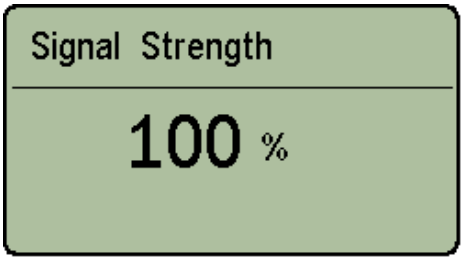
- Up to 16 sites can be saved.

2.9.1MENU 2.6.1 – SITENAME



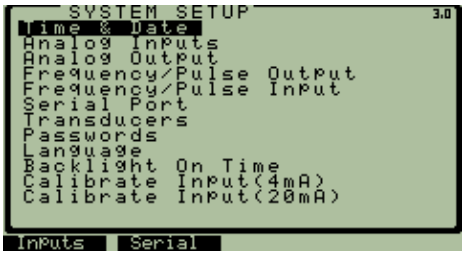
- Press the F1 key to move the upper cursor back to the left. Use the arrow keys to move the lower cursor to the required characters, and press Enter. When all characters have been entered, press F2 to save the new name.
- This is the standard method of entering text into the meter.

2.10MENU 2.7 – SIGNAL STRENGTH



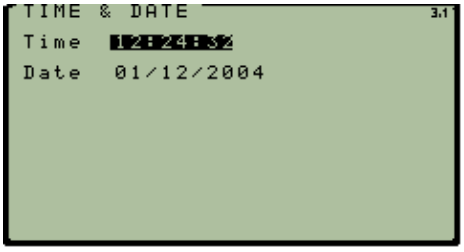
- Good Signal = 60 – 100%
- OK Signal = 40 – 60 %
- Bad = less than 35%. Meter may not work.
- Check; setup, re-apply couplant and restart the measure flow screen.
- Move the sensors to a new location as a weld seam or very bad section of pipe may have been found.

2.11MENU 3 – SYSTEM SETUP



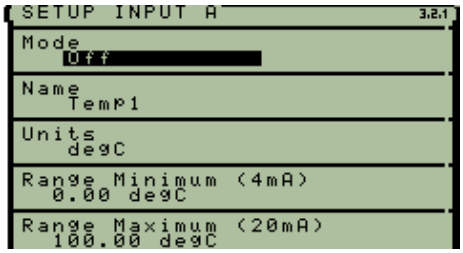
- Current IO;
  2 x 4-20mA Inputs,
  1 x 4-20mA Output.
- Open Collector IO;
  2 x Frequency / Pulse outputs
  2 x Frequency / Pulse inputs.
- Data is also output via a serial port.

2.11.1MENU 3.1 – TIME AND DATE



- Select Time or Date and press Enter to Edit. Then use the Left / Right arrow keys to move the cursor, and Up / Down arrows to edit each digit.

2.11.2MENU 3.2 – SETUP ANALOG INPUTS



Mode Enter Key switches between **Off / Temp / Other**. If you are not using the inputs then save power by setting to "Off". **Temp** is for temperature sensor inputs and **Other** is intended for any other input devices.

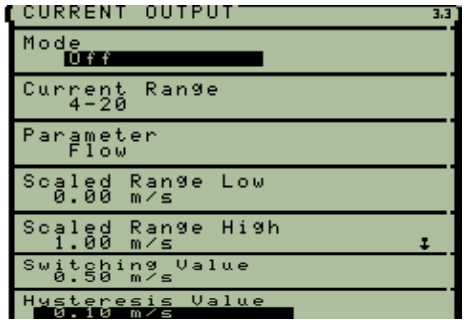
Name Press Enter to enter a name (if required), using the method described in menu 2.6.1.

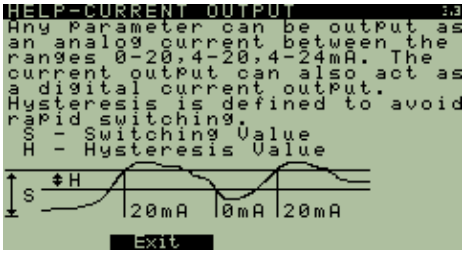
Units Press Enter to define units using the method described in Section 2.6.1. In Temp mode, Units = degC by default.

Range Minimum Enter the 4mA value for the current transmitter.

Range Maximum Enter the 20mA value for the current transmitter.

2.11.3MENU 3.3 – CURRENT OUTPUT

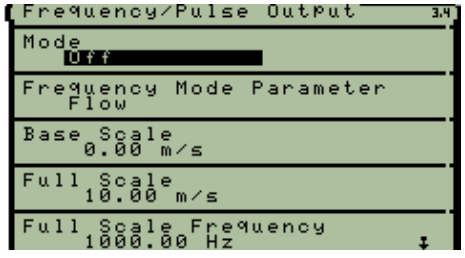


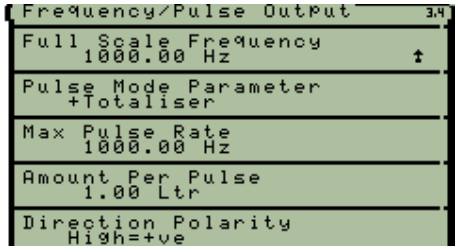


Mode	Enter key toggles between **Off / Scaled / Switched**.
Current Range	Enter key toggles between **4–20 / 0-20 / 4-24**
Parameter	Press Enter to select any of the measured parameters
Scaled Range Low	Parameter value for minimum current (Scaled Mode)
Scaled Range High	Parameter value for maximum current (Scaled Mode)
Switching Value	Parameter value at which the current output is switched (to high if rising, to low if falling) – please refer to “Help” illustration
Hysteresis Value	A “dead” zone below the switching value, within which the output will not immediately switch back. This prevents rapid switching of the output around the switching value. A value of around 10% of the switching value is suggested.

2.11.4MENU 3.4 – FREQUENCY / PULSE OUTPUT

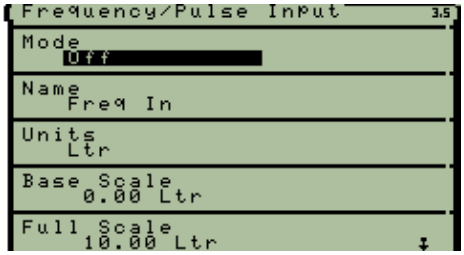
- The meter has two dedicated pulse or frequency outputs. One is used for rate output and the other is used for direction.

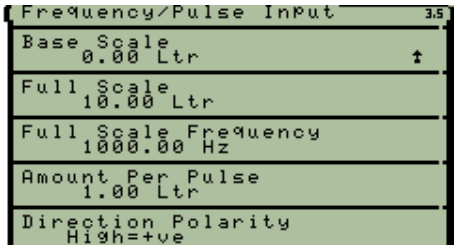




Mode	Switches between **Off / Frequency / Pulse**. Set to “Off” to conserve power if not required.
Frequency Mode Parameter	Defines which measurement is output (for example Flow).
Base Scale	Minimum measurement value
Full Scale	Maximum measurement value
Full Scale Frequency	Maximum Frequency you require the full-scale value to output.
Pulse Mode Parameter	Defines which measurement is output (for example Flow)
Max. Pulse Rate	Maximum pulse rate you require the full-scale value to output.
Amount per pulse	e.g. one pulse every ten litres.
Direction Polarity	This is used to set-up the flow direction output. Choose high or low for positive flow.

2.11.5MENU 3.5 – FREQUENCY / PULSE INPUT

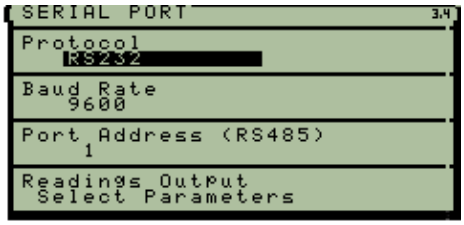




- The meter has one dedicated pulse or frequency input.

Mode	Toggles between Off / Frequency / Pulse. Set to "Off" to conserve power if not required.
Name	Enter the desired name for the Input
Units	Enter name of the input units.
Parameter	output (for example Flow).
Base Scale	Minimum measurement value
Full Scale	Maximum measurement value
Full Scale Frequency	Maximum Frequency you require the full-scale value to output.
Amount per pulse	e.g. one pulse every ten litres.
Direction Polarity	This is used to set-up the flow direction input. Choose high or low for positive flow.

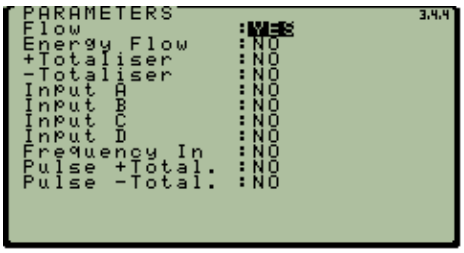
2.11.6MENU 3.6 – SERIAL PORT



- The meter has RS232 and RS485 Serial communications. Data files can easily be output to a PC using Windows Hyperterminal. Refer to Section 7 for further details of how to use this program.

