Portaflow 222 and 333

Portaflow 222: Portable Ultrasonic Flow Meter
Portaflow 333: Portable Ultrasonic Heat Meter

User Manual

Portaflow 333 shown

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CONTENTS

1 INTRODUCTION

1.1 General Description

The Portaflow range of portable flow meters uses clamp-on transducers to enable the flow of a liquid within a closed pipe to be measured accurately without needing to insert any mechanical parts through the pipe wall or protrude into the flow system.

Using ultrasonic transit time techniques, the Portaflow is controlled by a micro-processor system which contains a wide range of data that enables it to be used with pipes with an outside diameter ranging from 13mm up to 1000mm (depending on model) and constructed of almost any material. The instrument will also operate over a wide range of fluid temperatures.

All models have the following standard features are:

- Large, easy to read graphic display with backlighting.
- Simple to follow dual function keypad.
- Simple 'Quick Start' set up procedure.
- Continuous signal monitoring.
- Pulse output (volumetric or frequency).
- 4-20mA, 0-20mA or 0-16mA output.
- Rechargeable battery.
- Battery management.
- Diagnostics.

Volumetric flow rates are displayed in l/h, l/min, l/sec, gal/min, gal/h, USgals/min, USgals/h, Barrel/h, Barrel/day, m^3/s, m^3/min, m^3/h. Linear velocity is displayed in metres or feet per second. When operating in the 'Flow Reading' mode the total volumes, both positive and negative, are displayed up to a maximum 12-digit number.

The flowmeter can be used to measure clean liquids or oils that have less than 3% by volume of particulate content. Cloudy liquids such as river water and effluent can be measured along with cleaner liquids such as demineralised water.

Typical applications:

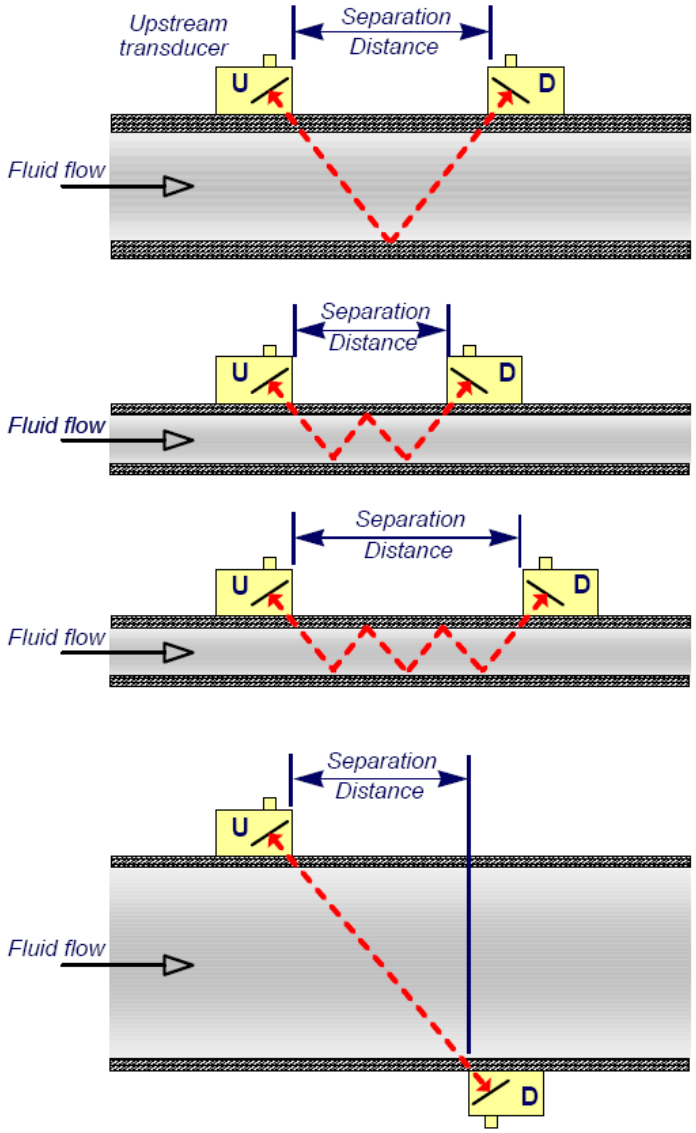
- River water.
- Seawater.
- Potable water.
- Demineralised water.
- Treated water.

1.2 How Does It Work?

Portaflow flow meters use a cross correlation transit time algorithm to provide accurate flow measurements.

An ultrasonic beam of a given frequency is generated by applying a repetitive voltage pulse to the transducer crystals. This transmission goes first from the downstream (blue) transducer to the upstream transducer (red) as shown in the upper half of Figure 1. The transmission is then made in the reverse direction, being sent from the upstream transducer (red) to the downstream transducer (blue) as shown in the lower half of Figure 1. The speed at which the ultrasound is transmitted through the liquid is accelerated slightly by the velocity of the liquid through the pipe. The subsequent time difference T1 – T2 is directly proportional to the liquid flow velocity.

The Portaflow system can be set up to operate in one of four modes determined mainly by the pipe diameter and the type of transducer set in use. The diagram below illustrates the importance of applying the correct separation distance between the transducers to obtain the strongest signal.



Reflex Mode

This is the mode most commonly used. The two transducers (U & D) are attached to the pipe in line with each other and the signals passing between them are reflected by the opposite pipe wall.

The separation distance is calculated by the instrument in response to entered data concerning the pipe and fluid characteristics.

Reflex Mode (double bounce)

In this mode the separation distance is calculated to give a double bounce. This is most likely to occur if the pipe diameter is so small that the calculated reflex mode separation distance would be impractical for the transducers in use.

Reflex Mode (triple bounce)

This illustration goes one step further to show a triple bounce situation. This would normally apply when working with very small pipes relative to the transducer range in use.

Diagonal mode

This mode might be selected by the instrument where relatively large pipes are concerned. In this mode the transducers are located on opposite sides of the pipe but the separation distance is still critical in order for the signals to be received correctly.

This mode might be used with the standard ‘A’ & ‘B’ transducer sets but for really large pipe installation the optional transducer set ‘D’ might be recommended.

Figure 1 Operating modes

1.3 Package Contents

The unit consists of the following components:

1. **Portaflow unit**
   Incorporating keypad and backlit display (333 model shown, 222 unit has white case).
2. Power supply with UK/US/European adapters, 110/240VAC.
3. Signal cable (4-20mA & 3 digital outputs)
4. Transducer cables (x2), 2m.
5. Chains x 2 (3.3m)
6. Guide rails (x2)
   For use with A or B type transducers.
7. Ultrasonic couplant.
8. Tape measure.
9. Transducer set 'B' for use on pipes 50mm to 2000mm outside diameter.
10. Test block
11. Syringe
12. Ruled separation bar (two piece).

Supplied with 333 models only:

13. Transducers set 'A': for use on pipes 13mm to 115mm outside diameter.
14. Heatsink compound
15. RTD PT100 temperature sensor cable (x2)
16. Steel banding (2 x 1.5m) – *333 units only*

The kit also contains a copy of this manual.

All models | *333 units only*

Figure 2 Package Contents (333 model shown)

1.4 Optional equipment (333 models only)

- Transducer set 'D' – used for monitoring pipes of 1500mm to 5000mm diameter, over a temperature range -20°C to +80°C. Kit is supplied in a separate case and includes the sensors together with ratchet straps and guide rails for attaching to the pipe.
- Magnetic guide rail kit, for use on mild steel and cast iron pipes (see Figure 1.3).

Figure 3 Magnetic guide rail

1.5 Display and connectors

The Portaflow unit is microprocessor-controlled, operated through a menu system using an inbuilt LCD display and keypad. It can display the instantaneous fluid flow rate or velocity, together with totalised values.

The instrument can also provide a variable current or variable 'pulse' (volumetric or frequency) output that is proportional to the detected flow rate. This output can be calibrated to suit a particular flow range and used with a range of external interface devices, such as those found in BMS or site monitoring systems.

Portaflow 333 units can also act as a data logger. When operating in the data logger mode the logged data can be output directly to a PC or printer using the RS232/USB interface or stored in the instrument's non-volatile memory for downloading at a later time. Up to 98k logging events can be stored internally.

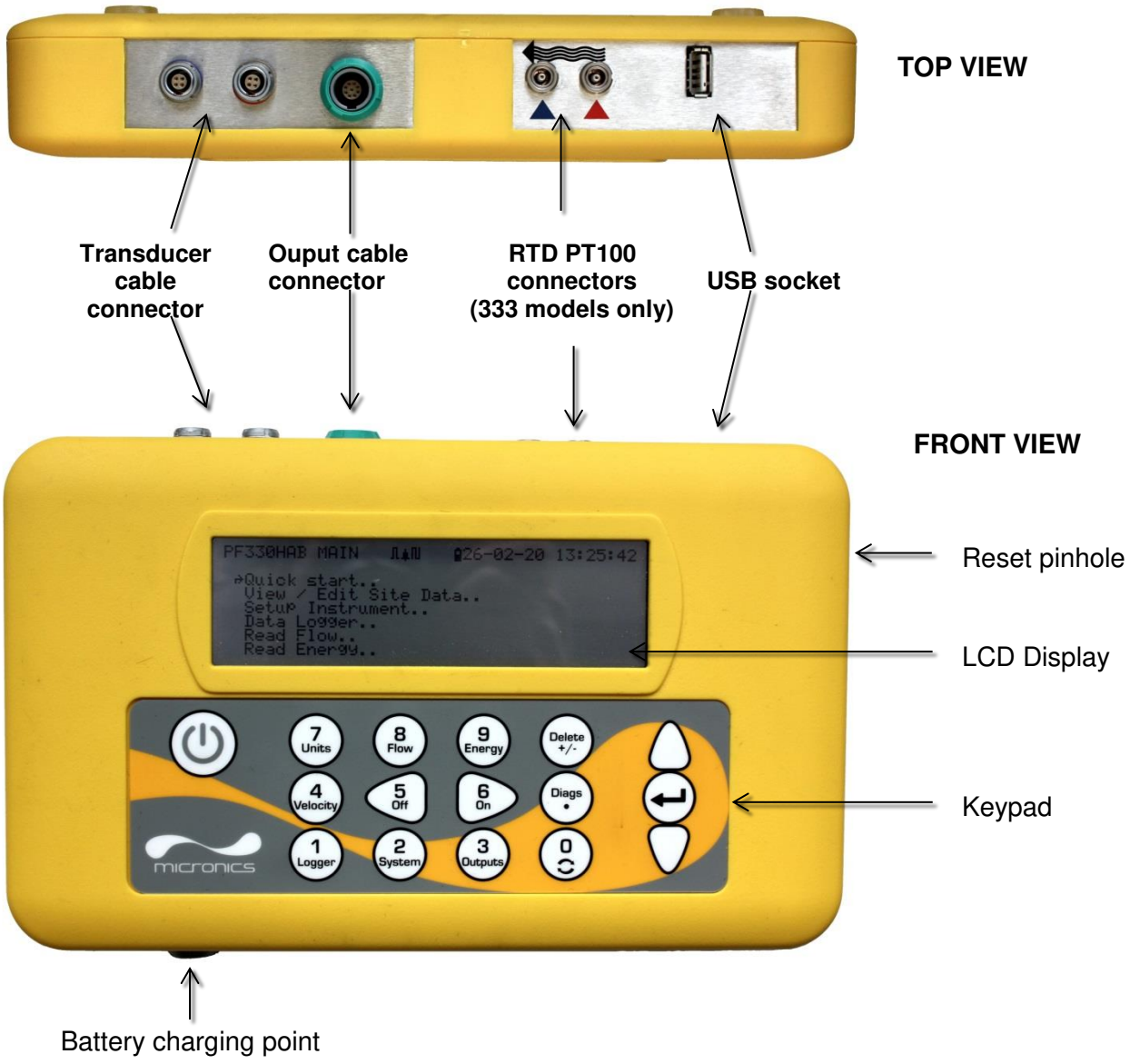


Figure 4 Portaflow unit (333 model shown)

1.6 Keypad

The instrument is configured and controlled via a 16-key tactile membrane keypad, as shown in Figure x.

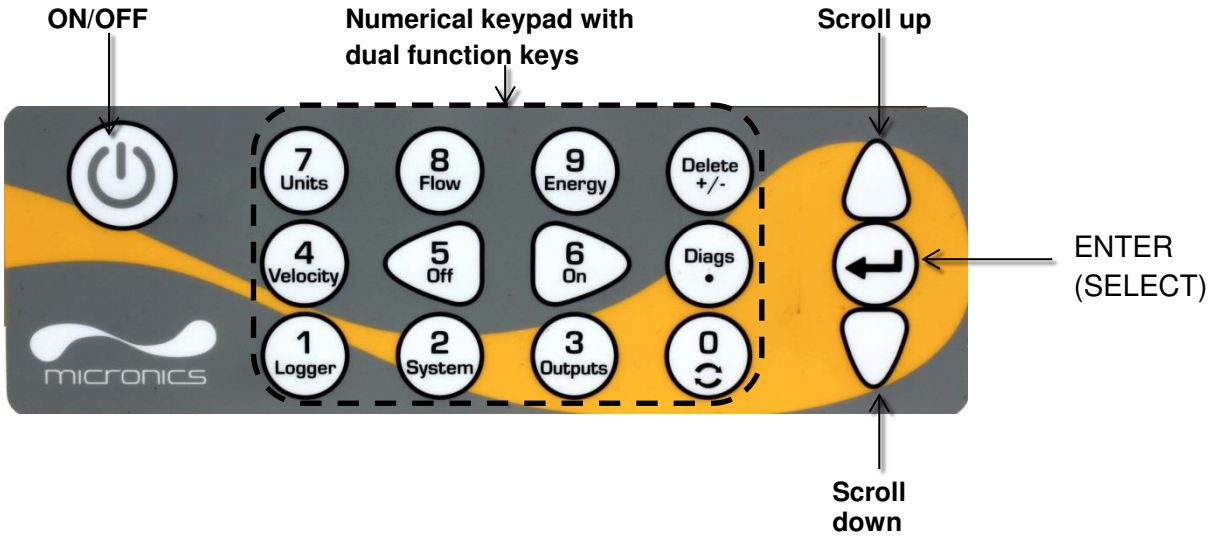


Figure 5 Portaflow keypad

1.6.1 ON/OFF Key

The ON/OFF key is on the top left of the keypad. When turned ON an initialisation screen is displayed on the LCD showing the instrument's serial number and software revision. Once this appears, the instrument can be started by pressing the ENTER key once – the initialization screen is then replaced by a MAIN MENU which provides access to the remaining functions.

1.6.2 Dual function numerical keypad

The block of keys shown in the centre of the keypad in Figure x are dual function keys. They can be used to enter straight-forward numerical data within menus or provide quick access to frequently used menus or commands from the Read Flow/Velocity/Energy display screens.

