# U1000MKII

## U1000MKII-FM: Clamp-on Ultrasonic Flow Meter
## U1000MKII-HM: Clamp-on Ultrasonic Heat Meter

# User Manual


U1000MKII-HM shown

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# 1 INTRODUCTION

## 1.1 General Description

This manual describes the installation and use of the two models in the U1000MkII range:

- **U1000MkII-FM** is an ultrasonic clamp-on flow meter for measuring flow rate and total flow with a volume pulse output and optional Modbus, M-Bus or 4-20mA flow proportional output. It can be used as a standalone meter or as part of an integral management system.
- **U1000MkII-HM** is an ultrasonic clamp-on thermal, heat/energy meter. It uses ultrasound to measure flow rate and is also equipped with PT100 temperature sensors to measure flow and return temperatures. The U1000MKII-HM displays energy rate and totalised energy with pulse output and communication options, so it can be used as a standalone meter or as an integral part of Automatic Monitoring & Targeting (aM&T) or a Building Energy Management System (BEMS).

The electronics and sensor housings form an integral unit which attaches to the pipe using the supplied hose clips. Power to the unit is provided by an external 12 - 24V DC/24V AC power supply (7W/7VA minimum). The unit operates on steel, stainless steel, copper and plastic pipes with internal diameter in the range 20mm (0.8”) to 165mm (6.5”) depending on the product purchased. The models can also be supplied with Modbus or M-Bus digital communication options.

Typical applications:

**U1000MkII-FM**

Hot water metering and flow measurement

Flow measurement for heat metering

Chilled water metering and flow measurement

Potable water metering and flow measurement

Process water metering and flow measurement

Ultra-pure water metering and flow measurement.

**U1000MkII-HM**

Hot water metering and flow measurement

Flow measurement for Energy Metering

Chilled water metering and flow measurement

**NOTE:**

U1000MkII-HM units' default configuration are:

- **Instrument Type:** Heating
- **Installation Side:** Return
- **Fluid:** Water

*Return* refers to the location of the flow measurement relative to flow circuit.

## 1.2 How Does It Work?

The U1000MKII uses 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.

With HM models, two temperature sensors measure the difference in temperature between the flow and return of the flow system being monitored. The temperature difference, in combination with the volume of water that has flowed through the system, is then used to calculate the energy transferred to or from the water.

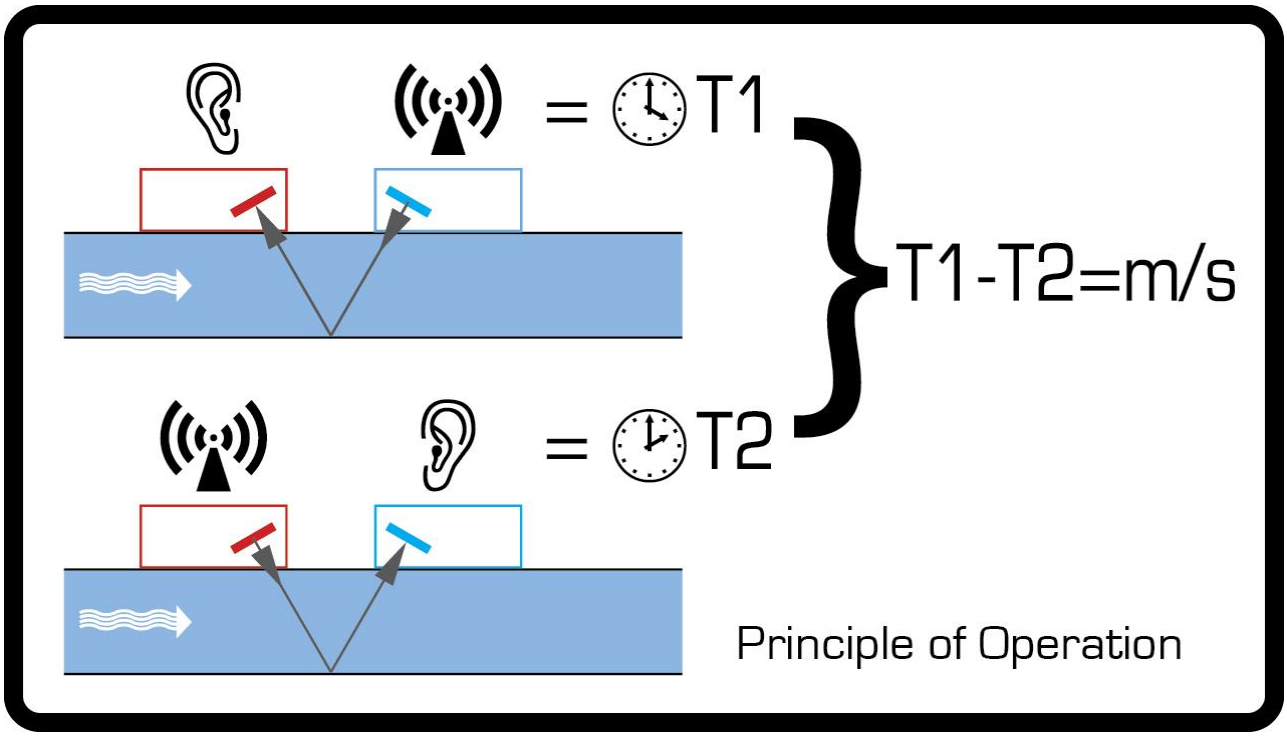



**Figure 1 Principle of Transit-Time operation**

## 1.3 Package Contents

The unit consists of two parts:

1. **Sensor Assembly**
   Incorporating guide rails and two transducers for flow measurement.
2. **Electronics Module**
   Consisting of the keypad and display, power, signal and comms connections. The Electronics Module clips onto the Sensor Assembly.

In addition, the kit contains:

3. Adhesive gel pads (4) p/n 223-5003.
4. 2-part adaptors for fixing sensor assembly to pipes with an OD less than 60mm (2)
   p/n 225-5005 (U1000 SMALL PIPE V CLAMP)
   p/n 225-5009 (U1000 VERY SMALL CIRCLE PIPE CLAMP)
5. *U1000MkII-HM only:* Non-releasable stainless cable ties for temperature sensors (2)
   p/n 223-5005
6. Quick release clamps for use with pipes with an OD of 25-70mm (2) p/n 225-5007.
7. Quick release clamps for use with pipes with an OD of 51-127mm (2) p/n 225-5001.
8. *U1000MkII-HM only:* PT100 temperature sensors with 3m cable (2)
   p/n 231-5005.
9. Modbus/M-Bus cable (optional) p/n 194-5040.

The kit also contains a copy of this manual.

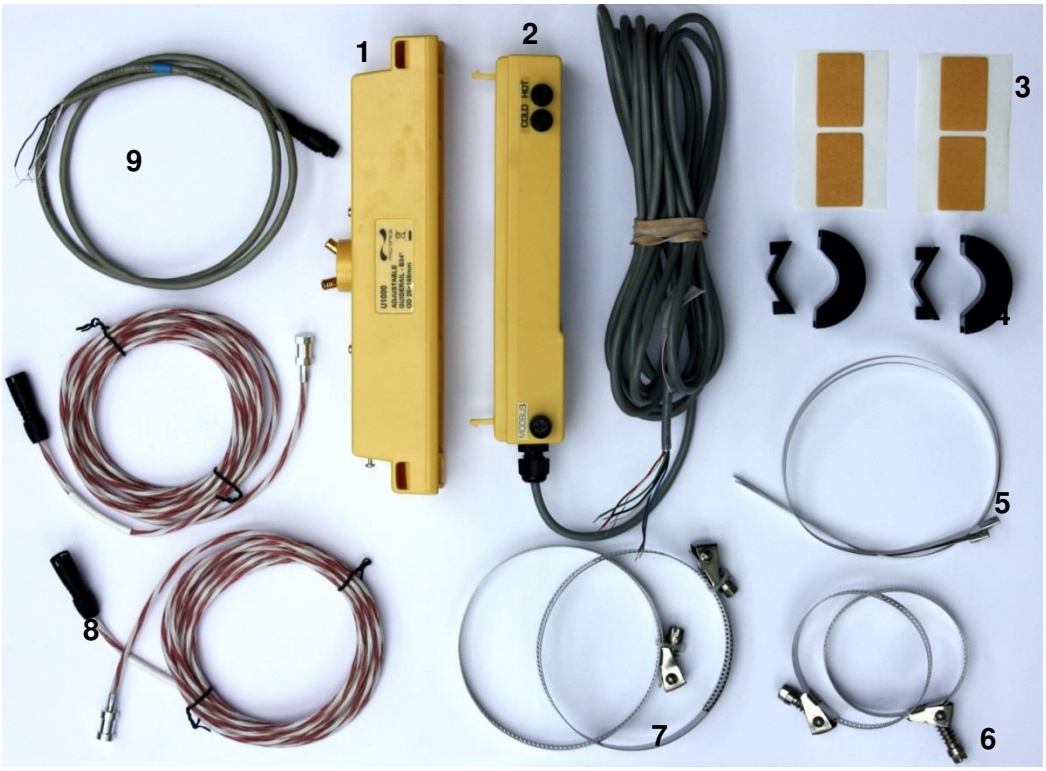



**Figure 2 Package Contents**

## 1.4 Display

The U1000MKII display comprises:

- One 2-line x 16 character LCD with backlight
- Four tactile key switches
- Two LEDs

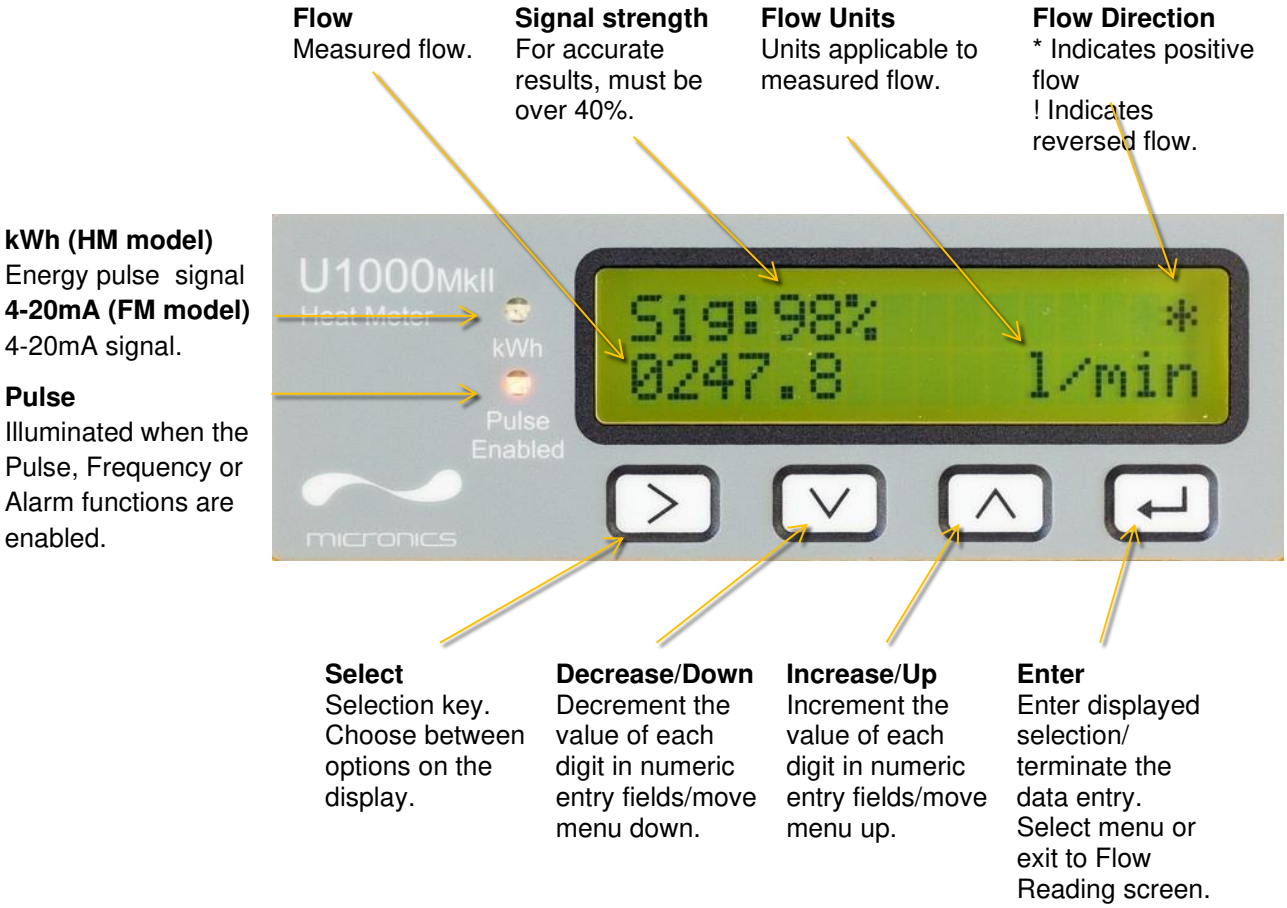



**Figure 3 U1000MKII Display (HM model shown)**

## 1.5 Quick Start Procedure

The following procedure summarises the steps required to set up the U1000MkII. Please refer to the referenced sections for full details.

1. Identify a suitable location for the U1000MkII on a straight length of pipe clear of bends and valves or similar obstructions (See pages 6 and 46).
2. Electronics Module:
    a. Connect to a 12 to 24V DC or 24V AC power supply (7W/7VA minimum per instrument) using the Blue and Brown wires. (See page 7).
    b. Switch on and program to determine the correct separation code (See page 15).
3. Sensor Assembly:
    a. Loosen but do not remove the two sensor-holding screws to lower the flow sensors so they can slide along the Sensor Assembly's internal guide rail (see page 16).
    b. Set the flow sensors to the correct separation (see page 16).
    c. Tighten the sensor-holding screws.
    d. Apply the gel pads to the sensors (see page 16).
    e. Mount the Sensor Assembly on to the pipe using the supplied hose clip (see page 18).
    If the pipe has an OD less than 60mm, use the adaptors provided (see page 17).
    f. Remove the sensor-holding screws (See page 18).
4. Connect the two wires from the Sensor Assembly to the Electronics Module (see page 19).

    **DO NOT CLIP THE ELECTRONICS MODULE ONTO THE SENSOR ASSEMBLY AT THIS STAGE. THE ELECTRONICS MODULE CAN BE FULLY CLIPPED DOWN LATER ONCE ALL MEASUREMENTS HAVE BEEN CHECKED.**
5. *U1000MkII-HM only*: Plug in the temperature sensors to the Electronics Module (see page 19) and attach the PT100 sensors to the flow and return pipes (see Section 2.1.1, page 6).
6. Check that flow readings can be obtained (see page 21).
7. Clip the Electronics Module to the Sensor Assembly and tighten the side screw to complete assembly (see page 22).

To use the Pulse Output features, see page 30.

To use the 4-20mA Output, see page 31 (*U1000MkII-FM only*).

To use the Modbus interface, see page 32. The address, data rate, and configuration of the instrument must be set using the Modbus Menu (see page 25). The default address is 1, the default data rate is 38400 baud, and the default Comms configuration is 8-None-2.

To use the M-Bus interface, see page 35. The primary address and data rate of the instrument must be set using the M-Bus Menu (see page 25). The default primary address is 1, and the default data rate is 9600 baud.