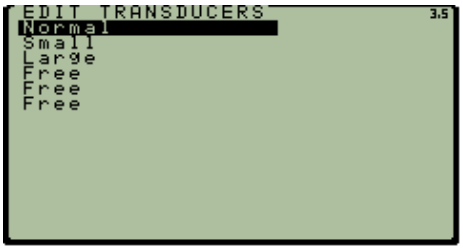
Protocol	Toggles between RS232 / RS485 / Off. (Set to *Off when not in use to conserve battery life).*
Baud Rate	Select from; 2400/4800/9600/19200/38400/57600
Port Address	Select from 1 to 99 (RS485 only).
Readings Output	Press Enter to go to the Output Parameters menu detailed below.
Other Details	Parity None, Data Bits 8, Stop Bits 1, Flow Control None.

2.11.6.1MENU 3.6.2 – OUTPUT PARAMETERS



- Choose which parameters are required to be output on the serial port. Enable or disable each parameter in turn. Multiple parameters are tab separated, and each line of data is terminated with <cr><lf>.

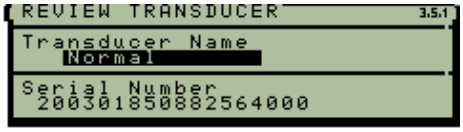
2.11.7MENU 3.7 – EDIT TRANSDUCERS



The correct transducer must be selected. The details for the two standard transducers are stored in the meter.

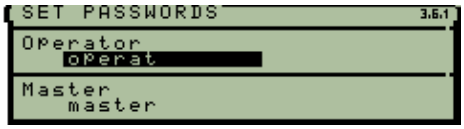
It is possible for the meter to store information for four more transducers. All sensors have a code number printed on them that contains detailed information about the sensor configuration. It is essential that the correct information for the required transducer is stored in the unit.

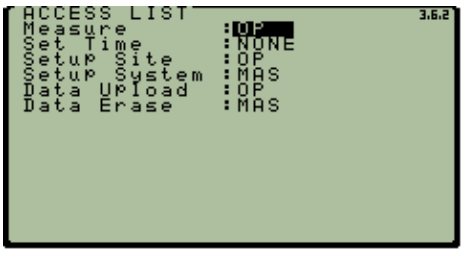
2.11.7.1MENU 3.7.1 – REVIEW TRANSDUCERS



- Pressing Enter in the Transducer Screen allows access to the transducer information page. The default code numbers for the standard transducer options are as follows:
- Small (4MHz) 400400590422564000
- Standard (1MHz) 100351230932564000

2.11.8MENU 3.8 – PASSWORDS





- For security the instrument has password protection for various parts of the menu. There are three password levels: Master, Operator and None.

Set Passwords The Set passwords page allows an alphanumeric password to be set for both Operator and Master functions.

Access List Defines which menus and functions are available to each password level. Use the arrows and the Enter key to switch each value through OP (Operator), MAS (Master) and NONE. If password protection is not required for a particular function, simply set it to “NONE”.

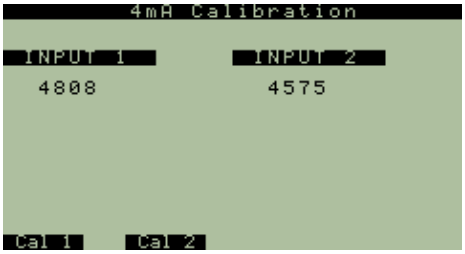
2.11.9MENU 3.9 – LANGUAGES

- Use the Up and Down arrows to select the required operating language.
- Only French, English and Turkish implemented *(as at 28/10/2005).*

2.11.10MENU 3.10 – BACKLIGHT ON TIME

- Select Backlight on time. The backlight increases the power consumption. It can be set to switch off after a period of time. Select Continuous to leave the backlight on until it is manually switched off.

2.11.11MENU 3.11 – CALIBRATE INPUT



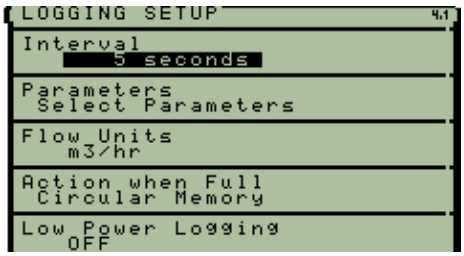
- Connect the 4-20 mA device and set it to output 4mA. The value is displayed on the meter. Press the F1 key to set the range minimum to this value for Input 1. Press the F2 key to set the value for Input 2
- Note that a similar procedure is required to set the 20mA level for each Input.

  Check that the value on the screen varies as the current input changes. For example, with a temperature sensor, raise the temperature and ensure that the value also rises. See Sections 4 & 8 for wiring details.

2.12 MENU 4 – DATA MANAGEMENT

- Logging, file and memory management menu.

2.12.1 MENU 4.1 – LOGGING SETUP



Interval Log a data point at this interval. Note that the device will log the averaged data values of the selected parameters at each interval

Parameters Select which measured values the instrument should log at each point.

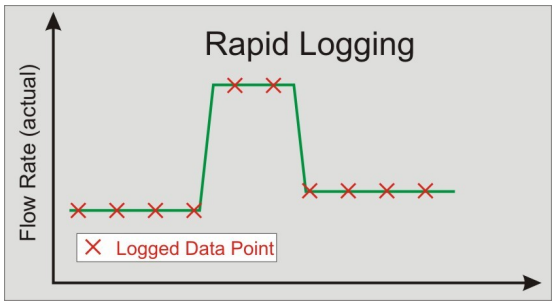
Flow Units Select the units in which to log flow. This may be different to the displayed units if necessary.

Action when Full The meter will perform one of three actions when the memory is full:

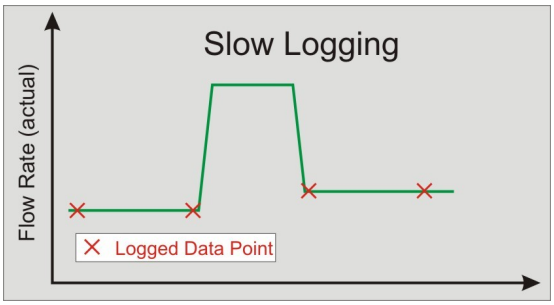
- *Circular Memory: the device will continue to log, overwriting the oldest data.*
- *Stop & Prompt the device will cease operating and will await action from the user.*
- *Run without Log the device will continue to display and output data, but no new data will be stored.*

Low Power Logging Turns the display off for very low power logging. Pressing any key reactivates the display. See Overleaf.

When choosing a logging interval, it is important to get the right balance between recording enough data to accurately represent the variations in the flow, and ensuring that the memory lasts for sufficient time. Using the Graph Display (see Section 2.7) before you start logging may give you an indication of the variation that may be encountered. Here are examples of two different logging setups measuring the same flow:



If there is a Rapid logging interval, you will record most peak events in the flow, but the memory will fill up quickly.



If there is a Slow logging interval, the memory will last for longer, but there is a risk that certain events may be missed.

Figure 34. Logging Sampling Rate.

2.12.2LOW POWER LOGGING

The flowmeter has been designed to make efficient use of the battery; under normal conditions (with the backlight off) it will last for over 6 days, 24 hours a day. However, the device also features a Low Power Logging mode, where this total logging time can be further extended. By using this mode, and also by turning off other unnecessary functions such as the analog data output, the battery capacity can be extended to a maximum of 25 - 30 days. Note that in such long-term scenarios it is also necessary to select a suitable logging regime; there is little point in the device working for 30 days if the memory is full after 5 days.

Logging Mode (no backlight)	**Max. Logging Interval (Logging Date/time & Flow only)**	**Estimated Battery Life (minimum).**
Normal	1 Sample every 20 Seconds	6 Days
Low Power	1 Sample every 100 Seconds	25 Days

In normal logging mode the battery lasts for 6 days therefore the most you can log is once every 20 seconds to fill the memory in 6 days.

1) Fully charge the battery for up to 18 hours.
2) Ensure that the backlight is turned off.
3) If a serial data output is not required during operation, switch off the Serial Port (Refer to Menu 3.6 and set: **Protocol = Off**).
4) Switch off any unused analog or frequency inputs and outputs (Refer to Menus 3.2, 3.3, 3.4 & 3.5, and set **Mode = Off** for each).
5) Set the required logging regime (Refer to Menu 4.1), ensuring that only the required parameters are logged, and that a suitable logging interval is chosen. Use Menu 4.5 to check the memory capacity with the current settings.
6) Switch Low Power Logging to **On** (Refer to Menu 4.1).
7) Return to the Main Menu, and install the system as normal (Refer to the Section 2 of this manual).
8) Start measuring flow.
9) When measurement begins, press '**Log ON?**' to turn the logging on. The meter will display instantaneous data readings as normal, until the first data point has been logged; this will not occur until one logging interval has elapsed (Menu 4.1). As soon as the first logging interval has passed, the device will enter Low Power Mode, and the screen will turn off. The device will continue to operate and log data.
10) To restore the flowmeter display, press any key (except the Enter or Off key).
11) When the screen is restored, the device will still be logging in low power mode. To stop the logging select **Log OFF?** If you do not stop logging, the meter will remain in low power logging mode, and the screen will switch off after one further logging period. This feature is useful if you want to check the flow rate without stopping the logging.
12) When you have completed your flow survey, remember to switch low power logging off in menu 4.1, and restore the serial port protocol in Menu 3.6 (this is necessary to allow data extraction).