NOTE: SOME OF THE FEATURES ACCESSED BY THESE KEYS ARE RESTRICTED IN THE PORTAFLOW MODEL 222 RANGE. AN "OPTION NOT AVAILABLE" MESSAGE IS DISPLAYED IF YOU SELECT A RESTRICTED FUNCTION.

Key	Use
0	No function
1	**333 models only:** Display the Logger menu (see page 31)
2	Display the System Settings menu (see page 17)
3	Display the Output Board Setup menu (see page 34)
4	Switch to the Read Velocity display from the Read Flow display or Read Energy display (333 models only)
5	No function - reserved for future use
6	No function - reserved for future use
7	Cycle through the available display units
8	Switch to the Read Flow display from the Read Velocity display or Read Energy display (333

	models only)
9	**333 models only:** switch to the Read Energy display from the Read Velocity display or Read Flow display
Delete +/-	No shortcut function: within text entries, deletes character to left of flashing cursor.
.	Display the Diagnostics screen (see page 46)

1.6.3 Menus and the menu selection keys

To navigate the Portaflow's menu system, use the three keys on the right hand side of the keypad:

1. Use the UP & DOWN arrow keys to scroll through a menu list and select a menu item, as indicated by an arrow-shaped cursor on the left-hand side of the screen.
2. Edit or open the active menu choice by pressing the ENTER key.
3. Use the UP and DOWN arrow keys to cycle through the available options or, for numerical settings, use the keypad to enter the required value.
4. Press the ENTER key to confirm the new setting.

Some menus have more options than can be shown on the screen at the same time, in which case the 'overflowed' choices can be brought into view by continuing to scroll beyond the lowest visible item.

Menus generally 'loop around' if you scroll beyond the first or last items. Sometimes, this is the quickest route to find the **Exit** command to close a menu.

If you select **Exit** on any menu it usually takes you back up one level in the menu hierarchy, but in some cases it may go directly to the *Read Flow* screen.

Figure 6 Main menu
(*Read Energy* and *Data Logger* options available with 333 models only)

2 INSTALLATION

2.1 Positioning the Transducers

For accurate measurements, the transducers must be installed at a position where the fluid flows uniformly. Flow profile distortions can result from upstream disturbance such as bends, tees, valves, pumps and other similar obstructions. To ensure a uniform flow profile, the unit must be mounted away from any cause of flow disturbance.

As a guide, we suggest this is best achieved by ensuring there is a straight length of pipe upstream of the transducers of at least 10 times the pipe diameter, and 5 times the pipe diameter on the downstream side, as shown in Figure x, but this may vary. Flow Measurements can be made on shorter lengths of straight pipe, but when the transducers are mounted this close to any obstruction the resulting errors can be unpredictable.

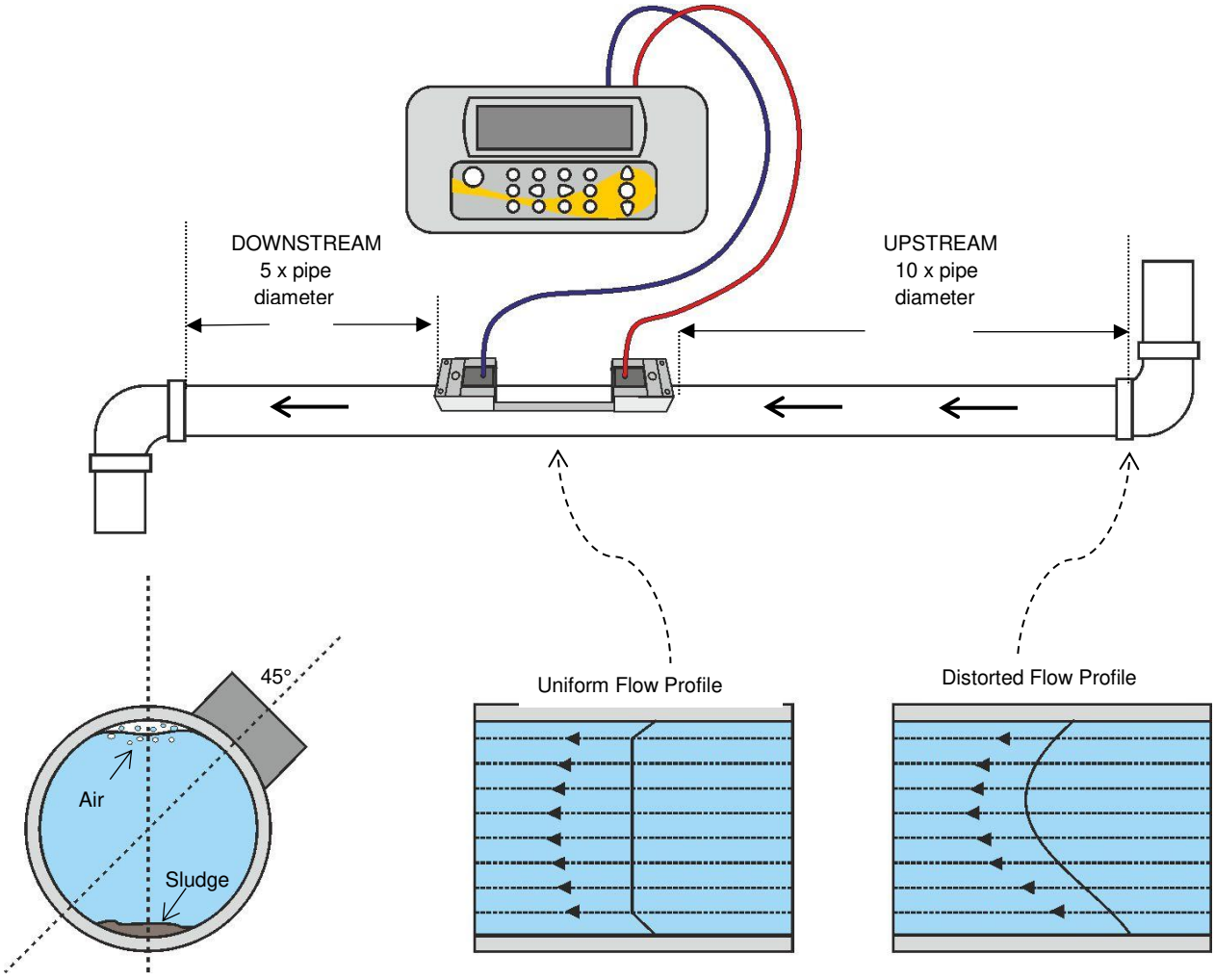


Figure 7 Location of unit

To obtain the most accurate results, the condition of both the liquid and the pipe must be suitable to allow ultrasound transmission along the predetermined path.

In many applications, an even flow velocity profile over a full 360° is unattainable due, for example, to the presence of air turbulence at the top of the flow and also possibly sludge at the bottom of the pipe. Experience has shown that the most consistently accurate results are achieved when the sensors are mounted at 45°with respect to the top of the pipe.

IMPORTANT: DO NOT EXPECT TO OBTAIN ACCURATE RESULTS IF THE UNIT IS POSITIONED CLOSE TO ANY OBSTRUCTION THAT DISTORTS THE UNIFORMITY OF THE FLOW PROFILE. MICRONICS LTD ACCEPTS NO RESPONSIBILITY OR LIABILITY IF PRODUCT HAS NOT BEEN INSTALLED IN ACCORDANCE WITH THESE INSTRUCTIONS.

2.2 Attaching the Transducers

Type ‘A’ & ‘B’ transducers connect to adjustable guide rails secured to the pipe using wrap-around chains and mechanically connected together by a steel separation bar. The separation bar also acts as a ruler to allow the distance between the transducers to be accurately set to the value indicated by the Portaflow unit.

NOTE: THE USE OF CHAINS TO FIX THE GUIDE RAIL TO THE PIPE CAN BE ELIMINATED ON STEEL PIPES BY USING THE OPTIONAL MAGNETIC GUIDE RAILS. IN ALL OTHER RESPECTS THE SETTING UP OF THE SENSORS IS THE SAME AS FOR STANDARD GUIDE RAILS.

2.2.1 Cleaning the contact area

Prepare the pipe by degreasing it and removing any loose material or flaking paint in order to obtain the best possible surface. A smooth contact between pipe surface and the face of the sensors is an important factor in achieving a good ultrasound signal strength and therefore maximum accuracy.

2.2.2 Assembling the guide rails on the separation bar

1. Slide the separation bar (D) into the front of the left hand guide rail, align the front edge of the guide rail with ‘0’ on the ruler scale (E) and secure it in place by tightening the thumbscrew (C).
2. Slide the other end of the separation bar into the front of the right hand guide rail, align the front edge of the guide rail to the required separation distance (obtained from the Portaflow unit) on the ruler (F), then secure it in place by tightening the thumbscrew.

NOTE: IF MAGNETIC GUIDE RAILS ARE USED ON STEEL PIPES THEN ONLY THE LOCATION AT 45° ON THE PIPE APPLY ON THE NEXT TWO SECTIONS.

2.2.3 Fixing the guide rail assembly to the pipe

1. On each guide rail, attach one end of a securing chain to a hook on the tensioning bar (B), wrap the chain around the pipe (G) and then attach it to the hook on the other end of the tensioning bar whilst keeping the chain as tight as possible.
2. Rotate the complete guide rail assembly so that it is approximately 45° with respect to the top of the pipe. Then tighten the chain by turning the tensioning thumb-wheel (A) on each guide block until the assembly is securely attached to the pipe.

NOTE: IF YOU ARE UNABLE TO GET SUFFICIENT TENSION ON THE CHAIN TO HOLD THE ASSEMBLY IN PLACE, FULLY SLACKEN THE TENSIONING THUMB-WHEEL AND SHORTEN

THE EFFECTIVE LENGTH OF THE CHAIN WRAPPED AROUND THE PIPE BY CONNECTING THE TENSIONING BAR TO THE NEXT LINK IN THE CHAIN, THEN RE-TENSION.

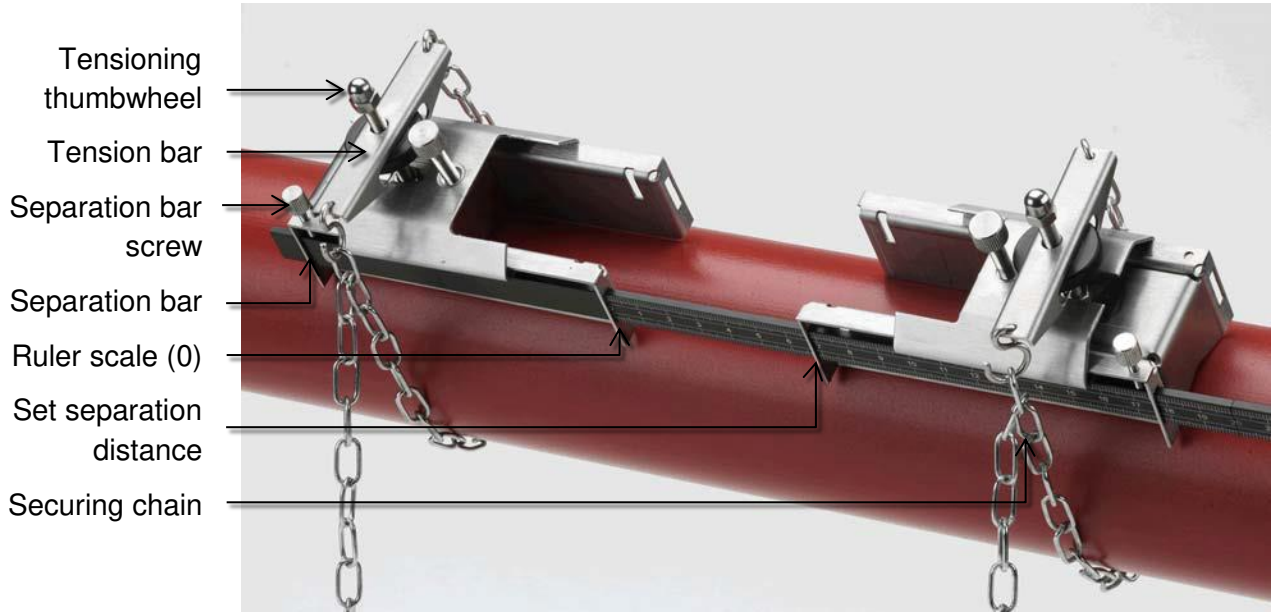


Figure 8 Guide rail assembly

2.2.4 Fitting the transducers

1. Slide the transducer cover plate (A) fully towards the outside of the guide assembly to allow sufficient access to fit the transducer.
2. Clean the face of the transducer, removing all traces of dirt and grease.
3. Apply a 3mm bead of ultrasonic couplant along the centre length of the transducer (E).

Figure 9 Applying ultrasonic couplant

4. Fit the transducer into the guide block – ensuring the lugs on the sides of the transducer are correctly located into the slots on the sides of the guide block.
5. Slide the transducer cover plate over the top of the transducer and tighten the thumbscrew finger-tight to secure the transducer in place. When securing the cover plate take care to leave sufficient room around the transducer connector to connect the cable.
6. Repeat the above steps for the second transducer.

7. Connect the transducers to the Portaflow unit using the coaxial cables provided. The RED cable must be connected to the upstream transducer and the BLUE cable to the downstream transducer. The sockets are also colour-coded.

NOTE. IF YOU OBSERVE NEGATIVE FLOW, SWAP THE RED AND BLUE CABLES AT THE SENSOR END.

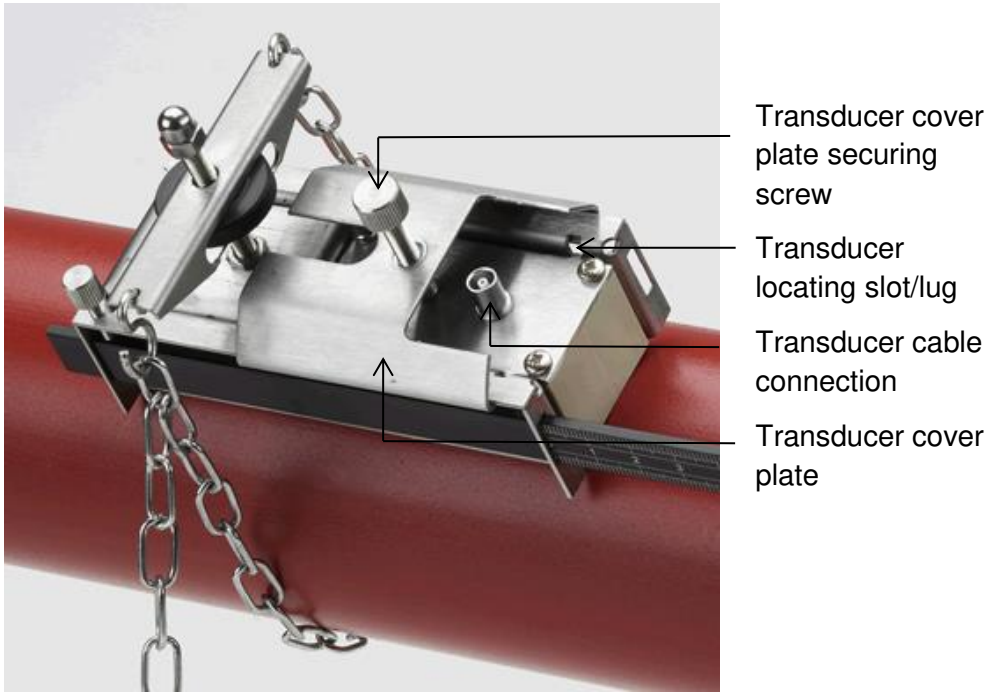


Figure 10 Transducer in guide rail

2.3 Connecting Temperature Probes (Portaflow 333 only)

The temperature sensors must be located at the input and output of the system that is being monitored. The area of pipe where they are to be attached must be free of grease and any insulating material. It is recommended that any coating on the pipe is removed so that the sensor has the best possible thermal contact with the pipe.