# 2 INSTALLATION

## 2.1 Identify Suitable Location

We recommend a location where there is a straight length of pipe with no bends, constrictions or obstructions within at least 10 times the pipe diameter upstream, and 5 times the pipe diameter downstream.

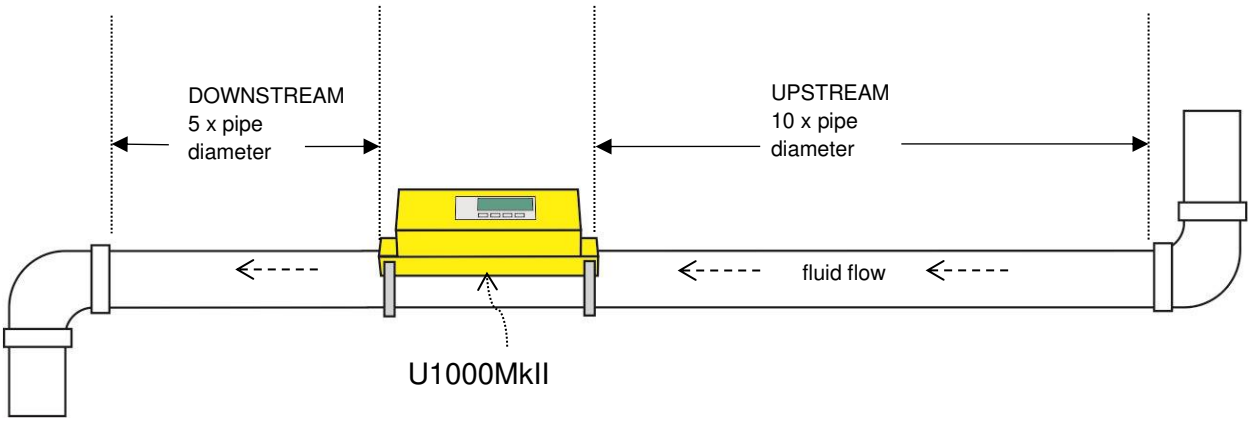



**Figure 4 Identifying a suitable location**

**IMPORTANT: DO NOT EXPECT TO OBTAIN ACCURATE RESULTS IF THE UNIT IS POSITIONED CLOSE TO ANY OBSTRUCTION THAT DISTORTS THE UNIFORMITY OF THE FLUID FLOW PROFILE (SEE PAGE 46). MICRONICS LTD ACCEPTS NO RESPONSIBILITY OR LIABILITY IF PRODUCT HAS NOT BEEN INSTALLED IN ACCORDANCE WITH THESE INSTRUCTIONS.**

### 2.1.1 Additional Considerations for Locating U1000MkII-HM

For optimum reliability on boiler applications, the flow measurement needs to be made on the cold side of the system. For optimum reliability in chiller applications, the flow measurement needs to be made on the warmer side of the system.

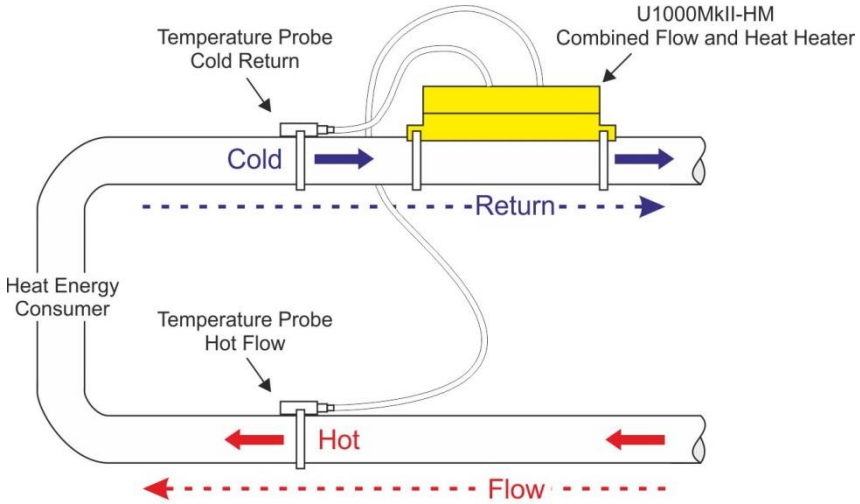



**Figure 5 Typical setup of U1000MkII-HM for boiler applications**

### 2.1.2 Clean the Pipe's Flow Sensor 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.

*U1000MkII-HM*: The area of pipe where the temperature sensors 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.

## 2.2 Connect Power and Signal Cables

This section explains how to connect power and signal cables to the Electronics Module.

### 2.2.1 Power Supply

The U1000MKII will operate within the voltage range 12 - 24V DC/24V AC. The supply must have a minimum rating of 7W/7VA per instrument. Connect the external power supply to the Brown and Blue wires of the six-core cable.

External power supply must be class 2 rated.

**IMPORTANT: IT IS THE RESPONSIBILITY OF THE INSTALLER TO CONFORM TO THE REGIONAL VOLTAGE SAFETY DIRECTIVES WHEN CONNECTING THE U1000MKII TO A POWER SUPPLY USING A MAINS-RATED TRANSFORMER.**

The U1000MKII interface cable supplied is a 6-core cable for power, pulse output and 4-20mA (if fitted) connections.

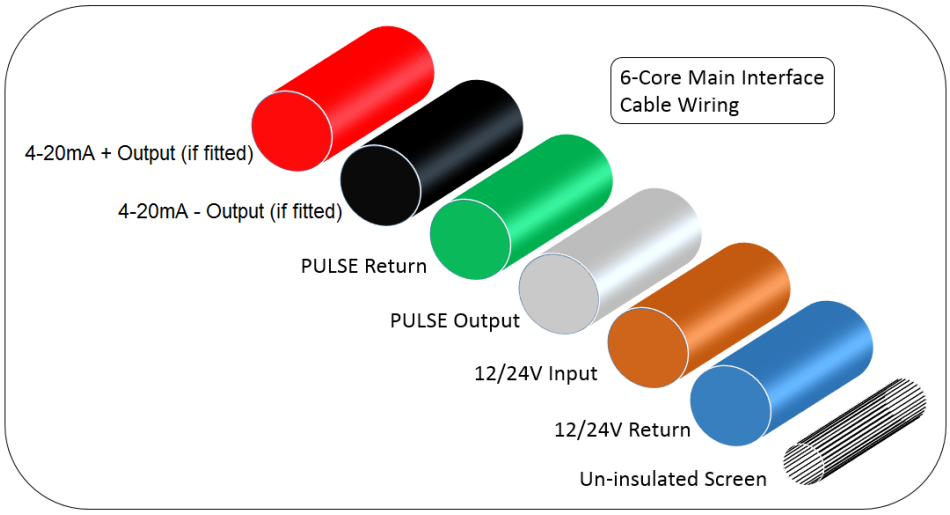



**Figure 6 6-core main interface cable**

The un-insulated wire is the connection to the screen of the cable and should be earthed for full immunity to electrical noise.

### 2.2.2 Pulse Output Connection

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 available at the White and Green wires. Electrically this is a Volt, or potential free contact and, when selected as a low flow alarm, is configurable NO/NC.

### 2.2.3 Current Output (U1000MkII-FM only, if fitted)

The isolated 4-20mA is a current source and can drive into a maximum load of 620Ω.

The 4-20mA current output is available at the Red and Black wires. The polarities are shown in Figure 6.

The alarm current due to a flow outside the range specified or due to a loss of signal is set at 3.5mA.

This output is suitable for SELV circuits only.

### 2.2.4 Modbus Connections (if fitted)

A separate 4 core plug-in cable is provided for the Modbus connections.

This plugs into the Electronics Module near the power cable entry.

| PIN | FUNCTION | COLOUR |
|---|---|---|
| 1 | MODBUS -ve | BLACK & BROWN |
| 2 | OPTIONAL GND | SCREEN |
| 3 | MODBUS +ve | BOTH WHITES |
| 4 | - | - |

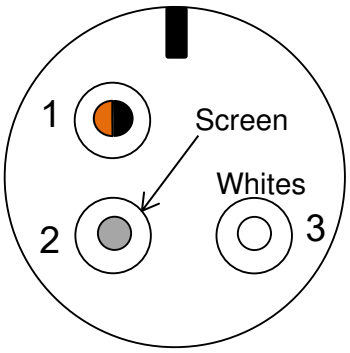



Figure 7 Modbus Connector Cable Part - Binder 99-9210-00-04 (Front View)

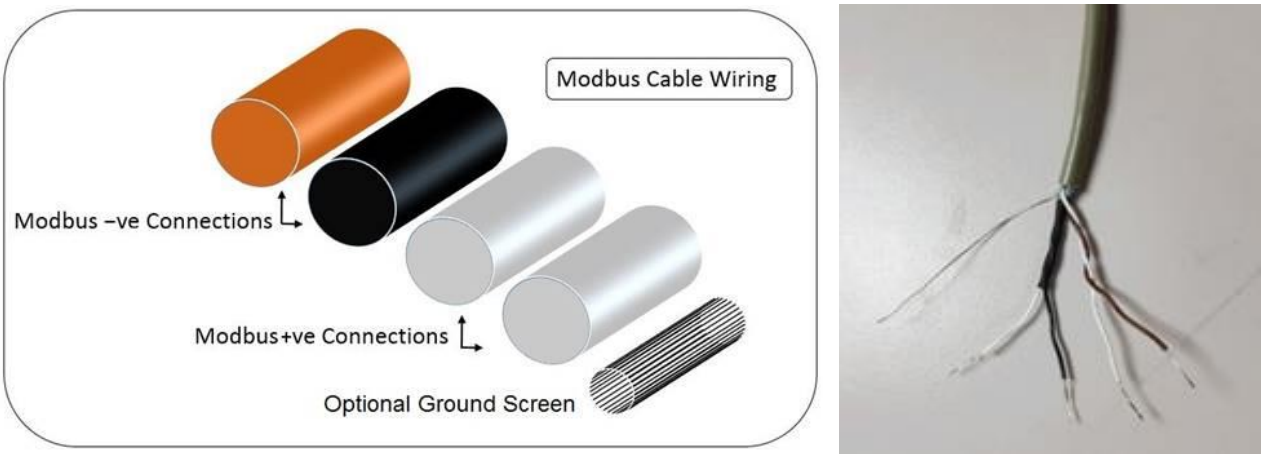



**Figure 8 Modbus cable wiring**

**NOTE: ENSURE THE WHITE WIRES ARE CORRECTLY ASSOCIATED WITH THE BLACK & BROWN WIRES. THE BLACK/WHITE TWISTED PAIR IS FITTED WITH A BLACK SLEEVE TO DISTINGUISH BETWEEN THE BLACK/WHITE AND BROWN/WHITE PAIRS.**

For reliable operation of a Modbus network the cable type and installation must comply with requirements in the Modbus specification document:

"**MODBUS over Serial Line Specification & Implementation guide V1.0**".

⚠ This output is suitable for SELV circuits only.

For full immunity to electrical interference the screen of the power/pulse output cable and Modbus cable should be connected to Earth.

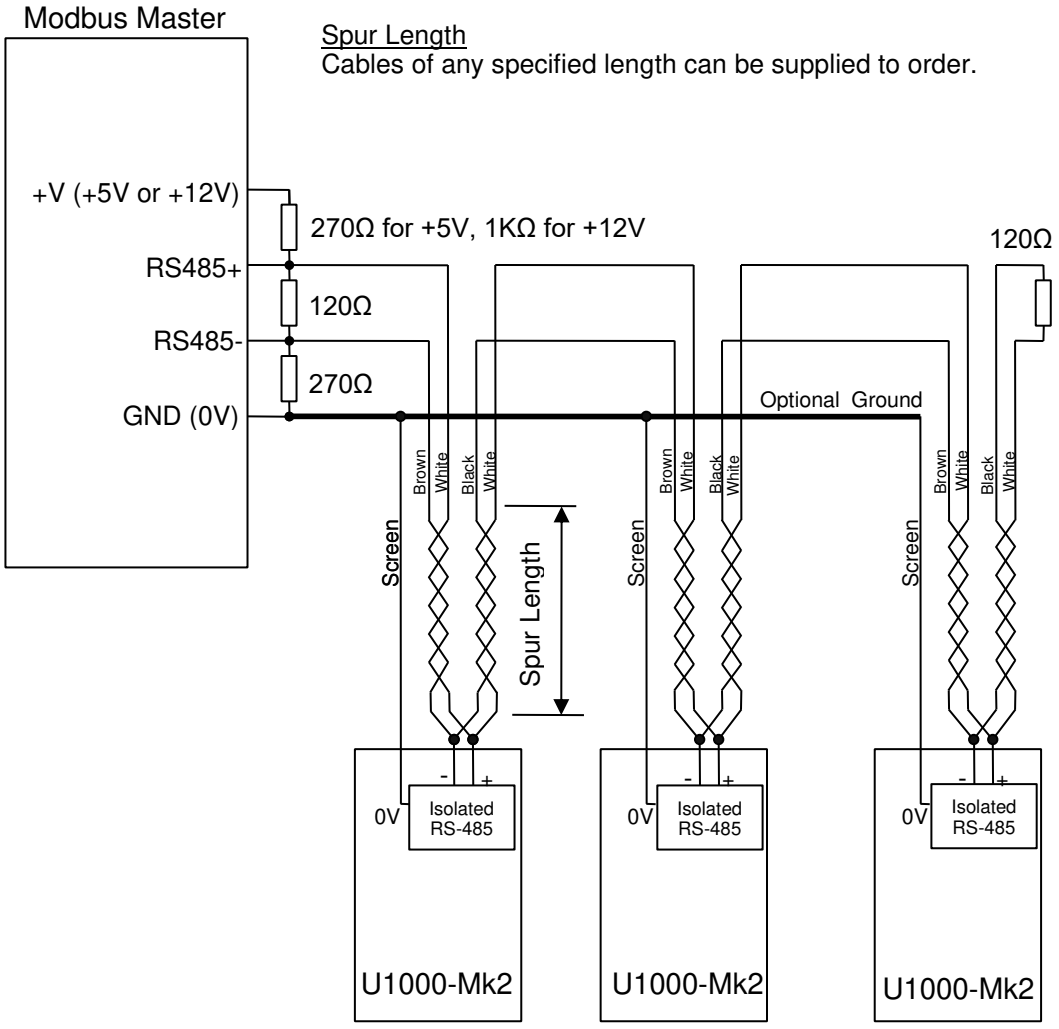



**Figure 9 Modbus wiring diagram**

### 2.2.5 M-Bus Connections (if fitted)

A separate 4 core plug-in cable is provided for the M-bus connections.