13) Extract your data as described in Menus 4.3 and 4.5, referring to Section 7 of this manual if necessary.

Note that all recorded data is safe in the event of the battery running flat.

Flowmeter Low Power Logging Times. Number in DAYS (24 hours continuous).

		Logging Interval in Minutes [Li]									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Number of measure-ments per sample [Ms].	**1**	28	30	31	31	32	32	32	32	32	32
	2	24	28	29	30	31	31	31	31	32	32
	3	22	26	28	29	30	30	31	31	31	31
	4	19	24	27	28	29	29	30	30	30	31
	5	18	23	26	27	28	29	29	30	30	30
	6	16	22	24	26	27	28	29	29	29	30
	7	15	21	23	25	26	27	28	29	29	29
	8	14	19	23	24	26	27	27	28	28	29
	9	13	19	22	24	25	26	27	28	28	28
	10	12	18	21	23	24	26	26	27	28	28

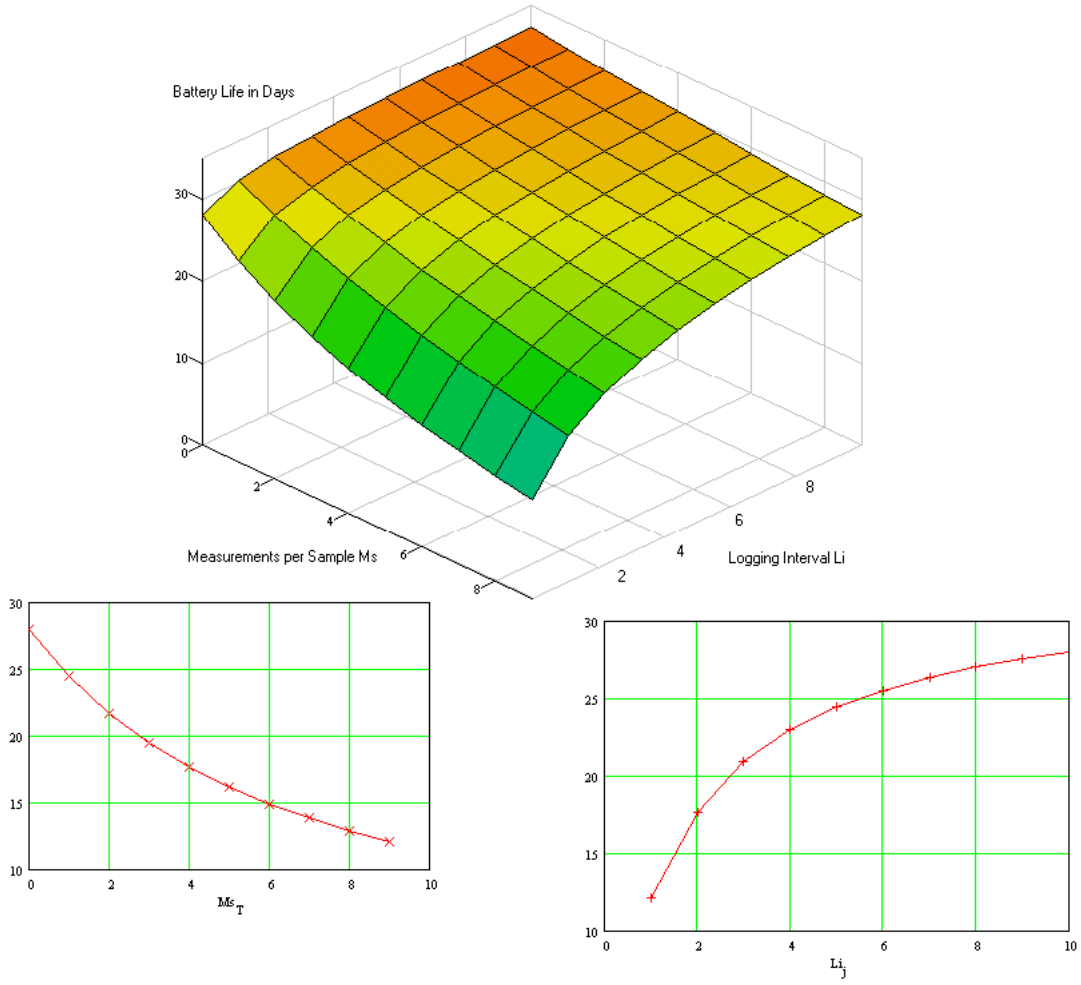


Figure 35. Battery Life in low power mode.

Explanation.

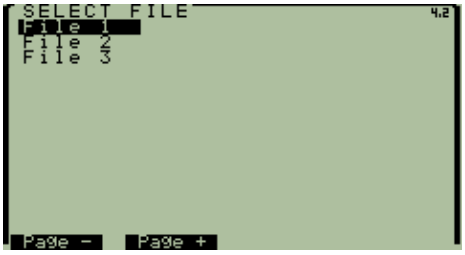
This plot is based on the table. The lower left figure plots Number of Measurements per sample (Ms) versus battery life in Days. The lower right figure plots Logging interval in Seconds, versus battery life in Days. The surface plot shows the situation when the two variables are combined.

Notes.

These values are for all input/output and display off.
The 4-20mA output does have a large effect on the logging times. The device is not designed to use the input/outputs in low power mode. It will have a similar battery life to when using the device in normal mode (6 days backlight off).

Make sure that you check memory available as this page is referring to battery life ONLY.

2.12.3MENU 4.2 – SELECT FILES

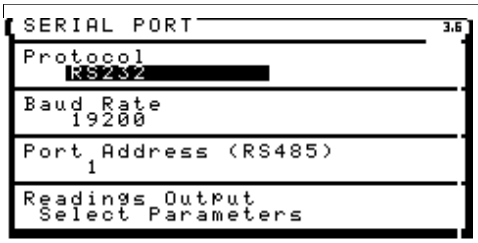


- Select logged data files from the list

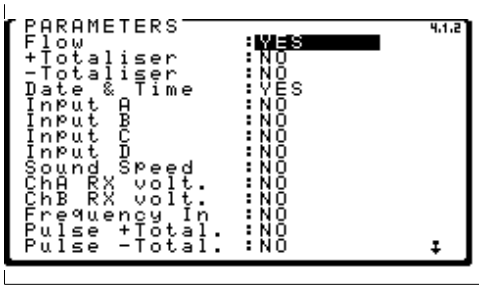
2.12.4MENU 4.2.1 – FILE RECORD

- Details of the saved file are displayed.

2.12.5MENU 4.3 – UPLOAD FILE (HYDREKA WINFLUID® FORMAT)



- The baud rate must be set at 19 200 on the flowmeter.



- In the Menu 4.1.2 :

Data Management / Logging setup / Parameters

Select the parameters « Flow » and « Date & Time » on « YES ». The other parameters are not yet working with Winfluid.

From the software Winfluid, select the Menu "Logger/Upload", in the section "Logger" select "ChronoFLO", in the section "Connection" , select "local", in the section "Port" select the Laptop serial port number on which the ChronoFLO is connected, then click on "Connect".