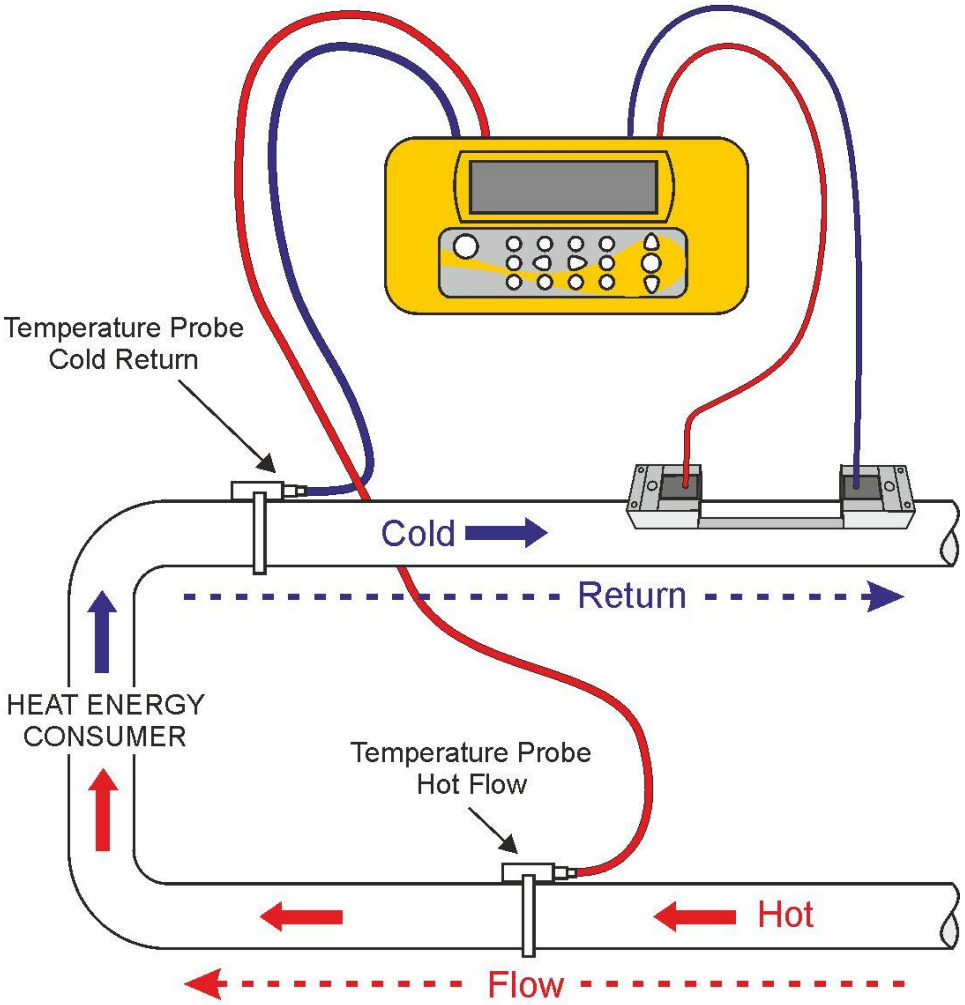


Figure 11 Portaflow 333 Temperature Probe Positioning

The sockets on the Electronics Module are marked Red (Hot) and Blue (Cold) - see **Error! Reference source not found.**. This defines the location of the temperature sensors on installations where heat is being extracted from the system.

Two separate 4-core plug-in cables are provided for the Temperature Sensor Probes connections.

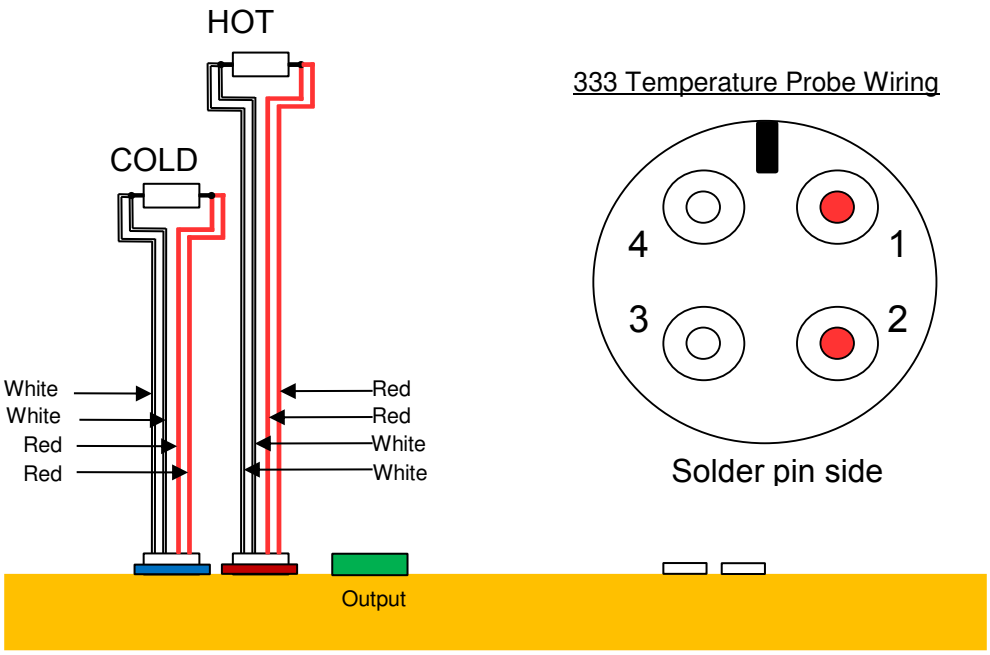


Figure 12 Portaflow 333 Temperature Probe Wiring

2.4 Connecting Outputs

The output cable provides a 4-20mA current source that can drive a maximum load of 620Ω and 3 digital output pairs for pulse or alarm outputs.

The isolated pulse output is provided by a SPNO/SPNC MOSFET relay which has a maximum load current of 500mA and maximum load voltage of 24V AC/DC.

This output is suitable for SELV circuits only.

The pulse output is a Volt, or potential free contact and, when selected as a low flow alarm, is configurable NO/NC.

The 4-20mA current output is available on the white (high polarity) and black (low polarity) wire pairs (pins 1&2 on the connector). The alarm current due to a flow outside the range specified or due to a loss of signal is set at 2.5mA.

Using the instrument's menu system (see page 34), you can:

- Select the current output function Off/On
- Select the current output signal range (4-20mA, 0-20mA, 0-16mA)
- Calibrate the current output signal to a required flow range

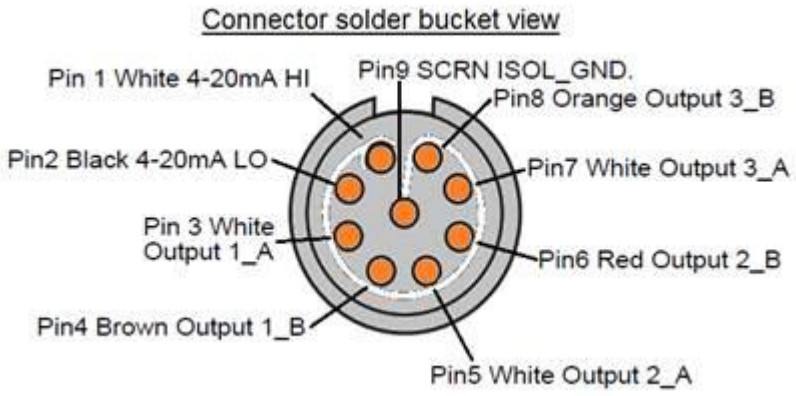


Figure 13 Output Wiring

The three digital output pairs for pulse or alarm outputs are as follows:

Output	Pin outs	Wire pair
Output 1	Pins 3 & 4	Brown/White
Output 2	Pins 5 & 6	Red/White
Output 3	Pins 7 & 8	Orange/White

2.5 Connecting the Power Supply

Operating power is provided by an internal battery that can be charged from the utility supply using the supplied external charger. When you first receive the unit you must put the battery on charge for a minimum of 6.5hrs before use. A fully charged battery will power the instrument for up to 20hrs depending on the output utilisation and backlight usage.

2.5.1 Charging the battery

1. Connect the external battery charger to the charger socket at the bottom of the instrument then switch on the utility supply.
2. When switched on, the instrument indicates charging with an animated battery symbol to the left of the date.
3. Leave the instrument on charge for at least 6.5 hours before using it for the first time.

2.5.2 Optimising battery life

The backlight can be configured in the Setup Instrument menu (see page 18) to be either permanently OFF, timed to switch off after 5-120s of keypad inactivity, or permanently ON. If the backlight is active continuously it will reduce the available battery operating time to 8 hrs. Similarly, if the 4-20mA output is used constantly at 20mA, the battery life would reduce by 50%. It is therefore beneficial to turn off the backlight and 4-20mA output facilities when they are not required.

When the instrument is operating in the *Flow Reading* mode the percentage battery charge level is displayed symbolically on the LCD screen. A warning message is triggered if the charge falls to approximately 30%, at which point there is up to four hours of battery operation remaining, depending on usage. The battery can be charged both while the instrument is in use or when switched off. The instrument's internal data is stored in non-volatile memory and will not be lost even if the battery discharges completely.

 **THE BATTERY IS NOT A USER-CHANGEABLE ITEM. THE INSTRUMENT MUST BE RETURNED TO YOUR DISTRIBUTOR IF THE BATTERY NEEDS REPLACING.**

 **ONLY USE THE SUPPLIED CHARGER, OR SPECIAL ADAPTOR LEAD. FAILURE TO COMPLY WITH THIS WILL INVALIDATE YOUR WARRANTY.**

2.6 Switching on for the first time

Leave the instrument on charge for at least 6.5 hours before using it for the first time.

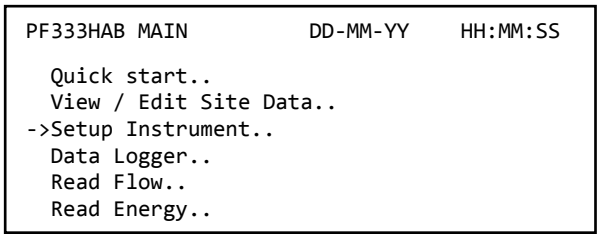
Switch on the instrument by pressing and holding down the ON/OFF button for about 5 seconds. Then, press the ENTER key to display the *MAIN* menu.

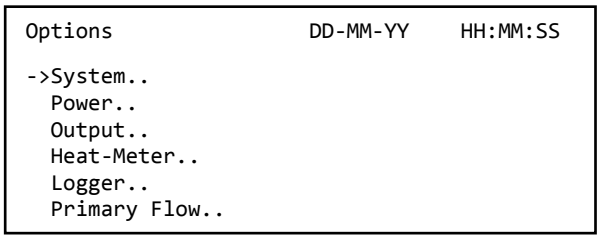
2.6.1 Selecting a Language

English is the default display language. German, French and Spanish options are available. To change the language:

1. From the *Main* menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key. With **System** selected in the *Options* menu, press the ENTER Key.

   Alternatively, from a *Read Flow/Velocity/Energy* screen, press the SYSTEM key (2). The *Options* menu is displayed.



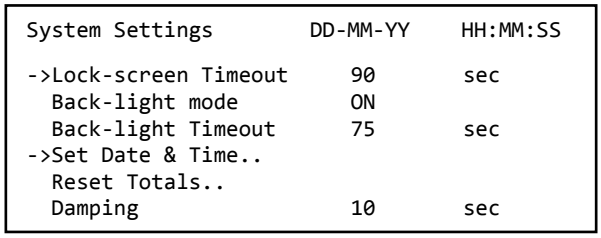


2. Use the UP/DOWN arrow keys to select **Language**. Press the ENTER key.
3. Use the UP/DOWN arrow keys to scroll through the available options.
4. With the required language highlighted, press the ENTER key.
5. Use the UP/DOWN arrow keys to select **Save Setup & Exit**. Press the ENTER key.

The selected language is now active for all screens.

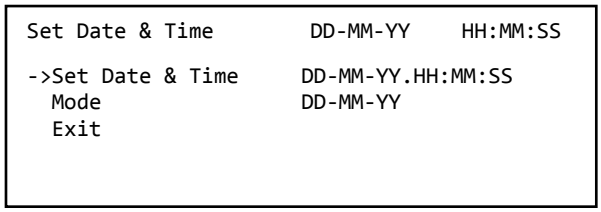
2.6.2 Setting the Date & Time

1. From the MAIN menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key. With **System** selected in the *Options* menu, press the ENTER Key.



   Alternatively, from a *Read Flow/Velocity/Energy* screen, press the SYSTEM key (2). The *System Settings* menu is displayed.

2. Use the UP/DOWN arrow keys to select **Set Date & Time**. Press the ENTER key.
   The *Set Date & Time* menu is displayed.

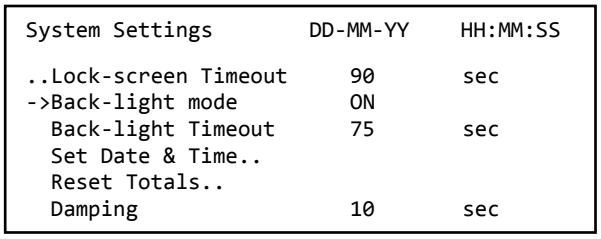


3. The instrument is configured to display dates in *DD-MM-YY* format. Proceed to step 6 unless you prefer to use MM-DD-YY format.
4. Use the UP/DOWN arrow keys to select **Mode**. Press the ENTER key.

5. Use the UP/DOWN arrow keys to choose the required format: DD-MM-YY or MM-DD-YY. Press the ENTER key.
6. Use the UP/DOWN arrow keys to select **Set Date & Time**. Press ENTER. A flashing cursor appears under the first date number. Enter the date and time sequence in *DD-MM-YY-HH-MM-SS* format then press the ENTER key.
7. Scroll down and select **Exit** then press the ENTER key to return to the MAIN menu.