This plugs into the Electronics Module near the power cable entry.

| PIN | FUNCTION | COLOUR |
|---|---|---|
| 1 | M-BUS | BLACK & BROWN |
| 2 | OPTIONAL GND | SCREEN |
| 3 | M-BUS | BOTH WHITES |
| 4 | - | - |

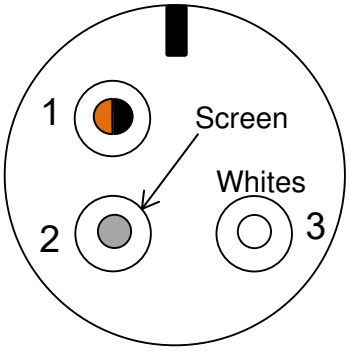



**Figure 10 M-Bus Connector Cable Part - Binder 99-9210-00-04 (Front View)**

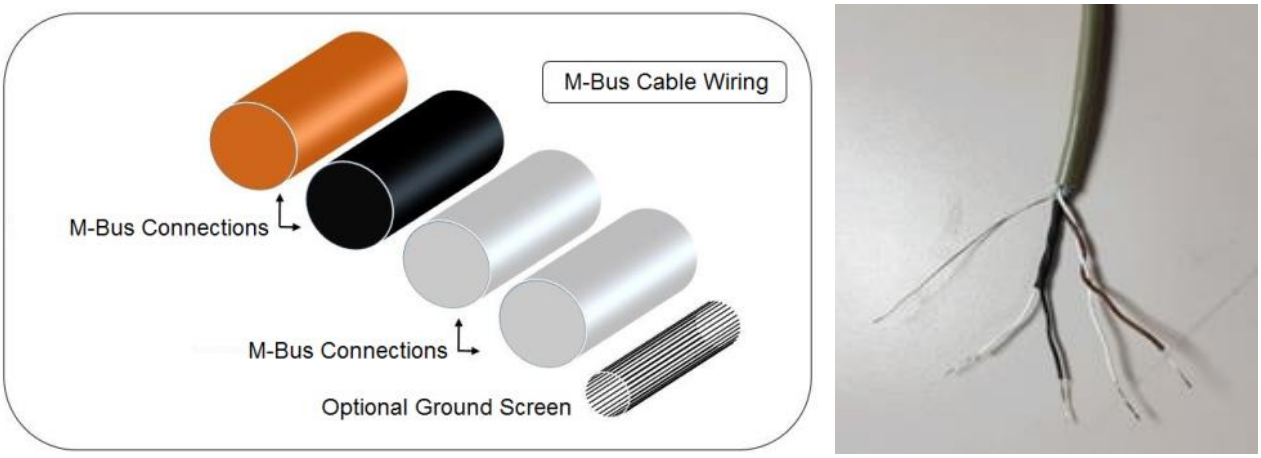



**Figure 11 M-Bus cable wiring**

**NOTE: ENSURE THE WHITE WIRES ARE CORRECTLY ASSOCIATED WITH THE BLACK & BROWN WIRES. THE BLACK/WHITE TWISTED PAIR IS FITTED WITH A BLACK SLEEVE TO DISTINGUISH BETWEEN THE BLACK/WHITE AND BROWN/WHITE PAIRS.**

For reliable operation of a M-bus network the cable type and installation must comply with requirements in the M-bus specification document:

Meter Communication Twisted Pair Baseband (M-Bus) Physical and Link Layer

For full immunity to electrical interference the screen of the power/pulse output cable and M-Bus cable should be connected to Earth.

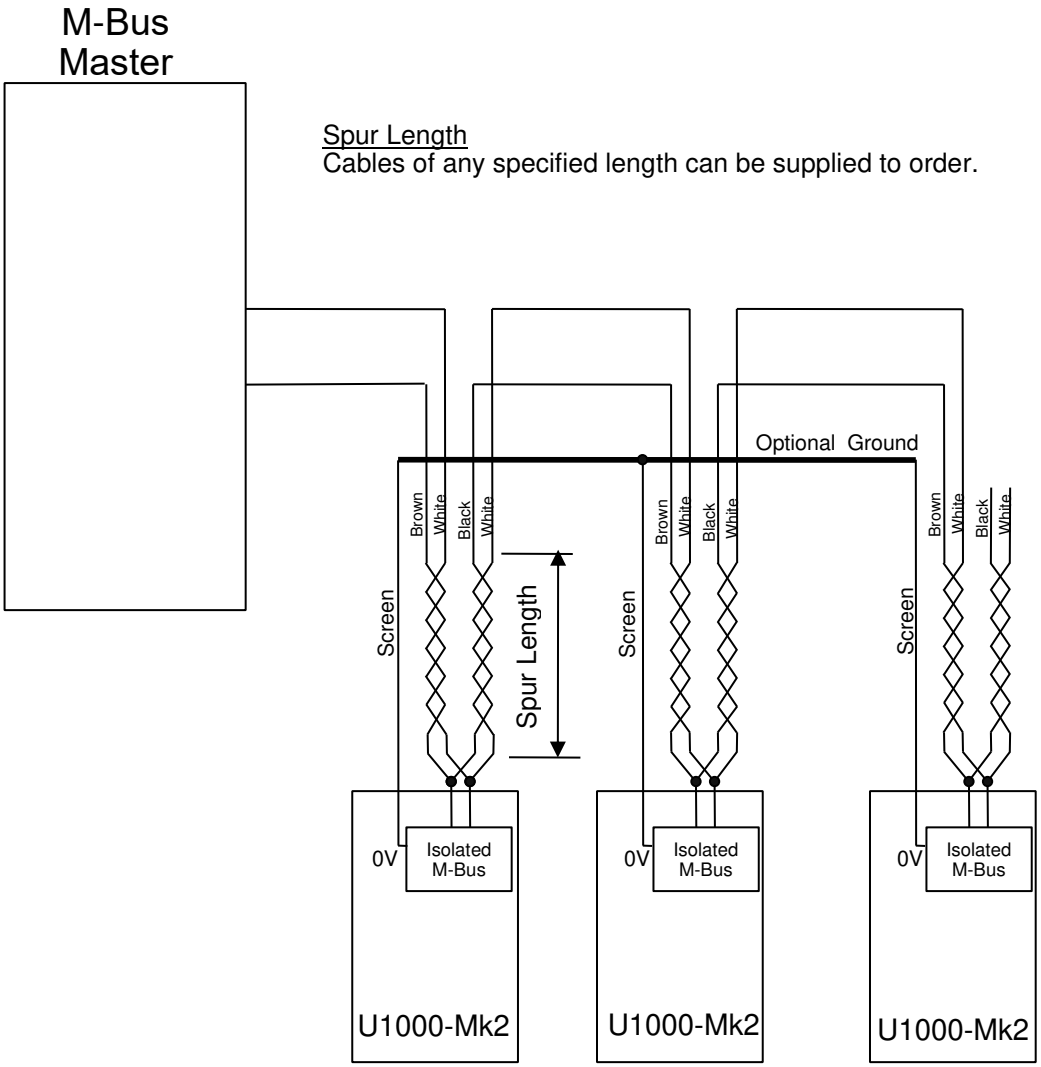



**Figure 12 M-Bus wiring diagram**

### 2.2.6 Temperature Sensor Probes (U1000-HM only)

Two separate 4-core plug-in cables are provided for the Temperature Sensor Probes connections. These plug into the right-hand side of the Electronics Module.

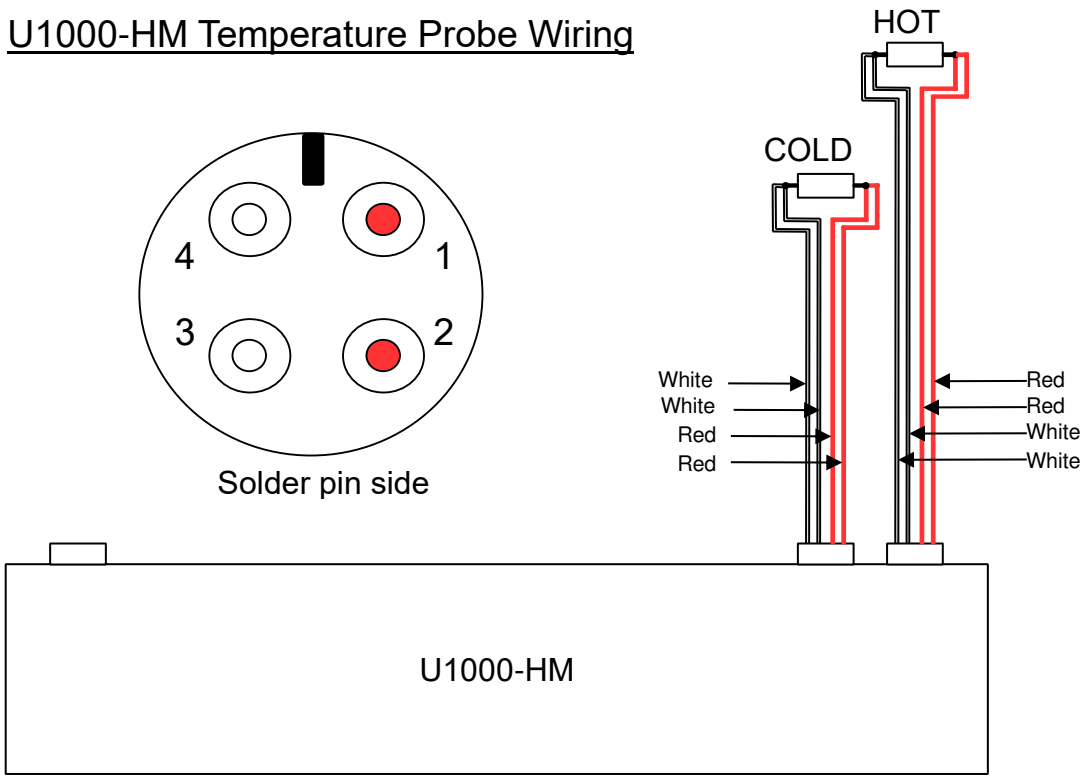



**Figure 13 U1000-HM Temperature Probe Wiring**

## 2.3 Switch On

**The initial screen sequence is different for the FM and HM models.**

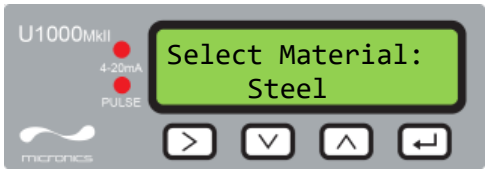
### 2.3.1 U1000MkII-FM

Switch on the power to the Electronics Module. A Micronics start-up screen is displayed for 5 seconds followed by hardware and software version information.


You are then prompted to enter the internal diameter of the pipe:

Use the >, ^ and v keys to change the value.

Press ↵ to confirm the value.




Select the pipe material by using the ^ and v keys to scroll through the list.

Press ↵ to confirm the material.


Select the fluid using the > key.

Press ↵ to confirm the fluid name.


The unit now shows the correct flow sensor separation (in this case, “B2”) for the chosen values of pipe ID, pipe material and fluid.

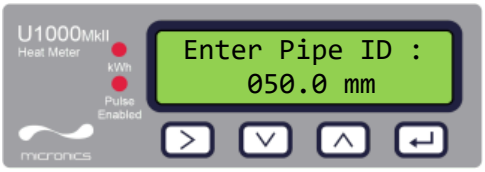
Make a note of the separation code.

All subsequent start-ups will use the same configuration.

Continue with the installation of the Sensor Assembly (see page 16).

### 2.3.2 U1000MkII-HM

Switch on the power to the Electronics Module. A Micronics start-up screen is displayed for 5 seconds followed by hardware and software version information.



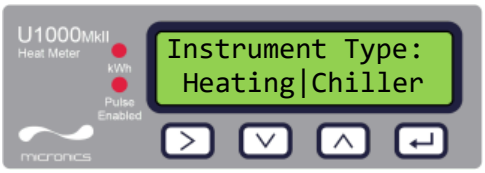

You are then prompted to enter the internal diameter of the pipe:

Use the >, ^ and v keys to change the value.

Press ↵ to confirm the value.


Select the pipe material by using the ^ and v keys to scroll through the list.

Press ↵ to confirm the material.



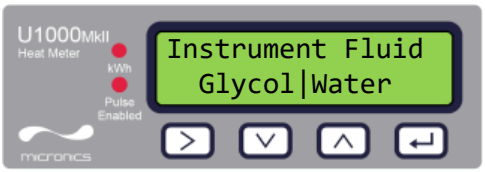

Select the instrument setting using >.
The unit is preconfigured for Heating applications.

Press ↵ to confirm the setting.


Select which side the electronics unit is installed using: >.

The unit is preconfigured for *Return*.

Press ↵ to confirm the setting.




Select the fluid using >.

Press ↵ to confirm the fluid name.


The unit now shows the correct flow sensor separation (in this case, “B-2”) for the chosen values of pipe ID, pipe material and fluid.

Make a note of the separation code.

All subsequent start-ups will use the same configuration

Continue with the installation of the Sensor Assembly (see page 16).

## 2.4 Adjust Flow Sensor Separation

Using the separation code displayed by the Electronics Module (see page 14/15), take the Sensor Assembly and adjust the flow sensor separation accordingly:


**Figure 14 Loosen the flow sensor-holding screws (left); slide to correct position (right)**

1. Undo the screws 2-3 turns, sufficiently to loosen the flow sensors and allow sideways movement. DO NOT fully unfasten or remove the screws at this stage.
2. Slide the flow sensors to the positions indicated on the display (e.g. “D5”).
3. With the flow sensors in the correct positions, tighten the sensor-holding screws so that the sensors are secure.

## 2.5 Apply Gel Pads

1. Apply a gel pad centrally onto the bases of each of the two flow sensors.
2. Remove the covers from the gel pads.
3. Ensure there are no air bubbles between each pad and sensor base.


**Figure 15 Applying the gel pads**

## 2.6 Clamp Sensor Assembly to Pipe

The next step involves clamping the Sensor Assembly onto the pipe. Ensure that you have selected a suitable location (see pages 6 and 46) and that the pipe is clean (see page 7). If you are installing the unit on a pipe with an outside diameter less than 60mm use one or more of the adaptors supplied with the unit.

### 2.6.1 Pipe Adaptors

The diagrams below show how the adaptors are fitted. The top 'V' shaped adaptor clips onto the ends of the Sensor Assembly and this should be used with all pipes with an outside diameter less than 60mm.

Additionally, for pipes with an outside diameter less than 40mm, a second adaptor should also be used. This fits underneath the pipe as shown below.

**IMPORTANT: DO NOT USE THESE ADAPTORS IF THE PIPE HAS AN OUTSIDE DIAMETER GREATER THAN 60MM.**

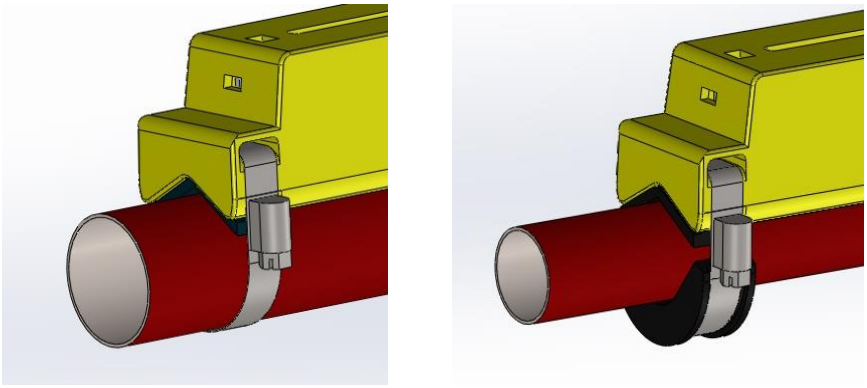


**Figure 16 Pipe adaptors in position: 40-60mm OD (left), less than 40mm OD (right)**

### 2.6.2 Attaching to Pipe

1. For pipes with an outside diameter less than 60mm, attach the black clips to the bottom of the Sensor Assembly as shown below.