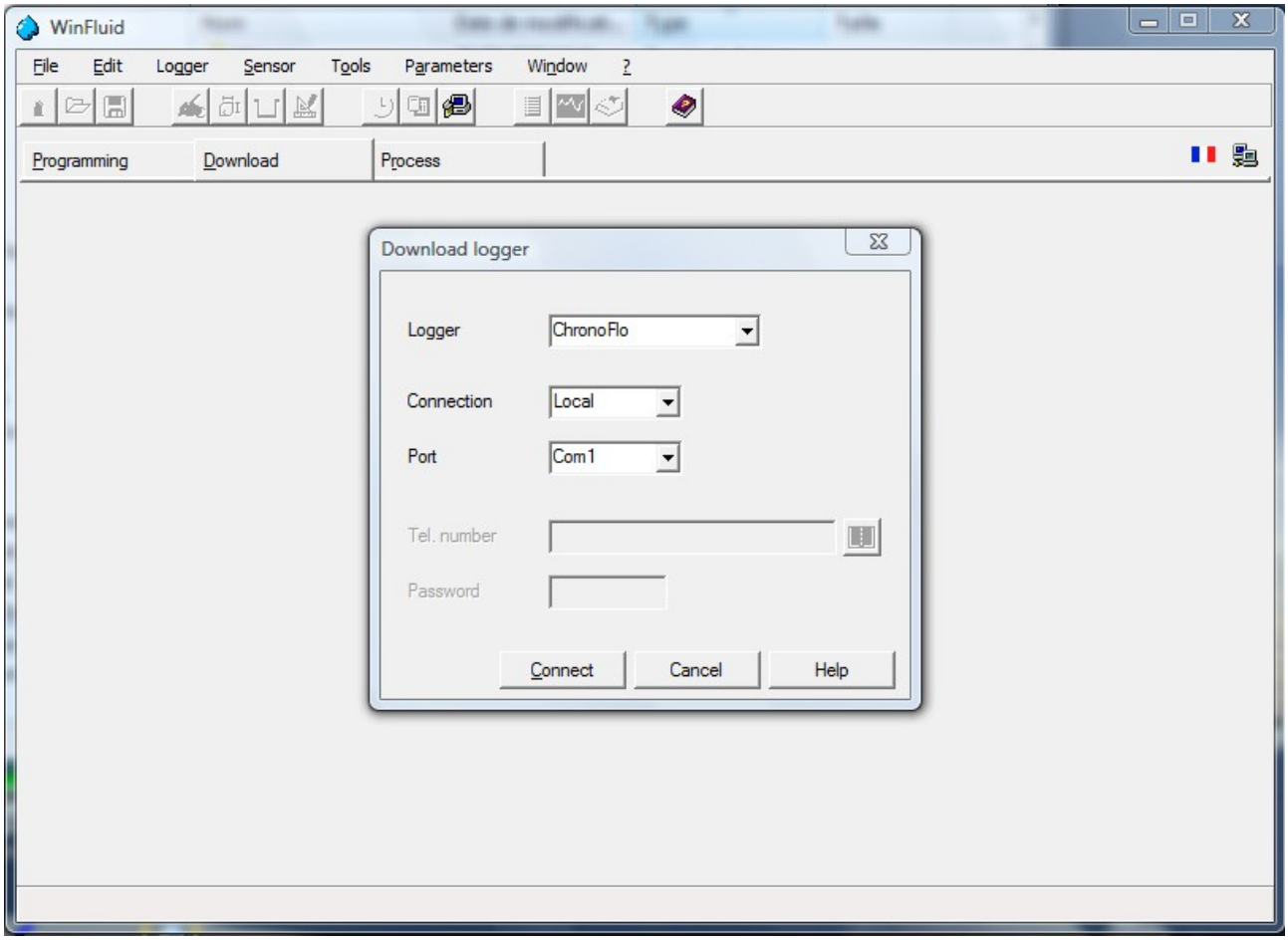


Figure 36. Winfluid Settings.

When the screen below is displayed select the file on the flow meter.

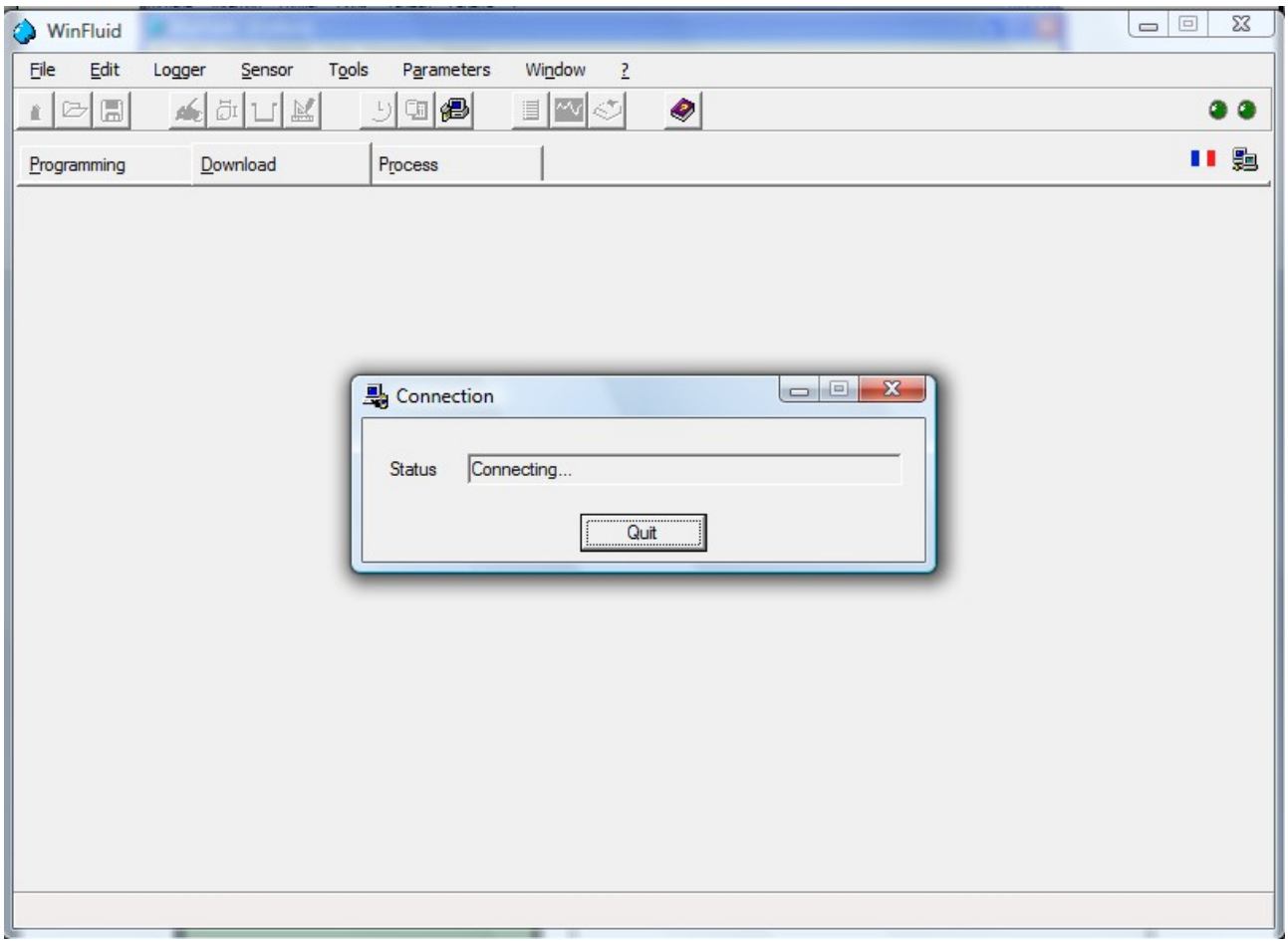
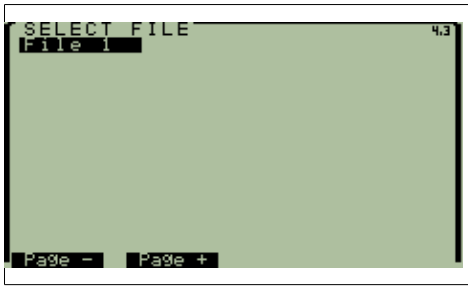


Figure 37. Winfluid Settings (continued).

	• Select the file to be downloaded and then press the key Entry to send the file into Winfluid format through the serial output

Note: users WITHOUT WINFLUID should use Menu 4.1.7 – Text file upload.

2.12.6MENU 4.4 – ERASE FILES

- Select the file to erase and then press enter.

2.12.7MENU 4.5 – MEMORY AVAILABLE

- Use this menu to see how long the 256kByte memory will last with current settings. The remaining capacity is given in terms of actual memory, % of total memory, number of records available, and time available. The format for this is Days:Hours:Mins:Seconds, for example 00:06:46:11 means that the logger has capacity to log for 0 days, 6 hours, 46 minutes and 11 seconds.

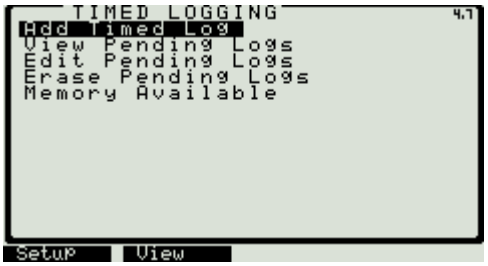
- In order to increase the logging time;
  - Increase the logging interval.
  - Log fewer parameters. Note that the start time, and logging interval are recorded at the start of each file, so the time stamp for each record can be calculated. It is therefore not necessary to log the date and time of each record.

Note that this estimation is based on memory, and not battery life. For details of how to increase logging duration based on power availability, please consult the Low Power Logging section (2.12.2).