NOTE: IF YOU MAKE A MISTAKE WHEN ENTERING THE DATA PRESS THE DELETE KEY TO MOVE THE CURSOR BACK TO THE NUMBER YOU WISH TO CHANGE, THEN CONTINUE. IF YOU ENTER AN INVALID NUMBER AN 'ERR:INVALID DATE OR TIME!**' ERROR MESSAGE IS DISPLAYED ON THE SECOND LINE OF THE SCREEN. IF THIS OCCURS REPEAT THE SET DATE/TIME PROCEDURE.**

2.6.3 Enabling/Disabling the Backlight



The backlight can be selected to be OFF, TIMED (illuminated until a set interval of keypad inactivity occurs), or ON permanently. If the backlight is not required it is recommended that you disable it to prolong the battery discharge time.

1. From the MAIN menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key. With **System** selected in the *Options* menu, press the ENTER Key.

   Alternatively, from a *Read Flow/Velocity/Energy* screen, press the SYSTEM key (2). The *System Settings* menu is displayed.
2. Use the UP/DOWN arrow keys to select **Back-light mode**. Press the ENTER key.
3. Use the UP/DOWN arrow keys to scroll through the available options: *On/Timed/Off*.
4. With the chosen mode selected, press the ENTER key.
5. If you select *Timed*, use the UP/DOWN arrow keys to select to **Back-light Timeout**. Press the ENTER key.
6. Use the keypad to enter the required timeout interval (5-120s). Press the ENTER key.
7. Select **Save Setup & Exit** then press the ENTER key to return to the *Options* menu.
8. Select **Exit** then press the ENTER key to return to the *Main* menu.

3 USING THE QUICK START MENU

If you want to perform a 'one-off' flow reading at a particular pipe location the *Quick start* menu provides the quickest way to set up the Portaflow system and access the FLOW READING screen.

If the point at which you intend to take the measurement is likely to require regular monitoring it is best to set it up as a 'Site' within the Portaflow, which then stores the site parameters (See Chapter 4).

Before you can use the Portaflow system you need to obtain the following details (this information will be required when setting up the Quick Start menu):

- Pipe outside diameter.
- Pipe wall thickness and material.
- Pipe lining thickness and material.
- Type of fluid.
- Fluid temperature.

3.1 Entering the site data

1. Select Quick Start from the MAIN MENU and press the ENTER key. You will then be presented with a series of screens in which to enter the data mentioned above.
2. Enter the pipe's outside diameter (15 – 2000 mm or its circumference (47.1 – 6283.2 mm). When you enter one value the other is calculated from it.

   Select CONTINUE and press the ENTER key.

3. Enter the pipe wall thickness (0.5 – 50 mm).

   Select CONTINUE and press the ENTER key.

4. Choose the pipe wall material: *Plastic/Cast Iron/Ductile Iron/Copper/Brass/Concrete/ Glass/Other (m/s)/Mild Steel/ S'less Steel 316/S'less Steel 303*.

   Select CONTINUE and press the ENTER key.

```
PF333HAB MAIN          DD-MM-YY    HH:MM:SS

->Quick start..
  View / Edit Site Data..
  Setup Instrument..
  Data Logger..
  Read Flow..
  Read Energy..
```

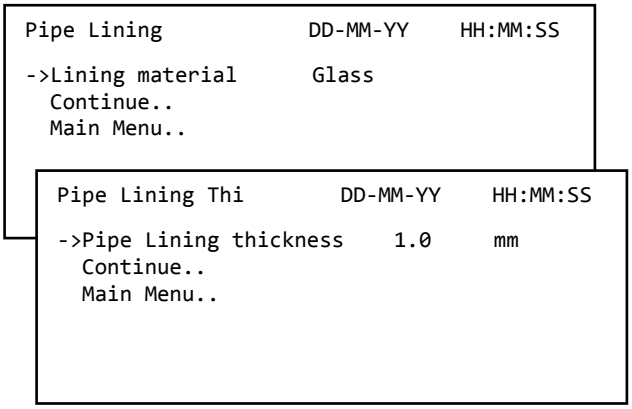
```
Pipe Outside Di        DD-MM-YY    HH:MM:SS

->Pipe outside diameter    114.30    mm
  Pipe circumference       359.08    mm
  Continue..
  Main Menu..
```

```
Pipe Wall Thick        DD-MM-YY    HH:MM:SS

->Pipe wall thickness      8.00     mm
  Continue..
  Main Menu..
```

```
Pipe Wall Mater        DD-MM-YY    HH:MM:SS

->Pipe wall material   Plastic
  Continue..
  Main Menu..
```

5. Identify the pipe lining material from the following options: *None/Rubber/Glass/Epoxy/Concrete/ Other (m/s)*. If the material is not listed, select *Other (m/s)* and enter the propagation rate of the pipe wall material in metres/sec. Contact Micronics if this is not known.

   Select CONTINUE and press the ENTER key.

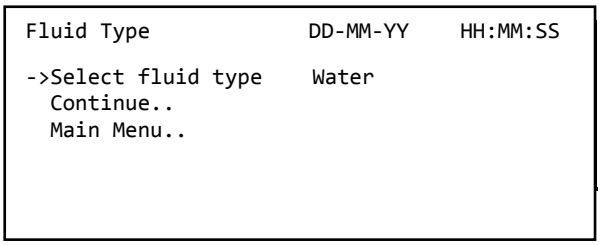


6. If no lining material was entered, go to step 7. Otherwise, enter the lining thickness (0 – 40 mm).

   Select CONTINUE and press the ENTER key.

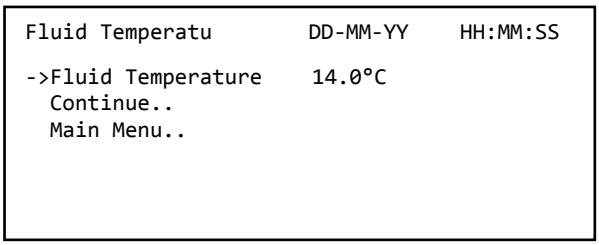
7. Select the fluid type from the following options: *Water/Glycol/water 50%/Glycol/water 30%/Lubricating oil/Diesel/Freon/Other (m/s)*. If the material is not listed, select *Other (m/s)* and enter the propagation rate of the pipe wall material in metres/sec. Contact Micronics if this is not known.

   Select CONTINUE and press the ENTER key.



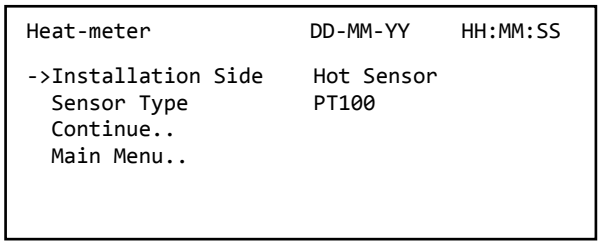
8. Enter the fluid temperature (-30 – 135.0 °C).

   Select CONTINUE and press the ENTER key.

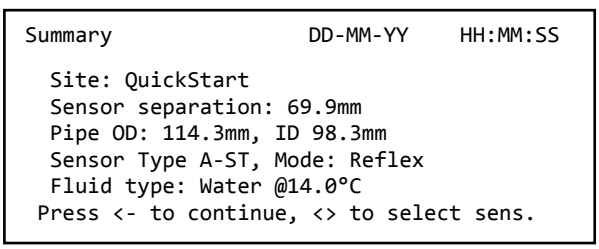


9. **PF333 Models Only**: Specify how the Heat meter is configured: *Hot Sensor/Cold Sensor/Fluid Temperature*.

   Select CONTINUE and press the ENTER key.

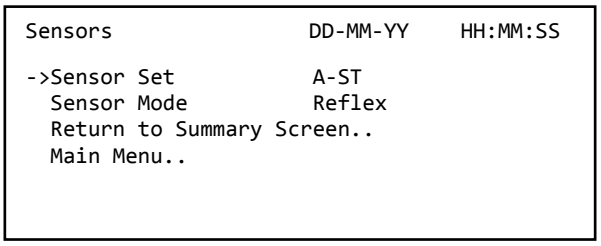


10. The *Summary* screen is displayed. This displays a summary of the entered parameters and informs you of the type of sensor to be used, the mode of operation and the distance to set up between the sensors.
    In this example, A-ST (A standard) sensors are recommended, operating in the 'Reflex' mode, spaced at 69.9mm apart.



NOTE: DO NOT PRESS THE ENTER KEY UNTIL THE CORRECT TRANSDUCERS ARE FITTED AND CONNECTED TO THE INSTRUMENT.

11. If you prefer to use a different configuration, press the UP or DOWN arrow key to select a different sensor set and mode.



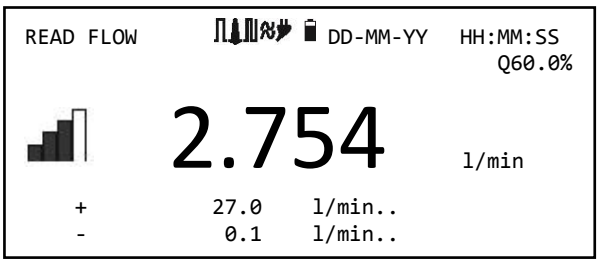
NOTE: THE SENSORS SCREEN WILL BE DISPLAYED AUTOMATICALLY IF THE ENTERED PIPE OD AND/OR TEMPERATURE ARE NOT VALID FOR THE CURRENTLY SELECTED SENSORS.

3.2 Attaching and Connecting the Sensors

1. Fit the designated sensors to the pipe using the appropriate guide rails as described in Paragraph 2.2. Take great care to set the separation distance as accurately as possible.
2. Connect the red and blue coaxial cables between the sensors and the test instrument, ensuring that the red connector on the instrument is connected to the 'upstream' sensor.

3.3 Taking a Flow Reading

1. Once the transducers have been fitted and connected, press the ENTER key on the Summary screen.
2. This will take you to the FLOW READING screen via a signal-checking screen.



3. Check that the indicated signal strength on the left of the screen is at least 2 bars (ideally 3 or 4). If less than 2 bars are shown it indicates there could be a problem with the transducer spacing, alignment or connections; or it could be due to an application problem.
4. Qxx.xx% indicates the signal quality and should have a value of 60% or greater.

The *Read Flow* screen is used most frequently during normal monitoring operation. It shows the instantaneous fluid flow together with totalised values (when enabled).

If the flow reading exceeds a value of +/-9999 in the current units then a *10 multiplier will be displayed above the units and the value displayed will be a tenth of the actual value. Similarly a * 100 and *1000 may be displayed on very large flow rates.

There are limitations on the use of these larger flow values with regards to logging of data and setting the current and pulse outputs.

3.4 Flow Monitoring

From the READ FLOW screen you can:

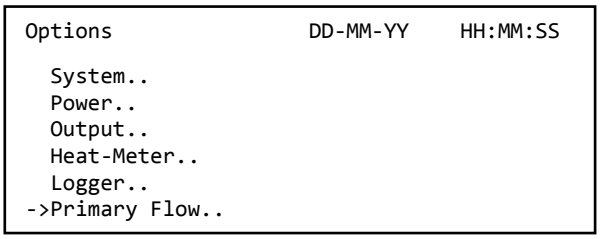
- Switch to the Read Energy display by pressing key 9.
- Switch to the Read Velocity display by pressing key 4.
- Switch back to the Read Flow display by pressing key 8.
- Change the display units by pressing key 7.

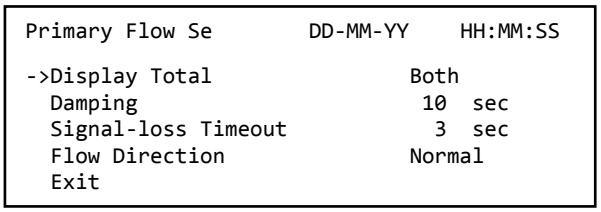
3.5 Total flows

The basic measurement indicated on the READ FLOW screen is the instantaneous flow rate, which in some applications may vary over a period of time. Average flow rates are therefore often required in order to get a better understanding of an application's true performance. This is simply achieved by noting the total flow over a specific period (for example 30-60 minutes) and then calculating the average flow rate over that period of time. BY default, the READ FLOW screen shows both the forward and reverse flow totals.

To change the totals display:

1. From the *Main* menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key.
2. Use the UP/DOWN arrow keys to select **Primary Flow**; press the ENTER Key. The Primary Flow screen is displayed.
3. Select **Display Total** and press the ENTER key. Use the UP/DOWN arrow keys to scroll through the available options: *Both / None / Fwd Total / Rev Total*.
4. With the required display option selected, press the ENTER key.
5. Select Exit and press the ENTER key to return to the *Options* menu.





6. Select Exit and press the ENTER key to return to the *MAIN* menu.

3.5.1 Calculating the average flow

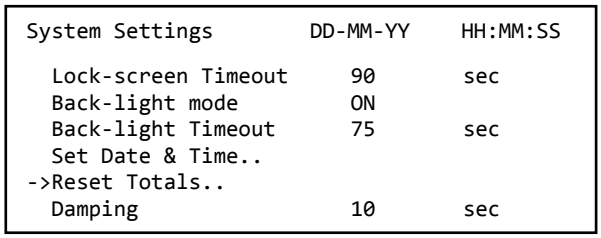
To calculate the average flow wait for the allotted monitoring period to expire then divide the indicated total flow by the time taken. This will give you the average flow in m/s, galls/hour or whatever units you select.

Note that in a bi-directional flow situation you must calculate the difference between the indicated positive and negative flow totals before carrying out the average flow rate calculation.

3.5.2 Resetting Totals

1. From the *MAIN* menu, use the Up and Down arrow keys to select **Setup Instrument**. Press the ENTER Key. With **System** selected in the *Options* menu, press the ENTER Key.

   Alternatively, from a *Read Flow/Velocity/Energy* screen, press the SYSTEM key (2). The *System Settings* menu is displayed.
2. Select **Reset Totals..** and press the ENTER key.
3. Enter the code….



4 MANAGING NAMED SITES

Setting up the Portaflow system using the Quick Start method described in the previous chapter is the recommended method to use in a 'one-off' situation.

If you have several site locations that you want to monitor on a frequent basis it is better to set up a named 'Site' to store the installation details, such as pipe dimensions and material, required to set-up the Portaflow system. These can then be recalled later when revisiting a particular location.