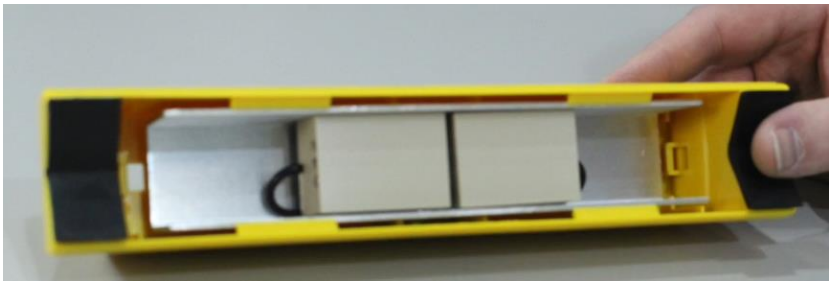


**Figure 17 Attaching pipe adaptor**

2. Place the Sensor Assembly on pipe.
3. For pipes with an outside diameter less than 40mm, position the curved adaptor under the pipe.

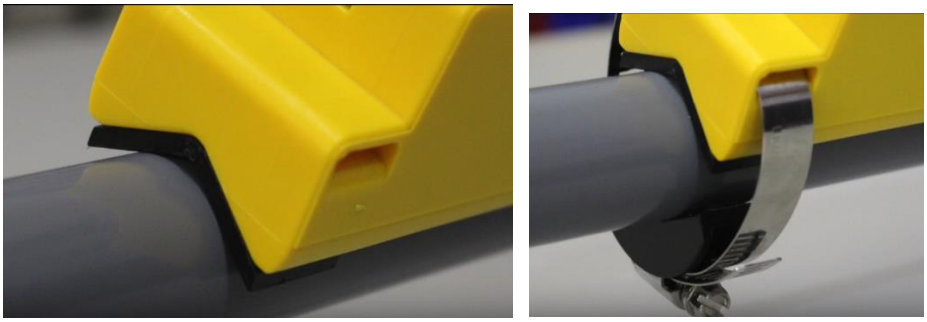


**Figure 18 Clamping pipe adaptor to pipe with OD less than 40mm**

4. Using the hose clips provided, clamp the Sensor Assembly (and adaptors, if used) to the pipe at an angle of 45° to the top of the pipe. Experience has shown that the most consistently accurate results are achieved when the unit is mounted at this angle (see page 46). This minimises the effect of any flow turbulence resulting from entrained air along the top of the pipe and sludge at the bottom.

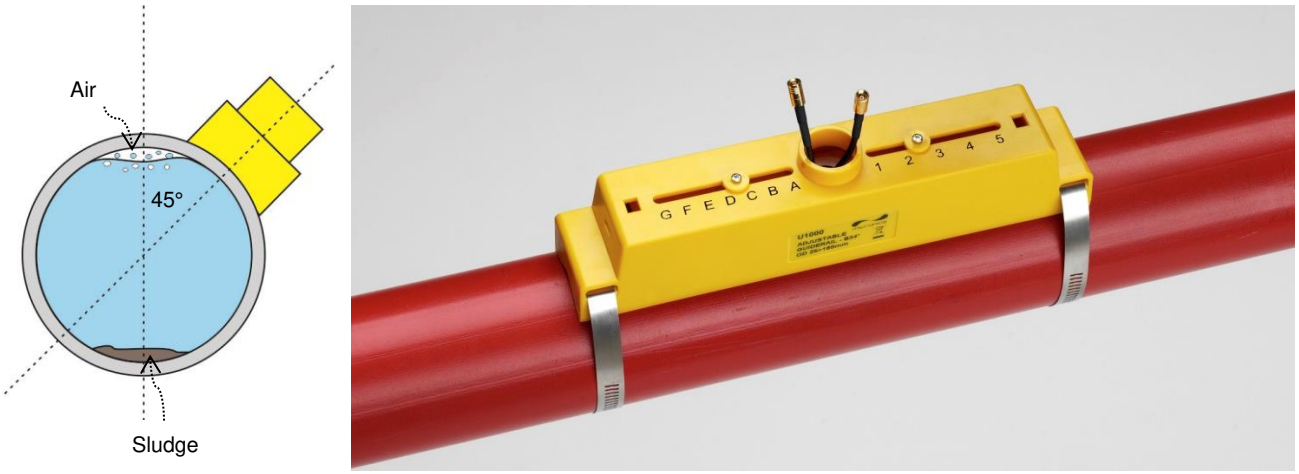



**Figure 19 Sensor Assembly clamped at 45°**

## 2.7 Remove Sensor-Holding Screws

Release and remove the sensor-holding screws. The flow sensors are spring-loaded to ensure good contact with the pipe surface.

**NOTE: THE SENSOR-HOLDING SCREWS AND WASHERS SHOULD BE KEPT IN A SAFE PLACE IN CASE IT IS NECESSARY TO RELOCATE THE UNIT (SEE PAGE 43).**


**Figure 20 Removing sensor-holding screws**

## 2.8 Connect Electronics Module

1. Ensure that the power is switched off.
2. Connect the Electronics Module (wired as described on page 7). The two leads can be connected either way round.

**IMPORTANT: DO NOT CLIP THE ELECTRONICS MODULE ONTO THE SENSOR ASSEMBLY UNTIL YOU HAVE CHECKED OPERATION.**


**Figure 21 Connecting the Electronics Module**

## 2.9 Attach the Temperature Sensors (U1000MkII-HM Only)

**IMPORTANT: THE TEMPERATURE SENSORS MUST BE BALANCED BEFORE INITIAL USE, USING THE PROCEDURE DESCRIBED BELOW AND USED WITH THE CABLE LENGTH SUPPLIED. EXTENDING OR SHORTENING THE CABLES WILL NEGATE THE CALIBRATION OF THE SENSORS.**

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.

The sockets on the Electronics Module are marked **Hot** and **Cold** (see Figure 22). This defines the location of the temperature sensors on installations where heat is being extracted from the system.


**Figure 22 Temperature Sensor connectors on the Electronics Module**

To ensure an accurate temperature differential:

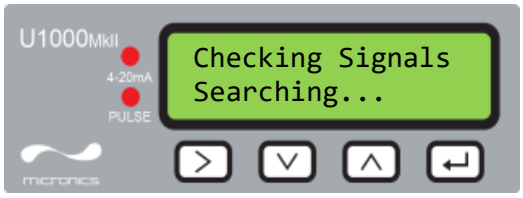
1. Plug the temperature sensors into the Electronics Module and place them touching each other for 1 minute.
2. Enter the password controlled menu and scroll to the *Calibration* sub-menu (see page 28).
3. Press the Enter key until the *Zero Temp Offset* screen is displayed (see page 28).
4. Select **Yes** and press the Enter key to display the *Attach Sensors* screen.
5. Press the Enter key again and wait for instrument to return to the *Zero Temp Offset* screen.
6. Switch off the power to the Electronics Module.
7. Complete the installation of the temperature sensors. The temperature sensors have a cut out profile to locate them; they are then anchored using the supplied cable ties. The cable ties should not be over tightened or the sensors may be damaged. If the sensors are located under pipe-lagging then ensure this does not put a strain on the sensor cables.
8. Tie down the sensor cables.

## 2.10 Normal Operation

The screen sequence is different for the FM and HM models.

### 2.10.1 U1000MkII-FM

Press ↵.

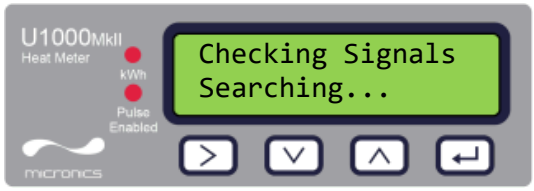



The unit checks for a valid flow signal.

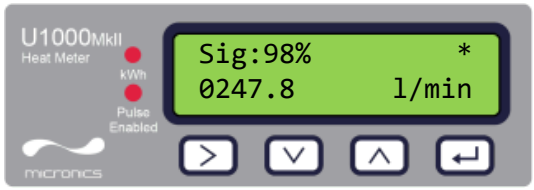

If a valid signal is found, signal strength and flow rate are displayed. The signal strength should be at least 40% for reliable operation.

### 2.10.2 U1000MkII-HM

Press ↵.

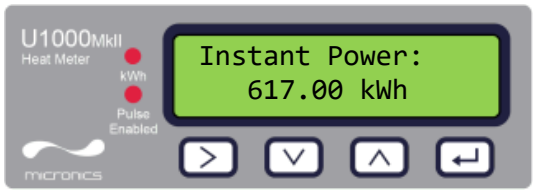


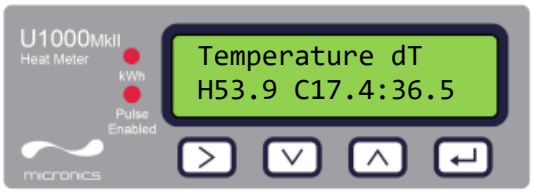

The unit checks for a valid flow signal.

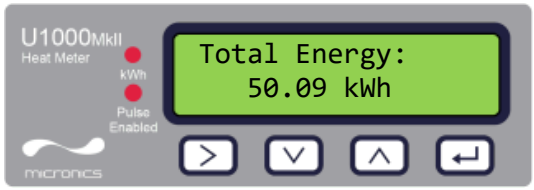


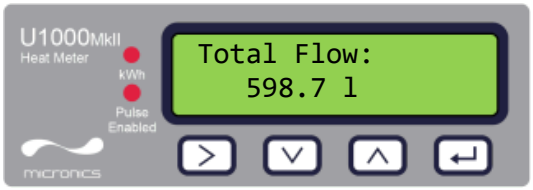

If a valid signal is found, signal strength and flow rate are displayed. The signal strength should be at least 40% for reliable operation.

Press the ^ and v keys to scroll to the *Total Flow*, *Temperature dT*, *Total Energy* and *Instant Power* screens.



### 2.10.3 Troubleshooting the Flow Reading

The direction of flow when powered up will be taken to be the positive flow direction. The pulse output will relate to the flow in this direction. If the flow is reversed then the flow rate will still be displayed but the activity indication will change from an asterisk to an exclamation mark and no pulses will be generated.

If the flow value is displayed as “-----“ this indicates that there is no usable signal from the flow sensors.

The cause of this could be:

- Incorrect pipe data
- Sensor not in contact with the pipe
- Air in the liquid/pipe
- No Gel pad or grease on the sensor
- Very poor pipe condition-surface/inside

## 2.11 Clip Electronics Module to Sensor Assembly

If the unit is working correctly, clip the Electronics Module onto the Sensor Assembly. Secure in place with the screw on the right side (see page 43, Figure 24).

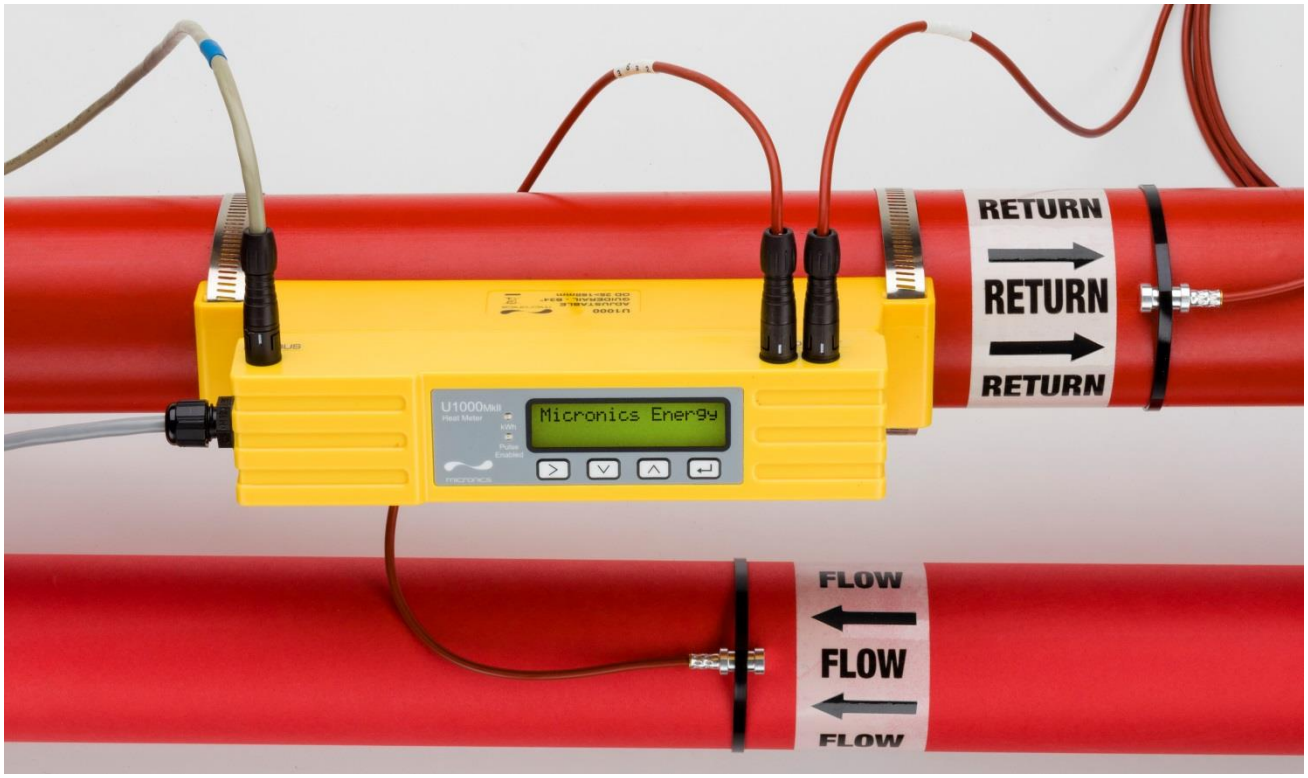



**Figure 23 Fully assembled U1000MkII-HM unit**

# 3 MENUS

The password-protected menus allow you to change the default settings:

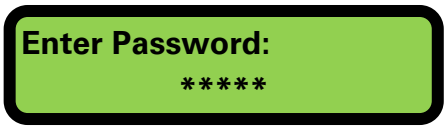
- Setup (see page 24)
- Modbus (see page 25) – *if Modbus output option installed*
- M-Bus (see page 25) – *if M-Bus output option installed*
- Current Output (see page 25) – *U1000MkII-FM only*
- Pulse Output (see page 27)
- Calibration (see page 28)
- Volume Total (see page 28)
- Exit

For troubleshooting purposes, an additional Diagnostics menu is available from the main *Flow Reading* or *Total Flows* screens (see page 29).

## 3.1 Accessing the Menus

Ensure that the instrument is in *Flow Reading* ,*Total Flow*, *Temperature dT*, *Total Energy*, *Instant Power* or *Total Flow* modes, then press ↵.


Enter 71360 and then press ↵.




The Setup Menu is displayed.


Use ^ and v to cycle through the menu sections.

Press ↵ to open a menu.