2.12.8 MENU 4.6 – TEXT FILE UPLOAD (USE WITH WINDOWS HYPERTERMINAL).

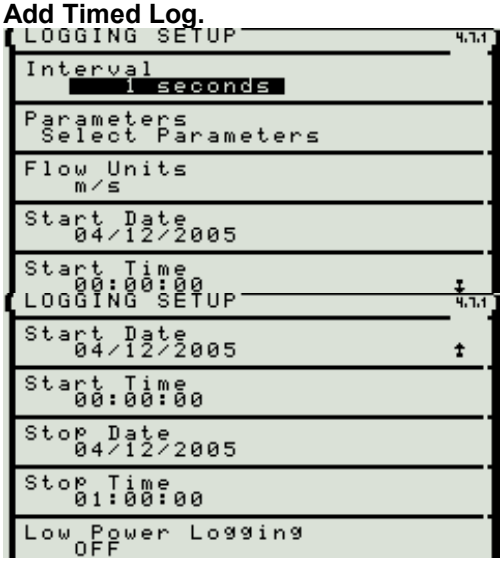
- Select the file for upload, and then pressing the Enter key to upload the file over the serial cable in ASCII text format. Refer to Section 7 for details of how to save this data to PC using Windows HyperTerminal.

2.12.9MENU 4.7 – TIMED LOGGING.



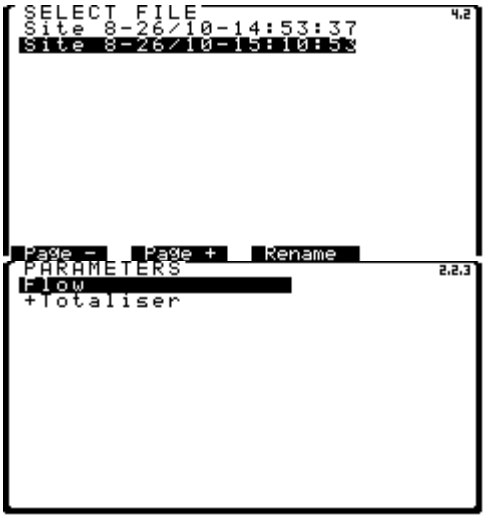
- This screen controls the log files. You can add a log, view and erase logs, as well as checking the memory space available.

Add Timed Log.



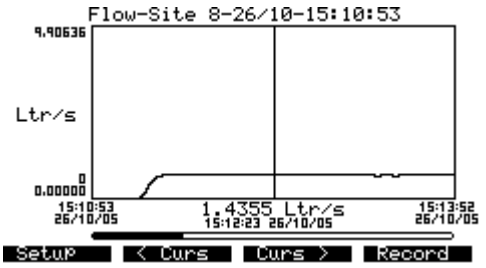
- Choose the logging interval, select parameters, the flow units, the start date and time and the stop date and time.
- Low power logging can be on or off.
- If two logging periods interfere then an error message will be displayed and the times will have to be resolved.

2.12.10MENU 4.8 – GRAPHIC DISPLAY OF THE LOGGED DATA.

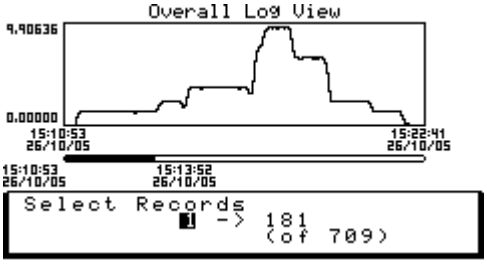


- Choose the log file to graph.

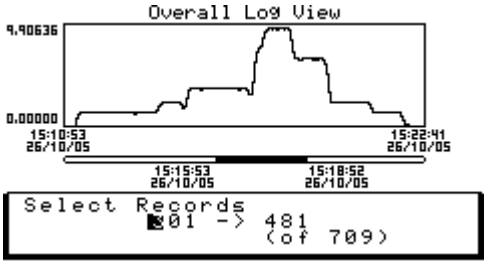
- Choose parameter from file – i.e. Flow.



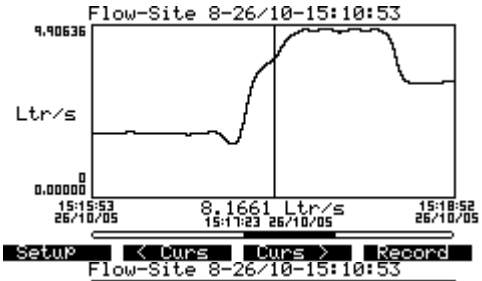
- **Detailed Log View** screen.
- Initially, the data it shows the first 180 points.
- ..Setup.. changes the Y axis and also the logged parameter viewed.
- The line in the middle of the data shows that the flow at this point was 1.4355 Ltr/s, at 15:12:23 on the 26/10/05.
- Pressing . < Curs . and . Curs > . moves the position of the line and allows you to closely examine the data.
- Notice the slider bar below the graph. The shaded area shows the position of the displayed data within the entire data log.
- Pressing the ▸ key moves to the next 180 points of data.
- Press . Record to get to next screen



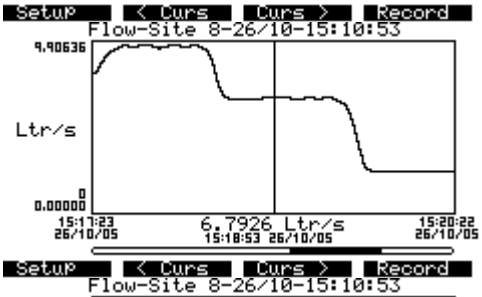
- **Overall Log View** screen.
- All the logged data is shown
- The slider bar below the graph shows the data that will displayed in the Detailed log view window.
- To move the slider bar use the ◂ ▸ ▲ ▼ keys to adjust the start value (.1 in this case) .



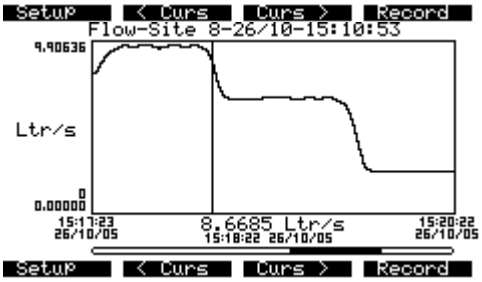
- The start record was changed to 301 and the slider has moved along.
- The corresponding times are shown next to the slider bar.
- Pressing Enter (↵ or ✓ key) or Back (- key) goes to the Detailed Log View.



- This shows the detailed view of the data.
- The graph below shows what happens when you press the ▸ key.



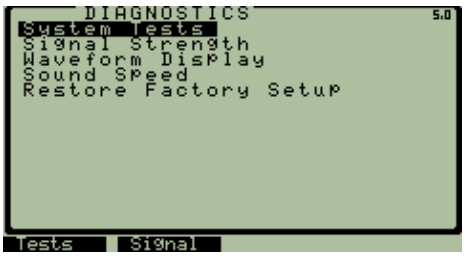
- Detailed log view showing a point value of 6.7926 Ltr/s at 15:18:53.



- Pressing F2 . < Curs . moves the vertical line to the left.
- This now shows a point value of 8.6685 Ltr/s at 15:188:22.

2.13MENU 5 – DIAGNOSTICS

- Features on this menu should only be accessed by expert users, or under guidance from the manufacturer.



System Tests.	Performs a series of internal diagnostic routines to check on instrument health.
Signal Strength	Displays the signal quality in percentage terms.
Waveform Display	Shows the ultrasonic waveform. Use the arrow keys to scroll and zoom the graph.
Sound Speed	Shows the speed of sound through the fluid, as calculated from the ultrasonic propagation time.
Restore Factory Setup	Restores all settings to factory default values.

2.14MENU 6 – BATTERY

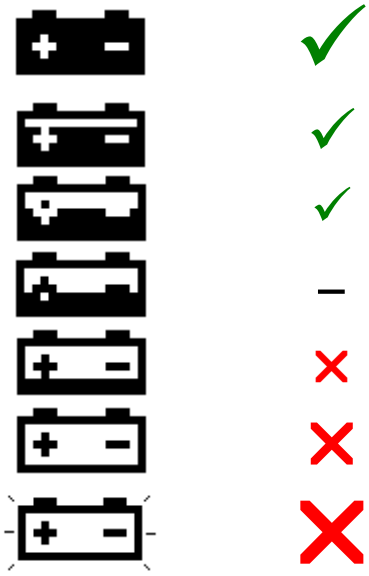
The battery capacity is very large. The battery will last for 10 hours with the back-light on continuously and about 6 days (24 hours a day) with the back light off. Therefore, when possible, switch the back-light off. Low power logging mode extends the operation time to 25 - 30 days (at normal temperatures). Please refer to section Logging set-up (4.1) for more detailed information on low power mode battery life.

A one hour charge will allow the flowmeter to operate for 9 hours, with the back-light off.

2.14.1BATTERY CHARGING.

- To charge the battery, connect the AC/DC power adapter and select “6. Charge Battery” from the main menu.
- Charging a fully discharged battery can take up to 18 hours. Charging may be stopped at any time.
- It is okay to partially charge the battery.
- The battery will only charge between 0 and 45 Celsius
- Temperature extremes may affect battery life.
- Provided the battery is recharged every three months, the battery will have a life span over 500 charge cycles.
- During charging it is normal for the power supply and the underneath of the unit to get hot.
- If the charger is restarted, after charging, the batteries may be hot and the device may not charge. This is normal.

Battery Indicator.