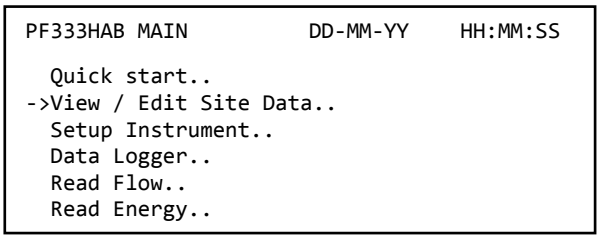
4.1 View/Edit Site Data

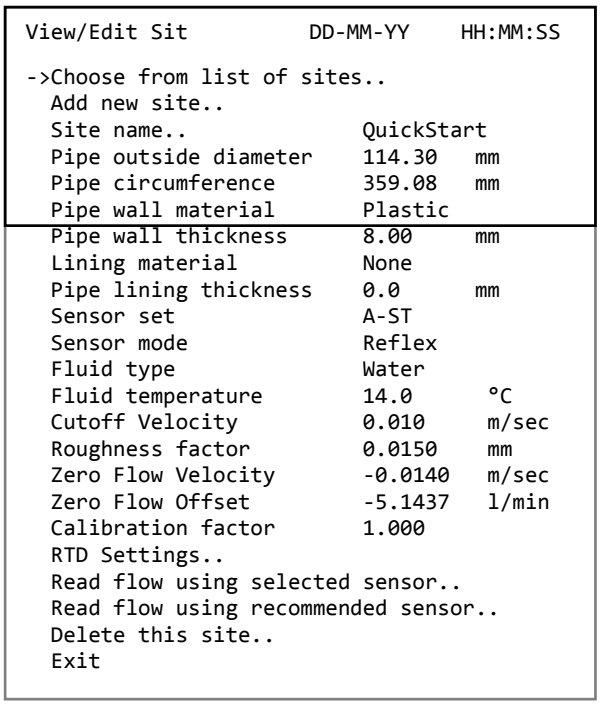
Use the **View**/**Edit Site Data** command on the *MAIN* Menu to display the View/Edit Site menu. This allows you to:

- Manage site names.
  The instrument can store up to 20 sites, the first site is reserved for the default *QuickStart* site and cannot be renamed; subsequent sites are initially named *Site01* through to *Site19*.

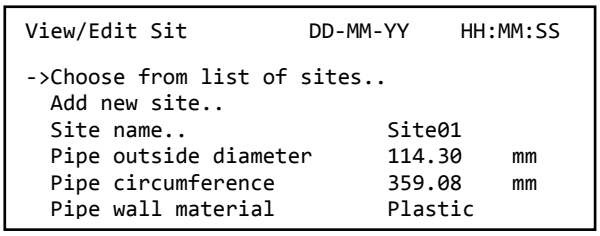
- Edit key parameters such as pipe outside diameter and wall thickness.

- Change calibration factors including Cutoff Velocity and Roughness Factor.





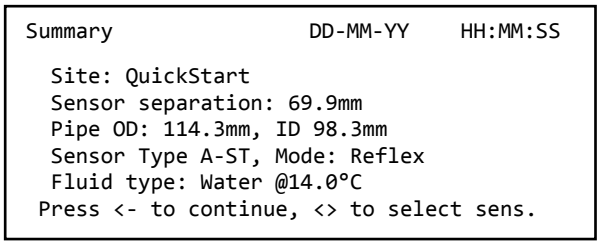
4.2 Selecting an existing site



1. Select **View** / **Edit Site Data** from the MAIN MENU.
2. Select **Choose from list of sites**.
3. Use the UP/DOWN arrows to select the required site, then press the ENTER key. The stored parameters are retrieved from memory and displayed on-screen.
4. Scroll down through the menu list and enter/change the data that might have changed since the last time the site was accessed (see *Managing Named Sites*, page 23). Changes are saved automatically.

NOTE: IF YOU SELECT A DIFFERENT SENSOR SET (E.G. A-ST) WHEN ENTERING NEW SITE DATA YOU COULD RECEIVE AN "INVALID" ERROR MESSAGE IF THE PREVIOUS SENSOR SET WAS OPERATING AT A TEMPERATURE ABOVE 135ºC. IF THIS OCCURS, IGNORE THE WARNING AS IT WILL DISAPPEAR WHEN YOU ENTER A TEMPERATURE IN THE CORRECT RANGE FOR NEW SENSORS.

5. Select **Read flow using selected sensor** or **Read flow using recommended sensor.**
6. The *Summary* screen now displays the parameters you have entered and informs you of the type of sensor to be used, the mode of operation and the distance to set up between the sensors.
   In this example it recommends type A-ST (A standard) sensors operating in the 'Reflex' mode spaced at 67.4mm apart.



NOTE: THE SENSORS SCREEN CAN BE ENTERED BY PRESSING THE ONE OF THE SCROLL KEYS. THIS ALLOWS THE TYPE AND MODE OF THE SENSORS BEING USED TO BE SELECTED. THIS MENU WILL BE ENTERED AUTOMATICALLY IF THE ENTERED PIPE OD AND/OR TEMPERATURE ARE NOT VALID FOR THE CURRENTLY SELECTED SENSORS.

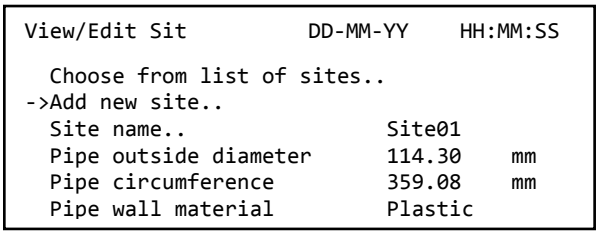
7. Ensure that the sensors are connected properly (see page 6).
8. Press the ENTER key to display the *READ FLOW* screen.

NOTE: DO NOT PRESS THE ENTER KEY UNTIL THE TRANSDUCERS ARE FITTED AND CONNECTED TO THE INSTRUMENT.

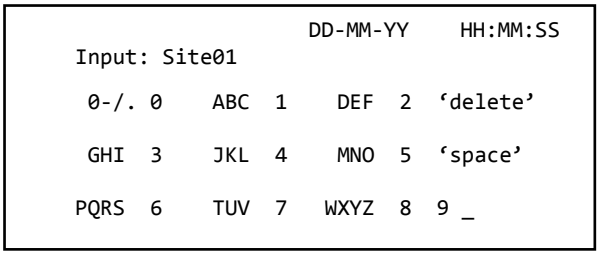
4.3 Adding a new site

NOTE: ONCE YOU HAVE SET UP A NAMED SITE YOU ARE ADVISED TO LOG SOME DATA TO THE SITE IN ORDER TO AVOID THE POSSIBILITY OF THE SITE NAME BEING OVERWRITTEN WHEN THE QUICK START DATA IS SAVED. SEE PAGE 19 FOR DETAILS.

1. Select **View** / **Edit Site Data** from the MAIN MENU.
2. Select **Add New site**.



3. You are prompted to edit the Site name. Sites are initially named *Site01* through to *Site19* using the numeric keypad in a Multi-Press mode.



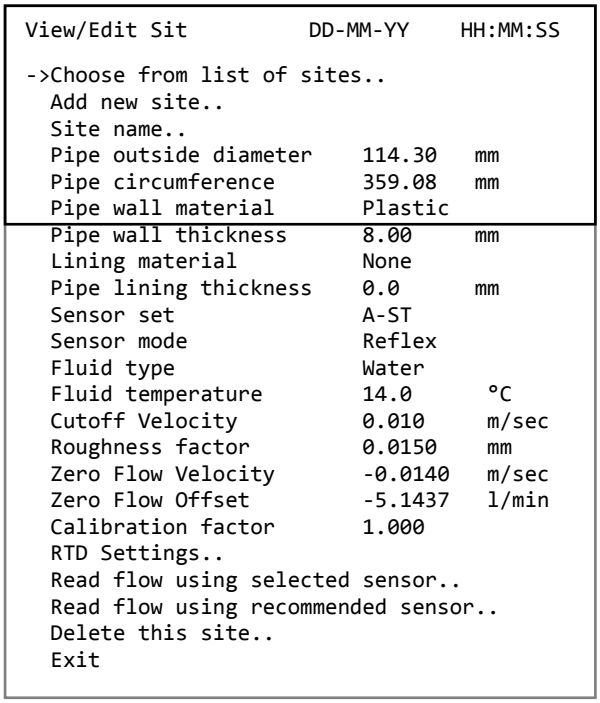
   Each key represents three or more characters. For example, "1" represents the characters **ABCabc1**. Repeatedly press the same key to cycle through the characters for that key. Pausing for a brief period of time will automatically choose the current character in the cycle. Punctuation and special characters (such as "$") can be accessed via the "0" key and spaces using the "9" key. Site names are limited to 8 characters.

NOTE: THAT THIS MENU ALLOWS YOU TO CHOOSE A SENSOR SET, UNLIKE THE QUICK START MENU WHICH ALSO RECOMMENDS THE SENSOR SET TO USE. IF YOU ENTER AN INAPPROPRIATE SENSOR SET IN THIS MENU YOU WILL BE PRESENTED WITH AN ERROR MESSAGE LATER WHEN YOU GO TO THE SENSOR SEPARATION SCREEN.

4.4 Changing a site name

To change a site name, select **Choose from list of sites** from the **View** / **Edit Site Data** menu. Select the required site from the displayed list of current sites. Use the same method described above for generating a new site. If you change a site name while the site is logging the logging will stop.

4.5 Editing site data



1. Having selected the appropriate site (see page 24), scroll through the menu list and enter/change the pipe, sensor and fluid parameters.
    - Pipe outside diameter
    - Pipe circumference
    - Pipe wall material
    - Pipe wall thickness
    - Lining material
    - Pipe lining thickness
    - Sensor set
    - Sensor mode
    - Fluid type
    - Fluid temperature

NOTE: IF YOU SELECT A DIFFERENT SENSOR SET (E.G. A-ST) WHEN ENTERING NEW SITE DATA YOU COULD RECEIVE AN "INVALID" ERROR MESSAGE IF THE PREVIOUS SENSOR SET WAS OPERATING AT A TEMPERATURE ABOVE 135ºC. IF THIS OCCURS, IGNORE THE WARNING AS IT WILL DISAPPEAR WHEN YOU ENTER A TEMPERATURE IN THE CORRECT RANGE FOR NEW SENSORS.

2. When all the data is correct you can either:
    a. Select **RTD Settings** to view the RTD configuration (*333 models only*).
    b. Select **Read flow with selected sensors** to continue fitting the transducers you have specified in the site description and then open the FLOW READING screen.
    c. Select **Read flow with recommended sensors** to view the optimum sensors and configuration for the parameters you have specified in the site description.
    d. Select **Delete this site** to delete the site name and values and restore it to the original *Site0x* name. You are prompted to confirm the action. Select **Yes** to continue with the deletion or **No** to cancel the action and keep the site.
    Press the ENTER key to continue.
    e. Select **Exit** to return to the MAIN MENU.

4.6 Changing calibration parameters

The Portaflow is fully calibrated before it leaves the factory; however the following adjustments are provided to allow you to further 'fine tune' your instrument to suit local conditions and application where necessary. Apart from the zero flow offset adjustment, these are normally carried out only where the instrument is to be used in a permanent or semi-permanent location.

4.6.1 Adjusting the zero cutoff

This adjustment allows you to set a minimum flow rate (m/s) below which the instrument will indicate '0'. The default setting is 0.1 m/s but you may adjust this value if required.

1. Select **View** / **Edit Site Data** from the MAIN MENU.
2. Use the UP/DOWN arrow keys to select **Cutoff Velocity**. Press the ENTER key.
3. Edit the value as required and then press the ENTER key.
4. Scroll down to select **Exit** and press the ENTER key to return to the *View/Edit Site Data* menu.

4.6.2 Adjusting the zero flow offset

The Portaflow unit operates by comparing the time taken to send an ultrasonic signal between two transducers in either direction. A zero flow offset adjustment is provided to compensate for any inherent differences between the two sensors, noise pick-up, internal pipe conditions etc. It can be used to 'zero' the flow indication under no-flow conditions.

IF YOU HAVE ADJUSTED THE ZERO CUTOFF POINT TO ANYWHERE ABOVE '0' YOU MUST RESET IT TO '0' BEFORE YOU CAN OBSERVE AND ADJUST THE SET ZERO FLOW OFFSET, AS ITS VALUE IS VERY SMALL. ONCE THE SET ZERO FLOW OFFSET HAS BEEN CALIBRATED YOU CAN THEN REAPPLY THE ZERO CUTOFF IF REQUIRED.

1. Stop the liquid flow.
2. With the instrument in FLOW READING mode press the Velocity function key and observe the reading (m/s). Any reading other than 0.000 indicates an offset error and in practice this will typically be in the range ±0.005m/s (possibly higher on smaller diameter pipes). If a greater figure is shown it is worth calibrating the offset to obtain a more accurate result. Continue as follows:
3. Press the ENTER key and select 'Yes' to confirm that you want to exit the flow screen. The Main Menu is displayed.
4. Select **View** / **Edit Site Data**.
5. Use the UP/DOWN arrow keys to select **Cutoff Velocity**. Press the ENTER key.
6. Edit the value as required and then press the ENTER key.
7. Scroll down to select **Exit** and press the ENTER key to return to the *View/Edit Site Data* menu.
8. Scroll down to select **Read flow using selected sensor** and press the ENTER key.
9. Check that the the Portaflow is now reading zero correctly.
10. Restart the fluid flow.

NOTE: IN ORDER TO CANCEL ANY APPLIED OFFSET YOU MUST EITHER READ FLOW VIA QUICK START OR SWITCH THE PORTAFLOW UNIT OFF & ON. ANY VALUE THAT YOU TRIM-OUT USING THE OFFSET ADJUSTMENT WILL BE ADDED/SUBTRACTED FROM THE FLOW READING ACROSS THE WHOLE RANGE.

4.6.3 Adjusting the calibration factor

IMPORTANT: USE THIS FACILITY WITH CARE & ONLY WHERE NECESSARY

THE PORTAFLOW UNIT IS FULLY CALIBRATED BEFORE LEAVING THE FACTORY AND UNDER NORMAL CIRCUMSTANCES DOES NOT REQUIRE FURTHER CALIBRATION WHEN USED ON SITE.

THIS FACILITY CAN BE USED TO CORRECT THE FLOW INDICATION WHERE UNAVOIDABLE ERRORS OCCUR DUE TO THE LACK OF A STRAIGHT PIPE OR WHERE THE SENSORS ARE FORCED TO BE FITTED CLOSE TO THE PIPE-END, VALVE, JUNCTION ETC.

ANY ADJUSTMENT MUST BE MADE USING A REFERENCE FLOWMETER FITTED IN THE SYSTEM.

With the system running:

1. Stop the Portaflow's totaliser and zero it (see page 22).
2. Run the Portaflow's totaliser to measure the total flow over a 30-60 minute period, and note the total flow indicated by the reference flow meter over the same period.
3. Calculate the % error between the Portaflow and reference meters. If the error is greater than ±1% calibrate the Portaflow as detailed below.
4. Press the ENTER key and select 'Yes' to confirm that you want to exit the *Read Flow* screen. The *Main Menu* is displayed.
5. Select **View** / **Edit Site Data**.
6. Use the UP/DOWN arrow keys to select **Calibration factor**. Press the ENTER key.
7. Change the calibration factor according to the error calculated in step 3. For example, if the Portaflow was reading 1% high then increase the Calibration factor value by 0.010. Conversely, if the reading is 1% low then decrease the calibration factor to 0.990.
8. Press the ENTER key to apply the change and return to the *View/Edit Site Data* menu.
9. Scroll down to select **Read flow using selected sensor** and press the ENTER key.
10. Check the flow measurement against the reference flow meter again.