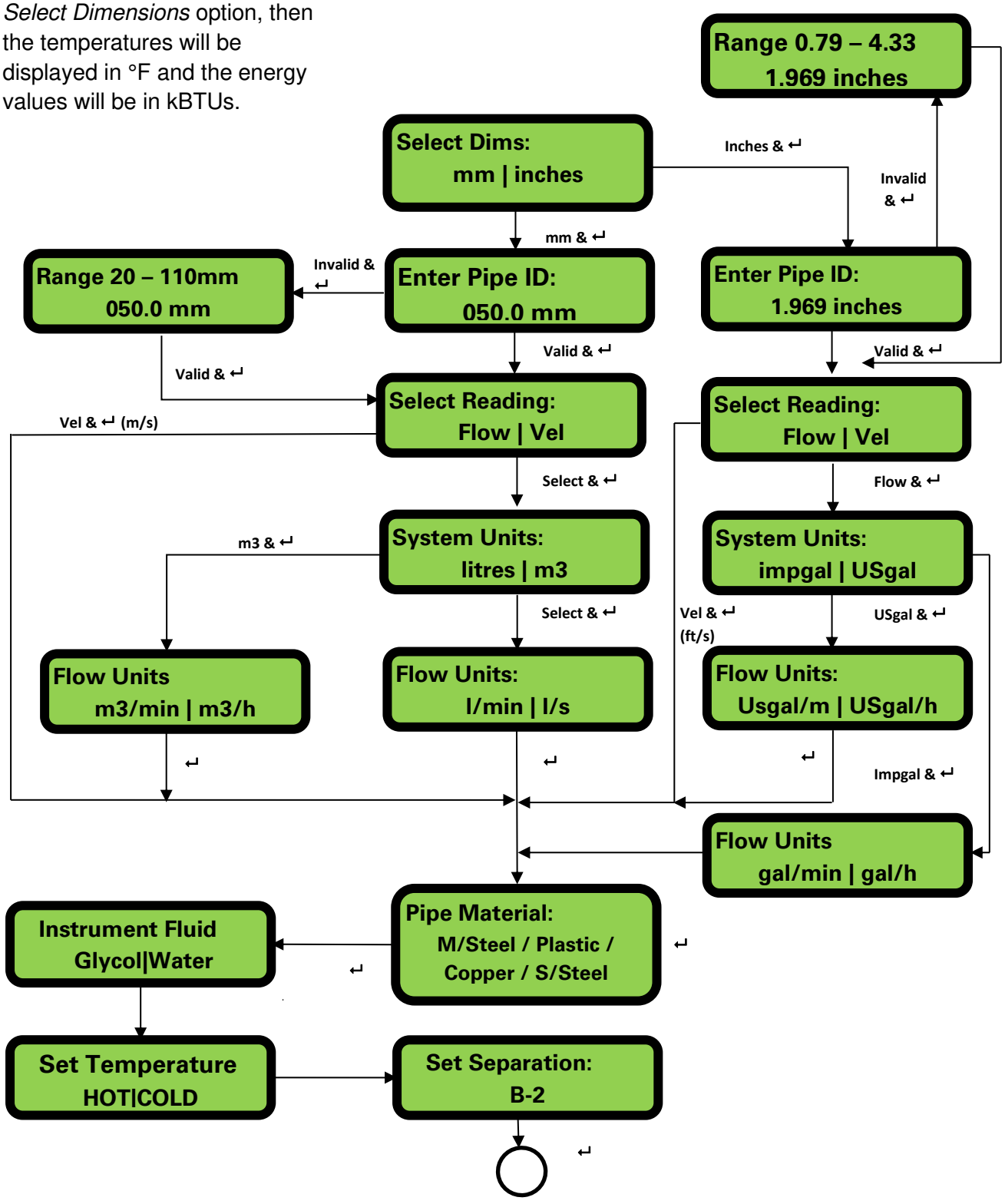
To return to the Flow Reading screen, scroll to **Exit** and press ↵.

Within a menu, press > to change between two displayed options (the active setting flashes) or, if there are several options, use ^ and v to cycle through the possible values.

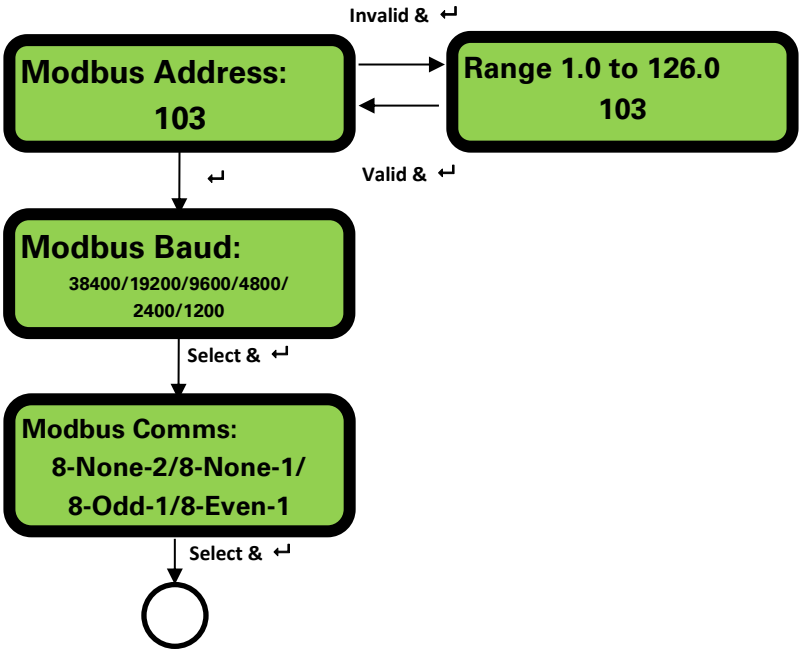
Press ↵ to confirm a value and display the next setting (or exit the menu if it is the last option).

## 3.2 Setup Menu

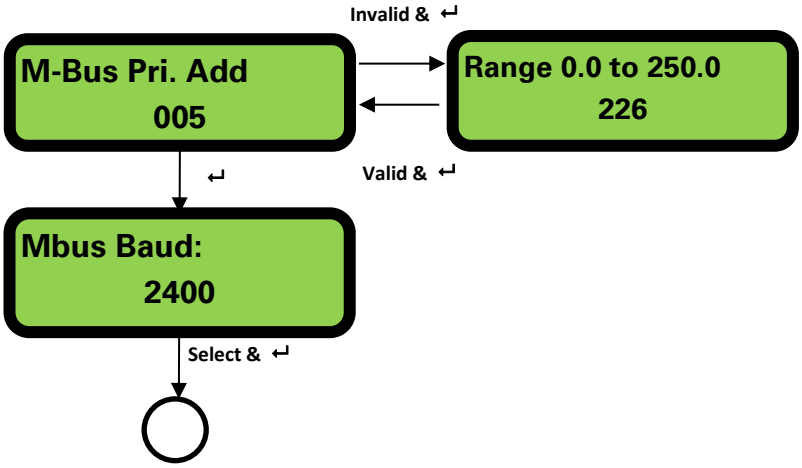
If “inches” is selected for the *Select Dimensions* option, then the temperatures will be displayed in °F and the energy values will be in kBTUs.