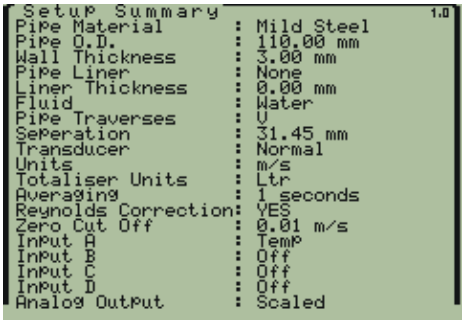


- A battery state indicator is always displayed on the screen and this shows an indication of the available charge in the battery.
- We recommend that you always charge the battery overnight, for 19 hours before extended use. This keeps the battery in peak condition, and will maximise operating times.
- Charging for just one hour will allow the flowmeter to operate, as long as the back-light off for 9 hours.

Figure 38. Battery Indicator.

The Battery must not be left uncharged for more than 6 months, or irreversible damage may occur. The Battery is not covered in the system Warranty.

2.15MENU 7 – SETUP SUMMARY



- This screen provides a summary of the meter settings.

3 ERROR CODES.

The flowmeter generates the following error codes:

Error Code	*Error Description*	*Default Value.*
0001	Received signal too small	0.00001 Volts.
0002	Correlation Peak Size (a low value means only noise is detected)	0.50
0004	Sound Speed outside allowed percentage range.(from value entered in set-up, i.e. 1500 m/sec means that the range will be from 1200 to 1800).	+/- 20%
0008	Flow velocity outside allowed range.	-25 m/sec to 25 m/sec
0020	Signal echo size error between two received waves, A & B. (meaning that echo B amplitude can equal 2 x echo A amplitude before an error code is generated).	2
8000	Flow change exceeded acceleration limit	2000 ns

DO NOT ADJUST THESE DEFAULT VALUES, UNLESS SPECFICALLY INSTRUCTED TO DO SO.

Note: If the flowmeter displays an error 0021, then this is Signal too small and Correlation peak size too low.

4 WIRING INFORMATION

Military miniature bayonet connectors are used throughout. The part numbers described are from Weald Electronics Limited and Amphenol Limited

4.1 POWER INPUT

Bulkhead Connector	Pin	Function	Line (Cable) Connector
Amphenol 62GB57A08-3P **No Weald Equivalent.**	A	+9 to 15vDC	Amhenol 62GB16F08-3S **No Weald Equivalent.**
	B	Power Ground	
	C	N/C	

4.2 RS232 / SERIAL COMMUNICATIONS

Bulkhead Connector	Pin	Function	Line (Cable) Connector
Weald LMH07A12.10SN Amphenol 62GB57A12-10S	A ,B,C,D,E,G,H	N/C	Weald LMH06F12.10PN Amphenol 62GB16F12-10P
	F	Signal Ground	
	K	Tx from Unit	
	J	Rx to Unit	

4.3 FREQUENCY (OPEN COLLECTOR) OUTPUT

Bulkhead Connector	Pin	Function	Line Connector
Weald LMH07A08.04SN Amphenol 62GB57A08-4S	A	Output 1	Weald LMH06F08.04PN Amphenol 62GB16F08-4P
	B	N/C	
	C	Ground	
	D	Output 2	

4.4 FREQUENCY (OPEN COLLECTOR) INPUT

Bulkhead Connector	Pin	Function	Line Connector
Weald LMH07A08.04PN Amphenol 62GB57A08-4P	A	Input 1	Weald LMH06F08.04S Amphenol 62GB16F08-4S
	B	N/C	
	C	Ground	
	D	Input 2	

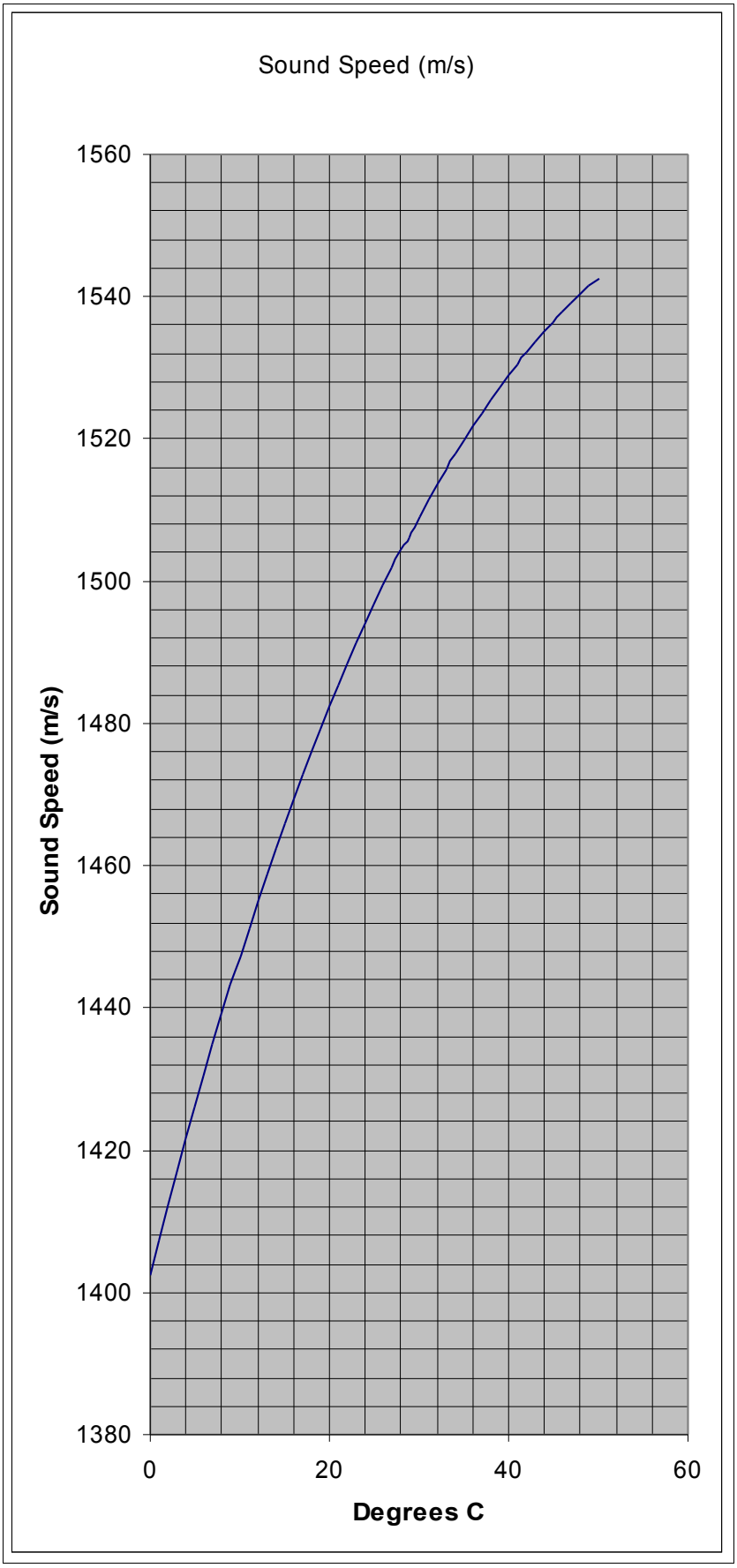
4.5 4-20MA I/O

Bulkhead Connector	Pin	Function	Line Connector
Weald LMH07A10.06PN Amphenol 62GB57A10-6P	A	Output +ve	Weald LMH06F10.06SN Amphenol 62GB16F10-6S
	B	Output Ground	
	C	Input 1+ve	
	D	Input 1 Ground	
	E	Input 2+ve	
	F	Input 2 Ground	

5 SOUND SPEED DATA

5.1 TEMPERATURE VARIATION IN POTABLE WATER

°C	Sound Speed (m/s)
0	1402.388
1	1407.367
2	1412.232
3	1416.985
4	1421.628
5	1426.162
6	1430.589
7	1434.912
8	1439.132
9	1443.251
10	1447.270
11	1451.191
12	1455.016
13	1458.747
14	1462.384
15	1465.931
16	1469.387
17	1472.755
18	1476.036
19	1479.231
20	1482.343
21	1485.372
22	1488.319
23	1491.187
24	1493.976
25	1496.687
26	1499.323
27	1501.883
28	1504.370
29	1506.784
30	1509.127
31	1511.399
32	1513.603
33	1515.738
34	1517.806
35	1519.808
36	1521.745
37	1523.618
38	1525.428
39	1527.176
40	1528.863
41	1530.489
42	1532.056
43	1533.564
44	1535.015
45	1536.409
46	1537.746
47	1539.028
48	1540.256
49	1541.430
50	1542.551