4.6.4 Adjusting the roughness factor

The roughness factor compensates for the condition of the internal pipe wall, as a rough surface will cause turbulence and affects the flow profile of the liquid. In most situations, it is not possible to inspect the pipe internally and the true condition is not known. In these circumstances experience has shown that the following values can be used:

Pipe Material	Roughness Factor
Non ferrous metal Glass Plastics Light metal	0.01
Drawn steel pipes: • Fine planed, polished surface • Plane surface • Rough planed surface	0.01
Welded steel pipes, new: • Long usage, cleaned • Lightly and evenly rusted • Heavily encrusted	0.1
Cast iron pipes: • Bitumen lining • New, without lining • Rusted / Encrusted	1.0

With the system running in FLOW READING mode:

1. Press the ENTER key and select 'Yes' to confirm that you want to exit the *Read Flow* screen. The *Main Menu* is displayed.
2. Select **View** / **Edit Site Data**.
3. Use the UP/DOWN arrow keys to select **Roughness factor**. Press the ENTER key.
4. Change the roughness factor according to the pipe material and condition as described above.
5. Press the ENTER key to apply the change and return to the *View/Edit Site Data* menu.
6. Scroll down to select **Read flow using selected sensor** and press the ENTER key to return to the Read Flow screen.

4.6.5 Adjusting the damping factor

By averaging-out the flow rate over several seconds, the Damping factor can be used to smooth out rapid changes in flow rate to prevent wild fluctuations in the displayed flow value. It has a range of 0 - 50 s, with a default setting of 10s.

1. From the *Main* menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key. With **System** selected in the *Options* menu, press the ENTER Key.

   Alternatively, from a *Read Flow/Velocity/Energy* screen, press the SYSTEM key (2). The *System Settings* menu is displayed.
2. Use the UP/DOWN arrow keys to select **Damping**. Press the ENTER key.
3. Enter the value of the Damping factor (0 - 50 s) as required to remove any unwanted display fluctuations. Increasing the value applies a greater smoothing affect.
4. Press the ENTER key to apply the selection and return to the **System** menu.
5. Select **Exit** and press the ENTER key to return to the Main menu.

NOTE: IF THE DAMPING FACTOR IS SET TOO HIGH THE VALUE DISPLAYED MAY APPEAR STABLE BUT IT MAY EXHIBIT LARGE STEP CHANGES WHEN THE VALUE IS UPDATED.

5 LOGGING FUNCTIONS

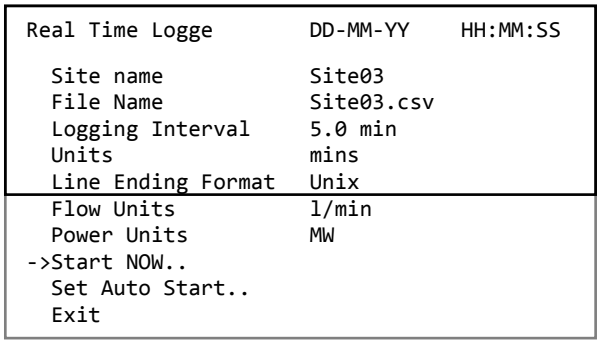
NOTE: THIS CHAPTER ONLY APPLIES TO 333 MODELS. 222 MODELS DO NOT HAVE LOGGING CAPABILITIES.

This procedure shows you how to set up a basic logging session under manual start/stop control. Logged data is saved to the instrument's memory and can be downloaded to a PC at a later time. Either -Flow Rate or +Flow Rate and ±Totals can be logged to Memory, RS232 or both. Totals are always logged and can be selectively down loaded after the logging has stopped.

NOTE: TO VIEW THE TOTALS ON THE SCREEN AND SEND THEM TO THE RS232/USB OUTPUT AS THEY ARE LOGGED, YOU HAVE TO SELECT THE REQUIRED OPTION IN THE DATA LOGGER MENU BEFORE SETTING UP THE FLOW READING.

5.1 Manual logging

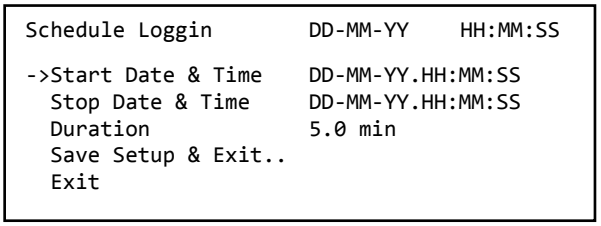
This procedure assumes that the Portaflow unit has been correctly installed and is operating in the FLOW READING mode.



1. Check that the indicated flow units are the same as those you want to appear on the logger output (e.g. l/min).
2. Press the Logger function key (1) to access the *Real Time Logger* screen.
3. Check that the site name is correct and make a note of the filename.
4. Select **Logging interval** and enter the required period (e.g. 5 minutes). Change the **Units** if required.
5. To start logging immediately, select **Start NOW**.

   NOTE: WHEN LOGGING IS IN PROGRESS, THIS MENU ITEM BECOMES STOP NOW**. USE THIS COMMAND TO STOP LOGGING ACTIVITY MANUALLY.**
6. If a log already exists for the selected site, you are prompted to either delete or save the existing log, or cancel the action.

5.2 Scheduling logging



To set a schedule for data logging:

1. Select **Set Auto Start** on the *Real Time Logger* screen.
2. Select **Start Date & Time**. A flashing cursor should appear under the first date number. Enter the date and time sequence in *dd-mm-yy-hh-mm-ss* order then press the ENTER key.
3. Select **Stop Date & Time** in the same way.

   NOTE THIS MUST BE LATER THAN THE START TIME.

4. *Duration* shows the logging period calculated from the Start and Stop times.
5. Select **Save Setup & Exit** and press the ENTER key to return to the *Real Time Logger* screen.

5.3 File naming

If you choose to save the existing log it will be saved to the highest number site that does not currently have an attached log (e.g. *Site19*, *Site18*.... etc). The name of the site to which the log is saved will be changed to *CopyQS_xx* (where *xx* is a numerical value which is incremented each time a log is saved). For example: if *Site19* is available when you elect to save the log, the log is saved to *Site19* and the sitename is changed to *CopyQS_1*. Files are saved in CSV file format.

NOTE: WHEN SETTING UP A NAMED SITE IT IS ADVISABLE TO RUN A BRIEF LOGGING SESSION ON THE NEW SITE TO ESTABLISH A DATA LOG FILE, AS THIS WILL PREVENT THE SITE NAME BEING OVERWRITTEN WHEN SAVING THE QUICKSTART LOG, AS DESCRIBED ABOVE.

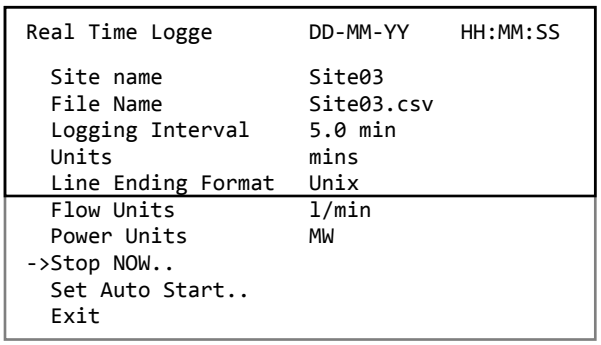
5.4 Stopping logging

From the FLOW READING screen, press the Logger function key to access the REAL TIME LOGGER screen.

1. Press the Logger function key (1) to access the *Real Time Logger* screen.
2. Select STOP NOW to cease logging.

NOTE: THE STOP NOW **OPTION REPLACES THE** START NOW **COMMAND WHEN LOGGING IS ACTIVE.**

3. Confirm the action when prompted.
4. Select **Exit** to return to the READ FLOW screen.



NOTE: THE LOGGED DATA WILL REMAIN STORED IN THE INSTRUMENT'S MEMORY AND CAN BE ACCESSED AT ANY TIME AS DESCRIBED ABOVE.

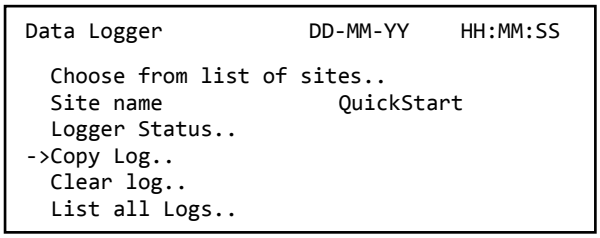
5.5 Copying logged data to a USB memory stick

This procedure describes how to copy a stored log file to a USB memory stick.

1. Connect the memory stick to the Portaflow USB socket (see page 6).
2. Access the *MAIN* menu.

   IMPORTANT: IF THIS IS DONE FROM THE FLOW READING SCREEN ANY LOGGING CURRENTLY TAKING PLACE WILL BE TERMINATED.

3. Select **Data Logger** from the *MAIN* menu.
4. Select **Choose from list of sites** and select the name of the site to download.
5. When you are ready to begin downloading the log select **Copy log**.



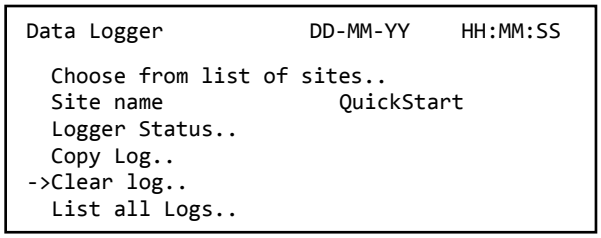
6. Logged data for the selected site is now copied to the USB memory stick.
7. Upon completion select **Exit** to return to the *MAIN* menu.

5.6 Clearing Log Files

1. Access the *MAIN* menu.

   IMPORTANT: IF THIS IS DONE FROM THE FLOW READING SCREEN ANY LOGGING CURRENTLY TAKING PLACE WILL BE TERMINATED.

2. Select **Data Logger** from the *MAIN* menu.
3. Select **Choose from list of sites** and select the name of the site to download.
4. Delete logged data for the selected site by selecting **Clear log**.



5. Upon completion select **Exit** to return to the *MAIN* menu.

6 OUTPUTS

6.1 4-20mA Current Output

The default 4-20mA output setting is OFF, and the 4-20mA LED on the keypad will not be illuminated. The default flow for 4mA is 0.

If the flow reading is greater than that set as the 20mA value, or there is negative flow, or no flow signal can be detected, then an alarm current of 2.5mA.

NOTE: THE 4-20MA CURRENT OUTPUT IS FACTORY CALIBRATED.

To change any of these settings:

1. From the MAIN menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key. With **Output** selected in the *Options* menu, press the ENTER Key.

   Alternatively, from a *Read Flow/Velocity/Energy* screen, press the OUTPUTS key (3). The *Output Board* menu is displayed.

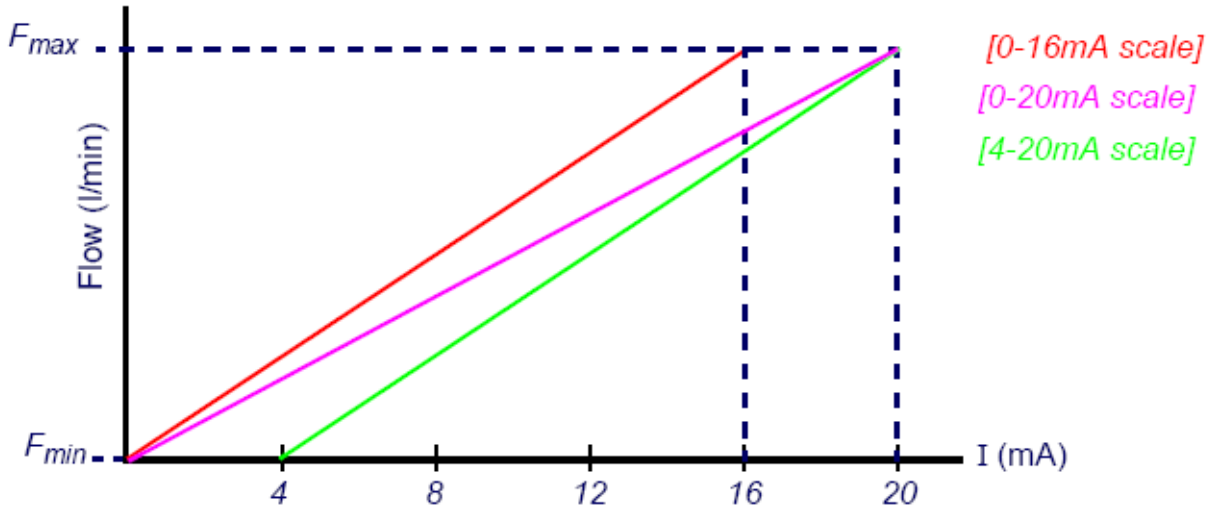
2. Use the UP/DOWN arrow keys to select **Current Loop Setup**. Press the ENTER key. The *Current Loop Setup* menu is displayed.

3. Edit the settings as required (see Table x). The 4-20mA can be set to represent a particular flow range. It is also possible to enter a negative figure for the minimum output and this would enable a reverse flow to be monitored.

Setting	Flow Options (default)	Power Options (default)
Current Loop Status	Off/On	
Measurement Source	Flow	Power
Value at min output metric Imperial US Imperial	 0 l/min 0 gal/min 0 US gal/min	 0 kW 0 BTU/hr 0 BTU/hr
Min output current	4.00 mA	
Calibrate min current	0.02 mA	
Value at max output metric Imperial US Imperial	 2000 l/min 439.939 gal/min 528.344 USgal/min	 0.033333 kW 113.738 BTU/hr 113.738 BTU/hr
Max output current	20.00 mA	
Calibrate max current	0.03 mA	
Output error current	2.50 mA	
Error Current Source	Exceeds Value/Under Value/Signal Loss/Out of Bounds/None	
Alarm trigger point metric Imperial US Imperial	 2000 l/min 439.939 gal/min 528.344 USgal/min	 0.033333 kW 113.738 BTU/hr 113.738 BTU/hr

6.1.1 Converting the measured current to flow rate

Assume the maximum flow rate is F_{max} (l/min) and the minimum flow rate F_{min} is '0' (l/min), as shown below.



To calculate the flow rate (l/min) for a measured current (mA) then:

0-20mA

$$Flow\ rate = I\ x\ \frac{(F_{max} - F_{min})}{20} + F_{\min}$$

0-16mA

$$Flow\ rate = I\ x\ \frac{(F_{max} - F_{min})}{16} + F_{\min}$$

4-20mA

$$Flow\ rate = (I - 4)\ x\ \frac{(F_{max} - F_{min})}{16} + F_{\min}$$

6.2 Digital Outputs

The three digital outputs can each be set up to operate in one of three modes:

- Pulse Output (set to *Normally Open* or *Normally Closed* contact types*)*
- Alarm Output (set to *Rising* or *Falling* signal directions)
- Frequency Output (with *High Frequency* and *Low Frequency* settings)

The measurement source can be:

- Volume (not compatible with Frequency Output)
- Flow (not compatible with Pulse Output)
- Energy (not compatible with Frequency Output)
- Power (not compatible with Pulse Output)
- Signal (not compatible with Pulse Output)

To configure any of the digital outputs:

1. From the MAIN menu, use the Up and Down scroll keys to select **Setup Instrument**. Press the ENTER Key. With **Output** selected in the *Options* menu, press the ENTER Key.