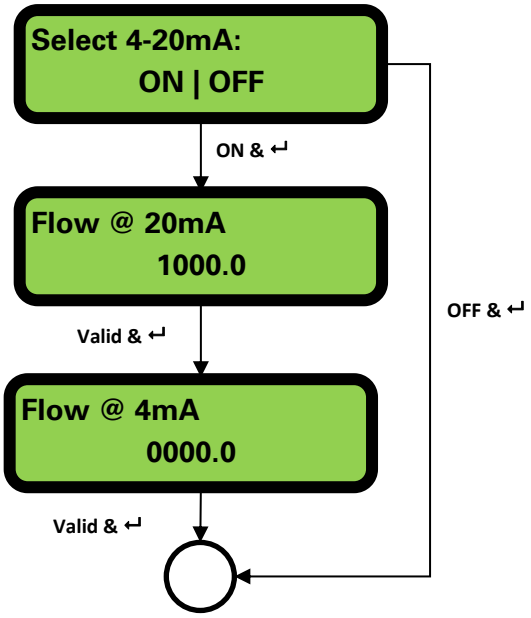
## 3.3 Modbus Menu




## 3.4 M-Bus Menu

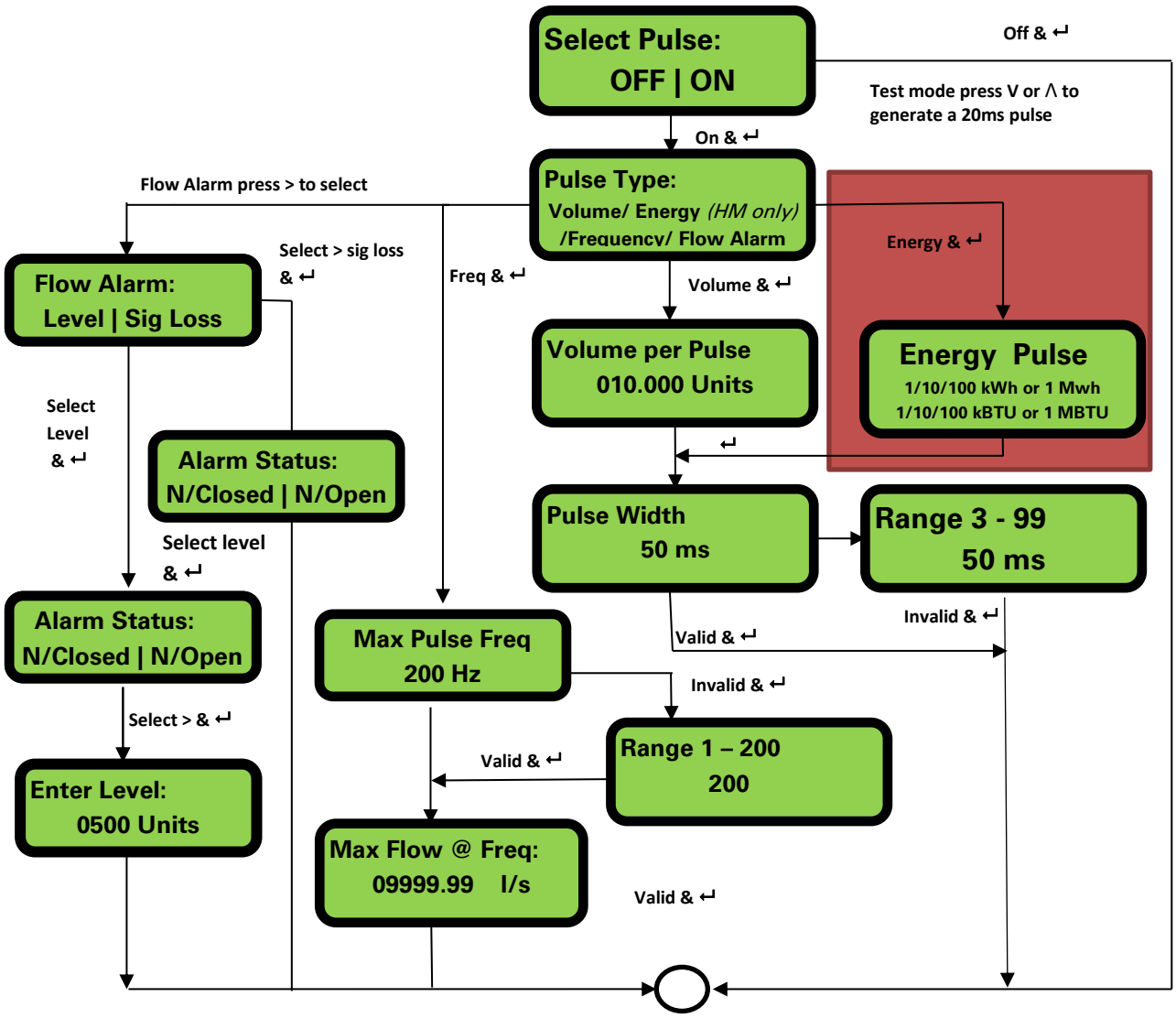


## 3.5 Current Output Menu (U1000MkII-FM only)



## 3.6 Pulse Output Menu

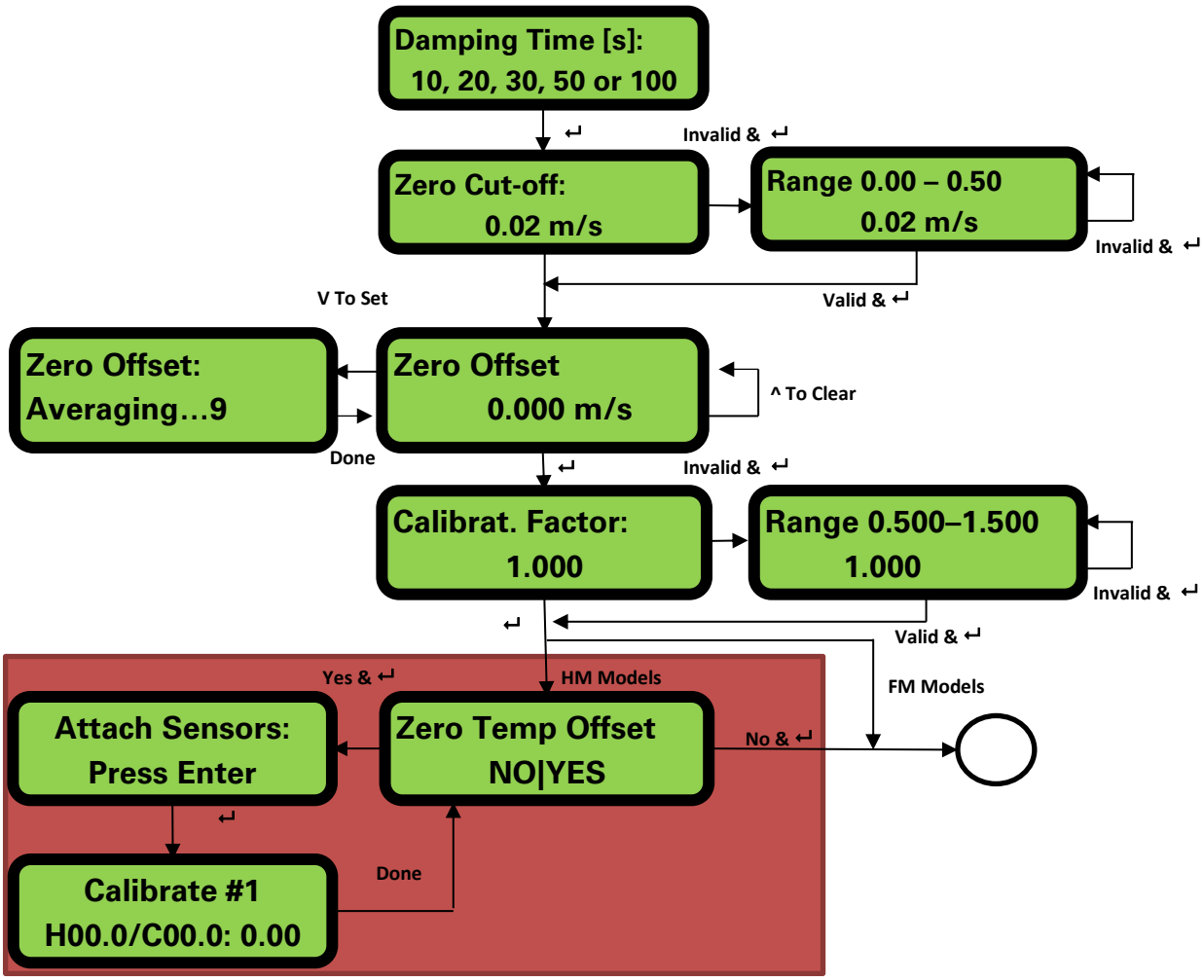
**NOTE: SCREENS WITHIN THE RED BOX ARE ONLY SHOWN ON U1000MKII-HM MODELS.**



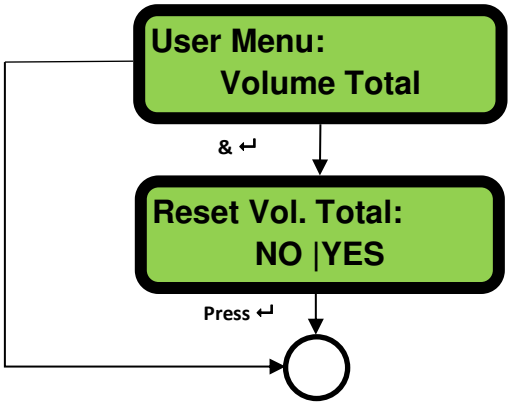
## 3.7 Calibration Menu

**NOTE: SET 'ZERO CUT-OFF' TO ZERO BEFORE SETTING 'ZERO OFFSET' THEN GO BACK TO SET 'ZERO CUT-OFF'.**

**NOTE: SCREENS WITHIN THE RED BOX ARE ONLY SHOWN ON U1000MKII-HM MODELS.**



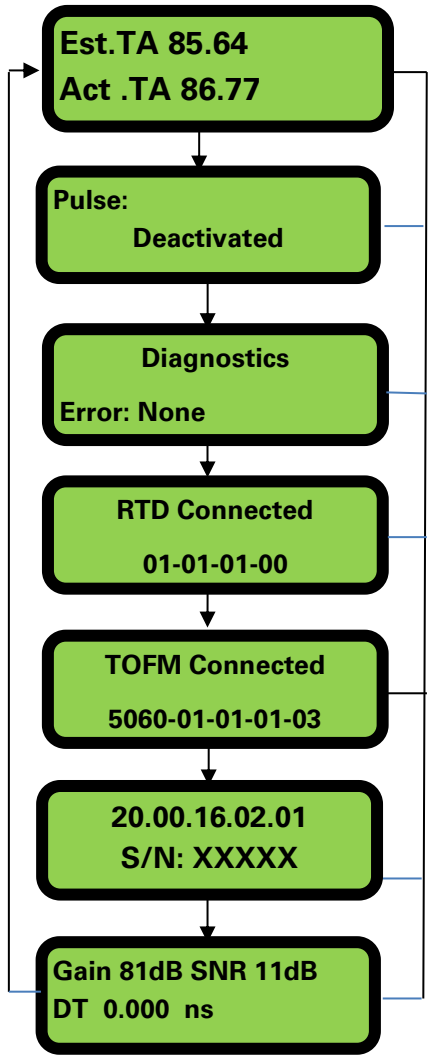

## 3.8 Volume Total Menu



## 3.9 Diagnostics Menu

The diagnostics menu provides some additional information about the flowmeter and its setup. The menu can be accessed by pressing the > key from the main flow-reading screen. Press the ^ and v keys to move between the diagnostics screens.

Press ↵ to exit the Diagnostics menu.




The Estimated TA (Time of Arrival) and Actual TA show the theoretical and measured transit times. If the actual value is displayed as 9999.99 then a usable signal could not be detected.

Displays the pulse status (for example): Deactivated, Volume 0.000 litres, Signal Loss, Alarm(On) 500.0 l/min, Alarm(Off) Signal Loss, Frequency 100.00 Hz.

This screen will display the Errors. A number between 0-255 will be displayed. If no errors reported "None" is displayed.

The RTD board's software version is shown on the lower line. The upper line shows its status.

The flow board's software version is shown on the upper line. The lower line shows its status.

The unit's software version is shown on the upper line. The lower line shows the unit's serial number.

Gain – a decibel number between -5dB and 80dB – *lower is better*, should be around 40dB or below. Above 60dB need to question the installation.
Signal/Noise ratio in dB, scale is 0 to 80dB – *higher is better*. Below 20 question the installation.
The lower line shows the current time differential between the upstream and downstream signals.

# 4 OUTPUTS

## 4.1 Pulse Output

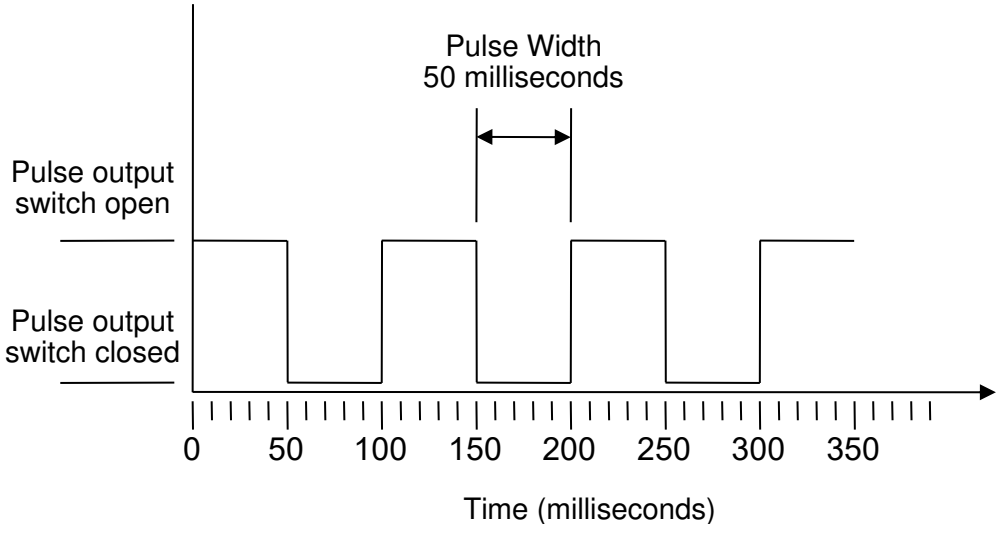
Pulse output can be set up to operate one of five modes:

- Volumetric
- Energy (U1000MkII-HM only)
- Frequency
- Low Flow Alarm
- Loss of Flow (Signal) Alarm

The Alarm functions allow you to set the alarm switch to *Normally Open* or *Normally Closed*.

### 4.1.1 Volumetric Pulse

The U1000MKII 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.**

### 4.1.2 Frequency Mode

In Frequency mode, the output frequency is proportional to the flow rate within a specified frequency range of 1 – 200Hz.

### 4.1.3 Energy Pulse (U1000Mkll-HM only)

When the *Pulse Output* is set to **Energy**, the kWh LED will be permanently illuminated. Choose from 1,10,100kWh or 1MWh when in metric mode and 1,10,100kBTU or 1MBTU in imperial mode. 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.

### 4.1.4 Flow Alarm - Low Flow

For the Low Alarm the user can set a range between 0 and 9999 (no decimal places), in the same units being used to measure flow. The default setting is normally open, but the user can select between N/O and N/C. There is a 2.5% hysteresis on the switching of the output. Once the low flow alarm is activated, the flow rate must rise by 2.5% more than the set value to deactivate the alarm again.

### 4.1.5 Flow Alarm – Signal Loss

If the flow reading (signal) is lost, as indicated by the flow rate being displayed as "-----", the alarm will be triggered. The default setting is normally open, but the user can select between N/O and N/C.

## 4.2 4-20mA Current Output (U1000Mkll-FM only)

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. This can be changed, see page 26.

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 3.5mA will generated.

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

## 4.3 Modbus (if fitted)

The Modbus RTU interface is configured via the Modbus sub menu.

- Float byte order –AB CD – Big endian – MSB first.
- The data rate can be selected in the range 1200 to 38400 baud.
- The address can be set in the range 1 to 126.
- Minimum Polling Rate 1000ms (1sec). Time out after 5 seconds.
- The U1000 MKII will only respond to Modbus requests while operational, while the flow reading, volume total, energy total, power or temperature screens are displayed.
- The instrument responds to the “read holding registers” request (CMD 03).
- If the flow reading is invalid then the flow value will be zero.
- If a U1000MkII-HM temperature sensor goes out of range then the value will go to -11°C (12.2°F).

The above faults will set the relevant status bit (see page 48).

On a unit set to Imperial the temperature is in °F, Power is in BTU/s and flow in US Gallons.

The U1000 complies with the Modbus specification document:
http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b.pdf

The following registers are available.

| Register Offset | Type | Typical Contents | Meaning | Notes |
|---|---|---|---|---|
| n/a | Byte | 0x01 | Instrument Address | |
| n/a | Byte | 0x03 | Instrument Command | |
| n/a | Byte | 0x40 | Number of bytes to read | |
| 0 | Int-16 | 0x00 | Device ID | 0xAC U1000MkII-FM/HM |
| | | 0xac | | |
| 1 | Int-16 | 0x00 | Status | 0x0000 OK Not[0x0000] Fault |
| | | 0x00 | | |
| 2 | Int-16 | 0x00 | System Type U1000MkII-HM only | 0x04 Heating system 0x0C Chiller system |
| | | 0x04 | | |
| 3 | Int-16 | 0x00 | Serial Identifier | |
| | | 0x01 | | |
| 4 | Int-16 | 0x23 | | |
| | | 0x45 | | |
| 5 | Int-16 | 0x60 | | |
| | | 0x00 | | |
| 6 | IEEE754 float | 0x40 | Measured Velocity | Units in m/s |
| | | 0x1f | | |
| 7 | | 0x67 | | |
| | | 0xd3 | | |
| 8 | IEEE754 float | 0x41 | Measured Flow | Units in $m^3$/hr for Metric Units in US Gal/m for Imperial |
| | | 0x8c | | |
| 9 | | 0xd8 | | |
| | | 0xb0 | | |
| 10 | IEEE754 float | 0x42 | Calculated Power (U1000MkII-HM only) | Units in kW for Metric Units in BTU/s for Imperial |
| | | 0x1c | | |
| 11 | | 0x2e | | |
| | | 0x34 | | |
| 12 | IEEE754 float | 0x44 | Calculated Energy (U1000MkII-HM only) | Units in kWh for Metric Units in BTU for Imperial |
| | | 0x93 | | |
| 13 | | 0xc6 | | |
| | | 0xe8 | | |

(continued)

| Register Offset | Type | Typical Contents | Meaning | Notes |
|---|---|---|---|---|
| 14 | IEEE754 float | 0x41 | Measured Temperature (Hot) (U1000MkII-HM only) | Units in Degrees Celsius for Metric Units in Degrees Fahrenheit for Imperial |
| | | 0x98 | | |
| 15 | | 0x00 | | |
| | | 0x00 | | |
| 16 | IEEE754 float | 0x41 | Measured Temperature (Cold) (U1000MkII-HM only) | Units in Degrees Celsius for Metric Units in Degrees Fahrenheit for Imperial |
| | | 0x88 | | |
| 17 | | 0x00 | | |
| | | 0x00 | | |
| 18 | IEEE754 float | 0x40 | Measured Temperature (Difference) (U1000MkII-HM only) | Units in Degrees Celsius for Metric Units in Degrees Fahrenheit for Imperial |
| | | 0x00 | | |
| 19 | | 0x00 | | |
| | | 0x00 | | |
| 20 | IEEE754 float | 0x60 | Measured Volume Total | Units in $m^3$ for Metric Units in US Gal for Imperial |
| | | 0xef | | |
| 21 | | 0x3c | | |
| | | 0x1c | | |
| 22 | Int-16 | 0x00 | Instrument Units | 0x00 Metric 0x01 Imperial |
| | | 0x00 | | |
| 23 | Int-16 | 0x00 | Instrument Gain | Gain in dB |
| | | 0x01 | | |
| 24 | Int-16 | 0x00 | Instrument SNR | SNR in dB |
| | | 0x0a | | |
| 25 | Int-16 | 0x00 | Instrument Signal | Signal in % |
| | | 0x62 | | |
| 26 | IEEE754 float | 0x42 | Measured Delta-Time Difference | Diagnostic Data Units in nanoseconds |
| | | 0xc9 | | |
| 27 | | 0xff | | |
| | | 0x7d | | |
| 28 | IEEE754 float | 0x42 | Instrument ETA | Diagnostic Data Units in nanoseconds |
| | | 0xa8 | | |
| 29 | | 0x8b | | |
| | | 0xf5 | | |
| 30 | IEEE754 float | 0x42 | Instrument ATA | Diagnostic Data Units in nanoseconds |
| | | 0xc8 | | |
| 31 | | 0x00 | | |
| | | 0x00 | | |
| n/a | Int-16 | 0xed | CRC-16 | |
| | | 0x98 | | |

## 4.4 M-Bus (if fitted)

After power-up, the unit defaults to the baud rate and primary address set in the M-Bus Menu (see page 25). Both the baud rate and primary address may be changed later over the M-Bus network. The secondary address is the unit serial number padded with two zeros.

Characters are configured as 8 data bits, 1 parity even bit and 1 stop bit, and the following bit rates are supported: 300, 2400 and 9600 baud.

The U1000 MKII will only respond to M-Bus requests while operational, while the flow reading, volume total, energy total, power or temperature screens are displayed.