5.2 STANDARD VALUES – VARIOUS FLUIDS

Liquid	Sound Speed (m/s)	Temperature Variation (m/s/°C)
Acetone $(CH_3)_2CO$ @ 25°C	1174	-4.5
Alcohol, ethanol, C_2H_5OH @ 25°C	1207	-4
Alcohol, methanol, CH_3OH @ 25°C	1103	-3.2
Benzene C_6H_6 @ 25°C	1295	-4.65
Carbon Tetrachloride CCl_4 @ 25°C	926	-2.7
Chloroform, $CHCl_3$ @ 25°C	987	-3.4
Freon, TF	716	
Glycerin $CH_2OHCHOHCH_2OH$ @ 25°C	1904	-2.2
Glycol - ethylene 1,2-ethanediol	1658	-2.1
Kerosone	1324	-3.6
Nitrobenzene $C_6H_6NO_2$ @ 25°C	1463	-3.6
Oil (Castor), $C_{11}H_{10}O_{10}$ @ 25°C	1477	-3.6
Oil (Corn)	1460	
Oil (Diesel)	1250	
Oil (Mineral Light - 'Diamond')	1440	
Oil (Mineral Heavy - 'Diamond')	1460	
Oil (SAE20)	1740	
Oil (SAE30)	1700	
Oil (Silicon Dow 200)	980	
Oil (Silicon Dow 710)	1352	
Oil (Transformer)	1391	
Oxygen O_2 @ 90 °K (-183°C)	900	
Paraffin @ 15°C	1300	
n-Pentane C_5H_{12} liquid @ 15°C	1027	
Potassium liquid @100°C liquid	1820	
Sodium liquid @ 300 C (*not standard sensors*)	2420	
Water (Heavy) D_2O	1400	
Water @ 20°C	1480	3.1
Water @ 25°C	1497	2.7
Water @ 30°C	1509	2.3
Water @ 60°C	1550	
Water - salt 10%	1470	
Water - salt 15%	1530	
Water - salt 20%	1600	
Water - sea @ 25°C	1531	
Xenon - liquid @ 166°K (-107°C)	630	

5.3 STANDARD VALUES - VARIOUS PIPE MATERIALS

Pipe Material	Sound Speed (m/s)
Aluminium 1100-0	3100
Aluminium 2117-T4	3100
Aluminium Rolled	3040
Asbestos Cement	2200
Brass (Naval)	2120
Concrete	3100
Copper	2260
Copper Annealed	2325
Copper Nickel (Cu:Ni 70%,30%)	2540
Copper Nickel (Cu:Ni 90%,10%)	2060
Copper Rolled	2270
Delrin (Acetal)	2470
Glass (heavy silicate flint)	2380
Glass (light borate crown)	2840
Glass (Pyrex)	3440
Gold (Hard Drawn)	1200
Inconel	3020
Iron	3020
Iron (Cast)	2400
Iron (Ductile)	3000
Lexan (Clear Polycarbonate)	2470
Molybdenum	3400
Monel	2400
Mortar	2000
Nickel	2960
Nylon (6-6)	2840
Plexiglas, Acrylic, Lucite	2651
Polyethylene (High Density)	2310
Polyethylene (Low Density)	1940
PVC	2252
Rubber	2500
Silver	1600
Stainless Steel 302	3120
Stainless Steel 303	3120
Stainless Steel 304L	3075
Stainless Steel 316	3070
Stainless Steel 347	3100
Stainless Steel 410	2990
Stainless Steel 430	2990
Steel (Carbon)	3230
Steel (Mild)	3235
Steel 1% Carbon, Hardened	3150
Tar Epoxy	2000
Teflon (TFE)	1456
Tin (Rolled)	1670
Titanium (Ti 150A)	3125
Tungsten (carbide)	3980
Tungsten (annealed)	2890
Tungsten (drawn)	2640
Zinc (rolled)	2410

6 STANDARD INTERNAL PIPE DIAMETERS (BRITISH)

Nominal Pipe Size (mm)	Mean Internal Diameter (mm) – Mild Steel – BS1387 – Medium Black	Mild Steel – BS1387 – Heavy Black	Mild Steel – BS1387 – Heavy Galvanised	Mild Steel – BS3600*	Cast Iron – BS1211 – Class C	UPVC – BS3505 – Class C	UPVC – BS3505 – Class E	Nominal Pipe Size (mm)	Mean Internal Diameter (mm) – Copper – BS2871: Part I – Table X	Copper – Table Y	Copper – Table Z
10	12.4	11.3	10.8				13.4	6	4.80	4.40	5.00
15	16.1	14.9	14.4				17.2	8	6.80	6.40	7.00
20	21.6	20.4	19.9				21.8	10	8.80	8.40	9.00
25	27.3	25.7	25.2				28.2	12	10.80	10.40	11.00
32	36.0	34.4	33.9				35.9	15	13.60	13.00	14.00
40	41.9	40.3	39.8				40.9	22	20.22	19.62	20.82
50	53.0	51.3	50.8			54.4	51.4	28	26.22	25.62	26.82
65	68.7	67.0	66.5			68.2	64.2	35	32.63	32.03	33.63
80	80.7	79.1	78.6		80.8	80.7	75.9	42	39.63	39.03	40.43
90	93.15	91.55	91.05					54	51.63	50.03	52.23
100	105.1	103.5	102.8		106.3	103.9	97.7	67**	64.27	62.67	64.67
125	129.95	128.85	128.35		130.8	127.6	120.0	76.1	73.22	72.22	73.82
150	155.4	154.3	153.8		159.2	153.2	144.0	108	105.12	103.12	105.72
175				183.0	184.1	176.3	165.9	133	130.38		130.38
200				207.3	210.2	201.5	190.9	159	155.38		156.38
225				232.7	236.1	224.8	212.8				
250				260.4	262.1	251.2	238.0				
300				311.3	328.6	298.0	282.2				
350				341.4							
400				392.2							
450				441.0							
500				492.0							
550				541.4							
600				592.4							

* BS 3600 quotes such a wide range of possible sizes for large steel pipes that the values given should only be regarded as typical.
** See BSI Amendment Slip AMD 1422:1974

Figure 39. Nominal Pipe Sizes – Dimension Chart.

7 USING WINDOWS HYPERTERMINAL

HyperTerminal is a program that is supplied with Windows, and it is used to communicate with external devices such as the FLOWMETER via the serial port(s) on your PC. There are other similar programs commercially available, such as ProComm.

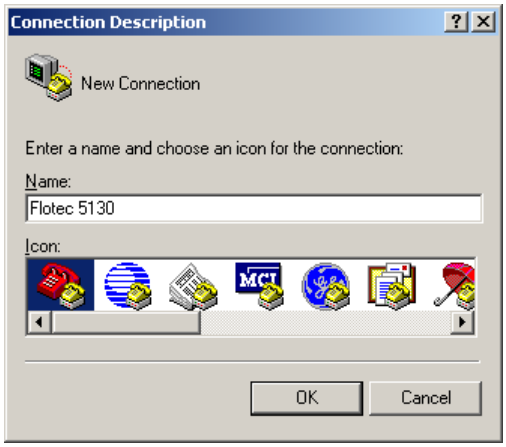
If HyperTerminal is already installed on your PC, you will be able to access it through the Start / Programs menu in Windows, either under its own HyperTerminal folder, or under Accessories / Communications.

If HyperTerminal is not installed, you can add it from your original Windows installation disks, or you can download it from the following location:

http://www.hilgraeve.com/htpe/htpe63.exe

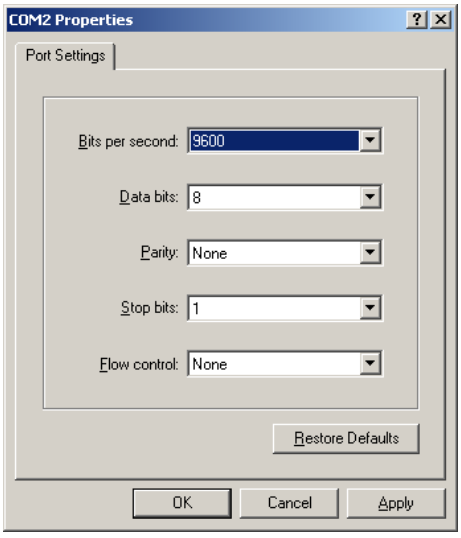
Save the file to your PC, and then Run it. This will now install HyperTerminal to your PC. Note that you should confirm that you are a PRIVATE USER of the PC, or HyperTerminal will not install.

On meter, check that the com port is switched on (Menu 3.6 - Serial Port). Check that the meter is connected to the PC serial port using the cable provided, and run HyperTerminal.



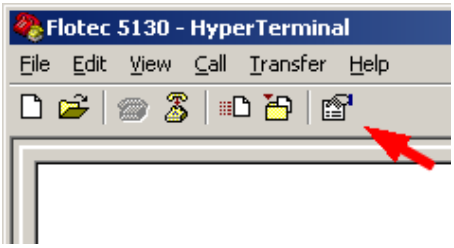
You will be asked for the name of the new connection. Choose a name and select OK.

Select the correct Com port and click OK.