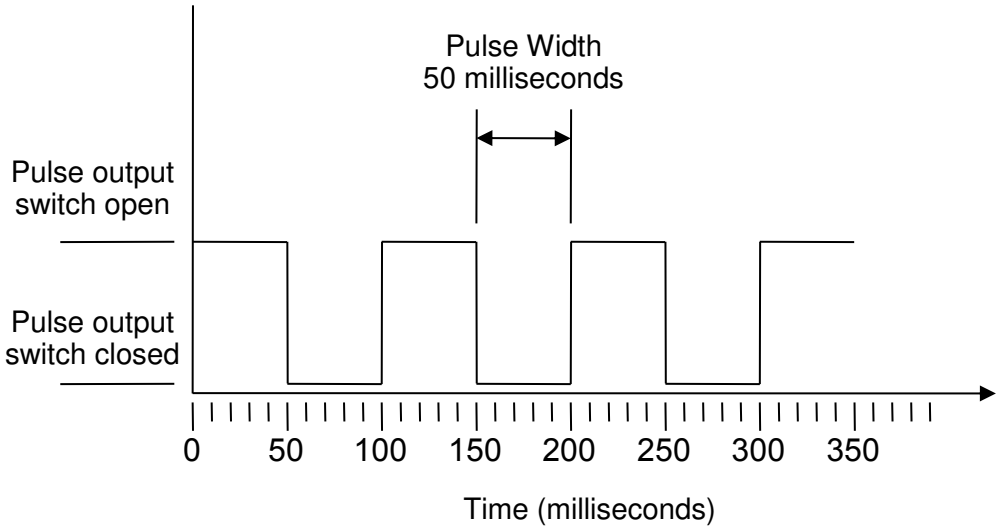
   Alternatively, from a *Read Flow/Velocity/Energy* screen, press the OUTPUTS key (3). The *Output Board* menu is displayed.

2. Use the UP/DOWN arrow keys to select **Digital Device 1/2/3 Setup**. Press the ENTER key. The *Output 1/2/3* menu is displayed.
3. Use the UP/DOWN arrow keys to select **Function**. Press the ENTER key.
4. Use the UP/DOWN arrow keys to scroll through the output types: **Pulse Output, Alarm Output or Frequency Output**. With the required output selected, press the ENTER key.
5. Edit the settings as required (see Table x).

Pulse Output		Alarm Output		Freq. Output	
Setting	**Option/default**	**Setting**	**Option/default**	**Setting**	**Option/default**
Quantity Per Pulse	Volume:0.010 m^3 Energy:36.000kJ	Direction	Rising / Falling	Low Freq.	0 Hz
Pulse Duration	50ms	Activation Level	Volume: 500m^3 Flow: 3e+07 l/min Energy:1.8e+06 kJ Power: 500kW Signal: 0.5	Low Value	Flow:0.00 l/min Power: 0 kW Signal:0
Contact Type	Normally Open/ Normally Closed	Deactivation Level	Volume 475m^3 Flow: 2.85e+07 l/min Energy:1.71e+06 kJ Power: 475kW Signal: 0.5	High Freq.	200 Hz
				High Value	Flow: 59999996.1 l/min Power: 1000 kW Signal: 1

6.2.1 Setting up Volumetric Pulse

The default pulse width is set to 50ms which represents half of one pulse cycle. A 50ms pulse width is required for most mechanical counters.



Default Pulse Width

Formula to obtain Volume per Pulse based on a (default) 50ms pulse width:
Volume per Pulse >= maximum flow rate (in litres per minute) / 600

Example for maximum flow rate of 500 l/min:
Volume per Pulse >= 500 l/min / 600 = 0.833 litres per pulse
Rounding up to nearest whole litre:
Set **Volume per Pulse** to **1 litre.**

6.2.2 Frequency Mode

In Frequency mode, the output frequency is proportional to the flow rate within a specified frequency range of 1 – 200Hz. The flow units are fixed as litres per second.

6.2.3 Energy Pulse (Portaflow 333 only)

Each pulse represents an amount of energy e.g. 1kWh. The same limitation on maximum pulse rate applies as detailed in the Volumetric Mode. Again a larger unit of energy per pulse or a smaller pulse width may be required.

7 MAINTENANCE AND REPAIR

This instrument does not contain any user-serviceable parts. The following notes are provided as a guide to general equipment care.

IMPORTANT: DO NOT DISASSEMBLE THIS UNIT UNLESS ADVISED BY MICRONICS. RETURN THE UNIT TO AN APPROVED SERVICE AGENT OR PLACE OF PURCHASE FOR FURTHER ADVICE.

1. Ensure the unit is switched off and disconnected from the mains, then wipe the exterior of the instrument with a clean, damp cloth or paper towel. The use of a solvent may damage the surface.
2. The instrument contains a rechargeable battery; dispose safely and in accordance with the local regulations in force in the country of operation.
3. Ensure all cables and connectors are kept clean and free from grease or contaminants. Connectors may be cleaned with a general purpose cleaner if necessary.
4. Avoid the use of excessive grease/ultrasonic couplant on the sensors as this may impair the performance of the equipment. Excessive grease/couplant can be removed from the sensors and guide rails using an absorbent paper towel and a general purpose solvent cleaner.
5. We recommend that the ultrasonic couplant is replaced on the sensors every 6 months, especially on pipes where the application is too hot to touch. If the signal level drops below 30% this is also an indication that the sensors need re-greasing.
6. Regularly check all cables/parts for damage. Replacement parts are available from Micronics.
7. Ensure the person who services your instrument is qualified to do so. If in doubt, return the instrument to Micronics with a detailed report on the nature of any problem.
8. Ensure that suitable precautions are taken when using any materials to clean the instrument/sensors.
9. The instrument and sensors should be calibrated at least once every 12 months. Contact Micronics or your local service agent for details.
10. When returning product to Micronics make sure it is clean and please notify Micronics if the instrument has been in contact with any hazardous substances.
11. If the instrument was supplied with dust or dirt caps make sure they are re-fitted when the instrument is not in use.

8 TROUBLESHOOTING

8.1 Overview

If you have a problem with your flow monitoring system it can be due to any of the following:

Faulty instrument	If you suspect the instrument is faulty you can check it out using a test block as described on page 44. This will establish that the instrument is functional and receiving a healthy signal from the connected transducers.
Incorrect setup	A low, or zero, signal could be caused by incorrect set-up such as: • Incorrect site data entered into the instrument. • Incorrect or non-matching ultrasonic transducers selected for use. • Incorrectly fitted transducers – lack of couplant applied, incorrect spacing, insecure attachment. • Poor connections between the probes and the instrument.
Application problem	If you are certain that the instrument is healthy and suitably set-up for the current site; and the probes are properly assembled and fitted correctly, there could be an application problem concerned with the site. Check such conditions such as: **Poor pipe outer surface quality** • Uneven surface preventing good surface contact with the transducer. • Flaking paint (should be removed). • Variable air gap in concrete-covered pipes affecting the ultrasonic signal quality. **Poor internal pipe construction** • Rough internal pipe walls affecting fluid flow (see roughness factor). • Internal welds positioned in the transducer signal path affecting the signal quality. • The 'drippings' in galvanised-dipped pipes or other irregularities interfering with the signal path. **Incorrect probe location** • Transducers located too close to bends or valves, disturbing the flow profile. • Transducers located too close to insertion probes, disturbing the flow profile. • For horizontal pipework transducers should not be positioned on the top of the pipe. **Poor fluid conditions within the pipe** • Fluid contains bubbles, high particle density or sludge. • Air in the top of the pipe. **Low fluid flow within the pipe** • Pipe obstructions. • Malfunctioning valve not opening fully (or closed inadvertently). **Liquid content problems** • Multiple liquid contents do not comply accurately to expected sound speed criteria. • Very hot pipe almost turns water to steam and therefore exhibits the wrong speed characteristics – could be due to reduced pipe pressure. • Flashover – liquid turns into a gas because of lower than required pressure. **Automatic signal loss recovery** • If the signal is lost or the Quality falls below 40% then the set up procedure, normally invoked by Read Flow in the main menu, is automatically run until a good quality signal is found.

8.2 General Troubleshooting Procedure

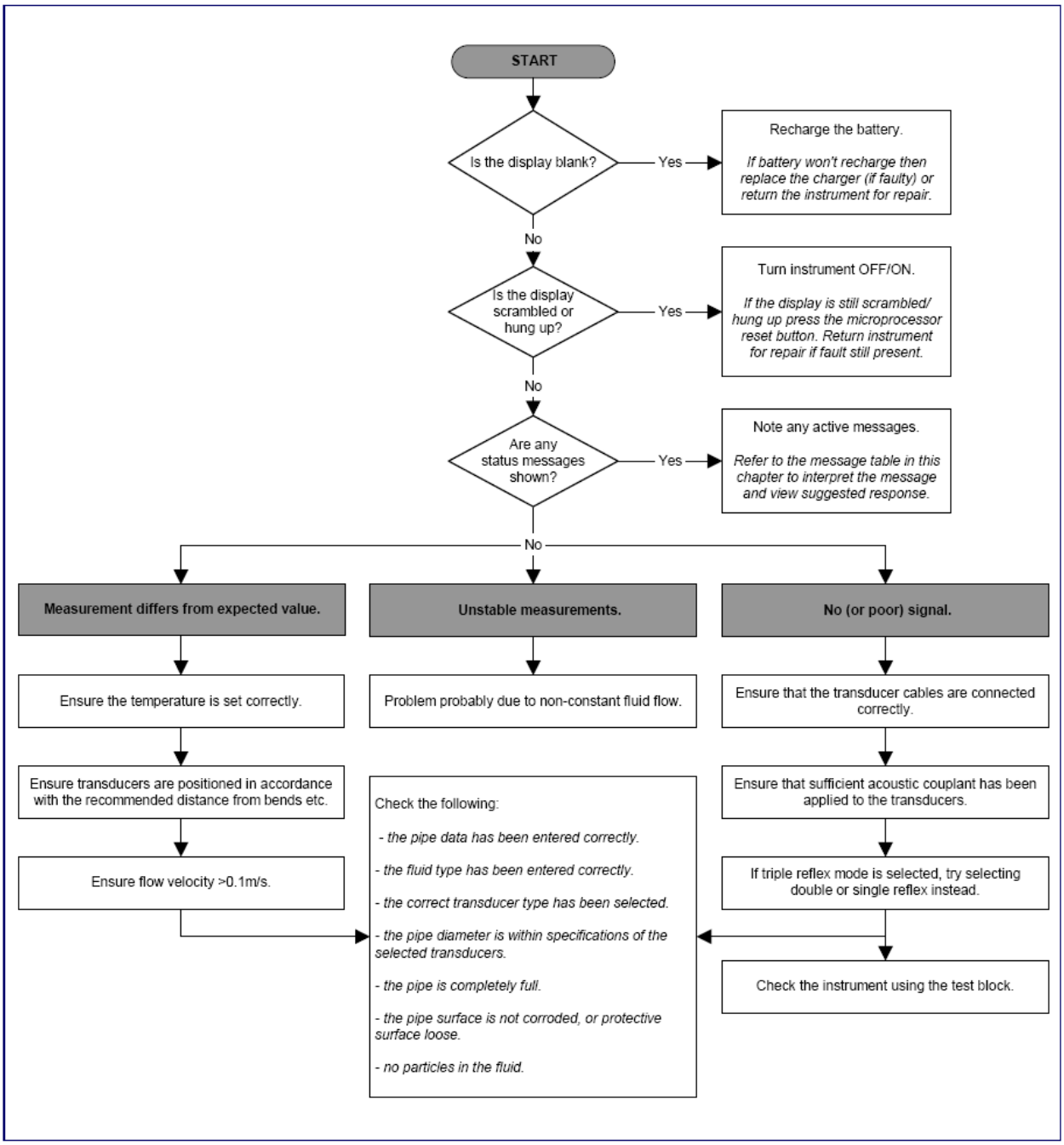


Figure 14 Troubleshooting chart

8.3 Warning and Status Messages

8.3.1 Flow Rate Errors

No flow signal	Interpretation: This message appears when the transducers cannot send or receive signals to each other. Response: Firstly check that all cables are connected, transducers are on the pipe correctly with sufficient couplant on the face. This condition could also be due to a partially empty pipe, aerated liquid, particulate content too high or when the condition of the pipe being measured is poor.
Flow signal is poor	Interpretation: This warning appears when the signal is lower than 25%. Response: This could be due to an application problem, a poor quality pipe – see also the conditions for No flow signal (above). Check for sufficient couplant.
Zero cut-off error!	Interpretation: You have entered an out-of-range value in the Zero cutoff field in the Options menu. Response: Enter a valid number.
Totaliser beyond maximum!	Interpretation: The totaliser has overflowed its maximum count. The counter will roll-over and restart from zero but this message alerts you to the fact. Response: Reset the totaliser as described in Paragraph 3.6.1.

8.3.2 Pulse Errors

Pulse Rate > Max	Interpretation: The flow rate exceeds the capability of the pulse output – i.e. too many pulses per second are required than can be achieved. Response: Narrow the pulse width time or increase the volume per pulse, as described on page 38.
Pulse volume error!	Interpretation: You have entered an out-of-range value in the Pulse volume error field in the PULSE OUTPUT menu – see page 38. Response: Enter a valid number.
Pulse width error	Interpretation: You have entered an out-of-range value in the Pulse width error field in the PULSE OUTPUT menu – see page 38. Response: Enter a valid number.

8.3.3 4-20mA errors

mA out > Max	Interpretation: The actual flow is higher than the maximum set on the mA range. Response: Re-scale the 4-20mA output to be able to cope with the higher flow –see page 36.

Calibration 20mA Error!	**NOTE: THE 4-20MA OUTPUT IS CALIBRATED BEFORE THE INSTRUMENT LEAVES THE FACTORY AND SHOULD NOT REQUIRE FURTHER ADJUSTMENT.** Interpretation: You have adjusted the DAC outside its accepted range when calibrating the 20mA signal output. Response: Re-calibrate the 4-20mA output – see page 36.
Calibration 4mA Error!	**NOTE: THE 4-20MA OUTPUT IS CALIBRATED BEFORE THE INSTRUMENT LEAVES THE FACTORY AND SHOULD NOT REQUIRE FURTHER ADJUSTMENT.** Interpretation: You have adjusted the DAC outside its accepted range when calibrating the 4mA signal output. Response: Re-calibrate the 4-20mA output – see page 36.