The M-Bus module supports the following functions:

- Acknowledge Function
- Slave Select Function
- Data Transfer Functions
- Switch Baud Rate Function
- Change Primary Address Function

### 4.4.1 Acknowledge Function

| **COMMAND:** | ACK | | |
|---|---|---|---|
| **DESCRIPTION:** | Response from the slave denoting that a message was received from the master. | | |
| **DIRECTION:** | SLAVE TO MASTER | | |
| **FRAME TYPE:** | ACK FRAME | | |
| | | | |
| **NAME** | **CODE** | | |
| ACKNOWLEDGE | 0xE5 | | |
| | | | |

### 4.4.2 Select Slave Function

| **COMMAND:** | SEND_NKE |
|---|---|
| **DESCRIPTION:** | Initialise / Reset slave device for communications. |
| **DIRECTION:** | MASTER TO SLAVE |
| **FRAME TYPE:** | SHORT / LONG FRAME |

| **PRIMARY ADDRESSING** | | **SECONDARY ADDRESSING** | |
|---|---|---|---|
| **NAME** | **CODE** | **NAME** | **CODE** |
| START | 0x10 | START | 0x68 |
| (C - FIELD)<br>INITIALISE SLAVE | 0x40 | LENGTH | 0x0B |
| (A - FIELD)<br>SLAVE PRIMARY ADDRESS | 0xXX | LENGTH | 0x0B |
| CHECKSUM | 0xXX | START | 0x68 |
| STOP | 0x16 | (C – FIELD)<br>INITIALISE SLAVE | 0x73 |
| | | (A – FIELD)<br>USE SECONDARY ADDRESSING | 0xFD |
| | | (CI – FIELD)<br>INITIALISE SLAVE | 0x52 |
| | | M-Bus IIN (BYTE 1) | 0xXX |
| | | M-Bus IIN (BYTE 2) | 0xXX |
| | | M-Bus IIN (BYTE 3) | 0xXX |
| | | M-Bus IIN (BYTE 4) | 0xXX |
| | | MANF. ID (BYTE 1) | 0xCD |
| | | MANF. ID (BYTE 2) | 0x54 |
| | | VERSION NUMBER | 0x01 |
| | | DEVICE TYPE ID | 0x04 |
| | | CHECKSUM | 0xXX |
| | | STOP | 0x16 |

MASTER TO SLAVE: SEND_NKE

SLAVE TO MASTER: ACK

### 4.4.3 Data Transfer Functions

| **No** | **VARIABLE** | **TYPE** | **SELECTION BITS** |
|---|---|---|---|
| 1 | FLOW RATE | IEEE754 FLOAT | LITRES / MINUTE |
| 2 | ENERGY | IEEE754 FLOAT | kWh |
| 3 | POWER | IEEE754 FLOAT | kW |
| 4 | TEMPERATURE (COLD) | IEEE754 FLOAT | CELCIUS |
| 5 | TEMPERATURE (HOT) | IEEE754 FLOAT | CELCIUS |
| 6 | TEMPERATURE (DIFFERENCE) | IEEE754 FLOAT | CELCIUS |

### 4.4.4 REQ_UD2 – REQUEST DATA

| **COMMAND:** | REQ_UD2 – REQUEST DATA | | |
|---|---|---|---|
| **DESCRIPTION:** | | | |
| **DIRECTION:** | MASTER TO SLAVE | | |
| **FRAME TYPE:** | CONTROL / LONG FRAME | | |
| | | | |
| **PRIMARY ADDRESSING** | | **SECONDARY ADDRESSING** | |
| **NAME** | **CODE** | **NAME** | **CODE** |
| START | 0x68 | START | 0x68 |
| LENGTH | 0x04 | LENGTH | 0x0C |
| LENGTH | 0x04 | LENGTH | 0x0C |
| START | 0x68 | START | 0x68 |
| (C - FIELD)<br>SEND_UD | 0x73 | (C - FIELD)<br>SEND_UD | 0x73 |
| (A - FIELD)<br>SLAVE PRIMARY ADDRESS | 0xXX | (A - FIELD)<br>USE SECONDARY ADDRESSING | 0xFD |
| (CI – FIELD)<br>SEND DATA TO SLAVE | 0x51 | (CI – FIELD)<br>SEND DATA TO SLAVE | 0x51 |
| DIF: REQUEST ALL DATA | 0x7F | M-Bus IIN (BYTE 1) | 0xXX |
| CHECKSUM | 0xXX | M-Bus IIN (BYTE 2) | 0xXX |
| STOP | 0x16 | M-Bus IIN (BYTE 3) | 0xXX |
| | | M-Bus IIN (BYTE 4) | 0xXX |
| | | MANF. ID (BYTE 1) | 0xCD |
| | | MANF. ID (BYTE 2) | 0x54 |
| | | VERSION NUMBER | 0x01 |
| | | DEVICE TYPE ID | 0x04 |
| | | DIF: REQUEST ALL DATA | 0x7F |
| | | CHECKSUM | 0xXX |
| | | STOP | 0x16 |

MASTER TO SLAVE: SEND_NKE

SLAVE TO MASTER: ACK

MASTER TO SLAVE: REQ_UD2 – REQUEST DATA

SLAVE TO MASTER: RSP_UD2 – RETURN DATA

### 4.4.5 RSP_UD2 – RETURN DATA

| **COMMAND:** | RSP_UD2 – RETURN DATA | | |
|---|---|---|---|
| **DESCRIPTION:** | | | |
| **DIRECTION:** | SLAVE TO MASTER | | |
| **FRAME TYPE:** | LONG FRAME | | |
| | | | |
| **NAME** | **DESCRIPTION** | **SIZE** | **CODE** |
| START | | 1 | 0x68 |
| LENGTH | | 1 | 0xXX |
| LENGTH | | 1 | 0xXX |
| START | | 1 | 0x68 |
| (C - FIELD) | RSP_UD | 1 | 0x08 |
| (A - FIELD) | SLAVE PRIMARY ADDRESS | 1 | 0xXX |
| (CI – FIELD) | RETURN DATA FROM SLAVE | 1 | 0x72 |
| M-Bus IIN (BYTE 1) | 12-BYTE FRAME HEADER | 1 | 0xXX |
| M-Bus IIN (BYTE 2) | | 1 | 0xXX |
| M-Bus IIN (BYTE 3) | | 1 | 0xXX |
| M-Bus IIN (BYTE 4) | | 1 | 0xXX |
| MANF. ID (BYTE 1) | | 1 | 0xCD |
| MANF. ID (BYTE 2) | | 1 | 0x54 |
| VERSION NUMBER | | 1 | 0x01 |
| DEVICE TYPE ID | | 1 | 0x04 |
| ACCESS NUMBER | | 1 | 0xXX |
| M-Bus INTERFACE STATUS | | 1 | 0xXX |
| SIGNATURE 1 | | 1 | 0x00 |
| SIGNATURE 2 | | 1 | 0x00 |
| DATA BLOCK 1 | | | |
| DATA BLOCK 2 | | | |
| DATA BLOCK 3 | | | |
| DATA BLOCK 4 | | | |
| DATA BLOCK 5 | | | |
| DATA BLOCK 6 | | | |
| DIF | 0x0F IDENTIFIES LAST BLOCK | 1 | 0x0F |
| CHECKSUM | | 1 | 0xXX |
| STOP | | 1 | 0x16 |

MASTER TO SLAVE: SEND_NKE

SLAVE TO MASTER: ACK

MASTER TO SLAVE: REQ_UD2 – REQUEST DATA

SLAVE TO MASTER: RSP_UD2 – RETURN DATA

### 4.4.6 Switch Baud Rate Function

SEND_UD – SET BAUD RATE 300

| **COMMAND:** | SEND_UD – SET BAUD RATE 300 | | |
|---|---|---|---|
| **DESCRIPTION:** | Sets the slave data rate to 300 baud. The slave responds to the request with ACK at the current baud and then modifies its baud setting. If the slave does not receive a message from the master at the new rate within 2 minutes, the slave defaults to a setting of 300 baud. | | |
| **DIRECTION:** | MASTER TO SLAVE | | |
| **FRAME TYPE:** | CONTROL / LONG FRAME | | |
| | | | |
| **PRIMARY ADDRESSING** | | **SECONDARY ADDRESSING** | |
| **NAME** | **CODE** | **NAME** | **CODE** |
| START | 0x68 | START | 0x68 |
| LENGTH | 0x03 | LENGTH | 0x0B |
| LENGTH | 0x03 | LENGTH | 0x0B |
| START | 0x68 | START | 0x68 |
| (C - FIELD)<br>SEND_UD | 0x73 | (C - FIELD)<br>SEND_UD | 0x73 |
| (A - FIELD)<br>SLAVE PRIMARY ADDRESS | 0xXX | (A - FIELD)<br>USE SECONDARY ADDRESSING | 0xFD |
| (CI – FIELD)<br>SET BAUD RATE 300 | 0xB8 | (CI – FIELD)<br>SET BAUD RATE 300 | 0xB8 |
| CHECKSUM | 0xXX | M-Bus IIN (BYTE 1) | 0xXX |
| STOP | 0x16 | M-Bus IIN (BYTE 2) | 0xXX |
| | | M-Bus IIN (BYTE 3) | 0xXX |
| | | M-Bus IIN (BYTE 4) | 0xXX |
| | | MANF. ID (BYTE 1) | 0xCD |
| | | MANF. ID (BYTE 2) | 0x54 |
| | | VERSION NUMBER | 0x01 |
| | | DEVICE TYPE ID | 0x04 |
| | | CHECKSUM | 0xXX |
| | | STOP | 0x16 |

MASTER TO SLAVE: SEND_NKE

SLAVE TO MASTER: ACK

MASTER TO SLAVE: SEND_UD – SET 300 BAUD

SLAVE TO MASTER: ACK

SEND_UD – SET BAUD RATE 2400

| **COMMAND:** | SEND_UD – SET BAUD RATE 2400 | | |
|---|---|---|---|
| **DESCRIPTION:** | Sets the slave data rate to 2400 baud. The slave responds to the request with ACK at the current baud and then modifies its baud setting. If the slave does not receive a message from the master at the new rate within 2 minutes, the slave defaults to a setting of 300 baud. | | |
| **DIRECTION:** | MASTER TO SLAVE | | |
| **FRAME TYPE:** | CONTROL / LONG FRAME | | |
| | | | |
| **PRIMARY ADDRESSING** | | **SECONDARY ADDRESSING** | |
| **NAME** | **CODE** | **NAME** | **CODE** |
| START | 0x68 | START | 0x68 |
| LENGTH | 0x03 | LENGTH | 0x0B |
| LENGTH | 0x03 | LENGTH | 0x0B |
| START | 0x68 | START | 0x68 |
| (C - FIELD)<br>SEND_UD | 0x73 | (C - FIELD)<br>SEND_UD | 0x73 |
| (A - FIELD)<br>SLAVE PRIMARY ADDRESS | 0xXX | (A - FIELD)<br>USE SECONDARY ADDRESSING | 0xFD |
| (CI – FIELD)<br>SET BAUD RATE 2400 | 0xBB | (CI – FIELD)<br>SET BAUD RATE 2400 | 0xBB |
| CHECKSUM | 0xXX | M-Bus IIN (BYTE 1) | 0xXX |
| STOP | 0x16 | M-Bus IIN (BYTE 2) | 0xXX |
| | | M-Bus IIN (BYTE 3) | 0xXX |
| | | M-Bus IIN (BYTE 4) | 0xXX |
| | | MANF. ID (BYTE 1) | 0xCD |
| | | MANF. ID (BYTE 2) | 0x54 |
| | | VERSION NUMBER | 0x01 |
| | | DEVICE TYPE ID | 0x04 |
| | | CHECKSUM | 0xXX |
| | | STOP | 0x16 |

MASTER TO SLAVE: SEND_NKE

SLAVE TO MASTER: ACK

MASTER TO SLAVE: SEND_UD – SET 2400 BAUD

SLAVE TO MASTER: ACK

SEND_UD – SET BAUD RATE 9600

| **COMMAND:** | SEND_UD – SET BAUD RATE 9600 | | |
|---|---|---|---|
| **DESCRIPTION:** | Sets the slave data rate to 9600 baud. The slave responds to the request with ACK at the current baud and then modifies its baud setting. If the slave does not receive a message from the master at the new rate within 2 minutes, the slave defaults to a setting of 300 baud. | | |
| **DIRECTION:** | MASTER TO SLAVE | | |
| **FRAME TYPE:** | CONTROL / LONG FRAME | | |
| | | | |
| **PRIMARY ADDRESSING** | | **SECONDARY ADDRESSING** | |
| **NAME** | **CODE** | **NAME** | **CODE** |
| START | 0x68 | START | 0x68 |
| LENGTH | 0x03 | LENGTH | 0x0B |
| LENGTH | 0x03 | LENGTH | 0x0B |
| START | 0x68 | START | 0x68 |
| (C - FIELD)<br>SEND_UD | 0x73 | (C - FIELD)<br>SEND_UD | 0x73 |
| (A - FIELD)<br>SLAVE PRIMARY ADDRESS | 0xXX | (A - FIELD)<br>USE SECONDARY ADDRESSING | 0xFD |
| (CI – FIELD)<br>SET BAUD RATE 9600 | 0xBD | (CI – FIELD)<br>SET BAUD RATE 9600 | 0xBD |
| CHECKSUM | 0xXX | M-Bus IIN (BYTE 1) | 0xXX |
| STOP | 0x16 | M-Bus IIN (BYTE 2) | 0xXX |
| | | M-Bus IIN (BYTE 3) | 0xXX |
| | | M-Bus IIN (BYTE 4) | 0xXX |
| | | MANF. ID (BYTE 1) | 0xCD |
| | | MANF. ID (BYTE 2) | 0x54 |
| | | VERSION NUMBER | 0x01 |
| | | DEVICE TYPE ID | 0x04 |
| | | CHECKSUM | 0xXX |
| | | STOP | 0x16 |

MASTER TO SLAVE: SEND_NKE

SLAVE TO MASTER: ACK

MASTER TO SLAVE: SEND_UD – SET 9600 BAUD

SLAVE TO MASTER: ACK

### 4.4.7 Change Primary Address Function

| **COMMAND:** | SEND_UD – SET PRIMARY ADDRESS | | |
|---|---|---|---|
| **DESCRIPTION:** | The primary address of the slave is set to a default value at power up. The master uses this command to assign a new unique primary address to the slave if required. | | |
| **DIRECTION:** | MASTER TO SLAVE | | |
| **FRAME TYPE:** | LONG FRAME | | |
| | | | |
| **PRIMARY ADDRESSING** | | **SECONDARY ADDRESSING** | |
| **NAME** | **CODE** | **NAME** | **CODE** |
| START | 0x68 | START | 0x68 |
| LENGTH | 0x06 | LENGTH | 0x0E |
| LENGTH | 0x06 | LENGTH | 0x0E |
| START | 0x68 | START | 0x68 |
| (C - FIELD)<br>SEND_UD | 0x73 | (C - FIELD)<br>SEND_UD | 0x73 |
| (A - FIELD)<br>SLAVE PRIMARY ADDRESS | 0xXX | (A - FIELD)<br>USE SECONDARY ADDRESSING | 0xFD |
| (CI – FIELD) | 0x51 | (CI – FIELD) | 0x51 |
| DIF: 8 BIT INTEGER | 0x01 | M-Bus IIN (BYTE 1) | 0xXX |
| VIF: SET PRIMARY ADDRESS | 0x7A | M-Bus IIN (BYTE 2) | 0xXX |
| NEW PRIMARY ADDRESS VALUE | 0xXX | M-Bus IIN (BYTE 3) | 0xXX |
| CHECKSUM | 0xXX | M-Bus IIN (BYTE 4) | 0xXX |
| STOP | 0x16 | MANF. ID (BYTE 1) | 0xCD |
| | | MANF. ID (BYTE 2) | 0x54 |
| | | VERSION NUMBER | 0x01 |
| | | DEVICE TYPE ID | 0x04 |
| | | DIF: 8 BIT INTEGER | 0x01 |
| | | VIF: SET PRIMARY ADDRESS | 0x7A |
| | | NEW PRIMARY ADDRESS VALUE | 0xXX |
| | | CHECKSUM | 0xXX |
| | | STOP | 0x16 |

MASTER TO SLAVE: SEND_NKE

SLAVE TO MASTER: ACK

MASTER TO SLAVE: SEND_UD – SET PRIMARY ADDRESS

SLAVE TO MASTER: ACK

# 5 RELOCATING THE UNIT

If it is necessary to relocate the unit use the following procedure:

1. Disconnect the temperature sensors (U1000MkII-HM only) and MODBUS cable (if used).
2. Unfasten hose clips and remove the complete unit from the pipe.
3. Undo the screw at the end of the Sensor Assembly and gently lift the same end of the Electronics Module as shown below.
4. The opposite end of the Electronics Module can now be released from the Sensor Assembly.