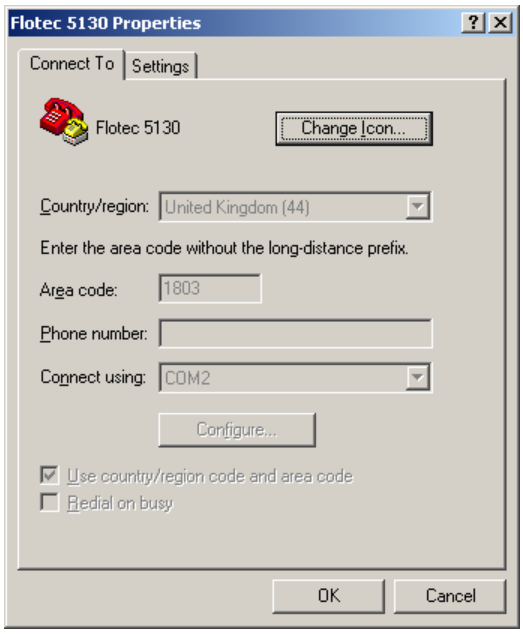
Make all the settings as indicated above, and click OK. Note that the Bits per second value (baud rate) may be set at any value from 4800 to 57600, provided it matches the serial port on the flowmeter (Menu 3.1).

This is usually all you need to do, but if you have problems, also check the following properties;

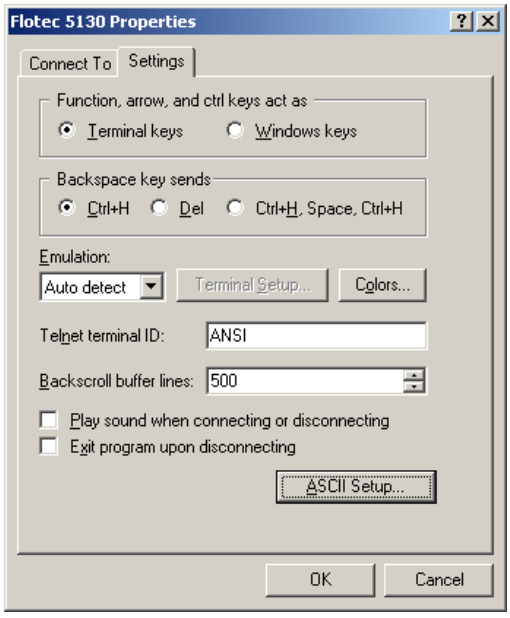


Click the Properties button as indicated.

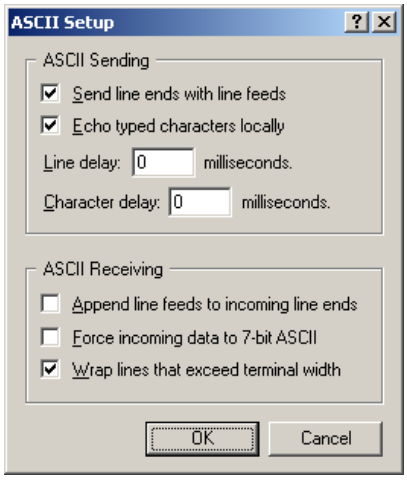
The following screen will appear:



Click the Settings tab:



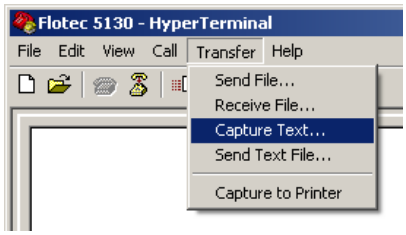
Ensure that the settings are as indicated and click the "ASCII Setup…" button.



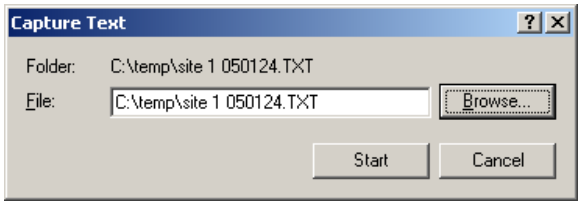
Check the boxes as indicated above and click OK twice to return to the main HyperTerminal screen

Once HyperTerminal has been setup as above, it will display all data that is output from the serial port of the flowmeter. In real time, this will simply be text data of the selected parameters (Menu 3.6.2). If you are uploading saved data, this too will be displayed on the screen as text as it is uploaded.

It is possible to save this data to the PC as it comes into the serial port, whether it is uploaded in real time or as a logged file. To do this, go to Transfer, Capture Text on the HyperTerminal menu:



Browse to the desired directory and type the desired filename (with .txt extension). Then click on "Start". Any data that is received will now be saved in this text file. When data upload is complete, select Transfer, Capture Text, Stop.



Note that there is currently no PC software for dedicated display of data from the FLOWMETER. However, since all data is in ASCII text format it may be manipulated and graphed using any standard spreadsheet package such as Microsoft Excel or Lotus 123.

8 CONNECTING EXTERNAL DEVICES.

As well as connection to a computer, the flowmeter also has 2 isolated open collector inputs and outputs, two 4-20 mA current transmitter inputs and one current output. The diagram below shows common connection diagrams for such devices. See section 3 for the pin connection details.

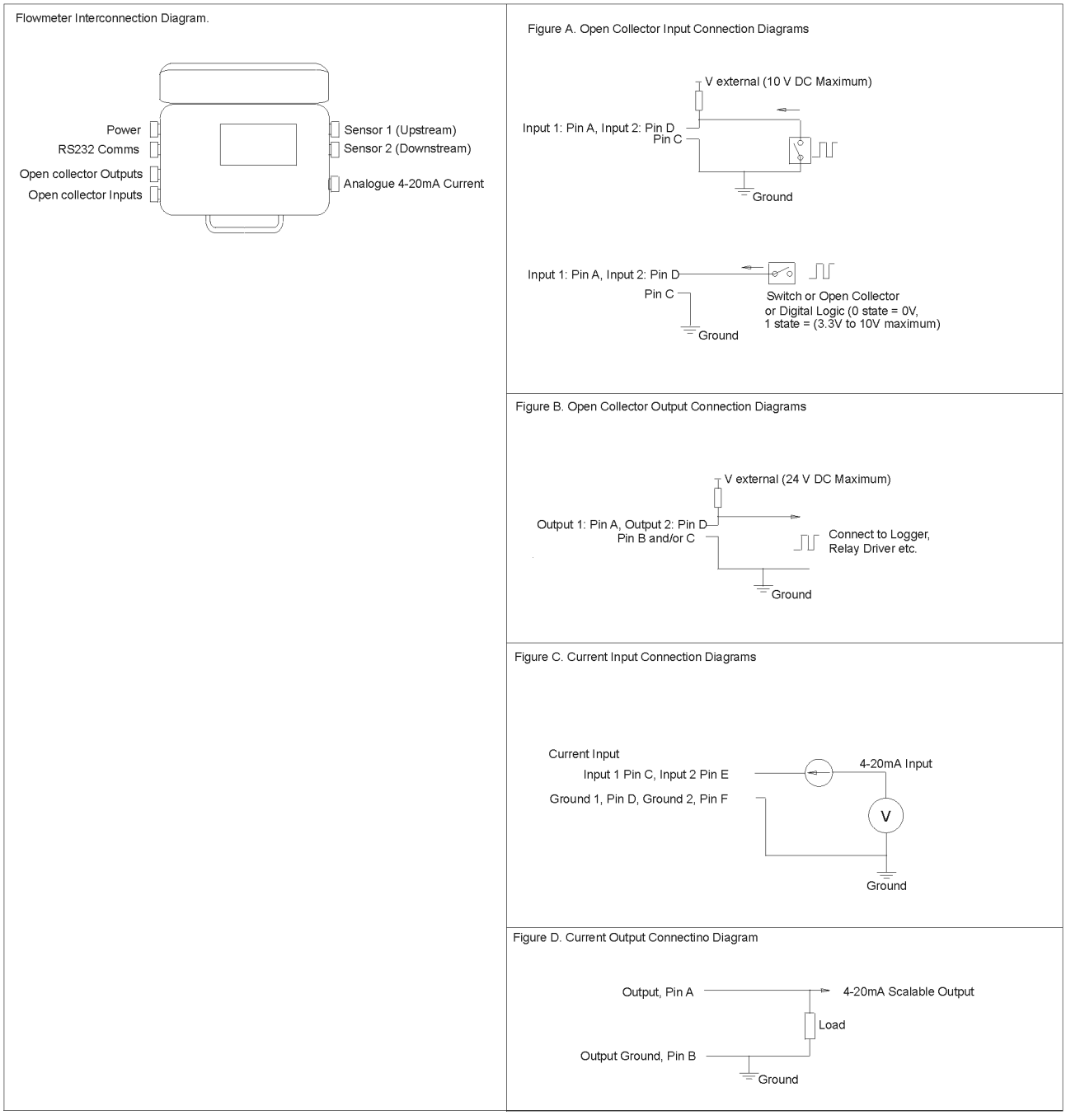


Figure 40. Attaching External Devices.