8.3.4 Data Logging Errors

Log not empty!	Interpretation: When using QuickStart and manually starting a log, this message is displayed to warn you that a log already exists. The screen will offer the option to cancel the logging, or save the log to another site. Response: Attempt to save the existing log, then re-start logging. If logging still fails to start, and the error message remains, then either all the sites are in use or all the Logger memory is full. Check for any unwanted log files and delete them.
Log memory full	Interpretation: This occurs when all the data logger memory locations are filled. The effect on the logging process will depend on the setting of the Memory rollover field in the REAL TIME LOGGER screen (which may be set to Stop or Overwrite). Response: Clear the logger memory, as described in Paragraph 3.6.4.

8.3.5 Battery Errors

Battery Low	Interpretation: The battery has discharged to below 30% remaining. This leaves the instrument with approximately 4 hours remaining, depending on power usage, before it needs recharging. Response: Recharge the internal battery at the earliest opportunity. Do not leave the instrument for a prolonged period with a fully discharged battery.
Battery Exhausted	Interpretation: The battery is approaching a fully discharged state and the instrument is about to store the internal data and shut-down. Response: Recharge the battery.

8.3.6 Set-up Errors

Pipe OD out of range	Interpretation: You have entered an out-of-range value for the pipe outside diameter dimension – i.e. larger or smaller than the unit or sensor can be used on.

	Response: Enter a valid number.
Wall thickness out of range	Interpretation: You have entered an out-of-range value for the pipe wall thickness dimension – accepted range is 1mm - 75mm. Response: Enter a valid number.
Lining thickness out of range	Interpretation: You have entered an out-of-range value for the lining thickness dimension – acceptable range is 0mm - 25mm. Response: Enter a valid number.
Temperature range	Interpretation: You have entered an out-of-range value for the fluid Temperature. Accepted temperature range -20°C to +300°C. Response: Enter a valid number.
Invalid Date or Time	Interpretation: The entered Date or Time is invalid, or when setting up 'timed' data logging the Stop time is set earlier than the Start time. Response: Enter a valid Date and Time.
Sensors: INVALID	Interpretation: The selected temperature is higher than the maximum allowed for the sensor type. Response: Select alternative sensors or change the temperature.
Mode: Err Typ	Interpretation: The selected sensors are invalid and the mode cannot be verified. Response: Select a valid sensor type and choose a mode that gives a non-zero separation distance.

8.4 Test Block

A test block is included with the Portaflow equipment to allow the transducers and inter-connecting cables to be functionally checked.

1. Switch ON the instrument.
2. Select **Quick Start** and enter the parameters shown in the table below for the appropriate transducer type (A or B):

Parameter	A Sensors	B Sensors
Pipe outside diameter	30.0mm	50.0mm
Pipe wall thickness	14.0mm	22.0mm
Pipe lining thickness	0.00	
Pipe wall material	Plastic	
Fluid type	Water	
Mode	Diagonal	
Temp	20°C	

3. At the end of the *Quick Start* procedure (see page 19), the *Summary* screen is displayed. Press the UP or DOWN arrow button. The *Sensors* screen is displayed.

```
Summary                DD-MM-YY    HH:MM:SS

  Site: TESTBLK
  Sensor separation: 2.0mm
  Pipe OD: 50.0mm, ID 6.0mm
  Sensor Type B-HT, Mode: Diagonal
  Fluid type: Water @20.0°C
 Press <- to continue, <> to select sens.
```

4. Use the UP/DOWN scroll keys to select **Sensor Set**. Press the ENTER key.
5. Select the appropriate sensor (the default will be "A") and press the ENTER key.
6. Select **Sensor mode**, choose **Diagonal** and press the ENTER key.
7. Select **Return to Summary screen** and press the ENTER key.

```
Sensors                DD-MM-YY    HH:MM:SS

->Sensor Set           B-HT
  Sensor Mode          Diagonal
  Return to Summary Screen..
  Main Menu..
```

8. Check that the3 parameters displayed are correct.
9. Apply acoustic couplant to the sensors and attach them to the test block with the connectors positioned towards the centre of the test block as shown in Figure x, and temporarily secure them in place using elastic bands or tape.
10. Connect the sensors to the Portaflow using the cables provided (see page 3).
11. Press the ENTER key to display the *Flow Reading* screen.
12. Press the SYSTEM key (2) to display the *System Settings* screen.
13. Set **Damping** to at least 10 seconds.
14. Select **Save Setup & Exit** and press the ENTER key to return to the *Read Flow* screen.
15. The flow reading value displayed is not important. The fact that a reading is obtained indicates that the instrument is functioning. This value may fluctuate but this is normal.

16. The signal strength indicator at the left of the display should show 3–4 bars.

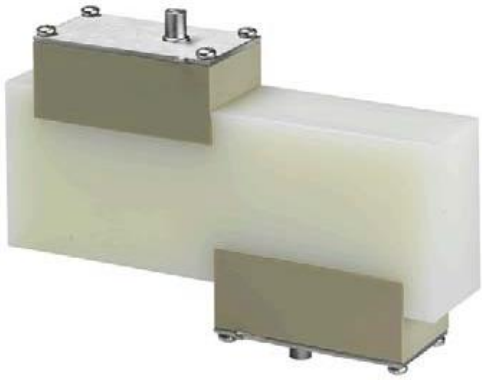


Figure 15 Sensors on the test block

8.5 Reset

To reset the Portaflow, carefully inserting a straightened paperclip into the pinhole located in the right-hand side of the instrument to operate the internal reset switch. Hold the paperclip perpendicular to the instrument while doing this.

8.6 Diagnostics

This feature is designed for advanced users and is intended to provide information that will aid the user to diagnose problems – e.g. no signal strength.

When operating in the FLOW READING mode you can access a diagnostics screen by pressing the **Daigs** function key and then selecting **Diagnostics** from the FLOW READING OPTIONS screen. This will display the operating values for the following parameters.

ETA (µs)	Value the instrument predicts will be the time in µsecs that it should take for the acoustic wave to propagate across a particular pipe size. This value is ascertained from the data entered by the user: pipe size, material, sensor set etc.
ATA (µs)	Value the instrument measures as the time taken for the acoustic wave to propagate across the pipe. It is used to see if the signal is being taken from the burst, at the correct time to get the strongest signal. This value is normally a few µs below the calculated µs value. If, however, this value is much greater than the calculated time then there is a problem with the set-up.
Upstream Fluid Time	
delta T	
Instantaneous Velocity	
Cutoff Velocity	
Flow (m/s)	Flow velocity in m/sec to 3 decimal places.
SNR	
Signal	Averaged value of Signal and should be a value between 800 and 1600 – where 800 is approximately 50%, and 1600 is approximately 100%.
Noise	
Gain	Gain values are typically in the range 600 to 850.
Pipe Bore	
Advanced Diagnostics..	Display the Advanced Diagnostics (see below)

8.6.1 Advanced Diagnostics

LFF [ns/m/s]	
Average Velocity	
Average delta t	
Reynolds Number	
Correction Factor	
Roughness factor	
Zero Flow Offset	
Calibration factor	
Separation distance	
Solid time	
Flow Side Temperature	
Return Side Temperature	
Sensor Set	
Sensor Mode	

9 APPENDIX

9.1 Specification

General	
DSP Measurement Technique	Transit time
Timing Resolution	50 pico-second, continuous signal level indication on display
Flow Velocity Range	Minimum Velocity 0.1m/s; Max Velocity 20m/s: Bi-directional.
Turn Down Ratio	100:1
Accuracy	±0.5% to ±2% of flow reading for flow rate >0.2m/s and Pipe ID >75mm. ±3% of flow reading for flow rate >0.2m/s and Pipe ID in range 13mm - 75mm. ±6% of flow reading for flow rate < 0.2m/s.
Repeatability	±0.5% of measured value or ±0.02m/s whichever is the greater.
Reynolds Number Correction	Flow velocity corrected for Reynolds number over entire velocity range.
Response Time	< 500ms depending on pipe diameter
Selectable Flow Units	VELOCITY: m/sec, ft/sec. VOLUME: l/s, l/min, l/h, gal/min, gal/h, USgals/min, USgals/h, Barrel/h, Barrel/day, m^3/s, m^3/min, m^3/h.
Selectable Volume Units	l, gal, USgals, Barrel, m^3.
Total Volume	12 digits – forward and reverse
Applicable Fluid Types	
Fluid Condition	Clean liquids or oils that have less than 3% by volume of particulate content. Applications include river water, sea water, potable water, demineralised water, glycol/water mix, hydraulic systems and diesel oil.
Applicable Pipe Types	
Pipe Materials	Any sonic conducting medium such as Carbon Steel, Stainless Steel, Copper, UPVC, PVDF, Concrete, Galvanised Steel, Mild Steel, Glass, Brass. Including Lined Pipes - Epoxy, Rubber, Steel, Plastic.
Pipe Dimension (OD)	Min 13 mm; Max 5000 mm with D sensor set.
Pipe Wall Thickness	1 mm – 75 mm
Pipe Lining	Applicable pipe linings include Rubber, Glass, Concrete, Epoxy, Steel.
Pipe Lining Thickness	0 mm – 25 mm
Pipe Wall Temperature Range	Standard sensor operating temperature is -20°C to +135°C.
Transducer Sets	
Standard	Temperature Range -20°C to +135°C. 'A-ST' (standard) 13 mm…115 mm pipe O.D. (2MHz). 'B-ST' (standard) 50 mm…2000 mm pipe O.D. (1MHz). 'D'* 1500 mm…5000 mm pipe O.D. * Temperature Range -20°C to +80°C (0.5MHz).
Datalogger (333 models only)	

Data Logged	Log application details, flow rate. Logs data selected in setup, e.g l, gals, USgals, m^3.
No. Data Points	200K
Time Stamping	All data points
No. Sites	20
No. Datapoints per Site	All free memory can be allocated to any site up to a max of 200,000 data points
Programmable Logging Interval	5 secs to 1hr – Updating on screen the end time of memory remaining as sample units are selected. At overflow overwrite old data - or user selectable stop logging when memory is full. Logged data downloadable to PC via USB cable or RS232. Transfer to Microsoft Windows or Micronics user-compatible software package (optional).
Languages	
Standard supported languages	English, French, German, Italian, Spanish, Portuguese, Russian, Norwegian, Dutch, Swedish.
Outputs	
USB Interface	Supports USB 2.0 Full Speed (12Mbits/sec) mode, USB software driver provided.
Printer/Terminal	Serial RS232-C inc. handshaking.
Analog Output	4–20mA, 0–20mA, 0–16mA. *Resolution:* 0.1% of full scale. *Alarm current:* Any between 0–26mA. *Isolation:* 1500V Opto-isolated. *Maximum Load:* 620 Ohms.
Pulse Output TTL	Opto-isolated MOSFET relay. Max Current: 150mA **Volumetric mode** *Pulse repetition rates:* up to 500 pulses/sec (depending on pulse width), 500ms for 1 pulse/sec, 5ms for 100 pulses/sec. **Frequency mode** *Max. pulse frequency:* 200Hz *Flow at max frequency:* 9999 l/s
Electrical	
Supply Voltage	
Input Voltage Range	9 – 24V DC
Power Consumption	10.5W
Cable	5m screened 6 core
Battery	
Technology	5-cell NiMH
Capacity	3.8Ahr
Operating Time	Typically 20 hours continuous with backlight and 4-20mA output OFF.
Recharge Time	6.5 hours
Service Life	>500 charge/discharge cycles
Power Supply/Charger	
Manufacturer	Mean Well type GE18I12-P1J
Input Voltage Range	90-264 VAC

Input Frequency Range	47-63 Hz
Output Voltage	12 VDC
Max. Output Current	1.2A
Approvals	FCC, C-Tick, UL, CUL, TUV, CB & CE.
Mechanical	
Carry case	
Rating	All components are contained in a hard-wearing IP67 rated carrying case with a protective moulded foam insert.
Enclosure	
Material	Flame retardant injection moulded ABS.
Dimensions	264mm x 168mm x 50mm.
Weight (including Battery)	1.1 kg
Protection	IP54
Keypad	
No. Keys	16
Display	
Format	240 x 64 pixel graphic display, high contrast black-on-white, with backlight.
Viewing Angle	Min 30°, typically 40°
Environmental	
Operating Temperature	–20°C to +50°C
Storage Temperature	–25°C to +65°C
Operating Humidity	90% RH MAX at +50°C
Charging Temperature	0°C to +40°C
Approvals	
Safety	BS EN 61010
EMC	BS EN 61326 - 1:2006, BS EN 61326-2-3:2006
Battery Charger	EN61204 - 3
Shipping Information	
Box Dimensions	410mm x 205mm x 355mm
Weight	7.5 kg
Volumetric Weight	5 kg
Micronics reserve the right to alter any specification without notification.	

9.2 Default values

The settings will be configured at the factory for metric units. The following table lists the metric and imperial default values.

Parameter	Default Value	
	Metric	**Imperial**
Dimensions	mm	inches
Flow Units	l/min	USgal/min
Pipe size (ID)	1" to 4" and 1" to 6" pipes: 50 mm 4" to 6" pipes: 127 mm	1" to 4" and 1" to 6" pipes: 1.969 in 4" to 6" pipes: 5.000 in
Pulse Output	Off	Off
Energy per Pulse *(U1000MkII-HM only)*	1kW	1kBTU
Volume per Pulse	10 litres	2.642 US gallons
Pulse Width	50 ms	50 ms
Damping	20 seconds	20 seconds
Calibration Factor	1.000	1.000
Zero Cut-off	0.02 m/s	0.07 ft/s
Zero Offset	0.000 m/s	0.000 ft/s

9.3 Limitations with Water-Glycol Mixtures

There is little available data on the specific heat capacity (K factor) for water glycol mixes and there is no practical method of determining the percentage of glycol in a system or the type of glycol in use. The flow calculations are based on a Water/Ethylene glycol mix of 30%.

In practical terms the results should not be considered more than an approximation as:

The fluid speed of sound can vary between 1480ms and 1578ms

No temperature compensation curve is available for water/glycol mixes,

The percentage of Glycol can vary the specific heat capacity from 1.00 to 1.6 J/M3 * K

The type of glycol added can change the specific heat capacity and fluid speed of sound considerably.

The Factory enabled user set-up of the application relies on the installer to set the correct operating parameters, a considerable variation in results can be obtained from incorrectly set-up units.

10 DECLARATION OF CONFORMITY

MICRONICS

EU Declaration of Conformity

Micronics Ltd

Knaves Beech Business Centre
Davies Way, Loudwater,
High Wycombe, Bucks.
HP10 9QR

The Products Covered by this Declaration
Portaflow 330, 220A, 220B, 440IP models.

(Also covered by this declaration are other models with identical construction to those listed above)

This product is manufactured in accordance with the following Directives and Standards.

Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the approximation of the laws of the Member States relating to electromagnetic compatibility

Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits

BS EN 61010-1:2010 Safety requirement for electrical equipment for measurement control and laboratory use. Part 1 General requirements

BS EN61326-1:2013 Electrical equipment for measurement control and laboratory use EMC requirements. Part 1: General requirements