**Figure 24 Separating Sensor Assembly and Electronics Module**

5. Disconnect the two wires connecting the Sensor Assembly and Electronics Module.
6. Remove the original gel pads from the two sensors.
7. Push the sensor blocks into the Sensor Assembly so that the washers and locking screws can be refitted.
8. Place replacement gel pads on the base of the sensors.
9. Follow the procedure for re-installing the unit on the pipe (see page 16).

# 6 APPENDIX

## 6.1 Specification

| | |
|---|---|
| **General** | |
| **Measuring Technique** | Transit time |
| **Measurement channels** | 1 |
| **Timing Resolution** | ±50ps |
| **Turn down ratio** | 200:1 |
| **Flow velocity range** | 0.1 to 10m/s |
| **Applicable Fluid types** | Clean water with < 3% by volume of particulate content, or up to 30% ethylene glycol. |
| **Accuracy** | ±3% of flow reading for velocity rate >0.3m/s |
| **Repeatability** | ±0.15% of measured value |
| **Pipe Ranges** | 25-115mmOD and 125-180mm OD<br>Note: Pipe size is dependent on pipe material and internal diameter. |
| **Selectable units for metric (mm)** | Velocity: m/s<br>Flow Rate: l/s, l/min, $m^3$/min, $m^3$/hr<br>Volume: litres, $m^3$ |
| **Selectable units for Imperial (inches)** | Velocity: ft/s<br>Flow rate: gal/min, gal/hr, USgal/min, USgal/hr<br>Volume: gals, USgals |
| **Totaliser** | 14 digits with roll over to zero |
| **Languages supported** | English only |
| **Power input** | 12 – 24V DC or 24V AC |
| **Power consumption** | 7W (DC) or 7VA (AC) maximum |
| **Cable** | 5m screened 6 core |
| **Pulse Output** | |
| **Output** | Opto-isolated MOSFET volt free contact (NO/NC). |
| **Isolation** | 1MΩ @ 100V |
| **Pulse width** | Default value 50ms; programmable range 3 – 99ms |
| **Pulse repetition rate** | Up to 166 pulses/sec (depending on pulse width) |
| **Frequency mode** | 200 Hz maximum (Range 1-200) |
| **Maximum load voltage/current** | 24V DC or 24V AC / 500mA |
| **Current Output** *U1000MkII-FM only (if fitted)* | |
| **Output** | 4 – 20mA |
| **Resolution** | 0.1% of full scale |
| **Maximum load** | 620Ω |
| **Isolation** | 1MΩ @ 100V |
| **Alarm current** | 3.5mA |

*continued on next page*

*continued from previous page*

| | |
|---|---|
| **Modbus** *(if fitted)* | |
| **Format** | RTU |
| **Baud rate** | 1200, 2400, 4800, 9600, 19200, 38400 |
| **Data-Parity-StopBits** | 8-None-2, 8-None-1, 8-Odd-2, 8-Even-1 |
| **Standards** | PI–MBUS–300 Rev. J |
| **Physical connection** | RS485 |
| **M-Bus** *(if fitted)* | |
| **Baud rates** | 300, 2400,& 9600 |
| **Data–Parity-StopBits** | 8-Even-1 |
| **Standards** | EN13757 / EN1434 |
| **Temperature sensors** | *U1000MkII-HM only* |
| **Type** | PT100 Class B 4 wire |
| **Range** | 2 to 85°C (36 to 185°F) |
| **Resolution** | 0.1°C / 1°F |
| **Sensor Accuracy** | ±0.725°C (±1.305°F) |
| **Enclosure** | |
| **Material** | Plastic Polycarbonate |
| **Fixing** | Pipe mountable |
| **Degree of Protection** | IP54 (Not verified by UL) |
| **Flammability Rating** | UL94 V-2/HB |
| **Dimensions** | 250mm x 48mm x 90mm (electronics module + sensor assembly) |
| **Weight** | 0.5kg |
| **Environmental** | |
| **Maximum Pipe temperature** | 0°C to 85°C |
| **Operating temperature (Electronics)** | 0°C to 50°C |
| **Storage temperature** | -10°C to 60°C |
| **Humidity** | 90% RH at 50°C Max |
| **Maximum altitude** | 4,000 metres |
| **Indoors/outdoors** | Indoors |
| **Wet locations** | A location in which water or other liquid can drip, splash, or flow on or against electrical equipment. |
| **Pollution degree** | 3: Conductive pollution or dry nonconductive pollution that becomes conductive due to condensation. |
| **Display** | |
| **LCD** | 2 line x 16 characters |
| **Viewing angle** | Min 30° |
| **Active area** | 58mm (W) x 11mm(H) |
| **Keypad** | |
| **Format** | 4 key tactile feedback membrane keypad |

Servicing or repairs to the unit can only be carried out by the manufacturer.

## 6.2 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" pipes: 50 mm<br>4" to 6" pipes: 127 mm | 1" to 4": 1.969 in<br>4" to 6" pipes: 5.000 in |
| **Pulse Output** | Off | Off |
| **Energy per Pulse**<br>*(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 |

## 6.3 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.

## 6.4 Positioning

For accurate measurements, the U1000MKII-FM/U1000MKII-HM 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 3, 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.

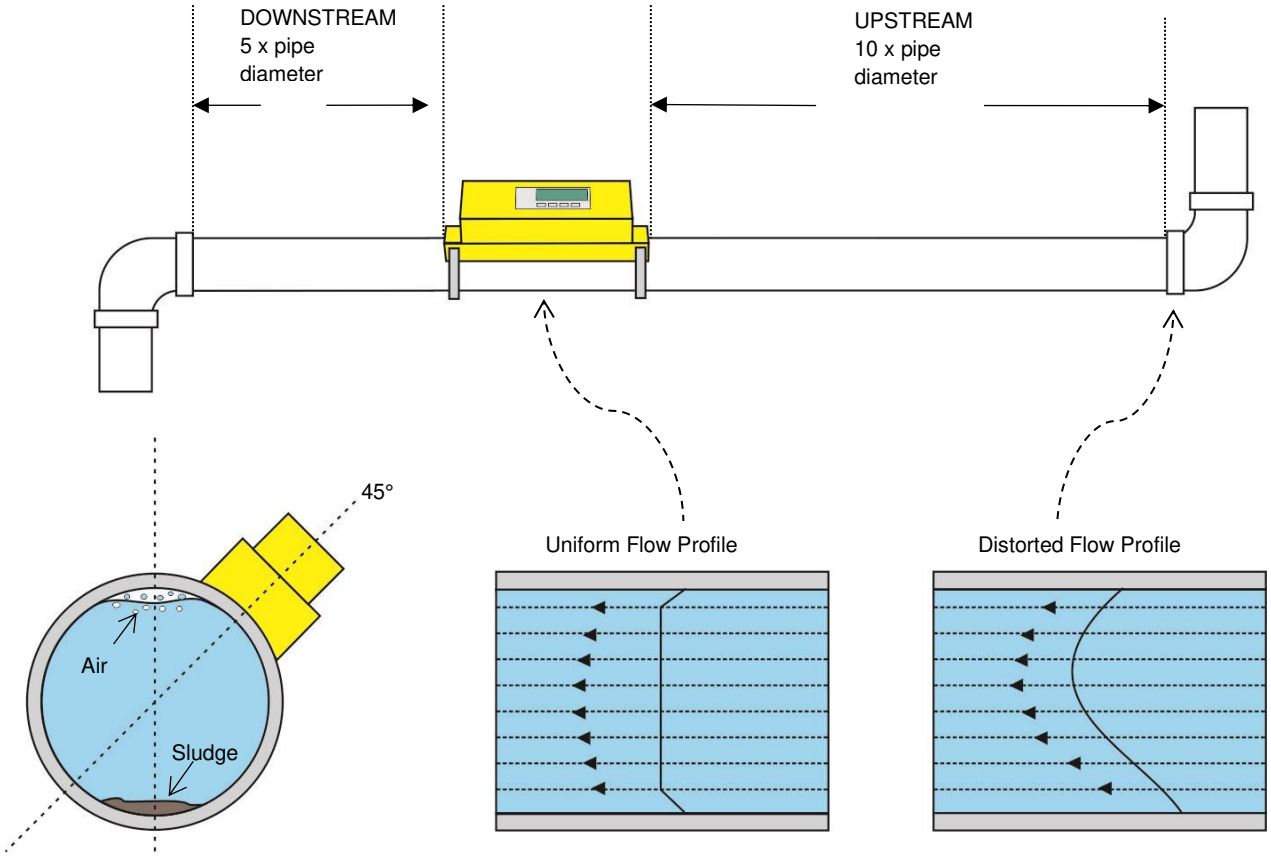



**Figure 25 Location of unit**

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. In chiller applications, the U1000MKII sensor/electronics must be mounted at 45°with respect to the top of the pipe to prevent condensation entering the electronics unit.

**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.**

## 6.5 Error and Warning Messages

### 6.5.1 Error Messages

Error Messages are displayed as a number in the diagnostics menu. Contact Micronics if other messages appear.

| Error Meaning | Status Byte | | | | | | | | Value |
|---|---|---|---|---|---|---|---|---|---|
| | Bit#7 | Bit#6 | Bit#5 | Bit#4 | Bit#3 | Bit#2 | Bit#1 | Bit#0 | |
| **RTD I2C failed** *(U1000MkII-HM only)* | | | | | | | | 1 | 1 |
| **RTD Thot failed** *(U1000MkII-HM only)* | | | | | | | 1 | | 2 |
| **RTD Tcold failed** *(U1000MkII-HM only)* | | | | | | 1 | | | 4 |
| **TOFM signal lost** | | | | | 1 | | | | 8 |
| **TOFM board failed** | | | | 1 | | | | | 16 |
| **TOFM window failed** | | | 1 | | | | | | 32 |
| **TOFM sensor type failed** | | 1 | | | | | | | 64 |
| **TOFM I2C failed** | 1 | | | | | | | | 128 |

### 6.5.2 Example Error Messages

| Error Message | Error Meaning |
|---|---|
| **None or 0** | None |
| **2** | Hot sensor error *(U1000MkII-HM only)* |
| **4** | Cold sensor error *(U1000MkII-HM only)* |
| **6** | Hot and Cold sensor error *(U1000MkII-HM only)* |
| **8** | No flow signal |
| **10** | Hot error and no flow signal *(U1000MkII-HM only)* |
| **12** | Cold error and no flow signal *(U1000MkII-HM only)* |
| **14** | Hot and Cold error and no flow signal *(U1000MkII-HM only)* |

### 6.5.3 Modbus Error Messages (if Modbus fitted)

| Test case | Transmitter | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Address | Command | Start Register | | Length (no of registers) | | CRC-16 | |
| | [1 byte] | [1 byte] | [2 bytes] | | [2 bytes] | | [2 bytes] | |
| No error | 0x01 | 0x03 | 0x00 | 0x00 | 0x00 | 0x20 | 0x44 | 0x12 |
| Incorrect function request | 0x01 | 0x0C | 0x00 | 0x00 | 0x00 | 0x20 | 0x10 | 0x13 |
| incorrect register start | 0x01 | 0x03 | 0x00 | 0xEF | 0x00 | 0x20 | 0x75 | 0xE7 |
| Incorrect register length | 0x01 | 0x03 | 0x00 | 0x12 | 0xFF | 0x02 | 0x25 | 0xFE |
| slave is busy | 0x01 | 0x03 | 0x00 | 0x00 | 0x00 | 0x20 | 0x44 | 0x12 |
| incorrect CRC-16 | 0x01 | 0x03 | 0x00 | 0x20 | 0x00 | 0x20 | 0x44 | 0xFF |

| Receiver | | | | | Comments |
|---|---|---|---|---|---|
| Address | Command | Error code | CRC-16 | | |
| [1 byte] | [1 byte] | [1 byte] | [2 bytes] | | |
| 0x01 | 0x03 | None | n/a | n/a | Example of a good message |
| 0x01 | 0x8C | 0x01 | 0x85 | 0x00 | ILLEGAL FUNCTION - the only acceptable command is 0x03 |
| 0x01 | 0x83 | 0x02 | 0xC0 | 0xF1 | ILLEGAL DATA ADDRESS - incorrect register start |
| 0x01 | 0x83 | 0x03 | 0x01 | 0x31 | ILLEGAL DATA VALUE - incorrect register length |
| 0x01 | 0x83 | 0x06 | 0xC1 | 0x32 | SLAVE DEVICE BUSY – U1000 is busy processing and is unable to respond |
| 0x01 | 0x83 | 0x07 | 0x00 | 0xF2 | CRC is incorrect |

### 6.5.4 Flow Errors

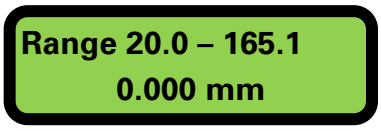
A signal strength of less than 40% indicates poor set up of the instrument, and the installation should be checked or possibly moved to a different site.

### 6.5.5 Flow Warnings

A signal strength of less than 40% indicates poor set up of the instrument, and the installation should be checked or possibly moved to a different site. A negative flow is indicated by an”!” being displayed on the top line instead of a “*”.

### 6.5.6 Data Entry Errors

These generally advise you that the data entered is not within the specified range:




Displayed when an invalid Pipe ID is entered, prompting the user to enter a value between 20 and 165mm depending on the product purchased.

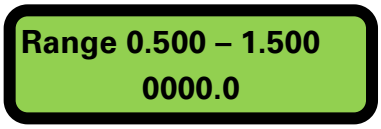

An attempt has been made to zero the offset between the temperature sensors, and the difference in temperature is too large. Ensure the temperature sensors are correctly plugged in and are both at the same temperature.


When programming a Frequency Pulse output the frequency is limited to the range 1 to 200 Hz.


When programming a Volume Pulse output the pulse width is limited to the range 3 to 99ms.


When programming the Zero Cut-off this is limited to the range 0.000 to 0.500.

**NOTE: THIS MUST BE SET TO ZERO BEFORE PERFORMING A ZERO OFFSET.**




When programming the Calibration Factor this is limited to the range 0.5 to 1.5.

# 7 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**
**Ultrasonic flow meter U1000, U1000-HM and U1000MKII**

**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**

**The Basis on which Conformity is being Declared**

The manufacturer hereby declares under his sole responsibility that the products identified above comply with the protection requirements of the EMC directive and with the principal elements of the safety objectives of the Low Voltage Equipment directive, and that the following standards have been applied:

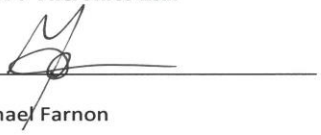
BS EN 61010-1:2010 Safety requirement for electrical equipment for measurement control and laboratory use. Part 1 General requirements

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

BS EN61326-2-3:2013 Electrical equipment for measurement control and laboratory use EMC requirements. Part 2-3: Particular requirements – Test configuration and performance criteria for transducers with integrated or remote signal conditioning.

This declaration of conformity is issued under the sole responsibility of the manufacturer.

**Signed for and on behalf of : Micronics Ltd.**

**Signature:** 

**Printed Name:** Michael Farnon

**Title:** Managing Director

**Date:** April 2018 **Location:** Loudwater

**Attention!**

The attention of the specifier, purchaser, installer, or user is drawn to special measures and limitations to use which must be observed when these products are taken into service to maintain compliance with the above directives.

Details of these special measures and limitations to use are available on request, and are also contained in the product manuals.

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